New Frontiers in Regional Science: Asian Perspectives 37

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Preface

The purpose of this book is to provide an overview of recent developments in local public economics and present a foundation for future progress.

The field of local public economics has developed alongside public finance theory. Whereas public finance theory deals mainly with various issues concerning nationwide fiscal management, the field of local public economics analyzes not only financial problems within a region but also interdependencies between regions, local governments, and, possibly, state and local governments. The research topics of local public economics can be attributed to the existence of jurisdictional boundaries and the vertical structure of the fiscal relationship between state and local governments.

Early studies in this field analyzed the behavior of local governments in the same way that households are analyzed by standard microeconomic theory. For example, these analyses include the optimal provision of local public goods and the optimal local government response to grants from the central government. These studies only examined the response of local governments to changes in the external environment and did not present the behavioral characteristics of local governments.

The next generation of research was carried out by considering the movement of factors, such as labor and capital, across local boundaries. In such cases, it is known that the policy decisions of each local government lead to inefficient resource allocations. The typical problem is fiscal competition, which results in fiscal externalities owing to the strategic actions of each local government. Fiscal externalities are also generated between central and local governments, leading to vertical competition.

As a way to avoid such horizontal and vertical fiscal competitions, it is necessary to set intergovernmental fiscal coordination and cooperative policies. Horizontal or vertical transfers can be considered as fiscal adjustment tools to mitigate such fiscal competition. However, to carry out such cooperative policies, it is necessary to provide incentives for institutional consensus and system design.

The third generation of research therefore has considered the derivation and characterization of incentive mechanisms and related policies for interregional cooperation. These cooperative policies include the voluntary consolidation of local governments and the joint provision of local public goods. However, in the case of voluntary adjustments, the scope is limited, and it is assumed that efficient fiscal management cannot be achieved. Therefore, to promote cooperative policies, a cooperative incentive that includes a transfer policy by the central government is required.

In addition, local governments are not always perfect agents of residents but rather may be more opportunistic. Because local decision makers are more sensitive to the voting behavior of local residents, their policies involve political bias. This bias may create a new barrier to the implementation of the cooperative policies mentioned above. Therefore, to execute studies of local public economics, it is necessary to consider such political economic factors, and it can be said that feasible institutional design is made possible by examining these factors.

Moreover, local public economics can be associated with various economic fields owing to its extensive scope of analysis. In addition to the public choice approach mentioned above, this field has similarities with international economics in the sense of cross-border transactions. Thus, this book can be regarded as a collaboration between local public economics and its related fields.

Through the generations of research noted above, the scope of local public economics has expanded, and our understanding of the local public sector has developed. At the same time, novel perspectives and analytical methods adopted from related fields are shedding new light on the topics dealt with by previous generations of research. Thus, the issues to be elucidated by local public economics are increasingly diversified with the expansion of the roles and functions of the local public sector.

We attempt to consider local public economics from several perspectives. For this purpose, this book consists of three parts and eighteen chapters. We briefly summarize these chapters and describe how each chapter investigates the field of public economics and presents analytical results.

Part I aims to examine fiscal decentralization and regional consolidation problems. Chapter 1 attempts to classify the results of political economic analyses of fiscal competition and municipal consolidation behavior and to apply these results to the regional coordination problem. For this purpose, the analysis focuses on the common pool problem in fiscal competition, municipal consolidation, and regional coordination and presents revised empirical propositions.

Chapter 2 examines whether a coordinated state capital tax reform improves social welfare in the steady state in an overlapping generations model with vertical and horizontal tax externalities. The analysis shows that the sign of the dynamic vertical tax externality effect depends on whether each state government ignores the effect of its tax rate on the federal tax revenue allocated to that state.

Chapter 3 constructs an asymmetric regions model in which the numbers of borders vary by extending the one-country model of Lucas (2004) to a two-country model. The analysis shows that central governments cannot internalize the fiscal externalities attributed to the existence of a national border in the case of a unitary nation with decentralization.

Chapter 4 investigates the relationship between firms' regional location choices and the subsidy policies of regional governments in an imperfectly competitive third-market model. Then, it demonstrates that even if firms' shareholders exist beyond the region, the result that regional governments provide no subsidies to firms remains unchanged. The discussion also points out that when regional governments have concerns about regional employment, there is no equilibrium of subsidy competition.

Chapter 5 extends the model of a two-level government constructed by Boadway and Keen (1996) to a model of a three-level government and derives the optimal tax and intergovernmental transfer system. The analysis shows that whenever the upper level of government is a Stackelberg leader, the second-best allocation can be always replicated irrespective of the intergovernmental transfer pattern.

Chapter 6 ascertains whether a soft budget constraint problem is caused by the Local Allocation Tax transfer in Japan. The theoretical background is constructed as a two-period Stackelberg game model that describes the dynamic commitment problem of the central government and the common pool behavior of prefectural governments. No definitive evidence is found for common pool behavior, whereas bailouts through the Local Allocation Tax transfer are clearly observed. In addition, it is apparent from the estimation controlling for structural changes that prefectural governments inherently discipline themselves irrespective of bailouts.

Chapter 7 considers a situation in which regional governments use consumption and capital taxes to finance required government expenditures and a central government sets monetary policy independently. The analysis shows that as the monetary expansion rate increases, the optimal regional tax mixture shifts toward capital taxation. It also proves that the optimal level of the consumption tax is higher in the case of reimbursement for a given monetary expansion rate.

Chapter 8 confirms the free-rider behavior of pre-merger municipalities in Japan. It divides pre-merger municipalities into cities and towns and villages. The results confirm that only pre-merger towns and villages that had the incentive to free ride exhibited free-rider behavior.

Part II examines several problems in the provision of local public services and vertical and horizontal fiscal adjustments among governments. Chapter 9 considers the neutrality theorem in the presence of public inputs with positive spillover effects. In this chapter, using a model consisting of two regions, two tradable goods, two primary factors of production, and public inputs, the effects of an interregional transfer taking the form of the primary factors of production are considered. Then, the analysis shows that Warr's neutrality theorem is to be modified. In other words, although the total provision of public inputs is independent of the distribution of primary factors, welfare may be affected by a transfer of primary factors. In addition, the possibility of the transfer paradox cannot be ignored.

Chapter 10 analyzes the efficiency of infrastructure provision in Italy at the execution stage, focusing on the level of government involved. The analysis shows that the empirical findings are robust to alternative estimators and empirical strategies and suggests that decentralized authorities might lack adequate bureaucratic structures to manage the execution stage efficiently.

Chapter 11 measures to what extent the suppression of urban sprawl should reduce the marginal cost of providing local public services in Japan by estimating the local expenditure function. Then, it shows that urban sprawl growth has a positive and significant impact on local public expenditure. Based on statistically significant and theoretically consistent outcomes, the analysis suggests that, in Japan, a decrease in urban sprawl reduces the marginal cost of providing local public services.

Chapter 12 considers the question of whether municipalities can provide adequate childcare services if appropriate incentive design is possible using the framework of principal–agent theory. The analysis shows that even with rent-seeking behavior, securing a supply of childcare services and striving to resolve the issue of waiting lists for children would improve social welfare.

Chapter 13 aims to analyze the efficiency of the provision of early childcare in Italy and studies the impact of demand-side factors. The analysis shows remarkable heterogeneity in the provision of childcare across Italian municipalities. It also finds that demand-side pressure affects efficiency.

Chapter 14 deals with the decision-making process in the heritage field. It is a common tenet in the normative literature on fiscal federalism that the allocation of functions among various layers of government should follow the so-called correspondence principle, that is, the geographical coincidence between the taxpayers and beneficiaries of a given good or service. The political economic analysis shows that devolution may tend to favor the conservation of heritage with "outstanding characteristics" over that of more "local" heritage, leading to an inefficient outcome. Possible measures to correct for this kind of political inefficiency are discussed.

Part III considers further applications of political economics and empirical analyses to local public finance. Chapter 15 studies the effect of lobbying activity by special interest groups on the optimal pricing rule of publicly produced final and intermediate goods. The analysis shows that when the weight that the government places on campaign contributions from a special interest group organized by workers increases, the price of publicly produced final goods decreases and that of intermediate goods increases. However, when the weight that the government places on campaign contributions from a special interest group organized by capitalists increases, the effect on the prices of final and intermediate goods depends on the dual roles of capitalists as consumers and firms.

Chapter 16 analyzes retrospective voting in Japanese mayoral elections. It shows that retrospective voting is prominent under lower economic growth. In other words, macroeconomic conditions can affect even mayoral elections. In addition, the empirical analysis suggests that the probability of re-election is lower for incumbent mayors who preside over periods of worsening local indicators. This finding is a healthy signal supporting the responsibility hypothesis. The analysis also concludes that, after decentralization, voters' attitudes toward monitoring incumbents clearly changed in periods of low economic growth and were able to partly cancel out the healthy signals sent to politicians.

Chapter 17 investigates a political economic analysis of regional health expenditure in Italy. It suggests that the impact of federalism on public expenditure depends on central and local government strategies to win an electoral competition. The analysis indicates that political competition actually works as a tool of fiscal discipline, and it has a restraining effect on public health expenditure.

Chapter 18 considers the discretionary premium-setting behavior of municipalities in the Japanese system of long-term care insurance (LTCI). The analysis finds that the premium-setting forecast is different for each municipality, contrary to the initial intention of the central government when the LTCI system was started. Moreover, the empirical results show that municipalities seem to have discretion in premium setting. In addition, premiums are influenced by the political power of the elderly when few neighboring municipalities are available for reference.

As illustrated by the above summaries, this book consists of contributions reflecting the authors' interests, and it is not a comprehensive textbook on local public economics. However, the chapters are related to each other in terms of research subjects, frameworks for study, analytical methodologies, and so on. We hope that readers will appreciate the latest achievements in local public economics after reading through this book.

These chapters cover a wide range of topics and conduct various theoretical and empirical analyses in local public economics. However, some important issues remain unresolved. Therefore, we look forward to another opportunity to address these unresolved problems.

Completing this book required the support of many people. Especially, we would like to dedicate this book to Prof. Testuya Nosse and Prof. Alan Williams and make this book a tentative response to them. We will also be delighted if this book seems to be *shinka tsutou* (running down a wood-burning fire).

Nagoya, Japan — Minoru Kunizaki
Toyama, Japan — Kazuyuki Nakamura

* * *

This book is also intended to commemorate the 60th birthdays of the two editors, Prof. Minoru Kunizaki and Prof. Kazuyuki Nakamura. Professor Kunizaki's main research interest is the theoretical and empirical studies of local governments. He has long conducted theoretical studies of mixed oligopolies, fiscal competition, municipal mergers, and coordination among local governments over wide areas as well as empirical studies of the estimation of the cost function for the supply of local public services. Professor Nakamura has focused on the relationship between local governments and residents' welfare. He has carried out studies of the efficiency of local public services, including local transportation systems, as well as theoretical analyses of income transfers between local governments and the welfare effect of decentralization. It may safely be said that Profs. Kunizaki and Nakamura cover almost all research areas of local public economics and have contributed to the development of the field of public economics.

Thus, those who respect Profs. Kunizaki and Nakamura, a group that includes both young and middle-aged Japanese scholars and distinguished Italian scholars, have compiled articles on local public economics to publish this book celebrating their sixty years. This book is therefore both a collection of the latest research and a pledge of honor to Profs. Kunizaki and Nakamura. We wish them good health, continued success, and prosperity.

The preparation of this book has been made possible by JSPS KAKENHI grant numbers 16K03722 and 17K03762. We thank Prof. Yoshiro Higano, editor-in-chief of the series *New Frontiers in Regional Science: Asian Perspectives*, for his support and for accepting our book for publication in this series. We thank Prof. Makoto Tawada for the aid and support that has continued from our previous book, *The Theory of Mixed Oligopoly*. Finally, we thank Mr. Yutaka Hirachi of Springer Tokyo for his encouragement and patience.

Nagoya, Japan Mitsuyoshi Yanagihara
Kyoto, Japan Kota Sugahara

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Contents

Part I
Decentralization and Coordination (Japanese Experience)

Chapter 1
Fiscal Competition, Municipal Consolidation, and Regional Coordination

Minoru Kunizaki

Abstract The purpose this chapter is to classify the results of a political economic analysis of fiscal competition and the behavior of municipal consolidation and apply these results to the regional coordination problem. We focus on the common pool problem in fiscal competition, municipal consolidation, and regional coordination, and we present revised empirical propositions. Specifically, we first consider the efficiency of fiscal competition and find that it is prevented by the opportunistic behavior of local governments and interest groups. Next, we summarize the empirical issues of municipal consolidation, consider the improvement of fiscal efficiency, and address the bond management problem from the point of view of political economics. Finally, we apply the political economic analyses of fiscal competition and municipal consolidation to the regional coordination problem.

Keywords Fiscal competition · Municipal consolidation · Regional coordination

1.1 Introduction

We aim to classify the results of political economic analyses of fiscal competition and the behavior of municipal consolidation, and we apply these results to the regional coordination problem. Since the 1980s, fiscal competition has been a major field of study in the local public economics literature. Many empirical analyses have confirmed the existence of fiscal competition or fiscal interactions. Analyses of this fiscal competition have been further developed and extended to political economic analysis of local public economics.

The behavior of municipal consolidations of local governments has also been studied from various perspectives. The main focus of these studies is verifying the effect of municipal consolidation on reducing local public expenditure. Political economic approaches have therefore been applied to the behavior of local governments.

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Furthermore, as part of the analysis of fiscal competition and municipal consolidation, lobbying activities have been analyzed using the common agent model. Through studies of lobbying activities, central government intervention in fiscal competition and municipal consolidation was endogenized, and the degree of policy bias of lobbying activities and the effect of regulating lobbying activity could be verified.

The common thread of these political economic analyses is verifying the relevance of fiscal competition and municipal consolidation (integration) to efficient fiscal management. In addition, these analyses consider the impact of the opportunistic behavior of municipalities and interest groups.

The local fiscal system in Japan is becoming more decentralized, and the scope of local governments' activities has also expanded owing to regional integration through consolidation. In addition, regional coordination of the maintenance and stabilization of local public services has recently expanded. In the process of regional negotiations of such coordination policies, opportunistic behavior may influence the related decision making. Therefore, in this chapter, we consider enhancing regional coordination policy by summarizing the results of political economic analyses of fiscal competition and municipal consolidation and applying these results to the regional coordination problem.

1.2 Ideal Fiscal Decentralization and Fiscal Competition

The externalities of local governments' activities can be internalized by a coordination policy in the case of perfect information. For example, even if the benefit of a local public good spills over to other regions, the externality can be internalized through negotiations between the regions. Alternatively, the under-taxation associated with fiscal externalities due to capital taxation can be avoided by coordinating to increase capital taxation. The conditions under which a coordination policy is established are exactly the same as the requirements of the Coase theorem.

Inman and Rubienfeld (1997) describe an ideal cooperative decentralization system. In this system, all local governments must set policies to internalize fiscal externalities, and the central government's policy requires the agreement of all local governments. Under these conditions, the central government sets policies that improve the Pareto efficiency of the local governments. Furthermore, the local governments can only implement coordination policies that are Pareto-improving. Therefore, cooperative decentralization guarantees an efficient resource allocation.

However, several implicit requirements are imposed on this ideal decentralization system. Specifically, this system requires zero bargaining costs and perfect information. First, to cooperatively implement a Pareto-improving policy, the local governments must make a unanimous decision. However, the appropriate policy planning for a unanimous decision cannot take place without perfect information. Furthermore, if the bargaining cost in the negotiation process is high, the negotiation is terminated before the Pareto optimal solution is reached (Mailath and Postlewaite 1990). In other words, the trigger in the repeated game becomes high, and it is impossible to realize the Coase situation. In addition, as pointed out by Myerson and Satterthwaite (1983), even if the bargaining cost is low, local governments have an incentive to exit the negotiations when they have asymmetric information. As a result, local governments adopt non-cooperative policies.

When bargaining costs and asymmetric information prevent the ideal cooperative decentralization, fiscal competition occurs. As shown in the pioneering studies of Zodrow and Mieszkowski (1986) and Wilson (1991), the non-cooperative behavior of local governments leads to an inefficient level of local welfare because of the fiscal externality. As Sugahara et al. (2011) showed, a move from the fiscal competition equilibrium to the coordination equilibrium is generally Pareto-improving.

In these fiscal competition analyses, it is assumed that local governments are benevolent toward local residents. In other words, the local governments make policy decisions as perfect agents that maximize their welfare. However, Brennan and Buchanan (1980) pointed out that without the pressure of fiscal competition, the Leviathan-type behavior by which local governments maximize tax revenue results in an increase in local public expenditure. They argued that fiscal competition implies that the mobility of labor and capital drives local governments to engage in tax competition and should result in the reduction of wasteful expenditure and the avoidance of inefficient market interventions. As a result, they concluded that the decentralization of tax revenues and expenditures tends to reduce the size of the public sector.

1.3 Fiscal Competition and the Leviathan Hypothesis

The efficiency of decentralization can be evaluated by verifying the Leviathan hypothesis presented above. Furthermore, if decentralization enhances fiscal competition, it may be possible to restrain the expansion of local expenditure. An early analysis of this problem by Oates (1985) demonstrated the link between decentralization and efficiency. In addition, Jin and Zou (2002), Cassette and Paty (2010), and Feld et al. (2010) supported this hypothesis.

It is difficult to judge whether fiscal competition or decentralization necessarily suppress expenditure. However, vertical fiscal imbalances and intergovernmental grants create additional issues not noted in these analyses. If local government autonomy is high, the Leviathan hypothesis is likely to be supported. However, if local governments highly depend on grants from the central government, the extent of fiscal competition is limited, and sufficient competitive pressure is not likely to arise Moreover, if vertical transfers can be advantageously induced by local governments, the efficiency of local governments may not be able to be improved.

Thus, if fiscal independence is low, that is, if decentralization is inadequate, grants to local governments may prevent the internalization of externalities and may weaken fiscal discipline. In this case, decentralization does not improve fiscal efficiency, and the expenditure restraint effect cannot be expected. It seems that soft budget constraints and common pool problems cause these limitations of fiscal competition.[1]

If local governments induce the central government to establish a transfer system, they can maintain their current situations without changing their expenditure levels even in the case of a policy change by receiving subsidies from the central government. Thus, local governments can maintain inefficiency through grants. This phenomenon is caused by the information asymmetry between the central and local governments and can be called an agency cost as a moral hazard of local government. Alternatively, the central government may create a common pool (common revenue source) from which local governments receive grants. Again, these transfers imply that local governments can maintain their current situations without reducing expenditures. To that end, local governments or local interest groups try to set up such a common pool by lobbying the central government.[2] From the point of view of interest groups, this lobbying activity involves purchasing policies (selling votes), whereas it can be viewed as buying votes (selling policies) from the point of view of the government. Thus, because a soft budget constraint creates moral hazard in the transfer system and the common pool is inefficient because of the lobbying activity, the same inefficiency phenomenon can have different causes.

This discussion implies that the efficiency hypothesis, which states that fiscal competition or decentralization improves the efficiency of local governments, depends on the institutional design of the vertical transfer. If the efficiency hypothesis does not hold, it is necessary to identify the soft budget constraint and the common pool, as shown here, to investigate the cause of the inefficiency. The soft budget constraint arises from the institutional acceptance of moral hazard. Thus, because the soft budget constraint problem is created by unintentional inefficiency of the central government, efficiency can be improved if it is be made observable by repeatedly changing the system. Conversely, because the common pool is the result of lobbying, the resulting inefficiency is intended by the central government. The problem of identifying the soft budget constraint and the common pool is discussed in the next section; here, we simply point out that considering the influence of political factors on the institutional design and extent of the central government is important for identification problems.

1.4 Municipal Consolidation

In the previous section, we examined the efficiency of fiscal competition. Municipal consolidation is a system change that affects the fiscal management of local gov-

[1]The term "common pool" can have two meanings. The first is a horizontal free rider incentive for "commons," and the second is "compensation (pork barrel)" for election cooperation. In this chapter, we use the term "common pool" in the latter sense.

[2]Mazza and Winden (2002) point out that decentralization is not effective for controlling public expenditure because of lobbying to the central government. See Shinozaki et al. (2016) for an analysis of multi-level lobbying activities.

ernments. Thus, in this section, we consider the types of incentives for municipal consolidations, which can be classified first by the impact of economies of scale of local public services and production efficiency and second by the free rider problem in bond management.

1.4.1 Efficiency Hypothesis of Municipal Consolidation

First, we consider the efficiency of local expenditures through consolidations. An analysis of the economies of scale of local public services was briefly mentioned by Shoup (1969), but many subsequent research results have been found. For example, the population expansion due to a consolidation is also expected to improve production efficiency owing to economies of scale. Furthermore, as Nakamura and Kunizaki (1994) showed, the production of public services is inefficient in smaller municipalities because small municipalities have weak fiscal conditions, eliminating and integrating inefficient facilities is difficult, and inefficiencies are preserved by grants from the central government. Empirical analyses have been conducted to understand the efficiency improvements of local public services driven by consolidation, as described above.

First, economies of scale have been verified as having an expenditure-reducing effect. However, because these results differ depending on expenditure items, the efficiency hypothesis has not generally been confirmed the existence of the expenditure reduction effect. Furthermore, as pointed out by Yamashita (2015), the reduction effect associated with merged municipalities is smaller than is found by comparing unmerged local governments. We discuss this interpretation later.

Next, the literature has not found remarkable improvements to production efficiency owing to consolidation. In particular, Sumi (2016) pointed out that the efficiency of merged municipalities is lower than that of unmerged municipalities. Thus, we cannot clearly confirm that consolidation improves productivity.

As mentioned above, current research results do not strongly support the efficiency hypothesis of municipal consolidations. As indicated by Kunizaki and Tahira (1992), economies of scale can differ depending on the public service items considered. As a result, economies of scale may weaken over expenditures. Furthermore, as Nakamura (2015) showed, the actual consolidation scale may be too small to realize economies of scale. Therefore, the effect of consolidation on expenditures may be determined by both the size of the consolidation and the size of public services.

Empirical analyses of the effect of municipal consolidation on production efficiency have not found noticeable improvements. This finding may indicate that consolidation does not significantly change the production style or the structure of expenditures. For example, if the public facility of each local government before the consolidation remains the same after the consolidation, the supply structure remains the same. Such inefficiency is maintained if there is no additional fiscal burden or the efficiency improvement is small.

If the efficiency hypothesis of municipal consolidation is not supported, it is necessary to consider the cause of the inefficiency. As mentioned earlier, if the decision on the expenditure reduction effect is simply a matter of consolidation, it is not consistent with comparisons with unmerged municipalities. That is, consolidation creates not reduction effect in the unmerged municipality, and, thus, there is no incentive to relatively improve the efficiency of the unmerged municipality. Alternatively, additional fiscal resources will be needed to maintain the inefficiency of the merged municipality.

Again, considering the soft budget constraint and the common pool, as discussed earlier, we examine the reason that the efficiency hypothesis is not supported in the case of consolidation. First, to have little or no expenditure reduction effect, grants to the merged municipality should work more advantageously than those to the unmerged municipality. Otherwise, we cannot explain the discriminatory results caused by municipal consolidations. If the driver of the inefficiency is the soft budget constraint, inefficiency should occur regardless of municipality size because if the institution is designed regardless of the characteristics of each municipality, the relationships between the degree of inefficiency, the municipal consolidation, and municipality characteristics will be weak.

However, according to Sumi (2016), if the inefficiency of a merged municipality is relatively high, the municipality receives a relatively favorable transfer. In other words, it can be said that transfers are intentionally provided to merged municipalities. Such transfers seem to reflect a common pool. This common pool problem cannot be identified by previous expenditure reduction effects or production efficiencies. Furthermore, if this intended transfer is not a political factor in the sense of lobbying but rather is initially set up as an incentive to promote consolidations, it is not a common pool factor but rather a policy inducement. In that case, the purpose of promoting the consolidation policy is not to improve the efficiency of fiscal management.

The above can be summarized as follows. First, if the efficiency hypothesis is not supported in the case of municipal consolidation, it is necessary to consider the factors driving the inefficiency. Because the inefficiency of expenditures varies depending on whether a consolidation occurs, it is unlikely that soft budget constraint is the driving factor. Two remaining possible causes are a common pool or a policy inducement for purposes other than efficiency.

1.4.2 Decision Making of Municipal Consolidation

In this subsection, we consider the types of incentives that drive the consolidation decision. In the 2000s, many Japanese municipalities faced institutional changes to stimulate consolidation and carried out voluntary consolidations. Miyashita and Nakazawa (2009) and Nakazawa (2015) derived interesting results regarding these consolidation decisions. Their analyses focused on presenting the consolidation motivations and incentives of municipalities. We follow their analysis and provide interpretations of the incentives.

First, Miyashita and Nakazawa (2009) analyzed the determinants of bargaining costs as the decision-making factor, following Buchanan. The term "bargaining costs" includes not only the actual cost associated with forming a consensus but also current and future opportunity costs. If this bargaining cost is sufficiently large, merging is difficult, and the number of merged municipalities is limited. As a result, it is necessary to raise the probability of consolidation for the absorptive and promotion types of consolidation with metropolitan cities. An uneven distribution of gravity among municipalities also raises the probability of consolidation. Thus, small-scale municipalities seek to be absorbed by large municipalities, and large-scale municipalities seek to expand their authority and fiscal size.

Furthermore, Nakazawa (2015) clarified the relationship between the consolidation probability and fiscal factors. He concluded that municipalities with higher dependencies on grants and weak fiscal conditions may merge earlier. However, small municipalities, such as towns and villages, tend to merge to receive preferential treatment from the central government if the public-debt-to-cost ratio is high. This analysis also suggests that municipalities with a high public-debt-to-cost ratios may not be able to merge and that the incentives of preferential treatment by the central government, especially special consolidation bonds, are triggered by consolidations.

These studies on consolidation decisions pointed out that large municipalities intend to expand their authority and expenditures and that small municipalities have a free rider incentive to shift their public deficit burdens to large municipalities. Small municipalities therefore try to reduce their public debt burdens through preferential treatment by the central government. These results show that large municipalities exhibit Leviathan behavior in the case of a promotion-type consolidation. For small municipalities, consolidation with large municipalities is an opportunity for free riding, but this free riding can drive large municipalities to refuse to consolidate if the degree of debt shifting is large. In addition, special bond issuances by municipalities with high public-debt-to-cost ratios can shift the burden to the central government, which creates a vertical free rider incentive.

The Leviathan behavior of large municipalities is consistent with the fact that efficiency improvement hypothesis is not supported. Because absorption-type consolidation involves the integration of large municipalities, declining fiscal competition and the expanding authority of large municipalities owing to consolidation are negative factors that reduce expenditures and production inefficiency.

Furthermore, in the case of consolidation as a tool for shifting the burdens of public bonds, preferential treatment by the central government is a requirement for consolidation to lead to vertical rather than horizontal free riding. If so, we can consider the factors that determine the preferential treatment of merged municipalities. Because this preferential treatment is institutionally restricted to merged municipalities, it is no longer intentional, as in the case of a soft budget constraint. Thus, either a common pool or a policy inducement for a different purpose should be a consolidation trigger.

Hinnerich (2009) and Jordahl and Liang (2010) examined the relationship between the transfer of public bond burdens and consolidation. As mentioned above, as long as the consolidation scale is large, small municipalities issue bonds before consolidation and exhibit the behavior of trying to shift the burden to merged local governments. These studies supported the existence of horizontal free rider incentives, but they did not explicitly consider central government interventions, and, thus, their findings of horizontal free rider incentives may be intertwined with central government interventions.

Nakazawa (2016) considered the distinction between horizontal free rider incentives and central government interventions. According to his analysis of data of the Japanese consolidation experience in the 2000s, the horizontal free rider incentive is reduced by central government restrictions on bonds issuance. Furthermore, Miyashita and Nakazawa (2014) showed evidence of a substitution from ordinary municipality bonds to preferential bonds, which shifted the burden to the central government, after consolidations.

These studies pointed out that if we ignore central government interventions, horizontal free riding may be detected. However, explicitly dealing with central government intervention means that behavior in response to preferential treatment for municipalities is detected. The empirical results of these studies confirmed that vertical free rider incentives are greater than horizontal free rider incentives. It is also necessary to verify the reasons for consolidation inducement or preferential treatment by the central government.

1.4.3 Empirical Proposition of Incentives for Municipal Consolidation

When introducing empirical analyses of consolidations, we have interpreted and examined the efficiency improvement hypothesis, the free riding hypothesis, and the common pool problem. Next, we consider the remaining problems of empirical analyses pf consolidations.

As mentioned above, the inefficiencies caused by vertical transfers are one factor that does not validate the efficiency hypothesis. If this inefficient factor is present, vertical transfers must discriminate between merged municipalities and unmerged municipalities. In addition, it is necessary to identify the determinants of vertical transfers to understand if the discriminatory transfer is set up for as a common pool or a policy inducement for some other purpose. Thus, we propose a process for estimating the vertical transfer function, as follows.

First, to demonstrate the relationship between consolidations and vertical transfers, it is necessary to confirm whether the transfer functions of merged and unmerged municipalities are identical. Second, when the identification of the transfer function is rejected, we examine the inference of a common pool by estimating the relationship between the transfer function and political factors. Furthermore, the impact of other policy objectives, such as decreasing a municipality's risk of bankruptcy, can be demonstrated by, for example, investigating whether the risk of bankruptcy changes with the transfer function before and after the consolidation. Performing these steps in sequence can lead to an alternative proposition to the efficiency improvement hypothesis in the case of consolidation.

Next, the horizontal free rider hypothesis concerning public bonds can be confirmed by conducting a difference-in-differences (DID) analysis at the level of public bonds. Specifically, such an analysis checks whether the DID parameters of municipalities with high and low levels of central government intervention are identical. If these parameters are identical and significant, the horizontal free rider hypothesis is supported. If they are not identical, we can confirm the existence of political factors by estimating a special bond function, and we can identify the common pool. Furthermore, if the political factors are not significant, we may be able to identify the policy purpose by examining the relationship between target variables assumed from other policy purposes and special bonds or vertical grants.

As described above, the confirmation of opportunistic behavior concerning consolidations requires understanding the horizontal behavior between municipalities and identifying the vertical behavior between central and local governments. The empirical analysis described above is required to distinguish these types of behavior.

1.5 Regional Coordination

As mentioned in the previous section, the neutrality of vertical transfers is required to improve the efficiency of fiscal management through fiscal competition and consolidation. In this section, we consider regional coordination policies as a measure for improving the efficiency of local governments.

As is well known, fiscal competition results in the under-supply of local public goods. However, it is possible to improve efficiency through a policy of cooperation among regions. The problem is whether such a coordination environment can be established. As shown in Sect. 1.2, unless the bargaining cost is small and there is no asymmetric information, local governments voluntarily shift to cooperation.

Because consolidation involves the integration of municipalities, it can be thought of as cooperation across all government activities. Thus, consolidation involves the negotiation of each such activity, and agreement is eventually reached if the gain from consolidation is large. Consolidations are only partially established when the total gain is large but the interests of local governments conflict. Even if cooperation occurs for certain public goods to obtain gains, a consolidation does not result, as the overall gain is small. As a result, because consolidation is an extreme coordination policy, the possibility of partial efficiency is eliminated. Such results are caused by the autonomy of individual municipalities and the continuation of their policy involvement. In fact, many local governments that are fiscally self-sustainable refuse to consolidate.

However, to maintain fiscal autonomy and soundness, it may be necessary to improve the efficiency of local public goods, which requires partially cooperative policies. One possible solution to this problem is “regional coordination.” In this context, regional coordination refers to partially cooperative policies between local governments, and it is assumed that the ranges and burdens of such policies are negotiated among local governments. This type of coordination without the involvement of the central government can be considered as a “horizontal cooperative policy” in a pure sense.

In general, the determination of the coordination contents depends on regional characteristics, such as the relative sizes and fiscal conditions of the local governments. For example, if the scale of each municipality is small and each municipality is fiscally autonomous, the benefits of interregional coordination are small, and coordination is difficult to establish. However, if the demographic compositions and contents of local public goods provision are different among regions, the joint use of public goods can allow an efficient supply to both regions, and a coordination incentive is generated to improve fiscal soundness.

As seen in the case of municipal consolidation, large municipalities may not encourage the free riding of small municipalities unless they are altruistic. However, unlike in the case of the consolidation, coordination can prevent free riding and reduce the bargaining cost burdens of small municipalities. As a result, the coordination contents and the burden structure can determine the range of coordination when municipalities receive Pareto-improving gains. Furthermore, if the economies of scale are present for the supply of public goods, the benefits of this coordination increase.

Having examined regional coordination without considering the opportunistic behavior of local governments, we now consider the consequences of coordination when each municipality acts opportunistically, for example, as a Leviathan or a free rider. First, in the case of coordination between municipalities of the same size, opportunistic behavior is discouraged by reciprocal checks. Problems arise when municipalities have a considerable size difference. If large municipalities engage in Leviathan behavior, they will shift the burden to small municipalities and try to expand their own authority. In this situation, small municipalities must anticipate public goods spillovers and consider their own burden. As a result, an excess supply of public goods and excess burdens occur in these circumstances, making it difficult to establish coordination. Therefore, opportunistic behavior makes coordination difficult, and either voluntary or horizontal coordination cannot be achieved or only some local governments partially coordinate. Opportunistic behavior may therefore cause regional disparities.

If the goal is promoting regional coordination, vertical transfers are necessary for cooperation. It should be noted here that vertical transfers in the case of opportunistic behavior do not necessarily improve efficiency, as discussed in the cases of fiscal competition and consolidation. As discussed above, large municipalities shift the burden of providing public goods to neighboring municipalities, but if that burden is shifted to the central government, this vertical behavior of large municipalities expands the size of expenditure, as with the common pool in the case of consolidation.

Small municipalities can also eliminate their own burdens through such vertical transfer. As a result, this coordination results in an excessive supply of public goods, or, at least, it does not reduce the supply of public goods, and the scope of coordination and the number of cooperative local governments may increase excessively.

1.5.1 Empirical Analysis of Regional Coordination

We previously discussed the possibility that voluntary regional coordination between municipalities can lead to Pareto improvements and distortions due to opportunistic behavior. In this subsection, we discussed the empirical verification of this regional coordination. Empirical analysis of regional coordination is a recent research topic. Sugahara (2014) conducted one such study, and, thus, we discuss the empirical problem by introducing his work.

Sugahara (2014) focused on public goods spillovers among municipalities using a repeated public goods game and analyzed the incentives for regional coordination. He found that regional coordination occurs if reciprocal interdependence among municipalities is high and the central municipality's fiscal condition is sound. He also showed that coordination is difficult if the fiscal condition of neighboring municipalities is weak. Furthermore, he concluded that the success or failure of coordination depends on the intention of the central or large municipality.

If the central government does not intervene in the establishment of coordination, each local government must voluntarily negotiate on the contents of any coordination. This negotiation is essentially the same as the problem of consolidation. In the case of consolidation, if the size of neighboring municipalities is small and the fiscal situation is weak, these municipalities have an incentive to free ride by consolidating within large municipalities, but large municipalities prevent such free riding through negotiation. According to Sugahara (2014), the same situation arises in the case of coordination. However, it should be noted that coordination involves selective or partial bargaining, whereas consolidation involves comprehensive bargaining.

1.5.2 Empirical Proposition Regarding Regional Coordination

Based on the above considerations, a major issue with voluntary coordination among local governments is the degree of interregional public goods provision and the associated burden. If each municipality forms a partnership as a result of coordination, the coordination should be Pareto improving. This result arises because voluntary coordination leads to cooperation contents that reduce free rider incentives and joint provision to improve economies of scale and production efficiency.

Therefore, we can present an efficiency hypothesis of regional coordination. In other words, if local governments voluntarily coordinate, the efficiency of public goods provision is improved. To confirm this hypothesis, analysis must be conducted in the following order. First, the factors that lead to consultation must be clarified. Second, when coordination occurs, the determinant factors of the cooperative contents should be analyzed. Third, it is necessary to confirm the efficiency improvements of cooperative local governments. The initial coordination consultation analysis can identify the relevant municipalities' incentives for participation. From this analysis, the presence or absence of horizontal free riding is verified. If the previous presumption is plausible, horizontal free riding incentives should be prevented by the negotiation process.

Next, the cooperation contents are analyzed to verify the range and size of regional coordination. If regional coordination reflects the demands of each local government, differences in regional characteristics, such as the population composition and industrial structure, should be reflected in the cooperation contents. If the homogeneity of the cooperation contents across regions is high, the cooperation is not selective, and the degree of freedom is low. Thus, the possibility of Pareto-improving coordination is reduced.

If free rider incentives are eliminated by the first analysis and if the selection and degree of freedom of the municipality are confirmed by the second analysis, the only remaining step is verifying the efficiency of coordination. However, if the first two steps are verified, efficient coordination is expected, and, thus, if efficiency cannot be confirmed, it is necessary to go back and consider factors other than horizontal regional cooperation.

The previous analysis rests on the premise of voluntary cooperation among local governments. However, if governments are not motivated by efficiency gains, other incentives must exist. Again, we may consider the same factors as in the common pool problem. The analysis in this case involves sequentially demonstrating the influence of central government interventions on coordination, the relevance of the cooperation contents, and vertical transfers. As a result, these analyses can identify efficiency and incentives for regional cooperation. Therefore, such comprehensive consideration is expected to ultimately contribute to effective regional coordination.

1.6 Conclusion

The purpose of this chapter was to discuss previous empirical analyses of fiscal competition and municipal consolidation and summarize the behavioral patterns of local and central governments based on the results of these analyses. Then, we applied the implications to the regional coordination problem. In other words, the validation of coordination policy was clarified by verifying the analyses of cooperation incentives and the efficiency hypothesis. Furthermore, we examined the relevance between coordination problems and vertical transfers.

We conclude by discussing the issues that not considered in this discussion. The first issue is identifying whether municipalities make short-term (short-sighted) or long-term (forward-looking) decisions even when merging or coordinating. The declining population, which will last for decades, is directly linked to the survival problem of local governments. Therefore, because fiscal management to this point affects the future fiscal situation, policymakers are forced to take long-term gains into consideration. However, short-sighted decision making will result in a greater burden in the future or the risk that the municipality collapses, resulting in a need for regulations on municipalities or additional policies to avoid these scenarios. To avoid such inefficiencies, it is useful to verify the behavior styles of local governments.

Next, although we examined horizontal coordination issues, such as consolidations of local governments and regional coordination, we did not consider municipalities that fell out of the scope of consolidation and coordination. Unmerged or non-coordinated municipalities are not necessarily those with high levels of self-reliance. Municipalities with a high risk of so-called "regional annihilation" as the population declines have become the top priority for the survival of fiscal management. In this case, because the problem cannot be relieved through consolidation or coordination seen earlier, some type of redistributive policy is needed.

Furthermore, we describe the possibility of vertical coordination between prefectures and municipalities. As discussed, if the large municipality is not altruistic, small municipalities cannot survive. Prefectural intervention or coordination may be effective in a situation that cannot be resolved by a municipal horizontal coordination policy. However, because municipalities have a responsibility to provide local public goods, it is necessary to confirm the effectiveness of coordination with the prefecture.

Finally, we conclude that the empirical problems discussed in this chapter still remain.

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Chapter 2
Coordinated State Capital Tax Reform in an Overlapping Generations Model

Tsuyoshi Shinozaki, Hideya Kato and Minoru Kunizaki

Abstract The analysis described in this chapter examines whether a coordinated state capital tax reform improves steady-state social welfare an overlapping generations (OLG) model with vertical and horizontal tax externalities. We show that an OLG model introduces dynamic efficiency and dynamic vertical externality effects, neither of which appear in static models. In particular, we show that the sign of the dynamic vertical tax externality effect depends on whether each state government ignores the effect of its own tax rate on federal tax revenue.

Keywords Vertical tax externalities · Horizontal tax externalities · Overlapping generations

2.1 Introduction

We analyze the welfare effects of a coordinated state capital tax reform under vertical and horizontal tax externalities in an overlapping generations (OLG) model. We focus on two cases: the case in which state governments consider the effects of their tax rates on federal tax revenues (i.e., federal public goods) and that in which state governments ignore this effect.

Through this analysis, we examine whether a coordinated state capital tax reform within a federation improves steady-state welfare. Previous theoretical studies of horizontal tax externalities, such as that of Zodrow and Mieszkowski (1986), have shown that competition for mobile capital among governments at the same level leads to a low capital tax rate. In contrast, previous studies of vertical tax externalities,

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such as that of Keen (1998), have shown that a shared tax base between the federal government and lower-level governments leads to an excessively high capital tax rate. Thus, Keen and Kotsogiannis (2002) remarked that "the question of whether equilibrium state taxes are likely to be high, too low, or just right…is obviously critical to issues of tax coordination." Their study considered coordinated tax reform and showed that whether capital taxes are too high or too low depends on the elasticities of the demand for capital and the supply of savings in a two-period model.

These studies' results are quite reasonable from a static perspective. However, tax competition and fiscal externalities have also been analyzed recently using economic growth or dynamic models (e.g., Rauscher 2005; Tamai 2008). Batina (2009) considered a coordinated capital tax reform in the case of horizontal tax externalities in an OLG model. He showed that the coordinated capital tax reform may reduce welfare in the steady state but that the outcome depends on whether the economy is under- or over-accumulated relative to the golden rule path because the size of each state government is small relative to that of the economy. In other words, the state governments recognize that their own policies do not affect overall resource allocation. In particular, Batina (2009) showed that in dynamic situation, a coordinated capital tax reform causes static horizontal tax competition because a capital tax distorts the allocation of investment. In addition, this reform causes a dynamic efficiency effect because it tends to decrease capital accumulation. The direction of this effect, however, depends on whether the economy is dynamically efficient or inefficient.

Despite the recent research interest in this topic, no previous study has considered the relationship between horizontal and vertical tax externalities in an OLG model. In such a model, the savings function depends on the wage and the interest rate, whereas in a two-period model, like that of Keen and Kotsogiannis (2002), the savings function depends only on the interest rate. Because the amount of savings determines the size of the federal government's tax base, this property of the savings function in an OLG model can generate a dynamic vertical tax externality effect in addition to the vertical externality effect generated in static frameworks.

Our analysis shows that an OLG model does introduce two dynamic effects that do not occur in static models: a dynamic efficiency effect and a dynamic vertical externality effect. In particular, we show that the sign of the dynamic vertical tax externality effect depends on whether the state governments ignore their effects on federal tax revenue. In other words, when each state government recognizes its effect, the dynamic vertical externality effect reduces the capital tax rate set by the state government. However, when the state governments do not recognize their effect, the dynamic vertical externality effect increases the capital tax rate set by the state government.

The remainder of this chapter is organized as follows. Section 2.2 describes the basic model. Section 2.3 discusses the optimal policy rule. Section 2.4 examines the impact of a coordinated tax reform on welfare. Section 2.5 concludes.

2.2 The Model

We consider a perfectly competitive economy. Economic activities are carried out in discrete time and last forever. The nation consists of N identical states (indexed by $i = 1, \ldots, N$). Capital is perfectly mobile, and labor is immobile across states. In each state, $L_{i,t}$ identical individuals are born in period t, and the population is assumed to grow at a rate of n.

A single private good is produced using a constant returns to scale production technology, $Y_{i,t} = F\left(K_{i,t}, L_{i,t}\right)$, where $Y_{i,t}$, $K_{i,t}$, and $L_{i,t}$ denote aggregate output, capital input, and labor input in state i in period t, respectively. This technology is common to all of the states. In the following discussion, we omit the subscript referring to state i except when it is absolutely necessary. Output per capita can be expressed as, $y_t = f(k_t)$ where $y_t \equiv Y_t/L_t$ and $k_t \equiv K_t/L_t$ denote the output-labor ratio and the capital-labor ratio, respectively.

The profit per capita of a firm is given by $f(k_t) - (r_t + \delta + \tau_t)k_t - w_t$, where r_t, w_t, $\tau_t \equiv \tau_t^S + \tau_t^F$, and δ are the net interest rate, the wage, the consolidated tax rate in period t, and the capital depreciation rate, respectively. τ_t^S denotes the state government capital tax rate, and τ_t^F denotes the federal government capital tax rate. The profit-maximizing conditions of the firm in a perfectly competitive market are given as

$$
\begin{aligned}
f_k(k_t) \equiv \frac{df(k_t)}{dk_t} &= r_t + \delta + \tau_t \equiv R_t, \\
f(k_t(R_t)) - R_t k_t(R_t) &= w_t.
\end{aligned}
\tag{2.1}
$$

From Eq. 2.1, we obtain $k_{tR} \equiv dk_t/dR_t = 1/f_{kk} < 0$ and $w_{tR} \equiv dw_t/dR_t = -k_t < 0$.

Individuals live for two periods, which we refer to as the young and old periods, and young and old generations are alive in every period. Individuals are assumed to be identical both within and across generations. In period t, each young individual supplies one unit of labor inelastically in exchange for a wage and allocates this wage between consumption in the current period, c_t, and savings, s_t. Thus, a young individual's budget constraint in period t is $w_t = c_t + s_t$. Savings earn the gross rate of return in the next period and enable individuals to consume in the old period. Individuals' consumption in the old period can be represented as $c_{t+1} = (1 + r_{t+1})s_t$. Therefore, the lifetime budget constraint of individuals is given by $w_t = c_t + c_{t+1}/(1 + r_{t+1})$.

The utility function of individuals born in period t is given by $u_t(c_t, c_{t+1}) + b(g_{t+1}) + B(G_{t+1})$, where g_{t+1} and G_{t+1} are the state public goods and the federal public goods per state available in period $t+1$, respectively.[1] $u_t(c_t, c_{t+1})$ is assumed to be additively separable. Federal public goods benefit all individuals, whereas a state's public goods only benefit residents of that state.

[1]For simplicity, we assume that the young generation cannot receive benefits from federal and state public goods. This simplification does not affect our main implications.

Individuals choose consumption levels in both periods to maximize their utility subject to the lifetime budget constraint. From the first-order condition, we obtain the following relationship:

$$\frac{\partial u_t/\partial c_t}{\partial u_t/\partial c_{t+1}} = 1 + r_{t+1}. \tag{2.2}$$

From Eq. 2.2, the savings function is given by $s_t(w_t, r_{t+1})$, where $0 < s_{tw} \equiv \partial s_t/\partial w_t < 1$ on the assumption of separability of the utility function and $s_{tr} \equiv \partial s_t/\partial r_{t+1} \gtreqless 0$. In what follows, we assume $s_{tr} \geq 0$. Thus, the indirect utility function is given by

$$\begin{aligned} &v_t(w_t, r_{t+1}, g_{t+1}, G_{t+1}) \\ &\equiv u_t(w_t - s_t(w_t, r_{t+1}), (1 + r_{t+1})s_t(w_t, r_{t+1})) \\ &\quad + b(g_{t+1}) + B(G_{t+1}). \end{aligned} \tag{2.3}$$

This indirect utility function has the standard properties of $v_{tw} \equiv \partial v_t/\partial w_t > 0$ and $v_{tr} \equiv \frac{\partial v_t}{\partial r_{t+1}} = v_{tw}\left(\frac{s_t}{1+r_{t+1}}\right) > 0$.

The capital market equilibrium condition in period $t + 1$ is given by

$$\sum_{i=1}^{N} s_{i,t}\big(w_{i,t}\big(R_{i,t}\big), r_{t+1}\big) = (1 + n)\sum_{i=1}^{N} k_{i,t+1}\big(R_{i,t+1}\big). \tag{2.4}$$

This economy must satisfy the following dynamic stability condition:

$$\frac{dr_{t+1}}{dr_t} = \frac{-\sum_{i=1}^{N} s_{iw} w_R}{\sum_{i=1}^{N} s_{ir} - (1 + n)\sum_{i=1}^{N} k_{iR}} \in (0, 1).$$

We can rewrite this stability condition in the steady state as

$$\sum_{i=1}^{N}(s_{iw} w_R + s_{ir}) - (1 + n)\sum_{i=1}^{N} k_{iR} > 0. \tag{2.5}$$

To prepare to analyze the welfare effect of a coordinated state tax reform, we show the comparative statics regarding the effect of changing the state capital tax rate on the interest rate in the steady state. As in Keen and Kotsogiannis (2002), the effect of changing the state capital tax rate is given by

$$\frac{dr}{d\tau_i^S} = -\frac{s_{iw} w_R - (1 + n)k_{iR}}{\sum_{i=1}^{N}(s_{iw} w_R + s_{ir} - (1 + n)\sum_{i=1}^{N} k_{iR})} \in \left[-\frac{1}{N}, 0\right). \tag{2.6}$$

We assume a symmetric equilibrium in which all state governments set the same tax rate. When all state governments simultaneously increase their tax rates in the symmetric equilibrium, the effect of the increase in the coordinated state capital tax rate is given by

$$\frac{dr}{d\tau^S} = -\frac{s_w w_R - (1+n)k_R}{s_w w_R + s_r - (1+n)k_R} \in [-1, 0). \tag{2.7}$$

Therefore, using Eq. 2.6 in the case of a symmetric equilibrium, we obtain the following relationship:

$$\frac{dr}{d\tau^S} = N\frac{dr}{d\tau_i^S}. \tag{2.8}$$

The federal and state governments supply federal and state public goods, respectively, by spending their capital tax revenues. Thus, the federal and state governments face the following budget constraints, respectively:

$$G_t = \frac{1}{N}\tau_t^F \sum_{i=1}^{N} k_{i,t} = \frac{\tau_t^F}{(1+n)N} \sum_{i=1}^{N} s_{i,t-1}\big(w_{i,t-1}, r_t\big), \tag{2.9}$$

$$g_{i,t} = \tau_{i,t}^S k_{i,t}. \tag{2.10}$$

We assume that no intergovernmental transfers are made and that the state governments behave as Nash competitors with respect to the federal government and other state governments.

In the next section, we consider state governments' behavior. To frame this discussion, we must first highlight the difference between an OLG model and a two-period model. In both models, an increase in the capital tax rate decreases the total amount of capital. Moreover, under the dynamic stability in an OLG model, the decrease in the capital level reduces the wage income of the next generation, and, thus, decreases their savings as well. Thus, an increase in the capital tax rate leads to capital accumulation effects. Because these capital accumulation effects do not arise in two-period models, we hereafter refer to these capital accumulation effects as "dynamic effects." By comparing the results of a static model to our results, we demonstrate the additional dynamic effects in the following sections.

2.3 State Optimal Policy Rule

In this section, we analyze the behavior of state governments and derive the optimal state government policy. We examine two cases; in the first case, state governments consider the effects of their own policies on federal government revenue, and, in the second case, state governments ignore these effects.[2] Following Batina (2009), the

[2]The first and second cases follow Keen and Kotsogiannis (2002) and Boadway and Keen (1996), respectively.

social welfare function of the government of state i in period t is $W_{i,t} = v_{i,t-1} + v_{i,t}$. In the steady state, this social welfare function can be written as $W_i = v_i$.[3] In this analysis, we focus on only the steady state to understand the long-run effects.

2.3.1 State Governments Consider Their Effects on Federal Revenue

First, we consider the case in which state governments take into account the effects of their policies on the federal government's revenue. In this case, the state governments' problem is formulated as

$$\max_{\tau_i^S} W_i = v_i(w_i(r+\tau_i), r) + b(g_i) + B(G_i),$$
$$s.t.\,\text{Eqs. 2.6, 2.9, and 2.10.} \tag{2.11}$$

Solving this maximization problem, we obtain the following rule evaluated in a symmetric equilibrium:

$$\frac{dW_i}{d\tau_i^S} = -v_w k + \frac{v_w}{1+r} k(n-r)\frac{1}{N}\frac{dr}{d\tau^S} + b_g\left\{k + \tau^S k_R\left(\frac{1}{N}\frac{dr}{d\tau^S} + 1\right)\right\}$$
$$+ B_G\tau^F\left\{s_r\frac{1}{N}\frac{dr}{d\tau^S} - s_w k\left(\frac{1}{N}\frac{dr}{d\tau^S} + 1\right)\right\} = 0. \tag{2.12}$$

We can see that each state government determines its own state capital tax rate by considering the following effects. The first term on the right-hand side of Eq. 2.12, $-v_w k$, represents the effect of the state government's own capital tax rate on wage income through capital accumulation. The second term, $\frac{v_w}{1+r}k(n-r)\frac{1}{N}\frac{dr}{d\tau^S}$, is the dynamic efficiency effect. The third and fourth terms, $b_g\left\{k + \tau^S k_R\left(\frac{1}{N}\frac{dr}{d\tau^S} + 1\right)\right\}$ and $B_G\tau^F\left\{s_r\frac{1}{N}\frac{dr}{d\tau^S} - s_w k\left(\frac{1}{N}\frac{dr}{d\tau^S} + 1\right)\right\}$, indicate the effects of the state tax rate on state tax revenue and federal tax revenue, respectively.

The dynamic effects are represented by the second term and part of the fourth term on the right-hand side of Eq. 2.12, $\frac{v_w}{1+r}k(n-r)\frac{1}{N}\frac{dr}{d\tau^S}$ and $-B_G\tau^F s_w k\left(\frac{1}{N}\frac{dr}{d\tau^S} + 1\right)$, respectively. The remaining terms reflect static effects.[4] The third term, $b_g\left\{k + \tau^S k_R\left(\frac{1}{N}\frac{dr}{d\tau^S} + 1\right)\right\}$, represents the static horizontal tax competition effect, and the other part of the fourth term, $B_G\tau^F s_r\frac{1}{N}\frac{dr}{d\tau^S}$, represents the static vertical tax competition effect.

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[3] In the steady state, we omit the subscript t.

[4] See Keen and Kotsogiannis' (2002) Eq. 2.8, which sets the rent tax rate equal to zero ($\theta = 0$). Strictly speaking, the first term in Eq. 2.12 is also a dynamic effect relating to the capital accumulation effect. However, we regard this effect as a static effect because a similar effect arises in Keen and Kotsogiannis' (2002) model through rent.

The dynamic efficiency effect is a unique characteristic of OLG models. The direction of this effect depends on the whether the economy is dynamically efficient or inefficient. If the economy is dynamically efficient, that is, if $r > n$ (dynamically inefficient, that is, $r < n$), this effect is positive (negative). The other dynamic effect (hereafter, the dynamic vertical tax externality effect), $-B_G \tau^F s_w k\left(\frac{1}{N}\frac{dr}{d\tau^S} + 1\right)$, reflects the reduction in the federal government's tax base through the reduction in wage income caused by the increase in the state capital tax rate. In other words, this term represents the effect on the federal government's tax base through capital accumulation. As mentioned above, this effect does not appear in a static model because, in static models, the savings function depends only on the interest rate. This dynamic vertical tax externality effect has the opposite welfare effect to that of the static vertical tax externality effect.

If N is large ($N \to \infty$), we follow Batina (2009) in our treatment of small states. In this case, each state government sets an optimal state capital tax rate without considering its effect on interest rates: $dr/d\tau^S = 0$. Therefore, Eq. 2.12 can be rewritten as $dW_i/d\tau_i^S = -v_w k + b_g\left\{k + \tau^S k_R\right\} - B_G \tau^F s_w k = 0$.

2.3.2 State Governments Ignore Their Effects on Federal Revenue

Next, suppose that each state government completely ignores the effect of its own tax rate on federal revenue. In this case, the maximization problem of each state government is given by

$$\max_{\tau_i^s, g_i} W_i = v_i(w_i(r + \tau_i), r) + b(g_i) + B(G_i),$$
$$s.t.\ \text{Eqs. 2.6 and 2.10 and } G_i \text{ is given.} \tag{2.13}$$

Solving this problem, we obtain the following condition, evaluated in a symmetric equilibrium

$$\begin{aligned}\frac{dW_i}{d\tau_i^S} &= -v_w k + \frac{v_w}{1+r}k(n-r)\frac{1}{N}\frac{dr}{d\tau^S} \\ &\quad + b_g\left\{k + \tau^S k_R\left(\frac{1}{N}\frac{dr}{d\tau^S} + 1\right)\right\} = 0.\end{aligned} \tag{2.14}$$

Comparing Eq. 2.14 to Eq. 2.12, the absence in Eq. 2.14 of the fourth term in Eq. 2.12 implies that the effect on federal revenue does not impact the optimal state government policy in this case. If the sign of the fourth term in Eq. 2.12 is positive (negative), the state governments set a lower (higher) state capital tax rate in this case than in the case described in Sect. 2.3.2. We also consider the case in which each state is small and find that Eq. 2.14 can be rewritten as $dW_i/d\tau_i^s = -v_w k + b_g\left(k + \tau^S k_R\right) = 0$.

2.4 Welfare Effects of a Coordinated Capital Tax Reform

In this section, we analyze the effects of a coordinated state capital tax reform on welfare in the steady state. In this coordinated tax reform, all state governments permanently raise their capital tax rates simultaneously (i.e., $d\tau_i^S = d\tau^S > 0$ for all i). The effect of the coordinated tax reform is given by

$$\frac{dW}{d\tau^S} = -v_w k + \frac{v_w}{1+r} k(n-r) \frac{dr}{d\tau^S} + b_g \left\{ k + \tau^S k_R \left(\frac{dr}{d\tau^S} + 1 \right) \right\} + B_G \tau^F \left\{ s_r \frac{dr}{d\tau^S} - s_w k \left(\frac{dr}{d\tau^S} + 1 \right) \right\}. \tag{2.15}$$

2.4.1 *Coordinated Tax Reform When State Governments Consider Their Effects on Federal Revenue*

First, we examine coordinated tax reform when state governments consider their effects on federal revenue. Subtracting Eq. 2.12 from Eq. 2.15 and using Eq. 2.8, we obtain the following result[5]

$$\frac{dW}{d\tau^S} = \left\{ \frac{v_w}{1+r} [k(n-r)] + b_g \tau^S k_R + B_G \tau^F (s_r - s_w k) \right\} \left(1 - \frac{1}{N} \right) \frac{dr}{d\tau^S}. \tag{2.16}$$

The effect of coordinated tax reform on welfare can be divided into three effects: (i) the dynamic efficiency effect, $\frac{v_w}{1+r} k(n-r)\left(1-\frac{1}{N}\right)\frac{dr}{d\tau^S}$; (ii) the horizontal externality effect, $b_g \tau^S k_R \left(1-\frac{1}{N}\right)\frac{dr}{d\tau^S}$.; and (iii) the vertical externality effect, $B_G \tau^F (s_r - s_w k)\left(1-\frac{1}{N}\right)\frac{dr}{d\tau^S}$, as the following proposition summarizes.

Proposition 1 *In an OLG model, the effect of a coordinated state capital tax reform on social welfare depends on (1) the dynamic efficiency effect, (2) the horizontal externality effect, and (3) the vertical externality effect.*

In a two-period model, the static effects are represented by the second term and part of the third term in Eq. 2.16, denoted by $b_g \tau^S k_R \left(1-\frac{1}{N}\right)\frac{dr}{d\tau^S}$ and $B_G \tau^F S_r \left(1-\frac{1}{N}\right)\frac{dr}{d\tau^S}$, respectively. The dynamic effects are represented by the first term and remaining part of the third term, denoted by $\frac{v_w}{1+r} k(n-r)\left(1-\frac{1}{N}\right)\frac{dr}{d\tau^S}$ and $-B_G \tau^F s_w k \left(1-\frac{1}{N}\right)\frac{dr}{d\tau^S}$, respectively.

The sign of the dynamic efficiency effect depends on whether the economy has under- or over-accumulated capital relative to the golden rule path. A coordinated tax reform improves social welfare if the economy is undercapitalized, that is, if $r > n$, and vice versa.

[5] All of the welfare responses are evaluated at the steady-state equilibrium. The analysis focuses on the indirect effects that operate through the interest rate because the direct effects drop out when the optimal policy rule and the envelope theorem are applied.

The horizontal externality effect is positive. Because tax competition among state governments leads to a low tax rate, a coordinated tax reform improves social welfare. This effect can be observed in the standard tax competition model as well.

From the stability condition in Eq. 2.5, the sign of the vertical externality effect is not necessarily negative; a coordinated tax reform can potentially create a positive vertical externality. In an OLG model, because the savings function depends not only on the interest rate but also on the wage, the sign of the welfare effect of the vertical tax externality depends on both the static and dynamic vertical externality effects.

Here, we assume that the capital level satisfies the golden rule ($r = n$) to focus on the relationship between the vertical and horizontal externalities. In this situation, if the dynamic vertical externality effect, which is positive, dominates the static vertical externality effect, which is negative, the state capital tax reform increases social welfare because the horizontal externality effect is positive. That is, in this case, the state tax rates are too low. In addition, we consider the case in which the supply of savings is independent of the interest rate ($s_r = 0$) and that in which the demand for capital is independent of the gross interest rate ($k_R = 0$). First, if $s_r = 0$, the static vertical externality effect; vanishes, and the total vertical externality effect is positive. Therefore, the horizontal and vertical externalities have opposite effects. Second, if $k_R = 0$, the horizontal externality effects vanish.[6] In this situation, the welfare effect depends on the dynamic and static vertical externality effects.

We summarize the above result as the following proposition.

Proposition 2 *If the capital level satisfies the golden rule, then*

1. *if the dynamic vertical externality effect dominates the static vertical externality effect, the coordinated state capital tax reform increases social welfare, as the initial state tax rate is too low relative to the optimal state tax rate;*
2. *if the supply of savings is independent of the interest rate* ($s_r = 0$)*, the coordinated state capital tax reform increases social welfare, as the initial state tax rate is too low;*
3. *if the demand for capital is independent of the gross interest rate* ($k_R = 0$)*, the welfare effect of the coordinated state capital tax reform depends on the dynamic and static vertical externality effects.*

We compare these results with those of Batina (2009) and Keen and Kotsogiannis (2002). First, suppose that the vertical tax externality effect does not arise ($T = 0$ or $B(G) = 0$) and that individual states are small ($N \to \infty$) in our model. Under this assumption, if the economy is dynamically efficient ($r > n$), the coordinated state tax reform increases social welfare. This result is consistent with that of Batina (2009). However, because the vertical externality does arise in our model, the coordinated tax reform does not necessarily improve social welfare even if the economy is dynamically efficient.

Next, we compare our model to that of Keen and Kotsogiannis (2002), who assume a two-period model and a quasi-linear utility function. Under these assumptions, they show that the vertical tax externality has a negative effect because the savings function is increasing in the interest rate rather than in rents: $s_r \geq 0$. In contrast, under our

[6] Here, following Keen and Kotsogiannis (2002), we depart from the assumption that $k_R < 0$ to explain an economic interpretation.

OLG model and a more general utility function, the savings function depends not only on interest rates but also on the wage: $s_r \geq 0$ and $s_w > 0$. Even if we assume the same quasi-linear utility function as Keen and Kotsogiannis (2002) use, the features of the savings function in our model do not change. Thus, the welfare effect brought about by the vertical externality is not necessarily negative. In addition, whether the capital in the economy is under- or over-accumulated is important for the welfare effect in the OLG model.

2.4.2 Coordinated Tax Reform When State Governments Ignore Their Effects on Federal Revenue

Next, we consider the case in which each state government ignores its effect on federal revenue, following Boadway and Keen (1996). Using the state government's optimal condition in Eq. 2.14, we obtain

$$\frac{dW}{d\tau^S} = \left\{ \frac{v_w}{1+r}[k(n-r)] + b_g \tau^S k_R \right\} \left(1 - \frac{1}{N} \right) \frac{dr}{d\tau^s} + B_G \tau^F \left\{ s_r \frac{dr}{d\tau^S} - s_w k \left(\frac{dr}{d\tau^S} + 1 \right) \right\}. \tag{2.17}$$

In this case, both the static externality effect, $B_G \tau^F s_r \frac{dr}{d\tau^S}$, and the dynamic vertical externality effects, $-B_G \tau^F s_w k \big(\frac{dr}{d\tau^S} + 1 \big)$, are negative. This result is inconsistent with that in Sect. 2.4.1 because each state government ignores the reduction in federal revenue caused by its tax increase. Thus, the state governments set a lower tax rate in this case than in the case in Sect. 2.4.1.

Proposition 3 *When each state government completely ignores the effect of its own tax rate on federal revenue, a coordinated tax reform produces a negative vertical externality effect.*

As in Sect. 2.4.1, we suppose that the capital level satisfies the golden rule ($r = n$) and focus on the relationship between the vertical and horizontal externalities. In this situation, positive horizontal and negative vertical effects arise. In addition, we again consider the cases of $s_r = 0$ and $k_R = 0$. First, if $s_r = 0$, the sign of Eq. 2.17 is ambiguous because the horizontal and vertical externality effects are positive and negative, respectively. Second, if $k_R = 0$, the horizontal externality effects vanish. In this situation, the sign of Eq. 2.17 is negative, meaning that the state tax rate is too high.

Proposition 4 *If each state government completely ignores its effect on federal revenue and the capital level satisfies the golden rule, then*

1. *the effect of the coordinated state capital tax reform on welfare depends on the horizontal and vertical externality effects;*

2. *if the supply of savings is independent of the interest rate* ($s_r = 0$)*, the effect of the coordinated state capital tax reform on welfare depends on the horizontal and vertical externality effects;*
3. *if the demand for capital is independent of the gross interest rate* ($k_R = 0$)*, the coordinated state capital tax reform decreases welfare, as the initial state tax rate is too high.*

The results in this section differ from those in the previous section. Unlike static models, which show that vertical tax externalities increase the state tax rate relative to the optimal tax rate, our model shows that the result depends on whether state governments consider the effects of their policies on federal government revenue.

2.5 Conclusion

This chapter investigated a coordinated state capital tax reform under vertical and horizontal externalities in an OLG model. We showed that an OLG model introduces dynamic efficiency and dynamic vertical externality effects, which do not arise in standard models. In particular, we showed that the direction of the dynamic vertical tax externality effect depends on whether each state government ignores the effect of its tax rate on the federal tax revenue allocated to that state. That is, when each state government recognizes this effect, the coordinated tax reform can produce a positive dynamic effect brought about by the vertical externality on welfare that operates in the same direction as that of the horizontal externality. In other words, because of this dynamic effect, the state tax rate tends to be too low. However, when no state government recognizes the effect of its tax rate on federal revenue, the coordinated tax reform can produce a negative dynamic effect on welfare through a vertical externality that operates in the same direction as that of the static vertical externality. In other words, the state tax rate tends to be too high.

This analysis is based on a number of assumptions. First, it is restricted to symmetric states and the steady state. Clearly, it is better to also consider asymmetric states and the effect of capital tax reform in a period of transition. Second, we do not analyze the strategy of the federal government, but it is also possible to consider that the federal government sets the federal capital tax rate optimally, following Boadway and Keen (1996) and Sato (2000). Thus, further extensions of this analysis are possible.

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Chapter 3
Cross-Border Shopping with Fiscal Externalities

Hideya Kato and Mitsuyoshi Yanagihara

Abstract In this analysis, we construct a model of asymmetric regions in which the numbers of national borders vary across regions by extending Lucas's (Reg Sci Urban Econ 34(4):365–385, 2004) one-country model to a two-country model. We consider the following three cases: an integrated world, unitary nations, and decentralization. In the integrated world, a supranational government uniformly implements policy; the outcome in this case is the second-best optimum. In the case of unitary nations, each central government sets a non-coordinated policy. Finally, under decentralization, the central and local governments in both countries set non-coordinated policies. We show that the central governments cannot internalize the fiscal externalities attributed to the existence of a national border in the unitary nations and decentralization cases. Furthermore, in the case of unitary nations, each central government sets a lower tax rate in the region with the national border than in the region without the national border.

Keywords Cross-border shopping · Commodity tax · Tax competition · Vertical externalities · Horizontal externalities

3.1 Introduction

Horizontal and vertical fiscal externalities greatly increase the difficulty of fiscal management when either central and local governments or different local governments implement their own policies. It is well known that when cross-border shopping is possible, commodity taxes imposed by governments at the same level produce horizontal fiscal externalities. As a result, all governments set lower tax rates to attract cross-border consumers. In contrast, vertical fiscal externalities arise when

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governments at different levels, such as central and local governments, impose taxes on the same tax base. For example, local governments may set higher local tax rates if they do not consider the negative effect of their own taxes on the central government's tax revenue. Specifically, these higher local tax rates shrink the tax base, reducing the central government's tax revenue, which is a negative fiscal externality. Thus, horizontal and vertical externalities tend to work in opposite directions.

In the 2000s, the coexistence of these two kinds of fiscal externalities was analyzed using models of symmetric regions. For example, Keen and Kotsogiannis (2002) analyzed the welfare effects of a coordinated state tax reform in a federation economy. Lucas (2004) considered a federal economy composed of a central government and two local governments in a cross-border shopping model and showed that a matching grant on a local tax can internalize both the horizontal and vertical externalities. In addition to the above studies, which considered these externalities in symmetric regions, other studies have considered these externalities in models of asymmetric regions.[1] For example, Kanbur and Keen (1993) and Nielsen (2001, 2002) focused on country size and assumed that either the two countries had different population densities or the border between the two countries was not in the middle of the land mass. Haufler (1996) focused on differences in the preferences for public goods of the two countries' residents.[2]

Recently, Agrawal (2012, 2013, 2016) considered the different characteristics of regional and national borders, defining asymmetric regions in terms of the presence or absence of a national border. Local governments can therefore set different policies depending on whether their regions include national borders. If a region is far from national borders, the local government does not need to consider cross-border shopping behavior. In contrast, if a region is close to a national border, its government must consider cross-border shopping behavior because the fiscal policies in that region affect the foreign government's behavior.

However, to the best of our knowledge, no previous study has considered a model of asymmetric regions with both vertical and horizontal fiscal externalities.[3] Therefore, we consider both types of externalities caused by central and local governments by constructing a model of two symmetric countries with two asymmetric regions. Our analysis considers the following three cases: an integrated world, unitary nations, and decentralization. In the integrated world, a supranational government uniformly implements policy, resulting in the second-best optimum. In the case of unitary nations, each central government sets a non-coordinated policy. Under

[1]Bucovetsky (1991), Wilson (1991), and Peralta and van Ypersele (2005) considered capital mobility in a capital taxation framework rather than cross-border shopping. They examined tax competition in models of asymmetric regions that assume different population sizes or levels of per capita capital stock.

[2]Other studies of cross-border shopping include, for example, that of Ohsawa (1999), who considered differences in geographical aspects of sizes and positions, and that of Lee (2008), who considered imperfectly competitive markets.

[3]One possible exception is Agrawal (2016), but in that model, the foreign country's tax rate was exogenously given and the tax competition between the governments of the two countries was not the focus.

decentralization, the central and local governments in both countries set non-coordinated policies.

The main results of the analysis are as follows. First, in the case of unitary nations, the central governments cannot replicate the second-best outcome achieved in an integrated world. Second, also in the case of unitary nations, the central governments set lower tax rates in the regions with national borders. Third, under decentralization, the central government can achieve the same equilibrium outcomes as in the unitary nations case through matching grants on local tax rates.

The remainder of this chapter is organized as follows. Section 3.2 introduces an extended version of Lucas's (2004) model. Section 3.3 analyzes the cases of an integrated world and unitary nations. We consider the decentralization case in Sect. 3.4. Finally, Sect. 3.5 concludes.

3.2 Model

We extend Lucas's (2004) model, which incorporates horizontal and vertical fiscal externalities into a cross-border shopping model, from one country to two countries. We consider a Hotelling framework, as described in Fig. 3.1. This framework consists of two symmetric countries, $i = 1, 2$, with asymmetric regions, $j = A, B$. We refer to region j in country i as region ij. The location space of each country is given by $\theta \in [-1, 1]$, which is divided into two regions at $\theta = 0$. Thus, the length of each country is two. As shown in Fig. 3.1, in each country, region B (i.e., region $1B$ and region $2B$) borders not only region A in the same country but also region B in the foreign country; in contrast, region A in each country only borders region B in the same country. In each region, the population size is normalized to one. Consumers are uniformly distributed, and those living in region ij are identified by the distance d_{ij} from the regional border within the country and the distance D_{ij} from the national border.

There are two private goods, x and y, in each region. Consumers can move to the other region to buy good y, but they cannot buy good x in the other region. We assume that the commodity tax is imposed only on good y in this economy.

Each country has a central government and two local governments. The central and local governments supply a national public good G and a local public good g respectively. The benefit of the national public good accrues to all consumers in that country, regardless of region, whereas that of the local public good accrues only to consumers in that region.

Firms are located in all regions and maximize their profits in perfectly competitive markets. They can sell output in their own region without bearing any transportation cost. Their output can be used interchangeably for the production of x, y, g and G the marginal rates of transformation between the public goods of each government and the private goods are normalized to one. Production is subject to a linear technology such that one unit of labor produces one unit of private or public goods.

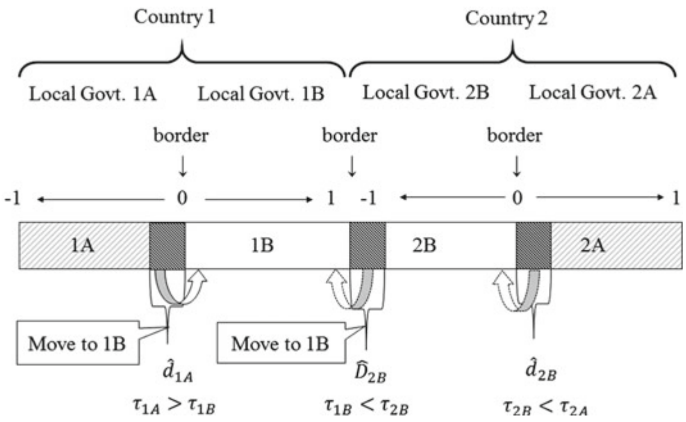

Fig. 3.1 The location space

3.2.1 Consumers

Consumers in region *ij* obtain utility from two private goods, x_{ij} and y_{ij}; local public goods, g_{ij}; and national public goods, G_i. Their utility function is therefore given by the following separable quasi-linear utility function:

$$x_{ij} + v(y_{ij}) + b(g_{ij}) + B(G_i), \tag{3.1}$$

where $v(y_{ij})$, $b(g_{ij})$, and $B(G_i)$ are increasing and strictly concave.

Although consumers can buy private goods in their own regions without incurring transportation costs, they must bear the cost of transportation to the border when they buy private goods in the other region. Following Lucas (2004), we suppose that good x is non-taxable and that good y is taxable in each location. Let t_{ij} be the tax rate set by the local government of region *ij*, and let T_{ij} be that set by the central government of country i in region *ij*. Only good y is taxed at a rate of $\tau_{ij} = t_{ij} + T_{ij}$ in region *ij*.[4] Both consumption goods are assumed to be numeraire goods: the consumer prices of x_{ij} and y_{ij} are 1 and $1 + \tau_{ij}$, respectively. As both countries are symmetric, we consider only the economy in country i in the following analysis.[5]

[4]It might be natural to assume that the central government sets a uniform tax rate in every region, as in previous studies. We do not make this assumption because we consider asymmetric regions in which the central governments set different tax rates rather than setting a uniform tax rate in each region. In fact, although the central governments of most countries set the same tax rates in each region, goods and services bought in Mexico within 20 km of the United States border were taxed by 11% until December 2013, whereas Mexico's standard tax rate was 16%.

[5]We can apply the same argument to the other country, i'.

3.2.1.1 Consumers Who Buy Goods in Their Own Region

When consumers living in region *ij* buy good *y* in their own region, they solve the following maximization problem:

$$\max_{x_{ij},y_{ij}} x_{ij} + v\left(y_{ij}\right) + b\left(g_{ij}\right) + B(G_i),$$
$$s.t.\ x_{ij} + \left(1 + \tau_{ij}\right)y_{ij} = wl_i, \tag{3.2}$$

where l_i is the labor supply, which is constant. From Eq. 3.2, we obtain demand functions represented by $x_{ij}\left(\tau_{ij}\right)$ and $y_{ij}\left(\tau_{ij}\right)$ $(j = A, B)$. By substituting these demand functions into the utility function, an indirect utility function, $V_{ij}\left(\tau_{ij}\right)+b\left(g_{ij}\right)+B(G_i)$, can be obtained. Roy's identity yields the following result: $\partial V_{ij}\left(\tau_{ij}\right)/\partial\tau_{ij} = -y_{ij}$.

3.2.1.2 Consumers Who Buy Goods in the Other Domestic Region

We next consider consumers in region *ij* who buy good *y* in the other region of their home country. We use i' and j' to denote the foreign country relative to country i and the other region relative to region j, respectively. If $\tau_{ij} > \tau_{ij'}$, consumers may purchase good *y* in the other region; the choice depends on the difference between τ_{ij} and $\tau_{ij'}$ and the distance $d_{ij} \in [0, 1]$ from the regional border. This distance is distributed according to a continuous distribution function $N\left[d_{ij}\right]$ with a positive density $n\left[d_{ij}\right]$, where $n_{ij} = \int_0^1 n\left[d_{ij}\right]\mathrm{d}d_{ij} = 1$.

When consumers in region *ij* buy good *y* in the other region of their home country, they solve the following utility maximization problem:

$$\max_{x_{ij},y_{ij'}} x_{ij} + v\left(y_{ij'}\right) + b\left(g_{ij}\right) + B(G_i),$$
$$s.t.\ x_{ij} + \left(1 + \tau_{ij'}\right)y_{ij'} + d_{ij} = wl_i. \tag{3.3}$$

This maximization problem gives the demand functions $x_{ij}\left(\tau_{ij'}, d_{ij}\right)$ and $y_{ij}\left(\tau_{ij'}\right)$. Substituting these demand functions into the utility function given in Eq. 3.3 again yields the indirect utility function $V_{ij}\left(\tau_{ij'}, d_{ij}\right)+b\left(g_{ij}\right)+B(G_i)$. From Roy's identity, we find that $\partial V_{ij}\left(\tau_{ij'}, d_{ij}\right)/\partial\tau_{ij'} = -y_{ij'}$ and $\partial V_{ij}\left(\tau_{ij'}, d_{ij}\right)/\partial d_{ij} = -1$.

3.2.1.3 Consumers Who Buy Goods in the Foreign Country

In this subsection, we consider the case in which consumers in region iB of country i buy good y in region $i'B$.[6] This situation can arise if $\tau_{i'B} < \tau_{iB}$. We define D_{iB} as consumers' distance from the national border, where D_{iB} has the same

[6]The consumers in region *B* can buy good *y* in the foreign country, but the consumers in region *A* cannot.

distributive features as those of d_{ij}. Then, the consumers' utility maximization problem is represented by

$$\max_{x_{iB}, y_{i'B}} x_{iB} + v(y_{i'B}) + b(g_{iB}) + B(G_i),$$
$$s.t.\ x_{iB} + (1 + \tau_{i'B})y_{i'B} + D_{iB} = wl_i. \tag{3.4}$$

Solving this problem, we obtain the demand functions $x_{iB}(\tau_{i'B}, D_{iB})$ and $y_{i'B}(\tau_{i'B})$ and, thus, the indirect utility function $V_{iB}(\tau_{i'B}, D_{iB}) + b(g_{iB}) + B(G_i)$. From Roy's identity, we find that $\partial V_{iB}(\tau_{i'B}, D_{iB})/\partial\tau_{i'B} = -y_{i'B}$ and $\partial V_{iB}(\tau_{i'B}, D_{iB})/\partial D_{iB} = -1$.

3.2.2 Threshold

Consumers decide where to buy good y depending on their distance from the national or regional borders. To see this result, we solve for the threshold at which consumers are indifferent between buying good y in their own region or in the other region of their home country.

As we have seen, consumers in region ij obtain utility $V_{ij}(\tau_{ij}) + b(g_{ij}) + B(G_i)$ or $V_{ij}(\tau_{ij'}, d_{ij}) + b(g_{ij}) + B(G_i)$ if they buy good y in their own region j or in the other region j', respectively. The point at which consumers are indifferent between buying good y in their home region or in the other region is given by

$$V_{ij}(\tau_{ij}) = V_{ij}(\tau_{ij'}, d_{ij}). \tag{3.5}$$

We represent the distance at which Eq. 3.5 holds as $\hat{d}_{ij}(\tau_{ij}, \tau_{ij'})$. If $V_{ij}(\tau_{ij}) > V_{ij}(\tau_{ij'}, d_{ij})$, consumers buy good y in their home region, j; if $V_{ij}(\tau_{ij}) < V_{ij}(\tau_{ij'}, d_{ij})$, they buy it in the other region, j'. That is, consumers who live at $d_{ij} > \hat{d}_{ij}$ buy good y in region j, and consumers who live at $d_{ij} < \hat{d}_{ij}$ buy good y in region j'.

Differentiating Eq. 3.5 with respect to t_{ij}, $t_{ij'}$, T_{ij}, and $T_{ij'}$, we obtain the following results:

$$\frac{\partial\hat{d}_{ij}}{\partial t_{ij}} = \frac{\partial\hat{d}_{ij}}{\partial T_{ij}} = y_{ij}, \quad \frac{\partial\hat{d}_{ij}}{\partial t_{ij'}} = \frac{\partial\hat{d}_{ij}}{\partial T_{ij'}} = -y_{ij'}. \tag{3.6}$$

The threshold of the distance $\hat{d}_{ij}$ increases (decreases) if the commodity tax rate in the home region increases (decreases). In contrast, the threshold of the distance $\hat{d}_{ij}$ decreases (increases) if the commodity tax rate in the other domestic region increases (decreases).

We next derive the threshold at which consumers in region iB are indifferent between buying good y in their home region or the foreign country. This condition is expressed as

$$V_{iB}(\tau_{iB}) = V_{iB}(\tau_{i'B}, D_{iB}) \tag{3.7}$$

We denote the distance at which Eq. 3.7 holds as $\widehat{D}_{iB}(\tau_{iB}, \tau_{i'B})$. Differentiating Eq. 3.7 with respect to t_{iB}, $t_{i'B}$, T_{iB}, and $T_{i'B}$, we obtain the following:

$$\frac{\partial \widehat{D}_{iB}}{\partial t_{iB}} = \frac{\partial \widehat{D}_{iB}}{\partial T_{iB}} = y_{iB}, \quad \frac{\partial \widehat{D}_{iB}}{\partial t_{i'B}} = \frac{\partial \widehat{D}_{iB}}{\partial T_{i'B}} = -y_{i'B}. \tag{3.8}$$

These results show that the threshold distance $\widehat{D}_{iB}$ increases (decreases) as the commodity tax rate in the home region (in the other country) increases.

The above thresholds are depicted in Fig. 3.1. If $\tau_{1A} > \tau_{1B}$, all consumers in region $1B$ buy good y in their home region because they have no incentive to shop in region $1A$ $\left(\hat{d}_{1B} = 0\right)$. In region $1A$, however, consumers located within the distance $d_{1A} < \hat{d}_{1A}$ buy good y in region $1B$, and only those who are located within the distance $d_{1A} > \hat{d}_{1A}$ purchase the good in their home region $1A$.

Next, if $\tau_{1B} < \tau_{2B}$, all consumers in region $1B$ buy good y in their home country because they have no incentive to shop in country 2 $\left(\widehat{D}_{1B} = 0\right)$. In contrast, whereas consumers in region $2B$ located within the distance $D_{2B} < \widehat{D}_{2B}$ buy good y in region $1B$, those located within the distance $D_{2B} > \widehat{D}_{2B}$ buy the good in their own region $2B$.[7]

3.3 Integrated World and Unitary Nations

3.3.1 Integrated World

In this section, we consider an integrated world in which a supranational government (organization) uniformly imposes a tax on good y and provides public goods to all consumers in each region: $\tau_{1A} = \tau_{1B} = \tau_{2A} = \tau_{2B} = \tau$, $g_{1A} = g_{1B} = g_{2A} = g_{2B} = g$, and $G_{1A} = G_{1B} = G_{2A} = G_{2B} = G$. The welfare maximization problem in the integrated world is formulated as

$$\max_{\tau,g,G} 4\{v(\tau) + b(g) + B(G)\}, \quad s.t.\, 4g + 2G = 4\tau y(\tau). \tag{3.9}$$

Solving this problem, we obtain the following first-order conditions:

$$\frac{\partial V(\tau)}{\partial \tau} + \lambda\left(y(\tau) + \tau\frac{\partial y(\tau)}{\partial \tau}\right) = 0, \tag{3.10}$$

$$b' - \lambda = 0, \tag{3.11}$$

[7] The cases of $\tau_{1A} < \tau_{1B}$ and $\tau_{2B} < \tau_{1B}$ are similar.

$$2B^{'} - \lambda = 0, \tag{3.12}$$

where λ is the Lagrange multiplier associated with the supranational government's budget constraint given by Eq. 3.9. From $V(\tau)/\partial\tau = -y$ and Eqs. 3.10–3.12, we obtain the following necessary condition:

$$b' = 2B^{'} = \frac{y(\tau)}{y(\tau) + \tau\frac{\partial y(\tau)}{\partial\tau}}. \tag{3.13}$$

The right-hand side of this equation represents the social marginal cost of the public fund, whereas b' and $2B'$ represent the social marginal benefits of the local and national public goods, respectively. This equation represents the optimality conditions for the supply of public goods referred to as the Atkinson and Stern (1974) rule. The condition given by Eq. 3.13 together with the budget constraint given by Eq. 3.9 gives the second-best optimum, denoted by (τ^*, g^*, G^*).

3.3.2 Unitary Nations

Next, we consider a unitary nation in which each central government sets the policies in its own country. The central government of country i behaves as a Nash competitor and chooses its tax rates τ_{iA} and τ_{iB}. The central government uses the tax revenue to supply local and national public goods. The central government chooses τ_{iA}, τ_{iB}, g_{iA}, g_{iB}, and G_i to maximize social welfare, taking $\tau_{i'B}$ as given. If $\tau_{iA} > \tau_{iB}$ and $\tau_{i'B} > \tau_{iB}$, the maximization problem of the central government of country i is formulated as[8]

$$\begin{aligned}\max_{\tau_{iA},\tau_{iB},g_{iA},g_{iB},G_i} \; & V(\tau_{iB}) + \int_{\hat{d}_{iA}}^{1} V(\tau_{iA})\mathrm{D}d_{iA} \\ & + \int_{0}^{\hat{d}_{iA}} V(\tau_{iB}, d_{iA})\mathrm{d}d_{iA} + \sum_{j=A,B} b\big(g_{ij}\big) + 2B(G_i),\end{aligned}$$

[8]If the reverse inequality holds, we can solve a similar maximization problem following the same procedure. In Appendix, we discuss the case in which $\tau_{iB} > \tau_{iA}$.

$$s.t. g_{iA} + g_{iB} + G_i = \tau_{iB}\left(y_{iB}(\tau_{iB}) + \int_0^{\hat{d}_{iA}} y_{iB}(\tau_{iB})\mathrm{d}d_{iA} + \int_0^{\widehat{D}_{i'B}} y_{iB}(\tau_{iB})\mathrm{d}D_{i'B} \right) + \tau_{iA}\int_{\hat{d}_{iA}}^{1} y_{iA}(\tau_{iA})\mathrm{d}d_{iA}. \tag{3.14}$$

From the first-order conditions for this problem and Roy's identity, we obtain the following equations:

$$-\left(1-\hat{d}_{iA}\right)y_{iA} + \lambda_u\left\{(\tau_{iB}y_{iB} - \tau_{iA}y_{iA})\frac{\partial \hat{d}_{iA}}{\partial \tau_{iA}} + \left(1-\hat{d}_{iA}\right)\left(y_{iA} + \tau_{iA}\frac{\partial y_{iA}}{\partial \tau_{iA}}\right)\right\} = 0, \tag{3.15}$$

$$-\left(1+\hat{d}_{iA}\right)y_{iB} + \lambda_u\left\{\left(1+\hat{d}_{iA}\hat{D_{i'B}}\right)y_{iB} + \tau_{iB}\left[\left(1+\hat{d}_{iA}\right)\frac{\partial y_{iB}}{\partial \tau_{iB}} + y_{iB}\left(\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + \frac{\partial \hat{D}_{i'B}}{\partial \tau_{iB}}\right)\right] - \tau_{iA}y_{iA}\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}}\right\} \tag{3.16}$$

$$b'(g_{iA}) - \lambda_u = 0, \tag{3.17}$$

$$b'(g_{iB}) - \lambda_u = 0, \tag{3.18}$$

$$2B'(G_i) - \lambda_u = 0, \tag{3.19}$$

where λ_u is the Lagrange multiplier associated with the unitary nation's budget constraint in Eq. 3.14. From Eqs. 3.15–3.19 and the assumption of symmetric countries $\left(\widehat{D}_{1B} = \widehat{D}_{2B} = 0\right)$, we obtain the following necessary conditions for the local and national public goods[9]:

$$2B'_i = b'_{iA} = b'_{iB} = \frac{\left(1-\hat{d}_{iA}\right)y_{iA}}{\left(1-\hat{d}_{iA}\right)y_{iA}(1-\varepsilon_{\tau iA}) + (\tau_{iB}y_{iB} - \tau_{iA}y_{iA})\frac{\partial \hat{d}_{iA}}{\partial \tau_{iA}}} = \frac{\left(1+\hat{d}_{iA}\right)y_{iB}}{y_{iB}\left[\left(1+\hat{d}_{iA}\right)(1-\varepsilon_{\tau iB}) + \tau_{iB}\left(\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + \frac{\partial \widehat{D}_{iB}}{\partial \tau_{iB}}\right)\right] - \tau_{iA}y_{iA}\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}}}, \tag{3.20}$$

[9] We can also derive similar conditions for the public goods in country i' because the two countries are symmetric.

where $\varepsilon_{\tau ij} \equiv -\frac{\tau_{ij}}{y_{ij}(\tau_{ij})} \cdot \frac{\partial y_{ij}(\tau_{ij})}{\partial \tau_{ij}} > 0$. These conditions imply that the marginal benefits of the public goods, $2B_i'$, b_{iA}', and b_{iB}', are equal to the marginal costs of public funds (MCPF) of the local public goods A and B. Comparing Eq. 3.13 with Eq. 3.20, we can verify that the central governments cannot replicate the second-best optimum in the unitary nations case. This result is intuitively clear because each central government is a Nash competitor.

Here, we prove by induction that the tax rates in regions A and B are different (i.e., $\tau_{iA} \neq \tau_{iB}$). Suppose that the tax rates in regions A and B are same: $\tau_{iA} = \tau_{iB} = \tau_i$. In this situation, we obtain the following results: $y_{iA}(\tau_{iA}) = y_{iB}(\tau_{iB}) = y(\tau_i)$ and $\hat{d}_{iA} = 0$. Substituting these results into Eq. 3.20, we can see that the MCPF of local public good A is larger than that of local public good B.[10] Furthermore, Eq. 3.20 does not hold if $\tau_{iA} = \tau_{iB} = \tau_i$, implying that $\tau_{iA} \neq \tau_{iB}$. As we can assume that the MCPF is increasing in its own tax rate, $\tau_{iA} > \tau_{iB}$ holds at the optimum.

We summarize the above findings as the following proposition.

Proposition 1 *In the case of unitary nations, the tax rate in region A is higher than that in region* ***B****.*

This proposition holds because region B has more borders than region A and therefore faces intensified tax competition. This result is not derived by Lucas (2004), who considers two symmetric regions in a one-country model.

3.4 Decentralization

In this section, we consider the case of decentralization. The local government of each region supplies local public goods using commodity tax revenues and intergovernmental transfers from the central government to maximize social welfare in that region. Then, the central government of each country chooses the central tax rates T_{ij}, the national public good, and the matching grant to maximize social welfare in that country. Intergovernmental transfers take the form of a matching grant on the local tax rates, t_{ij}. The central government is the first mover, and the local governments are followers. However, governments at the same level behave as Nash competitors.

We consider the following two-stage game. In the first stage, the central government has a Stackelberg advantage vis à vis the local governments. However, each central government engages in Nash competition with the governments of other countries. In the second stage, the local governments are followers with respect to the central government but engage in Nash competition with respect to other local governments.

[10] We obtain the following result: $MCPF_{iA} = 1/(1-\varepsilon_i) > 1/\left(1 - \varepsilon_i - y_i \frac{\partial \widehat{D}_{i'B}}{\partial \tau_i}\right) = MCPF_{iB}$, where $\varepsilon_i \equiv -\frac{\tau_i}{y}\frac{\partial y}{\partial \tau_i}$.

3.4.1 Local Governments' Behavior

The central government provides fiscal transfers through matching grants on the local tax rates, m_{ij}. As described above, each local government supplies local public goods using commodity tax revenues and intergovernmental transfers from the central government to maximize social welfare in its region. If $\tau_{iA} > \tau_{iB}$ and $\tau_{iB} < \tau_{i'B}$, the budget constraints of the local governments are given by

$$g_{iA} = (1 + m_{iA})t_{iA} \int_{\hat{d}_{iA}}^{1} y_{iA}(\tau_{iA})\mathrm{d}d_{iA} \tag{3.21}$$

$$g_{iB} = (1 + m_{iB})t_{iB} \left(y_{iB}(\tau_{iB}) + \int_{0}^{\hat{d}_{iA}} y_{iB}(\tau_{iB})\mathrm{d}d_{iA} + \int_{0}^{\widehat{D}_{i'B}} y_{iB}(\tau_{iB})\mathrm{d}D_{i'B} \right). \tag{3.22}$$

We obtain the following properties for later use:

$$\frac{\partial g_{iA}}{\partial t_{iA}} = (1 + m_{iA})y_{iA} \left\{ \left(1 - \hat{d}_{iA}\right)(1 - \varepsilon_{iA}) - t_{iA} \frac{\partial \hat{d}_{iA}}{\partial \tau_{iA}} \right\}, \tag{3.23}$$

$$\begin{aligned} \frac{\partial g_{iA}}{\partial T_{iA}} &= -(1 + m_{iA})y_{iA} \left\{ \left(1 - \hat{d}_{iA}\right)\varepsilon_{iA} + t_{iA} \frac{\partial \hat{d}_{iA}}{\partial \tau_{iA}} \right\} \\ &= \frac{\partial g_{iA}}{\partial t_{iA}} - (1 + m_{iA})y_{iA}\left(1 - \hat{d}_{iA}\right), \end{aligned} \tag{3.24}$$

$$\frac{\partial g_{iA}}{\partial m_{iA}} = t_{iA}\left(1 - \hat{d}_{iA}\right)y_{iA}, \tag{3.25}$$

$$\frac{\partial g_{iA}}{\partial t_{iB}} = \frac{\partial g_{iA}}{\partial T_{iB}} = -(1 + m_{iA})t_{iA}y_{iA}\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}}, \tag{3.26}$$

$$\frac{\partial g_{iB}}{\partial t_{iA}} = \frac{\partial g_{iB}}{\partial T_{iA}} = (1 + m_{i\mathrm{B}})t_{iB}y_{iB}\frac{\partial \hat{d}_{iB}}{\partial \tau_{iA}}, \tag{3.27}$$

$$\frac{\partial g_{iB}}{\partial t_{iB}} = (1 + m_{iB})y_{iB} \left\{ \left(1 + \hat{d}_{iA} + \widehat{D}_{i'B}\right)(1 - \varepsilon_{iB}) + t_{iB}\left(\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + \frac{\partial \widehat{D}_{i'B}}{\partial \tau_{iB}} \right) \right\}, \tag{3.28}$$

$$\begin{aligned} \frac{\partial g_{iB}}{\partial T_{iB}} &= -(1 + m_{iB})y_{iB} \left\{ \left(1 + \hat{d}_{iA} + \widehat{D}_{i'B}\right)\varepsilon_{iB} - t_{iB}\left(\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + \frac{\partial \widehat{D}_{i'B}}{\partial \tau_{iB}} \right) \right\} \\ &= \frac{\partial g_{iB}}{\partial t_{iB}} - (1 + m_{iB})\left(1 + \hat{d}_{iA} + \widehat{D}_{i'B}\right)y_{iB}, \end{aligned} \tag{3.29}$$

$$\frac{\partial g_{iB}}{\partial t_{iA}} = \frac{\partial g_{iB}}{\partial T_{iA}} = (1 + m_{iB}) t_{iB} y_{iB} \frac{\partial \hat{d}_{iA}}{\partial \tau_{iA}}, \tag{3.30}$$

$$\frac{\partial g_{iB}}{\partial m_{\mathrm{iB}}} = t_{iB}\left(1 + \hat{d}_{iA} + \widehat{D}_{i'B}\right) y_{iB}. \tag{3.31}$$

Because the countries are symmetric, we focus only on the regions in country i. The local government of region iA, which has only one border, is a follower and chooses t_{iA} and g_{iA} to maximize the utility of consumers in that region, taking T_{iA}, τ_{iB}, G_i, m_{iA}, and m_{iB} as given. Continuing to assume that $t_{iA} > t_{iB}$, the maximization problem of the local government of region *iA* is given by

$$\max_{t_{iA}, g_{iA}} \int_{\hat{d}_{iA}}^{1} V(\tau_{iA}) \mathrm{d}d_{iA} + \int_{0}^{\hat{d}_{iA}} V(\tau_{iB}) \mathrm{d}d_{iA} + b(g_{iA}) + B(G_i), \ s.t. \,\text{Eq. 3.21}. \tag{3.32}$$

Solving this problem, we obtain the following first-order conditions:

$$\left(1 - \hat{d}_{iA}\right) \frac{\partial V(\tau_{iA})}{\partial \tau_{iA}} + \lambda_{iA} \left\{ (1 + m_{iA}) y_{iA} \left[\left(1 - \hat{d}_{iA}\right)(1 - \varepsilon_{tiA}) - t_{iA} \frac{\partial \hat{d}_{iA}}{\partial \tau_{iA}} \right] \right\} = 0, \tag{3.33}$$

$$b'(g_{iA}) - \lambda_{iA} = 0, \tag{3.34}$$

where λ_{iA} is the Lagrange multiplier that corresponds to the local government's budget constraint in Eq. 3.21. From these conditions, we obtain the following necessary condition for public good provision in region *iA*:

$$b'(g_{iA}) = \frac{\left(1 - \hat{d}_{iA}\right) y_{iA}}{(1 + m_{iA}) y_{iA} \left\{ \left(1 - \hat{d}_{iA}\right)(1 - \varepsilon_{tiA}) - t_{iA} \frac{\partial \hat{d}_{iA}}{\partial \tau_{iA}} \right\}}, \tag{3.35}$$

where $\varepsilon_{tiA} \equiv -\frac{t_{iA}}{y_{iA}(\tau_{iA})} \frac{\partial y_{iA}(\tau_{iA})}{\partial t_{iA}} > 0$ is the elasticity of demand for good y_{iA} with respect to the tax rate in region *iA*. The left-hand side of the equation represents the marginal benefit of the public good, and the right hand side represents its marginal cost, which is equal to the MCPF.

The local government of region *iB*, which has two borders, chooses t_{iB} and g_{iB} to maximize the utility of consumers in that region, taking T_{iB}, τ_{iA}, $\tau_{i'B}$, m_{iA}, and m_{iB} as given. Continuing to assume that $\tau_{iA} > \tau_{iB}$ and $\tau_{i'B} > \tau_{iB}$, we find that the maximization problem of the local government of region *iB* is given by

$$\max_{t_{iB}, g_{iB}} V(\tau_{iB}) + b(g_{iA}) + B(G_i), \quad s.t. \,\text{Eq.3.22}. \tag{3.36}$$

Solving this problem, we obtain the following first-order conditions:

$$\frac{\partial V(\tau_{iB})}{\partial \tau_{iB}} + \lambda_{iB}(1+m_{iB})y_{iB}\left\{\left(1+\hat{d}_{iA}+\widehat{D}_{i'B}\right)(1-\varepsilon_{tiB}) - t_{iB}\left(\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + \frac{\partial \widehat{D}_{i'B}}{\partial \tau_{iB}}\right)\right\} = 0, \tag{3.37}$$

$$b'(g_{iB}) - \lambda_{iB} = 0, \tag{3.38}$$

where λ_{iB} is the Lagrange multiplier that corresponds to the local government's budget constraint in Eq. 3.22. From Roy's identity, we obtain the following necessary conditions for public good provision in region *iB*:

$$b'(g_{iB}) = \frac{y_{iB}}{(1+m_{iB})y_{iB}\left\{\left(1+\hat{d}_{iA}\right)(1-\varepsilon_{tiB}) - t_{iB}\left(\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + \frac{\partial \widehat{D}_{i'B}}{\partial \tau_{iB}}\right)\right\}}, \tag{3.39}$$

where $\varepsilon_{tiB} \equiv -\frac{t_{iB}}{y_{iB}(\tau_{iB})}\frac{\partial y_{iB}(\tau_{iB})}{\partial t_{iB}} > 0$ is the elasticity of demand for good y_{iB} with respect to the tax rate in region *iB*. This condition is interpreted similarly to the interpretation of Eq. 3.35. The left-hand side of Eq. 3.39 is the marginal benefit of the public good, and the right-hand side is the MCPF. If $m_{iA} = m_{iB} = 0$, Eqs. 3.35 and 3.39 are not identical to Eqs. 3.13 and 3.20. That is, in the case of decentralization without matching grants, the central government cannot replicate the second-best outcome or the equilibrium outcome in the case of unitary nations.

3.4.2 Central Governments' Behavior

The central government supplies the national public good by taxing good y and setting matching grants. If $\tau_{iA} > \tau_{iB}$ and $\tau_{i'B} > \tau_{iB}$, the budget constraint of the central government of country i is

$$\begin{aligned} G_i &= (T_{iA} - t_{iA}m_{iA})\int_{\hat{d}_{iA}}^{1} y_{iA}(\tau_{iA})\mathrm{d}d_{iA} \\ &\quad + (T_{iB} - t_{iB}m_{iB})\left(y_{iB}(\tau_{iB}) + \int_0^{\hat{d}_{iA}} y_{iB}(\tau_{iB})\mathrm{d}d_{iA} + \int_0^{\widehat{D}_{i'B}} y_{iB}(\tau_{iB})\mathrm{d}D_{i'B}\right). \end{aligned} \tag{3.40}$$

We obtain the following properties for later use:

$$\begin{aligned} \frac{\partial G_i}{\partial t_{iA}} &= -m_{iA}\left(1-\hat{d}_{iA}\right)y_{iA} + (T_{iA} - t_{iA}m_{iA})\left(1-\hat{d}_{iA}\right)\frac{\partial y_{iA}}{\partial \tau_{iA}} \\ &\quad - (T_{iA} - t_{iA}m_{iA})y_{iA}\frac{\partial \hat{d}_{iA}}{\partial \tau_{iA}} + (T_{iB} - t_{iB}m_{iB})y_{iB}\frac{\partial \hat{d}_{iA}}{\partial \tau_{iA}}, \end{aligned} \tag{3.41}$$

$$\frac{\partial G_i}{\partial t_{iB}} = -m_{iB}\left(1 + \hat{d}_{iA} + \widehat{D}_{i'B}\right)y_{iB} + (T_{iB} - t_{iB}m_{iB})\left(1 + \hat{d}_{iA} + \widehat{D}_{i'B}\right)\frac{\partial y_{iB}}{\partial \tau_{iB}}$$
$$- (T_{iA} - t_{iA}m_{iA})y_{iA}\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + (T_{iB} - t_{iB}m_{iB})y_{iB}\left(\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + \frac{\partial \widehat{D}_{i'B}}{\partial \tau_{iB}}\right), \quad (3.42)$$

$$\frac{\partial G_i}{\partial T_{iA}} = \left(1 - \hat{d}_{iA}\right)y_{iA} + (T_{iA} - t_{iA}m_{iA})\left(1 - \hat{d}_{iA}\right)\frac{\partial y_{iA}}{\partial \tau_{iA}} - (T_{iA} - t_{iA}m_{iA})y_{iA}\frac{\partial \hat{d}_{iA}}{\partial \tau_{iA}}$$
$$+ (T_{iB} - t_{iB}m_{iB})y_{iB}\frac{\partial \hat{d}_{iA}}{\partial \tau_{iA}} = \frac{\partial G_i}{\partial t_{iA}} + \left(1 - \hat{d}_{iA}\right)(1 + m_{iA})y_{iA}, \quad (3.43)$$

$$\frac{\partial G_i}{\partial T_{iB}} = \left(1 + \hat{d}_{iA} + \widehat{D}_{i'B}\right)y_{iB} + (T_{iB} - t_{iB}m_{iB})\left(1 + \hat{d}_{iA} + \widehat{D}_{i'B}\right)\frac{\partial y_{iB}}{\partial \tau_{iB}}$$
$$- (T_{iA} - t_{iA}m_{iA})y_{iA}\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + (T_{iB} - t_{iB}m_{iB})y_{iB}\left(\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + \frac{\partial \widehat{D}_{i'B}}{\partial \tau_{iB}}\right)$$
$$= \frac{\partial G_i}{\partial t_{iB}} + (1 + m_{iB})\left(1 + \hat{d}_{iA} + \widehat{D}_{i'B}\right)y_{iB}. \quad (3.44)$$

The central government of country i sets the tax rates, T_{iA} and T_{iB}; the matching grants, m_{iA} and m_{iB}; and the national public good, G_i, to maximize the utility of consumers in that country. The central government takes the reactions of its country's local governments into account, and it takes the policy variables of the other country as given. We continue to assume that $\tau_{iA} > \tau_{iB}$ and $\tau_{i'B} > \tau_{iB}$, and, thus, the maximization problem for the central government of country i is given by

$$\max_{T_{iA}, T_{iB}, m_{iA}, m_{iB}, G_i} V(\tau_{iB}) + \int_0^{\hat{d}_{iA}} V(\tau_{iB}, d_{iA})\mathrm{d}d_{iA}$$
$$+ \int_{\hat{d}_{iA}}^{0} V(\tau_{iA})\mathrm{d}d_{iA} + b(g_{iA}) + b(g_{iB}) + 2B(G_i), \quad s.t.\,\text{Eq.3.40}. \quad (3.45)$$

From this problem and the envelope theorem, we obtain the following conditions:

$$\left(\frac{\partial g_{iA}}{\partial t_{iB}} + \frac{\partial G_i}{\partial t_{iB}} - \hat{d}_{iA}\frac{\partial g_{iB}}{\partial t_{iB}}\right)\frac{\partial t_{iB}}{\partial T_{iA}} + \left(\frac{\partial g_{iB}}{\partial t_{iA}} + \frac{\partial G_i}{\partial t_{iA}}\right)\frac{\partial t_{iA}}{\partial T_{iA}}$$
$$+ \left(\frac{\partial g_{iA}}{\partial T_{iA}} + \frac{\partial G_i}{\partial T_{iA}}\right) + (1 + m_{iB})t_{iB}y_{iB}\frac{\partial \hat{d}_{iA}}{\partial T_{iA}} = 0, \quad (3.46)$$

$$\left(\frac{\partial g_{iB}}{\partial t_{iA}} + \frac{\partial G_i}{\partial t_{iA}}\right)\frac{\partial t_{iA}}{\partial T_{iB}} + \left(\frac{\partial g_{iA}}{\partial t_{iB}} + \frac{\partial G_i}{\partial t_{iB}} - \hat{d}_{iA}\frac{\partial g_{iB}}{\partial t_{iB}}\right)\frac{\partial t_{iB}}{\partial T_{iB}}$$
$$+ \left(\frac{\partial g_{iB}}{\partial T_{iB}} + \frac{\partial G_i}{\partial T_{iB}}\right) - (1 + m_{iA})t_{iA}y_{iA}\frac{\partial \hat{d}_{iA}}{\partial t_{iB}} = 0, \quad (3.47)$$

$$\left(\frac{\partial g_{iB}}{\partial t_{iA}} + \frac{\partial G_i}{\partial t_{iA}}\right)\frac{\partial t_{iA}}{\partial m_{iA}} + \left(\frac{\partial g_{iA}}{\partial t_{iB}} + \frac{\partial G_i}{\partial t_{iB}} - \hat{d}_{iA}\frac{\partial g_{iB}}{\partial t_{iB}}\right)\frac{\partial t_{iB}}{\partial m_{iA}} = 0, \tag{3.48}$$

$$\left(\frac{\partial g_{iA}}{\partial t_{iB}} + \frac{\partial G_i}{\partial t_{iB}} - \hat{d}_{iA}\frac{\partial g_{iB}}{\partial t_{iB}}\right)\frac{\partial t_{iB}}{\partial m_{iB}} + \left(\frac{\partial g_{iB}}{\partial t_{iA}} + \frac{\partial G_i}{\partial t_{iA}}\right)\frac{\partial t_{iA}}{\partial m_{iB}} = 0. \tag{3.49}$$

Equations 3.48 and 3.49 imply that the optimal matching grants yield $\frac{\partial g_{iB}}{\partial t_{iA}} + \frac{\partial G_i}{\partial t_{iA}} = 0$ and $\frac{\partial g_{iA}}{\partial t_{iB}} + \frac{\partial G_i}{\partial t_{iB}} - \hat{d}_{iA}\frac{\partial g_{iB}}{\partial t_{iB}} = 0$. Thus, we implicitly obtain the following optimal matching grants:

$$m_{iA} = \frac{\left(1 - \hat{d}_{iA}\right)T_{iA}\frac{\partial y_{iA}}{\partial \tau_{iA}} + (\tau_{iB}y_{iB} - T_{iA}y_{iA})\frac{\partial \hat{d}_{1A}}{\partial \tau_{iA}}}{\left(1 - \hat{d}_{iA}\right)\left(y_{iA} + t_{iA}\frac{\partial y_{iA}}{\partial \tau_{iA}}\right) - t_{iA}y_{iA}\frac{\partial \hat{d}_{1A}}{\partial \tau_{iA}}}, \tag{3.50}$$

$$m_{iB} = \frac{-\hat{d}_{iA}E_{iB} + T_{iB}\frac{\partial y_{iB}}{\partial \tau_{iB}} - \left(\frac{\hat{d}_{iA}t_{iB} - T_{iB}}{\left(1+\hat{d}_{iA}\right)}\right)y_{iB}F_{iB} - \frac{\tau_{iA}y_{iA}}{\left(1+\hat{d}_{iA}\right)}\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}}}{\left(1 + \hat{d}_{iA}\right)E_{iB} - t_{iB}y_{iB}F_{iB}}, \tag{3.51}$$

where $E_{iB} \equiv y_{iB}(\tau_{iB}) + t_{iB}\partial y_{iB}(\tau_{iB})/\partial \tau_{iB}$ and $F_{iB} \equiv \partial \hat{d}_{iA}/\partial \tau_{iB} + \partial \widehat{D}_{i'B}/\partial \tau_{iB}$ (see Appendix). Substituting Eqs. 3.50 and 3.51 into Eqs. 3.35 and 3.39, respectively, we obtain the condition in Eq. 3.20.

Equation 3.50 expresses corrections for the three fiscal externality types. More concretely, the first term in the numerator represents the effect of the vertical fiscal externality on the matching grant. As the vertical fiscal externality is negative in this case, a positive central government tax rate implies that this matching grant should tend to reduce the local government tax rate. As a result, the central government should set a lower matching grant. The second term in Eq. 3.50 represents the effect of the horizontal fiscal externality on the matching grant. In contrast to the vertical fiscal externality, the horizontal fiscal externality implies that the matching grant should give the local governments an incentive to raise the tax rate. Finally, the third term represents the effect of cross-border shopping on the net revenue of the central government. If cross-border shopping reduces the tax revenue of the central government, this negative effect should be suppressed by a decrease in the matching grant, and vice versa. The implications of Eq. 3.51 can be deduced by the same arguments used to deduce those of Eq. 3.50.[11]

Thus, in the case of decentralization, the central government can replicate the equilibrium outcomes in the case of unitary nations using matching grants on the local tax rates. As in the case of unitary nations, when the central government uses matching grants in the decentralization case, the tax rates in regions A and B differ.

[11] Along with these three effects, a tax distortion effect, which is represented by the first term in Eq. 3.51, also occurs because the local government does not consider the effect of the tax rate on the welfare of cross-border shoppers in that country.

Proposition 2 *In the decentralization case, a central government can achieve the same equilibrium outcomes as in the unitary nations case through matching grants on the local tax rates.*

3.5 Conclusion

In this chapter, we constructed a model of two asymmetric regions with different numbers of borders by extending Lucas's (2004) model to a model of two symmetric countries. In doing so, we obtained the following results.

First, in the unitary nations case, the central governments cannot replicate the equilibrium outcomes of the integrated world case. This finding means that central governments cannot achieve the second-best optimum unless they collaborate internationally, an outcome that is reflected in today's more economically integrated world. Second, in the unitary nations case, the central government sets a lower tax rate in the region with a national border. In other words, central governments choose distinct fiscal policies for each region based on each region's characteristics. Third, in the decentralization case, the central government can achieve the equilibrium outcomes of the unitary nations case through matching grants on the local tax rate. This finding suggests that providing local governments with an incentive for taxation is useful as a measure of control.

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Appendix

Case of $\tau_{iB} > \tau_{iA}$

If $\tau_{iB} > \tau_{iA}$ and $\tau_{i'B} > \tau_{iB}$, the central government of country i's maximization problem is formulated as

$$\max_{\tau_{iA},\tau_{iB},g_{iA},g_{iB},G_i} V(\tau_{iA}) + \int_{\hat{d}_{iB}}^{1} V(\tau_{iB})\mathrm{d}d_{iB}$$

$$+\int_0^{\hat{d}_{iB}} V(\tau_{iA}, d_{iB})\mathrm{d}d_{iB} + \sum_{j=A,B} b\left(g_{ij}\right) + 2B(G_i),$$

$$s.t.\ g_{iA} + g_{iB} + G_i = \tau_{iA}\left(y_{iA}(\tau_{iA}) + \int_0^{\hat{d}_{iB}} y_{iB}(\tau_{iA}, d_{iB})\mathrm{d}d_{iB}\right)$$

$$+ \tau_{iB}\left(\int_{\hat{d}_{iB}}^{1} y_{iB}(\tau_{iB})\mathrm{d}d_{iB} + \int_0^{\widehat{D}_{i'B}} y_{iB}(\tau_{iB})\mathrm{d}D_{i'B}\right). \tag{3.52}$$

From the first-order conditions for this problem and Roy's identity, we obtain the following conditions:

$$-\left(1+\hat{d}_{iB}\right)y_{iA} + \lambda_c\left\{\left(1+\hat{d}_{iB}\right)\left(y_{iA} + \tau_{iA}\frac{\partial y_{iA}}{\partial \tau_{iA}}\right) + (\tau_{iA}y_{iA} - \tau_{iB}y_{iB})\frac{\partial \hat{d}_{iB}}{\partial \tau_{iA}}\right\} = 0, \tag{3.53}$$

$$-\left(1-\hat{d}_{iB}\right)y_{iB} + \lambda_c\left\{\left(1-\hat{d}_{iB}\right)\left(y_{iB} + \tau_{iB}\frac{\partial y_{iB}}{\partial \tau_{iB}}\right)\right.$$

$$\left. + (\tau_{iA}y_{iA} - \tau_{iB}y_{iB})\frac{\partial \hat{d}_{iB}}{\partial \tau_{iB}} + \tau_{iB}y_{iB}\frac{\partial \widehat{D}_{i'B}}{\partial \tau_{iB}}\right\} = 0, \tag{3.54}$$

$$b'(g_{iA}) - \lambda_c = 0, \tag{3.55}$$

$$b'(g_{iB}) - \lambda_c = 0, \tag{3.56}$$

$$2B'(G_i) - \lambda_c = 0, \tag{3.57}$$

where λ_c is the Lagrange multiplier that corresponds to the central government's budget constraint, Eq. 3.52. From Eqs. 3.53–3.57 and the assumption of symmetric countries $\left(\widehat{D}_{1B} = \widehat{D}_{2B} = 0\right)$, we obtain the following necessary condition for the local and national public goods[12]:

$$2B_i' = b_{iA}' = b_{iB}' = \frac{\left(1+\hat{d}_{iB}\right)y_{iA}}{\left(1+\hat{d}_{iB}\right)Y_{iA} + (\tau_{iA}y_{iA} - \tau_{iB}y_{iB})\frac{\partial \hat{d}_{iB}}{\partial \tau_{iA}}}$$

[12]We can also derive similar conditions for the public goods in the other country because the two countries are symmetric.

$$= \frac{\left(1-\hat{d}_{iB}\right)y_{iB}}{\left(1-\hat{d}_{iB}\right)Y_{iB} + (\tau_{iA}y_{iA} - \tau_{iB}y_{iB})\frac{\partial \hat{d}_{iB}}{\partial \tau_{iA}} + \tau_{iB}y_{iB}\frac{\partial \hat{D}_{i'B}}{\partial \tau_{iB}}}, \tag{3.58}$$

where $Y_{ij} \equiv y_{ij}\left(\tau_{ij}\right) + \tau_{ij}\partial y_{ij}\left(\tau_{ij}\right)/\partial \tau_{ij}$, $(j = A, B)$. These conditions imply that the marginal benefits of public funds must equal the MCPF.

Suppose that the tax rates in region A and B are the same: $\tau_{iA} = \tau_{iB} = \tau_i$. In this case, we obtain the following results: $y_{iA}(\tau_{iA}) = y_{iB}(\tau_{iB}) = y(\tau_i)$ and $\hat{d}_{iA} = 0$. Substituting these results into Eq. 3.58, the MCPF of local public good A is smaller than that of local public good B. We can see that Eq. 3.58 does not hold if $\tau_{iA} = \tau_{iB} = \tau_i$. This result means that $\tau_{iA} \neq \tau_{iB}$. Given the general assumption that the MCPF is increasing in its own tax rate, $\tau_{iA} < \tau_{iB}$ in the optimum. This result is inconsistent with the assumption that $\tau_{iB} > \tau_{iA}$.

Proof of Eqs. 3.50 and 3.51

Substituting Eqs. 3.27 and 3.41 into $\frac{\partial g_{iB}}{\partial t_{iA}} + \frac{\partial G_i}{\partial t_{iA}} = 0$ and then simplifying the resulting expression, we obtain

$$\begin{aligned}&\left\{\left(1-\hat{d}_{iA}\right)\left(y_{iA} + t_{iA}\frac{\partial y_{iA}}{\partial \tau_{iA}}\right) - t_{iA}y_{iA}\frac{\partial \hat{d}_{iA}}{\partial \tau_{iA}}\right\}m_{iA}\\ &= \left(1-\hat{d}_{iA}\right)T_{iA}\frac{\partial y_{iA}}{\partial \tau_{iA}} + (\tau_{iB}y_{iB} - T_{iA}y_{iA})\frac{\partial \hat{d}_{iA}}{\partial \tau_{iA}}.\end{aligned} \tag{3.59}$$

Solving Eq. 3.59 with respect to m_{iA}, we can obtain Eq. 3.50.

Substituting Eqs. 3.26, 3.28, and 3.42 into $\frac{\partial g_{iA}}{\partial t_{iB}} + \frac{\partial G_i}{\partial t_{iB}} - \hat{d}_{iA}\frac{\partial g_{iB}}{\partial t_{iB}} = 0$ and simplifying the resulting expression, we obtain

$$\begin{aligned}&\left(1+\hat{d}_{iA}\right)\left\{\left(1+\hat{d}_{iA}+\widehat{D}_{i'A}\right)\left(y_{iB} + t_{iB}\frac{\partial y_{iB}}{\partial \tau_{iB}}\right) + t_{iB}y_{iB}\left(\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + \frac{\partial \widehat{D}_{i'B}}{\partial \tau_{iB}}\right)\right\}m_{iB}\\ &= -\hat{d}_{iA}\left(1+\hat{d}_{iA}\right)\left(y_{iB} + t_{iB}\frac{\partial y}{\partial \tau_{iB}}\right) + \left(1+\hat{d}_{iA}\right)T_{iB}\frac{\partial y_{iB}}{\partial \tau_{iB}}\\ &\quad - \hat{d}_{iA}t_{iB}y_{iB}\left(\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + \frac{\partial \widehat{D}_{i'B}}{\partial \tau_{iB}}\right) + T_{iB}y_{iB}\left(\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + \frac{\partial \widehat{D}_{i'B}}{\partial \tau_{iB}}\right) - \tau_{iB}y_{iA}\frac{\partial \hat{d}_{iA}}{\partial \tau_{iB}}.\end{aligned} \tag{3.60}$$

Because $\widehat{D}_{i'B} = 0$ from the assumption of symmetric countries, we can obtain Eq. 3.51.

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Chapter 4
Subsidy Competition Between Regions: An Extension to Cross-shareholding and Employment Concerns

Kojun Hamada, Yoshitomo Ogawa and Mitsuyoshi Yanagihara

Abstract In this chapter, we investigate the relationship between firms' regional location choices and the subsidy policies of regional governments in an imperfectly competitive third-market model. The seminal paper by Janeba (J Int Econ 44(1):135–153, 1998) has found that no subsidies are given to firms, and we check whether this result continues to hold when we extend the model in two ways. First, we incorporate the distributions of firms' shareholders across regions to examine whether the difference in these distributions affects the zero-subsidy result. We demonstrate that even if firms' shareholders are located in both regions, the zero-subsidy result continues to hold. Second, we consider the situation in which regional governments have concerns about the regional employment associated with firms' locations, and we examine whether these governments' consideration of employment affects the zero-subsidy result. We find that when regional governments have concerns about regional employment, the subsidy competition has no subgame perfect Nash equilibrium.

Keywords Subsidy competition · Location choice · Cross-shareholding · Regional employment · Third-market model

4.1 Introduction

In this chapter, we investigate the effect of firms' regional location choices on regional governments' subsidy policies in an imperfectly competitive third-market model. In the context of the theory of international trade, Janeba (1998) was the first to show that when a firm that is initially located in either its home country or a foreign country can choose where it produces an export good before exporting that good

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to an imperfectly competitive third market, the governments of both the home and foreign countries impose no export tariffs or subsidies on the export good. This result can be immediately applied to a firm's regional location choice in the context of regional economies. In other words, when a firm producing a good to be sold in a third market chooses its production location after observing the subsidy levels offered by two regional governments, neither regional government provides a subsidy to that firm.

In his seminal study, Janeba (1998) only explored a model in which a region's welfare is defined as the profit of the firm located in that region, and he did not consider the existence of foreign shareholders. In practice, however, even if a firm is located in one region, its shareholders might be located across all regions, and their locations might affect firms' location choices or regional governments' subsidy policies. Moreover, employees' locations might also affect regional governments' decisions. Generally speaking, the social welfare in a region depends not only on the profit of the firm located in that region but also on the welfare of shareholders and employees in that region.

Therefore, in this chapter, we extend the model accordingly and examine whether the result that regional governments provide no subsidies to firms continues to hold. First, we incorporate the locations of firms' shareholders into the model and examine whether the difference in the proportion of shareholders of each firm in each region affects the original zero-subsidy result. Second, we consider the case in which firms employ workers in each region and examine whether this extension changes the existing results.

Although these extensions have not been previously explored in the literature, a considerable number of studies have tackled tax or subsidy competition between governments. For example, Bond and Samuelson (1989), Bucovetsky and Wilson (1991), and Gordon (1992) are seminal pioneering studies on capital income tax competition to attract firms to a region. Bond and Samuelson (1989) compared the Nash equilibrium tax rates under tax deduction and credit systems and showed that capital exporting and importing countries both prefer tax deduction systems to tax credit systems because a tax deduction system yielding double taxation mitigates the harsh capital trade competition. Bucovetsky and Wilson (1991) explored a model in which both wage and capital income taxes are part of the tax competition among regional governments. They showed that regional governments choose not to levy capital income taxes on firms. Gordon (1992) showed that capital income is taxed if a dominant capital exporter exists, but it is not taxed if no capital exporter is dominant. These findings of excessively low tax rates suggest the existence of a type of prisoners' dilemma in the context of the tax competition game owing to fiscal externalities.

In another strand of the literature on tax or subsidy competition, it is a well-established result that governments excessively subsidize exporting firms to promote domestic firms' exports and increase social welfare. In three seminal studies, Brander and Spencer (1985), Eaton and Grossman (1986), and Helpman and Krugman (1989) used a third-market model to demonstrate that governments fall into excessive subsidy competition for export promotion, resulting in a prisoners' dilemma situation.

This result is also important for strategic trade theory in the context of international trade.

In contrast with the abovementioned studies, Janeba (1998) examined whether such excessive tax or subsidy competition between governments can still arise if firms can freely choose their production locations after observing the tax or subsidy policies set by governments ex ante. Janeba's (1998) study demonstrated that if firms can choose their production locations, excessive fiscal competition does not occur in the equilibrium; only a laissez-faire equilibrium with no tax or subsidy arises in this case. Firms' ability to choose their locations invalidates any government's efforts to outwit other governments. Therefore, firms' ability to choose their locations after taxes or subsidies are defined is critical for determining whether excessive competition between governments occurs in the equilibrium.

As one extension of the existing studies on subsidy competition, we consider that shareholders may be located across regions and investigate whether an interregional distribution of firms' profits changes the original laissez-faire result. Janeba (1998) only explored a model in which each firm's stocks are predetermined to be owned by home residents in an initially established country, regardless of each firm's location. However, in some recent studies on tax competition in an imperfectly competitive market, firms' stocks are assumed to be held not only by domestic residents but also by foreigners. For example, Huck and Konrad (2003) introduced internationally distributed firm ownership into the model of Brander and Spencer (1985), and Ogawa (2013) analyzed tax competition allowing for foreign ownership of mobile capital. However, these studies do not consider internationally mobile firms. Recently, Morita et al. (2017) analyzed the properties of the Nash equilibrium taxes and subsidies in the case of corporate tax competition between two countries in a two-sector model in which oligopolists could choose to locate in either country and each country had some level of unemployment. They showed that a unique and stable Nash equilibrium of corporate taxes exists and examined the relationship between the wage rates and the equilibrium tax rates.

Thus, following the recent trend of growing interest in firms' interregional distributions, we attempt to generalize the original setting of Janeba (1998) to allow for the existence of shareholders across regions, and we investigate whether and how the initial laissez-faire result of no taxes or subsidies changes when shareholders across regions are incorporated into the model.

Our other extension of the existing literature involves examining any changes to the model if regional governments care about the employment generated by firms in that region. We consider whether the initial subsidy result holds when regional governments' objectives include maximizing not only the established firm's profit but also the wage income from regional employment created by local firms. Typically, in a third-market model, the social welfare of an exporting region is defined as the firm's profit less any subsidy. Thus, we determine whether the original laissez-faire outcome can still be maintained even when the government's objective is changed by explicitly incorporating the employment concerns of governments in the original setting.

We demonstrate the following results. First, even if firms' shareholders are located in other regions, regional governments still do not subsidize firms. This result suggests that any effects of regional governments' location subsidies are invalidated by firms' ex-post location choices, regardless of the proportions of shareholders in different regions. Second, when regional governments have concerns about regional employment, the subsidy competition has no subgame perfect Nash equilibrium. This result suggests that if regional governments care about regional employees, a perpetual spiral of increasing subsidy competition can be triggered. Finally, we make a modest contribution to the process of determining the subsidy equilibrium. Although Janeba (1998) used a model in which an export tariff is imposed on exporting firms in an ad valorem manner, the derivation of the equilibrium result is somewhat complicated, and a specific tariff is typically used in the literature on strategic trade theory in a third-market model. Thus, we consider a specific subsidy rather than an ad valorem subsidy and show that the same result can be readily derived even for different forms of taxation.

The remainder of this chapter is organized as follows. Section 4.2 describes the imperfectly competitive third-market model in which regional governments choose the optimal subsidy for firms located in that region, and, after observing this subsidy, firms choose a region. Section 4.3 presents the main result on the equilibrium subsidy policy for regional governments when shareholders may be located in any region. Section 4.4 presents the main result on the equilibrium subsidy policy when governments care about regional employment. Section 4.5 concludes the chapter with some final remarks.

4.2 The Model

In this section, we set up a model in which two firms compete on supply in a third market after choosing their production locations. The basic setting follows that of Janeba (1998), that is, a duopoly model in which the exporting countries' governments provide subsidies based on standard strategic trade theory. However, it departs from this model in two important ways.

First, our model differs from the original setting in that we consider competition between two regions within a country.[1] Specifically, in this model, there exist two exporting regions, indexed by $i \in \{1, 2\}$, and an importing region that has a goods market. Neither exporting regions has a goods market, whereas the importing region has no firm to produce goods. Initially, region i has only one firm, which we call firm i after the indexed region. Firms 1 and 2 export a homogenous good in the third market and engage in Cournot duopoly competition. The governments of the exporting regions can subsidize the firms located in those regions to promote their

[1] The seminal study of strategic trade theory is that of Brander and Spencer (1985). The model is called the third-market model since Brander (1995).

exports. We henceforth call the government of region i regional government i. The government of the importing region has no active role in this model.

Second, our setting differs from that of Janeba (1998) because we consider the case in which regional governments use specific rather than ad valorem subsidies. Janeba (1998) originally examined tax competition using an ad valorem tariff or subsidy, as in the setting of Eaton and Grossman (1986). However, many existing studies, including that of Brander and Spencer (1985), adopted specific tariffs or subsidies in the context of strategic trade theory to improve the tractability of the model. We explore the model in which a specific subsidy is given.

We now define the notation used in the model. q_i denotes firm i's quantity, $Q \equiv q_1 + q_2$ denotes total output, and p denotes the price. $p = p(Q)$ is the inverse demand function; we assume that $p' < 0$ and $p' + p''q_i \leq 0$.[2] The latter assumption guarantees the second-order condition for profit maximization. $C_i(q_i)$ denotes firm i's cost function, and we assume that $C_i' > 0$ and $C_i'' \geq 0$ so that cost is an increasing convex function. The location choices of firms 1 and 2 are denoted by k and l, respectively, with $k, l \in \{1, 2\}$. That is, $k = 1$ ($k = 2$) implies that firm 1 continues to produce in its original region 1 (relocates to region 2), and, likewise, $l = 2$ ($l = 1$) implies that firm 2 continues to produce in its original region 2 (relocates to region 1). s_k, $k \in \{1, 2\}$ denotes regional government k's specific subsidy.[3] For brevity, we assume that the subsidization itself does not generate any welfare loss, such as, for example, the inefficiency associated with the tax collection necessary for the subsidy payment.

Firms aim to maximize the sum of their profits and export subsidies, and governments aim to maximize their nation's social welfare. Firm i's profit before receiving any subsidy is $\widehat{\pi}^i \equiv p(Q)q_i - C_i(q_i)$, and firm i's total profit after receiving any subsidy is $\pi^i \equiv \pi^i(q_i, q_j; s_k) = (p(Q) + s_k)q_i - C_i(q_i)$, $j \in \{1, 2\}$, $j \neq i$, where s_k is the specific export subsidy paid to firm i by regional government k when firm i is located in region k. Regional governments do not discriminate between firms located in that region. Thus, denoting region k's subsidy expenditure (if negative, tax revenue) by S_k, if $(k, l) = (1, 1)$, $S_1 = s_1 Q$ and $S_2 = 0$; if $(k, l) = (1, 2)$, $S_1 = s_1 q_1$ and $S_2 = s_2 q_2$; if $(k, l) = (2, 1)$, $S_1 = s_1 q_2$ and $S_2 = s_2 q_1$; and if $(k, l) = (2, 2)$, $S_1 = 0$ and $S_2 = s_2 Q$. The consumer surplus of the third-market region is $CS \equiv \int_0^Q p(x)dx - p(Q)Q$.

Furthermore, we extend the original setting to allow for the existence of shareholders in other regions. We denote the share ratio of firm i's profit for region j's shareholders as α_{ij}. Thus, firm i's profits are shared by the shareholders in regions i and j according to the ratios of $\alpha_{ii} \in (0, 1]$ and $\alpha_{ij} \in [0, 1)$, respectively.[4] Note that $\sum_j \alpha_{ij} = 1$, that is, $\alpha_{11} + \alpha_{12} = 1$ and $\alpha_{22} + \alpha_{21} = 1$. Without loss of generality,

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[2] Throughout the chapter, single and double primes denote first and second differentiation, respectively, with respect to a variable.

[3] $s_k > 0$ ($s_k < 0$) represents a specific subsidy (tax).

[4] More specifically, α_{11} (α_{12}) is the fraction of firm 1's profit shared by region 1's (2's) residents, respectively, and, likewise, α_{22} (α_{21}) is the fraction of firm 2's profit shared by region 2's (1's) residents, respectively.

we assume that $\alpha_{ii} > \frac{1}{2}(> \alpha_{ij})$, which implies that region i's residents account for a majority of firm i's shareholders. Thus, region i's producer surplus consists of the sum of the share of firm i's profit and that of firm j's profit received by region i's residents, that is, $PS_i \equiv \alpha_{ii}\pi^i + \alpha_{ji}\pi^j$. Region i's social welfare is $W_i \equiv PS_i - S_k$.[5] Thus, the regional government aims to maximize W_i.

We make several additional assumptions regarding costs and subsidies. First, the switching cost of firm relocation is assumed to be zero. To support the notion of the complete relocation of firms, we assume that production plants are indivisible and that a substantial plant-specific fixed cost is required for firms to produce. Thus, it is economically impossible for a firm to simultaneously produce in two regions. Second, we assume that each regional government subsidizes only outputs generated in its own region. This assumption implies a source-based subsidy.[6] Third, we assume that each firm's cost function is independent of its own and its rival's location choices. This assumption incorporates the assumptions of no transportation costs and no location-specific differences between regions. These three assumptions imply that slight subsidy differentials crucially affect firms' location choices. Finally, we assume a tie-breaking rule that if the subsidies do not differ between regions, firms choose to locate in their initially established regions. However, the equilibrium results remain unchanged if we define another tie-breaking rule.

The timing of this three-stage game proceeds as follows. In the first stage, both regional governments simultaneously and non-cooperatively set their optimal specific subsidies, (s_1, s_2), to maximize regional social welfare. In the second stage, after correctly observing the optimal subsidy levels, (s_1, s_2), both firms simultaneously and non-cooperatively choose their locations for producing the export good, (k, l). In the third stage, after correctly observing the outcomes of the first and second stages, both firms engage in Cournot quantity competition and simultaneously and non-cooperatively determine their output, (q_1, q_2). Regional governments can commit to their subsidy policies regardless of firms' location choices in the second stage. The solution concept is the subgame perfect Nash equilibrium (SPNE), and we solve for the SPNE by backward induction.

4.3 Case 1: Firms' Shares are Held Across Regions

4.3.1 The Third Stage

First, we consider the third stage, in which firms engage in Cournot competition in the third market. Firms 1 and 2 maximize their profits after receiving subsidies, $\pi^1 = (p(Q) + s_k)q_1 - C_1(q_1)$ and $\pi^2 = (p(Q) + s_l)q_2 - C_2(q_2)$, with respect to q_1

[5] In the original model, region i's social welfare is $W_i = pq_i - C_i = \widehat{\pi}^i$, which is equal to firm i's profit before any subsidies. In contrast, in our extended model, social welfare is not necessarily equivalent to firm i's profit before any subsidies.

[6] Source-based taxation is assumed in Janeba's (1998) original setting.

and q_2, respectively. Note that the shareholding ratios in each region, $(\alpha_{ii}, \alpha_{ij})$, are independent of the profit maximization because they only affect the distribution of the maximized profit between regions. The first-order conditions for profit maximization are as follows[7]:

$$\pi_1^1 = p + p'q_1 - C_1' + s_k = 0. \tag{4.1}$$

$$\pi_2^2 = p + p'q_2 - C_2' + s_l = 0. \tag{4.2}$$

The second-order condition is satisfied by the assumptions, and the existence of a Nash equilibrium is guaranteed.[8] Because $\pi_{ii}^i < \pi_{ij}^i$, the uniqueness and the stability of the Nash equilibrium are also guaranteed.[9]

We denote the equilibrium output levels by $(q_1(s_k, s_l), q_2(s_k, s_l))$, $k, l \in \{1, 2\}$. By totally differentiating (4.1) and (4.2) with respect to (s_k, s_l) and noting that $\pi_{ii}^i < \pi_{ij}^i \leq 0$, we obtain the following derivatives of (q_1, q_2).

$$\frac{\partial q_1}{\partial s_k} = -\frac{\pi_{22}^2}{\Pi} > 0, \quad \frac{\partial q_1}{\partial s_l} = \frac{\pi_{12}^1}{\Pi} \leq 0, \tag{4.3}$$

$$\frac{\partial q_2}{\partial s_l} = -\frac{\pi_{11}^1}{\Pi} > 0, \quad \frac{\partial q_2}{\partial s_k} = \frac{\pi_{21}^2}{\Pi} \leq 0, \tag{4.4}$$

where $\Pi \equiv \pi_{11}^1\pi_{22}^2 - \pi_{12}^1\pi_{21}^2 > 0$. From (4.3) and (4.4), it is straightforward that an increase in the subsidy to a firm (the rival firm) increases (decreases) that firm's output. By totally differentiating the profit function, we obtain the sign of the change in profits as follows:

$$\frac{\partial \pi^1}{\partial s_k} = (1 + \frac{p'\pi_{21}^2}{\Pi})q_1 > 0, \quad \frac{\partial \pi^1}{\partial s_l} = -\frac{p'\pi_{11}^1}{\Pi}q_1 < 0, \tag{4.5}$$

$$\frac{\partial \pi^2}{\partial s_l} = (1 + \frac{p'\pi_{12}^1}{\Pi})q_2 > 0, \quad \frac{\partial \pi^2}{\partial s_k} = -\frac{p'\pi_{22}^2}{\Pi}q_2 < 0. \tag{4.6}$$

An increase in the subsidy to a firm increases its profit because both the direct effect of the subsidy for a given level of output and the indirect effect on revenue of the resulting increase in output are positive. On the other hand, an increase in the subsidy to a firm decreases the rival firm's profit because there is no direct effect and the only indirect effect is the negative effect of the resulting decrease in output.

[7]The subscripts of the profit function denote partial derivatives with respect to outputs. For example, $\pi_2^1 \equiv \partial\pi^1/\partial q_2$.

[8]The second-order condition is $\pi_{ii}^i = 2p' + p''q_i - C_i'' < 0$.

[9]$\pi_{ii}^i = 2p' + p''q_i - C_i'' < \pi_{ij}^i = p' + p''q_i \leq 0$.

4.3.2 The Second Stage

In the second stage, after anticipating the outcome in the third stage, as discussed in Sect. 4.3.1, firms choose whether to locate in region 1 or 2. Firms prefer higher subsidies and are willing to relocate to a highly subsidized region. Because the switching cost associated with a location change is assumed to be zero, firms choose to completely shift production to the region with the higher subsidy if there is even a small difference in subsidies between regions. As in the third stage, the fractions of shareholders in each region, $(\alpha_{ii}, \alpha_{ij})$, do not affect the firms' location choices at all because firms' profit maximization is independent of the distribution of the maximized profit across the residents of each regions.

Given the assumption that firms' location choices depend only on the subsidy differential, we obtain the following lemma.

Lemma 1 *Each firm chooses to locate in the region with higher subsidies.*

Proof When $s_1 < s_2$, firm 1 prefers to locate in region 2 rather than in region 1 because relocating increases its profit by $\partial\pi^1/\partial s_k > 0$. Firm 2 also prefers staying in region 2 to moving to region 1 because a location change would decrease its profit. When $s_1 = s_2$, the subsidies are the same in both regions, which means that firms' profits are the same regardless of location, and they are indifferent between locations. We thus invoke the tie-breaking rule and assume that each firm chooses to produce in its initial region. Finally, $s_1 > s_2$ is the mirror image of the case in which $s_1 < s_2$, and the same argument applies. In all cases, firms choose to locate in the region with higher subsidies. □

This lemma is the same as Janeba's (1998) Proposition 2. It implies that firms always produce in the region with higher subsidies when they anticipate the result of Cournot competition in the upcoming third stage.

4.3.3 The First Stage

In the first stage, after anticipating firms' location choices in the second stage and output decisions in the third stage, as we have already discussed, each regional government sets the optimal subsidy rate to maximize its regional welfare. When firms' shares can be held in each region, the regional social welfare is given by $W_i = \alpha_{ii}\pi^i + \alpha_{ji}\pi^j - S_k$.

Lemma 1 indicates that firms choose to produce in the high-subsidy region. Thus, when a region provides a higher subsidy to firms than another region does, both firms choose to locate in that region. Suppose that $s_1 > s_2$ ($s_1 < s_2$). Because both firms choose to locate in region 1 (2), their location choice in the second stage is $(k, l) = (1, 1)$ ($(k, l) = (2, 2)$) and the subsidy rate to both firms is s_1 (s_2). We denote the common subsidy rate by $s \equiv s_k$ in this case, as we rewrite the profits of firms 1 and 2 as $\pi^1 = (p + s)q_1 - C_1(q_1)$ and $\pi^2 = (p + s)q_2 - C_2(q_2)$, respectively. When the firms locate in the same region, we denote the output levels in the Cournot-Nash equilibrium as $(q_1^*(s), q_2^*(s))$.

By combining both effects on the first derivatives in (4.3) and (4.4), the comparative statics of the equilibrium outputs are obtained as follows:

$$q_1'(s) = -\frac{\pi_{22}^2 - \pi_{12}^1}{\Pi}, \tag{4.7}$$

$$q_2'(s) = -\frac{\pi_{11}^1 - \pi_{21}^2}{\Pi}. \tag{4.8}$$

In general, the signs of $q_1'(s)$ and $q_2'(s)$ are indeterminate because they depend on the degree of firm homogeneity, which, in this model, specifically refers to the homogeneity of the cost function. If costs are very asymmetric, $\pi_{ji}^j < \pi_{ii}^i (< 0)$ can occur, and $q_i'(s) < 0$ can occur as a result. However, if firms' cost functions are relatively similar, then $\pi_{ii}^i < \pi_{ji}^j$, as is normally assumed. Throughout this chapter, we make the following assumption on what can be called "limited cost divergence" to exclude any irregular cases.[10]

Assumption 1 The firms' cost functions are sufficiently similar that $\pi_{ii}^i < \pi_{ji}^j < 0$ holds.

This assumption implies that when firms produce in the same region, an increase in the regional government's subsidy increases both firms' outputs, that is, $q_1'(s) > 0$ and $q_2'(s) > 0$. Although Assumption 1 is placed on the endogenous variables, it is satisfied in many situations. For example, when demand is linear, Assumption 1 always holds. Moreover, even when demand is not linear, if the cost functions of both firms are almost the same, Assumption 1 holds.[11]

Totally differentiating the profit functions, we obtain the derivative of profits with respect to the subsidy as follows:

$$\frac{d\pi^1}{ds} = \left(1 + p' q_2'(s)\right) q_1 = \frac{(2p' - C_1'')\pi_{21}^2 - \pi_{11}^1 C_2''}{\Pi} q_1 > 0, \tag{4.9}$$

$$\frac{d\pi^2}{ds} = \left(1 + p' q_1'(s)\right) q_2 = \frac{(2p' - C_2'')\pi_{12}^1 - \pi_{22}^2 C_1''}{\Pi} q_2 > 0. \tag{4.10}$$

An increase in the subsidy to a firm increases its profit, that is, $d\pi^i/ds > 0$. Thus, the direct revenue effect of a subsidy always exceeds the indirect effect of the decrease in price caused by the increase in the rival firm's output.

Denoting region i's social welfare when firms i and j choose regions k and l, respectively, as $W_i^{(k,l)}$, the social welfare of regions 1 and 2 is given as follows:

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[10] Janeba (1998) investigated tax competition under an assumption that he similarly called limited cost divergence.

[11] $\pi_{ii}^i < \pi_{ji}^j \Leftrightarrow p' + p''(q_i - q_j) - C_i'' < 0$. If demand is linear, that is, if $p'' = 0$, then the above inequality always holds. If $C_i(\cdot) = C_j(\cdot)$, the equilibrium outputs of the firms are identical, that is, $q_i = q_j$. Furthermore, in this case, $p' + p''(q_i - q_j) - C_i'' = p' - C_i'' < 0$ holds.

$$\begin{aligned} W_1^{(1,1)} &= \alpha_{11}\pi^1 + \alpha_{21}\pi^2 - s_1(q_1+q_2) && \text{if } s_1 > s_2, \\ W_1^{(1,2)} &= \alpha_{11}\pi^1 + \alpha_{21}\pi^2 - s_1 q_1 && \text{if } s_1 = s_2, \\ W_1^{(2,2)} &= \alpha_{11}\pi^1 + \alpha_{21}\pi^2 && \text{if } s_1 < s_2, \end{aligned} \tag{4.11}$$

and

$$\begin{aligned} W_2^{(1,1)} &= \alpha_{22}\pi^2 + \alpha_{12}\pi^1 && \text{if } s_1 > s_2, \\ W_2^{(1,2)} &= \alpha_{22}\pi^2 + \alpha_{12}\pi^1 - s_2 q_2 && \text{if } s_1 = s_2, \\ W_2^{(2,2)} &= \alpha_{22}\pi^2 + \alpha_{12}\pi^1 - s_2(q_1+q_2) && \text{if } s_1 < s_2. \end{aligned} \tag{4.12}$$

Note that the firms' location choice is never $(k, l) = (2, 1)$ because of the tie-breaking rule.

Under Assumption 1, we immediately obtain the following lemma.

Lemma 2 *Suppose that Assumption 1 holds and that regional government* 2 *offers no subsidy, that is, $s_2 = 0$. Then, the best response of regional government* 1 *is any nonpositive subsidy rate, regardless of the proportions of firms' shareholders in each region. Regional government* 1 *is indifferent between all subsidy rates with $s_1 \leq 0$.*

Proof When $s_2 = 0$, region 1's social welfare given by (4.11) is as follows:

$$\begin{aligned} W_1^{(1,1)} &= \alpha_{11}\pi^1 + \alpha_{21}\pi^2 - s_1(q_1+q_2) && \text{if } s_1 > 0, \\ W_1^{(1,2)} &= \alpha_{11}\pi^1 + \alpha_{21}\pi^2 && \text{if } s_1 = 0, \\ W_1^{(2,2)} &= \alpha_{11}\pi^1 + \alpha_{21}\pi^2 && \text{if } s_1 < 0. \end{aligned} \tag{4.13}$$

Social welfare is the same when $s_1 = 0$ and when $s_1 < 0$. If regional government 1 offers a subsidy (i.e., $s_1 > 0$), it attracts both firms, but region 1's social welfare decreases by $s_1(q_1 + q_2) < 0$. We show that when $s_1 > s_2 = 0$, the derivative of region 1's social welfare $W_1^{(1,1)}$ with respect to s_1 is negative. Specifically, using (4.7)–(4.10), we obtain the derivative of social welfare as follows:

$$\begin{aligned} \frac{dW_1^{(1,1)}}{ds_1} &= \alpha_{11}\frac{d\pi^1}{ds_1} + \alpha_{21}\frac{d\pi^2}{ds_1} - (q_1+q_2) - s_1(q_1' + q_2') \\ &= -\alpha_{12}q_1 - \alpha_{22}q_2 + (\alpha_{21}p'q_2 - s_1)q_1' + (\alpha_{11}p'q_1 - s_1)q_2' < 0. \end{aligned} \tag{4.14}$$

Note that $q_i' > 0$ by Assumption 1. The sign of (4.14) is obtained by $s_1 > 0$ and $q_i' > 0$. As long as $s_1 > s_2 (= 0)$, a reduction in subsidy s_1 increases social welfare. Thus, a positive subsidy is never an optimal strategy for regional government 1. □

This lemma claims that when a region does not initially offer a subsidy, another regional government does not wish to attract both firms through subsidization. Although Lemma 2 is essentially the same as Janeba's (1998) Proposition 3, its claim generally holds for any distribution of firms' shareholders between regions. Intuitively, under Assumption 1, no regional government pays subsidies even if each firm has shareholders in each region. Because Assumption 1 implies that the direct revenue effect of a subsidy is never overcompensated by the negative indirect effect of the decrease in price induced by the increase in total output, as shown in (4.9) and (4.10), an increase in the subsidy always causes a decrease in social welfare.

Combining Lemmas 1 and 2, we now present the main result on the SPNE of this subsidy competition game.

Proposition 1 *Suppose that Assumption 1 holds. Then, the only SPNE is for neither regional government to offer a subsidy,* $s_1 = s_2 = 0$*, regardless of the distribution of firms' shareholders between regions.*

Proof The proof consists of three steps that use Lemmas 1 and 2.

Step 1: Suppose that $s_2 < 0$ in the equilibrium. When $s_1 < s_2 < 0$, both firms locate in region 2 (Lemma 1). In this case, the social welfare in regions 1 and 2 is given by the third rows of (4.11) and (4.12), respectively, and the equilibrium outputs of both firms are independent of s_1. Now, suppose that regional government 1 reduces its tax rate (because s_1 is negative). If $s_1 = s_2 < 0$ is chosen, the market structure drastically changes, and firms produce in their initial located regions according to the tie-breaking rule. Tax revenue is transferred from region 2 to region 1, and region 1's social welfare increases, but the equilibrium outputs in this case are the same as those when $s_1 < s_2 < 0$. Thus, $s_1 < s_2 < 0$ cannot occur in the equilibrium. Moreover, regional government 1 could undercut its tax rate slightly to attract both firms (Lemma 1). When moving from $s_1 = s_2$ to $(0 >)s_1 > s_2$, regional government 1 obtains more social welfare because it receives the tax revenue from firm 2 but the equilibrium outputs change only marginally. Thus, $s_1 = s_2 < 0$ also cannot occur in the equilibrium. Similar to the result of Lemma 2, when $s_1 > s_2$, $dW_1^{(1,1)}/ds_1 < 0$ for $s_1 > 0$. Thus, the best response to a negative subsidy is itself a negative subsidy. When $s_2 < 0$, then, regional government 1 necessarily deviates from the initial tax rate and undercuts its tax rate slightly more than s_2 does. The same arguments hold for regional government 2. Therefore, an equilibrium with any positive tax (negative subsidy) rate can never exist.

Step 2: On the contrary suppose that $s_2 > 0$ in the equilibrium. The same argument applies as that described in Step 1, and, similarly, an equilibrium with any positive subsidy rate can never exist.

Step 3: The final step is to prove that when $s_2 = 0$, the best response of regional government 1 is also to offer no subsidy, $s_1 = 0$. This assertion immediately follows from Lemma 2. □

Proposition 1 is similar to Janeba's (1998) Proposition 4, in which the equilibrium is called a laissez-faire equilibrium. However, Proposition 1 claims that even if both firms have shareholders in both regions, the optimal subsidy policy for both regional governments is still to offer no subsidy. Stated differently, the firms' shareholder distributions do not affect the laissez-faire result. As shown in the proof of Proposition 1, the basic logic of Proposition 1 is that unless $s_1 = s_2 = 0$, each regional government has an incentive to deviate from its initial subsidy. Only when $s_1 = s_2 = 0$ do both regional governments lack any incentive to deviate because attracting both firms to a region through subsidies reduces social welfare by an amount equal to the subsidy, and imposing a tax drives the original firm in that region to relocate to the other region without any corresponding increase in tax revenue.[12]

Proposition 1 suggests that regulations on foreign capital do not change the taxation policies of regional governments to attract businesses to those regions. It also suggests that the Janeba's (1998) laissez-faire result holds even in a more generalized environment in which firms' shares can be held across regions.

4.4 Case 2: Regional Governments Consider Regional Employment

In the previous section, we showed that the best responses of both regional governments are to offer no subsidies, regardless of the distribution of the firms' shareholders. Thus, Janeba's (1998) result is robust as long as the same location choice model is applied. In this section, we instead assume that regional governments have concerns about employment in their regions and investigate the effect of these concerns on their subsidy choices. For simplicity of analysis, we assume that firms can elastically demand labor. That is, each region has a sufficient labor force.[13] Unlike in Sect. 4.3, we do not consider shareholders distributed across regions. All of the shareholders of firm i are residents of region i, and firm i's profit is distributed only to region i.

We now describe some additional notation. Labor is the only input used to produce a good. L_i^k denotes the labor input of firm i in region k, and w is the wage paid per employee. w is assumed to be constant and exogenously given over regions because each region has many potential workers. q_i^k denotes the output of firm i located in region k. Firms have identical production functions denoted by $q_i^k = f(L_i^k)$. The labor input function of firm i in region k is denoted by $L_i^k = L(q_i^k)$, which is defined as the inverse of the production function. We assume that $L' > 0$ and $L'' > 0$, as usual. We consider the situation in which regional governments subsidize the firms located in their regions.[14] Firm i's profit is given by

$$\pi^i = p(Q)q_i - wL_i^k + s_k q_i. \tag{4.15}$$

[12]This logic is quite similar to that of the Bertrand paradox when two firms with the same constant marginal cost engage in price competition in a homogeneous-good market. In the Bertrand paradox, the price is equal to the marginal cost in the equilibrium because neither firm can obtain positive profits by changing its price. Likewise, in the laissez-faire equilibrium, neither regional government can obtain more welfare by changing the subsidy level.

[13]This assumption can be also interpreted as the constant existence of unemployment in each region such that firms' labor demand can be always absorbed within each region.

[14]Note that we do not consider the situation in which the subsidy is given to regional employees because we do not explicitly introduce labor income or utility into the model to keep the analysis simple.

As in the previous section, we solve for the equilibrium by backward induction from the third stage to the first stage. In the third stage, firms engage in Cournot competition in a third market.

The first-order conditions for profit maximization are as follows:

$$\pi_1^1 = p + p'q_1 - wL' + s_k = 0. \tag{4.16}$$

$$\pi_2^2 = p + p'q_2 - wL' + s_l = 0. \tag{4.17}$$

Because the firm's cost function in this section is $C_i(q_i) = wL(q_i)$, $C_i' > 0$ and $C_i'' \geq 0$ hold, as in the previous section, and the features of the first partial derivatives in (4.3) and (4.6) hold here as well. Likewise, the results for firms' location choices in the second stage also apply. As a result, Lemma 1 again holds.

This analysis differs from that in the previous section in that regional governments care about the employment of regional labor. Thus, region i's social welfare includes not only firm i's profit and subsidy revenue or payment to or from another region but also the total wage income of employees in region i. That is, $W_i = \pi^i + wL^i - S_i$, where L^i denotes the total employment in region i. We define L^i such that the following equalities hold: $L^i = 0$ when no firm locates in region i, $L^i = L_j^i$ when only firm j locates in region i, and $L^i = L_1^i + L_2^i$ when both firms locate in region i.

In the above setting, the number of firms located in region i determines the total regional wage income wL^i as well as the subsidy payment S_i. Specifically, $S_i = 0$ when no firm locates in region i, $S_i = s_i q_i$ when only firm i locates in region i, $S_i = s_i q_j$ when only firm j locates in region i, and $S_i = s_i Q$ when both firms locate in region i.

Thus, region i's social welfare is expressed as follows:

$$\begin{array}{lll} W_1^{(1,1)} = \pi^1 + w(L_1^1 + L_2^1) - s_1 Q = pq_1 + wL(q_2) - s_1 q_2 & \text{if } s_1 > s_2, \\ W_1^{(1,2)} = \pi^1 + wL_1^1 - s_1 q_1 = pq_1 & \text{if } s_1 = s_2, \\ W_1^{(2,2)} = \pi^1 = pq_1 - wL(q_1) + s_2 q_1 & \text{if } s_1 < s_2, \end{array} \tag{4.18}$$

and

$$\begin{array}{lll} W_2^{(1,1)} = \pi^2 = pq_2 - wL(q_2) + s_1 q_2 & \text{if } s_1 > s_2, \\ W_2^{(1,2)} = \pi^2 + wL_2^2 - s_2 q_2 = pq_2 & \text{if } s_1 = s_2, \\ W_2^{(2,2)} = \pi^2 + w(L_1^2 + L_2^2) - s_2 Q = pq_2 + wL(q_1) - s_2 q_1 & \text{if } s_1 < s_2, \end{array} \tag{4.19}$$

where $W_i^{(k,l)}$ is region i's social welfare when firms 1 and 2 locate in regions k and l, respectively.

When regional governments care about regional employment, the equilibrium result is drastically different from that of the previous section. In some cases, the existence of the SPNE is not guaranteed. The following proposition is the main result on the SPNE in the subsidy competition game when both regional governments care about regional employment.

Proposition 2 *Suppose that Assumption 1 holds and the wage is sufficiently large. When both regional governments care about regional employment, the subsidy competition has no SPNE.*

Proof First, we consider the case in which $s_2 = 0$. In this case, region 1's social welfare is given by (4.18), as follows:

$$\begin{array}{lll} W_1^{(1,1)} = pq_1 + wL(q_2) - s_1 q_2 & \text{if } s_1 > 0, \\ W_1^{(1,2)} = pq_1 & \text{if } s_1 = 0, \\ W_1^{(2,2)} = pq_1 - wL(q_1) & \text{if } s_1 < 0. \end{array} \tag{4.20}$$

Since $wL(q_2)$ is sufficiently large, $wL(q_2) - s_1 q_2 > 0$. Thus, the best response of regional government 1 is to offer a positive subsidy to attract firm 2 and increase employment in the region. As the same logic applies to regional government 2, the laissez-faire result, that is, $(s_1, s_2) = (0, 0)$, cannot be the equilibrium. Second, we consider the case in which $s_2 \neq 0$. Because w is sufficiently large, $L'' > 0$, and $\partial q_2/\partial s_1 > 0$, $wL\big(q_2(s_1)\big) > s_1 q_2(s_1)$ continues to hold regardless of the value of s_1 when $s_1 > s_2$. In this case, (4.19) implies that the best response of regional government 1 is to offer a higher subsidy than that of the rival government to attract firm 2 and increase regional employment because $W_1^{(1,1)} > W_1^{(1,2)} > W_1^{(2,2)}$ is satisfied. The best response of regional government 1 is $s_1 = s_2 + \varepsilon$, where ε is an infinitesimal positive number. As the same logic also applies to regional government 2, its best response is also $s_2 = s_1 + \varepsilon$. Thus, no set of subsidies, (s_1, s_2), can be the SPNE because both governments have incentives to deviate from any set and offer a slightly higher subsidy than that of the rival government. □

The result of Proposition 2 drastically differs from that of Proposition 1. When regional governments do not care about regional employment, the laissez-faire result is the unique SPNE. However, when regional governments factor regional employment into social welfare, an SPNE no longer exists. The rationale for Proposition 2 is simple. As long as social welfare increases when regional employment increases, attracting both firms raises welfare discontinuously. Thus, each regional government necessarily has the incentive to outwit the opposing government by marginally increasing the subsidy level to attract both firms. When a government succeeds in attracting both firms, the social welfare discontinuously increases, whereas the subsidy increase necessary to attract these firms is marginal.

Proposition 2 suggests that making different assumptions about the policy objectives of regional governments leads to different results in the case of subsidy competition between governments. In addition, lack of an equilibrium in this case implies that the subsidy competition between regional governments is usually unstable. To acquire the additional employment associated with an entering firm, a regional government must constantly outwit the rival government by increasing the subsidy payment to firms. Unlike in the previous case, in this case, the laissez-faire result is not an SPNE. Moreover, no strategy pair with equal subsidies can be an SPNE. As each government's best response is to offer a higher subsidy level than that of its opponent, a perpetual spiral of endlessly increasing subsidies by both governments occurs when the employment is emphasized. Thus, Proposition 2 can be interpreted as both governments falling into an endless competition to increase subsidies if they care about regional employment.

4.5 Concluding Remarks

In this chapter, we reconsidered subsidy competition between regional governments by incorporating other stakeholders of firms into the model, and we found several important results. First, we demonstrated that even if firms' shareholders are distributed across regions, the original result that regional governments offer no subsidies to firms remains unchanged. This result suggests that any effects of regional governments' subsidies are invalidated by the firms' ex-post location choices, regardless of the distribution of firms' shareholders across regions. Second, we showed that when we extend the basic model to the situation in which regional governments have concerns about regional employment, the subsidy competition has no SPNE, depending on the circumstances. The second result suggests that if regional governments care about regional employment, a subsidy competition will be triggered. Thus, both governments fall into an endless subsidy competition to raise subsidy levels.

Finally, we discuss future research directions. First, a future extension is to investigate the changes in the results if the interests of various firms' stakeholders are explicitly considered and if firms' objective functions vary across regions. These extensions are supported by some discussions in the existing literature. For example, Haufler and Stähler (2013) assume that firms' shareholders live in the third-market country and firms' profits are not included in social welfare. Furthermore, as is often discussed, companies' ownership structures differ across different types of capitalism. For example, it is widely recognized that in Anglo-American capitalism, firms aim to maximize shareholder value, whereas in German and Japanese capitalism, firms tend to regard various additional stakeholders as important as well.[15]

Second, in this model, we only considered the situation in which regional governments care about sum of the usual social welfare and the total wage income of regional employees to simplify the analysis. However, the consumption behavior of regional employees should ideally be incorporated into the model. Another possible extension is to incorporate employees as active agents in the model, determine their utility maximization, and investigate the subsidy competition between regional governments when the general equilibrium in the goods market is explicitly considered.

Third, we took the timing of decision making in the two-stage game as given. In the first stage, both governments determined their subsidy levels, and in the second

[15] Albert (1993) first classified the practice of capitalism in developed countries into two types: Anglo-American capitalism and Rhine (German-Japanese) capitalism. Aoki (1980, 1988) demonstrated that the objective of Japanese companies is endogenously determined by Nash bargaining between shareholders and employees. Several studies (Aoki 1990; Imai and Komiya 1995) regard German-Japanese firms as employee-controlled firms.

stage, both firms choose their locations. However, if governments cannot commit to their subsidy policies, the timing of decision making might change. Examining timing differences in subsidy competition are also left for future work.

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Chapter 5
Neutrality of Intergovernmental Transfers

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Abstract In this chapter, we extend the model of a two-level government constructed by Boadway and Keen (Int Tax Finance 3:137–155, 1996) to include a third level and derive the optimal tax and intergovernmental transfer system. We analyze whether the second-best allocation can be replicated when three types of intergovernmental transfer schemes are available and find that this allocation can always be replicated if the upper level of government is a Stackelberg leader, regardless of the intergovernmental transfer scheme.

Keywords Three-tiered government · Intergovernmental transfer · Vertical tax externality

5.1 Introduction

We investigate whether fiscally decentralized systems in developed countries can achieve the second-best allocation by extending the model of a two-level government constructed by Boadway and Keen (1996) to three levels and deriving the optimal tax and intergovernmental transfer system. In practice, both two-level and three-level government systems are common, and these systems use various types of intergovernmental transfers to adjust their budgets. According to the OECD/UCLG (2016), two-level, three-level, and more-than-three-level government systems account for 31, 46, and 23% of a sample of 101 countries, respectively. This report also indicated that the tax bases of the three-level governments overlap in 13 of 35 OECD mem-

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ber countries, particularly for personal or corporate income taxes.[1] Therefore, it is meaningful to consider vertical tax externalities in three-level government systems.

A major issue in the local public finance literature is whether governments can internalize fiscal externalities. Generally, fiscal externalities can be categorized as horizontal or vertical fiscal externalities, and both types of externalities are addressed by many studies (Dahlby 2008). As this analysis focuses on vertical externalities, we describe the most relevant literature accordingly.

A vertical fiscal externality arises when the policies of one level of government affect the budget constraint of another level of government (Dahlby 2008). For example, consider a federal government and a state government that impose federal and state taxes, respectively, on the same tax base, and assume that the demand function is decreasing in price. When the state government increases the state tax rate, the federal government's tax revenue decreases because its tax base shrinks with the increase in the state tax rate. Previous studies have shown that when both governments behave as Nash competitors, the optimal tax rate at each level of government is higher than the socially optimal tax rate (Keen 1998). For the governments to internalize this externality, the federal government must behave as a Stackelberg leader and use an intergovernmental transfer (Boadway and Keen 1996).

Boadway and Keen (1996) considered the situation in which federal and local governments operate at different levels and analyzed whether the vertical tax externality caused by imposing a local labor tax can be internalized using intergovernmental transfers and federal and local labor taxes. They showed that when the federal government behaves as a Stackelberg leader and can decide the direction of the intergovernmental transfer, the second-best allocation can always be achieved and negative intergovernmental transfers can arise in which local governments provide transfers to the federal government when all rents are allocated to the local governments.

Aronsson and Wikstrom (2001) analyzed the optimal tax and intergovernmental transfers in a three-level government model. They considered two types of games: a Nash game among local, regional, and central governments, and a Stackelberg game in which it is assumed that the highest government level acts as the leader. They found that even if all governments behave as Nash players, the second-best allocation can be replicated when an intergovernmental transfer is designed by the central government to induce the second-best policy. Furthermore, they showed that if the regional government acts as a Stackelberg leader and the local governments are followers, the central government implements the second-best allocation by restricting taxation at the local or the regional level and designing intergovernmental transfer schemes.

Although Aronsson and Wikstrom (2001) extended the previous analyses to more than two levels of government, they considered only one type of intergovernmental transfer scheme: intergovernmental transfers from the federal government to state and local governments. However, in developed countries, three kinds of transfer

[1]This information comes from a country report by OECD/UCLG (2016). Strictly speaking, subnational governments can control their tax policies in eight of 13 countries: Belgium, Italy, Japan, Norway, Portugal, Spain, Switzerland, and Sweden. Thus, our analysis may be more applicable to the inter-governmental relationships in these countries.

schemes are typically available. Specifically, these schemes involve transfers (i) from the federal government to the state governments and from the state government to the local governments, (ii) from the federal government to the local governments and from the state government to the local governments, and (iii) from the federal government to the state and local governments.

We therefore extend the existing literature by analyzing whether the second-best allocation can be replicated when we consider the above three types of intergovernmental transfer schemes, and we show that whenever the upper level of government is a Stackelberg leader, the second-best allocation can always be replicated regardless of the intergovernmental transfer scheme.

The remainder of this chapter is organized as follows. Section 5.2 describes the basic model and shows the properties of the second-best allocation. Section 5.3 analyzes fiscal federalism using a three-tiered government model. Section 5.4 discusses the direction of intergovernmental transfers, and Sect. 5.5 concludes.

5.2 The Model

We adopt a three-tiered government system by extending the two-tiered government system examined in Boadway and Keen (1996) to examine the vertical fiscal externalities that can occur among a federal government, state governments, and local governments. Specifically, we consider a federal economy with m symmetric regions and k symmetric localities within each region. Each locality contains n identical households.

Household

The utility function of a representative individual is

$$U = u(x, l) + b(g) + \Gamma(z) + B(G), \tag{5.1}$$

where x and l are quantities of private goods and labor, respectively, and g, z, and G are quantities of local, state, and federal public goods, respectively. The sub-utility $u(x, l)$ is quasi-concave, increasing in x, and decreasing in l, and the functions $b(g)$, $\Gamma(z)$, and $B(G)$ are strictly concave and increasing in each factor.

The budget constraint faced by the household is

$$x = (w - \tau)l, \tag{5.2}$$

where w and τ are the real wage rate and the consolidated labor tax rate, respectively. The optimal labor supply, that is, the labor supply function of a household, is given by $l = l(w-\tau)$. Following Boadway and Keen (1996), we assume that $l_w(w-\tau) > 0$.[2]

[2] This assumption comes from the property $u_x + l\{(w_\tau - 1)u_{xx} + u_{lx}\} > 0$.

The indirect utility function is written as $v(w - \tau) + b(g) + \Gamma(z) + B(G)$, where $v'(w - \tau) = u_x l$.

Firm

Output is produced in each locality using labor and a fixed factor. The production technology is represented by an increasing, strictly concave function, $f(L)$, where L is labor demand. Output can be used interchangeably for the production of x, g, z, and G. We assume that the private goods sector is perfectly competitive and that unemployment does not exist.

The equilibrium market wage and labor market condition are given by $w = f_L$ and $L = nl$, respectively. From both equations, the wage rate and the labor supply are obtained as $w = w(\tau)$ and $l = l(\tau)$, respectively, and we can calculate the effect of the labor tax on wage as follows:

$$w_\tau = -\frac{f_{LL} n l_w}{1 - f_{LL} n l_w} \in (0, 1). \tag{5.3}$$

All rents are assumed to accrue to the public sector. $\theta_F \in [0, 1]$, $\theta_S \in [0, 1]$, and $\theta_L = 1 - (\theta_F + \theta_S) \in [0, 1]$ denote the proportions of rents that are allocated to the federal, state, and local governments, respectively. The rent is written as

$$r(\tau) = f - nlf_L. \tag{5.4}$$

The effect of the labor tax on rent is

$$r_\tau = (1 - w_\tau) f_{LL} n^2 l_w l = -w_\tau nl = \frac{n^2 l f_{LL} n l_w}{1 - f_{LL} n l_w} < 0. \tag{5.5}$$

Government

The budget constraints of the local, state, and federal governments are given by

$$g\left(t_L, t_S, T, S^{FL}, S^{SL}, \theta_F, \theta_S\right) = nt_L l + (1 - \theta_F - \theta_S) r + S^{FL} + S^{SL}, \tag{5.6}$$

$$z\left(t_L, t_S, T, S^{FS}, S^{SL}, \theta_S\right) = knt_S l + \theta_S kr + S^{FS} - kS^{SL}, \tag{5.7}$$

and

$$G\left(t_L, t_S, T, S^{FS}, S^{SL}, \theta_F\right) = mknTl + \theta_F mkr - mS^{FS} - mkS^{FL}, \tag{5.8}$$

respectively. t_L, t_S, and T represent the local, state, and federal labor tax rates, respectively, and S^{FL}, S^{SL}, and S^{FS} represent intergovernmental (lump-sum) transfers from the federal government to the local government, from the state government to the local government, and from the federal government to the state government, respectively. The consolidated tax rate is $\tau = t_l + t_s + T$.

Second-best allocation

To analyze the efficient intergovernmental transfer system, we derive the second-best allocation by solving the social welfare maximization problem of the unitary government. The optimization problem of the unitary government is written as

$$\max_{\tau,g,z,G} v(w-\tau) + b(g) + \Gamma(z) + B(G),$$
$$\text{s.t.} \quad G + mz + mkg = mkn\tau l + mkr. \tag{5.9}$$

The unitary government must satisfy the following condition:

$$\frac{mknB_G(G)}{u_x} = \frac{kn\Gamma_z(z)}{u_x} = \frac{nb_g(g)}{u_x} = \frac{1}{1-\frac{\tau l_w}{l}}. \tag{5.10}$$

This condition represents a modified Samuelson condition for the second-best allocation. The first three terms in Eq. 5.10, $mknB_G/u_x$, $kn\Gamma_z(z)/u_x$, and $nb_g(g)/u_x$, represent the marginal rates of substitution (MRS) of federal, state, and local public goods for the marginal utility of consumption, respectively. The final term in Eq. 5.10, $\frac{1}{1-\frac{\tau l_w}{l}}$, represents the marginal cost of public funds (MCPF), in which $\frac{\tau l_w}{l}$ represents the distortion from imposing a labor tax and we assume that $1 > \frac{\tau l_w}{l}$. Thus, this modified Samuelson condition implies that the MRSs of federal, state, and local public goods must correspond exactly to the MCPF in the second-best allocation.

5.3 Various Intergovernmental Transfer Schemes and Optimal Tax Rates

In this section, we analyze the optimal tax rates and intergovernmental transfer policies in the case of three levels of government. We consider the following three types of intergovernmental transfers.

Scheme 1: Optimal federal-state and state-local transfers

The federal government can determine the direction and level of its intergovernmental transfer to the state governments. Each state government can decide the direction and level of its intergovernmental transfer to the local governments.

Scheme 2: Optimal federal-local and state-local transfers

The federal and state governments can decide the directions and levels of their intergovernmental transfers to the local governments.

Scheme 3: Optimal federal-state and federal-local transfer

The federal government can decide the direction and level of its intergovernmental transfers to the state and local governments.

We consider the optimal tax and intergovernmental transfer policies chosen in the equilibrium of a Stackelberg game with the upper level of government as the leader. In other words, the first mover is the federal government, the second mover is the state government, and the third mover is the local government. To focus on the internalization of the vertical tax externality, we assume labor is not permitted to move across localities or states.

5.3.1 Scheme 1. Optimal Federal-State and State-Local Transfers

In scheme 1, intergovernmental transfers are provided from the federal government to the state governments and from the state governments to the local governments. The resulting game consists of three stages. In the first stage, the federal government sets the federal labor tax rate and its intergovernmental transfer to the state governments to maximize national welfare. In the second stage, given the federal labor tax rate and the intergovernmental transfers from the federal government to the state governments, each state government determines its state labor tax rate and its intergovernmental transfer to the local governments to maximize state welfare. In the third stage, given the federal and state labor tax rates and the intergovernmental transfers from the state governments to the local governments, each local government sets its local tax rate to maximize local welfare.

Local government's problem

As is standard, we solve this game using backward induction. First, we solve the problem of the local government in the third stage. The local government's problem is given by

$$\begin{aligned} &\max_{t_L} v(w(\tau)-\tau)+b(g)+\Gamma(z)+B(G), \\ &s.t.\ g = nt_L l(w(\tau)-\tau)+\{1-(\theta_F+\theta_S)\}r(w(\tau)-\tau)+S^{SL}. \end{aligned} \tag{5.11}$$

The local government must satisfy the following first-order condition:

$$v_w(w_\tau-1)+b'(g)g_{t_L}=0. \tag{5.12}$$

From Eq. 5.12, we can calculate the MRS of local public goods.

$$\frac{nb_g(g)}{u_x}=\frac{1}{1-\frac{\tau l_w(w-\tau)}{l}+\frac{z_{t_L}}{(w_\tau-1)knl}+\frac{G_{t_L}}{(w_\tau-1)knml}}. \tag{5.13}$$

Comparing Eqs. 5.10 and 5.13, we find that the MCPF of this problem differs from that of the second-best allocation. For example, if t_S and T are positive, then the MCPF of Eq. 5.13 is larger than that of the second-best outcome because the signs of both z_{t_L} and G_{t_L} are negative. However, if t_S and T are negative, then these signs depend on the signs of $t_S - \theta_S nlf_{LL}$ and $T - \theta_S nlf_{LL}$.

Consider the case of positive federal and state taxes. Because the federal, state, and local governments share the tax base, the tax base shrinks due to the vertical tax externality when the local tax level increases. However, in the case of negative federal and state taxes (i.e., subsidies), an increase in the local tax increases the tax base by subsidizing wages. When the effect of the increase in the tax base is larger than the effect of the decrease in rent revenue, the MCPF in Eq. 5.13 is smaller than that in the second-best allocation. Thus, we find that when $z_{t_L} = 0$ and $G_{t_L} = 0$, the MCPF of Eq. 5.13 exactly corresponds to the MCPF of the second-best allocation.

Lemma 1 *If the federal and state governments satisfy $z_{t_L} = 0$ and $G_{t_L} = 0$, then the tax policy of each local government can achieve the MCPF of the second-best allocation.*

State government's problem

Next, we consider the second stage. The state government's problem is given by

$$\max_{t_S, z, S^{SL}} v(w(\tau) - \tau) + b(g) + \Gamma(z) + B(G),$$
$$s.t.\ z = knt_S l(w(\tau) - \tau) + k\theta_S r(\tau) - kS^{SL} + S^{FS}. \tag{5.14}$$

Each state government must satisfy the following first-order condition:

$$v_w(w_\tau - 1)\left(1 + \frac{\partial t_L}{\partial t_S}\right) + b_g(g)\left(g_{t_S} + g_{t_L}\frac{\partial t_L}{\partial t_S}\right) + \Gamma_z(z)\left(z_{t_S} + z_{t_L}\frac{\partial t_L}{\partial t_S}\right) = 0,$$

and

$$v_w(w_\tau - 1)\frac{\partial t_L}{\partial S^{SL}} + b_g(g)\left(g_{S^{SL}} + g_{t_L}\frac{\partial t_L}{\partial S^{SL}}\right) + \Gamma_z(z)\left(z_{S^{SL}} + z_{t_L}\frac{\partial t_L}{\partial S^{SL}}\right) = 0. \tag{5.15}$$

Using Eqs. 5.12 and 5.15 can be rewritten as

$$b_g(g) - k\Gamma_z(z)\left\{1 + \frac{z_{t_L}\left(1 + \frac{\partial t_L}{\partial t_S}\right)}{knl}\right\} = 0,$$

and

$$b_g(g) - \Gamma_z(z)\left\{k + z_{t_L}\frac{\partial t_L}{\partial S^{SL}}\right\} = 0. \tag{5.16}$$

From Eq. 5.16, we obtain $z_{t_L}\Gamma_z(z)\left(1 + \frac{\partial t_L}{\partial T} + nl\frac{\partial t_L}{\partial S^{SL}}\right) = 0$. Note that because $1 + \frac{\partial t_L}{\partial t_S} = 1 + \frac{\partial t_L}{\partial T} = \left\{\frac{n(w_\tau - 1)}{b_g}\right\}\frac{(b_g)^2 l_w - b_{gg} l v_w}{v_{ww}(w_\tau - 1)^2 + v_w w_{\tau\tau} + b_{gg}\left(g_{t_L}\right)^2 + b_g g_{t_L t_L}} > 0$ and

$\frac{\partial t_L}{\partial S^{SL}} = -\frac{b_{gg} g_{t_L}}{v_{ww}(w_\tau - 1)^2 + v_w w_{\tau\tau} + b_{gg}\left(g_{t_L}\right)^2 + b_g g_{t_L t_L}} < 0$, we find that $1 + \frac{\partial t_L}{\partial T} + nl\frac{\partial t_L}{\partial S^{SL}} = \frac{nl_w(w_\tau - 1)b_g}{v_{ww}(w_\tau - 1)^2 + v_w w_{\tau\tau} + b_{gg}\left(g_{t_L}\right)^2 + b_g g_{t_L t_L}} > 0$. Thus, $z_{t_L} = 0$ is a necessary condition to satisfy both parts of Eq. 5.16, and when $z_{t_L} = 0$, the MRS of state public goods must correspond to the MRS of local public goods, $\frac{nk\Gamma_z(z)}{u_x} = \frac{nb_g(g)}{u_x}$.

Because $z_{t_L} = nl_w k(w_\tau - 1)(t_S - \theta_S nl f_{LL})$, the optimal state tax rate is

$$t_S^* = \theta_S nl f_{LL} \leq 0. \tag{5.17}$$

Using the budget constraint for the state government and noting that the optimal level of state public goods is positive ($z^* > 0$) we can write the optimal intergovernmental transfer as follows:

$$S^{SL,*} = \frac{1}{k}\left\{\theta_S k(nl)^2 f_{LL} - z^* + \theta_S kr + S^{FS}\right\}. \tag{5.18}$$

The sign of $S^{SL,*}$ depends on θ_S and S^{FS} because the first, second, and third terms (i.e., $\theta_S k(nl)^2 f_{LL}$, $-z^*$, and $\theta_S kr$) represent the state tax revenue, the optimal level of state public goods, and the allocated rent revenue, respectively. In particular, because the optimal state labor tax rate is negative, the net tax revenue, $\theta_S kn^2 l^2 f_{LL} - z$, is negative. In other words, the state government cannot cover its expenditures with its tax revenue. The fourth term, S^{FS}, denotes the level of the intergovernmental transfer from the federal government. Thus, when $k\theta_S r(\tau) + S^{FS} + kn^2 l^2 \theta_S f_{LL} - z >, =, < 0$, the optimal intergovernmental transfer is positive, zero, or negative. For example, when the federal government provides a relatively large intergovernmental transfer, S^{FS}, or when the state government receives a large share of rent, this transfer is positive because of their budget constraints.

Lemma 2 *If $z_{t_L} = 0$, the MRS of state public goods must correspond to the MRS of local public goods, which the states can achieve by imposing a state labor tax and providing intergovernmental transfers. When $k\theta_S r(\tau) + S^{FS} > (=, <)\ kn^2 l^2 \theta_S f_{LL} - z$, the optimal state-local intergovernmental transfer is positive, zero, or negative, respectively.*

Note that when the state government imposes the optimal state tax, $t_S^* = \theta_S nl f_{LL}$, that is, when $z_{t_L} = 0$, the vertical tax externality can be partially internalized.

Federal government's problem

Finally, we consider the first stage. The federal government's problem is given by

$$\begin{aligned} &\max_{T, S^{FS}} v(w(\tau) - \tau) + b(g) + \Gamma(z) + B(G), \\ &s.t.\ G = mknTl + mk\theta_F r - mS^{FS}. \end{aligned} \tag{5.19}$$

Substituting the first-order conditions of the state and local governments into the first-order condition of this problem, the federal government must satisfy the following two conditions:

$$nk\{mB_G(G) - \Gamma_z(z)\} + B_G(G)G_{t_L}\left\{1 + \frac{\partial t_L}{\partial T} + \left(1 + \frac{\partial t_L}{\partial t_S}\right)\frac{\partial t_S}{\partial T}\right\} = 0,$$

and

$$\{mB_G(G) - \Gamma_z(z)\} + B_G(G)G_{t_L}\left\{\frac{\partial t_S}{\partial S^{FS}} + \frac{\partial t_L}{\partial t_S}\frac{\partial t_S}{\partial S^{FS}} + \frac{\partial t_L}{\partial S^{SL}}\frac{\partial S^{SL}}{\partial S^{FS}}\right\} = 0. \tag{5.20}$$

We can see that $G_{t_L} = 0$ is a necessary condition to satisfy both parts of Eq. 5.20, and when $G_{t_L} = 0$, the MRS of federal public goods must correspond to the MRS of state public goods, that is, $\frac{nmkB_G(G)}{u_x} = \frac{nk\Gamma_z(z)}{u_x}$. The federal government must satisfy Eq. 5.20 and the budget constraint.[3]

We now consider the implications of $G_{t_L} = 0$. Because $G_{t_L} = mknTl_w(w_\tau - 1) + mk\theta_F r_\tau = nmkl_W(w_\tau - 1)\{T - \theta_F f_{LL}nl\}$, we can obtain the optimal federal labor tax rate as follows:

$$T^* = \theta_F nl f_{LL} \leq 0. \tag{5.21}$$

Using the budget constraint for the federal government, we can obtain the optimal intergovernmental transfer as follows:

$$S^{FS,*} = \frac{1}{m}\left\{mk\theta_F f_{LL}(nl)^2 - G^* + mk\theta_F r\right\}. \tag{5.22}$$

The sign of $S^{FS,*}$ depends on θ_F. The first term, $mk\theta_F f_{LL}(nl)^2$, and the second term, $-G^*$, denote that the federal government can cover its own government expenditure with its own tax revenue. Because the optimal federal labor tax rate is negative, the net tax revenue, $mk\theta_F f_{LL}(nl)^2 - G$, is negative. The third term, $mk\theta_F r$, is the share of allocated rent, $mk\theta_F r$, which is either zero or positive. When the federal government's rent revenue can cover its subsidies and the quantity of federal public goods, $mk\theta_F + rmk\theta_F f_{LL}n^2l^2 - G >, =, < 0$, the optimal federal intergovernmental transfer is positive, zero, or negative, respectively.

[3] To compare these results to those of Boadway and Keen (1996), we assume that $1 + \frac{\partial t_L}{\partial T} + \left(1 + \frac{\partial t_L}{\partial t_S}\right)\frac{\partial t_S}{\partial T} \neq 0$ and $\frac{\partial t_S}{\partial S^{FS}} + \frac{\partial t_L}{\partial t_S}\frac{\partial t_S}{\partial S^{FS}} + \frac{\partial t_L}{\partial S^{SL}}\frac{\partial S^{SL}}{\partial S^{FS}} \neq 0$. The derivations of both signs of the equations are complex, and we apply this assumption to the following sections. That is, we focus on the case of $z_{t_L} = 0$ and $G_{t_L} = 0$, following Boadway and Keen (1996).

Lemma 3 *Under $G_{t_L} = 0$, the MRS of federal public goods must correspond to the MRS of state public goods, which can be achieved by imposing a federal labor tax and by providing intergovernmental transfers. When $mk\theta_F + rmk\theta_F f_{LL} n^2 l^2 - G >(=,<)0$, the optimal federal-state intergovernmental transfer is positive, zero, or negative, respectively.*

Note that when the federal government imposes the optimal federal tax, $T^* = \theta_F f_{LL} nl$, that is, when $G_{t_L} = 0$ is satisfied, we find that the vertical tax externality caused by imposing the federal tax is partially internalized, as is the case for the state tax in Lemma 1.

Second-best allocation

We can now check whether the optimal policies at each level of government can achieve the second-best allocation. From Lemma 1, we know that if $z_{t_L} = 0$ and $G_{t_L} = 0$ are satisfied, the MCPF corresponds to that of the second-best allocation. From Lemmas 2 and 3, we find that both conditions can be satisfied and, moreover, that $\frac{kn\Gamma_z(z)}{u_x} = \frac{nb_g(g)}{u_x}$ and $\frac{mknB_G(G)}{u_x} = \frac{kn\Gamma_z(z)}{u_x}$ are satisfied. Thus, under this intergovernmental transfer system, the country can replicate the second-best allocation.

The reason that the second-best allocation can be replicated is that each level of government can internalize its vertical tax externality step by step by imposing a negative or zero federal or state tax. That is, in the third stage, the imposed local labor tax generates two distinct vertical tax externalities that affect the budgets of the state and federal governments. Thus, the problem is whether the upper-level governments can internalize the vertical externalities. In the second stage, the state government, which can anticipate the policies of the local governments, can partially internalize the vertical tax externality to the state budget by imposing a negative or zero state tax. In the first stage, the federal government, which can anticipate the policies of both the local and the state governments, can also internalize the vertical externality by imposing a negative or zero federal tax. Thus, this transfer system, which we call transfer scheme 1, plays the role of internalizing all vertical tax externalities.

Proposition 1 *When the federal government can set the federal tax and the size of the intergovernmental transfer from the federal government to the state governments and the state governments can set the state tax and the size of the intergovernmental transfers from state to local governments, the second-best allocation can be replicated.*

5.3.2 Scheme 2. Optimal Federal-Local and State-Local Transfers

We now consider the second intergovernmental transfer scheme, in which transfers are provided from the federal government to the local governments and from the state governments to the local governments. The only difference between Sect. 5.3.1

and this section is that, in this section, the federal government can provide intergovernmental transfers only to local governments and not to state governments. Thus, the structure of the game itself is the same as that in Sect. 5.3.1, and the results of the second and final stages are also not changed. The results of Lemmas 1 and 2 therefore also hold in this case. The only remaining question is whether the federal government can replicate the second-best allocation through intergovernmental transfers from the federal government to the local governments.

Federal government's problem

We consider the first stage of the game following the same process as in Sect. 5.3.1. In this scheme, each local government is a decision maker as opposed to the state governments. The federal government's problem is given by

$$\begin{aligned} &\max_{T,S^{FL}} v(w(\tau)-\tau)+b(g)+\Gamma(z)+B(G),\\ &s.t.\ G = mknTl + mk\theta_F r - mkS^{FL}. \end{aligned} \tag{5.23}$$

Solving this problem and substituting the first-order conditions of the state and the local governments, we find that the federal government must satisfy the following two conditions:

$$nk\{mB_G(G)-\Gamma_z(z)\}+B_G(G)G_{t_L}\left\{1+\frac{\partial t_L}{\partial T}+\left(1+\frac{\partial t_L}{\partial t_S}\right)\frac{\partial t_S}{\partial T}+\frac{\partial t_S}{\partial S^{FL}}\frac{\partial S^{FL}}{\partial T}\right\}=0,$$

and

$$\left\{mkB_G(G)-b_g(g)\right\}+B_G(G)G_{t_L}\left\{\frac{\partial t_S}{\partial S^{FL}}+\frac{\partial t_L}{\partial t_S}\frac{\partial t_S}{\partial S^{FL}}+\frac{\partial t_L}{\partial S^{SL}}\frac{\partial S^{SL}}{\partial S^{FL}}\right\}=0. \tag{5.24}$$

We can see the difference between Eqs. 5.20 and 5.24 from the second part of Eq. 5.24. This equation shows that the federal government adjusts to equalize the MRSs of federal and local public goods, that is, $\frac{nmkB_G(G)}{u_x}=\frac{nb_g(g)}{u_x}$, when $G_{t_L}=0$. Moreover, the federal government anticipates the optimal policies of the state governments, $\frac{nk\Gamma_z(z)}{u_x}=\frac{nb_g(g)}{u_x}$; from Eq. 5.16, these sequentially optimal tax policies lead to $\frac{nmkB_G(G)}{u_x}=\frac{nk\Gamma_z(z)}{u_x}=\frac{nb_g(g)}{u_x}$, which corresponds to the MRS of the second-best allocation, and $G_{t_L}=0$, which corresponds to the MCPF of the second-best allocation. Thus, the difference from the intergovernmental transfer scheme in Sect. 5.3.1 arises because the federal government indirectly equalizes the MRSs of federal and state public goods through the optimal policies of the state government, whereas, in the previous analysis, the federal government can directly equalize the MRSs.

The optimal federal labor tax is the same as that in Eq. 5.21. However, the level of the optimal intergovernmental transfer differs from that in scheme 1 as follows:

$$S^{FL,*} = \frac{1}{mk}\left\{mk\theta_F f_{LL} n^2 l^2 - G + \theta_F r\right\}. \tag{5.25}$$

Note that $G = mknTl + \theta_F r - mkS^{FL}$ per the budget constraint of the federal government.

Second-best allocation in scheme 2

We can easily determine whether the optimal policies at each level of government can achieve the second-best allocation. Because (i) $\frac{mknB_G(G)}{u_x} = \frac{nb_g(g)}{u_x}$ and $\frac{mknB_G(G)}{u_x} = \frac{kn\Gamma_z(z)}{u_x}$ and (ii) $z_{t_L} = 0$ and $G_{t_L} = 0$ are satisfied by the optimal state labor tax, the optimal federal labor tax, and the intergovernmental transfer, the second-best allocation can be replicated.

Note that the internalization of vertical tax externalities in this scheme differs from that for scheme 1. When the local governments create two distinct vertical tax externalities on the state and federal budgets and the state governments then partially internalize the vertical tax externality on their budgets, as in scheme 1, the federal government faces the problem of modifying the vertical tax externality on the federal budget. Because the federal government can only use intergovernmental transfers to the local governments to internalize the externality, it must adjust the MRS between the three levels of governments using the state governments' behavior. That is, the federal government recognizes that the equalization of the MRSs of the federal and local public goods leads to the equalization of the MRSs of the federal and state public goods through the optimal policies of the state governments. Thus, the federal government can again replicate the second-best allocation.

Proposition 2 *When the federal government and each state government can provide intergovernmental transfers to the local governments, the second-best allocation can be replicated.*

5.3.3 Scheme 3. Optimal Federal-State and Federal-Local Transfers

We now consider the scheme in which intergovernmental transfers are provided from the federal government to the state and local governments. In this case, we assume that the state governments cannot use intergovernmental transfers as a policy tool and the federal government can set the intergovernmental transfers to both the state and local governments. Thus, the result of the third stage, in which the local government tax rate is set by local government, does not change, and Lemma 1 also holds in this case. However, the behaviors of the federal and state governments differ from those in Sect. 5.3.2.

State government's problem

Unlike in Sect. 5.3.2, we now consider the situation in which the state governments can only use the labor tax to finance the provision of state public goods. Thus, the first part of Eq. 5.16, $b_g(g) - k\Gamma_z(z)\left\{1 + \frac{z_{t_L}\left(1+\frac{\partial t_L}{\partial t_S}\right)}{knl}\right\} = 0$, holds. However, because the state government cannot use intergovernmental transfers as a policy tool to equalize the MRSs of the state and local public goods, the state governments cannot internalize any vertical tax externalities.

Federal government's problem

In this case, the federal government has three kinds of policy tools: the federal labor tax, intergovernmental transfers from the federal government to the state governments, and intergovernmental transfers from the federal government to the local governments. Thus, the federal government's problem is

$$\max_{T,S^{FS},S^{FL}} v(w(\tau) - \tau) + b(g) + \Gamma(z) + B(G),$$
$$s.t.\ G = mknTl + mk\theta_F r - mS^{FS} - mkS^{FL}. \tag{5.26}$$

Solving this problem and substituting the first-order conditions of the state and local governments, we find that the federal government must satisfy the following three conditions:

$$\left\{B_G(G)mkG_{t_L} + \Gamma_z(z)kz_{t_L}\right\}\left\{1 + \frac{\partial t_L}{\partial T} + \left(1 + \frac{\partial t_L}{\partial t_S}\right)\frac{\partial t_S}{\partial T}\right\}$$
$$+ \Gamma_z(z)kz_{t_L}\left\{\left(1 + \frac{\partial t_L}{\partial t_S}\right)\frac{\partial t_S}{\partial T}\right\} - \left(b_g(g) - mkB_G(G)\right)nl = 0,$$
$$B_G(G)mkG_{t_L}\frac{\partial t_L}{\partial S^{FL}} + b'(g) - mkB_G(G) = 0$$

and

$$\left\{mkB_G(G) - b_g(g)\right\}\frac{1}{k} - \Gamma_z(z)z_{t_L}\left(1 + \frac{\partial t_L}{\partial t_S}\right)\frac{1}{nl}$$
$$+ B_G(G)mkG_{t_L}\left(1 + \frac{\partial t_L}{\partial t_S}\right)\frac{\partial t_S}{\partial S^{FS}} = 0. \tag{5.27}$$

Solving Eq. 5.27 with regard to z_{t_L}, G_{t_L}, and $mkB_G(G) - b_g(g)$, we find that $z_{t_L} = 0$, $G_{t_L} = 0$, and $mkB_G(G) - b_g(g) = 0$ are necessary conditions to satisfy the three parts of Eq. 5.27. Thus, as in the previous subsection, $G_{t_L} = 0$ and $\frac{nmkB_G(G)}{u_x} = \frac{nk\Gamma_z(z)}{u_x}$ are satisfied in this stage. Moreover, the federal government can control the optimal tax policy of the state governments because $z_{t_L} = 0$.

As a result, because $z_{t_L} = 0$ is satisfied, the optimal state tax rate, which is controlled by the federal government, is $t_S^* = \theta_S nlf_{LL} \leq 0$. Because $G_{t_L} = 0$ is also satisfied, the optimal federal labor tax rate is $T^* = \theta_F f_{LL}nl \leq 0$.

Next, we can obtain the optimal intergovernmental transfers using the budget constraints of the federal and state governments as follows:

$$S^{FL,*} = \frac{1}{k}\left\{\theta_S k n^2 l^2 f_{LL} - z + \theta_S k r\right\}$$

and

$$S^{FS,*} = \frac{1}{m}\left\{mk\theta_F f_{LL} n^2 l^2 - G + mk\theta_F r\right\}. \tag{5.28}$$

As in Sect. 5.3.2, the signs of $S^{FL,*}$ and $S^{FS,*}$ depend on θ_S and θ_F, respectively, because the first and the second terms reflect the budgets of the federal and state governments, respectively.

Second-best allocation in scheme 3

The federal government can control the policies of the state and local governments. In particular, because the state governments can only control the state tax rate, they cannot ensure that Eq. 5.16 is satisfied. However, because the federal government recognizes the optimal state tax policy, it can adjust for two kinds of vertical externalities: those affecting the federal budget and those affecting the state budgets.

Proposition 3 *When the federal government can choose the optimal federal tax rate and the intergovernmental transfers to both the state and local governments, the second-best allocation can be replicated.*

Finally, from Propositions 1, 2, and 3, we can obtain the following theorem. Theorem 1 When the upper level of government is a Stackelberg leader and can determine the direction of intergovernmental transfers and each level of government can set the tax rate at that level, the second-best allocation can be replicated.

5.4 Direction of Intergovernmental Transfers

Following Boadway and Keen (1996), we compare the directions of the intergovernmental transfer scheme according to allocated rents. In particular, we consider the following three typical cases: (i) the case in which all rent is allocated to local governments, (ii) the case in which all rent is allocated to state governments; and (iii) the case in which all rent is allocated to the federal government.

5.4.1 All Rent Is Allocated to Local Governments ($\theta_L = 1$ and $\theta_S = \theta_F = 0$)

We first consider the case in which all rent is allocated to local governments. In this case, $t_L^* > 0$, $t_S^* = 0$, and $T^* = 0$ from Eqs. 5.12, 5.17 and 5.21.

5.4.1.1 Intergovernmental Transfer Scheme 1

We consider the optimal federal-state and state-local transfers. The directions of these transfers are determined by Eqs. 5.18 and 5.22 such that

$$S_{p1}^{FS,*} = -\frac{G^*}{m} < 0$$

and

$$S_{p1}^{SL,*} = -\frac{1}{k}\left(z^* + \frac{G^*}{m}\right) < 0.$$

In this case, the federal and state governments are not allocated rent, and neither level of government has any internal revenue because they each choose a zero tax rate. Thus, the optimal direction of the federal-state transfer runs from the state governments to the federal government. Moreover, because the federal government must receive intergovernmental transfers from the state governments and because the tax and rent revenues of the state government are also zero, the state governments provide intergovernmental transfers to the local governments to finance the optimal levels of state and federal public goods.

5.4.1.2 Intergovernmental Transfer Scheme 2

Next, we consider the optimal federal-local and state-local transfers. The direction is determined by Eqs. 5.18 and 5.25.

$$S_{p2}^{FL,*} = -\frac{G^*}{mk} < 0$$

and

$$S_{p2}^{SL,*} = -\frac{z^*}{k} < 0.$$

In this case, each local government must provide intergovernmental transfers to the federal and state governments equal to the sum of $S_{p2}^{FL,*} + S_{p2}^{SL,*}$. Unlike in scheme 1, the local governments divide their intergovernmental transfers across two levels of government.

5.4.1.3 Intergovernmental Transfer Scheme 3

Finally, we consider the optimal federal-state and federal-local transfers. The directions of these transfers are determined by Eq. 5.28 such that

$$S_{p3}^{FS,*} = z^* > 0$$

and

$$S_{p3}^{FL,*} = -\frac{1}{k}\left(z^* + \frac{1}{m}G^*\right) < 0.$$

In this case, the local governments must provide intergovernmental transfers to the federal government. Specifically, the local and state governments must provide $\frac{G^*}{mk}$ and $\frac{z^*}{k}$, respectively. The federal government must transfer z^* to the state governments to provide state public goods.

Because only the local government has internal revenue, the sign of the transfer from the local government is always negative. Moreover, when comparing schemes 1, 2, and 3, the directions of schemes 1 and 2 are negative because $S_{p1}^{FS,*} < 0$ and $S_{p2}^{FL,*} < 0$, and the direction of scheme 3 is positive because $S_{p3}^{FS,*} > 0$.

5.4.2 All Rent Is Allocated to State Governments ($\theta_S = 1$ and $\theta_F = \theta_L = 0$)

Next, we consider the case in which all rent is allocated to the state governments. In this case, $t_L^* > 0$, $t_S^* = \theta_S nlf_{LL} \leq 0$, and $T^* = 0$ from Eqs. 5.12, 5.17 and 5.21.

5.4.2.1 Intergovernmental Transfer Scheme 1

We consider the optimal federal-state and state-local transfers. The directions of these transfers are determined by Eqs. 5.18 and 5.22, as follows:

$$S_{p1}^{FS,*} = -\frac{G^*}{m} < 0$$

and

$$S_{p1}^{SL,*} = \frac{1}{k}\left\{r + kf_{LL}(nl)^2 - z^* - \frac{G^*}{m}\right\} \lesseqgtr 0.$$

In this case, all rent is attributed only to the state governments, and the tax revenue is attributed only to the local governments. The federal government must receive intergovernmental transfers from the state governments because the tax and rent revenues of the federal government are zero. Thus, the sign of the optimal federal-state transfer is always negative. Moreover, because the state government must impose a negative labor tax (hereafter, labor subsidy), the state government's revenue comes only from rent. Thus, when the rent revenue, r, is larger than, equal to, or smaller than the sum of the labor subsidy, $f_{LL}(nl)^2$; the optimal level of state public goods, $\frac{1}{k}z^*$; and the optimal federal-state transfer, $\frac{G^*}{km}$, the optimal state-local transfer is positive, zero, or negative, respectively.

5.4.2.2 Intergovernmental Transfer Scheme 2

Next, we consider the optimal federal-local and state-local transfers. The directions of these transfers are determined by Eqs. 5.18 and 5.25, as follows:

$$S_{p2}^{FL,*} = -\frac{G^*}{mk} < 0$$

and

$$S_{p2}^{SL,*} = \frac{1}{k}\left(r + kf_{LL}n^2l^2 - z^*\right) \lesseqgtr 0.$$

Because the federal government has no internal revenue, it must receive intergovernmental transfers. As for the optimal state-local transfer, because each state government receives rent revenue, if the rent revenue is larger than, equal to, or smaller than the sum of the labor subsidy and the optimal level of state public goods, then the optimal state-local transfer is positive, zero, or negative, respectively.

5.4.2.3 Intergovernmental Transfer Scheme 3

Finally, we consider the optimal federal-state and federal-local transfers. The directions of these transfers are determined by Eq. 5.28.

$$S_{p3}^{FS,*} = z^* - kf_{LL}n^2l^2 - r \lesseqgtr 0$$

and

$$S_{p3}^{FL,*} = \frac{-1}{mk}\left(G^* + mS_{p3}^{FS,*}\right) \begin{matrix} < \\ = \\ > \end{matrix} 0$$

$$\leftrightarrow \begin{matrix} S_{p3}^{FS,*} > 0 \\ S_{p3}^{FS,*} = 0 \; and \; G^* = mS_{p3}^{FS,*} \\ S_{p3}^{FS,*} < 0 \; and \; G^* < mS_{p3}^{FS,*} \end{matrix}.$$

Because the state government must provide state public goods and labor subsidies, if its expenditure is larger than, equal to, or smaller than its rent revenue, then the optimal federal-state transfer is positive, zero, or negative, respectively. The sign of the optimal federal-local transfer depends on the sign of the optimal federal-state transfer because the federal government does not have any internal revenue. If the optimal federal-state transfer is negative and the federal government can finance the optimal level of federal public goods, the sign of the optimal federal-local transfer is positive.

5.4.3 *All Rent Is Allocated to the Federal Government ($\theta_F = 1$ and $\theta_S = \theta_L = 0$)*

Next, we consider the case in which all rent is allocated to the federal government. In this case, $t_L^* > 0$, $t_S^* = 0$, and $T^* = \theta_F nlf_{LL} \leq 0$ from Eqs. 5.12, 5.17 and 5.21.

5.4.3.1 Intergovernmental Transfer Scheme 1

We consider the optimal federal-state and state-local transfers. The direction is determined by Eqs. 5.18 and 5.22 such that

$$S_{p1}^{FS,*} = \frac{1}{m}\left(r + mkf_{LL}(nl)^2 - G^*\right) \lesseqgtr 0$$

and

$$S_{p1}^{SL,*} = \frac{1}{k}\left\{\frac{1}{m}\left(r + mkf_{LL}(nl)^2 - G^*\right) - z^*\right\} \lesseqgtr 0 \leftrightarrow \begin{matrix} S^{FS,*} \leq 0 \\ \frac{r}{m} = \frac{1}{m}\left(G^* - mkf_{LL}(nl)^2\right) + z^* \\ \frac{r}{m} > \frac{1}{m}\left(G^* - mkf_{LL}(nl)^2\right) + z^* \end{matrix}.$$

In this case, when the rent revenue, r, received by federal government receives is larger than, equal to, or smaller than the sum of the optimal labor subsidy, $kf_{LL}(nl)^2$, and the optimal level of national public goods, G^*, then the sign of the optimal federal-state transfer, $S^{FS,*}$, is positive, zero, or negative, respectively. Because the state government receives neither rent nor tax revenue, if the federal-state transfer, $S^{FS,*}$, is positive and larger than the optimal level of state public goods, then the sign of the state-local transfer, $S^{SL,*}$, is positive. If they are equal, then the state-local transfer is zero.

5.4.3.2 Intergovernmental Transfer Scheme 2 ($S^{FS,*} = 0$)

Next, we consider the optimal federal-local and state-local transfers. The directions of these transfers are determined by Eqs. 5.18 and 5.25, as follows:

$$S_{p2}^{FL,*} = \frac{1}{mk}\left(r + mkf_{LL}n^2l^2 - G^*\right) \lesseqgtr 0$$

and

$$S_{p2}^{SL,*} = -\frac{z^*}{k} < 0.$$

Unlike in scheme 1, we find that the optimal state-local transfer is always negative because the state government has no internal revenue. The optimal federal-local transfer, $S_{p2}^{FL,*}$, is positive, zero, or negative when the sum of rent revenue of the federal government and the labor subsidy are larger than, equal to, or smaller than the optimal level of federal public goods, respectively.

5.4.3.3 Intergovernmental Transfer Scheme 3

Finally, we consider the optimal federal-state and federal-local transfers. The directions of these transfers are determined by Eq. 5.28, as follows:

$$S_{p3}^{FS,*} = z^* > 0$$

and

$$S_{p3}^{FL,*} = \frac{1}{mk}\left(r + mkf_{LL}n^2l^2 - G^* - mz^*\right) \lesseqgtr 0.$$

In this case, the federal government must provide the optimal federal-state transfer, $S_{p3}^{FS,*} = z^*$. Furthermore, if the rent revenue of the federal government is larger than equal to, or smaller than the sum of the labor subsidy and the optimal levels of federal and state public goods, then the optimal federal-local transfer is positive, zero, or negative, respectively.

We summarize the above results in Table 5.1. Note that Boadway and Keen (1996) showed that if the federal receipt of rents is low enough relative to the required subsidy and the federal government's own expenditure needs, which may plausibly be the case, then the federal government must obtain transfers from the states. In other words, the optimal fiscal gap may be negative. This case corresponds to that of $\theta_F = \theta_S = 0$ and $\theta_L = 1$ in transfer scheme 1. However, as shown, various transfer schemes are optimal.

Table 5.1 Intergovernmental transfer schemes and allocated rents

Rent allocation	Scheme 1	Scheme 2	Scheme 3
(i) $\theta_F = \theta_S = 0$ and $\theta_L = 1$	$S^{SL,*} < 0$ and $S^{FS,*} < 0$	$S^{SL,*} < 0$ and $S^{FL,*} < 0$	$S^{FL,*} < 0$ and $S^{FS,*} > 0$
(ii) $\theta_F = \theta_L = 0$ and $\theta_S = 1$	$S^{SL,*}(>, =, <)0$ and $S^{FS,*} < 0$	$S^{SL,*}(>, =, <)0$ and $S^{FL,*} < 0$	$S^{FL,*}(>, =, <)0$ and $S^{FS,*}(<, =, >)0$
(iii) $\theta_S = \theta_L = 0$ and $\theta_F = 1$	$S^{SL,*}(>, =, <)$ and $S^{FS,*}(<, =, >)0$	$S^{SL,*} < 0$ and $S^{FL,*}(>, =, <)0$	$S^{FL,*}(>, =, <)0$ and $S^{FS,*} > 0$

5.5 Conclusion

This chapter extended the two-level government model constructed by Boadway and Keen (1996) to three levels and derived the optimal tax and intergovernmental transfer systems. Specifically, we showed that the second-best allocation can always be replicated independent of the intergovernmental transfer schemes whenever the upper level of government is a Stackelberg leader and that various intergovernmental transfer schemes are possible depending on the rent allocation.

Throughout the analysis, we assumed that the upper level of government is a Stackelberg leader and that labor mobility is prohibited between localities to focus on the vertical tax externality. One possible extension of this work is to consider the case in which a lower level government is the Stackelberg leader, as in Köthenbürger (2004), because each level government might have identical information. A further extension of our research could be to explore a model in which horizontal fiscal externalities are also explicitly included.

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Chapter 6
Searching for a Soft Budget Constraint: The Case of the Intergovernmental Transfer System in Japan

Kota Sugahara

Abstract In this chapter, we ascertain whether a soft budget constraint problem is caused by the Local Allocation Tax (LAT) transfer in Japan. We develop a two-period Stackelberg game model that describes the dynamic commitment (DC) problem of the central government and the common pool behavior (CPB) of prefectural governments. We identify two types of CPB: the typical behavior caused by the marginal cost being less than the marginal benefit of the transfer and a type of fiscal externality that changes the transfers to other prefectures. Then, we estimate the reaction function of the central government, which represents a DC problem, and the borrowing equation for capturing the CPB of the prefectural government. We find no definitive evidence for CPB, whereas the bailout driven by the LAT transfer is clear. In addition, the estimate that controls for structural changes demonstrates that prefectural governments inherently discipline themselves regardless of any bailout. Therefore, we cannot identify any SBC problem associated with the LAT transfer. Thus, even if we do observe CPB, its source might be a fiscal externality through the egalitarian structure of the LAT transfer system rather than a bailout by the central government.

Keywords Intergovernmental transfer · Soft budget constraint · Common pool

6.1 Introduction

The objective of this analysis is to ascertain whether a soft budget constraint (SBC) problem arises in the intergovernmental transfer system of Japan, that is, Local Allocation Tax (LAT) transfers from the central government to sub-national governments.

According to the seminal review of Kornai et al. (2003), the SBC problem caused by a bailout leads to the inefficient behavior of the supported organization. According to Goodspeed (2002), the SBC problem consists of two phases: a dynamic commitment (DC) problem affecting the decision-making of the central government that

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faces the possible failure of a sub-national government and the common pool behavior (CPB) of a sub-national government to avoid fully paying the marginal cost of the bailout. In the context of LAT transfers, we hypothesize that a sub-national government expecting an increase in the LAT transfer sets an inefficient level of expenditures (Akai et al. 2003).

Because such hypotheses can be evaluated using stochastic frontier analysis, this approach underpins a primary stream of the empirical analysis of the intergovernmental SBC problem in the Japanese literature.[1] However, Hayashi (2002) pointed out an incorrect assumption regarding the distribution of inefficiency term and argued that previous analyses inaccurately capture the SBC problem with respect to LAT transfers. Furthermore, the stochastic frontier-based approach a priori assumes the relation between the amount of the LAT transfer and the inefficiency of each sub-national government rather than ascertaining the reaction of the central government to a failure of a sub-national government and the behavior of the sub-national government given the expectation of bailouts in the LAT transfer system.[2]

Nevertheless, the standard approach to causality in the SBC problem is to confirm the reactions of the supporting and supported governments. The literature related to the intergovernmental SBC problem is classified into three approaches: the difference-in-difference approach,[3] the VAR model,[4] and estimations of the reaction function. Our analysis is most inspired by those of Pettersson-Lidbom (2010) and Bordignon and Turati (2009), which are leading empirical studies of SBC phenomena. Pettersson-Lidbom (2010) estimated an equation that represents the debt held the Swedish local government with an expectation on a discretionary fiscal transfer from the central government and identified the SBC phenomenon. Bordignon and Turati (2009) confirmed the SBC hypothesis for health expenditures by Italian regional governments. These analyses focus on the role of expectations about the bailout in the behavior of sub-national governments. They assume that central government transfers are determined by the demographic, geographic, and economic

[1]Yamashita et al. (2002) first addressed the SBC problem in the context of LAT transfers. Miyazaki (2004) considered the relation between LAT transfers and inefficient public investment by prefectural governments. Ogawa and Tanahashi (2008) and Otsuka et al. (2014) showed that the LAT makes prefectural management inefficient. However, Tazika and Miyazaki (2006) found no evidence of the SBC problem regarding municipal efforts to cut expenses.

[2]Hayashi (2006) argued that stochastic frontier-based approaches cannot distinguish the SBC problem from other phenomena that cause the inefficient behavior of sub-national governments, such as interregional spillovers of the benefit of local public goods and interregional fiscal competition.

[3]This method captures the effect of institutional and structural changes to transfer systems on the expectations or behavior of lower-tier governments, such as Swedish municipalities (Dietrichson and Ellegard 2015), German states (Baskaran 2017), and Dutch municipalities (Allers and Merkus 2013).

[4]Irandoust (2017) approaches the Swedish SBC problem by checking for cointegration between spending and revenue. Paleologou (2013) considers the linkage between revenue and expenditure in Sweden, Greece, and Germany.

characteristics of each region, and thus, are assumed to be given for each sub-national government.[5]

From a different perspective, Miyazaki (2007), in an exceptional study on the SBC problem of LAT transfers in Japan, studied the effect of past prefectural expenditures on discretionary changes in the LAT formula by implementing dynamic panel data estimation. To accurately capture the effect, Miyazaki (2007) aimed to investigate the calculation of individual expense items rather than that of total expenditure. Then, he showed that the calculation formula had changed to substantially support the prefectures facing larger deviations in expenses from their budgets in the previous period.

In the context of DC and CPB, Miyazaki's (2007) analysis can be considered to address the DC problem, and the analyses by Pettersson-Lidbom (2010) and Bordignon and Turati (2009) clarify CPB. Based on these studies, we attempt to ascertain both DC and CPB to comprehensively explore the SBC problem of the LAT transfer system.

We obtain the following results from our empirical analysis. First, bailouts by LAT transfers occur regardless of the fiscal health of a prefectural government. Second, a positive fiscal externality arises from prefectures with better fiscal health to those with worse fiscal health. Third, we observe that CPB is caused not by bailouts but by the cost reduction effect of the fiscal externality. Fourth, it appears that prefectural governments may inherently discipline themselves irrespective of the bailout by controlling the effects of structural changes.

The remainder of the chapter is composed of the following parts. In the next section, we review the LAT transfer system and discuss the possibility that the SBC phenomenon may arise in the system. Then, in Sect. 6.3, we construct a theoretical model to interpret the estimation results. After establishing the empirical strategy in Sect. 6.4, we consider the SBC problem in the case of LAT transfers by interpreting the estimation results in Sect. 6.5. Finally, Sect. 6.6 provides concluding remarks.

6.2 Institutional Description

6.2.1 Local Allocation Tax Transfer Calculation

In Japan, there are 47 prefectures and 1718 municipalities. This analysis considers the relation between the 47 prefectures and the central government. Figure 6.1 shows the composition of total prefecture revenues; the LAT transfer is the second-largest revenue source and accounts for 17.0% of total revenue. Its share varies across prefectures from 0 to 39.0%.

LAT transfers are used to adjust imbalances in revenue resources between local governments and to ensure their financial capacity to provide standard public services

[5]Using a similar framework, the SBC problem is identified in German states (Baskaran 2012) and Italian and French regions (Josselin et al. 2013; Padovano 2014).

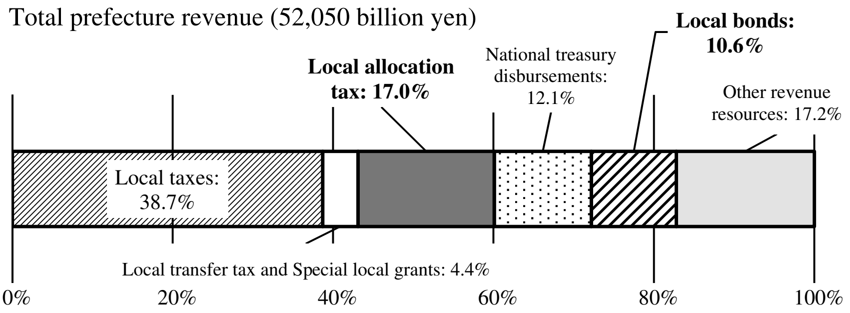

Fig. 6.1 Composition of revenues (FY2015 settlement). *Source* The Ministry of Internal Affairs and Communications (MIC) (2017)

and basic infrastructure to residents across the country.[6] Because LAT transfers are preferentially distributed to prefectures that are unable to acquire the necessary tax revenue, these transfers are important revenue sources for prefectures that do not have adequate financial capabilities.

Specifically, the transfer distributed to prefecture i is calculated as follows:

$$LAT_i = SFD_i - SFR_i,$$

where SFD_i denotes the standard fiscal demand (SFD) determined based on the rational and appropriate service standards for each prefectural government[7] and SFR_i denotes the standard fiscal revenues, which are defined as the sum of 75% of local tax revenues and some intergovernmental transfers. The LAT transfer is positive for a prefecture whose SFR_i is less than its SFD_i and is zero for a prefecture whose SFR_i exceeds its SFD_i.

Each element of SFD_i is derived by multiplying the unit cost, the measurement unit, and the correction coefficients. The unit cost is estimated as the average cost of public service, which is assumed to be provided in the standard model of a prefecture.[8] Thus, the unit cost is commonly applied to calculate the SFD_i for all prefectures. The measurement units are defined by real statistics, such as the population, the length of rivers in each prefecture, and so on. The correction coefficients are used to take into account demographic and geographic characteristics of the prefecture that may cause additional service costs. Therefore, the same coefficients are applied to similar prefectures in terms of these characteristics. In addition, a certain percentage of expenses for debt service are included as elements of SFD_i.

Akai et al. (2003) and Miyazaki (2007) investigated the formula for the SFD_i in detail and pointed out that the unit cost and some correction coefficients are

[6]This information comes directly from MIC (2017).

[7]This information comes directly from MIC (2017).

[8]It is assumed to be a virtual jurisdiction of 1.7 million people who form 690 thousand households in an area of 6.5 thousand km^2 with roads up to 3.9 thousand km long.

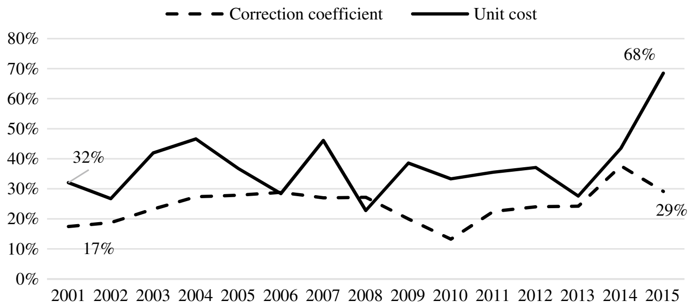

Fig. 6.2 Acceptance rate of requests regarding the standard fiscal demand formula. *Source* Website of MIC

estimated based on the past administration cost, and, thus, may be affected by the previous expenditure behavior of sub-national governments.

Furthermore, in recent decades, 40.3% of 90 requests regarding unit costs and 24.7% of 126 requests regarding correction coefficients from prefectures and municipalities for the revision of the calculation formula of the SFD_i have been accepted, as shown by Fig. 6.2. Thus, the DC problem may be inherent in the LAT transfer system.

From a macro perspective, although it is institutionalized that the LAT transfer is financed by a fixed percentage of national tax revenues,[9] this amount does not correspond to and has been less than the total amount required across all sub-national governments. These shortages have been compensated by special increases in the LAT source and additional issues of local bonds as an exception. According to the FY2015 settlement, a 7.8 trillion yen shortage of the source was compensated by a 2.4 trillion yen increase in the LAT source and 5.4 trillion yen increase in the issue of local bonds. Although the ratios of increases in the LAT source have varied across periods,[10] this evidence suggests that sub-national governments might be able to expect a bailout with a certain probability.

6.2.2 Local Bonds and the Discretion of Prefectural Governments

Returning to Fig. 6.1, we know the fourth largest source of revenue is the issue of local bonds. Although the component ratio is 10.6% on average, it ranges among prefectures from 2.2 to 18.5% depending on their financial conditions. Recently, the

[9]These fixed percentages are 33.1% of personal income tax and corporate tax revenues, 50% of liquor tax revenues, 22.3% of consumption tax revenues, and tall local corporate tax.

[10]For instance, 51.8% of the shortage in FY2010 was compensated by a special increase in the LAT source.

outstanding debts of sub-national governments have become a serious problem, as have those of the central government. During the past two decades, the total outstanding debt across all sub-national governments has rapidly increased from 92.9 trillion yen in FY1995 to 199 trillion yen in FY2015. At the same time, expenses for debt service have increased from 8.8% of total expenditures in FY1995 to 13.1% in FY2015. In the case of prefectures, the percentage in FY2015 (14.2%) was become double that of FY1995 (7.4%). This evidence indicates that sub-national governments' budgets have become more rigid, and their fiscal health has declined.

Local bonds are closely connected with the LAT transfer system. First, as mentioned above, additional issues of local bonds are required to compensate for shortages in the LAT source; these bonds are called "bonds for the extraordinary financial measures (BEFM)".[11] These bonds were issued starting FY2001, but other kinds of bonds were used in the past. Second, part of the expenses for debt service for almost of all kinds of bonds are included in the SFD. In particular, the debt service expenses of BEFMs are perfectly included as one element of the SFD. Therefore, local bonds issues can be considered as automatically supported by LAT transfers. Furthermore, the number of SFD elements related to expenses for debt service has increased from eight items in FY1985 to 16 items in FY2015. That is, it is possible to consider a discretionary increase in the financial support from LAT transfers.

However, sub-national governments are legally restricted from issuing local bonds at their own discretion, and, thus, they cannot freely borrow money to finance their deficits. First, Article 5 of Local Finance Law only permits the issue of local bonds to finance public investment expenses. Second, sub-national governments were unable to issue local bonds without the permission of the central government until 2006. Third, governments whose real debt service ratios exceed 18% are still restricted from issuing bonds even though the permission scheme has been changed to a consultation scheme.[12]

Figure 6.3 shows trends in the bond dependence rate, which is the ratio of local bond revenue to total prefecture revenue. We find a structural change in 1993, after which the mean bond dependence rate consistently exceeds 12% because local bonds have been used as the revenue sources for countercyclical measures since the collapse of the Heisei bubble economy. Although the effect of the introduction of BEFMs on the mean of the dependence rate is not immediately clear, the standard deviation seems to have increased starting in 2001. Although the introduction of the consultation scheme for the issue of local bonds may not have had a clear effect on the mean and standard deviation of the dependence rate, the standard deviation seems to have increased gradually. From this evidence, sub-national governments may be considered to have a certain amount of discretion to issue local bonds and, thus, can engage in CPB.

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[11]These bonds are issued as an exception to Article 5 of Local Finance Law to address shortages in the general revenue resources of sub-national governments. The proceeds from these bonds can be used for expenses other than investment expenses (MIC 2017).

[12]The real debt service ratio is an index of the size of the redemption amount of debt and similar expenditures and represents the cash flow level (MIC 2017). The average value for a prefecture in FY2015 was 12.7%, whereas it was 9.9% on average for all sub-national governments.

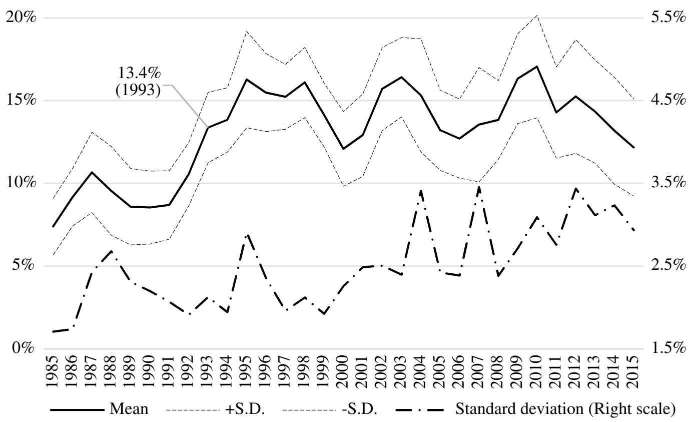

Fig. 6.3 Bond dependence rate (prefectures). *Source* Annual Report for Local Public Finance (MIC, each year)

6.3 Theoretical Background

6.3.1 Basic Setup

We briefly consider the theoretical background of the SBC under a fiscal equalization scheme, by extending the simple two-period Stackelberg game between the central and regional governments that is proposed by Goodspeed (2002).

Whereas Goodspeed (2002) assumes that a central government with a political motivation controls interregional transfers to garner votes, we apply the assumption of a *fiscal egalitarian* central government that seeks to reduce inter-prefectural disparities in fiscal health. This assumption might be more appropriate for the behavior of the central government in Japan than the assumption of a political motivation is. Typically, the term "egalitarian" is used to describe a social welfare function that aims to equalize individual incomes or utilities in welfare economics.[13] To distinguish our use of the term, we refer to a *fiscal egalitarian* central government in this discussion.

Our model includes n prefectures, denoted by the subscript $i (= 1, \ldots, n)$, each of which have a prefectural government and one standardized resident in two periods.[14] Each prefectural government belongs to the good group (G) or the bad group (B) depending on its fiscal health. For simplicity, we assume homogeneous levels of fiscal health within each group. Moreover, we assume that prefectural governments do not move between groups even if their fiscal health changes. The classification

[13]This definition is described by Atkinson and Stiglitz (1980) in their Chap. 11.

[14]For simplicity, we assume a homogeneous population size among prefectures and that the heterogeneity of fiscal health is mainly caused by income differences.

is used as a reference for the intergovernmental fiscal transfer implemented by the central government.

The utility function of a representative resident in prefecture i is composed of his consumption of a private good ($c_{i,1}$, $c_{i,2}$) and a local public good ($q_{i,1}$, $q_{i,2}$) over two periods based on his income ($y_{i,1}$, $y_{i,2}$), which we take as given.

A prefectural government levies a local tax on its resident's income at a controllable rate $t_{i,1}$ and borrows money to provide the local public good ($q_{i,1}$) in period 1. Then, it provides the local public good ($q_{i,2}$) and pays debt services using local tax revenue ($t_{i,2}y_{i,2}$) in period 2. The central government provides an intergovernmental fiscal transfer ($g_{i,1}$, $g_{i,2}$) financed by the central tax revenue in both periods.

The structure of Stackelberg game between a prefectural government and the central government is described as the follows. In both periods, we use a Nash game to reflect the relations among prefectural governments.

1. The central government sets the amount of the transfer ($g_{i,1}$) to the prefectural government prior to period 1.
2. The prefectural government sets the local tax rate ($t_{i,1}$) and the amount to borrow ($b_{i,1}$) to produce the local public good in period 1, taking $g_{i,1}$ as given.
3. The central government sets the central tax rate (t_2^C) and the transfer amount ($g_{i,2}$) in period 2, taking $b_{i,1}$ and $t_{i,1}$ as given. Then, the prefectural government sets the local tax rate ($t_{i,2}$).

Therefore, the prefectural government, as the Stackelberg leader, determines the financing of the local public good in period 1, anticipating the behavior of the central government, as the follower, in period 2.

6.3.2 The Optimization Problem of the Central Government

To evaluate this game, we first consider the optimization problem of the central government, which is motivated by fiscal egalitarianism. The objective function of the central government is composed of each prefecture's utility, with weights based on fiscal health (G or B), and the amount of borrowing of each prefectural government, as follows:

$$\max_{g_{i,2}} \sum_i w_i(\mathbf{b})\left[v_i\left(q_{i,2}\right) + z_i\left(c_{i,2}\right)\right]$$
$$s.t. \quad t_2^C \sum_i y_{i,2} = \sum_i g_{i,2}$$
$$q_{i,2} = g_{i,2} + t_{i,2}y_{i,2} - b_{i,1}(1+r)$$
$$c_{i,2} = y_{i,2}\left(1 - t_{i,2} - t_2^C\right),$$

where $v_i(\cdot)$ and $z_i(\cdot)$ are the sub-utilities of local public and private good consumption, respectively. They are strictly concave, such that $v_{qq} < 0 < v_q$, $z_{cc} < 0 < z_c$. $\mathbf{b} = \left(b_{1,1}, \ldots, b_{n,1}\right)$ is a vector of the amount of the borrowing by each prefectural government. The egalitarian weight, $w_i(\mathbf{b})$, which is a function of this vector, will be explained later. The central government maximizes this objective function subject to the budget constraints of governments and households.

Using the balanced budget condition of the central government, we obtain the following first-order condition:

$$w_i v_i' - \frac{1}{Y}\sum_{i=1}^{n} w_i z_i' y_{i,2} = 0,\ \ for\ all\ i, \tag{6.1}$$

where $Y = \sum_{i=1}^{n} y_{i,2}$ and $\partial t_2^C/\partial g_{i,2} = 1/Y$. From Eq. 6.1, assuming an interior optimum, the optimization condition of the central government's fiscal transfer can be derived as follows:

$$w_1(\mathbf{b})v_1' = w_2(\mathbf{b})v_2' =, \ldots, = w_n(\mathbf{b})v_n'. \tag{6.2}$$

In other words, the central government sets the amount of the transfer to each prefectural government to equalize the weighted marginal utilities among prefectures. The egalitarian weight depends on the amount of borrowing.

6.3.3 Fiscal Egalitarianism and Dynamic Commitment

We characterize the egalitarian weight as a function of borrowing in the first period.[15] Importantly, one prefecture's weight can be affected by another prefectural government's fiscal health because the objective of the intergovernmental transfer is to reduce fiscal health disparities. We explain this characteristic by choosing four prefectural governments. Two of them (prefectures 1 and 2) are in the bad group, and other two (prefectures 3 and 4) are in the good group.

6.3.3.1 Weight of a Prefecture in the Bad Group

The weight of a prefecture in the bad group always increases when its own fiscal health becomes much worse: $\partial w_h/\partial b_{h,1} > 0,\ h = 1, 2$. Furthermore, because fiscal demand is measured by a common formula for calculating the transfer, such as the SFD formula mentioned in Sect. 6.2, the egalitarian weights of the group members simultaneously increase in the transfer system: $\partial w_h/\partial b_{k,1} > 0, h,\ k = 1, 2,\ h \neq k$. In addition, we assume within-group homogeneity: $\partial w_h/\partial b_{h,1} = \partial w_h/\partial b_{k,1}$.

[15] Although Cowell (2000) noted that various features of egalitarian-based social welfare function are considered, we do not strictly specify the features of the objective function of the central government to keep the empirical analysis tractable. However, we can consider the egalitarian weight as the coefficient on the first derivative of the objective function with respect to the amount of borrowing. Thus, we refer to assumptions on the second and cross derivatives in the following explanation.

Furthermore, a decrease in the local public good in the prefecture in the good fiscal health group, $q_{l,2} (l = 3, 4)$, caused by an increase in borrowing by that prefectural government ($b_{l,1}$) causes the transfer to that prefecture ($g_{l,2}$) to increase. However, such a bailout expands the disparity of fiscal health, which is undesirable for the egalitarian central government. Thus, the central government increases the weight of a prefecture in the bad group as borrowing by a good-fiscal-health prefectural government increases: $\partial w_h/\partial b_{l,1} > 0$.

6.3.3.2 Weight of a Prefecture in the Good Group

The weight of a prefecture in the good group does not increase if its own fiscal health becomes worse: $\partial w_l/\partial b_{l,1} = 0$. Furthermore, the weight does not change if the fiscal health of a prefectural government in the same group becomes worse: $\partial w_l/\partial b_{m,1} = 0, l, m = 3, 4, l \neq m$. However, the weight does decrease when borrowing by a prefectural government in the bad group increases: $\partial w_l/\partial b_{h,1} < 0$ because the egalitarian central government intends to reduce fiscal health disparities.

6.3.3.3 Transfer to a Prefecture in the Bad Group

Next, we consider the relationship between changes in transfers and borrowing. The transfer in period 2 is represented by the following function from the first-order condition (Eq. 6.1).

$$g^*_{i,2} = g_{i,2}(\mathbf{b})\text{for all } i. \tag{6.3}$$

From the comparative statics, the influences of the prefectural government's decisions as a Stackelberg leader on the central government's reaction in period 2 are described as follows:[16]

$$\frac{\partial w_h}{\partial b_{h,1}} v'_h - w_h v''_h (1+r) - \frac{1}{Y}\frac{\partial X}{\partial b_{h,1}} \gtreqless 0 \Rightarrow \frac{\partial g_{h,2}}{\partial b_{h,1}} \gtreqless 0, \tag{6.4a}$$

$$\frac{\partial g_{h,2}}{\partial b_{k,1}} > 0,\ and \tag{6.4b}$$

$$\frac{\partial g_{h,2}}{\partial b_{l,1}} > 0, \tag{6.4c}$$

where $\frac{\partial X}{\partial b_{h,1}}\left(= \frac{\partial X}{\partial b_{k,1}}\right) = \frac{\partial w_1}{\partial b_{h,1}} z'_1 y_1 + \frac{\partial w_2}{\partial b_{h,1}} z'_2 y_2 + \frac{\partial w_3}{\partial b_{h,1}} z'_3 y_3 + \frac{\partial w_4}{\partial b_{h,1}} z'_4 y_4$, which represents a change in the weight of the marginal social disutility on taxation to finance a bailout for a prefectural government in the bad group that borrows more.

[16] See the appendix for the derivation.

Because the signs of the first and second terms on the left-hand side of the left sub-equation in Eq. 6.4a are positive, $\partial g_{h,2}/\partial b_{h,1} > 0$ if $\partial X/\partial b_{h,1} < 0$. In other words, the central government rescues a prefectural government in the bad fiscal health group if the central government's strong fiscal egalitarianism underrates the marginal disutility of the prefecture with good fiscal health.

The DC problem in the context of this model means that a change in the egalitarian weight accelerates the bailout. Suppose that the weight is not influenced by an increase in the borrowing, even though $w_h > w_l$. The left sub-equation in Eq. 6.4a can be rewritten as $-w_h v_h''(1+r) > 0$, and, thus, $\partial g_{h,2}/\partial b_{h,1} > 0$. Thus, the central government intends to compensate for the decrease in the local public good in a bad-fiscal-health prefecture using the transfer. That is, the bailout is inherently assumed in our model, in contrast to the literature on the SBC. The bailout is further increased as the egalitarian weight changes as borrowing changes, especially for the bad-fiscal-health prefecture.[17]

Furthermore, we recognize from Eq. 6.4b that $\partial g_{h,2}/\partial b_{k,1} > 0$. We call the increase in the transfer a positive fiscal externality through the equal treatment of prefectures in the same fiscal health group. However, we know from Eq. 6.4c that the transfer to a prefecture with bad fiscal health increases when a good-fiscal-health prefectural government borrows more: $\partial g_{h,2}/\partial b_{l,1} > 0$. That is, a positive fiscal externality always occurs through the transfer system regardless of the strength of fiscal egalitarianism.

6.3.3.4 Transfer to a Prefecture in the Good Group

$$w_l v_l''(1+r) + \frac{1}{Y}\frac{\partial X}{\partial b_{l,1}} \gtreqless 0 \Rightarrow \frac{\partial g_{l,2}}{\partial b_{l,1}} \lesseqgtr 0, \tag{6.5a}$$

$$\frac{\partial g_{l,2}}{\partial b_{m,1}} < 0, \; and \tag{6.5b}$$

$$\frac{\partial g_{l,2}}{\partial b_{h,1}} < 0, \tag{6.5c}$$

where $\frac{\partial X}{\partial b_{l,1}}\left(= \frac{\partial X}{\partial b_{m,1}}\right) = \frac{\partial w_1}{\partial b_{l,1}} z_1' y_1 + \frac{\partial w_2}{\partial b_{l,1}} z_2' y_2 > 0$ represents an increase in the weight of the marginal disutility of bad-fiscal-health prefectures on taxation to finance a bailout for a good-fiscal-health prefectural government that borrows more.

The first term on the left-hand side of the left sub-equation in Eq. 6.5a represents a marginal reduction in the sub-utility in the second period caused by a decrease in the local public good owing to an increase in the payment for borrowing. Therefore, if the central government is not too concerned about the reduction in the utility of good-fiscal-health prefectures relative to the marginal disutility of bad-fiscal-health

[17] Relaxing our assumption on the number of prefectures, we find another possibility that brings about $\partial X/\partial b_{h,1} < 0$. If the number of good-fiscal-health prefectures is larger than that of bad-fiscal-health prefectures, $\partial X/\partial b_{h,1}$ tends to be negative. Either way, a bailout for a bad-fiscal-health prefecture may occur under a strong egalitarian central government.

prefectures on taxation, it does not rescue a good-fiscal-health prefectural government even if it borrows more.

From Eq. 6.5b, transfers to good-fiscal-health prefectures decrease owing to the budget constraint of the transfer system when other prefectural governments in a same group increase their own borrowing. That is, a negative fiscal externality is caused by the monetary trade-offs among good-fiscal-health prefectures. However, we recognize from Eq. 6.5c the other type of the negative fiscal externality, which is caused by the egalitarian transfer system.

6.3.4 Optimization Problem of a Prefectural Government

Considering the reaction of the central government, the optimization problem of a prefectural government is described as follows:

$$\max_{b_{i,1},t_{i,1},t_{i,2}} u_i\left(q_{i,1}\right) + v_i\left(q_{i,2}\right) + x_i\left(c_{i,1}\right) + z_i\left(c_{i,2}\right)$$

s.t.

$$\begin{aligned} q_{i,1} &= g_{i,1} + t_{i,1}y_{i,1} + b_{i,1}, \\ c_{i,1} &= y_{i,1}\left(1 - t_{i,1}\right), \\ q_{i,2} &= g^*_{i,2} + t_{i,2}y_{i,2} - b_{i,1}(1+r), \\ c_{i,2} &= y_{i,2}\left(1 - t_{i,2} - t_2^C\right), \\ t_2^C \sum_i y_{i,2} &= \sum_i g^*_{i,2}, \text{ and} \\ g^*_{i,2} &= g_i(\mathbf{b}), \ \ for\ all\ i. \end{aligned} \tag{6.6}$$

$u_i(\cdot)$ and $x_i(\cdot)$ are the sub-utilities for local public and private good consumption in the first period. They are also strictly concave such that: $u_{qq} < 0 < u_q, x_{cc} < 0 < x_c$.

We follow Goodspeed (2002) and assume that the prefectural governments actually decide $t_{i,2}$ in period 1 because the decision-making of the central government and prefectural governments in period 2 is a Nash game.

The first-order conditions are summarized as follows:

$$t_{i,1} : u'_{i,1} - x'_{i,1} = 0, \tag{6.7a}$$

$$b_{i,1} : u'_{i,1} - (1+r)v'_{i,2} + v'_{i,2}\frac{\partial g_{i,2}}{\partial b_{i,1}} - \frac{z'_{i,2}y_{i,2}}{Y}\sum_i \frac{\partial g_{i,2}}{\partial b_{i,1}} = 0, \text{ and} \tag{6.7b}$$

$$t_{i,2} : v'_{i,2} - z'_{i,2} = 0. \tag{6.7c}$$

Equation 6.7b is derived from the following equilibrium budget equation:

$$Y\sum_i \frac{dt_2^C}{dg^*_{i,2}} = \sum_i \frac{\partial g_{i,2}}{\partial b_{i,1}} = \frac{\partial g_{i,2}}{\partial b_{i,1}} + \sum_{j\neq i} \frac{\partial g_{j,2}}{\partial b_{i,1}} \tag{6.8}$$

That is, we recognize that the increase in the central government's tax rate covers the changes in transfers not only to i but also to the other prefectural governments, according to the right-hand side of Eq. 6.8.

Using Eqs. 6.7c and 6.7b can be rewritten as the following optimization condition:

$$\frac{u'_{i,1}}{v'_{i,2}} = (1+r) - \left(1 - \frac{y_{i,2}}{Y}\right)\frac{\partial g_{i,2}}{\partial b_{i,1}} + \frac{y_{i,2}}{Y}\sum_{j \neq i}\frac{\partial g_{j,2}}{\partial b_{i,1}}. \tag{6.9}$$

6.3.5 Common Pool Behavior

The first term of Eq. 6.9, $(1+r)$, is the opportunity cost of the borrowing at the first-best rate. Because $y_{i,2}/Y < 1$ by definition, the sign of the second term on the right-hand side of Eq. 6.9 depends on the sign of $\partial g_{i,2}/\partial b_{i,1}$. The meaning of the third term on the right-hand side of Eq. 6.9 is complicated because the sign of $\partial g_{j,2}/\partial b_{i,1}$ for each j can be considered either positive or negative, as mentioned above. Furthermore, because the third term consists of increases and decreases in transfers to the prefectural governments other than i, the sign of the third term consequently depends on its composition. Therefore, we consider CPB by the four prefectures mentioned above. Recall that two of them (prefectures 1 and 2) are in the bad group, whereas the others (prefectures 3 and 4) are in the good group. We rewrite Eq. 6.9 as follows:

$$\frac{u'_{i,1}}{v'_{i,2}} = (1+r) - \left(1 - \frac{y_{i,2}}{Y}\right)\frac{\partial g_{i,2}}{\partial b_{i,1}} + \frac{y_{i,2}}{Y}\left(\sum_{h}\frac{\partial g_{h,2}}{\partial b_{i,1}} + \sum_{l}\frac{\partial g_{l,2}}{\partial b_{i,1}}\right),$$

where $h = 1, 2$ and $l = 3, 4$.

6.3.5.1 Common Pool Behavior by a Prefecture in the Bad Group

Suppose prefecture i is in the bad fiscal health group. As described above, the sign of $\partial g_{i,2}/\partial b_{i,1}$ may be positive under an egalitarian central government. Therefore, we recognize that the second term, with a negative sign, represents the inefficiency bias causing over-borrowing. This behavior is a typical CPB because the marginal cost is smaller than the marginal benefit of a transfer.

Then, we show that the sign of $\partial g_{h,2}/\partial b_{i,1}$ may be positive because of a positive fiscal externality caused by the equal treatment of prefectures in the same group, whereas the sign of $\partial g_{l,2}/\partial b_{i,1}$ is negative owing to fiscal egalitarianism. That is, the sign of the third term is ambiguous.

Therefore, at first, we suppose that the sign of the third term is negative. In that case, the third term implies a decrease in the burden of i's borrowing on i's residents and, in addition to the second term on the right-hand side of Eq. 6.9, stimulates the CPB of the prefectural government. This result is obtained if where the proportion of prefectures that receive a negative fiscal externality is relatively high, that is, if most prefectures belong to the good fiscal health group, whereas i is part of the minority belonging to the bad fiscal health group.

Second, we suppose that the sign of the third term is positive. In that case, the third term implies an additional burden of i's borrowing on i's residents and reduces the amount of i's borrowing to an inefficiently low level. This case arises if the majority of prefectural governments belongs to the bad group and receives a positive fiscal externality from an increase in i's borrowing.

6.3.5.2 Common Pool Behavior by a Prefecture in the Good Group

In contrast, suppose prefecture i is in the good fiscal health group. As described above, $\partial g_{i,2}/\partial b_{i,1}$ may be zero if the central government is not to concerned about the utility reduction in the prefecture. Thus, the decision-making of a good-fiscal-health prefectural government regarding its borrowing does not depend on the degree of the discount on the burden of i's borrowing on i's residents.

However, the sign of $\partial g_{h,2}/\partial b_{i,1}$ may be positive because of a positive fiscal externality through the egalitarian transfer system, whereas the sign of $\partial g_{l,2}/\partial b_{i,1}$ is negative owing to the budget constraint of the transfer system. That is, the sign of the third term is also ambiguous. Thus, this scenario is the same as that described above, but it is more straightforward because the second term is zero. That is, over-borrowing will occur if the sign of the third term is negative, and vice versa.

Summarizing the above discussion, we propose empirical propositions. To verify the typical common pool behavior represented by the second term on the right-hand side of Eq. 6.9, we check the sign of the relation between the prefectural government's borrowing and the expectation regarding the central government's reaction in the empirical analysis in the next section. We deduce from the possibility of over-borrowing bias that we will observe a positive sign. However, if we observe a negative sign for the relation between the prefectural government's borrowing and the expectation regarding transfers to other prefectural governments in the following empirical analysis, we consider that CPB is restrained by the prefectural government's awareness of the additional burden of borrowing as a Stackelberg leader.

6.4 Strategy for Empirical Analysis

6.4.1 Estimation Model

To empirically investigate the DC problem and CPB, we set up the following empirical model:

$$g_{i,t} = \alpha + \beta_1 b_{i,t-1} + \beta_2 b_{j,t-1} + \varepsilon_{i,t}, \text{ and} \tag{6.10}$$

$$b_{i,t} = \gamma + \delta_1 G^*_{i,t} + \delta_2 G^*_{j,t} + \mu_{i,t}, \tag{6.11}$$

where α, β_1, β_2, γ, δ_1, and δ_2 are the estimated parameters and $\varepsilon_{i,t}$ and $\mu_{i,t}$ are the error terms.

To interpret the estimation results, we suppose four situations for the relationship between prefectures i and j with respect to fiscal health. In situation I, prefecture i belongs to the bad group, whereas prefecture j belongs to the good group: $i \in B,\ j \in G$. Situation II is the opposite case ($i \in G,\ j \in B$). In situation III, both prefectures are bad-fiscal-health prefectures ($i, j \in B$), and in situation IV, both belong to the good group ($i, j \in G$).

Equation 6.10 represents the reaction function of the central government and corresponds to Eq. 6.3 in the theoretical model. The transfer to i in period t is influenced by i's and j's borrowing in period $t-1$ if bailouts and the fiscal externality of the egalitarian transfer occur, which corresponds to Eq. 6.4a–c in the theoretical model. $b_{j,t-1}$ is the weighted average of borrowing by prefectural governments other than i, and we explain the construction of this variable in the next subsection. A significantly positive β_1 indicates a bailout, and insignificance indicates commitment. According to our theoretical model, the sign is predicted to be positive for the estimations of Situations I and III but insignificant for Situations II and IV. A significantly positive (negative) β_2 indicates a positive (negative) fiscal externality. According to the theoretical prediction, the sign of β_2 may be positive for Situations I and III but may be negative for Situations II and IV.

Equation 6.11 is derived from Eq. 6.9 and illustrates the relation between the prefectural government's borrowing and the expectation of the transfers to i and j in next period, $G^*_{i,t}$ and $G^*_{j,t}$. Equation 6.11 does not represent the reaction function of the prefectural government to the transfer. Instead, this equation represents the decision-making of the prefectural government regarding local bonds considering the reaction of the central government. Therefore, we should consider that $G^*_{i,t}$ and $G^*_{j,t}$ denote properties of the reaction function and that the resulting δ_1 and δ_2 must be interpreted relative to the resulting β_1 and β_2.

Because various pairs are considered, we classify representative interpretations in Table 6.1. According to the theoretical model in the previous section, a positive sign of δ_1 accompanied by $\beta_1 > 0$ indicates the inefficiency bias of a bailout, which leads to over-borrowing, a typical CPB. We suppose that such a result will be obtained from the estimation models of Situations I and III. In contrast, if the signs of δ_1 and β_1 are insignificant, we can conclude that commitment by the central government restrains the CPB of the prefectural governments. This result is predicted to be obtained from the models of Situations II and IV.

The interpretation of the results for δ_2 is somewhat complicated. Suppose that $\beta_2 > 0$ is observed. This result indicates a positive fiscal externality from j to i, that is, the availability of Situations I and III. If Situation I is suitable for the result, a negative fiscal externality from i to j can be considered. That is, the prefectural government expects that $G^*_{j,t}$ is decreasing in $b_{i,t-1}$ and reduces the marginal cost of borrowing, and, thus, a larger $G^*_{j,t}$ has a stronger cost-reduction effect. Consequently,

Table 6.1 Theoretical interpretation of the relationship between parameters

		β_1		β_2	
		+ (Bailout)	Insignificant (Commitment)	+ (Positive FE)	− (Negative FE)
δ_1	+	Stimulating CPB (I, III)		Unrelated	
	Insignificant		Restraining CPB (II, IV)		
δ_2	+	Unrelated		Stimulating CPB (I)	Stimulating CPB (IV)
	−			Restraining CPB (III)	Restraining CPB (II)

Note CPB denotes common pool behavior. FE denotes fiscal externality. The situation that corresponds to the theoretical model is in parentheses

the prefectural government chooses to over-borrow. We assume that $\delta_2 > 0$ represents the above scenario. CPB is stimulated by the expected cost-reduction effect of the transfer system.

In contrast, if Situation III is appropriate, a positive fiscal externality from i to j can to be considered. In this situation, the prefectural government expects that $G^*_{j,t}$ is increasing in $b_{i,t-1}$ and increases the marginal cost of borrowing. As a result, $\delta_2 < 0$ is observed in this situation. Thus, CPB is restrained by the expected increasing effect of the transfer.

However, if $\beta_2 < 0$ is obtained from the estimation result on Eq. 6.10, a negative fiscal externality from j to i, and, thus, a positive fiscal externality from i to j will be supposed based on Situation II of our theoretical model. Such a positive fiscal externality might increase the marginal cost of borrowing. The prefectural government expects that a larger amount of $G^*_{j,t}$ has a stronger cost-increasing effect and intends to reduce the amount of borrowing. In this scenario, $\delta_2 < 0$ is observed. That is, CPB is restrained by the expected increasing effect of the transfer.

Although Situation IV is an alternative theoretical interpretation for $\beta_2 < 0$, we observe a mutually negative fiscal externality between i and j. Thus, it is expected that $G^*_{j,t}$ is decreasing in $b_{i,t-1}$ and reduces the marginal cost of borrowing. As in Situation IV, we will observe $\delta_2 > 0$, which means CPB is stimulated by the expected cost reduction effect of the transfer system.

6.4.2 Estimation Strategy

6.4.2.1 Estimation Procedure

Following Miyazaki (2007), we consider that the LAT transfer to the prefectural government is influenced by the past LAT because the calculation of the standard fiscal demand depends on the previous formula. Therefore, we transform Eq. 6.10 into the following dynamic panel model with a two-way error component.

$$g_{i,t} = \alpha + \rho g_{i,t-1} + \beta_1 b_{i,t-1} + \beta_2 b_{j,t-1} + \phi_i + \tau_t + \epsilon_{i,t}. \tag{6.12}$$

Then, we assume rational expectations for the transfers $G^*_{i,t}$ and $G^*_{j,t}$ in Eq. 6.11. The prefectural government expects the transfers based on the available information in period $t-1$.

$$G^*_{i,t} = E\left(g_{i,t}|I_{t-1}\right) \text{ and } G^*_{j,t} = E\left(g_{j,t}|I_{t-1}\right).$$

In addition, the relation between the actual and the expected value is represented as

$$g_{i,t} = G^*_{i,t} + \varepsilon_{i,t},\ g_{j,t} = G^*_{j,t} + \varepsilon_{j,t}, \text{ and}$$

$$E\left(\varepsilon_{i,t}\right) = E\left(\varepsilon_{j,t}\right) = 0.$$

Substituting these expressions into Eq. 6.11, the borrowing equation of regional government i is represented as

$$b_{i,t} = \gamma + \delta_1 g_{i,t} + \delta_2 g_{j,t} - \delta_1 \varepsilon_{i,t} - \delta_2 \varepsilon_{j,t} + \mu_{i,t}.$$

Furthermore, we assume a two-way error component, such that

$$b_{i,t} = \gamma + \delta_1 g_{i,t} + \delta_2 g_{j,t} + \zeta Z_{i,t} + \phi_i + \tau_t + \psi_{i,t}. \tag{6.13}$$

Because $\psi_{i,t}$ involves $\varepsilon_{i,t}$ and $\varepsilon_{j,t}$, $g_{i,t}$ and $g_{j,t}$ are correlated with $\psi_{i,t}$, and we cannot implement OLS with these variables. Thus, we employ the fitted value of $g_{i,t}$ derived from the estimation of Eq. 6.12.

We use the following procedure to estimate β_1, β_2, δ_1, and δ_2.

1. First, we carry out a panel OLS regression of $b_{i,t}$ on regional characteristics ($Z_{i,t}$) and obtain the fitted value $\hat{b}_{i,t}$ to avoid the endogeneity of $b_{i,t-1}$ in Eq. 6.12. That is, we assume that the central government anticipates a certain amount of local bond issuance based on the regional characteristics of the prefecture.
2. Second, we produce $\hat{b}_{j,t}$ by calculating a weighted average of $\hat{b}_{i,t}$ using the group weight matrix, which will be explained later.

3. Third, we perform a Blundell-Bond-type system generalized method of moments (GMM) estimation on Eq. 6.12 using lagged variables of $\hat{b}_{i,t}$ and $\hat{b}_{j,t}$.
4. Fourth, we produce $\hat{g}_{j,t}$ by multiplying $\hat{g}_{i,t}$, which is the fitted value from the third stage of estimation, by the weight matrix.
5. Finally, using $\hat{g}_{i,t}$ and $\hat{g}_{j,t}$, we carry out panel OLS regression on Eq. 6.13.

6.4.2.2 Group Weight Matrix

In empirical analysis, a reference prefectural government, that is, prefectural government j in the previous theoretical model must be assumed. Following Pettersson-Lidbom (2010) and Baskaran (2012), we construct group weight matrices that assume Situations I–III in our theoretical model using the index of financial capability (IFC), which is defined as the ratio of standard fiscal revenue to SFD.[18] The IFC is used as an indicator for the fiscal health of a sub-national government in Japan.

At first, we classify the 47 prefectures into six groups according to their average IFC for 1985–2015, following the "Table of the fiscal index on prefectural government" by the Ministry of Internal Affairs and Communications (MIC).[19] Table 6.2 summarizes the six groups.

Briefly, the members of Group 5 are located in metropolitan areas and have large populations and abundant tax sources. For instance, Kanagawa and Saitama border Tokyo. The members of Group 4 are located in suburbs of metropolitan areas or the centers of rural area. The members of Group 3-1 have poor tax sources with sparser populations and fewer firms, because they are in the more inconvenient countryside. The prefectures in the lower level groups receive more LAT transfers per capita.

Table 6.2 Fiscal health groups by IFC

Group	IFC range	Group members
6	More than 1	Tokyo
5	0.7–1.0	Aichi, Kanagawa, Osaka, Saitama, Shizuoka
4	0.5–0.7	Chiba, Fukuoka, Gifu, Gunma, Hiroshima, Hyogo, Ibaragi, Kyoto, Mie, Miyagi, Shiga, Tochigi
3	0.4–0.5	Fukushima, Ishikawa, Kagawa, Nagano, Niigata, Okayama, Toyama, Yamaguchi
2	0.3–0.4	Ehime, Fukui, Hokkaido, Kumamoto, Nara, Oita, Saga, Wakayama, Yamagata, Yamanashi
1	Less than 0.3	Akita, Aomori, Iwate, Kagoshima, Kochi, Miyazaki, Nagasaki, Okinawa, Shimane, Tokushima, Tottori

[18] See Sect. 6.2 for the definitions of SFD and standard fiscal revenue.

[19] Although Tokyo has not received an LAT since the LAT system was established, the behavior of Tokyo may be influenced by fiscal externalities created by the LAT system. Therefore, we include Tokyo in the sample.

Then, using the classification, we construct the following threes type of weight matrix. The first type is the higher group weight, defined as

$$\omega_j^H = \frac{1}{n_j^H},\ j \in \text{higher group than } i\text{'}s, \tag{6.13}$$

where n_j^H is the number of prefectures belonging to groups with higher IFCs than that of i's group. This weight represents Situation I, in which $i \in B,\ j \in G$ in the theoretical model in the previous section, and implies that prefecture i is aware of prefectures in higher IFC groups. The higher group weight matrix $\boldsymbol{\Omega}^H$ includes the weight ω_j^H as its element. By definition, the sum of its row elements equals one. Using the matrix, j's borrowing is defined as the weighted average of the borrowing of the prefectural governments in higher groups, that is, $\hat{b}_{j,t-1}^H = \boldsymbol{\Omega}^H \hat{b}_{i,t-1}$.

The second type is the lower group weight, defined as

$$\omega_j^L = \frac{1}{n_j^L},\ j \in \text{lower group than } i\text{'}s, \tag{6.14}$$

where n_j^L is the number of prefectures belonging to groups with lower IFCs than that of i's group. This weight represents Situation II, in which $i \in G,\ j \in B$ in the theoretical model, and means that prefectural government i is conscious of prefectural governments in lower IFC groups. The lower group weight matrix $\boldsymbol{\Omega}^L$ includes the weight ω_j^L as its element. Using this matrix, j's borrowing is defined as the weighted average of the borrowing by the prefectural governments in lower groups, that is, $\hat{b}_{j,t-1}^L = \boldsymbol{\Omega}^L \hat{b}_{i,t-1}$.

We call the third type the same group weight and define it as

$$\omega_j^S = \frac{1}{n_j^S},\ j \in \text{same group than } i\text{'}s, \tag{6.15}$$

where n_j^S is the number of prefectures belonging to i's group. This weight represents Situations III and IV, in which $i, j \in I$ in the theoretical model, and means that prefectural government i is conscious of the prefectural governments in the same group.[20] The same group weight matrix $\boldsymbol{\Omega}^S$ includes the weight ω_j^S as its element. Using this matrix, of j's borrowing is defined as the weighted average of the borrowing by the prefectural governments in lower groups, that is, $\hat{b}_{j,t-1}^S = \boldsymbol{\Omega}^S \hat{b}_{i,t-1}$.

Using above-described group weight matrices, we also produce $\hat{g}_{j,t}$ for the panel OLS given by Eq. 6.13 by the same procedure: $\hat{g}_{j,t}^H = \boldsymbol{\Omega}^H \hat{g}_{i,t}$, $\hat{g}_{j,t}^L = \boldsymbol{\Omega}^L \hat{g}_{i,t}$ and $\hat{g}_{j,t}^S = \boldsymbol{\Omega}^S \hat{g}_{i,}$.

[20]Because we cannot distinguish Situation IV from III by the group weight, we distinguish between these situations from the estimation result.

Table 6.3 Descriptive statistics

Name of variable	Obs.	Mean	Std. Dev.	Max	Min
$BOND_{i,t}$	1457	59.288	27.533	208.654	5.692
$LAT_{i,t}$	1457	99.819	58.225	293.466	0.000
$SFR_{i,t}$	1457	79.237	20.657	213.648	34.868
$POP_{i,t}$	1457	2.661	2.454	12.880	0.580
$AREA_{i,t}$	1457	7.827	11.578	83.520	1.861
$OLD_{i,t}$	1457	0.189	0.053	0.324	0.073
$YOUNG_{i,t}$	1457	0.160	0.028	0.272	0.106
$SECOND_{i,t}$	1457	0.290	0.061	0.440	0.138
$THIRD_{i,t}$	1457	0.613	0.062	0.774	0.450
$UNEMP_{i,t}$	1457	0.046	0.016	0.126	0.014
$R\_SELF_{i,t}$	1457	0.431	0.129	0.897	0.211
$R\_GRANT_{i,t}$	1457	0.192	0.057	0.413	0.053

6.4.3 Data Set

Table 6.3 provides descriptive statistics about the variables used in the estimation.[21] We employ a sample of 47 prefectures from 1985–2015. Local bond revenue per capita ($BOND_{i,t}$) represents i's borrowing ($b_{i,1}$), and LAT transfer revenue per capita ($LAT_{i,t}$) represents the intergovernmental transfer ($g_{i,2}$) made by the central government in the theoretical model in Sect. 6.3. These endogenous variables represent decision-making by prefectural governments and the reaction of the central government in Eqs. 6.10 and 6.11. We confirm that $BOND_{i,t}$ and $LAT_{i,t}$ are stationary using the Levin, Lin, and Chu t-test; the Im, Pesaran, and Shin W-stat test; and the augmented Dickey-Fuller-Fisher chi-square test. We employ the standard fiscal revenue per capita ($SFR_{i,t}$) in the estimation of Eq. 6.12 to control for the effect of fluctuations in tax revenue on $LAT_{i,t}$.

Explanatory variables are used to control for three types of regional characteristics in the first regressions to obtain the fitted values of $BOND_{i,t}$. The total population ($POP_{i,t}$), area ($AREA_{i,t}$), ratio of people aged over 65 years to the total population ($OLD_{i,t}$), and the ratio of people aged under 15 years to the total population ($YOUNG_{i,t}$) represent demand for prefectural public services. The ratio of labor in secondary ($SECOND_{i,t}$) and tertiary ($THIRD_{i,t}$) industries to the total labor force and the unemployment rate ($UNEMP_{i,t}$) are variables capturing the economic features

[21] The definitions of variables are summarized in Table 6.8 in the Appendix.

of a prefecture. The third type of regional characteristics reflect the financial conditions of prefectural governments. The ratio of self-generated funding sources to total revenue ($R\_SELF_{i,t}$) represents the abundance of a prefectures revenue sources, particularly prefectural tax revenue. Another such variable is the ratio of specific grants, called national treasury disbursements,[22] to total revenue ($R\_GRANT_{i,t}$). Because public engineering work expenses are usually financed by special grants in addition to local bonds and other sources of revenue, a higher ratio of special grants is considered to cause less need for local bond revenue. To avoid endogeneity, we employ a moving average over the past three years for $R\_SELF_{i,t}$ and $R\_GRANT_{i,t}$.[23]

6.5 Estimation Results

6.5.1 Main Result

6.5.1.1 Dynamic Commitment and Fiscal Externalities

We first implement OLS on the two-way error component model to obtain the fitted value of $BOND_{i,t}$. The results are summarized in Table 6.9 in the Appendix. Then, using the group weight matrix described in the previous section, we produce three types of variables representing j's borrowing in Situations I–III in the theoretical model: $fBOND^{H}_{j,t-1}$, $fBOND^{L}_{j,t-1}$, and $fBOND^{S}_{j,t-1}$, respectively.

We face some technical problems with dynamic panel data estimation with a relatively smaller number of cross-sections. The literature on the dynamic panel data model suggests a reliability check for a sample with a large cross-section and a short time series, such as N = 100 and T = 5, and shows that a two-step system GMM estimator is the most efficient among representative dynamic panel data model estimators (e.g., Blundell and Bond 1998; Windmeijer 2005). However, according to Soto (2009), two-step GMM is biased and results in a larger standard deviation to standard error ratio than one-step GMM does for a small cross-section sample, such as N = 35 and T = 12, even if homoscedastic standard errors are assumed. Furthermore, a long time series produces a substantial number of Arellano-Bond type instrument variables and hazards moment conditions with both one- and two-step estimators. Because our sample has N = 47 and T = 30, the problem pointed out by Soto (2009) may be more serious in our analysis than in his example.[24] Therefore,

[22]This is a collective term for the national obligatory share, commissioning expenses, incentives for specific policies, or financial assistance disbursed from the central government to sub-national governments (MIC 2017).

[23]Therefore, the range of dates for these two variables is 1982–2015.

[24]In fact, the parameter of the lagged-dependent variable (ρ in Eq. 6.12) largely differs among the estimation models in our trial estimation with two-step GMM. Furthermore, ρ in the estimation of Model II is greater than one, whereas $LAT_{i,t}$ can be confirmed as a stationary variable by unit root tests, as mentioned above.

Table 6.4 Estimation of dynamic commitment and fiscal externality (main estimation)

Dep. $LAT_{i,t}$	Model I $i \in B, j \in G$ $\hat{b}_{j,t-1} = fBOND^H_{j,t-1}$	Model II $i \in G, j \in B$ $\hat{b}_{j,t-1} = fBOND^L_{j,t-1}$	Model III $i, j \in I$ $\hat{b}_{j,t-1} = fBOND^S_{j,t-1}$
$LAT_{i,t-1}(\rho)$	0.723***	0.805***	0.727***
	(0.023)	(0.032)	(0.026)
$fBOND_{i,t-1}(\beta_1)$	0.614***	0.450***	0.722***
	(0.074)	(0.098)	(0.117)
$\hat{b}_{j,t-1}(\beta_2)$	0.262**	0.062	0.012
	(0.103)	(0.110)	(0.122)
$SFR_{i,t}$	−0.571***	−0.398***	−0.522***
	(0.053)	(0.117)	(0.050)
$Const$	38.410***	28.721***	36.817***
	(2.970)	(5.403)	(3.025)
OBS.	1380	1080	1380
No. of cross sections	46	36	46

Note Heteroskedasticity-robust standard errors are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Period fixed effect terms are excluded from the table to avoid complexity

we employ one-step GMM with some additional restrictions on the formation of instrumental variables. First, to complement the weakness of one-step GMM, we add year dummies capturing fixed period effects to the equations in levels.[25] Second, we restrict the maximum lag of Arellano-Bond type instrumental variables for equations in first differences to be five to constrain the number of instrumental variables.

Table 6.4 summarizes the results of the estimation of Eq. 6.12. Models I–III in the table represent Situations I–III, respectively, in the theoretical model. We assume that all explanatory variables except the lagged-dependent variable are given for the central government and are therefore exogenous. Because we drop Tokyo, which does not take $fBOND^H_{j,t-1}$ and $fBOND^S_{j,t-1}$, from Model I and III, and we drop the 11 prefectures of IFC group 1, which do not take $fBOND^L_{j,t-1}$, from Model II, the number of observations differs among the estimation models.

The greatest difference between the estimation model and the theoretical model is that we view the relation between prefecture i and the other prefectures from the perspective of relative fiscal health. Thus, we expect that the sign of β_1 will not vary largely among the estimation models, which is contrary to our theoretical prediction. Therefore, we will take the sign of β_1 into account across the models when we

[25] As is standard, the lagged difference between the dependent variable and a constant are the only instrumental variables for equations in levels. It seems that the residuals, which are used in the variance-covariance matrix in the second step, are biased by heteroskedasticity across periods as the periods are long without fixed effect treatment.

evaluate which situation is appropriate for explaining the SBC phenomenon based on the estimation results.

We now discuss the results for β_1. We observe a positive sign, which indicates a bailout in all of the models. Because, the SFD includes expenses for debt services as one of the elements of fiscal demand, as we described in Sect. 6.2.1, the LAT transfer automatically increases if a prefectural government borrows much more regardless of its fiscal health. However, it may be doubtful that the evidence indicates a DC problem because it seems that the central government initially has no option to discipline prefectures with worsening fiscal health.

We now discuss the results for β_2 in Eq. 6.12. We find a positive fiscal externality from prefecture *j* to prefecture *i* in Model I. However, the sign of β_2 is insignificant in Models II and III. Therefore, we suppose that fiscal egalitarianism, as described in the theoretical model for Situation I ($i \in B,\ j \in G$), may exist behind the LAT system.

6.5.1.2 Common Pool Behavior

Next, we study the borrowing decisions of the prefectural government. Using a fitted value of $LAT_{i,t}$ and the group weight matrix, we produce three types of $\hat{g}_{j,t}$. Because $\hat{g}_{i,t}$ and $\hat{g}_{j,t}$ are not correlated with the error term,[26] we can implement panel OLS for Eq. 6.13. Table 6.5 summarizes the results. Similar to the previous estimation, each of $fLAT^{H}_{j,t}$, $fLAT^{L}_{j,t}$, and $fLAT^{S}_{j,t}$ represents $\hat{g}_{j,t}$ in the estimations of Models I–III.

The results for δ_1 are remarkably contrary to the previous results for the DC problem. We do not observe that a bailout stimulates the CPB of prefectural governments. The reason the governments do not engage in CPB may be that they do not consider an increase in the LAT transfer to be a discretional bailout by the central government, as the LAT transfer automatically increases if the prefectural government borrows much more regardless of its fiscal health. That is, the prefectural governments may not treat the relation with the central government as a strategic game.

Moreover, the result for the effect of the fiscal externality on CPB (δ_2) is significant in Model I only. We obtained a positive sign for β_2, which indicates a positive fiscal externality from *j* to *i,* in a previous estimation result. Thus, we assume a negative fiscal externality from *i* to *j*, as we described in Sect. 6.3. Because the negative fiscal externality reduces the marginal cost of borrowing, the prefectural government expects that the larger amount of transfers to other prefectures has a stronger cost-reducing effect. Consequently, the prefectural government increases its borrowing in advance. We suppose such a scenario underpins positive sign of δ_2 found for Model I, as shown in Table 6.5.

Although we assume a simultaneous change in the central tax burden with a change in the transfer in our theoretical model, an increase in the LAT transfer may cause an increase in central bonds in practice matter in Japan. Therefore, we should

[26] As for the 11 prefectures of IFC group 1, we implement the estimation without $\hat{b}_{j,t-1}$ and derive the fitted value for the estimation of CPB.

Table 6.5 Estimation of common pool behavior

Dep. $BOND_{i,t}$	Model I $i \in B, j \in G$ $\hat{g}_{j,t} = fLAT^{H}_{j,t}$	Model II $i \in G, j \in B$ $\hat{g}_{j,t} = fLAT^{L}_{j,t}$	Model III $i, j \in I$ $\hat{g}_{j,t} = fLAT^{S}_{j,t}$
$fLAT_{i,t}(\delta_1)$	−0.080	0.018	−0.041
	(0.056)	(0.058)	(0.055)
$\hat{g}_{j,t}(\delta_2)$	0.427***	−0.221	0.056
	(0.106)	(0.201)	(0.067)
$POP_{i,t}$	−12.204***	−19.418***	−18.858***
	(2.795)	(2.636)	(3.245)
$AREA_{i,t}$	−0.104	−1.244	−0.014
	(1.021)	(1.087)	(1.090)
$OLD_{i,t}$	2.911***	1.954***	3.333***
	(0.365)	(0.645)	(0.420)
$YOUNG_{i,t}$	1.289	−1.878	−0.054
	(1.129)	(1.304)	(1.349)
$SECOND_{i,t}$	0.017	0.888**	0.411
	(0.429)	(0.376)	(0.389)
$THIRD_{i,t}$	−0.609*	−0.322	−0.275
	(0.324)	(0.365)	(0.324)
$UNEMP_{i,t}$	−6.244***	−6.211***	−7.346***
	(1.138)	(1.454)	(1.240)
$R\_SELF_{i,t}$	−0.355**	−0.706**	−0.507***
	(0.176)	(0.196)	(0.181)
$R\_GRANT_{i,t}$	−0.160	−0.222	−0.384**
	(0.178)	(0.162)	(0.193)
$Const$	87.827***	207.836***	114.603***
	(31.937)	(51.840)	(39.170)
Adj. R^2	0.840	0.820	0.831
	(10.774)	(10.038)	(11.113)
OBS.	1380	1080	1380
No. of cross sections	46	36	46

Note Heteroskedasticity−robust standard errors are in parentheses. $***p < 0.01$, $**p < 0.05$, $*p < 0.1$. Cross-section and period fixed effect terms are excluded from the table to avoid complexity interpret the cost reduction effect as a restraint on the issuance of central bonds, that is, a latent or a subsequent burden on the central taxation.

Summarizing the estimation results for Eqs. 6.12 and 6.13, it is appropriate to explain the SBC problem in the LAT transfer system using Situation I of our theoretical model, in which prefectural governments with relatively worse fiscal health are supported by an egalitarian intergovernmental transfer system. Furthermore, this transfer system provides a fiscal externality from better-fiscal-health prefectures to worse-fiscal-health prefectures.

However, contrary to our theoretical prediction, we find that bailouts do not cause prefectural governments to engage in CPB. We observed CPB drives the cost reduction effect of the fiscal externality through the LAT transfer system. Therefore, our analysis provides a counter-finding to those in the previous literature regarding the SBC problem in the case of LAT transfers.

6.5.2 Estimation Controlling for Structural Changes

To solidify our observation, we attempt to implement the estimation with dummy variables that capture the structural changes mentioned in Sect. 6.2.2. We check whether these structural changes affect the estimation results, employing the following dummy variables. *dCM* takes a value of one starting in 1993 and zero otherwise to capture the first structural change, which is related to countercyclical measures. *dBEFM* indicates the ability to issue BEFMs and takes a value of one starting in 2001 and zero otherwise. Finally, *dSCH* is the dummy variable capturing the scheme change from permission to consultation and takes a value of one starting in 2006 and zero otherwise.

Table 6.6 shows the results of the estimation for the DC problem and fiscal externality. As with the results in Table 6.4, we observe bailouts in every model ($\beta_1 > 0$). The first structural change seems to decrease bailouts from the perspective of Model III. In addition, the structural change around BEFMs might also have a negative effect on bailouts. In contrast, the scheme change of local bonds issues seems to increase bailouts from the perspective of Model I. However, because the results on the cross terms are not stable throughout the models, we can only demonstrate the existence of bailouts by the central government.

However, some of the results for β_2 differ from the main results. At first, in Model I, we also find a positive fiscal externality from prefectures with better fiscal health to those with worse fiscal health and, furthermore, that the externality was reduced by the issue of BEFMs. As we described in Sect. 6.2.1, because BEFM issuances are intended as substitutes for extraordinary borrowing by the LAT special account of the central government to tighten the balance of the special account, such issuances are considered to restrain the positive fiscal externality by hardening the budget of the LAT transfer. However, we recognize in Model II that BEFM issuances cause a negative fiscal externality from prefectures with worse fiscal health to those with better fiscal health. That is, the issue of the BEFM strengthens the role of the

Table 6.6 Estimation for DC and fiscal externality (including structural changes)

Dep. $LAT_{i,t}$	Model I $i \in B$, $j \in G$ $\hat{b}_{j,t-1} = fBOND^H_{j,t-1}$	Model II $i \in G$, $j \in B$ $\hat{b}_{j,t-1} = fBOND^L_{j,t-1}$	Model III $i, j \in I$ $\hat{b}_{j,t-1} = fBOND^S_{j,t-1}$
$fBOND_{i,t-1}(\beta_1)$	0.609***	0.530***	0.945***
	(0.097)	(0.102)	(0.143)
$fBOND_{i,t-1} * dCM$	0.055	0.016	−0.123**
	(0.055)	(0.059)	(0.062)
$fBOND_{i,t-1} * dBEFM$	−0.039	−0.041	−0.094*
	(0.039)	(0.063)	(0.050)
$fBOND_{i,t-1} * dSCH$	0.176**	0.026	0.092
	(0.068)	(0.070)	(0.061)
$\hat{b}_{j,t-1}(\beta_2)$	0.966***	0.182	−0.275*
	(0.283)	(0.440)	(0.146)
$\hat{b}_{j,t-1} * dCM$	−0.197	0.053	0.159*
	(0.183)	(0.171)	(0.831)
$\hat{b}_{j,t-1} * dBEFM$	−0.466***	−0.405**	−0.069
	(0.163)	(0.191)	(0.065)
$\hat{b}_{j,t-1} * dSCH$	−0.040	0.254	0.135
	(0.126)	(0.217)	(0.086)

Note Selected results. Heteroskedasticity-robust standard errors are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

LAT transfer as a redistribution device. We find a negative sign of β_2 in Model III. Although it is difficult to clarify the fiscal externality in Model III because of different directions among groups, the result might show that the negative fiscal externality among the members of the good-fiscal-health group dominates the positive fiscal externality among the members of the bad-fiscal-health group.

Next, we turn to the estimation result on CPB summarized in Table 6.7. Interestingly, we find that prefectural governments essentially restrain their borrowing ($\delta_1 < 0$), corresponding to bailouts by the central government. Although this phenomenon is not predicted by our theoretical model, it might be considered that the prefectural government inherently disciplines itself regardless of bailouts. However, the introduction of BEFMs and, in particular, the implementation of countercyclical measures stimulated borrowing by prefectural governments. Prefectural governments may have been forced to behave as if they were seeking a benefit from a common pool by the measures of the central government. Therefore, the prefectural governments regained discipline because the scheme change gave it more discretion to issue local bonds.

Table 6.7 Estimation of common pool behavior (including structural changes)

Dep. $BOND_{i,t}$	Model I $i \in B, j \in G$ $\hat{g}_{j,t} = fLAT^{H}_{j,t}$	Model II $i \in G, j \in B$ $\hat{g}_{j,t} = fLAT^{L}_{j,t}$	Model III $i, j \in I$ $\hat{g}_{j,t} = fLAT^{S}_{j,t}$
$fLAT_{i,t}(\delta_1)$	−0.279***	−0.300***	−0.299***
	(0.065)	(0.100)	(0.077)
$fLAT_{i,t} * dCM$	0.221**	0.203***	0.207***
	(0.075)	(0.077)	(0.063)
$fLAT_{i,t} * dBEFM$	0.136**	0.009	0.090*
	(0.068)	(0.063)	(0.053)
$fLAT_{i,t} * dSCH$	−0.157***	−0.019	−0.138***
	(0.037)	(0.059)	(0.031)
$\hat{g}_{i,t}(\delta_2)$	0.466***	0.180	0.124
	(0.143)	(0.254)	(0.107)
$\hat{g}_{i,t} * dCM$	−0.240**	−0.179	−0.099*
	(0.112)	(0.132)	(0.054)
$\hat{g}_{i,t} * dBEFM$	−0.146	0.082	−0.034
	(0.104)	(0.135)	(0.044)
$\hat{g}_{i,t} * dSCH$	0.046	−0.174	−0.001
	(0.069)	(0.118)	(0.033)

Note Selected results. Heterosedasticity-robust standard errors are in parentheses. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Furthermore, we find the cost-reducing effect of a negative fiscal externality from prefectures with worse fiscal health to those with better fiscal health, as we found in Table 6.5. However, this effect seems to be weakened by structural changes in the implementation of countercyclical measures. However, because this change brings a large increase in the LAT transfer accompanied by an increase in specific grants, these increases in the transfer might decrease the negative fiscal externality directly rather than having a cost-reducing effect.

Contrary to the previous results, we did not observe the stimulating effect of bailouts through LAT transfers, as the estimation considers structural changes. Furthermore, it appears that prefectural governments inherently discipline themselves regardless of any bailout. This result implies that omitting the structural changes creates a type II error.

6.6 Concluding Remarks

We discussed whether an SBC problem occurs in the intergovernmental transfer system of Japan, that is, the system of LAT transfers from the central government to prefectures and municipalities.

Although previous empirical analyses of the intergovernmental SBC in Japan has mainly used a stochastic frontier-based approach, it is argued that this analysis is misleading for capturing the SBC problem in the case of the LAT transfer owing to an incorrectly assumed distribution of the inefficiency term. However, it is common to confirm a reaction of supporting and supported governments using an approach to the causality of the SBC problem.

Thus, following Goodspeed (2002), we constructed a theoretical model to capture two phases of the SBC problem: the DC problem of the decision-making of the central government facing the failure of a sub-national government and the CPB of a sub-national government that can avoid full payment for the marginal cost of a bailout. Based on this framework, we attempted to ascertain each of the DC problem and CPB to explore the SBC problem in the LAT transfer system.

We obtained the following results from the empirical analysis. First, bailouts through LAT transfers were found regardless of the fiscal health conditions of prefectural governments. Second, we found a positive fiscal externality from prefectures with better fiscal health to those with worse fiscal health. Third, we observed that CPB was caused not by bailouts but by the cost-reduction effect of the fiscal externality. Fourth the estimation controlling structural changes showed that a prefectural government inherently disciplines itself regardless of any bailout.

From the results, we find little evidence for the CPB of prefectural governments, whereas bailout by LAT transfers clearly emerge. Therefore, we cannot find evidence supporting the SBC problem of the LAT transfer. Then, even if we do observe CPB, its source might be the fiscal externalities caused by the egalitarian structure of the LAT transfer system rather than bailouts by the central government. That is, a negative fiscal externality reduces the marginal cost of borrowing, which implies a latent or a subsequent burden on central taxation.

Our analysis could be further improved or extended by choosing alternative estimation methods and dependent variables. For instance, our results may depend on the definition of a prefecture j, that is, the group weight. Although we create the weight as a simple discrete value based on IFC groups, we could instead create continuous weights. We could also choose an alternative index to measure fiscal health. Finally, we may obtain different results if we employ statistics other than local bonds, such as expenses for non-granted public engineering work, for which a prefectural government may have a higher degree of discretion, as the dependent variable. These ideas are topics for our future analysis.

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Appendix

Reaction of the Transfer to a Change in Borrowing

Noting that $\partial t_2^C/\partial g_{i,2} = 1/Y$, the total differential with respect to $g_{i,2}$ and $b_{i,1}$ is derived as follows:

$$\frac{\partial g_{h,2}}{\partial b_{h,1}} = \frac{-1}{Z_h}\left(\frac{\partial w_h}{\partial b_{h,1}} v_h' - w_h v_h''(1+r) - \frac{1}{Y}\frac{\partial X}{\partial b_{h,1}}\right), \tag{6.16}$$

$$\frac{\partial g_{h,2}}{\partial b_{k,1}} = \frac{-1}{Z_h}\left(\frac{\partial w_h}{\partial b_{k,1}} v_h' - \frac{1}{Y}\frac{\partial X}{\partial b_{k,1}}\right), \tag{6.17}$$

$$\frac{\partial g_{h,2}}{\partial b_{l,1}} = \frac{-1}{Z_h}\left(\frac{\partial w_h}{\partial b_{l,1}} v_h' - \frac{1}{Y}\frac{\partial X}{\partial b_{l,1}}\right), \tag{6.18}$$

$$\frac{\partial g_{l,2}}{\partial b_{l,1}} = \frac{1}{Z_l}\left(w_l v_l''(1+r) + \frac{1}{Y}\frac{\partial X}{\partial b_{l,1}}\right), \tag{6.19}$$

$$\frac{\partial g_{l,2}}{\partial b_{m,1}} = \frac{1}{Z_l}\left(\frac{1}{Y}\frac{\partial X}{\partial b_{m,1}}\right), \text{ and} \tag{6.20}$$

$$\frac{\partial g_{l,2}}{\partial b_{h,1}} = \frac{-1}{Z_l}\left(\frac{\partial w_l}{\partial b_{h,1}} v_l' - \frac{1}{Y}\frac{\partial X}{\partial b_{h,1}}\right), \tag{6.21}$$

where $Z_h = w_h v_h'' + \sum_i y_i^2 z_i''/Y < 0$ and $Z_l = w_l v_l'' + \sum_i y_i^2 z_i''/Y < 0$.

Using $\partial w_h/\partial b_{h,1} = \partial w_h/\partial b_{k,1}$ and the first-order condition, we can show that the sign of the term in parentheses on the right-hand side of Eq. 6.17 is positive, and, thus, we can derive Eq. 6.4b from Eq. 6.17. We can also derive Eq. 6.4c from Eq. 6.18 and Eq. 6.5c from Eq. 6.21 in the same manner as the derivation of Eq. 6.4b.

Appendix Tables for Empirical Results

Table 6.8 Definitions of variables

Variable	Definition	Source
$BOND_{i,t}$	Local bond revenue per capita: 1000 yen	Annual Statistic of Local Public Finance
$LAT_{i,t}$	Local allocation tax transfer per capita: 1000 yen	Annual Statistic of Local Public Finance
$SFR_{i,t}$	Standard fiscal revenue per capita: 1000 yen	Annual Statistic of Local Public Finance
$POP_{i,t}$	Total population: 1000 people	Population Census, Population from the Basic Resident Registration
$AREA_{i,t}$	Area: 1000 km^2	Survey on Area of Prefectures and Municipalities
$OLD_{i,t}$	The ratio of people aged 65 years or over to the total population: %	Population Census
$YOUNG_{i,t}$	The ratio of people aged 14 years or younger to the total population: %	Population Census
$SECOND_{i,t}$	The ratio of labor in secondary industries to the total labor force: %	Population Census
$THIRD_{i,t}$	The ratio of labor in tertiary industries to the total labor force: %	Population Census
$UNEMP_{i,t}$	Unemployment rate: %	Population Census
$R\_SELF_{i,t}$	The ratio of self-generated funding sources to total revenue: %	Annual Statistic of Local Public Finance
$R\_GRANT_{i,t}$	The ratio of specific grant revenue to total revenue: %	Annual Statistic of Local Public Finance

Table 6.9 Results of the first estimation of $BOND_{i,t}$

Variable	Coefficient	Std. error
$POP_{i,t}$	−16.901***	2.795
$AREA_{i,t}$	−0.050	1.061
$OLD_{i,t}$	3.196***	0.445
$YOUNG_{i,t}$	0.392	1.313
$SECOND_{i,t}$	0.565	0.388
$THIRD_{i,t}$	−0.039	0.322
$UNEMP_{i,t}$	−7.146***	1.178
$R\_SELF_{i,t}$	−0.475***	0.177
$R\_GRANT_{i,t}$	−0.404*	0.217
$Const.$	85.057**	41.601
$Adj.R^2$	0.848	11.060

Note Heteroskedasticity-robust standard errors are employed. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$. Cross-section and period fixed effect terms are excluded from the table to avoid complexity

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Chapter 7
The Optimal Regional Tax Structure in a Monetary Economy

Akihiko Kaneko and Daisuke Matsuzaki

Abstract In this chapter, we consider a situation in which regional governments use consumption and capital taxes to finance required government expenditures and a central government enacts a helicopter monetary policy independently. Under this policy, the central government equally distributes newly printed money to the regional economies. We consider two scenarios, one in which the government expenditures of the regional economies are totally wasted and one in which they are reimbursed. In both scenarios, as the monetary expansion rate increases, the optimal regional tax mix shifts toward capital taxation. We also show that the optimal level of the consumption tax is higher in the case of reimbursement for a given monetary expansion rate.

Keywords Endogenous fertility · Endogenous growth · Financing methods · Money-in-the-utility-function model

7.1 Introduction

The optimal mix of regional and central government taxes has been discussed in the context of fiscal federalism. The most active research topic in this field is the externalities between regional and central governments (Dahlby 1996; Gordon 1983; Wildasin 1989). As the regional and central governments have a tax base in common, a change in one government's tax policy affects the tax policy of the other. In other words, a vertical externality arises between the central and regional governments. Under the assumption that the tax base can move among regional economies, a horizontal externality also arises among the regional economies. Many researchers investigate the possibility of excess taxation by the regional government. However, these studies only examine the relationship between the tax policies of the central

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and regional governments. Thus, in this chapter, we instead discuss the relationship between the central government's monetary policy and the regional governments' tax policies.

Another strand of the literature examines the relationship between monetary and fiscal policy by taking the zero interest rate condition into account. Over the last two decades, many developed countries have exercised drastic monetary policies to tackle economic downturns, especially after the global financial crisis. In Japan, the official interest rate has been almost zero since 1999. After 2008, the Federal Reserve Bank, the Bank of England, and the European Central Bank also started the so-called quantitative easing process by purchasing assets from private financial institutions regardless of the interest rate. This action increases the broad money supply directly as well as indirectly through the bank lending induced by an increase in excess reserves. At the zero interest rate, the conventional monetary policy has no further role. Thus, researchers are reexamining the role of fiscal policy under the zero interest rate condition using the New Keynesian model. This literature emphasizes the beneficial effects of fiscal policy. For example, Eggertsson (2009), Christiano et al. (2011), and Woodford (2011) show that government spending multipliers can be very large at the zero bound and that increasing government spending can be welfare improving. Correira et al. (2013) find that tax policy can deliver a stimulus at no cost and in a time-consistent manner. These studies focus on the interaction between monetary and fiscal policy. However, no studies have considered the relationship between monetary policy and regional tax policy.

To understand the relationship between a central government monetary policy and a regional government tax policy, we consider the following situation. The economy consists of one central government and N symmetric regional governments. The regional governments need to finance a given level of expenditure. In the following sections, we consider two cases, one in which expenditures are neither distributed to households nor contribute to the level of utility and or production (i.e., wasteful expenditure) and one in which expenditures are reimbursed to the households in a lump-sum manner. We assume that the regional economies have the right to set consumption and capital taxes. The central government issues nominal money and distributes seigniorage to the regional jurisdictions. The households derive utility from consumption, money holdings, and the number of children.

A change in monetary policy may affect the regional tax policy for two reasons. First, a change in monetary policy affects the level of seigniorage received by the regional governments. Thus, the regional governments have an incentive to change their tax rates to satisfy their budget constraints. Second, monetary policy affects the consumption, money holdings, and fertility rates of the households, changing the effect of the regional tax. In particular, as Kaneko and Matsuzaki (in press) reveal, under endogenous fertility, the effectiveness of a consumption tax varies according to monetary policy. Thus, in the case of endogenous fertility, the extent to which the regional governments change their tax policies depends on the monetary policy.

We can summarize the results of this analysis as follows. First, we analytically show that in the case of wasteful expenditure, the optimal regional tax mix favors capital taxation more as the monetary expansion rate grows. We also demonstrate that the optimal consumption tax rate is higher in the case of reimbursement than it is in the case of wasteful expenditure for a given monetary expansion. We perform a numerical simulation based on Japanese data, and we obtain three results. First, we confirm that a monetary expansion shifts the optimal regional tax mix toward capital taxation in the case of reimbursement. Second, although the optimal consumption tax rate is the same even if the fertility decision is exogenous in the case of wasteful expenditure, we confirm that the optimal consumption tax rate is higher for endogenous fertility than for exogenous fertility in the case of reimbursement. Third, we show that the welfare level is higher in the case of reimbursement than it is in the case of wasteful expenditure for a given monetary expansion rate.

The remainder of this chapter is organized as follows. Section 7.2 describes the model in the case of wasteful expenditure. Section 7.3 derives the optimal mix of regional taxes. In Sect. 7.4, we develop a model with reimbursement. Section 7.5 demonstrates the numerical simulation, and Sect. 7.6 concludes.

7.2 Model

We consider an economy that consists of firms, representative regional households that live in each region, one central government, and N symmetric regional jurisdictions. As mentioned above, the regional governments must finance a given level of expenditure. In each jurisdiction, perfectly competitive firms produce the final goods.

7.2.1 Firms

Firms produce final goods that can be used for consumption, investment, and raising children. Production of the good is carried out by a regional household that uses AK technology, following Rebelo (1991).

$$y_t^i = Ak_t^i,$$

where y_t^i is the per capita real output in region i at time t, A is the technology level, and k_t^i is the per capita real capital stock in region i at time t. Throughout this chapter, the superscript i and the subscript t index the jurisdiction and time.

7.2.2 Households

In each regional jurisdiction, households determine their consumption, savings, and number of children. A household can accumulate two types of assets, money and capital. The household receives utility from consumption, money holdings, and the number of children, denoted by c_t^i, m_t^i, and n_t^i, respectively. The regional household's lifetime utility is written as

$$U^i = \int_0^\infty \left[\ln c_t^i + \alpha \ln m_t^i + \beta \ln n_t^i \right] e^{-\rho t} dt, \tag{7.1}$$

where ρ is the subjective discount rate, α is preference for money holding, and β is the preference for the number of children.

The household maximizes its own utility subject to the following budget constraint:

$$\dot{m}_t^i + \dot{k}_t^i = (1 - \tau_k^i) A k_t^i - \pi_t m_t^i - (m_t^i + k_t^i) n_t^i - (1 + \tau_c^i) c_t^i - (1 + \tau_c^i) q n_t^i, \tag{7.2}$$

where π_t is the inflation rate, τ_c^i is the consumption tax rate, τ_k^i the capital tax rate, and q is the childrearing cost.[1] As we consider a growing economy, we assume that the childrearing cost is increasing as the economy grows. Specifically, we assume that $q = \bar{q} k_t^i$, following Chang et al. (2013). The term on the right-hand side of (7.2), $(m_t^i + k_t^i) n_t^i$, reflects the wealth reduction due to having new children. Households should reallocate their assets to newborn children. Chang et al. (2013) call this reduction in total assets the wealth-narrowing effect of newborn children.

The Hamiltonian function associated with this problem is as follows:

$$\begin{aligned} H = {} & \ln c_t^i + \alpha \ln m_t^i + \beta \ln n_t^i + \lambda_t^i [(1 - \tau_k^i) A k_t^i \\ & - \pi_t m_t^i - (m_t^i + k_t^i) n_t^i - (1 + \tau_c^i) c_t^i - (1 + \tau_c^i) q n_t^i]. \end{aligned}$$

λ_t^i is a co-state variable. Thus, the necessary conditions for optimality are:

$$\frac{\partial H}{\partial c_t^i} = 0; \ \frac{1}{c_t^i} = \lambda_t^i (1 + \tau_c^i), \tag{7.3}$$

$$\frac{\partial H}{\partial n_t^i} = 0; \ \frac{\beta}{n_t^i} = \lambda_t^i [m_t^i + k_t^i + (1 + \tau_c^i) \bar{q} k_t^i], \tag{7.4}$$

$$\frac{\partial H}{\partial m_t^i} = -\dot{\lambda}_t^i + \lambda_t^i \rho; \ \frac{\alpha}{m_t^i} - \lambda_t^i (\pi_t + n_t^i) = -\dot{\lambda}_t^i + \lambda_t^i \rho, \tag{7.5}$$

$$\frac{\partial H}{\partial k_t^i} = -\dot{\lambda}_t^i + \lambda_t^i \rho; \ \lambda_t^i [(1 - \tau_k^i) A - n_t^i - (1 + \tau_c^i) \bar{q} n_t^i] = -\dot{\lambda}_t^i + \lambda_t^i \rho. \tag{7.6}$$

[1] In some countries, such as Canada, England, and France, a reduced tax rate is applied to education and child-care services, whereas in other countries, such as Japan and the United States, it is not. In our analysis, we do not take this reduced tax rate into account for simplicity.

The transversality conditions are

$$\lim_{t\to\infty} \lambda_t^i m_t^i e^{-\rho t} = 0, \quad \lim_{t\to\infty} \lambda_t^i k_t^i e^{-\rho t} = 0.$$

7.2.3 The Governments

The regional governments need to collect a certain amount of tax revenue. To finance this revenue, they can levy consumption and capital taxes. They also receive seigniorage from the central government, which supplies nominal money at a constant rate μ. Therefore, the budget constraint of the regional government is

$$\frac{\mu m_t}{N} + \tau_k^i A k_t^i + \tau_c^i c_t^i + \tau_c^i \bar{q} n_t^i k_t^i = \eta A k_t^i, \tag{7.7}$$

where m_t is the total amount of real money. The left-hand side corresponds to revenue of the regional government, and the right-hand side corresponds to its expenditure. We assume that the ratio of government expenditure to output, η, is constant.

Defining the supply of nominal money in period t as M_t^s, $\dot{M}_t^s / M_t^s = \mu$ holds. The money market equilibrium condition can be expressed as

$$M_t^s = p_t m_t. \tag{7.8}$$

Owing to the symmetry of the regional economies, $m_t = N L_t^i m_t^i$ holds, where L_t^i stands for the total population in region i. Rewriting (7.8) using this relationship, we obtain

$$M_t^s = p_t m_t^i L_t^i N,$$

where p_t represents the general price level. The growth rate of the population in the region i is n_t^i, and the growth rate of the money supply in the regional economy can be expressed as

$$\frac{\dot{m}_t^i}{m_t^i} = \mu - \pi_t - n_t^i, \tag{7.9}$$

where n_t^i represents the population growth rate in region i. Note that, owing to the symmetry, the regional population growth n_t^i is equal to the total population growth rate n_t. In the following discussion, we omit the time subscript for convenience.

7.2.4 Equilibrium

From the household's budget constraint (7.2) and the money market equilibrium condition (7.9), we find that

$$\dot{k}^i = (1-\eta)Ak^i - (1+\bar{q})n^i k^i - c^i \tag{7.10}$$

holds.

We denote the consumption-to-capital ratio, c^i/k^i, and the money-to-capital ratio, m^i/k^i, as χ^i and z^i. From (7.3) and (7.4), we obtain

$$n^i = \frac{\beta(1+\tau_c^i)c^i}{m^i + k^i + (1+\tau_c^i)\bar{q}k^i} = \frac{\beta(1+\tau_c^i)\chi^i}{z^i + 1 + (1+\tau_c^i)\bar{q}}. \tag{7.11}$$

Equation (7.11) indicates that there are two opposing effects of an increase in a consumption tax on the population growth rate. The consumption tax rate in the numerator reflects the substitution effect, which makes consumption less attractive than having a child. The consumption tax rate in the denominator reflects the cost effect of the consumption tax. As an increase in the consumption tax increases the cost of child bearing, it decreases the fertility rate. A simple calculation shows that the former effect dominates the latter effect.[2]

From (7.3), (7.5), and (7.6), we also obtain

$$\pi = \frac{\alpha(1+\tau_c^i)\chi^i}{z^i} - (1-\tau_k^i)A + (1+\tau_c^i)\bar{q}n^i.$$

Substituting this expression into (7.9), we obtain a dynamic equation of money holdings in region i:

$$\frac{\dot{m}^i}{m^i} = \mu - \frac{\alpha(1+\tau_c^i)\chi^i}{z^i} + (1-\tau_k^i)A - (1+\tau_c^i)\bar{q}n^i - n^i. \tag{7.12}$$

From (7.3) and (7.6), the motion of consumption per capita is

$$\frac{\dot{c}^i}{c^i} = -\frac{\dot{\lambda}}{\lambda} = (1-\tau_k^i)A - n^i - (1+\tau_c^i)\bar{q}n^i - \rho. \tag{7.13}$$

Combining (7.10), (7.12), and (7.13), we obtain

[2]Differentiating n^i with respect to τ_c^i gives

$$\frac{\partial n^i}{\partial \tau_c^i} = \frac{\beta\chi^i[z^i + 1 + (1+\tau_c^i)\bar{q}] - \beta\chi^i(1+\tau_c^i)\bar{q}}{[z^i + 1 + (1+\tau_c^i)\bar{q}]^2} = \frac{\beta\chi^i(z^i+1)}{[z^i + 1 + (1+\tau_c^i)\bar{q}]^2} > 0.$$

$$\frac{\dot{\chi}^i}{\chi^i} = \frac{\dot{c}^i}{c^i} - \frac{\dot{k}^i}{k^i} = (1-\tau_k^i)A - n^i - (1+\tau_c^i)\bar{q}n^i - \rho - [A - (1+\bar{q})n^i - \chi^i - \eta A]$$
$$= -\tau_c\bar{q}n^i + \chi^i - \rho + \eta A - \tau_k^i A, \tag{7.14}$$

$$\frac{\dot{z}^i}{z^i} = \frac{\dot{m}^i}{m^i} - \frac{\dot{k}^i}{k^i} = \mu - \frac{\alpha(1+\tau_c^i)\chi^i}{z^i} + (1-\tau_k^i)A - (1+\tau_c^i)\bar{q}n^i - n^i$$
$$- [A - (1+\bar{q})n^i - \chi^i - \eta A]$$
$$= \mu - \frac{\alpha(1+\tau_c^i)\chi^i}{z^i} + \chi^i - \tau_c^i\bar{q}n^i + \eta A - \tau_k^i A. \tag{7.15}$$

Equations (7.14) and (7.15) constitute the autonomous dynamic system of this economy.

The balanced growth path (BGP) is defined as the situation in which all real variables grow at the same constant rates. From (7.14),

$$\chi^i = \tau_c^i\bar{q}n^i + \rho - \eta A + \tau_k^i A \tag{7.16}$$

holds on the BGP. Rearranging the above equation using (7.7), we obtain

$$\chi^i = \frac{-\mu z^i + \rho}{1+\tau_c^i}. \tag{7.17}$$

We can also establish that

$$\mu - \frac{\alpha(1+\tau_c^i)\chi^i}{z^i} + \chi^i - \tau_c^i\bar{q}n^i + \eta A - \tau_k^i A = 0$$

holds on the BGP from (7.15). Substituting (7.16) into this expression, we obtain

$$\mu - \frac{\alpha(1+\tau_c^i)\chi^i}{z^i} + \rho = 0.$$

Combining this result with (7.17) gives the equilibrium level of z^i:

$$z^{i*} = \frac{\alpha\rho}{(1+\alpha)\mu + \rho}. \tag{7.18}$$

$*$ indicates the optimal level. The equilibrium level of z^i (z^{i*}) is uniquely determined once the central government sets its monetary policy, μ.

Introducing z^{i*} into (7.17) gives

$$\chi^{i*} = \frac{\rho(\mu+\rho)}{[(1+\alpha)\mu+\rho](1+\tau_c^i)}. \tag{7.19}$$

Then, using (7.11), we obtain the equilibrium level of the fertility rate,

$$n^{i*} = \frac{\beta\rho(\mu+\rho)}{\alpha\rho + [1+(1+\tau_c^i)\bar{q}][(1+\alpha)\mu+\rho]}. \tag{7.20}$$

The equilibrium growth rate can be calculated from (7.10) using (7.19) and (7.20) as follows:

$$\begin{aligned} g^{i*} &\equiv (1-\eta)A - (1+\bar{q})n^{i*} - \chi^{i*} \\ &= (1-\eta)A - \frac{\beta\rho(\mu+\rho)(1+\bar{q})}{\alpha\rho + [1+(1+\tau_c^i)\bar{q}][(1+\alpha)\mu+\rho]} - \frac{\rho(\mu+\rho)}{[(1+\alpha)\mu+\rho](1+\tau_c^i)}. \end{aligned} \tag{7.21}$$

7.3 The Optimal Mix of Regional Taxes

The regional governments determine the mix of regional taxes, the levels of the consumption and capital taxes, to maximize the welfare of the regional household.

First, we depict the government's behavior in the case of wasteful expenditure. From (7.18) and (7.19), we know that the consumption and money holding levels change according to the following equations on the BGP.

$$c_t^i = \frac{\rho(\mu+\rho)}{[(1+\alpha)\mu+\rho](1+\tau_c^i)} k_t^i, \quad m_t^i = \frac{\alpha\rho}{(1+\alpha)\mu+\rho} k_t^i. \tag{7.22}$$

Capital itself grows at the equilibrium growth rate,

$$k_t^i = k_0^i e^{g^{i*}t}, \tag{7.23}$$

where k_0^i is the initial level of capital stock and g^{i*} is given in (7.21).

Substituting (7.22) and (7.23) into (7.1) yields a maximized lifetime utility of

$$\begin{aligned} U^{i*} = \int_0^\infty \Bigg\{ &\ln\left(\frac{\rho(\mu+\rho)}{[(1+\alpha)\mu+\rho](1+\tau_c^i)} k_0^i e^{g^{i*}t} \right) \\ &+ \alpha \ln\left[\frac{\alpha\rho}{(1+\alpha)\mu+\rho} k_0^i e^{g^{i*}t} \right] + \beta \ln n^{i*} \Bigg\} e^{-\rho t} dt. \end{aligned}$$

Calculating this utility, we obtain

$$\begin{aligned} U^{i*} = &\frac{(1+\alpha)g^{i*}}{\rho^2} + \frac{1}{\rho}\ln\left\{ \frac{\rho(\mu+\rho)}{[(1+\alpha)\mu+\rho](1+\tau_c^i)} \right\} + \frac{\alpha}{\rho}\ln\left[\frac{\alpha\rho}{(1+\alpha)\mu+\rho} \right] \\ &+ \frac{\beta}{\rho}\ln n^{i*} + \frac{(1+\alpha)\ln k_0^i}{\rho}. \end{aligned} \tag{7.24}$$

Equation (7.24) shows that the lifetime utility consists of five parts: growth, consumption, money holding, fertility, and the initial level of capital. The regional governments maximize (7.24) to achieve the most welfare for regional households. Differentiating (7.24) with respect to τ_c^i gives

$$\frac{dU^{i*}}{d\tau_c^i} = \frac{1}{\rho^2}(1+\alpha)\frac{dg^{i*}}{d\tau_c^i} + \frac{\beta}{\rho n^{i*}}\frac{dn^{i*}}{d\tau_c^i} - \frac{1}{\rho(1+\tau_c^i)}. \tag{7.25}$$

From (7.21),

$$\frac{dg^{i*}}{d\tau_c^i} = -(1+\bar{q})\frac{dn^{i*}}{d\tau_c^i} - \frac{d\chi^{i*}}{d\tau_c^i}.$$

Because $dn^{i*}/d\tau_c^i < 0$, $d\chi^{i*}/d\tau_c^i < 0$, we find that $dg^{i*}/d\tau_c^i > 0$. Inserting the above equation into (7.25), we can rewrite the effect of the consumption tax on lifetime utility as follows:

$$\frac{dU^{i*}}{d\tau_c^i} = -\frac{\bar{q}}{\rho^2}\left[\frac{(\alpha-\tau_c^i)\rho - \tau_c^i(1+\alpha)\mu}{\mu+\rho}\right]\frac{dn^{i*}}{d\tau_c^i} - \frac{1+\alpha}{\rho^2}\frac{d\chi^{i*}}{d\tau_c^i} - \frac{1}{\rho(1+\tau_c^i)}. \tag{7.26}$$

From (7.26), we can obtain the optimal consumption tax. Specifically, by substituting (7.19) and (7.20) into the above equation, we obtain

$$\begin{aligned}&\left\{\alpha\rho - [(1+\alpha)\mu+\rho]\tau_c^i\right\}\Big\{\beta\bar{q}^2[(1+\alpha)\mu+\rho]^2(1+\tau_c^i)^2\\&\quad+\left\{\rho\alpha+[1+(1+\tau_c^i)\bar{q}][(1+\alpha)\mu+\rho]\right\}^2\Big\} = 0.\end{aligned}$$

As the solutions to the equation in the second curly brackets on the left-hand side are imaginary,[3] the optimal level of consumption tax is

$$\tau_c^{i*} = \frac{\alpha\rho}{(1+\alpha)\mu+\rho}. \tag{7.27}$$

Equation (7.27) shows that an increase in μ lowers the optimal consumption tax level. In fact, an increase in μ has two effects on the optimal consumption tax rate. Given the budget constraint, the regional governments can reduce the optimal

[3]Setting the terms in the second curly brackets equal to zero, we obtain the following quadratic equation with respect to $(1+\tau_c^i)$:

$$\begin{aligned}&(1+\beta)\bar{q}^2((1+\alpha)\mu+\rho)^2(1+\tau_c^i)^2 + 2\bar{q}(1+\alpha)(\mu+\rho)((1+\alpha)\mu+\rho)(1+\tau_c^i)\\&\quad+[\alpha\rho+((1+\alpha)\mu+\rho)]^2 = 0.\end{aligned}$$

The discriminant of the above equation is $4\bar{q}^2((1+\alpha)\mu+\rho)^2[(1+\alpha)^2(\mu+\rho)^2 - (1+\beta)(1+\alpha)^2(\mu+\rho)^2]$, which is always negative. Thus, two solutions are imaginary.

consumption tax rate when the central government increases seigniorage through a monetary expansion. However, an increase in money holding costs caused by a monetary expansion reduces money holdings, consumption, and the fertility rate [see (7.18)–(7.20)]. Thus, the consumption tax rate should be increased accordingly to keep the revenue from the consumption tax constant. In our model, the former effect always dominates the latter effect, and an increase in monetary expansion reduces the optimal consumption tax rate.

Note that substituting (7.27) into (7.19) and (7.20) gives

$$\chi^{i*} = \frac{\rho}{1+\alpha}, \quad n^{i*} = \frac{\beta\rho}{(1+\alpha)(1+\bar{q})}.$$

The values of χ^{i*} and n^{i*}, do not depend on μ. A monetary expansion reduces money holdings from (7.18), and it also lowers the optimal consumption tax rate, as we have already seen below (7.27). Because z^i represents money holdings, we can determine from (7.11) that a decrease in money holdings enhances n^i through a reduction of the wealth-narrowing effect. Therefore, in the model without the regional governments' behavior, like that of Chang et al. (2013), a monetary expansion reduces n^i with certainty. However, we find that a decrease in the consumption tax rate lowers the level of n^i, as we discuss below (7.11). The latter effect cancels out the former effect, and, thus, n^{i*} does not depend on μ in our model. Consequently, the growth rate under the optimal consumption tax rate g^{i*} also does not depend on μ [see (7.21)].

Substituting z^{i*}, χ^{i*}, n^{i*}, and τ_c^{i*} into (7.7), the optimal level of capital tax can be derived as follows:

$$\tau_k^{i*} = \eta - \frac{\alpha\rho[(1+\alpha)(1+\bar{q})\mu + (1+\bar{q}+\bar{q}\beta)\rho]}{(1+\alpha)(1+\bar{q})[(1+\alpha)\mu+\rho]A}. \tag{7.28}$$

We obtain the effect of an increase in μ on τ_k^i by differentiating (7.28) with respect to μ, as follows:

$$\frac{\partial \tau_k^{i*}}{\partial \mu} = \frac{\bar{q}\beta\alpha\rho^2}{[(1+\alpha)\mu+\rho]^2(1+\bar{q})A} > 0. \tag{7.29}$$

This result indicates that an increase in μ raises the optimal level of the capital tax. A change in the capital tax revenue per unit of capital caused by a change in the capital tax is always constant because of Ak technology. Because capital tax revenue is more inelastic than consumption tax revenue, the regional governments prioritize to raise the capital tax rate compared to the consumption tax rate increases when the central government increases seigniorage through monetary expansion. We summarize the above argument in the following proposition.

Proposition 1 *Monetary expansion leads to a decrease in the consumption tax and an increase in the capital tax in the case of wasteful government expenditure.*

7.4 Reimbursement Case

Thus far, we have assumed that regional government expenditures are wasteful. Now, we present the model in the case of reimbursement.

The regional government redistributes its revenue to the regional household in a lump-sum manner. The household's budget constraint is

$$\dot{m}^i + \dot{k}^i = (1 - \tau_k^i)Ak^i + \tau_2 - \pi m^i - (m^i + k^i)n^i - (1 + \tau_c^i)c^i - (1 + \tau_c)qn^i,$$

where τ_2 is lump-sum transfer from the regional government. The household with the same utility function as (7.1) maximizes its utility. The budget constraint of the regional government can be modified as follows:

$$\frac{\mu m}{N} + \tau_k^i A k^i + \tau_c^i c^i + \tau_c^i \bar{q} n^i k^i = \tau_2. \tag{7.30}$$

τ_2 represents the amount of reimbursement.

The (monetary) policy of the central government is the same as before. Specifically, nominal money is distributed to each region in a lump-sum manner, as in (7.9).

Using a similar procedure to that used above, the dynamic equation of $\dot{\chi}^i$ and $\dot{z}^i$ become

$$\begin{aligned}
\frac{\dot{\chi}^i}{\chi^i} &= \frac{\dot{c}^i}{c^i} - \frac{\dot{k}^i}{k^i} = (1 - \tau_k^i)A - n^i - (1 + \tau_c^i)\bar{q}^i n^i - \rho - (A - (1 + \bar{q})n^i - \chi^i) \\
&= -\tau_k^i A - \tau_c^i \bar{q} n^i + \chi^i - \rho, && (7.31) \\
\frac{\dot{z}^i}{z^i} &= \frac{\dot{m}^i}{m^i} - \frac{\dot{k}^i}{k^i} = \mu - \frac{\alpha(1 + \tau_c^i)\chi^i}{z^i} + (1 - \tau^i)A \\
&\quad - (1 + \tau_c^i)\bar{q}n^i - n^i - (A - (1 + \bar{q})n^i - \chi^i) \\
&= \mu - \frac{\alpha(1 + \tau_c^i)\chi^i}{z^i} + \chi^i - \tau_k^i A - \tau_c^i \bar{q} n^i. && (7.32)
\end{aligned}$$

The level of transfer τ_2 increases as the economy increases. Specifically, $\tau_2 = \eta A k^i$. From the budget constraint of the regional government (7.30),

$$\mu z^i + \tau_k^i A + \tau_c^i \bar{q} n = \eta A - \tau_c^i \chi^i.$$

However, the balanced growth equilibrium level of χ^i is determined by (7.31), as follows:

$$\chi^i = \rho + \tau_k^i A + \tau_c^i \bar{q} n^i. \tag{7.33}$$

Thus, χ^i can be expressed as

$$\chi^i = \frac{\rho + \eta A - \mu z^i}{1 + \tau_c^i}. \tag{7.34}$$

Similarly, on the BGP, (7.32) indicates that

$$\mu - \frac{\alpha(1 + \tau_c^i)\chi^i}{z^i} + \chi^i - \tau_k^i A - \tau_c^i \bar{q} n^i = 0.$$

Combining this result with (7.33), we obtain

$$\mu - \frac{\alpha(1 + \tau_c^i)\chi^i}{z} + \rho = 0.$$

Applying (7.34) to the above equation gives the equilibrium level of z^i:

$$z^{i**} = \frac{\alpha(\eta A + \rho)}{(1 + \alpha)\mu + \rho}. \tag{7.35}$$

$**$ indicates the optimal level in the case of reimbursement. From Equations (7.34), (7.11), and (7.35), the equilibrium levels of χ^i and n^i are given by

$$\chi^{i**} = \frac{(A\eta + \rho)(\mu + \rho)}{(1 + \tau_c^i)[(1 + \alpha)\mu + \rho]}, \tag{7.36}$$

$$n^{i**} = \frac{\beta(A\eta + \rho)(\mu + \rho)}{\alpha(\eta A + \rho) + [1 + (1 + \tau_c^i)\bar{q}][(1 + \alpha)\mu + \rho]}. \tag{7.37}$$

The BGP growth rate in this case, g^{i**}, is

$$\begin{aligned} g^{i**} &\equiv A - (1 + \bar{q})n^{i**} - \chi^{i**} \\ &= A - \frac{\beta(1 + \bar{q})(A\eta + \rho)(\mu + \rho)}{\alpha(\eta A + \rho) + [1 + (1 + \tau_c^i)\bar{q}][(1 + \alpha)\mu + \rho]} - \frac{(A\eta + \rho)(\mu + \rho)}{(1 + \tau_c^i)[(1 + \alpha)\mu + \rho]}. \end{aligned} \tag{7.38}$$

The lifetime utility of a household can be calculated in the same way as (7.24) is calculated.

$$
\begin{aligned}
U^i = &\int_0^\infty \left\{ \ln\left(\frac{(A\eta+\rho)(\mu+\rho)}{(1+\tau_c^i)[(1+\alpha)\mu+\rho]} k_0^i e^{g^{i**}t} \right) \right. \\
&\left. +\alpha \ln\left[\frac{\alpha(\eta A+\rho)}{(1+\alpha)\mu+\rho} k_0^i e^{g^{i**}t} \right] + \beta \ln n^{i**} \right\} e^{-\rho t} dt \\
= &\int_0^\infty \left[(1+\alpha) g^{i**} t + \ln\left\{ \frac{(A\eta+\rho)(\mu+\rho)}{(1+\tau_c^i)[(1+\alpha)\mu+\rho]} \right\} \right. \\
&\left. +\alpha \ln\left[\frac{\alpha(\rho+\eta A)}{(1+\alpha)\mu+\rho} \right] + \beta \ln n^{i**} + (1+\alpha)\ln k_0 \right] e^{-\rho t} dt.
\end{aligned}
$$

Calculating this value, we obtain

$$
\begin{aligned}
U^{i**} = &\frac{(1+\alpha) g^{i**}}{\rho^2} + \frac{1}{\rho} \ln\left\{ \frac{(A\eta+\rho)(\mu+\rho)}{[(1+\alpha)\mu+\rho](1+\tau_c^i)} \right\} + \frac{\alpha}{\rho} \ln\left[\frac{\alpha(A\eta+\rho)}{(1+\alpha)\mu+\rho} \right] \\
&+ \frac{\beta}{\rho} \ln n^{i**} + \frac{(1+\alpha)\ln k_0^i}{\rho}.
\end{aligned} \tag{7.39}
$$

Like (7.24), (7.39) indicates that the lifetime utility consists of five parts. Differentiating this with respect to τ_c^i, we have

$$
\frac{dU^{i**}}{d\tau_c^i} = \frac{1}{\rho^2}(1+\alpha)\frac{dg^{i**}}{d\tau_c^i} + \frac{\beta}{\rho n^{i**}} \frac{dn^{i**}}{d\tau_c^i} - \frac{1}{\rho}\frac{1}{1+\tau_c^i}. \tag{7.40}
$$

Principally, we can derive the optimal consumption tax rate using the same procedure as that used for (7.27). However, it is impossible to derive an analytical solution in this case, so, instead, we can establish the following proposition:

Proposition 2 *The optimal consumption tax rate is higher in the case of reimbursement than in the case of wasteful expenditure under the same monetary expansion rate.*

Proof Evaluating the derivative of the utility function at the optimal consumption tax rate in the case of totally wasteful government expenditure, $dU^i/d\tau_c^i$ becomes

$$
\left.\frac{dU^{i**}}{d\tau_c^i}\right|_{\tau_c^i=\tau_c^{i*}} = \frac{\eta A}{\rho^2}\left[\frac{\alpha\rho - (1+\alpha)(\mu+\rho)(1+\bar{q})}{(A\eta+\rho)(\mu+\rho)} \right] \left.\frac{dn^{i**}}{d\tau_c^i}\right|_{\tau_c^i=\tau_c^{i*}} + \frac{A\eta[(1+\alpha)\mu+\rho]}{\rho^2(1+\alpha)(\mu+\rho)}.
$$

Because $dn^{i**}/d\tau_c^i < 0$ from (7.37), the sign of the right-hand side of the above equation is always positive. Thus, the optimal consumption tax rate in this case is higher than in previous case. □

The reason for this result is that the government has an incentive to raise the consumption tax more because the tax revenue is reimbursed to households.

It is impossible to analytically compare the optimal capital tax in the case of wasteful expenditure with that in the case of reimbursement. Instead, we show some numerical results below.

7.5 Numerical Simulation

Although we derived an analytical solution in the case of wasteful expenditure, we cannot derive an analytical solution for the optimal regional tax mix in the case of reimbursement, and, thus, we use numerical analysis. We conduct a numerical simulation for both cases to compare the differences in the two economies numerically.

To calculate the optimal regional tax mix from (7.26) and (7.40), we need the value of productivity, A; the preference for money holding, α; the preference for the number of children, β; and the cost of childrearing, $\bar{q}$. It is difficult to obtain these values from the data directly, and, hence, we estimate them using Japanese data from 1995 to 2015. For most of this period, Japan set its consumption tax rate at 5%.[4] According to the World Bank (2017), the average growth rate of GDP is 0.0083, and the population growth rate is 0.0068. The consumption to GDP ratio, c/y, is 0.5696. Data from the Bank of Japan (2017) indicate that $m/y = 0.2138$ and that the growth rate of M2 in Japan was 0.0269 on average from 1995 to 2015. We use the latter value for μ. Taking the average ratio of the total expenditures of Japanese local governments to GDP in 2015, we set η to be 0.2.

7.5.1 *Wasteful Expenditure Case*

Here, we calculate A, α, β, and $\bar{q}$ from the model of wasteful expenditure. Because we use an AK-type production function, (7.22) can be written as the following equations:

$$\frac{\rho(\mu+\rho)}{(1+\tau_c)[(1+\alpha)\mu+\rho]} = A\frac{c}{y},$$
$$\frac{\alpha\rho}{(1+\alpha)\mu+\rho} = A\frac{m}{y}.$$

The subjective discount rate, ρ, is set as 0.04, which is a commonly used parameter value in the literature. We solve the above simultaneous linear equations with the estimated values and find that A and α are 0.0662 and 0.0239, respectively. From (7.21), we know that

$$g = (1-\eta)A - (1+\bar{q})n - \frac{c}{y}A. \tag{7.41}$$

Introducing the values that we have derived thus far into this equation, we obtain a value of 0.0239 for $\bar{q}$. Finally, (7.20) yields a value of 0.1784 for β (we make use of the symmetry of the regions, that is, $n_i = n$). Using the values derived above, we obtain Fig. 7.1, which shows the optimal consumption tax rate according to (7.25). Specifically, the vertical axis indicates $dU/d\tau_c$, and the other axes show the levels

[4]Precisely, of this 5% tax rate, 1% is the regional tax rate.

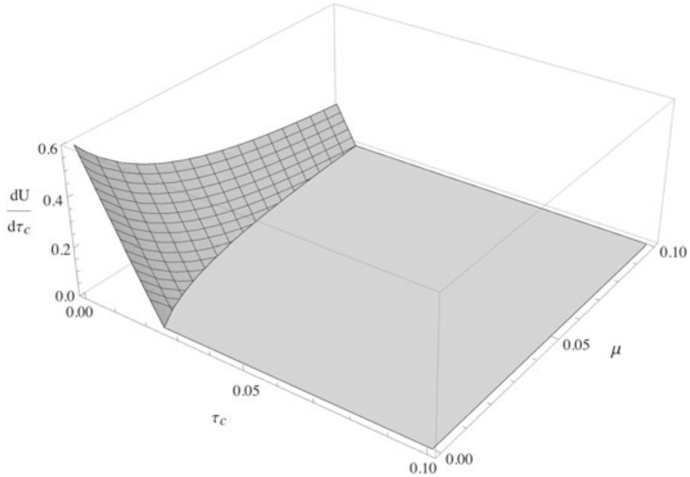

Fig. 7.1 The case of wasteful expenditure

Table 7.1 The optimal consumption tax, the optimal capital tax, the growth rate, and the welfare level in the case of wasteful expenditure

μ	τ_c^{i*}	τ_k^{i*}	z^{i*}	n^{i*}	χ^{i*}	g^{i*}	U^{i*}
0.05	0.010483	0.185870	0.010483	0.006807	0.039066	0.006924	−101.60937
0.01	0.019029	0.185849	0.019029	0.006807	0.039066	0.006924	−101.25314
0	0.023900	0.185837	0.023900	0.006807	0.039066	0.006924	−101.11696
−0.01	0.032123	0.185817	0.032123	0.006807	0.039066	0.006924	−100.94029

of μ and τ_c. Because the bottom of the figure corresponds to $dU/d\tau_c = 0$, the locus of the bottom part shows the optimal consumption tax rate for a given monetary expansion rate.

Once we calculate the optimal consumption tax rate, we can obtain the optimal capital tax rate from (7.7), the growth rate from (7.21), and the welfare level from (7.24). The results corresponding to several different values of the monetary expansion rate are shown in Table 7.1. As we have seen from (7.27) and (7.29), the level of the optimal consumption (capital) tax decreases (increases) as the monetary expansion rate increases.

7.5.2 *Reimbursement Case*

In this subsection, we show the numerical results in the case of reimbursement. As in the last subsection, we can obtain Fig. 7.2, which is similar to Fig. 7.1 from (7.40).

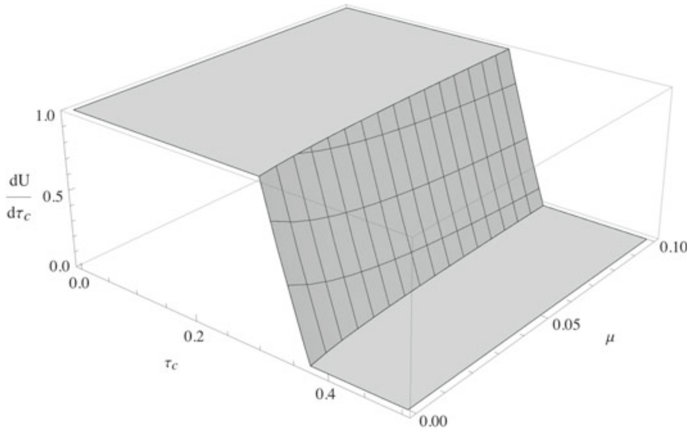

Fig. 7.2 Reimbursement Case

Based on the optimal consumption tax, we can also calculate the optimal capital tax, the growth rate, and the level of welfare attained. The results are shown in Table 7.2.

We also calculate the numerical results by setting β to 0, because unlike in the case of wasteful expenditure, the optimal consumption tax is directly affected by the degree of preference for the number of children β. Table 7.3 shows the results.

Table 7.2 The optimal consumption tax, the optimal capital tax, the growth rate, and the welfare level in the case of reimbursement

μ	τ_c^{i**}	τ_k^{i**}	z^{i**}	n^{i**}	χ^{i**}	g^{i**}	U^{i**}
0.05	0.347293	−0.016253	0.013953	0.008960	0.038999	0.018027	−93.150818
0.01	0.358656	−0.016272	0.025328	0.008936	0.038999	0.018051	−92.790865
0	0.365132	−0.016284	0.031811	0.008923	0.039000	0.018064	−92.652619
−0.01	0.376064	−0.016303	0.042755	0.008901	0.039001	0.018086	−92.472536

Table 7.3 Results in the case of $\beta = 0$ and $n = 0.0068$

μ	τ_c^{i**}	τ_k^{i**}	z^{i**}	χ^{i**}	g^{i**}	U^{i**}
0.05	0.344953	−0.014951	0.013953	0.039066	0.020171	−70.706642
0.01	0.356328	−0.014979	0.025328	0.039066	0.020171	−70.350408
0	0.362811	−0.014995	0.031811	0.039066	0.020171	−70.214230
−0.01	0.373755	−0.015022	0.042755	0.039066	0.020171	−70.037561

7.5.3 *Implications*

The above numerical results provide some implications. We compare the case of wasteful expenditure, which we call case 1, to the case of reimbursement, which we call case 2.

1. Table 7.2 shows that, in case 2, the level of the optimal consumption (capital) tax decreases (increases) as the monetary expansion rate increases. As shown by Proposition 2, the optimal consumption tax in case 2 is higher than that in case 1. Although the result could not be shown analytically, the optimal capital tax is lower in case 2 than in case 1 (in fact, a subsidy on capital accumulation is the optimal policy in case 2).
2. As (7.27) does not depend on β, we know that the optimal consumption tax rate remains the same even if the fertility decision is exogenous in case 1. For case 2, Table 7.3 shows that the optimal consumption tax is higher in the case of endogenous fertility ($\beta > 0$) than in the case of exogenous fertility ($\beta = 0$). We can understand the details of this result by considering the regional governments' problem (see Appendix).
3. We show that the welfare level is higher in case 2 than in case 1 for a given monetary expansion rate. As explained in reference to (7.24) and (7.39), the lifetime utility consists of five parts. The money holding and initial level of capital are the same in both cases. Tables 7.1 and 7.2 show that although the fertility and growth parts are higher in case 2 than in case 1 because of reimbursement, the consumption part is lower in case 2 than in case 1 because of a higher optimal consumption tax rate. This result implies that the former positive effect on the welfare level is stronger than the latter negative effect.

7.6 Conclusion

In this chapter, we consider the case in which the regional government uses consumption and capital taxes to finance required government expenditures and the central government enacts monetary policy independently. We analyze two scenarios, one in which the regional government expenditures are totally wasted and one in which they are reimbursed to households. In both scenarios, as the monetary expansion rate increases, the optimal regional tax mix shifts toward capital taxation. We also show that the optimal level of the consumption tax is higher in the reimbursement case for a given monetary expansion rate.

We conclude by suggesting directions for further research. First, our model can be extended to an analysis in asymmetric jurisdictions. When regional jurisdictions are asymmetric, a monetary expansion affects each region unevenly. Moreover, the regions must interact strategically. We may observe differences in the tax policies of large and small regions. Second, it would be interesting to investigate a similar analysis in the neoclassical model. To simplify the analysis, we employ the endogenous growth model to ensure a constant interest rate. In the neoclassical growth model, the marginal productivity of capital varies according to the level of capital accumulation. We think that this extension complicates the analysis, but it could find a richer relationship between the optimal tax structure and economic growth than the one documented in this chapter. Future research should be directed at addressing these aspects.

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Appendix: A Detailed Explanation of Implication 3

From (7.38), $dg^{i**}/d\tau_c^i$ in case 2 is given as follows:

$$\frac{dg^{i**}}{d\tau_c^i} = -(1+\bar{q})\frac{dn^{i**}}{d\tau_c^i} - \frac{d\chi^{i**}}{d\tau_c^i}. \tag{7.42}$$

Introducing (7.37) and (7.42) into (7.40) gives

$$\frac{dU^{i**}}{d\tau_c^i} = Z_1\frac{dn^{i**}}{d\tau_c^i} - \frac{1}{\rho^2}(1+\alpha)\frac{d\chi^{i**}}{d\tau_c^i} - \frac{1}{\rho(1+\tau_c^i)},$$

where $Z_1 \equiv \frac{1}{\rho^2}\left\{-(1+\bar{q})(1+\alpha) + \rho\frac{\alpha(\eta A+\rho)+[1+(1+\tau_c^i)\bar{q}][(1+\alpha)\mu+\rho]}{(A\eta+\rho)(\mu+\rho)}\right\}$.

Generally, the sign of Z_1 is ambiguous, but in our numerical results based on several levels of μ under the optimal consumption tax rate τ_c^{i**} in Table 7.2, Z_1 always takes a negative value, as shown below.

From (7.37), we obtain that

$$\frac{dn^{i**}}{d\tau_c^i} = -\frac{\beta(A\eta+\rho)(\mu+\rho)\bar{q}[(1+\alpha)\mu+\rho]}{\{\alpha(\eta A+\rho)+[1+(1+\tau_c^i)\bar{q}][(1+\alpha)\mu+\rho]\}^2} < 0. \tag{7.43}$$

From (7.43) and Z_1 in Table 7.4, we can conclude that $Z_1\frac{dn^{i**}}{d\tau_c^i} > 0$.

However, when the fertility rate is exogenous ($\beta = 0$), $\frac{dn^{i**}}{d\tau_c^i} = 0$ and

$$\left.\frac{dU^{i**}}{d\tau_c^i}\right|_{\beta=0} = -\frac{1}{\rho^2}(1+\alpha)\frac{d\chi^{i**}}{d\tau_c^i} - \frac{1}{\rho(1+\tau_c^i)}.$$

Table 7.4 Values of Z_1

μ	Z_1
0.05	−157.465
0.01	−156.145
0	−155.402
−0.01	−154.164

Because χ^{i**} in (7.36) does not depend on β, we conclude that

$$\left.\frac{dU^{i**}}{d\tau_c^i}\right|_{\tau_c^i=\tau_c^{i**}} > \left.\frac{dU^{i**}}{d\tau_c^i}\right|_{\tau_c^i=\tau_c^{i**},\beta=0}.$$

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Chapter 8
Free-Rider Behavior and Amalgamation Patterns

Katsuyoshi Nakazawa

Abstract The analysis described in this chapter confirms that pre-merger municipalities in Japan engage in free-rider behavior. Municipalities have an incentive to issue public debt before amalgamation because they can benefit from local public projects ahead of a merger and can subrogate the debt burden to the newly created post-merger municipality. Previous studies of this behavior applied the difference-in-differences method to samples of pre-merger and never-merged municipalities. These studies considered this method's assumption of parallel local public debt accumulation trends for the pre-merger and never-merged municipalities, but doubt regarding the assumption that the merged municipalities are chosen at random remains, particularly in the voluntary amalgamation case. Thus, in this study, I use Heckman's sample selection estimate to deal with the sample selection problem. Moreover, I choose an additional index for the free-rider incentives of pre-merger municipalities. Finally, I classify pre-merger municipalities as either cities or towns and villages. The results confirm that only pre-merger towns and villages with incentives to free ride engage in free riding.

Keywords Voluntary amalgamation · Free-rider behavior · Sample selection

8.1 Introduction

Municipalities have an incentive to issue public debt before an amalgamation. Municipalities can benefit from local public projects by issuing public debt prior to a merger, but they can subrogate the debt burden to the newly created post-merger municipality. The strength of the incentive to free ride depends on the population size (tax base). Specifically, municipality i's marginal social cost of borrowing is given by $N_i/N_j < 1$, where N_i denotes municipality i's population before the merger and N_j is the population of the post-merger municipality, which includes municipality i. A

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smaller value of N_i/N_j implies that municipality i has a greater incentive to free ride because it can subrogate more of its debt to residents of other municipalities.

Hinnerich (2009) used difference-in-difference (DID) estimation in the context of Swedish municipalities and found that smaller pre-merger municipalities tended to accumulate more public debt than the never-merged ones did. Jordahl and Liang (2010) conducted a similar analysis of Swedish municipalities in different years. Analyses of the free-rider behavior of pre-merger municipalities have been conducted using data from various countries. Blom-Hansen (2010) and Hansen (2014) focused on Danish municipalities, Saarimaa and Tukiainen (2015) focused on Finnish municipalities, and Nakazawa (2016, 2018) and Hirota and Yunoue (2017) focused on Japanese municipalities. All of these studies obtained similar results to those of Hinnerich (2009).

Although many studies employ Hinnerich's (2009) method, several analytical issues remain. The first issue relates to the empirical method. These studies applied the DID method to samples of pre-merger and never-merged municipalities. However, although they considered the DID method's assumption of parallel public debt accumulation trends for pre-merger and never-merged municipalities, doubt that the merged municipalities were truly randomly chosen remains, particularly in case of voluntary amalgamation. When municipality amalgamation is voluntary, as in the case of Japan, the municipalities that choose to amalgamate are likely to have certain characteristics in common. For example, Nakazawa and Miyashita (2013, 2014) found that Japanese municipalities with worse fiscal situations and greater dependencies on inter-governmental subsidies tended to choose amalgamation. To overcome this problem, Hirota and Yunoue (2017) employed propensity score matching, and Nakazawa (2018) divided pre-merger municipalities into two groups, those that had the chance to free ride and those that did not. In this study, I address the sample selection problem by employing Heckman's two-stage sample selection model.

The second issue relates to the free-rider incentive. Hinnerich (2009) formulated the strength of pre-merger municipality i's incentive to free ride as $Freeride_i = 1 - N_i/N_j \in [0, 1]$. Many studies following Hinnerich (2009) used the same formulation. However, is it not clear that this formulation is reasonable. For example, Fig. 8.1 illustrates two different cases in which pre-merger municipality i has a free-rider incentive of 0.25. Although municipality i's free-rider incentive is the same in both cases, the free-rider incentives of the partners are different. In case A, only two municipalities are merged, and the population of municipality i's merger partner is relatively large. In case B, municipality i merges with three municipalities with the same population. Municipality i may not engage in the same free-rider behavior in both cases. Thus, the strength of the incentive to free ride might not depend on the population size of the merged municipality but rather on that of the merging partner.

In this study, I employ an additional index of the free-rider incentive based on the ratio of the population of municipality i to that of the participating municipality with the largest population. I denote this index as PSLP. The PSLP of municipality i is defined as $PSLP_i = 1 - N_i/max\{N_m\}$, where N_m is the set of populations of all municipalities, including municipality i, that participate in an amalgamation. The PSLAs of municipality i in cases A and B are 0.67 and 0, respectively.

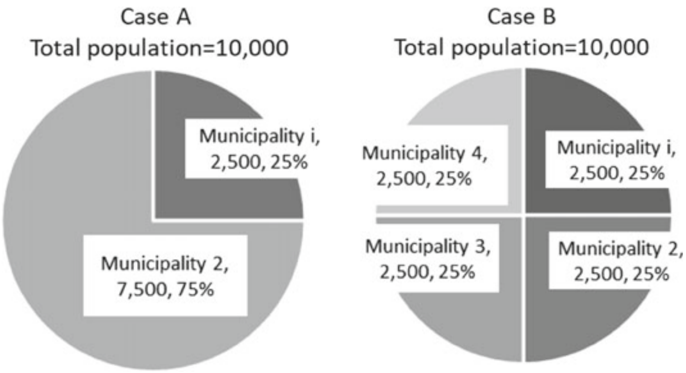

Fig. 8.1 Free-rider incentive in two different cases

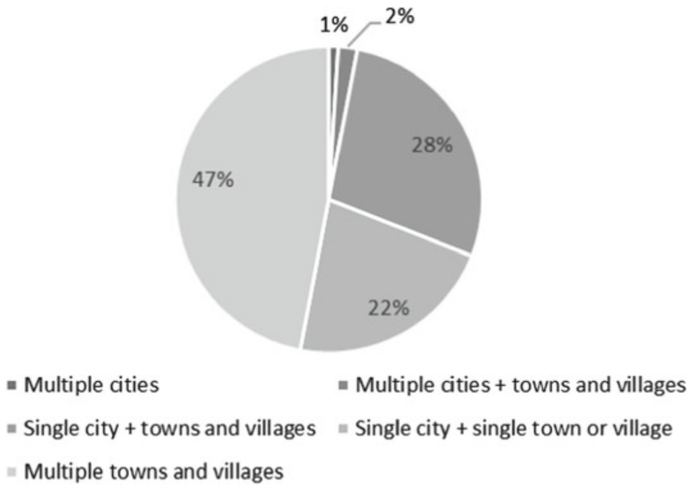

Fig. 8.2 Distribution of amalgamation types. *Source* Ministry of Internal Affairs and Communications (http://www.soumu.go.jp/gapei/gapei.html)

The third issue relates to the local public debt accumulation of municipalities that exhibit free-rider behavior. Amalgamations of multiple cities are only 3% of all amalgamations, as shown in Fig. 8.2. When, instead, a city absorbs a nearby town or village, the city does not seem to have an incentive to free ride prior to the amalgamation because it would still end up bearing the debt burden. Thus, cities may behave differently from towns and villages, and I divide the sample into cities and towns and villages before performing the estimation.

The remainder of the chapter is organized as follows. Section 8.2 explains municipality amalgamations in Japan. In Sect. 8.3, the empirical methodology is presented, and the data are described. Section 8.4 presents the estimation results and discusses the main findings. Section 8.5 concludes.

8.2 Municipality Amalgamations in Japan

In Japan, municipality amalgamations can be roughly grouped into three big waves. The first wave, from 1888 to 1889, reduced the number of municipalities from 71,314 to 15,820. The second wave lasted from 1953 to 1961 and further reduced the number of municipalities from 9868 to 3472. In the most recent wave, from April 1999 to January 2012, the number of municipalities was almost halved from 3229 to 1719. The Japanese national government enacted the Municipal Amalgamation Law (the old law, henceforth) in 1965 to promote municipality amalgamation. This law included several measures to encourage amalgamation, such as guaranteeing the same inter-governmental subsidy (i.e., the local allocation tax grant (LAT))[1] to the merged municipality for ten years after amalgamation. However, although the old law was revised every 10 years until the 1990s, it did not provide incentives for voluntary amalgamation, and the number of municipalities decreased by only 163 from 1965 to 1999.

A remarkable change occurred in the latter half of the 1990s, when the Japanese government reviewed the roles of the national, prefectural, and municipal governments. In 1999, the old law was amended to conform to the provisions of the Comprehensive Decentralization Law, and several additional measures were included to provide financial support for municipality amalgamations. First, the LAT guarantee period was extended to 15 years after an amalgamation. Second, the law allowed merged municipalities to finance 95% of the cost related to the amalgamation by issuing special-purpose amalgamation bonds for ten years after the merger. Moreover, the national government covered 70% of the principal and interest payments on these bonds through the LAT. These incentives induced many municipalities to undergo amalgamation.

Figure 8.3 shows the number of amalgamations in each fiscal year from 1999 to 2011. The number of mergers peaks in fiscal years 2004 and 2005 because the financial support provided by the national government for municipal mergers under the old law was revised under the new law in fiscal year 2006. Thus, many municipalities pursued amalgamation until the end of fiscal year 2005.

As described above, Japanese municipalities with worse fiscal situations and higher dependencies on inter-governmental subsidies tend to choose amalgamation. Therefore, the sample of Japanese municipality amalgamations may face a sample selection problem.

[1] The LAT is an intergovernmental subsidy intended to adjust the uneven distribution of national government resources among local governments.

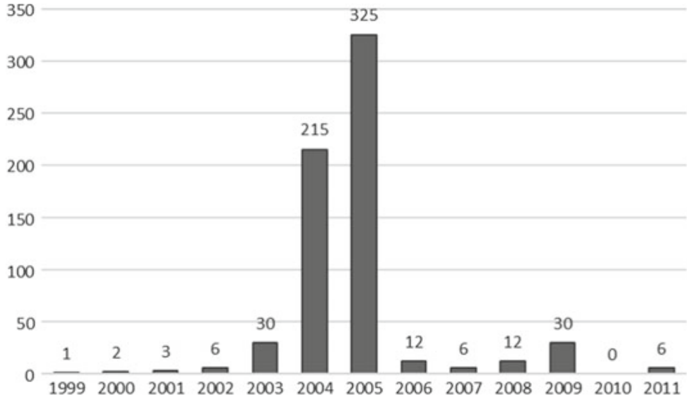

Fig. 8.3 Number of amalgamations by year. *Source* Ministry of Internal Affairs and Communications (http://www.soumu.go.jp/gapei/gapei.html)

8.3 Empirical Framework and Data

This analysis uses Heckman's two-stage sample selection model, which requires two stages of estimation. In the first stage, I perform a probit estimation of the merger decision. Then, I estimate the formula for local public debt per capita in the pre-merger municipality by substituting the parameters obtained in the first stage into the formula. In this study, I employ the ML method for estimation.

In the first stage, I follow Nakazawa and Miyashita (2013, 2014) in employing several explanatory variables that might affect the merger decision. First, the ordinary balance ratio is the ratio of fixed expenditures (e.g., labor costs, the repayment cost of local public debt, etc.) to fiscal resources that the municipality can freely use. A high ordinary balance ratio is considered to indicate financial stringency. Second, the public debt cost ratio is the ratio of annual public debt expenses related to principal redemptions and interest payments to the general budget. Third, the LAT ratio is the ratio of the LAT grant to total revenue. These three variables indicate a municipality's financial situation, and municipalities with worse financial situations are expected to be more likely to pursue amalgamation. Finally, I include five variables related to municipalities' social environments: population, area, aging ratio, the ratio of secondary industry workers to total workers, and the ratio of third industry workers to total workers.

In the second stage, I employ the change in local public debt per capita (ΔDebt) as the objective variable. The key regressors in this stage are the *Freeride* and *PSLP* indices of the pre-merger municipalities described above. I also employ debt expenditure ratio (DER) dummies as variables affecting the change in the local public debt per capita of pre-merger municipalities. The DER is the average over the past three years of the ratio of a municipality's debt expenditures to its stable revenues that are not use-specific. In Japan, public bond issuances by local governments are strongly managed by the national government using the DER, an index of public debt balances. When the DER exceeds a constant value, restrictions on the flotation of loans are imposed, and improvement programs are initiated by the local government. These restrictions likely control free-rider behavior before amalgamation (Nakazawa 2016). When the DER exceeds 15%, the municipality is required to start a financial improvement program and reduce the DER to 13% within seven fiscal years, and when it exceeds 20%, public bond issuances by the municipality are severely curbed. Therefore, I employ two DER dummies. The first dummy takes a value of one when the municipality's DER ranges from 10 to 15% (DER 10_15). The second DER dummy takes a value of one when the municipality's DER exceeds 15% (DER_15).

This study focuses on amalgamations between FY2004 and FY2005 because a sufficient number of amalgamations were carried out during that time, as shown in Fig. 8.3. I use data from the pre-merger and never-merged municipalities from FY1998 as the pre-treatment data.[2] Thus, I assume that the financial situations of the municipalities immediately before the old law was changed might affect the amalgamation decision. The change in the local public debt per capita of pre-merger municipalities is calculated from FY1998 to FY2003 for municipalities that merged in FY2004 and from FY1998 to FY2004 for municipalities that merged in FY2005. The estimation sample sizes are 2021 (FY2004) and 2229 (FY2005). The number of never-merged municipalities is 1214. Table 8.1 provides summary statistics for the variables used in the analysis.

Comparing the FY2004 merger group with the FY2005 merger group, the average incentive to free ride is greater for the FY2004 group. Both merger groups have a higher average growth rate of public debt than the never-merged group has, although that of the FY2004 merger group is higher on average. This result strongly suggests the existence of free-rider behavior.

Figure 8.4 illustrates the average change in local public debt per capita in each group. The amount of change in each group is almost the same. However, the pre-merger groups accumulate local public debt per capita faster than the never-merged group does in the post-treatment periods (from FY1999).

8.4 Empirical Results

Tables 8.2 and 8.3 shows the empirical results of free-rider behavior based on ML estimation of Heckman's sample selection.

As mentioned above, cities may have different incentives related to amalgamation and local public debt accumulation than towns and villages have. In the first stage, cities with high levels of local public debt per capita and aging ratios tend to choose amalgamation. Towns and villages with high dependencies on the LAT and high aging ratios tend to choose amalgamation. As Nakazawa and Miyashita (2013, 2014) show, towns and villages with worse fiscal situations and high dependencies on inter-

[2]In 1999, the old law was amended.

Table 8.1 Summary statistics

	Amalgamation	Mean	S.D.	Min.	Max.
Freeride	FY2004	0.743	0.256	0.011	0.998
	FY2005	0.699	0.274	0.000	0.998
	Never-merged	0.000	0.000	0.000	0.000
PSLP	FY2004	0.519	0.387	0.000	0.998
	FY2005	0.458	0.389	0.000	0.998
	Never-merged	0.000	0.000	0.000	0.000
ΔDebt (1000 JPY)	FY2004	113.193	22.096	−839.511	2446.380
	FY2005	90.815	244.068	−975.021	3490.310
	Never-merged	55.266	197.746	−1308.930	1292.960
DER_10_15	FY2004	0.490	0.500	0.000	1.000
	FY2005	0.459	0.498	0.000	1.000
	Never-merged	0.444	0.497	0.000	1.000
DER_15	FY2004	0.032	0.176	0.000	1.000
	FY2005	0.027	0.161	0.000	1.000
	Never-merged	0.028	0.165	0.000	1.000
Ordinary balance ratio	FY2004	81.468	6.470	35.900	128.000
	FY2005	81.694	6.327	56.500	137.100
	Never-merged	82.039	8.427	35.000	114.500
Public debt cost ratio	FY2004	14.541	3.780	1.100	27.400
	FY2005	14.105	3.604	1.300	31.200
	Never-merged	13.782	4.063	1.700	31.600
LAT ratio	FY2004	37.448	11.971	0.370	76.720
	FY2005	35.424	12.925	0.050	65.290
	Never-merged	28.750	15.781	0.070	72.770
Population	FY2004	22,715	60,509	344	787,585
	FY2005	27,385	76,438	204	1400,000
	Never-merged	54,885	177,465	446	3400,000
Area	FY2004	91.213	76.699	1.270	513.280
	FY2005	110.094	114.917	1.640	801.490
	Never-merged	138.526	176.228	3.470	1408.100
Aging ratio	FY2004	25.341	6.678	9.400	49.320
	FY2005	23.486	6.165	8.820	47.540

(continued)

Table 8.1 (continued)

	Amalgamation	Mean	S.D.	Min.	Max.
	Never-merged	20.315	6.170	6.840	46.180
Secondary industry workers ratio	FY2004	33.158	8.267	2.780	57.680
	FY2005	33.003	8.639	8.640	56.100
	Never-merged	31.880	9.229	1.420	61.420
Third industry workers ratio	FY2004	48.982	9.120	23.300	80.100
	FY2005	50.396	9.752	24.780	86.300
	Never-merged	54.229	11.404	20.480	98.980

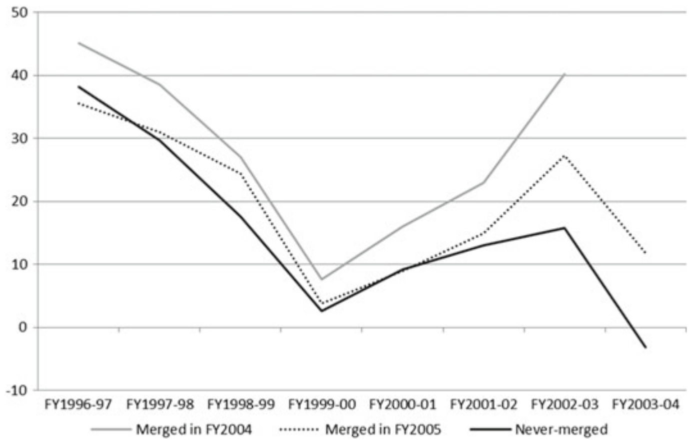

Fig. 8.4 Average change in local public debt per capita (1000 JPY)

governmental subsidies tend to choose amalgamation. Wald tests for sample selection are significant at the 1% level except in the case of cities in FY2004, which means that sample selection exists.

The results of the second stage clearly show that the coefficients on *Freeride* are significantly positive for towns and villages. The assumption that cities have no incentive to free ride because they end up subrogating the load seems to be justified. The point estimates of the coefficients on *Freeride* for towns and villages in FY2004 and FY 2005 are 106.080 and 85.806, respectively, and the average *Freeride* values for towns and villages in FY2004 and FY 2005 are 0.810 and 0.783. Therefore, towns and villages that merged in FY2004 accumulated 859,248 JPY per capita, on average, prior to merging. Towns and villages that merged in FY2005 accumulated 671,861 JPY per capita on average prior to merging. I also find that the debt expenditure ratio dummies have significantly negative effects on local public debt accumulation, implying that the regulations on local public debt strongly control debt accumulation.

Next, I re-estimate the model using *PSLP* instead of *Freeride*. Again, the *PSLP* of the municipality i is defined as $PSLP_i = 1 - N_i/max\{N_m\}$, where N_m is the

Table 8.2 Estimation results for *Freeride*: cities

	FY2004		FY2005	
	Coef.	z	Coef.	z
ΔDebt				
Freeride	−32.456	−1.12	1.708	0.07
DER_10_15	−27.626	−1.94*	−15.949	−1.21
DER_15	−57.322	−2.22**	−68.863	−3.92***
Constant	127.315	2.90***	84.834	3.67***
Amalgamation				
Ordinary balance ratio	−0.055	−5.24***	−0.057	−5.86***
Public debt cost ratio	0.077	3.42***	0.051	2.22**
LAT ratio	−0.007	−0.66	−0.004	−0.50
Population	0.000	0.33	0.000	0.22
Area	−0.001	−1.71*	0.000	−0.54
Aging ratio	0.100	4.40***	0.086	4.41***
Secondary industry workers ratio	0.004	0.21	−0.012	−0.75
Third industry workers ratio	0.016	0.94	0.000	−0.18
Constant	0.174	0.09	2.854	1.75*
Athrho	−0.553	−1.26	−0.504	−2.66***
ln sigma	4.251	23.75***	4.310	27.59***
Rho	−0.503		−0.465	
Sigma	70.205		74.427	
Lambda	−35.278		−34.630	
Sample	474		541	
Censored	370		370	
Uncensored	104		171	
Log likelihood	−799.044		−1265.793	
Wald test	1.59		7.05***	

Notes ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.1 levels, respectively

set of the populations of the municipalities, including municipality i, that participate the amalgamation. Note that *PSLP* is not related to the total population of the municipality after amalgamation but rather evaluates the relative relationship of the focal municipality's population to that of the municipality with the largest population among the merging municipalities. Tables 8.4 and 8.5 present the estimation results.

The first-stage estimation results are almost the same as those in Tables 8.2 and 8.3. In the second stage, the coefficients on *PSLP* are significantly positive for towns and villages. However, FY2004 result is only significant at 10% level. The assumption that cities have no incentive to free ride because they would still end up subrogating the load again seems to be justified. The point estimates of the coefficients on *PSLP*

Table 8.3 Estimation results for *Freeride*: Towns and villages

	FY2004		FY2005	
	Coef.	z	Coef.	z
ΔDebt				
Freeride	106.080	2.72***	85.806	2.35**
DER_10_15	−77.324	−4.09***	−57.664	−3.20***
DER_15	−225.551	−5.71***	−369.362	−5.12***
Constant	172.126	4.87***	105.113	3.37***
Amalgamation				
Ordinary balance ratio	0.002	0.39	0.019	3.69***
Public debt cost ratio	0.003	0.34	−0.017	−1.73*
LAT ratio	0.008	1.99**	0.011	3.06***
Population	0.000	−1.68*	0.000	−1.56
Area	−0.004	−9.29***	−0.002	−5.75***
Aging ratio	0.070	7.50***	0.030	3.81***
Secondary industry workers ratio	0.014	3.11***	0.012	3.03***
Third industry workers ratio	0.000	−0.09	0.000	0.02
Constant	−2.258	−4.06***	−2.555	−5.06***
Athrho	−0.565	−6.33***	−0.203	−3.07***
ln sigma	5.386	63.78***	5.563	38.80***
Rho	−0.512		−0.200	
Sigma	254.336		260.814	
Lambda	−130.167		−52.235	
Sample	1547		1688	
Censored	844		844	
Uncensored	703		844	
Log likelihood	−5727.242		−6972.506	
Wald test	7.05***		9.43***	

Notes ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.1 levels, respectively

for towns and villages in FY2004 and FY 2005 are 39.436 and 64.267, respectively, and the average *PSLP* values of towns and villages in FY2004 and FY 2005 are 0.267 and 0.272. Therefore, towns and villages that merged in FY2004 accumulated 105,294 JPY per capita on average prior to the merger. Towns and villages that merged in FY2005 accumulated 169,991 JPY per capita on average prior to the merger.

To determine whether *Freeride* or *PSLP* is a more appropriable description of the opportunistic behavior of pre-merger municipalities, I divide pre-merger municipalities (towns and villages) into three categories with respect to their incentive to free ride. Specifically, "weak" denotes *Freeride* $\in$ [0, 0.33], "moderate" municipalities have *Freeride* $\in$ [0.33, 0.66], and "strong" municipalities have *Freeride* $\in$ [0.66, 1].

Table 8.4 Estimation results of *PSLP*: Cities

	FY2004		FY2005	
	Coef.	z	Coef.	z
ΔDebt				
PSLP	−49.387	−1.39	12.578	0.37
DER_10_15	−26.406	−1.86*	−15.011	−1.10
DER_15	−57.515	−2.25**	−67.562	−3.73***
Constant	116.225	2.73***	84.250	3.97***
Amalgamation				
Ordinary balance ratio	−0.054	−5.22***	−0.057	−5.86***
Public debt cost ratio	0.077	3.40***	0.051	2.22**
LAT ratio	−0.007	−0.69	−0.005	−0.50
Population	0.000	0.35	0.000	0.22
Area	−0.001	−1.68*	−0.004	−0.54
Aging ratio	0.101	4.50***	0.086	4.41***
Secondary industry workers ratio	0.005	0.25	−0.012	−0.75
Third industry workers ratio	0.017	1.00	−0.003	−0.18
Constant	0.087	0.05	2.861	1.75*
Athrho	−0.529	−1.16	−0.514	−2.66***
ln sigma	4.245	24.11***	4.312	27.59***
Rho	−0.485		−0.473	
Sigma	69.754		74.604	
Lambda	−33.831		−35.266	
Sample	474		541	
Censored	370		370	
Uncensored	104		171	
Log likelihood	−799.188		−1265.721	
Wald test	1.650		6.85***	

Notes ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.1 levels, respectively

Moreover, I add $PSLP = 0$, which indicates no incentive to free ride. Figure 8.5 shows the average changes in local public debt per capita according to the strength of the free-rider incentive.

Figure 8.5 offers clear evidence of the free-rider incentives of the municipalities that merged in FY2004 and FY2005. The changes in local public debt per capita seems to change monotonously across categories. I assume that the municipality with the largest population among the municipalities participating in the merger might not have an incentive to free ride. Therefore, the average change in the local public debt per capita of the $PSLP = 0$ group should be lower than that of the weak incentive group. However, the $PSLP = 0$ groups that merge in FY2004 and FY2005

Table 8.5 Estimation results of *PSLP*: Towns and villages

	FY2004		FY2005	
	Coef.	z	Coef.	z
ΔDebt				
PSLP	39.436	1.65*	64.267	2.86***
DER_10_15	−75.702	−4.02***	−59.021	−3.35***
DER_15	−224.136	−5.69***	−372.192	−5.13***
Constant	237.204	8.63***	136.365	6.53***
Amalgamation				
Ordinary balance ratio	0.002	0.36	0.019	3.70***
Public debt cost ratio	0.003	0.33	−0.017	−1.71*
LAT ratio	0.008	1.97**	0.011	3.06***
Population	0.000	−1.80*	0.000	−1.54
Area	−0.004	−9.30***	−0.002	−5.80***
Aging ratio	0.070	7.59***	0.029	3.79***
Secondary industry workers ratio	0.014	3.11***	0.012	3.02***
Third industry workers ratio	0.000	−0.03	0.000	0.00
Constant	−2.252	−4.05***	−2.550	−5.05***
Athrho	−0.585	−6.83***	−0.195	−2.95***
ln sigma	5.546	63.74***	5.561	38.08***
Rho	−0.526		−0.192	
Sigma	256.348		260.018	
Lambda	−134.818		−50.002	
Sample	1547		1688	
Censored	844		844	
Uncensored	703		844	
Log likelihood	−5728.357		−6790.851	
Wald test	46.40***		8.68***	

Notes ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.1 levels, respectively

accumulate more debt than the weak groups do. Therefore, pre-merger municipalities exhibit free-rider behavior according to the ratio of their populations to the population of the municipality after amalgamation.

8.5 Concluding Remarks

This analysis examines the free-rider behavior of pre-merger municipalities. Before amalgamations, municipalities can benefit from local public projects by issuing pub-

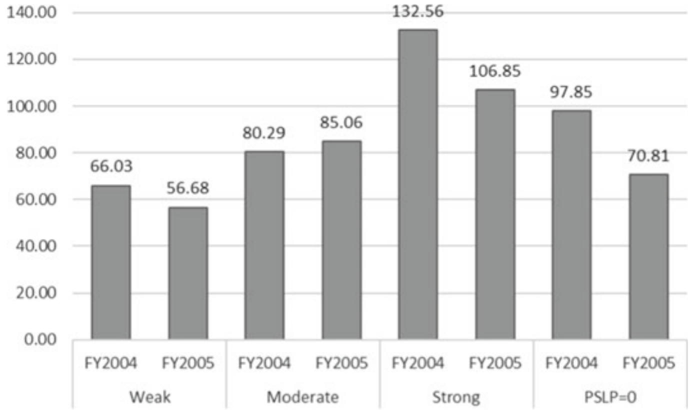

Fig. 8.5 Change in local public debt, sorted by the strength of the incentive to free ride

lic debt, and they can subrogate the load to the newly created post-merger municipality. The novel contributions of this analysis are as follows.

The first contribution is employing Heckman's sample selection estimate in the context of this problem. Previous studies employ the DID method between pre-merger and never-merged municipalities. However, although these studies do consider the assumption of parallel public debt accumulation trends for the pre-merger and never-merged municipalities when applying this method, doubt remains regarding whether the merged municipalities were really selected at random, particularly in cases of voluntary amalgamations, as in Japan. Therefore, I employed Heckman's sample selection method to handle the sample selection problem. Wald tests for sample selection are significant at the 1% level except the case of cities in FY2004, which means that a sample selection problem exists.

The second contribution of this analysis is to updating the index of the free-rider incentives of pre-merger municipalities. In this analysis, I assume that the municipality with the largest population among the municipalities participating in the merger might not have incentives to free ride. The empirical results for towns and villages initially seemed to support the assumption, but an additional check did not support the assumption.

The final contribution of this analysis is classifying pre-merger municipalities as either cities or towns and villages. When the amalgamation involves a city absorbing a surrounding town or village, the city would seem to have no incentive to free ride at amalgamation because the cities would end up subrogating the load. The empirical results support this assumption.

In conclusion, pre-merger municipalities exhibit free-rider behavior according to the ratio of the population size of the focal municipality to the population size of the municipality after amalgamation. Moreover, cities do not have incentives to free ride in this context because they become the main obligor the debt load.

This analysis has room for further improvement by considering the free-rider behavior of pre-merger municipality. Specifically, future work can consider whether municipalities truly engage in opportunistic behavior and, if so, why other municipalities still permit mergers. Municipalities may allow opportunistic behavior before a merger because they expect financial support after the merger. Thus, my future analysis should consider the consensus process of municipal mergers.

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Part II
Vertical and Horizontal Fiscal Adjustment (From Traditional View to New View)

Chapter 9
Distribution of Factor Endowments and the Non-cooperative Provision of Public Inputs

Kazuyuki Nakamura

Abstract In this chapter, we consider the neutrality theorem in the presence of public inputs with positive spillover effects. We use a model consisting of two regions, two tradable goods, two primary factors of production, and public inputs to analyze the effects of an interregional transfer that takes the form of the primary factors of production. In this setting, Warr's neutrality theorem does not fully hold. Although the total provision of public inputs is independent of the distribution of primary factors, the transfer of primary factors may change the welfare level. Furthermore, the possibility of the transfer paradox cannot be excluded. In addition, we show that a Pareto-improving redistribution of the primary factors is possible even if only one region is a non-contributor.

Keywords Neutrality theorem · Transfer paradox · Public inputs

9.1 Introduction

Factor endowments are critical for understanding the efficiency and equity of a regional economy. According to the Heckscher-Ohlin (H-O) model, the patterns of production and trade in a region are determined by its factor endowments. Thus, because factor prices are equalized among regions through trade, the distribution of factor endowments is a source of interregional disparities in income. The central governments of many countries implement interregional transfers to mitigate income inequality. At the same time, regional governments implement various policies, such as infrastructure construction and technical assistance to firms, to raise the productivity of their industries. However, because public goods can create externalities, government interventions to improve regional welfare are not always effective. Thus, this analysis investigates the effects of interregional transfers of factors of production on individual welfare and on the provision of an interregional public input.

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Interregional income transfers in the presence of public goods have previously been considered in the fields of regional and public economics. In his seminal work, Warr (1983) showed that income redistribution among agents does not affect the total provision of public goods. This neutrality theorem of public goods has significant policy implications with respect to international aid and interregional income transfers. Ihori (1994, 1996) extensively considered the neutrality theorem in the context of a regional economy and demonstrated that the transfer paradox may arise if governments provide impure public goods. Boadway et al. (1989) considered the effects of interregional income transfers in the presence of spillovers of public goods and a federal grants system.[1] They argued that the neutrality theorem holds in the presence of matching grants by the federal government to stimulate local governments' provision of public goods.

Our analysis differs from the existing literature in two ways. First, we consider the neutrality theorem in the presence of public inputs with positive spillovers across regions, whereas most previous studies dealing with the neutrality theorem focused on public (consumption) goods. In practice, however, governments provide public inputs, such as infrastructure and R&D activities, in addition to final goods. For example, every prefectural government in Japan operates research institutes to support industrial activity. Although this assistance is mainly aimed at the producers in each prefecture, the outcomes spill over to producers in other prefectures owing to the non-excludability of R&D activities. Furthermore, most prefectures in Japan operate universities and provide environmental protection, both of which benefit not only the producers those regions but also producers in other regions.

The international economics literature has intensively investigated the effect of public inputs on the standard trade theory (Abe 1990). Tawada and Abe (1984), Altenburg (1987), and Ishizawa (1991) investigated the shape of the production possibility frontier in the presence of public inputs. Kemp and Abe (1994) showed that if the government provides a public input without spillovers, an international income transfer improves (harms) the welfare of the recipient (donor) country. They also suggested that even if the public input is international, the income transfer does not cause the transfer paradox to arise. In this chapter, however, we show that these results are partly modified if the setting is changed.

Second, we focus on how the distribution of the primary factors of production affects the supply of public inputs and the level of welfare. In the standard model of the voluntary provision of public goods (Andreoni 1988; Bergstrom et al. 1986; Warr 1983), income and wealth (i.e., factors of production) are indistinguishable, and it is assumed that each agent can convert one unit of wealth into a fixed amount of private goods. However, even in a simple H-O model consisting of two goods and two factors, transfers of the factors of production could have different effects than transfers of income or final goods have.

Indeed, understanding the effects of the distribution and redistribution of primary factors on the level of regional welfare is helpful for understanding recent trend in regional policies. Japan's regional development policies can be categorized

[1] Buchholz et al. (2015) also discusses this topic.

into two groups. The first is interregional income redistribution policies through fiscal transfers via the Local Allocation Tax; these policies are aimed at alleviating income disparities among regions. The second is regional development programs, such as Regional Revitalization, which aims to alleviate economic disparities by promoting industrial agglomeration and the development of human resources in non-metropolitan areas. Such programs can be regarded as measures to correct imbalances in the primary factors of production.[2]

Transfers of factors of production are also relevant in an international context. Brakman and van Marrewijk (1998) considered the welfare consequences of international transfers of factors of production in the absence of public inputs and found that transfers of factors of production do not cause the transfer paradox if the assumptions made by the standard H-O model are satisfied. In this chapter, we show how these results change when public inputs are taken into account.[3]

Overall, the results of this chapter reveal that Warr's (1983) conclusion may be partially modified when interregional public inputs and transfers of primary factors are considered. Warr's theorem can be decomposed into two parts: (i) the total provision of public goods is independent of the distribution of income and (ii) welfare is independent of the distribution of income in the presence of public goods. The distinction between these two parts is not important as long as income transfers are considered in the context of public consumption goods. However, as our analysis will show, although Warr's first claim is valid under the standard assumptions of the H-O model with public inputs, the second claim does not hold in general. Furthermore, the possibility of the transfer paradox cannot be excluded.

Previous studies have shown that the neutrality result may not hold in the case of price changes, which are not incorporated into the models of Warr (1983) and Bergstrom et al. (1986). Long and Shimomura (2007) considered the neutrality theorem in the context of an international trade model and argued that the theorem does not hold because of changes in the relative prices of public goods caused by the redistribution of primary factors. Villanacci and Zenginobuz (2012) constructed a general equilibrium model with public goods financed by households' voluntary contributions, non-linear public goods production technology, and multiple private goods. They argued that the standard results of the neutrality theorem did not hold in this case because of the relative price effect.[4] Our analysis considers a different setting and shows that the second part of the neutrality theorem may not hold even in a small open economy in which the market prices of final goods are given if we include public inputs in the model.

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[2]In 2015, the Japanese government launched a tax incentive program to promote the relocation of businesses' operating functions, such as headquarters, planning, information processing, and R&D, from Tokyo's 23 wards to other local areas. This incentive can be interpreted as a policy promoting the redistribution of the factors of production.

[3]Yano and Nugent (1999) and Schweinberger (2002) considered the welfare effects of transfers in the form of the factors of production.

[4]Villanacci and Zenginobuz (2006) also discussed this point. Additionally, Faias et al. (2015) derived a condition for the redistribution of endowments satisfying the neutrality result using a general equilibrium model with multiple private and public goods.

Finally, previous studies have considered factor redistribution in the H-O model in the presence of a non-contributing region. As found by Bergstrom et al. (1986), the neutrality theorem does not hold in the presence of non-contributors when income redistribution is implemented between non-contributors and contributors. Building on this setting, Cornes and Sandler (2000) and Boadway and Hayashi (1999) demonstrated that income redistribution from the non-contributors to contributors could Pareto improve welfare. They also argued that the possibility of Pareto-improving redistribution increases with the number of non-contributors. In this chapter, we show that a Pareto-improving redistribution of the primary factors is possible even if only one region is a non-contributor.

The remainder of this chapter is organized as follows. In Sect. 9.2, we present an extended version of the H-O model with public inputs. The effects of transfers of primary factors on the total provision of public inputs and welfare under a constant consumer price are examined in Sect. 9.3. Concluding remarks are presented in Sect. 9.4.

9.2 The Model

9.2.1 Basic Setup

The analytical framework is a small open economy model of trade with spillovers of public inputs in which two regions, labeled A and B, produce two tradable private goods. In each region, the private goods are produced using two primary factors, 1 and 2, and public inputs g. The vector of the primary factors employed by the private sector in region J is $v^{JP} \equiv \left[v_1^{JP}, v_2^{JP}\right]$, where $J = A, B$.[5] The private sector production technology, which is assumed to be a constant returns to scale technology in primary inputs, is identical across regions. For analytical simplicity, the unit cost function of the jth private sector in region J is specified as

$$c^j\left(w^J, g\right) = a^j(g)\tilde{c}^j\left(w^J\right), \quad j = 1, 2, \text{ and } J = A, B,$$

where $w^J \equiv \left[w_1^J, w_2^J\right]$ denotes the vector of factor prices in region J. In this expression, the effect of the public input on the unit cost is represented by $a^j(g) > 0$, where we assume that $a^{j\prime}(g) < 0$ and $a^{j\prime\prime}(g) > 0$. Let good 2 be the numeraire good. If both private goods are produced in region J, a competitive market ensures that

$$c^1\left(w^J, g\right) = P, \tag{9.1}$$

$$c^2\left(w^J, g\right) = 1, \tag{9.2}$$

[5] In the following analysis, we do not distinguish column vectors from row vectors for notational simplicity as long as no confusion arises

where P denotes the consumer price.

The public input produced by the government of region J is financed via a residence-based lump-sum tax and is denoted by g^J.[6] Because the public input has a spillover effect, each region's contribution to the public inputs can be used in the private sectors of both regions: $g = g^A + g^B$.[7] The production technology of the public input is assumed to be a constant returns to scale technology in the primary factors. Thus, the unit cost function of the public input in region J can be written as $c^g\left(w^J\right)$. We omit the superscript distinguishing the region because the production technology for public inputs is identical among regions. From the properties of the unit cost function, $c_w^g w^J = c^g\left(w^J\right)$ and $c_w^g g^J = v^{Jg}$ hold, where $c_w^g \equiv \left[\partial c^g/\partial w_1^J, \partial c^g/\partial w_2^J\right]$ and $v^{Jg} \equiv \left[v_1^{Jg}, v_2^{Jg}\right]$ denote the vector of input coefficients and that of the primary factors used by the government of region J, respectively.

The two private industries are assumed to have different factor intensities without a reversal in the primary inputs. The well-known results on trade theory indicate that the factor prices are uniquely determined for given goods prices and public inputs (Dixit and Norman 1980). Thus, the factor price vector can be written as a function of P and g as $w^J = w^J(P, g)$. Throughout this chapter, the factor endowments in both regions are assumed to satisfy the following assumption.

Assumption 9.1 Two tradable private goods are produced in both regions.

Because the production technology is assumed to be identical across regions, the unit cost is also the same. That is, $w^A(P, g) = w^B(P, g)$ holds. This property is known as factor price equalization. Hereafter, we omit the superscript denoting the region when we refer to the factor prices.

Differentiating Eqs. 9.1 and 9.2 and denoting the share of the ith factor reward in the jth sector as $\theta_i^j \equiv \left(w_i/c^j\right)\left(\partial c^j/\partial w_i\right)$, we obtain the comparative statics as follows[8]:

$$w_{1g} = \frac{\partial w_1}{\partial g} = \frac{w_1}{g}\left(\frac{\theta_2^2\varepsilon^1 - \theta_2^1\varepsilon^2}{\Theta}\right), \tag{9.3}$$

$$w_{2g} = \frac{\partial w_2}{\partial g} = \frac{w_2}{g}\left(\frac{-\theta_1^2\varepsilon^1 + \theta_1^1\varepsilon^2}{\Theta}\right), \tag{9.4}$$

where $\Theta \equiv \theta_1^1 - \theta_1^2 = \theta_2^2 - \theta_2^1$. The sign of this expression is determined by the difference in the factor intensities of the two private sectors. If the first private sector intensively employs the first (second) factor of production, then Θ is positive (negative). In Eqs. 9.3 and 9.4,

[6] Kemp and Abe (1994) assumed that each household contributes to public inputs in an egalitarian society. In our setting, as in that of Long and Shimomura (2007), the contributors are not households but the regional governments.

[7] According to the terminology used by Arce and Sandler (2002), the public inputs discussed in this chapter can be classified as regional public (intermediate) goods with an aggregate technology of summation.

[8] See Appendix A.1 for the derivation.

$$\varepsilon^j = -\frac{a^{j\prime}(g)g}{a^j(g)} \geq 0, \ j = 1, 2,$$

denotes the elasticity of the cost reduction in the jth sector with respect to the public inputs. In the following discussion, we refer to this elasticity as the *productivity effect*. The impact of a change in public inputs on the factor prices depends on the factor intensity and the productivity effects of the public inputs in each industry. In general, the sign of w_g is ambiguous. For analytical simplicity, we assume that the following property holds.

Assumption 9.2 Both factor prices increases as public inputs increase, and $w_g \equiv \left[w_{1g}, w_{2g}\right] > 0$ holds.

This assumption is referred to as a *natural friend* by Ishizawa (1991).[9] As a special case, if the productivity effects are symmetric across the two industries, $\varepsilon^j = \varepsilon$, $j = 1, 2$, then Eqs. 9.3 and 9.4 can be written as $w_g = (\varepsilon/g)w > 0$. If $\varepsilon^1 \neq \varepsilon^2$, then the difference in productivity effects can be represented in terms of elasticities as follows:

$$\frac{\partial \log w_1}{\partial \log g} - \frac{\partial \log w_2}{\partial \log g} = \frac{\varepsilon^1 - \varepsilon^2}{\Theta}, \tag{9.5}$$

where $\partial \log w_1/\partial \log g = w_{ig}g/w_i$. Equation 9.5 shows that as the public input increases, the price of the intensively employed factor in the sector with high productivity increases at a higher rate than the price of the other factor does. The reasoning behind this result is straightforward. An increase in public inputs reduces the unit cost in each private sector and, thus, has the same effect as an increase in the consumer price. It can easily be verified that the rate of change in the unit cost following an increase in public inputs is proportional to the productivity effects in the sector.[10] Thus, from the Stolper-Samuelson theorem, an increase in public inputs substantially increases the price of the factor that is intensively employed in the sector with high productivity effects.

In summary, the supply side of the model described above is characterized by a revenue function $R^J\left(P, g, v^{JP}\right)$ for $J = A, B$. From the well-known properties of the revenue function, we obtain $R_v^J \equiv \left[\partial R^J/\partial v_1^{JP}, \partial R^J/\partial v_2^{JP}\right] = w$ and $R_{vv}^J = O$. The marginal benefit of public inputs can be represented by $R_g^J = w_g v^{JP}$. Because the factor prices are independent of the factor endowments, we find that the change in the marginal benefit of public inputs is $R_{gv}^J = w_g$, where $R_{gv}^J \equiv \left[\partial R_g^J/\partial v_1^{JP}, \partial R_g^J/\partial v_2^{JP}\right]$. Thus, given a small change in the factor endowments, the marginal benefit of the public inputs changes as follows:

[9] For example, consider the unit cost function that takes the form of $c^j = g^{-\varepsilon^j}(w_1/\delta_j)^{\delta_j}\left[w_2/\left(1-\delta_j\right)\right]^{1-\delta_j}$ for $\delta_j \in (0, 1)$ and $j = 1, 2$. In this case, $w_g > 0$ holds if and only if $\max\{(1-\delta_2)/(1-\delta_1), \delta_2/\delta_1\} > \varepsilon^2/\varepsilon^1 > \min\{(1-\delta_2)/(1-\delta_1), \delta_2/\delta_1\}$ holds.

[10] See Appendix A.1 for the derivation.

$$dR_g^J = w_{1g}dv_1^{JP} + w_{2g}dv_2^{JP} = \frac{1}{g}\left[\left(\frac{\partial \log w_1}{\partial \log g}\right)w_1dv_1^{JP} + \left(\frac{\partial \log w_2}{\partial \log g}\right)w_2dv_2^{JP}\right].$$

If the productivity effects are the same in the two industries (i.e., $\varepsilon^j = \varepsilon$, for $j = 1, 2$) the above expression can be simplified as $dR_g^J = (\varepsilon/g)wdv^{JP}$. In this situation, the marginal benefit of the public inputs changes according to the change in the factor endowments, as measured by the monetary unit. The impact of the change in the factor endowments on the marginal benefit depends on which factor is altered. Considering Eq. 9.5, we obtain Lemma 9.1, which has an important implication for the subsequent analysis.

Lemma 9.1 *Assume small changes in the factor endowments, such as $w_i dv_i^{JP}$ for $i = 1, 2$, and $w_1dv_1^{JP} = w_2dv_2^{JP}$. Then, the increase in the marginal benefit of public inputs is greater when the primary factor that is used intensively in the sector with higher productivity effects is increased.*

Proof The result follows from Eq. 9.5.

The reasoning behind this result is simple. With all else constant, a change in the factor endowments alters the outputs in the private sector according to the Rybczynski theorem. That is, an increase in a factor endowment increases the output of the sector that uses that factor intensively and decreases the output of the other sector. If the primary factor that is transferred is used intensively in the sector with a relatively high productivity effect, the output of that sector will increase. Thus, the marginal benefit of the public input increases at a faster rate.

Because the total factor endowment is assumed to be fixed, the resource constraint in region $J \in \{A, B\}$ can be written as

$$v^{JP} = v^J - c_w^g g^J,$$

where $v^J \equiv \left[v_1^J, v_2^J\right]$ denotes the vector of factor endowments in region J. Substituting the resource constraint into the revenue function, we obtain

$$R^J = R^J\left(P, g, v^J - c_w^g g^J\right),\ J = A, B.$$

Consumer preferences are represented by an expenditure function $E^J\left(P, u^J\right)$ for $J = A, B$, where u^J denotes the utility of region J. For given amounts of public inputs, the income-expenditure constraint of the private sector in region J can be written as follows:

$$E^J\left(P, u^J\right) - R^J\left(P, g, v^J - c_w^g g^J\right) = 0. \tag{9.6}$$

9.2.2 Non-cooperative Behavior of Governments

The government of each region is assumed to maximize the welfare of that region. Each regional government determines its contribution to the public inputs under the Nash conjecture and a given consumer price. Differentiating Eq. 9.6, we obtain the first-order condition for maximizing the welfare of region J, as follows:

$$\frac{R_g^J\left(P, g, v^J - c_w^g g^J\right) - c^g[w(P, g)]}{E_u^J} = 0. \tag{9.7}$$

Equation 9.7 states that the marginal benefit of the public input should equal its marginal cost.[11] This expression is the same as the Lindahl pricing rule adopted by Altenburg (1987) and Abe (1990). However, because the benefit from the public input spills over to other regions, the behavior described by Eq. 9.7 does not achieve an efficient allocation.

We assume that the second-order condition of the government, that is,

$$\Lambda^J = R_{gg}^J - R_{gv}^J c_{ww}^g w_g g^J - 2c_w^g w_g < 0,$$

is satisfied. As discussed by Ishizawa (1991), the second-order condition reflects the shape of the production possibility frontier. If this condition is satisfied, then the production possibility frontier perceived by the government has a negative slope.[12]

Before investigating the effects of transfers of primary factors, we consider the behavior of the government. Using Eq. 9.7, the optimal response function of the government in region J can be written as $g^J = \varphi\left(g^I, P, v^J\right)$, $I, J = A, B$. Differentiating Eq. 9.7, we obtain the slope of the optimal response function as follows:

$$\varphi_I^J = -1 - \frac{c_w^g w_g}{\Lambda^J}, \; I, J = A, B, \tag{9.8}$$

where $\varphi_I^J \equiv \partial\varphi^J/\partial g^I$. The sign of Eq. 9.8 is ambiguous in general. In the special case of symmetric productivity effects (i.e., $\varepsilon^j = \varepsilon(g)$ for $j = 1, 2$) with an elasticity with respect to public inputs $\varepsilon' g/\varepsilon$ of less than unity, then the optimal response function has a negative slope.[13]

More generally, to determine the sign of Eq. 9.8, a condition corresponding to the normality condition in the context of the voluntary provision of public goods (e.g., Andreoni 1988; Bergstrom et al. 1986) can be used. Suppose that $\bar{v}^g$ denotes an increase in the primary factors such that one more unit of public inputs can

[11] Differentiating the revenue function, we obtain $dR^J/dg^J = R_g^J - R_v^J c_w^g - R_v^J c_{ww}^g w_g g^J$. Because the production technology has constant returns to scale, $R_v^J c_{ww}^g w_g g^J = w c_{ww}^g w_g g^J = 0$ and $R_v^J c_w^g = w c_w^g = c^g$. Thus, we obtain Eq. 9.7.

[12] Ishizawa (1991) showed that Marshallian stability is equivalent to a negatively sloping production possibility frontier.

[13] See Appendix A.2 for the derivation.

be produced. That is, $\bar{v}^g \equiv [c^g_{w1}, c^g_{w2}]$. Now, we define the marginal propensity to contribute to public inputs as

$$\bar{g}^J_v \equiv \varphi^J_v \bar{v}^g, \tag{9.9}$$

where

$$\varphi^J_v \equiv \left[\frac{\partial \varphi^J}{\partial v_1}, \frac{\partial \varphi^J}{\partial v_1}\right] = -\frac{1}{\Lambda^J} w_g,\ J = A, B \tag{9.10}$$

denotes the change in the optimal response function caused by the primary factors.

Then, we obtain Lemma 9.2.

Lemma 9.2 *If the marginal propensity to contribute to public inputs is greater than zero and less than one, then the slope of the optimal response function is greater than -1 and less than zero.*

$$\bar{g}^J_v \in (0, 1) \Rightarrow \varphi^J_I \in (-1, 0).$$

Proof Substituting Eqs. 9.9 and 9.10 into Eq. 9.8, we obtain $\varphi^J_I = -1 + \bar{g}^J_v$. The claim then immediately follows from the above equation.

In the literature on the voluntary provision of public goods, normality is a sufficient condition to ensure the existence and uniqueness of a Nash equilibrium. However, in the present model, a non-specialization condition must be taken into account as well. In the following discussion, we assume that a unique equilibrium exists and that both regions contribute to the public inputs in the equilibrium. Therefore, the Nash equilibrium can be written as follows:

$$g^J = \tilde{g}^J\left(P, v^A, v^B\right),\ J = A, B. \tag{9.11}$$

Substituting Eq. 9.11 into the income-expenditure constraints, the utility if the Nash equilibrium holds can be written as follows:

$$u^J = \tilde{u}^J\left(P, v^A, v^B\right),\ J = A, B. \tag{9.12}$$

9.2.3 Disposable Income in Equilibrium

Itaya et al. (1997) formally proved that the disposable (net) income is equalized across contributors under the voluntary provision of public goods. In our model, if the productivity effects are the same across two regions, then disposable income is equalized.[14] As $w_g = (\varepsilon/g)w$ holds under symmetric productivity effects, we obtain the marginal benefits of contributing regions as

$$\varepsilon^j = \varepsilon \Rightarrow R_g^J = \frac{\varepsilon}{g} R^J, \text{ for } j = 1, 2, \text{ and } J = A, B.$$

Because the marginal benefit is equal to the common marginal cost in an interior equilibrium, the symmetric productivity effects equalize the disposable income.

However, if the productivity effects are not symmetric, the interior Nash equilibrium equalizes the marginal benefit but not the disposable income. Lemma 9.3 confirms this result.

Lemma 9.3 *If the productivity effects are not symmetric, then disposable income is not generally equalized in the equilibrium.*

Proof See Appendix A.3.

This result suggests that in the Nash equilibrium, disposable income and, therefore, welfare depend on the distribution of the factor endowments. In the next section, we investigate the effects of primary factor transfers on the provision of public inputs and welfare.

9.3 Transfer of Primary Factors of Production

In this section, we consider the effects of primary factor transfers when the consumer price is given exogenously.

9.3.1 Two Contributing Regions

We begin by considering the case in which neither region is a non-contributor. Starting from the initial equilibrium, we assume that a small transfer of primary factors to region B from A is made; we denote this transfer as $d\tau \equiv [d\tau_1, d\tau_2] = -dv^A = dv^B > 0$. Differentiating Eq. 9.7 and using Eqs. 9.8 and 9.10, we obtain $dg^J = \varphi_I^J dg^I + \varphi_v^J dv^J$. Thus, the change in the contributions to the public inputs in each region is represented as

$$d\tilde{g}^A = \frac{-\varphi_v^A + \varphi_B^A \varphi_v^B}{1 - \varphi_B^A \varphi_A^B} d\tau = -\frac{1}{w_g c_w^g} w_g d\tau, \tag{9.13}$$

[14]In our model, disposable income is equal to the value of the revenue function. The budget constraint of the government in region J is $tax\ revenue = c^g g^J$. The gross regional product (GRP) in region J can be written as $GRP = wv^J$. Thus, disposable income is represented by $wv^J - c^g g^J = wv^{JP} = R^J(P, g, v^{JP})$.

$$d\tilde{g}^B = \frac{\varphi_v^B - \varphi_A^B \varphi_v^A}{1 - \varphi_B^A \varphi_A^B} d\tau = \frac{1}{w_g c_w^g} w_g d\tau, \tag{9.14}$$

where $1 - \varphi_B^A \varphi_A^B > 0$ follows from the stability condition of the public input game.[15] If each primary factor is a natural friend of the public inputs, then the primary factor transfer increases the supply of public inputs in the recipient region and reduces that in the donor region. Intuitively, the transfer of primary factors to region B from region A induces a downward shift in the optimal response function of A by $-\varphi_v^A d\tau$ and an upward shift in the optimal response function of B by $\varphi_v^B d\tau$. Thus, we obtain Proposition 9.1.

Proposition 9.1 *Given a constant consumer price, a primary factor transfer does not affect the total provision of public inputs.*

Proof The claim follows immediately from Eqs. 9.13 and 9.14.

This proposition shows that the first part of the neutrality theorem is relevant for the case of primary factor transfers. It is easily shown that the contribution to the public inputs in each region does not change if the transfer instead takes the form of final goods.[16]

Note that the change in the contribution to public inputs may change depending on which primary factor is transferred even though the same amounts are transferred in terms of the monetary unit. Suppose that the ith primary factor is transferred. From Eqs. 9.13 and 9.14, the change in the public inputs can be represented as

$$d\tilde{g}^A = -\frac{1}{w_g c_w^g g}\left(\frac{\partial \log w_i}{\partial \log g}\right) w_i d\tau_i.$$

Taking Eq. 9.5 into account, the above equation indicates that the public inputs provided by the donor region greatly decrease if the primary factor that is used intensively in the high productivity sector is transferred.[17] The reasoning for this result is simple. As shown in Lemma 9.1, the transfer of the primary factor changes the marginal benefit of public inputs via the Rybczynski effect. Reacting to this change in the marginal benefit, each region adjusts its provision of public inputs according to the first-order condition.

Next, we consider regional welfare. Differentiating Eq. 9.6, we obtain the welfare effects of the transfer of primary factors as $E_u^J du^J = w dv^J + R_g^J dg^I$. Using Eqs. 9.13 and 9.14, we obtain

[15] See Appendix A.4 for more details.

[16] Suppose instead that the transfer takes the form of final goods. Let T^J denote the amount of the transfer. The income expenditure constraint can be written as $E^J - R^J - T^J = 0$ for $J = A, B$ and $T^A + T^B = 0$. Clearly, the first-order condition of the government is not altered, and, hence, the provision of public inputs is not affected by the income transfer. The welfare effects can be written as $E_u^J du^J = dT^J$.

[17] Herein, the private sector with the higher productivity effect of the public input is referred to as the *high productivity sector*.

$$E_u^A d\tilde{u}^A = -wd\tau + \frac{c^g}{w_g c_w^g} w_g d\tau, \quad (9.15)$$

and

$$E_u^B d\tilde{u}^B = wd\tau - \frac{c^g}{w_g c_w^g} w_g d\tau. \quad (9.16)$$

In Eqs. 9.15 and 9.16, the first terms on the right-hand side (RHS) represent the distributive effects, which have opposite effects on the welfare of the two regions. The second terms on the RHS of Eqs. 9.15 and 9.16 are reaction effects, which also work in opposite directions, as shown in Proposition 9.1. Equations 9.15 and 9.16 indicate that primary factor transfers only have distributive effects; the sum of the welfare measured in monetary terms, $E_u^A d\tilde{u}^A + E_u^B d\tilde{u}^B$, does not change. Substituting Eq. 9.5 into Eqs. 9.15 and 9.16, we obtain

$$E_u^A d\tilde{u}^A = -E_u^B d\tilde{u}^B = \frac{w_1 w_2}{c_w^g w_g g}\left(\frac{\varepsilon^1 - \varepsilon^2}{\Theta}\right)\left(c_{w2}^g d\tau_1 - c_{w1}^g d\tau_2\right). \quad (9.17)$$

Because c_{w2}^g / c_{w1}^g represents the factor intensity in the public sector, we can obtain the condition such that the welfare in each region is independent of the distribution of the primary factors.

Proposition 9.2 *Under a constant consumer price, a primary factor transfer does not affect the welfare in each region, if either of the following hold:*

- (i) *the productivity effects are symmetric in the two private sectors, or*
- (ii) *the transfer is made at the same ratio as the factor intensity of the public sector.*

Proof The claim immediately follows from Eq. 9.17.

Condition (i) of Proposition 9.2 can be intuitively explained as follows. Let $\Delta\tau \equiv [\Delta\tau_1, \Delta\tau_2]$ denote the primary factors to be transferred to region B from region A. Equation 9.13 can be rewritten as $\Delta g^A = -(w/c^g)\Delta\tau$ given that of $\varepsilon^j = \varepsilon$, $j = 1, 2$. Thus, the reduction in regional income induced by the transfer of primary factors is equal to the reduction in the cost of providing public inputs $c^g \Delta g^A$. Thus, $E_u^A \Delta u^A = -c^g \Delta g^A + R_g^A \Delta g^B = 0$.

Then, condition (ii) of Proposition 9.2 can be explained as follows. Suppose that the transfer of primary factors to region B from region A can be written as $\Delta\tau = \alpha c_w^g$ for $\alpha > 0$. In this case, $\Delta g^A = -\alpha$ holds. Therefore, a decrease in the provision of public inputs reduces the primary factor by αc_w^g. The change in disposable income in region A can be represented as $\Delta R^A = w\left(\Delta v^{AP} - \Delta\tau\right)$, where Δv^{AP} represents the change in the primary factor caused by the change in public input provision. Because $\Delta v^{AP} = \alpha c_w^g = \Delta\tau$, the disposable income and the welfare stay the same because the transfer keeps the primary factors available in the private sector constant.

Proposition 9.2 implies that the second claim of the neutrality theorem, which states that welfare is not affected by the income transfer, may hold under certain conditions. However, this claim does not always hold. In particular, the possibility of the transfer paradox, in which the transfer of primary factors harms the recipient region and benefits the donor region, cannot be excluded. Proposition 9.3 summarizes this result.

Proposition 9.3 *The transfer of primary factors harms the recipient region and benefits the donor region if the primary factor that is intensively employed in the high-productivity sector is transferred at a ratio beyond the input ratio of the public sector.*

Proof The claim immediately follows from Eq. 9.17.

We can explain Proposition 9.3 as follows. Let $\Delta\tau = [\Delta t_1, 0]$ denote the vector of the primary factors transferred to region B from region A. That is, $\Delta\tau_2/\Delta\tau_1 = 0 < c_{w2}^g/c_{w1}^g$. In the recipient region, according to the Rybczynski theorem, the transfer of the first primary factor increases the output of the sector that uses the first factor intensively, but it reduces the output of the other sector. As a result, the marginal benefit of public inputs increases in the recipient region but decreases in the donor region. Thus, the demand for primary factors for public input production increases in the recipient region but decreases in the donor region. As shown by Eq. 9.13, a transfer of Δt_1 decreases the provision of the public input in region A by $\Delta g^A = -\left[w_{1g}/(w_g c_w^g)\right]\Delta t_1$. The change in public inputs alters the primary factors available in the private sector as follows:

$$\begin{bmatrix} \Delta v_1^{AP} \\ \Delta v_2^{AP} \end{bmatrix} = -c_w^g \Delta g^A = \frac{1}{c_w^g w_g}\begin{bmatrix} c_{w1}^g w_{1g} \\ c_{w2}^g w_{1g} \end{bmatrix}\Delta t_1.$$

Note that the amounts of both primary factors available in the private sector are affected even though only one of the two primary factors is transferred. Thus, the total effects on disposable income are represented as follows:

$$\begin{aligned} \Delta R^A &= w\left(\Delta v^{AP} - \Delta\tau\right) = \left(w_1 \frac{c_{w1}^g w_{1g}}{c_w^g w_g} + w_2 \frac{c_{w2}^g w_{1g}}{c_w^g w_g} - w_1\right)\Delta t_1 \\ &= \frac{w_1 w_2}{c_w^g w_g g}\left(\frac{\varepsilon^1 - \varepsilon^2}{\Theta}\right) c_{w2}^g \Delta t_{1.} \end{aligned}$$

Therefore, $\Delta R^A > (<)0$ if and only if $\left(\varepsilon^1 - \varepsilon^2\right)/\Theta > (<)0$. Based on the definition of Θ , the result stated in Proposition 9.3 is confirmed.

Proposition 9.3 suggests that the transfer paradox is not a special case but rather generally occurs in the context of public inputs with spillovers and transfers of primary factors. For example, we consider the case in which each government contributes to R&D activities with spillovers. These activities may be more beneficial to the capital-intensive manufacturing sector. In this case, interregional aid in the form of capital goods to stimulate production in the manufacturing sector reduces welfare in the recipient region.

9.3.2 Non-contributor and Pareto-improving Redistribution

Thus far in the analysis, we have assumed that both regions contribute to the provision of public inputs. However, either region may be a non-contributor depending on the distribution of factor endowments. Thus, in this section, we consider the situation in which only one region is a contributor. We assume, without loss of generality, that region A is the non-contributor. Thus, for region A, Eq. 9.7 can be rewritten as

$$\frac{R_g^A\left(P, g, v^A - c_w^g g^A\right) - c^g[w(P, g)] + \lambda}{E_u^A} = 0, \tag{9.18}$$

where $\lambda > 0$ denotes the difference between the marginal benefit and the marginal cost at $g^A = 0$. For analytical simplicity, we consider a small transfer the primary factors so that region A is still a non-contributor after the transfer. As in the previous subsection, $d\tau > 0$ denotes the vector of primary factors transferred to region B from region A. Differentiating Eq. 9.18 and Eq. 9.7, we obtain

$$\begin{aligned} d\lambda &= -\left(R_{gg}^A - c_w^g w_g\right) dg^B + w_g d\tau, \\ dg^B &= \varphi_v^B d\tau. \end{aligned}$$

Clearly, the transfer of primary factors to the contributor from the non-contributor increases the provision of the public input under Assumption 9.2 because such a transfer only shifts optimal response function of the contributor upward.

Next, we consider welfare. Because $g^A = 0$ holds, we can obtain the change in welfare due to the transfer by differentiating Eq. 9.6, as follows:

$$E_u^A d\tilde{u}^A = -\left(w + \frac{R_g^A}{\Lambda^B} w_g\right) d\tau, \tag{9.19}$$

and

$$E_u^B d\tilde{u}^B = w d\tau, \tag{9.20}$$

where $R_g^A / \Lambda^B < 0$ follows from the second-order condition. In contrast to the analysis in the previous subsection, the transfer of the primary factors may change the total welfare, as measured in monetary terms:

$$E_u^A d\tilde{u}^A + E_u^B d\tilde{u}^B = -\frac{R_g^A}{\Lambda^B} w_g d\tau, \tag{9.21}$$

Next, we investigate the possibility of Pareto improvement. In general, a Pareto-improving transfer scheme can be constructed.

Proposition 9.4 *Suppose that only one region is a contributor in the initial equilibrium. If the productivity effects are not symmetric (i.e., $\varepsilon^1 \neq \varepsilon^2$), then there exists a Pareto-improving redistribution of the primary factors.*

Proof See Appendix A.5.

This proposition states that a redistribution of the primary factors can achieve Pareto improvement in general. However, if the productivity effects are the same in the private sectors, there is a plausible condition for which the redistribution of primary factors is not Pareto-improving.

Corollary 9.1 *Suppose that only one region is a contributor in the initial equilibrium, that the productivity effects are symmetric, and that the elasticity of the productivity effects is less than unity (i.e., $\varepsilon' g/\varepsilon < 1$). Then, there exists no Pareto-improving redistribution of primary factors.*

Proof See Appendix A.6.

As mentioned in the previous section, $\varepsilon' g/\varepsilon < 1$ is a sufficient condition for the negative slope of the optimal response function. Within the context of the voluntary provision of public (consumption) goods, Cornes and Sandler (2000) argued that if there is only one contributor, no Pareto-improving redistribution exists under the normality assumption. The findings described above are consistent with their analysis.

In the presence of asymmetric productivity effects, Proposition 9.4 implies that transfers of primary factors can improve the welfare of both the non-contributor and the contributor. Indeed, the direction of transfers to ensure Pareto improvement can be found as follows.

Corollary 9.2 *Suppose that only one region is a contributor in the initial equilibrium and that the productivity effects differ across two industries. The following factor redistribution, $d\tau^* \equiv \left[d\tau_1^*, d\tau_2^*\right]$, is always Pareto-improving*:

$$d\tau_1^* = \delta(P, g)\left[\beta w_2 + (1-\beta)\left(w_2 + \frac{R_g^A}{\Lambda^B} w_{2g}\right)\right], \tag{9.22}$$

$$d\tau_2^* = -\delta(P, g)\left[\beta w_1 + (1-\beta)\left(w_1 + \frac{R_g^A}{\Lambda^B} w_{1g}\right)\right], \tag{9.23}$$

where $\beta \in [0, 1]$ *and*

$$\delta(P, g) = \begin{cases} 1 & if\left(\varepsilon^1 - \varepsilon^2\right)/\Theta \geq 0, \\ -1 & if\left(\varepsilon^1 - \varepsilon^2\right)/\Theta < 0. \end{cases}$$

Proof Substituting Eqs. 9.22 and 9.23 into Eqs. 9.19 and 9.20, we obtain

$$E_u^A d\tilde{u}^A = \delta(P, g)\frac{w_1 w_2}{g}\left(\frac{\varepsilon^1 - \varepsilon^2}{\Theta}\right)\beta,$$
$$E_u^B d\tilde{u}^B = \delta(P, g)\frac{w_1 w_2}{g}\left(\frac{\varepsilon^1 - \varepsilon^2}{\Theta}\right)(1 - \beta).$$

The results directly follow from the above equation.

In this redistribution, the change in public input provision is represented by

$$d\tilde{g}^B = -\frac{w_g}{\Lambda^B}d\tau^* = -\delta(P, g)\left(\frac{\varepsilon^1 - \varepsilon^2}{\Theta}\right)\frac{w_1 w_2}{g\Lambda^B} > 0. \tag{9.24}$$

Thus, a Pareto-improving redistribution of the primary factors increases the provision of public inputs.

This result indicates that a transfer of primary factors may be Pareto-improving depending on the relative productivity effects and the factor intensity of the private sectors. For example, we consider a transfer scheme that leaves the contributor's welfare unchanged, that is, $\beta = 1$. If the ith factor is intensively used in the high (low) productivity sector, then the ith factor should be transferred from (to) the non-contributing region to (from) the contributing region, according to Eqs. 9.22 and 9.23.

The bilateral transfer of primary factors described in Eqs. 9.22 and 9.23 may not seem feasible. Instead of this scheme, a transfer of primary factors combined with income transfers can also be considered to be Pareto-improving. For example, the contributor receives the first factor from region A by $d\hat{\tau}_1$. In exchange for this transfer, region B transfers final goods or income to region A by dT. Because the final goods transfer has no effect on the government's behavior, the change in the welfare of each region can be written as $E_u^A d\tilde{u}^A = -\big(w_1 + R_g^A w_{1g}/\Lambda^B\big)d\hat{\tau}_1 + dT$ and $E_u^B d\tilde{u}^B = w_1 d\hat{\tau}_1 - dT$.[18] Because $w_1 + R_g^A w_{1g}/\Lambda^B < w_1$ holds, the transfer of primary factors combined with the transfer of final income (i.e., $d\hat{\tau}_1$ and dT, where $dT/d\hat{\tau}_1 \in \big(w_1 + R_g^A w_{1g}/\Lambda^B, w_1\big)$) is Pareto-improving. This result depends on the presence of two primary factors. In this situation, transfers for distributive purpose and to stimulate public input provision can be implemented separately.

9.4 Concluding Remarks

In this chapter, we considered the relationship between the non-cooperative provision of public inputs with spillover and factor endowments, and we showed that that the neutrality theorem obtained by Warr (1983) is partially modified when spillovers of public inputs and transfers of primary factors are taken into account. In other words, unlike in the standard model of the voluntary provision of public goods, transfers of primary factor may change the resources that are available in the private sector.

[18] See Footnote 13.

Consequently, depending on the factor intensities in the private and public sectors and the different productivity effects of public inputs in the private sector, the level of net regional income maybe affected by transfers of primary factors. In particular, the transfer paradox may occur even in the case of two contributing regions.

Throughout this chapter, we focused on a regional economy consisting of two small regions, but this model could be extended to a large economy in which goods' prices are determined in an international market. In such an extension, a market-clearing condition for private goods would need to be introduced as well model. Even in that case, however, the basic results obtained in this chapter would not change under certain conditions. Suppose that each government sets its contribution to public inputs under the current goods price. If the marginal propensities to consume the private goods are the same across regions, a change in the factor endowments would not alter the world price of private goods. Thus, Propositions 9.1 and 9.3 continue to hold, implying that the paradoxical result cannot be excluded in that case.

Interregional disparities, as measured by the distributions of income and primary factors of production, have been a central issue for local public finance and industrial policy in Japan. Our analysis suggests that the welfare disparity between regions cannot be judged only the distribution of factor endowments. In this sense, the actual disparities must be accurately understood to correct the interregional disparities.

Furthermore, the complexities in the relationship between the distribution of resources and economic welfare are driven by the strategic behavior of regional governments. In recent years, the local public finance and industrial policies in Japan have seemed to emphasize regional autonomy and have encouraged competition among regions. However, this analysis suggests that efforts toward cooperative policy-making across wide areas are necessary.

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Appendix

A.1 Derivation of Eq. 9.3

Differentiating Eqs. 9.1 and 9.2, we obtain the following matrix:

$$\begin{bmatrix} dw_1 \\ dw_2 \end{bmatrix} = \begin{bmatrix} c^1_{w1} & c^1_{w2} \\ c^2_{w1} & c^2_{w2} \end{bmatrix}^{-1} \left(\frac{1}{g} \begin{bmatrix} \varepsilon^1 c^1 \\ \varepsilon^2 c^2 \end{bmatrix} dg + \begin{bmatrix} 1 \\ 0 \end{bmatrix} dP \right), \tag{9.25}$$

where $c^j_{wi} \equiv \partial c^j / \partial w_i$ and $c^j_g \equiv a^{j\prime}(g)\tilde{c}^j(w) = a^{j\prime}(g)c^j(w)/a(g)$. The inverse of the coefficient matrix can be written as

$$\begin{bmatrix} c^1_{w1} & c^1_{w2} \\ c^2_{w1} & c^2_{w2} \end{bmatrix}^{-1} = \frac{1}{\Theta}\begin{bmatrix} \theta^2_2 \frac{w_1}{c^1} & -\theta^1_2 \frac{w_1}{c^2} \\ -\theta^2_1 \frac{w_2}{c^1} & \theta^1_1 \frac{w_2}{c^2} \end{bmatrix}. \tag{9.26}$$

Using Eq. 9.26, we obtain Eqs. 9.3 and 9.4. From Eq. 9.25, the change in the unit cost of the jth sector caused by an increase in the public inputs can be written as $dc^j = -\varepsilon^j c^j (dg/g)$. Thus, the rate of change in the unit cost due to the change in public inputs is proportional to the productivity effects (i.e., $dc^j/c^j = -\varepsilon^j (dg/g)$ holds for $j = 1, 2$).

A.2 Slope of the Optimal Response Function Under Symmetric Productivity Effects

Suppose that $\varepsilon^j = \varepsilon$ for $j = 1, 2$. Then, $w_g = (\varepsilon/g)w$ and

$$w_{gg} = \frac{\varepsilon - 1 + \varepsilon' g/\varepsilon}{g} w_g. \tag{9.27}$$

Because the revenue function can be written as $R^J = w(P, g)v^{JP}$, we obtain

$$R^J_{gg} = w_{gg}v^{JP} = \frac{\varepsilon - 1 + \varepsilon' g/\varepsilon}{g} w_g v^{JP} \tag{9.28}$$

and $w_g c^g_w = (\varepsilon/g)c^g$. Furthermore, $w_g c^g_{ww} w_g g^J = 0$ owing to the homogeneity of w in the unit cost function. Inserting Eqs. 9.27 and 9.28 into Eq. 9.8 and taking into account the first-order condition, we obtain

$$\Lambda^J\big|_{\varepsilon^j=\varepsilon} = R^J_{gg} - 2c^g_w w_g = -\frac{1 + \varepsilon - \frac{\varepsilon' g}{\varepsilon}}{g} R^J_g. \tag{9.29}$$

Thus,

$$\varphi^J_I\big|_{\varepsilon^j=\varepsilon} = -1 + \frac{\varepsilon}{1 + \varepsilon - \frac{\varepsilon' g}{\varepsilon}}, \tag{9.30}$$

holds in the equilibrium. Therefore, if $\varepsilon' g/\varepsilon - 1 < 0$ holds, then $\varphi^J_I\big|_{\varepsilon^j=\varepsilon} \in (-1, 0)$. As specified by Tawada and Abe (1984), if $a(g)$ takes the form of $a(g) = g^{-\varepsilon}$ and $\varepsilon > 0$, then Eq. 9.8 can be simplified as $\varphi^J_I = -1/(1 + \varepsilon) \in (-1, 0)$.

A.3 Proof of Lemma 9.3

In the equilibrium, $R_g^A = R_g^B$ holds. Thus, the disposable incomes are equalized if and only if there exists a $\rho > 0$ such that $R^J = \rho R_g^J$ holds for $J = A, B$. Because $R^J = wv^{JP}$ and $R_g^J = w_g v^{JP}$, we obtain

$$R^J - \rho R_g^J = \left(w_1 - \rho w_{1g}\right)v_1^{JP} + \left(w_2 - \rho w_{2g}\right)v_2^{JP}. \tag{9.31}$$

Thus, $R^J - \rho R_g^J = 0$ can be written as the following system:

$$\begin{bmatrix} w_1 v_1^{AP} + w_2 v_2^{AP} & -w_{1g} v_1^{AP} - w_{2g} v_2^{AP} \\ w_1 v_1^{BP} + w_2 v_2^{BP} & -w_{1g} v_1^{BP} - w_{2g} v_2^{BP} \end{bmatrix} \begin{bmatrix} 1 \\ \rho \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}. \tag{9.32}$$

The determinant of this system is given by $\left(v_1^{AP} v_2^{BP} - v_2^{AP} v_1^{BP}\right)\left(w_{1g} w_2 - w_{2g} w_1\right)$. Thus, as long as $\left(v_1^{AP}/v_2^{AP}\right) \neq \left(v_1^{BP}/v_2^{BP}\right)$, no ρ exists that satisfies $R^J - \rho R_g^J = 0$ for $J = A, B$ if

$$w_{1g} w_2 - w_{2g} w_1 = \frac{w_1 w_2}{g}\left(\frac{\varepsilon^1 - \varepsilon^2}{\Theta}\right) \neq 0$$

holds.

A.4 Stability Condition for the Public Input Game

We consider the public input game characterized by $g^J = \varphi\left(g^I\right)$ under a constant consumer price. Specifically, following Sandmo (1980), we consider the following adjustment process:

$$g_{(t)}^J = \varphi^J\left(g_{(t-1)}^I\right), \tag{9.33}$$

for $I, J = A, B$, where (t) indicates the time period. A linear approximation of the adjustment process around the equilibrium gives

$$\Delta g_{(t)}^J \approx \varphi_I^J\left(g^{I*}\right)\Delta g_{(t-1)}^I, \tag{9.34}$$

where $\Delta g_{(t)}^J \equiv g_{(t)}^J - g^{J*}$ and g^{J*} denotes the equilibrium value. The stability condition of this adjustment process is

$$\left|\varphi_B^A\left(g^{B*}\right)\varphi_A^B\left(g^{A*}\right)\right| < 1.$$

Thus, $1 - \varphi_B^A \varphi_A^B > 0$ follows from the stability condition. From Eq. 9.8, we can easily verify that $c_w^g w_g \neq 0$ is a necessary condition for stability.

A.5 Proof of Proposition 9.4

Equations 9.19 and 9.20 can be written as follows:

$$\begin{bmatrix} -w_1 - \left(R_g^A/\Lambda^B\right)w_{1g} & -w_2 - \left(R_g^A/\Lambda^B\right)w_{2g} \\ w_1 & w_2 \end{bmatrix} \begin{bmatrix} d\tau_1 \\ d\tau_2 \end{bmatrix} = \begin{bmatrix} E_u^A d\tilde{u}^A \\ E_u^B d\tilde{u}^B \end{bmatrix}. \tag{9.35}$$

Applying Gordan's Theorem of Alternative (Mangasarian 1969) to Eq. 9.35, $E_u^A d\tilde{u}^A > 0$ and $E_u^B d\tilde{u}^B > 0$ can be shown to be feasible if and only if

$$\begin{bmatrix} x_1 & x_2 \end{bmatrix} \begin{bmatrix} -w_1 - \left(R_g^A/\Lambda^B\right)w_{1g} & -w_2 - \left(R_g^A/\Lambda^B\right)w_{2g} \\ w_1 & w_2 \end{bmatrix} = \begin{bmatrix} 0 & 0 \end{bmatrix}, \tag{9.36}$$

does not have a nonnegative solution. The determinant of the system can be written as

$$\det \begin{bmatrix} -w_1 - \left(R_g^A/\Lambda^B\right)w_{1g} & -w_2 - \left(R_g^A/\Lambda^B\right)w_{2g} \\ w_1 & w_2 \end{bmatrix} = -\frac{R_g^A}{\Lambda^B}\left(w_{1g}w_2 - w_{2g}w_1\right).$$

Hence, if

$$w_{1g}w_2 - w_{2g}w_1 = \frac{w_1 w_2}{g}\left(\frac{\varepsilon^1 - \varepsilon^2}{\Theta}\right) \neq 0,$$

holds, then Eq. 9.36 does not have a non-trivial solution.

A.6 Proof of Corollary 9.1

Under symmetric productivity effects, the following expression holds:

$$-\frac{R_g^A}{\Lambda^B} w_{ig} = \frac{R_g^A}{\left(\frac{1+\varepsilon-\varepsilon' g/\varepsilon}{g}\right) R_g^B} \left(\frac{\varepsilon}{g}\right) w_i = \frac{\varepsilon R_g^A}{(1+\varepsilon-\varepsilon' g/\varepsilon) R_g^B} w_i, \tag{9.37}$$

for $i = 1, 2$. Because region A is the non-contributor, $R_g^A < c^g(P, g) = R_g^B$ holds in the initial equilibrium. Thus, if the elasticity of the productivity effects is less than unity, we obtain

$$\frac{\varepsilon R_g^A}{(1+\varepsilon-\varepsilon' g/\varepsilon)R_g^B} < 1. \tag{9.38}$$

Hence,

$$-w_i - \frac{R_g^A}{\Lambda^B} w_{ig} = -q w_i < 0, \tag{9.39}$$

where $q \equiv 1-\varepsilon\left(R_g^A/R_g^B\right)\left(1+\varepsilon-\varepsilon' g/\varepsilon\right)^{-1} > 0$. Substituting Eq. 9.39 into Eq. 9.36, we obtain

$$\begin{bmatrix} x_1 & x_2 \end{bmatrix} \begin{bmatrix} -q w_1 & -q w_2 \\ w_1 & w_2 \end{bmatrix} = \begin{bmatrix} 0 & 0 \end{bmatrix}. \tag{9.40}$$

Here, Eq. 9.40 can easily be verified to have a solution, such as $\begin{bmatrix} x_1 & x_2 \end{bmatrix} = [1/q, 1]$. Applying Gordan's Theorem to Eq. 9.40, the corollary can be confirmed.

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Chapter 10
An Assessment of the Efficiency of Decentralization in the Execution of Public Works

Calogero Guccio, Giacomo Pignataro and Ilde Rizzo

Abstract This paper analyzes the efficiency of infrastructure provision in Italy at the execution stage, focusing on the level of government involved. Different nonparametric and parametric frontier estimates are generated to estimate an input distance function for a large sample of Italian public works in the period 2000–2005. Decentralized contracting authorities appear to be systematically less efficient in managing the execution process. These empirical findings are robust to alternative estimators and empirical strategies and suggest that decentralized authorities might lack the adequate bureaucratic structures to manage the execution stage efficiently.

Keywords Infrastructure provision · Public work · Local government · Public procurement · Distance function

10.1 Introduction

Sub-national governments are important actors in the provision of public goods and services to citizens in all OECD countries, though with differences across them (OECD 2017). They also play an important and increasing role in the provision of infrastructures, with a share in total capital expenditures that is, on average, twice their share in total recurrent expenditures (Frank and Martinez-Vazquez 2015). In the European Union older member states the share of sub-national investment in economic infrastructures is 70%, while the sub-national share of gross fixed capital formation in hospitals, schools, housing, recreation and social protection is even higher (Kappeler et al. 2013). Therefore, sub-national governments are key players to sustain the level of public investment.

As it is well known, decentralization is meant to respond to the differences in local preferences, to improve political accountability and to increase confidence in public policy. At the same time, however, decentralization can limit the exploita-

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tion of economies of scale in service provision and it may increase geographical inequalities (Oates 2005). As for the effects of decentralization, Martinez-Vazquez et al. (2016), in their wide and exhaustive survey, suggest that overall "there are reasons to be optimistic about a net positive impact of decentralized systems having been introduced all over the world in the past several decades, especially when those decentralization processes have been well-designed and implemented" (p. 1121).

In the light of the importance of public investment for the accumulation of the economic and social capital of local communities and the relevant role of sub-national governments, some papers investigate the effects of decentralization on the level, quality and composition of infrastructure spending and the relationship with the financing systems: Estache and Sinha (1995), using a mixed sample of industrialized and developing countries, find that decentralization increases both total and sub-national spending on public infrastructure; Viñuela (2015) shows that decentralization is associated with lower amounts of fixed capital formation and better quality of public infrastructure; Faguet (2004), using Bolivia as a case study, emphasizes how decentralization changes the pattern of national public investments, with local preferences and needs as main drivers of such changes; Kappeler and Välilä (2008) suggest that fiscal decentralization affects the composition of public investment, boosting economically productive investment, such as infrastructure; Kappeler et al. (2013) find that revenue decentralization fosters sub-national infrastructure investment and that such effect is inversely related with the use of earmarked grants. In more general terms, Bahl and Bird (2014) review the theoretical and practical issues underlying the decentralization of responsibility for infrastructure in developing countries and outline that the theory and the practice often diverge, i.e. the expected positive effects of decentralization, as suggested by the literature, are not confirmed in practice, if the structure of local governance and finance is weak.

The actual realization of the potential gains of decentralization in the provision of infrastructures, if any, depends however on the efficiency of procurement, especially during the execution stage. In fact, public works rely on long-term contracts, which are often incomplete (Bajari and Tadelis 2001) and such a feature crucially affects their capability of delivering the planned benefits within the costs and time agreed on in the contract (Bajari et al. 2007; Guccio et al. 2009).

No great attention has been paid to the effects of decentralization on the efficient execution of public works contracts. To the best of our knowledge, few papers have investigated these effects from different perspectives, as far as Italy is concerned. Chiappinelli (2017) focuses on the award of work contracts and finds that municipalities perform worse than all other type of contracting authorities. Decarolis and Giorgiantonio (2015) analyze the pros and cons of different local regulation suggesting, among the other things, the need for a greater coordination between the central and the local levels of government; Decarolis and Palumbo (2011) and Guccio et al. (2014a) outline the negative impact of decentralization on delays in public works while Guccio et al. (2014c), taking into account simultaneously costs overruns and delays, reach the conclusion that local governments appear to be less efficient in managing the execution process.

The present study contributes to this literature with an empirical analysis of public works execution, based on data drawn from a large sample of Italian public works in the period 2000–2005. Italy is an interesting case study in which to test the differences in efficiency across different levels of government, since all levels are involved in the infrastructure provision. Furthermore, the procurement system is highly fragmented with more than thirty thousand contracting authorities mainly of small size and often with poor administrative and technical structures (Banca d'Italia 2011). The work extends Guccio et al. (2014c), providing a more robust empirical analysis, which overcomes some of the problems arising from the use of non-parametric efficiency estimators, using both nonparametric and parametric frontier approaches, with efficiency defined as the capacity to complete the infrastructure execution within the time and costs agreed on the contracts (Guccio et al. 2012, 2014b; Finocchiaro Castro et al. 2014). Moreover, this study also examines the main determinants of the variability of efficiency across the different institutions, with a specific concern for the impact of the different levels of government.

The results conform to the ones in Guccio et al. (2014c), with a more robust approach, and show that, ceteris paribus, decentralized contracting authorities appear to be less efficient in managing the execution process, in the sense that they employ more resources to meet the targets of time and costs specified in the infrastructure contracts.

The paper is organized as follows. In Sect. 10.2 we describe the empirical strategy, in Sect. 10.3 the data and the DEA efficiency estimates are presented, in Sect. 10.4 the main empirical results are provided while in Sect. 10.5 some concluding remarks are offered.

10.2 Empirical Strategy

10.2.1 A General Overview of the Empirical Approach

In most empirical investigations the efficiency of execution of public works contracts is defined in terms of either cost overruns or time delays. Its measurement is generally carried out in terms of the relative excess costs and time with respect to the costs and the time agreed on in the original contract. These measures have two main limitations. Firstly, they actually represent productivity measures, since they do not arise from a comparison with any, however determined, efficient benchmark. Secondly, considering separately the two phenomena does not allow evaluating the overall performance of the procurer in carrying out the contract. To take account of these two limitations, we aim at measuring the procurers' capacity in achieving both the targeted results of time and costs, through a benchmarking of their performance, regarding as best performers those procurers that minimize the actual time and costs of execution of public works (Guccio et al. 2012; Finocchiaro Castro et al. 2014).

As for the methods for carrying out benchmarking, we first consider non-parametric frontiers (Guccio et al. 2012). A well-established and useful non-parametric methodology certainly is Data Envelopment Analysis—DEA (Charnes et al. 1978), a technique generally used to estimate a production function, which is capable to handle multiple inputs and outputs without requiring a priori assumptions of a specific functional form on production technologies and the relative weighting scheme. However, one of the main problems arising from the use of non-parametric frontier estimators like DEA is that they are very sensitive to outliers and extreme data points since they do not allow for random noise in the Data Generating Process (DGP) (Simar and Wilson 2008). Therefore, to deal with this problem, we compare the DEA outcome of our empirical analysis with a different estimate of efficiency, carried out on the basis of a parametric Stochastic Frontier Approach—SFA (Aigner et al. 1977; Meeusen and Van den Broeck 1977). In the next paragraphs we provide a brief illustration of the two approaches.

10.2.2 DEA Estimation

In line with the notation used by Simar and Wilson (2008), we consider a production process using the vector of inputs $\{x = x_i, i = 1, \ldots, n\} \in \Re_+^N$ to produce a vector of outputs $\left\{y = y_s, s = 1, \ldots, m\right\} \in \Re_+^M$. The production process is constrained by the production possibility set Ψ, which is the set of physically attainable points (*x, y*) given by:

$$\Psi = \left\{(x, y) \in \Re_+^{N+M} | = (x, y) \text{ is feasible}\right\} \tag{10.1}$$

The efficiency of a generic decision-making unit (DMU) like, for example, a procurer carrying out a public work contract is measured by the distance between the observed input-output mix and the optimal mix located on the frontier of Ψ, which is the boundary of optimal production plans.

The single DMU efficiency score, as defined by Debreu (1951) and Farrell (1957) in the input-oriented case, is:

$$\lambda(x, y) = \inf\{\lambda | (\lambda x, y) \in \Psi\} \tag{10.2}$$

where a value of $\lambda(x, y) < 1$ measures the radial distance of the DMU from the full efficient frontier and a value of $\lambda(x, y) = 1$ means that the DMU is fully efficient. Being Ψ the frontier and $\lambda(x, y)$ unknown, they should be estimated from a sample of i.i.d. observations $\mathcal{X}_n = \left\{(x_i, y_i), i = 1, \ldots, n\right\}$.

The DEA estimator assumes the convexity of the hull and, thus, under the hypothesis of constant returns to scale (CRS), can be defined as:

$$\hat{\Psi}_{\mathrm{DEA}} = \left\{ (x, y) \in \mathbb{R}_{+}^{N+M} | y \leq \sum_{i=1}^{n} \gamma_i x_i ; x \geq \sum_{i=1}^{n} \gamma_i y_i , \right.$$
$$\left. \text{for}(\gamma_1, \ldots, \gamma_n) \text{ suchthat } \gamma_i \geq 0, i = 1, \ldots, n \right\} \tag{10.3}$$

A DEA non-parametric estimator of the efficiency scores can be calculated by replacing the true production set Ψ in (10.2) with the estimator $\hat{\Psi}_{\mathrm{DEA}}$:

$$\hat{\lambda}_{\mathrm{DEA}}(x, y) = \inf \left\{ \theta | (\theta x, y) \in \hat{\Psi}_{\mathrm{DEA}} \right\} \tag{10.4}$$

where, by construction, $\hat{\lambda}_{\mathrm{DEA}}(x, y) \leq \lambda(x, y)$ (Simar and Wilson 2008).

Since DEA does not allow for any statistical inference and measurement error, Simar and Wilson (1998, 2000) introduced a bootstrapping methodology to determine the statistical properties of DEA estimators.[1] The idea is to simulate a true sampling distribution by mimicking their DGP—here the outputs from DEA (Simar and Wilson 2008)—by constructing a pseudo-data set and re-estimating the DEA model with this new data set. Repeating the process many times allows for achieving a good approximation of the true distribution of the sampling. The Simar and Wilson (1998) bootstrap procedure gives an estimated bias and the variance, which in turn provide confidence intervals. Later, Simar and Wilson (2000) provided an improved and more flexible procedure that automatically corrects for biases without explicit use of a noisy bias estimator.[2] Thus, the latter bootstrapping algorithm (Simar and Wilson 2000) is used in this paper to control for consistency among the efficiency estimates. This procedure is also adopted because it does not assume homogeneity on the distribution of efficiency, which may be too restrictive for this analysis and may invalidate the inference on the efficiency estimates.[3]

10.2.3 SFA Estimation

As mentioned earlier, we also use the SFA approach, to overcome some limitations of non-parametric techniques, mainly the fact that the latter do not accommodate for noise, and therefore can be considered as a non-statistical technique where the inefficiency scores and the envelopment surface are "calculated" rather than estimated.

In our exercise, in order to measure DMUs technical efficiency scores we have specified a cross-section stochastic production frontier with the Cobb-Douglas func-

[1]However, some major issues regarding the use of asymptotic results and bootstrap remain: first, the high sensitivity of non-parametric approaches to extreme values and outliers; second, the way to allow stochastic noises in a non-parametric frontier (Simar and Wilson 2008). Another common problem is given by the dimensionality space (i.e. number of input and output variables included in the efficiency analysis) and by the reliability of the results obtained through the DEA model.

[2]See Simar and Wilson (2008) for technical details on the bootstrap procedures.

[3]See Simar and Wilson (2008) for a more detailed discussion of this point.

tional form (Aigner et al. 1977; Meeusen and Van den Broeck 1977). More precisely, we estimate a Cobb-Douglas production function with half-normal distribution. Furthermore, since in the SFA efficiency estimates individual efficiency scores are unobservable, and can be predicted by the mean—or the mode—of the conditional distribution of the efficiency scores, in our empirical exercise we use the technique suggested by Jondrow et al. (1982).

10.2.4 Accounting for Environmental Variables in DEA and in SFA

The final step of our analysis is to investigate the impact of environmental variables (Z_i) on technical efficiency in public work execution obtained both with DEA and SFA.

As for the DEA estimates, Simar and Wilson (2007) underline that traditional regression yields biased estimates due to serial correlation of the error term (ε_i) with environmental variables (Z_i). Therefore, they suggest applying a semi-parametric two-step bias-corrected truncated estimator that they indicate as the only known method for ensuring a feasible and consistent inference on the second stage regression (Simar and Wilson 2011).

Specifically, in this paper the Algorithm#2 of Simar and Wilson (2007) is applied, where the unobserved regressand λ_i is replaced by its bias-corrected estimate $\hat{\hat{\lambda}}_i$ obtained using DEA with bootstrap and a maximum likelihood truncated estimator. More specifically, the second-stage regression can be summarized as follows:

a. Apply maximum likelihood to estimators of $\hat{\hat{\lambda}}_i$ to obtain estimates of $\left(\hat{\beta}, \hat{\sigma}\right)$ in a truncated regression, where, i = 1, ..., n, is the number of DMUs.
b. Repeat the steps from (i) to (iii), L times to obtain b numbers of bootstrap estimates of $\left\{(\hat{\beta}^*, \hat{\sigma}_\varepsilon^*)_b\right\}_{b=1}^{L}$:

   (i) For each DMU, $i = 1, \ldots, n$, draw ε_i from the left-truncated $\left(1 - z_i\hat{\beta}\right)$ normal distribution;
   (ii) Use ε_i for each DMUs $i = 1, \ldots, n$, to calculate fitted DEA scores: $\hat{\hat{\lambda}}_i^* = z_i\hat{\beta} + \varepsilon_i$;
   (iii) Apply maximum likelihood to estimators of $\hat{\hat{\lambda}}_i^*$ to obtain estimates of $(\hat{\beta}^*, \hat{\sigma}_\varepsilon^*)$ in a truncated regression.

c. Compute the bias-corrected estimator of $\hat{\hat{\beta}}$ as well as the percentile bootstrap confidence intervals at a given level of significance using the bootstrap estimates obtained from the previous step $\left\{(\hat{\beta}^*, \hat{\sigma}_\varepsilon^*)_b\right\}_{b=1}^{L}$ and the original parameters.

Finally, to validate the robustness of our results on the role of environmental variables in explaining DMUs efficiency, we use the SFA approach, as an alternative to DEA, to examine the efficiency of DMUs and its determinants.

A large body of early SFA literature has often incorporated environmental variables using a two-step approach (i.e. in the first step, SFA estimates of inefficiency are obtained without controlling for these factors while in the second one, the estimated inefficiency scores are regressed with them).[4] However, as pointed out by Greene (2008), this approach leads to severely biased results. Thus we shall only focus on model extensions based on simultaneous estimation. More precisely, we use the approach proposed by Kumbhakar et al. (1991) and further developed by Battese and Coelli (1995) that avoids the problems associated with the two-stage approach. In fact, in the one-stage specification approach proposed by Battese and Coelli (1995) technical inefficiency is estimated from the stochastic frontier and simultaneously explained by a set of environmental variables (Zi). This approach avoids the inconsistency problems of the SFA two-stage approach adopted by early literature, as illustrated in Wang and Schmidt (2002).

10.3 Data and Efficiency Estimates

To perform the efficiency estimates, we use a sample of 3113 Italian public works contracts for roads and highways, with data collected by the Italian Public Contracts Authority (*Autorità di Vigilanza sui contratti pubblici di lavori, servizi e furniture*, AVCP). The estimated engineering costs of these contracts range from 150,000 euros to 5 million euros.

The DEA efficiency estimates are computed according to different classes of work values and types of works, namely maintenance work or new work. To check for the robustness of the DEA findings with respect to the sampling variation, a bootstrap procedure with 1,000 bootstrap draws is implemented (Simar and Wilson 1998) to correct the bias in the DEA estimators and to obtain the confidence intervals. The kernel density estimates for the DEA efficiency scores by type of public work are shown in Fig. 10.1. The same figure shows the unbiased DEA scores obtained using the bootstrap method.

As mentioned in Sect. 10.2, we also estimate the efficiency of public works execution using the SFA approach. Table 10.1 reports the statistics of the efficiency estimates using the DEA approach and the SFA distance function.

Figure 10.2 shows a scatterplot of the efficiency estimates using the SFA distance function and the DEA approach (both uncorrected and bias corrected). The high correlations between the DEA and SFA estimates displayed in Fig. 10.2 suggest that both approaches perform well in terms of external validity.

Table 10.2 provides the statistics of the efficiency estimates by type of contracting authority, according to an institutional differentiation relevant to the Italian pub-

[4]For a discussion on SFA one and two-step and DEA two-stage see Schmidt (2011).

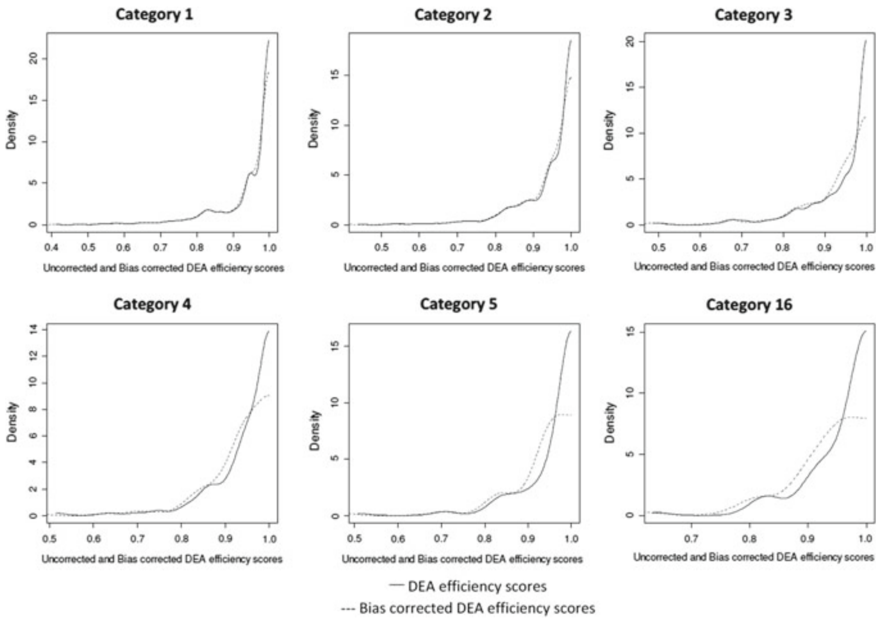

Fig. 10.1 The kernel density distribution of DEA efficiency scores by type of public work. *Note* Kernel density functions of public works contracts efficiencies derived from both uncorrected and bias corrected DEA efficiency scores using univariate kernel smoothing distribution and the appropriate bandwidth. The reported kernel density estimates employ the reflection method described by Silverman (1986) and Scott (1992). *Source* Authors' elaboration on data provided by AVCP and by Guccio et al. (2012)

Table 10.1 Statistics of DEA/SFA efficiency estimates by category of public work

Category		Obs.	DEA estimates		SFA estimates	
			Mean	St. dev.	Mean	St. dev.
Repairs	150,000–500,000	1,811	0.9301	0.0871	0.9273	0.0799
New		810	0.9305	0.0795	0.9184	0.0880
Repairs	500,000–1,500,000	247	0.9223	0.0887	0.9155	0.1008
New		104	0.9249	0.0938	0.9102	0.0960
Repairs	1,500,000–5,000,000	85	0.9296	0.0880	0.9104	0.0827
New		56	0.9279	0.0842	0.8944	0.1024
All sample		3,113	0.9294	0.0855	0.9259	0.0876

Source Authors' elaboration on data provided by AVCP and by Guccio et al. (2012)

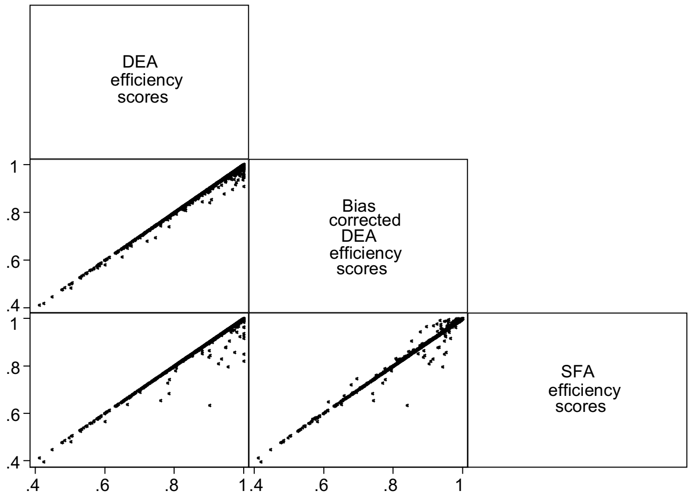

Fig. 10.2 Scatterplot between efficiency estimates. *Source* Authors' elaboration on data provided by AVCP and by Guccio et al. (2012)

lic works sector[5]: centralized contracting authorities (CENTRALIZED; i.e., ministries, other central administrations, public enterprises, and private concessionaires) [6]; and decentralized contracting authorities (DECENTRALIZED; regions, provinces, and municipalities above and below 5,000 inhabitants).[7] As shown in Table 10.2, DECENTRALIZED authorities account for 80.73% of the sample. Within these, large municipalities play a major role, representing almost 42% of DECENTRALIZED public works. In addition, the decentralized contracting authorities seem, on average, to be systematically less efficient than the centralized ones according to both the DEA and SFA approaches.

To assess whether certain groups of observations are more efficient, efficiency measurement literature proposes applying various approaches.[8] In the next section, we apply different techniques to investigate the observed differences in the efficiency of public works execution.

[5]A similar differentiation of Italian contracting authorities can be found in Bandiera et al. (2009) and Guccio et al. (2014a).

[6]Private concessionaires of public infrastructures such as motorways, when acting as contracting authorities, must follow the Italian code of public contracts for works, services, and supplies (Legislative Decree No. 50/2016, and following modifications).

[7]This split was performed because small municipalities might not be able to exploit economies of scale and so may exhibit a lower administrative capacity when monitoring the implementation of a contract.

[8]See the surveys by Greene (2008) and Simar and Wilson (2008).

Table 10.2 DEA/SFA efficiency estimates by contracting authorities

Contracting authorities	Obs.	DEA estimates		SFA estimates	
		Mean	St. dev.	Mean	St. dev.
CENTRALIZED	600	0.9440	0.0793	0.9422	0.0794
DECENTRALIZED	2,513	0.9233	0.0883	0.9219	0.0890
Region & province councils (R&P)	*874*	*0.9259*	*0.0958*	*0.9243*	*0.0966*
Large municipalities (LM)	*1,318*	*0.9241*	*0.0820*	*0.9232*	*0.0829*
Small municipalities (SM)	*321*	*0.9126*	*0.0911*	*0.9116*	*0.0909*
Total	3,113	0.9294	0.0855	0.9259	0.0876

Source Authors' elaboration on data provided by AVCP and by Guccio et al. (2012)

10.4 Empirical Findings

To identify the most efficient groups of contracting authorities and, therefore, the best practices, we assess the equality of the distributions of the DEA/SFA efficiency scores for the different DECENTRALIZED authority groups against those of the CENTRALIZED authorities, as proposed by related literature.

First, to test for significant differences in the DEA/SFA efficiency estimates of the contracting authorities groups, we perform several tests often used in related literature (i.e., the Mann–Whitney, Kolmogorov–Smirnov, and Epps–Singleton tests). In addition, for the DEA bias-corrected efficiency scores, we use the bootstrap-based procedure proposed by Simar and Wilson (2008, 471–476). Table 10.3 presents the results. In almost all cases, the null hypothesis is rejected. Therefore, it seems that, on average, the public works performed by the CENTRALIZED group are executed more efficiently. In addition, the kernel density functions for the DEA efficiency estimates by type of contracting authority are displayed in Fig. 10.3. These density functions confirm the above-mentioned results.

Second, in order for these differences in performance to be significantly attributed to the nature of the contracting authorities, we must control for other environmental factors that, in principle, may affect the execution performance. Therefore, we follow the two-step approach, suggested by Coelli et al. (1998), to regress DEA efficiency estimates against a set of covariates. Table 10.4 shows the covariates used to perform the two-stage analysis, as well as their meanings and descriptive statistics.[9]

[9] Our aim here is to assess the observed differences in efficiency per contracting authority group. We do not have a detailed discussion of these covariates, borrowing quite closely from Guccio et al. (2014a). However, we do not use the total value and the duration of works, as estimated by the contracting authority at the bidding stage, since such variables are strictly correlated with the variables used in the first stage. As an alternative, to control for complexity, we have used the classes of work values. Furthermore, we have also performed several estimates including other covariates with results substantially identical to the ones reported. All estimates are available from authors upon request.

Table 10.3 Testing for differences on the average efficiency scores of the different groups of contracting authorities

Efficiency estimates	Centralized versus decentralized				Centralized versus R&P				Centralized versus LM				Centralized versus SM			
	MW	KS	ES	SW	MW	KS	ES	SW	MW	KS	ES	SW	MW	KS	ES	SW
DEA	−6.236	0.263	65.610		−1.964	0.161	19.313		−7.057	0.273	79.822		−7.441	0.328	70.507	
	(0.000)	(0.000)	(0.001)		(0.052)	(0.000)	(0.001)		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	
DEA *biased corrected scores*				84.214				9.132				92.818				65.409
				(0.000)				(0.003)				(0.000)				(0.000)
SFA	−5.366	0.234	57.505		−1.515	0.160	18.369		−6.018	0.269	67.550		−6.836	0.317	64.803	
	(0.000)	(0.000)	(0.000)		(0.129)	(0.000)	(0.001)		(0.000)	(0.000)	(0.000)		(0.000)	(0.000)	(0.000)	

Note Mann–Whitney (MW) test; Kolmogorov–Smirnov (KS) two-sample test; Epps–Singleton (ES) two-sample test; (SW) mean equivalence test proposed by Simar and Wilson (2008, pp. 471–476). *p*-values in parentheses
Source: Authors' elaboration on data provided by AVCP and by Guccio et al. (2012)

The two-stage analysis is frequently implemented after conducting traditional DEA analyses. However, different estimators have been proposed (Simar and Wilson 2011). Here, we apply both semi-parametric (Simar and Wilson 2007) and parametric (Banker and Natarajan 2008) estimators. Moreover, we employ the SFA approach using the Battese and Coelli (1995) one-stage specification, according to which technical efficiency is estimated from the stochastic frontier and simultaneously explained by a set of covariates used in the second stage of the DEA approach.[10]

Tables 10.5, 10.6 and 10.7 provide the results of the estimates. Table 10.5 reports the estimates obtained following the Simar and Wilson (2007) procedure. Table 10.6 reports the estimates computed according to Banker and Natarajan (2008), and Table 10.7 reports the SFA estimates. In each group of estimates, the first two columns are baseline specifications, with the control set limited to the type of contracting authority (using different disaggregations). Then, the column pairs (3, 4), show the effect of the "other" covariates on efficiency levels. All these estimates include a full set of regional fixed effects. Finally, the column pairs (5, 6) add year and provincial fixed effects.[11] In all estimates, the omitted category is the CENTRALIZED contracting authorities.

The results reported in the abovementioned Tables show quite clearly that DECENTRALIZED contracting authorities appear to be less efficient than the CEN-

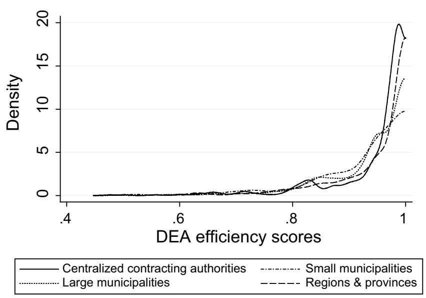

Fig. 10.3 The kernel density distribution of DEA efficiency scores by type of contracting authorities. *Note* Kernel density functions of public works AGGIUNGERE dopo contracts efficiencies derived from both uncorrected and bias corrected DEA efficiency scores using univariate kernel smoothing distribution and the appropriate bandwidth. The reported kernel density estimates employ the reflection method described by Silverman (1986) and Scott (1992). *Source* Authors' elaboration on data provided by AVCP and by Guccio et al. (2012)

[10]This approach avoids the inconsistency problems of the SFA two-stage approach adopted by early literature, as explained in Wang and Schmidt (2002). For a discussion on SFA one and two-step and DEA two-stage see Schmidt (2011).

[11]We have introduced fixed time effects since the database is time truncated and it includes the contracts awarded in the period 2000–2004 and completed by 2005. Moreover, it has to be noted that the inclusion of provincial fixed effects enable us to control for different environmental and social characteristics (i.e. different levels of efficiency of the public bureaucracy, presence of criminal organizations, etc.) that in principle could affect the public work execution.

Table 10.4 Employed covariates in the second stage analysis

Variables	Definition	Mean	St. dev.
CENTRALIZED	Dummy for central authorities	0.1927	0.3945
DECENTRALIZED	Dummy for sub-national authorities	0.8073	0.3945
R&P	*Dummy for regional and provincial authorities*	*0.2808*	*0.4494*
LM	*Dummy for large municipalities*	*0.4234*	*0.4942*
SM	*Dummy for small municipalities*	*0.1031*	*0.3042*
NEW_PW	Dummy for type of infrastructure work (new/repair)	0.3116	0.4632
PW_CLASS_1	Dummies for the class of works with reserve price between 150,000 and 500,000 euro	0.8420	0.3648
PW_CLASS_2	Dummies for the class of works with reserve price between 500,000 and 1,500,000 euro	0.1128	0.3163
PW_CLASS_3	Dummies for the class of works with reserve price between 1,500,000 and 5,000,000 euro	0.0453	0.2080
WCI	Weighted public work composition index	1.1004	0.2305
PROJECT	Dummy for the completion of the project design by the firm	0.8304	0.3754
SUBCONTRACT	Dummy for subcontracting	0.7555	0.4298
DISPUTE	Dummy for legal dispute between firm and contracting authority	0.0177	0.1318
RELATIONSHIP	Relationships between firm and contracting authority	2.7677	3.7349
FINANCE	Dummy for the financial source of the work	0.4128	0.4924
Other covariates			
REGION_j	Dummies for region in which the infrastructure takes place: $j = 1$ to 20		
YEAR_i	Dummies for year of public work award: $i = 2000, 2001, 2002, 2003$		
PROVINCE_z	Dummies for province in which the infrastructure takes place		

Note See Guccio et al. (2014a) for an exhaustive discussion on those covariates as determinant of the efficiency in infrastructure provision and public works procurement in Italy
Source Authors' elaboration on data provided by AVCP by Guccio et al. (2012, 2014a)

TRALIZED authorities. These results are robust to different estimators and different specifications.[12]

10.5 Concluding Remarks

This study uses both the DEA and the SFA approaches to determine performance levels in a large sample of Italian public works contracts for roads and highways. In

[12]Overall, the results of other controls are in line with literature previously reported.

Table 10.5 Estimation results for bootstrap truncated regression—public works with a value over 150,000 EUR

Variables	Truncated regression—DEA bias-adjusted coefficient (a)					
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	0.9440***	0.9430***	0.9437***	0.9481***	0.9639***	0.9615***
	(0.0069)	(0.0132)	(0.0137)	(0.0138)	(0.0826)	(0.0825)
DECENTRALIZED	−0.0142***		−0.0199***		−0.0162***	
	(0.0042)		(0.0046)		(0.0046)	
R&P		−0.0114**		−0.0177***		−0.0127**
		(0.0047)		(0.0051)		(0.0052)
LM		−0.0157***		−0.0209***		−0.0177***
		(0.0045)		(0.0049)		(0.0049)
SM		−0.0164***		−0.0242***		−0.0229***
		(0.0062)		(0.0067)		(0.0067)
NEW_PW			0.0013	0.0013	0.0006	0.0008
			(0.0033)	(0.0033)	(0.0033)	(0.0033)
PW_CLASS_1			0.0185**	0.0192**	0.0147**	0.0159**
			(0.0075)	(0.0076)	(0.0074)	(0.0075)
PW_CLASS_2			0.0065	0.0069	0.0042	0.0050
			(0.0085)	(0.0085)	(0.0083)	(0.0083)
WCI			−0.0127*	−0.0119*	−0.0137**	−0.0125*
			(0.0067)	(0.0068)	(0.0066)	(0.0067)
PROJECT			0.0108**	0.0109***	0.0060	0.0062
			(0.0042)	(0.0042)	(0.0043)	(0.0043)
SUBCONTRACT			−0.0047	−0.0046	−0.0034	−0.0032
			(0.0040)	(0.0040)	(0.0039)	(0.0039)
RELATIONSHIP			−0.0076	−0.0078	−0.0086	−0.0092
			(0.0117)	(0.0117)	(0.0115)	(0.0115)
DISPUTE			−0.0006	−0.0005	−0.0005	−0.0004
			(0.0004)	(0.0004)	(0.0004)	(0.0004)
FINANCE			0.0107***	0.0108***	0.0077**	0.0077**
			(0.0034)	(0.0034)	(0.0034)	(0.0034)
Control for region	Yes	Yes	Yes	Yes	No	No
Control for year of award	No	No	No	No	Yes	Yes
Control for province	No	No	No	No	Yes	Yes
Observation	3,113	3,113	3,113	3,113	3,113	3,113

***, ** and *: Coefficients are significantly different from zero at the 99, 95 and 90% confidence levels respectively
(a) DEA bootstrapped truncated estimates algorithm 1 (n = 1000), Simar and Wilson (2007)
Source Authors' elaboration on data provided by AVCP and by Guccio et al. (2012, 2014a)

Table 10.6 Estimation results for linear regression—public works with a value over 150,000 EUR

Variables	Robust OLS DEA second stage regression (b)					
	(1)	(2)	(3)	(4)	(5)	(6)
INTERCEPT	0.9153***	0.9150***	0.9143***	0.9124***	0.9730***	0.9593***
	(0.0648)	(0.0644)	(0.0649)	(0.0647)	(0.0151)	(0.0162)
DECENTRALIZED	−0.0161***		−0.0211***		−0.0174***	
	(0.0041)		(0.0049)		(0.0050)	
R&P		−0.0129***		−0.0186***		−0.0135**
		(0.0048)		(0.0055)		(0.0056)
LM		−0.0178***		−0.0224***		−0.0191***
		(0.0045)		(0.0052)		(0.0052)
SM		−0.0185***		−0.0253***		−0.0239***
		(0.0061)		(0.0068)		(0.0069)
NEW_PW			0.0010	0.0012	0.0005	0.0007
			(0.0032)	(0.0032)	(0.0033)	(0.0033)
PW_CLASS_1			0.0150*	0.0157*	0.0113	0.0125
			(0.0080)	(0.0080)	(0.0080)	(0.0080)
PW_CLASS_2			0.0035	0.0039	0.0013	0.0021
			(0.0092)	(0.0092)	(0.0091)	(0.0091)
WCI			−0.0119	−0.0110	−0.0129*	−0.0116
			(0.0072)	(0.0073)	(0.0073)	(0.0073)
PROJECT			0.0106**	0.0107**	0.0058	0.0060
			(0.0045)	(0.0045)	(0.0047)	(0.0047)
SUBCONTRACT			−0.0051	−0.0050	−0.0038	−0.0036
			(0.0044)	(0.0044)	(0.0043)	(0.0044)
RELATIONSHIP			−0.0088	−0.0092	−0.0099	−0.0105
			(0.0149)	(0.0150)	(0.0155)	(0.0156)
DISPUTE			0.0007	0.0006	0.0006	0.0005
			(0.0005)	(0.0005)	(0.0005)	(0.0005)
FINANCE			0.0104***	0.0104***	0.0074**	0.0074**
			(0.0038)	(0.0038)	(0.0037)	(0.0037)
Control for region	Yes	Yes	Yes	Yes	No	No
Control for year of award	No	No	No	No	Yes	Yes
Control for province	No	No	No	No	Yes	Yes
Observation	3,113	3,113	3,113	3,113	3,113	3,113
Adj. R-square	0.0613	0.0709	0.0762	0.0784	0.1288	0.1371

***, ** and *: Coefficients are significantly different from zero at the 99%, 95% and 90% confidence levels respectively
(b) DEA two stage OLS estimates (Banker and Natarajan 2008)
Source Authors' elaboration on data provided by AVCP and by Guccio et al. (2012, 2014a)

Table 10.7 Estimation results for SFA—public works with a value over 150,000 EUR

Variables	SFA one stage models—explanatory environmental variables					
	(1)	(2)	(3)	(4)	(5)	(6)
INTERCEPT	−4.3168***	−4.4490***	−4.4180***	−4.4541***	−4.0099***	−3.9952***
	(0.0577)	(0.0630)	(0.2143)	(0.2141)	(0.2549)	(0.2556)
DECENTRALIZED	−0.1938***		−0.3979***		−0.3317***	
	(0.0612)		(0.0733)		(0.0814)	
R&P		−0.1494*		−0.3183***		−0.2525***
		(0.0799)		(0.0832)		(0.0915)
LM		−0.1486**		−0.3607***		−0.3294***
		(0.0749)		(0.0788)		(0.0874)
SM		−0.4357***		−0.7353***		−0.6216***
		(0.1011)		(0.1068)		(0.1175)
NEW_PW			0.0621	0.0340	0.0497	0.0302
			(0.0576)	(0.0581)	(0.0620)	(0.0623)
PW_CLASS_1			0.2972**	0.3119**	0.3091**	0.3235**
			(0.1315)	(0.1310)	(0.1362)	(0.1359)
PW_CLASS_2			0.1183	0.1206	0.1191	0.1236
			(0.1483)	(0.1476)	(0.1517)	(0.1514)
WCI			−0.2514**	−0.2381**	−0.3584***	−0.3229***
			(0.1139)	(0.1143)	(0.1227)	(0.1234)
PROJECT			0.3065***	0.3377***	0.2304***	0.2480***
			(0.0721)	(0.0725)	(0.0760)	(0.0761)
SUBCONTRACT			−0.0574	−0.0082	−0.1038	−0.0689
			(0.0627)	(0.0638)	(0.0648)	(0.0656)
RELATIONSHIP			−0.5519***	−0.5581***	−0.5179**	−0.5486***
			(0.1996)	(0.2013)	(0.2037)	(0.2051)
DISPUTE			−0.0074	−0.0050	−0.0192***	−0.0165***
			(0.0057)	(0.0059)	(0.0058)	(0.0060)
FINANCE			0.2351***	0.2730***	0.1575***	0.1837***
			(0.0549)	(0.0558)	(0.0581)	(0.0587)
Control for region	Yes	Yes	Yes	Yes	No	No
Control for year of award	No	No	No	No	Yes	Yes
Control for province	No	No	No	No	Yes	Yes
Observation	3,113	3,113	3,113	3,113	3,113	3,113
Log likelihood	3,611,923	4,132,071	4,166,413	4,177,088	4,298,851	4,305,714
Wald (Prob > χ^2)	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

***, ** and *: Coefficients are significantly different from zero at the 99, 95 and 90% confidence levels respectively
Source Authors' elaboration on data provided by AVCP and by Guccio et al. (2012, 2014a)

particular, the DEA—in addition to the bootstrap technique—and the SFA estimators are used to assess whether the characteristics of the contracting authority affect the efficient execution of the contracts.

The empirical results reveal that the decentralized authorities performance in the execution of public works is systematically worse than the one of central authorities, generating cost overruns and delays when providing infrastructures. These results suggest that the decentralized authorities might lack the adequate bureaucratic structures to manage the execution of public works contracts efficiently. As a result, inefficiencies are more likely to be generated.

These issues are quite relevant in the Italian debate on public procurement, which has been recently reformed by the Procurement Code (Codice dei contratti pubblici).[13] The system is evolving towards establishing mandatory consortia of small municipalities for centralizing procurement activities and introducing a qualification system for contracting authorities to verify their capability in running procurement activities according to the type, size and complexity of the contract.[14] The definition of the qualification system is under discussion and it seems oriented toward fixing specific requirements for all the procurement stages (planning, design, contract award and execution) to be fulfilled by public organizations in order to be included in the List of contracting authorities, operated by the National Anticorruption Authority.

In general terms, the provisions contained in the Code seem to move in the right direction, stressing the importance of adequate administrative and technical structures for managing the public works procedures and activities in an efficient way. To be effective, however, the system needs to be dynamic, so as to provide public organizations with real incentives toward better performance rather than just favoring bureaucratic compliance.

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[13]Legislative Decree n. 50/2016, and following modifications

[14]The qualification will be required for works above 150,000 euros.

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Chapter 11
Urban Sprawl and Local Public Service Costs in Japan

Tomoya Ida and Hiroshi Ono

Abstract In this chapter, we measure the extent to which the suppression of urban sprawl reduces the marginal cost of providing local public services in Japan by estimating the local expenditure function. We expand on existing estimates in Japan by establishing a theoretical framework to economically interpret the estimated parameters. Specifically, we first derive the estimated local expenditure function by combining the supply and demand functions for local public services. Second, we implement the estimation using cross-sectional data from 2008 for 1085 Japanese municipalities. Overall, urban sprawl growth has a positive and significant impact on local expenditure, with the parameters for the relationship estimated to be between 0.011 and 0.055. This statistically significant and theoretically consistent outcome suggests that, in Japan, a one percent decrease in urban sprawl can reduce the marginal cost of providing local public services by 0.053–0.113%. These results contribute to the quantitative evaluation of compact cities.

Keywords Compact city · Quantitative evaluation · Urban sprawl · Public costs · Japanese municipalities

11.1 Introduction

Recently, several Japanese municipalities have used the phrase “compact city” in their town development slogans, as this concept of the urban idea has rapidly grown in popularity in Japan. The benefits and problems of compact cities have been discussed from economic, environment, community, and other viewpoints. Thus, the arguments regarding these cities are often mixed, and different scholars offer dif-

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ferent opinions. This inconsistency of viewpoints may cause confusion, and further analysis of compact cities is necessary to distinguish between these different viewpoints. Our analysis is conducted from the perspective of economics with a specific focus on public finance.

To understand the benefits of compact cities from a public finance perspective, we consider their impacts on urban sprawl. Urban sprawl causes three problems. First, it leads local governments to supply inefficient quantities of local public services. For example, providing a certain quality of garbage collection requires more time and effort in sprawling cities than in compact cities. Second, in sprawling cities, local government must choose inefficient locations for infrastructure that requires a certain level of regular maintenance and repair. Third, local governments must provide daily services, such as water, gas, and electricity, to all residents, and sprawling residential areas increase the quantity of these services. The formation of a compact city could reduce these three costs of urban sprawl.

Compact cities can also be criticized from a public finance perspective. For example, compact cities feature frequent congestion and poor living environments, among other issues, and these issues lead to additional costs. The provision of garbage collection, for instance, takes longer in areas with more traffic congestion. In areas with poor living conditions, more police are required to handle higher crime rates. In the first example, compact cities reduce the efficiency of local public service provision, and in the second example, compact cities increase the quantity of services. Both effects tend to increase local public costs.

Numerous studies address this issue in the context of Europe and the U.S. However, they do not necessarily find the same impact of the urban structure on the cost of local public services. Some studies empirically show that the cost of providing local public services increases in dense cities because of many social factors, including poverty and crime (e.g., Ladd 1992, 1994; Ladd and Yinger 1989; Pflieger and Ecoffey 2011). However, other researchers, including Carruthers and Ulfarsson (2003, 2008) and Hortas-Rico and Sole-Olle (2010), argue that low-density development leads to greater costs of providing local public services.

Existing studies in the Japanese context measure these effects using different methods from those used by the above analyses. For instance, Kuramoto (2010) does not empirically find any negative causality between compact cities and local expenditures, whereas other studies do find such a causality (e.g., Kawasaki 2009; Kutsuzawa 2015, 2016). However, no previous studies have estimated the extent to which the cost of providing local public services is reduced by the formation of compact cities. Such an estimation requires the quantitative evaluation of compact cities. To achieve this aim, we must tackle the following three issues found in the existing estimations for Japan.

The first issue is the lack of an explicit theoretical framework that provides a perspective for empirical analyses. The extent to which the formation of compact cities reduces local public costs depends not only on the current level of urban compactness but also on the change in urban compactness. Although existing regression analyses confirm the existence of effects, the quantitative evaluation of compact cities requires the estimated parameters to be economically interpreted as well. The second issue is that previous studies do not distinguish between local expenditures and local public service provision costs. Local expenditures include not only the cost of providing local public services but also residents' demand for local public services. As previously mentioned, the formation of compact cities reduces the costs of providing local public services but does not reduce local expenditures, and, thus, this distinction is important. The third issue is insufficient consideration of the various urban structures. To better consider these structures, we need to establish methods that can express a variety of suburban development types.

In light of the prior literature and current political discussions, this chapter measures the extent to which the suppression of urban sprawl reduces the marginal cost of providing local public services using local expenditure models. Specifically, we first derive the local expenditure function by combining the supply and demand functions for local public services. This theoretical analysis addresses the first and second issues described above. Second, we use a cross-sectional dataset comprising 1085 Japanese municipalities in 2008 for the estimation. We employ proxy variables reflecting the diversity of urban structure to address the third issue. Finally, we use the empirical results to calculate the elasticity of the marginal local public cost with respect to urban sprawl. This elasticity indicates the percentage decrease in the marginal cost of providing local public services given a one percent decrease in urban sprawl. We find it ranges from 0.053 to 0.113. This measurement contributes to the quantitative evaluation of compact cities.

The remainder of the chapter is organized as follows. Section 11.2 presents the measurements of urban sprawl as well as our proxy variables for urban structures. Section 11.3 derives the theoretical model, which accounts for the correlation between urban structures and local public costs. Section 11.4 discusses the data and variable selection, and Sect. 11.5 presents the empirical results. Section 11.6 concludes the discussion.

11.2 Urban Sprawl Measurements

Here, we discuss the methodology for measuring urban sprawl. As no statistical data specifically measure urban sprawl in Japan, proxy variables are often used for this purpose. We also follow such a methodology for this analysis. Specifically, we choose proxy variables that directly indicate the phenomenon or have a high correlation with the characteristics of the phenomenon. The definition of a phenomenon is generally used to formulate these variables. Thus, to support our choice of variables, we review the definition of urban sprawl.

The OECD (2012, p. 16) defines urban sprawl as the "Uncontrolled expansion of urban development characterized by low density, segregated land use and inefficient infrastructure provision. Urban sprawl can take the form of 'leapfrog development' whereby development 'leaps' over undeveloped land." Additionally, existing studies in the fields of city planning and social science propose various definitions (e.g.,

Table 1 in Jaeger et al. 2010). However, as Johnson (2001) asserts, urban sprawl has no universal definition, perhaps because it can take various patterns.

For this analysis, we require an alternative definition of urban sprawl to construct an appropriate proxy. As urban sprawl refers to suburban development, we must be able to identify characteristics that we can use as the components of a definition. Regarding this matter, Galster et al. (2001, p. 685) propose the following definition of urban sprawl: "Sprawl is a pattern of land use in an urbanized area that exhibits a low level of eight distinct dimensions: density, concentration, centrality, clustering, continuity, nuclearity, mixed uses, and proximity."

First, density is the average number of residential units per square mile of developable land in an urban area. Second, concentration is the degree to which development is disproportionately located over a relatively small part of the total urbanized area rather than being evenly spread. Third, centrality is the degree to which residential or nonresidential development (or both) is located close to the central business district (CBD) of an urban area. Fourth, clustering is the degree to which development is tightly clustered to minimize the amount of land used within each square mile of developable land occupied by residential or nonresidential development. Fifth, continuity is the degree to which developable land has been built upon at urban densities in an unbroken fashion. Sixth, nuclearity is the extent to which an urban area is characterized by a mononuclear (as opposed to polynuclear) pattern of development. Seventh, mixed use means the degree to which two different land uses commonly exist within the same small area. Finally, proximity is the degree to which differently utilized land areas are close to each other across an urbanized area.

The definition of Galster et al. (2001) encapsulates the diversity of the notion of urban sprawl. However, because no data are available for some of these dimensions in Japan, we employ only four of them: density, concentration, centrality, and clustering. These dimensions are only some components of the definition, and, thus, to construct a proxy variable, we must discuss how to represent these dimensions.

First, we consider density, which is the most important characteristic of urban sprawl. We can consider two density types: population and house densities. The former is calculated as the population divided by the unit area, whereas the latter is the number of houses divided by the unit area. Although population density is more commonly employed, house density is more suitable for measuring urban sprawl because it can mitigate the influence of land use restrictions. Conversely, house density does include some statistical biases because economic conditions affect housing construction. In other words, the usage of only the house density has benefits and drawbacks, and we therefore adopt both densities as indexes.

Second, concentration is interpreted as the degree to which residential areas are close to each other, as shown in Fig. 11.1. The shaded areas indicate inhabitable land, and the circles indicate residential areas. In the figure, the residential areas are concentrated in the left-hand city, implying high concentration, but they are widely scattered in the right-hand city, implying low concentration.

Third, centrality is interpreted as the degree to which residential areas are close to the CBD. We illustrate centrality in Fig. 11.2, which employs the same notation as Fig. 11.1 and includes a star to represent the CBD. The residential areas are close

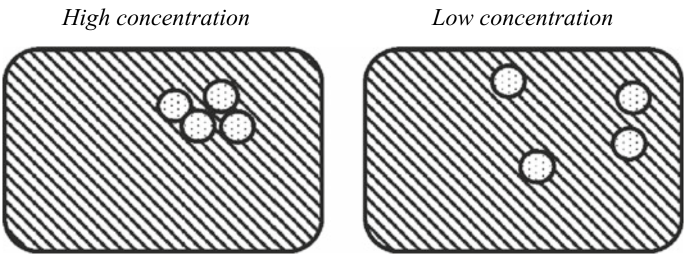

Fig. 11.1 Concentration

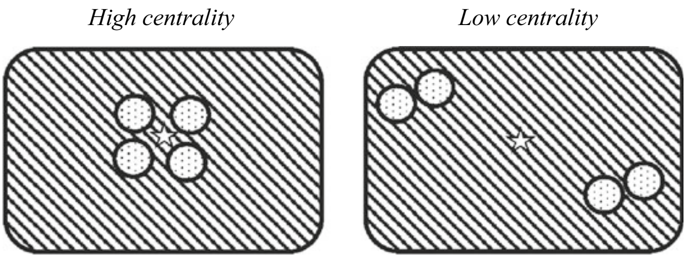

Fig. 11.2 Centrality

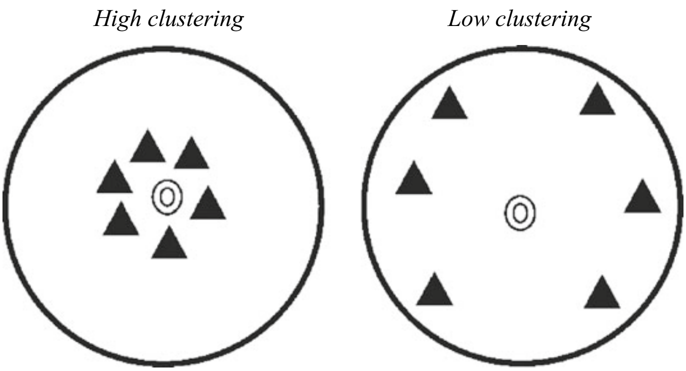

Fig. 11.3 Clustering

to the CBD in the left-hand city, implying high centrality, and they are distant from it in the right-hand city, implying low centrality.

Fourth, clustering is interpreted as the degree to which residential units are close to each other within residential areas. In Fig. 11.3, we illustrate clustering; the triangles represent residential units, and the double circles represent the central facilities of residential areas. The residential units are concentrated in the left-hand side residential area, implying high clustering, and they are scattered in the right-hand city, implying low clustering.

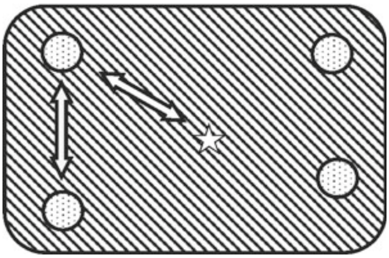

Fig. 11.4 Difference between concentration and centrality

Next, we discuss the importance of the four dimensions. As previously stated, density is the most important dimension of urban sprawl, but density alone may be an insufficient proxy. For instance, suppose that in Figs. 11.1 and 11.2, the left- and right-hand cities have identical residential areas, populations, and numbers of houses. Although it is clear that the left-hand cities are compact and the right-hand cities are sprawling, only a measure of density would indicate that the cities have identical urban structures. Accordingly, we must introduce the other three dimensions to adequately measure sprawl.

We can illustrate the distinction between concentration and centrality using Fig. 11.4. Whereas a low concentration implies long distances between residential areas, a low centrality implies long distances between residential areas and the CBD. In other words, both dimensions represent the distribution of residential areas in different ways. Furthermore, low clustering implies long distances between residential units within residential areas. Even if two cities have identical distributions of residential areas, one urban area may be more sprawling if residential units are more scattered within residential areas. Therefore, all four dimensions are important for measuring urban structures. For convenience, we call the population and house densities "density information," and we call the other three dimensions "spatial information."

Finally, we define urban sprawl as a pattern of land use in a municipality that exhibits low levels of some combination of four distinct dimensions: density, concentration, centrality, and clustering. We follow the definition to construct the proxy variable for urban sprawl. Our proxy variable can describe other urban structures as well. For example, a compact city is defined as a pattern of land use with high levels across the four distinct dimensions. Thus, we call our proxy variable for urban sprawl "urban structure."[1]

[1] Galster et al. (2001) define urban sprawl on the basis of urbanized areas corresponding to densely inhabited districts (DID). However, there are no DIDs in small Japanese municipalities. As this study aims to analyze all municipalities in Japan, we cannot use this measure directly.

11.3 Theoretical Framework

This section outlines the empirical model used in analyzing the determinants of local expenditures, which follows the framework of Hortas-Rico and Sole-Olle (2010). We theoretically obtain the estimated expenditure function by combining models of the cost and demand for local public services. The standard model of local public production (e.g., Bradford et al. 1969; Brueckner 1981; Duncombe and Yinger 1993; Hayashi 2012) assumes that the public output produced by a local government does not necessary coincide with the outcome of the local public services actually consumed by citizens.[2] Our model follows this assumption.

We assume that local public services are produced using capital and labor. Capital is assumed to be perfectly mobile, which implies that the rental price of capital is the same in all municipalities. The range of wages for labor is also assumed to be the same in all municipalities because Japanese local governments follow common salary schedules. The production function is assumed to be Cobb-Douglas and identical across local governments. Consequently, the cost function of local public services is as follows:

$$C(O) = O \cdot \overline{S}, \tag{11.1}$$

where O is the public output produced by a local government and $\overline{S}$ represents the parameters of the production function, which is assumed to be the responsibility of the local government.

In this model, a process transforms the public outputs produced by a local government into the outcome of local public services actually consumed by citizens. The standard model of public production suggests that this process is influenced by congestion and the regional environment, whereas we assume that the relevant influencing factors are the urban structure and the regional environment. In other words, the outcome of local public services (Q), which reflects the quality of services enjoyed by the residents, depends on the level of local public output or activity performed by the local government (O), the urban structure (D) predetermined by the optimal behavior of outside developers, and the given regional environment $\mathbf{z} = (z_1, \ldots, z_n)$, as follows:

$$Q = O / \left(D^{\alpha} \cdot \prod z_j^{\beta_j} \right), \tag{11.2}$$

where α is a parameter of the urban structure and β_j is a parameter of regional environment j.

Substituting Eq. 11.2 into the cost function, Eq. 11.1, we find the cost function for the outcome of local public services as follows:

$$C(Q, D, \mathbf{z}) = Q \cdot D^{\alpha} \cdot \prod z_j^{\beta_j} \cdot \overline{S},$$

[2] Bradford et al. (1969) called the former outputs "D-outputs" and the latter outputs "C-outputs."

which can also be expressed at the per capita level as:

$$c(q, D, \mathbf{z}) = q \cdot D^{\alpha} \cdot \prod z_j^{\beta_j} \cdot \overline{S}. \tag{11.3}$$

Estimating Eq. 11.3 requires data on the outcomes of local public services (q). However, these data are not available in Japan. We could identify a proxy, but such an operation would likely cause sample selection bias. Therefore, to obtain a usable expression without the outcomes of local public services (q), our model introduces a demand function for the outcome of local public services.

To derive the demand function for outcome of local public services, we analyze a theoretical model that describes the decision-making process of the local government.[3] This model assumes that a local government aims to maximize the utility of representative identical voters, $U(x, q, \mathbf{v})$, with respect to the consumption of a private good (x) and the outcomes of local public services (q) for a given set of regional preferences, $\mathbf{v} = (v_1,\ldots, v_{\mathrm{m}})$.

We impose the following three constraints on the maximization problem of the representative voter:

$$\begin{cases} x + t \cdot b_r = y, \\ c = t \cdot b + g, \\ c = q \cdot D^{\alpha} \cdot \prod z_j^{\beta_j} \cdot \overline{S}. \end{cases} \tag{11.4}$$

The first part of Eq. 11.4 is an individual budget constraint in which t is the tax rate, b_{r} is the tax base of the representative voter, and y is the representative voter's income level. The second part of Eq. 11.4 is a local government budget constraint per capita, where b is the total tax base and g is the total amount of transfers received in the jurisdiction. The third part of Eq. 11.4 is a cost function for the outcome of local public services. For convenience, we omit the expression of "per capita" from the terms except when it is necessary for clarity.

Combining these three constraints, we can derive the following expression:

$$x + q \cdot D^{\alpha} \cdot \prod z_j^{\beta_j} \cdot \overline{S} \cdot (b_r/b) = y + g \cdot (b_r/b), \tag{11.5}$$

where (b_r/b) indicates the tax share of the representative voter, that is, the degree to which the representative voter can influence the tax system. Accordingly, the cross term $(g \cdot b_r/b)$ represents the partial amount of received transfers that a representative voter can control in the jurisdiction. Therefore, the right-hand side of Eq. 11.5 measures the overall income, and the left-hand side reflects the sum of private and local public spending in the jurisdiction.

The maximization problem yields the following first-order condition:

$$\frac{\partial U(x,\ q,\ \mathbf{v})/\partial q}{\partial U(x,\ q,\ \mathbf{v})/\partial x} = D^{\alpha} \cdot \prod z_j^{\beta_j} \cdot \overline{S} \cdot (b_r/b) \equiv p, \tag{11.6}$$

[3]The function is not strictly a demand function, but it is so named for the convenience of description.

where p denotes the tax price, which is defined as the product of the marginal cost of providing local public services c_q $(= \partial c/\partial q)$ and the tax share b_r/b.

We derive the demand function for the outcome of local public services by combining Eqs. 11.5 and 11.6. To obtain an easily estimable framework, this model assumes that the derived function is log-linear, as follows:

$$q = \kappa \cdot p^{\varepsilon} \cdot y^{\eta} \cdot (g \cdot b_r/b)^{\theta} \cdot \prod v_k^{\lambda_k}. \tag{11.7}$$

Thus, the demand for local public services depends on the basic component (κ), the tax price (p), the income of the representative voter (y), the partial amount of received transfers controlled by the representative voter in the jurisdiction $(g \cdot b_r/b)$, and regional preferences $(\mathbf{v})$.[4] Additionally, $\varepsilon, \eta, \theta$, and λ are parameters. We interpret ε as the tax price elasticity of demand for local public services and η as the income elasticity. Combining Eqs. 11.3 and 11.7 yields

$$e = \kappa \cdot \left(D^{\alpha} \cdot \prod z_j^{\beta_j} \cdot \overline{S}\right)^{1+\varepsilon} \cdot (b_r/b)^{\varepsilon+\theta} \cdot y^{\eta} \cdot g^{\theta} \cdot \prod v_k^{\lambda_k}. \tag{11.8}$$

Taking logarithms of both sides of Eq. 11.8, we obtain an estimable function of local expenditure as

$$\begin{aligned} \ln e = {} & \ln K + (1+\varepsilon) \cdot \alpha \cdot \ln D + (1+\varepsilon) \cdot \sum \beta_j \cdot \ln z_j \\ & + (\varepsilon + \theta) \cdot \ln(b_r/b) + \eta \cdot \ln y + \theta \cdot \ln g + \sum \lambda_k \cdot \ln v_k, \end{aligned}$$

where $K \equiv \kappa \cdot \overline{S}^{1+\varepsilon}$. After simplifying the parameters, the equation becomes

$$\begin{aligned} \ln e = {} & X + \phi_D \cdot \ln D + \sum \phi_{z_j} \cdot \ln z_j + \psi \cdot \ln(b_r/b) \\ & + \eta \cdot \ln y + \theta \cdot \ln g + \sum \lambda_k \cdot \ln v_k + \mu, \end{aligned} \tag{11.9}$$

where $X (= \ln K)$ is a constant and μ denotes the error term. We omit all subscripts for notational convenience. This expression implies that local expenditures depend on a set of cost and demand factors. The former are the urban structure (D) and regional environment $(\mathbf{z})$, and the latter are the income level of the representative voter (y), the tax share (b_r/b), the total amount of transfers received by the jurisdiction (g), and regional preferences $(\mathbf{v})$. Note that the estimated parameters for cost factors, φ_l $(l = D, z_i)$, are defined as the product of $(1 + \varepsilon)$ and α or β.

Next, we interpret the estimated parameters for all variables, beginning with the cost factors. First, in the case of the urban structure (D), the local government of a sprawling city must increase local public output (O) more relative to other cities

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[4] The basic component (κ) reflects not only the responsibilities of the local government but also the basic local public services required for citizens' lives regardless of economic factors, intergovernmental transfers, and regional preferences. When we estimate the outcome demand function for local public services, this component is the constant term.

to maintain the outcome of local public services (q). Therefore, we might expect to find a positive relationship between the urban structure (D) and local expenditures (e). However, overcrowding may also increase local public output because traffic congestion leads to supply inefficiencies. We assume that both effects occur simultaneously. Thus, if the estimated effect of the urban structure (D) is positive, then urban sprawl is the dominant source of inefficiency; otherwise overcrowding is the dominant source of inefficiency. Additionally, according to Eqs. 11.3 and 11.9, the parameter (α) of urban structure (D) can be represented as

$$\frac{\partial C_q / C_q}{\partial D / D} = \alpha = \phi_D / (1 + \varepsilon).$$

In other words, the parameter (α) represents the urban sprawl elasticity of marginal local public cost, which indicates the percentage decrease in the marginal cost of providing local public services given a one percent decrease in urban sprawl. From Eq. 11.9, $(1 + \varepsilon)$ can be calculated by $(1 + \psi - \theta)$.

Second, we consider the estimated parameter of the regional environment j (z_{i}), which serves to segregate the public output produced by local governments from the outcome of the local public services actually consumed by local citizens. In other words, the regional environment leads to an inefficient supply of local public services, and the estimated parameter (ϕ_{z_j}) is expected to be positive.

We now turn to the demand factors. First, we consider the estimated tax share parameter (b_{r}/b). The estimated parameter ($\psi = \varepsilon + \theta$) can be either negative or non-negative. As shown earlier, ε is the tax price elasticity of demand for local public services, and its sign is expected to be negative. θ represents the effect of the partial amount of received transfers controlled by the representative voter in the jurisdiction on the demand for the outcome of local public services. We expect the sign of this parameter to be positive. Thus, as mentioned, the tax share parameter can be negative or non-negative.

Second, we consider the estimated parameter of income (y), calculated as the income elasticity of outcome demand for local public services. This sign may be either positive, negative, or zero. If the estimated parameter (η) is positive, residents regard local public services as superior goods, but if η is negative (zero), residents regard local public services as inferior goods (neutral goods).

Third, we consider the estimated parameter of the kth regional preference (v_k), which increases the demand for outcome of local public services. We therefore expect the estimated parameter (λ_k) to be positive.

Finally, we confirm the sign condition for our estimation. The demand for local public services increases as the tax price decreases, meaning that the tax price elasticity of demand for local public services (ε) is expected to be negative. From the definition ($\psi = \varepsilon + \theta$) in Eq. 11.9, ($\psi - \theta$) must be negative.

11.4 Data and Method

We estimate the local expenditure function, Eq. 11.9, using the ordinary least squares (OLS) method. We undertake the empirical test using cross-sectional data from 1085 Japanese municipalities in 2008. The selected period is not random, as most Japanese municipalities have experienced mergers over the past decade. These social changes could result in spurious correlations between urban development and local public service costs. For example, if several municipalities merge to streamline their administrations, the new jurisdiction superficially appears to be sprawling even though the administrative boundaries have changed independently of urban development. Therefore, we could erroneously interpret urban sprawl as reducing local public service costs. According to the Ministry of Internal Affairs and Communications (2010), most municipal mergers were almost complete by 2006. Thus, we select 2008 as the analysis year for our cross-sectional data. Although panel data would be preferable for estimation purposes, such data are unavailable for recent years.

As of 2008, there were 1793 municipalities in Japan. We obtained our final sample of 1085 municipalities as follows. First, we exclude municipalities with fewer than 15,000 inhabitants because data are not available for our main variables. Thus, some depopulated regions are excluded from our analysis as well. Second, as it is unclear whether some data for municipalities that merged between January 2008 and March 2009 are for new or old jurisdictions, we exclude such jurisdictions as well. Third, we exclude some municipalities that receive no transfers, as indicated by Eq. 11.9. Nevertheless, our dataset is sufficiently representative because it accounts for about 85% of the total population. Additionally, our sample focuses on large- and medium-sized municipalities because the effects of growth on urban sprawl and depopulation in small jurisdictions are often ambiguous.

Before conducting the analysis, we describe the sample used for our estimation. Our variable definitions and data sources are provided in Table 11.1, and descriptive statistics are given in Table 11.2. All variables are per capita and at the municipal level, although we sometimes omit the terms "per capita" and "municipal" for convenience. The dependent variable (e) is expenditures.[5] The proxy for the urban structure (D) is the primary independent variable. The urban structure only reflects geographic characteristics and does not represent the quality of life. According to the definition of urban sprawl given in Sect. 11.2, we construct proxy variables for urban structure that only reflect two types of characteristics: density information (i.e., housing and population densities) and spatial information (i.e., concentration, centrality, and clustering) (see Table 11.3). To interpret the empirical results, note that the proxy variables for urban structure are constructed such that a higher value for a variable reflects a higher level of the urban sprawl characteristic and a more sprawling city. Conversely, a lower value of a proxy variable implies a lower level of the urban sprawl characteristic and, thus, a more compact city. We now describe each characteristic of urban sprawl.

[5] Expenditures include costs unaffected by urban sprawl.

Table 11.1 Variable definitions and data sources

	Variable	Unit	Definition	Source and creation method
Dependent variables	Expenditures	Million yen	Total expenditures/population	
	Total expenditures	Million yen	Total expenditures	Statements of municipal accounts
	Total population	Person	Total population	System of social and demographic statistics
Independent variables	Housing density	House/km^2	Number of total houses/inhabitable area	
	Number of total houses	House	Number of total houses	Housing and land survey
	Inhabitable area	km^2	Inhabitable area	Geospatial information authority of Japan
	Population density	Person/km^2	Total population/inhabitable area	
	Number of detached houses	House	Number of detached houses	Housing and land survey
	Ordinary households of which main earner is an employee by commuting hours of main earner (over 1 h)	Household	Ordinary households of which main earner is an employee by commuting hours of main earner (range of 60–90 m and over 90 m)	Housing and land survey
	Dwellings by distance to the nearest nursery (over 1000 m)	Dwelling	Dwellings by distance to the nearest nursery (over 1000 m)	Housing and land survey
	Tax share	Number	Working population/taxpayer population	
	Working population	Person	Working population	System of social and demographic Statistics
	Taxpayer population	Person	Taxpayer population	Statements of municipal accounts

(continued)

Table 11.1 (continued)

	Variable	Unit	Definition	Source and creation method
	Income	Million yen	Total taxable income/total population	Statements of municipal accounts
	Transfer	Million yen	(Local allocation tax + Treasury disbursements + Prefectural disbursements + Special grants to local governments)/total population	Statements of municipal accounts
	Vacant housing rate	Number	(Number of vacant houses/total population)/total number of houses	
	Number of vacant houses	House	Number of vacant houses	Housing and land survey
	Total waste matter	Ton	Total waste matter/total population	Survey on disposal of general waste
	Number of general clinics	Installations	Number of general clinics/total population	Ministry of health, labour, and welfare

Notes All variables are given on a per capita basis at the municipal level. However, the expressions "per capita" and "municipal" are sometimes omitted for convenience

First, we describe the density data. We use the reciprocal of housing density, defined as the inhabitable area divided by the total number of houses, and the reciprocal of population density, defined as the inhabitable area divided by the total population.

Second, for concentration, we use the number of detached houses. In many cases, detached houses are built on suburban land, which are residential areas. When a private developer develops farmland suburbs into residential areas, the person does not consider the circumference area. Hence, connections to the other residential area are missing. In areas with numerous detached houses, the residential areas tend to be scattered in the suburbs.

Table 11.2 Descriptive statistics

Variables	Mean	Median	Maximum	Minimum	Std. dev.
Expenditures	0.382	0.353	3.507	0.191	0.143
Reciprocal of housing density	743.52	348.31	7118.36	8.97	1025.50
Reciprocal of population density	1699.82	843.82	13,403.92	22.67	2119.42
Number of detached houses	21,986.99	11,860.00	542,510.00	2330.00	34,799.61
Ordinary households of which main earner is an employee by commuting hours of main earner (over 1 h)	3150.71	660.00	294,210.00	20.00	11,579.45
Dwellings by distance to the nearest nursery (over 1000 m)	12,314.28	7710.00	217,790.00	200.00	15,753.90
Tax share	1.504	1.485	4.694	1.167	0.180
Income	1.270	1.238	3.008	0.399	0.308
Transfer	0.160	0.133	0.592	0.025	0.101
Vacant houses rate	3.43E−06	2.50E−06	3.80E−05	3.00E−08	3.32E−06
Total waste matter	0.350	0.347	1.667	0.1607	0.079
Number of general clinics	6.70E−04	6.57E−04	1.54E−03	1.48E−04	2.00E−04

Table 11.3 Data for urban structure variables

A—Density information		B—Spatial information	
Characteristic	Data	Characteristic	Data
Reciprocal of housing density	Inhabitable area/total number of houses [a1]	Concentration	Number of detached houses [b1]
Reciprocal of population density	Inhabitable area/total population [a2]	Centrality	Ordinary households of which main earner is an employee by commuting hours of main earner (over 1 h) [b2]
		Clustering	Dwellings by distance to the nearest nursery (over 1000 m) [b3]

Third, for centrality, we use "Ordinary households of which main earner is an employee by commuting hours of main earner (over 1 h)." The public transportation system is underdeveloped in small towns, meaning that suburban residents drive to work daily. When their residential areas are far from the CBD, traffic congestion occurs on main roads daily, and suburban residents have long commuting times. To simplify the analysis, we assume a single CBD. However, commuters can travel from their cities of residence to other cities to work. In Japan, territories are small, and cities are contiguous, which means that border crossing is frequent. Because almost all local city commuters who live in the suburbs require long commuting times, we do not consider the effect of border crossing. Of course, this simplification may not be appropriate for cities in some metropolitan areas. Thus, we utilize multiple proxies for urban structure to avoid such issues.

Fourth, we use "Dwellings by distance to the nearest nursery (over 1000 m)" to reflect clustering. If dwellings are far from the center of a residential area, we consider that area to be more scattered. We use nurseries to represent central facilities in residential areas; nurseries are typically established in concentrated dwelling areas because it is difficult for children to travel to them by walking long distances.

Both density and spatial information should be used simultaneously to understand the constructed urban structure. We thus use a proxy variable for the urban structure that multiplies each type of density and spatial information. However, we cannot consider multiple characteristics at the same time because of information duplication. For example, both the population and housing densities include the data of inhabitable areas. Moreover, because no criteria are available to determine the most suitable number of information requirements, our proxy variables for urban structure reflect only one side of many of the characteristics. For instance, one proxy variable for urban structure, a2b1, captures the urban characteristics of "reciprocal of population density" and "distance to residential area." According to Table 11.3, the first component is density information (a2) and the second one is spatial information (b1).

Furthermore, our spatial information includes some characteristics at different spatial levels. Concentration and centrality provide distribution information for residential areas. Clustering, however, provides distribution information for residential units within a residential area. Thus, the urban structure (D) considers two spatial level cases among municipalities. In the first case, the distribution information of residential areas is heterogeneous, but that of residential units within a residential area is homogeneous (i.e., a1b1, a1b2, a2b1, and a2b2). The second case considers the opposite situation (i.e., a1b3 and a2b3).[6]

Finally, we briefly describe the other variables. First, the vacant housing rate is used to represent the regional environment. Areas with higher vacant housing rates do not have many dwellings and have lower per capita provision of local public services.

[6]This model excludes the cases in which all characteristics are homogeneous or heterogeneous in spatial information. When all characteristics are heterogeneous, the urban structure (D) must include multiple spatial information characteristics. However, this operation is not feasible for the reasons described above. When all characteristics are homogeneous in spatial information, the variables are composed of only density information. As previously stated, such a measure might be insufficient.

Second, the tax share is defined as the working population divided by the number of taxpayers. We can interpret this variable as the tax bill of a representative inhabitant divided by per capita tax revenue. Unfortunately, in Japan, the data for this variable are unavailable. However, we can also interpret the tax bill of a representative resident as the revenue divided by the taxpayer population. Moreover, per capita tax revenues are revenues divided by the working population. Third, for income, we employ total taxable income. Fourth, transfers are defined as transfers received from the national or prefecture levels of government, that is, the sum of local allocation taxes, treasury disbursements, prefectural disbursements, and special grants to local governments. Finally, the proxy variables for regional preferences are total waste matter, which indicates the demand for quality of life, and the number of general clinics, which indicates the demand for local medical treatment from residents.

11.5 Empirical Results

Tables 11.4, 11.5 and 11.6 provide the results for the local expenditure function, as specified in Eq. 11.9, using OLS. Table 11.4 provides the results for the estimated local expenditure function including the vacant housing rate as a proxy for the regional environment. This model assumes regional preferences are the same in all cities and acts as a base regression model. Tables 11.5 and 11.6 provide the results for the estimated local expenditure function, which includes the regional environment and preference variables.[7] This local expenditure function assumes that regional preferences, such as the living environment and demand for local medical care, vary by city. Given the three types of local expenditure functions, the findings support our theoretical expectations for the signs of the parameters and their magnitudes, as shown in Tables 11.4, 11.5 and 11.6. We explain the empirical findings for individual variables as follows.

First, urban structure is positive and statistically significant at the one percent level for a two-tailed hypothesis test in almost all models. In line with the theory, the inefficiency associated with overcrowding may be the dominant factor. However, for any type of urban structure, growth in urban sprawl leads to greater local expenditure. Therefore, the dominant factor in inefficient supply is urban sprawl. We calculate the urban sprawl elasticity of local public service cost by dividing the respective parameters by $(1 + \varepsilon)$, as previously discussed. The urban sprawl elasticity of local public service cost ranges from 0.053 to 0.113, which means that a one percent reduction in urban sprawl in Japan reduces local public service cost at the margin by 0.053–0.113%. This finding is similar to the values obtained by Hortas-Rico and Sole-Olle (2010) in the Spanish context, which range from 0.14 to 0.24.

The results for the other estimated variables are mostly congruent with the theory. The vacant housing rate, that is, the regional environment ($\mathbf{z}$), is positive and

[7] The estimated equations in Tables 11.5 and 11.6 contain different regional preference variables as a robustness check.

statistically significant at the ten percent level for the two-tailed hypothesis test in almost all models. The proportion of vacant housing explains the lower per capita provision of local public services. Growth in areas with numerous vacant houses leads to greater local expenditures. Second, the tax share is statistically significant at the five percent level for the two-tailed hypothesis test in almost all models, which suggests an increase in the tax share leads to a decrease in demand for local public services and local expenditures. Third, the effect of transfers is positive and statistically significant at the one percent level for the two-tailed hypothesis test in all models, indicating that transfers lead to greater local expenditures in Japan. Fourth, income has a positive and statistically significant effect at the one percent level for a two-tailed hypothesis test in almost all models. The estimated parameter is the income elasticity of outcome demand for local public services. Residents regard local public services as superior goods. Finally, Tables 11.5 and 11.6 indicate that total waste matter and the number of general clinics have positive effects that are statistically significant at the one percent level for a two-tailed hypothesis test in all models. In line with our intuition, these results show that greater resident demand for local public services causes higher local expenditures.

Table 11.4 Empirical results with the vacant houses rate as a proxy for the regional environment and no regional preference variables

Urban structure pattern	a1b1	a1b2	a1b3	a2b1	a2b2	a2b3
Constant	−0.026 (−0.367)	−0.009 (−0.108)	−0.091 (−1.277)	0.028 (0.395)	0.064 (0.755)	−0.072 (−1.011)
Urban structure	0.043*** (6.342)	0.011* (1.71)	0.024*** (5.169)	0.054*** (8.033)	0.019*** (3.165)	0.029*** (6.366)
Tax share	−0.204*** (−2.675)	−0.418*** (−6.014)	−0.273*** (−3.67)	−0.160** (−2.128)	−0.418*** (−6.037)	−0.243*** (−3.299)
Income	0.272*** (5.051)	0.120** (2.417)	0.226*** (4.288)	0.292*** (5.57)	0.109** (2.19)	0.241*** (4.63)
Transfer	0.371*** (26.49)	0.383*** (27.081)	0.379*** (27.158)	0.364*** (26.131)	0.379*** (26.762)	0.375*** (26.995)
Regional environment (vacant houses rate)	0.027*** (3.732)	0.006 (0.875)	0.012* (1.856)	0.033*** (4.675)	0.011 (1.638)	0.014** (2.273)
Urban sprawl elasticity of marginal local public cost	0.101	0.053	0.068	0.113	0.096	0.077
Adj. R-squared	0.670	0.658	0.666	0.677	0.661	0.670
F-statistic	440.700	418.821	432.779	454.957	422.980	440.878

Notes The t-statistics are shown in parentheses. *, **, and *** denote significance at the 10, 5, and 1% levels, respectively

Table 11.5 Empirical results with the vacant houses rate as a proxy for the regional environment and total waste matter as a proxy for regional preferences

Urban structure pattern	a1b1	a1b2	a1b3	a2b1	a2b2	a2b3
Constant	0.168** (2.147)	0.224** (2.497)	0.116 (1.472)	0.192** (2.466)	0.273*** (3.019)	0.122 (1.565)
Urban structure	0.041*** (6.109)	0.013** (2.196)	0.024*** (5.192)	0.049*** (7.348)	0.020*** (3.219)	0.028*** (6.061)
Tax share	−0.180** (−2.394)	−0.379*** (−5.525)	−0.239*** (−3.247)	−0.152** (−2.048)	−0.381*** (−5.574)	−0.220*** (−3.017)
Income	0.269*** (5.06)	0.123** (2.507)	0.229*** (4.411)	0.281*** (5.415)	0.113*** (2.306)	0.238*** (4.636)
Transfer	0.380*** (27.35)	0.392*** (27.987)	0.387*** (28.069)	0.373*** (26.85)	0.388*** (27.665)	0.384*** (27.838)
Regional environment (vacant houses rate)	0.029*** (4.087)	0.012* (1.681)	0.015** (2.45)	0.033*** (4.756)	0.015** (2.202)	0.017*** (2.724)
Regional preferences (total waste matter)	0.139*** (5.678)	0.151*** (6.087)	0.146*** (5.946)	0.122*** (4.988)	0.147*** (5.955)	0.137*** (5.601)
Urban sprawl elasticity of marginal local public cost	0.093	0.058	0.063	0.103	0.084	0.070
Adj. R-squared	0.679	0.669	0.676	0.684	0.671	0.679
F-statistic	383.258	366.856	378.026	391.670	369.651	382.966

Notes The t-statistics are shown in parentheses. *, **, and *** denote significance at the 10, 5, and 1% levels, respectively

Overall, the empirical results show good support for the proposed models. The cost and demand factors are important for local expenditures, and these results contribute to urban studies by empirically showing the influence of urban sprawl growth on local public service cost. In particular, the urban sprawl elasticity of marginal local public costs is relatively high when concentration (b1) is used as the proxy variable for urban structure.

11.6 Concluding Remarks

The growth of urban sprawl may lead to the inefficient supply of local public services, thereby increasing their cost of provision. In this chapter, we empirically investigated this issue in Japan using a local expenditure model. Specifically, we estimated a local expenditure model by employing cross-sectional data from 1085

Table 11.6 Empirical results with the vacant houses rate as a proxy for the regional environment and the number of general clinics as a proxy for regional preferences

Urban structure pattern	a1b1	a1b2	a1b3	a2b1	a2b2	a2b3
Constant	0.525*** (3.577)	0.518*** (3.229)	0.444*** (3.027)	0.537*** (3.702)	0.589*** (3.703)	0.447*** (3.07)
Urban structure	0.046*** (6.841)	0.015** (2.35)	0.026*** (5.676)	0.055*** (8.3)	0.022*** (3.628)	0.031*** (6.726)
Tax share	−0.168** (−2.204)	−0.398*** (−5.755)	−0.239*** (−3.223)	−0.134* (−1.797)	−0.399*** (−5.793)	−0.215*** (−2.929)
Income	0.277*** (5.175)	0.112** (2.257)	0.229*** (4.381)	0.291*** (5.578)	0.100** (2.025)	0.240*** (4.656)
Transfer	0.361*** (25.721)	0.375*** (26.279)	0.370*** (26.434)	0.356*** (25.461)	0.371*** (26.011)	0.367*** (26.307)
Regional environment (vacant houses rate)	0.035*** (4.727)	0.014* (1.936)	0.019*** (2.891)	0.040*** (5.482)	0.019*** (2.601)	0.021*** (3.222)
Regional preferences (number of general clinics)	0.067*** (4.289)	0.061*** (3.818)	0.066*** (4.171)	0.062*** (4.022)	0.062*** (3.888)	0.063*** (4.072)
Urban sprawl elasticity of marginal local public cost	0.098	0.064	0.067	0.108	0.097	0.074
Adj. R-squared	0.675	0.663	0.671	0.681	0.665	0.675
F-statistic	376.236	355.838	369.029	494.155	359.613	375.468

Notes The t-statistics are shown in parentheses. *, **, and *** denote significance at the 10, 5, and 1% levels, respectively

Japanese municipalities in 2008. Overall, the empirical results support the theoretical model in Sect. 11.3, as a one percent reduction in urban sprawl in Japan is found to reduce the marginal cost of providing local public services between 0.053 and 0.113. Our findings are similar to those found in the Spanish context in the seminal study of Hortas-Rico and Sole-Olle (2010). In addition, Kawasaki (2009) and Kuramoto (2010) also find similar conclusions regarding Japanese municipalities using different methods. Accordingly, our estimation is considered to be reasonable.

Occasionally, critics point out that compact cities create problems of traffic congestion, atmospheric pollution, loss of green land, housing shortages, and so on. However, our empirical results indicate that the criticisms of compact cities are not relevant, at least from the viewpoint of public finance. If compact cities increase the cost of providing local public services more than urban sprawl does, then the urban structure parameters estimated in this analysis would be negative. However, we do not obtain negative values.

These results have some implications for policies to reduce the impact of urban sprawl growth on local public finance. Density is a crucial dimension of urban sprawl. Hence, the first priority is policies that lead to high densities. However, our empirical results also show that low concentration intensifies the effect of urban sprawl growth on local public service costs. Accordingly, local governments should implement policies to concentrate residential areas as their second priority.

Finally, we outline the limitations of this chapter and scope for future research. First, this chapter only focuses on the economic influence of compact cities, and we should also analyze the benefits and problems of compact cities comprehensively. Some scholars assert that compact cities can improve the environment, accessibility, amenities, and so on, whereas others present opposite opinions. Thus, multiphasic analysis is necessary to assess compact cities. Second, within the public finance context, we should examine the impact of urban sprawl on local revenue as well. For example, urban sprawl might increase the municipal revenue from land taxes because forest development increases the land value of the suburbs. Therefore, it is important to investigate the revenue side as well.

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Chapter 12
Theoretical Analysis of the Strategic Provision of Public Childcare Service Administration by Private and Public Providers

Yurika Shiozu

Abstract The analysis described in this chapter seeks to determine whether municipalities can provide adequate childcare services given the appropriate incentive design using the framework of principal-agent theory. We use the Laffont and Tirole model to show that even with rent-seeking behavior, securing a supply of childcare services and striving to resolve the issue of waiting lists for children would improve social welfare. Specifically, we find that allowing the movement of funds across budget items to raise the salary levels of childcare facility managers and lower the wages of nursery school teachers could solve the issue of long waiting lists.

Keywords Principal-agent theory · Childcare services · Rent-seeking behavior

12.1 Introduction

The purpose of this chapter is to use principal-agent theory to reveal whether local governments can provide adequate childcare services if appropriate incentives can be designed. In urban areas of Japan, the demand for licensed childcare services continues to far outstrip the supply. In the past, women in Japan often left their jobs to have children, and the demand for childcare services was not particularly high. However, in recent years, the number of women who continue working even after having children has steadily increased. Accordingly, the demand for childcare services has been rising steadily in urban areas, and some children are placed on waiting lists and are unable to access childcare services. To eliminate these waiting lists, the supply of childcare services needs to be increased. Indeed, the admissions capacity of nursery schools recently increased substantially. However, as supply is increased to eliminate excess demand for childcare, latent demand is stimulated.

In Japan, excess demand has arisen because large subsidies keep the price of childcare artificially low. For example, putting a child under three years old in nursery

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school for 11 h per day and 20 days per month would cost over 200,000 yen. However, the maximum amount that guardians are charged for childcare is around 80,000 yen.

Additionally, nursery schools need to secure facilities and a certain number of nursery school teachers to provide quality services. However, because land prices are high in urban areas and nearby residents may not give consent, it is challenging to secure a site. Moreover, it is difficult for nursery schools to secure staff because nursery school teachers are extremely low-paid compared to the average pay across all industries.

Thus, the pay level of nursery school teachers needs to be improved, and national and local governments have enacted a variety of measures to address this issue. For instance, the Japanese government has a policy of bearing additional payments to nursery school teachers according to their experience, and the Tokyo metropolitan area provides assistance with housing expenses. However, despite these improvements, we cannot verify that the various subsidies are helping to improve the pay levels of nursery school teachers because the salaries of these workers and those of other positions, such as nursery school directors, are added together and published as labor costs.

In fact, although the annual base salary for private nursery school principals used in subsidy calculations is about 4.8 million yen, the average payment in practice is about 6.5 million yen per year. Because private nursery schools can only make up this difference by pulling funds from other spending areas, these schools are incentivized to lower the pay levels of nursery school teachers by, for example, downgrading them from full-time to part-time employment. Additionally, because nursery school principals do not need to be certified in childcare, these posts are often filled by operators of childcare service businesses. Some reports have identified social welfare corporations for which the chairperson of the board or relatives are paid exorbitant amounts. Furthermore, some providers use surplus funds as internal reserves to establish additional nursery schools. Setting aside part of the profits from an existing business to start a new business is not an issue in the operation of a regular company. However, in the case of social welfare businesses, accumulating internal reserves in this way is often considered problematic.

A large body of research focuses on theoretical analyses of scenarios in which the government is a regulatory agency and companies are agents that conduct business. Laffont and Tirole (1993) demonstrated that when governments do not have accurate information about the levels of efficiency of companies (i.e., agents conducting business), providing a certain amount of rent to an inefficient agent allows the government to guarantee supply.

This chapter focuses on incentives in its analysis of system design to solve the problem of childcare waiting lists. Section 12.2 provides an overview of the licensed childcare services system in Japan and previous studies. Sections 12.3 and 12.4 present benchmarks and set up the theoretical model based on Laffont and Tirole (1993). We analyze the case which the government provides subsidies to nursery schools as a reward and disperses administrative costs separately in Sect. 12.3, and in Sect. 12.4, the government pays subsidies to nursery schools for their overall cost as lump sum transfers. In Sect. 12.5, we validate that the model developed in

Sects. 12.3 and 12.4 can describe the Japanese system of nursery school subsidies. Section 12.6 presents conclusions and opportunities for future study.

12.2 Overview of Japanese Public Childcare Services and Previous Studies

12.2.1 Overview of Japanese Public Childcare Services

Because childcare services are a social welfare service in Japan, the required facility sizes and numbers of nursery school teachers are stipulated in the Child Welfare Act. Schools need to be licensed by the local government to begin operating, and local governments determine nursery school capacity, childcare fees, and admissions. Accordingly, even if there is excess demand for childcare services, supply and demand are not balanced by price mechanisms. Furthermore, simply increasing supply is not a satisfactory solution because entering this market is not easy.

Additionally, proprietors of childcare service businesses receive subsidies from national and local governments. The total cost of nursery school becomes the formal price according to the national standard set by the prime minister. Administrative expenses are further divided into labor costs and management expense grants. The actual formula used to calculate subsidies divides unit costs into detailed categories, such as nursery school capacity, age of children, and nursery school teachers' number of years of experience.

The supply for licensed childcare services is provided by three types of businesses: publicly funded and run, publicly funded and privately run, and privately funded and run. Each local government sets the local standard cost of labor, and management and operation costs are taken from the national standard. The administrative costs of public nursery schools are financed by nursing fees and taxes. As nursery school teachers and other public nursery school staff are public service workers, their salaries are set based on the salary schedule for public service workers.

Publicly funded and run nursery schools are established and directly operated by local governments. Among these schools' expenses, labor costs are paid from general accounts and administrative and operational expenses are covered by general revenue sources and childcare fees.

Publicly funded and privately run nursery schools are established by local governments but operated by the private sector. The operating expenses of these nursery schools are paid out of the national treasury, prefectural and municipal funds, and childcare fees. In this case, both labor costs and other expenses, such as administrative and operational expenses, are included under nursery school operational expenses.

Finally, privately funded and run nursery schools are established and operated by the private sector. Here, the term "private sector" refers to social welfare corporations, joint-stock corporations, and nonprofit organizations (NPOs). Among these, social welfare corporations are the most common. In some municipalities, the quality of childcare drops when schools are operated by joint-stock corporations, and, thus, such corporations are not allowed to enter the market. Furthermore, although there are no issues with childcare quality when it comes to NPOs, continuity is considered to be a problem.

12.2.2 Previous Studies

Many studies have used principal-agent theory to conduct theoretical analyses that treat governments as regulatory agents and companies as agents that conduct business. However, no previous study has focused specifically on nursery school operations using principal-agent theory. We discuss that most important studies that comprise a basic framework for this field. Holmstrom (1979) clearly defined moral hazard and adverse selection using the example of auto insurance and claimed that these risks could be effectively avoided by incorporating a self-assessment of risk into contracts. Fudenberg and Tirole (1990) demonstrated that social welfare would improve if the government tolerated monopoly profits when renegotiating with monopolistic enterprises in the military industry. Baron and Besanko (1984) also showed that applying monopoly profits can contributes to improvements in social welfare to a certain extent. Salanie (1997) demonstrated that when moral hazard and adverse selection exist under asymmetric information, the second-best outcome can be reached if the government presents a contract. Laffont and Tirole (1993) revealed that when the businesses regulated by the government include efficient and inefficient companies among under asymmetric information, providing rents to inefficient companies contributes to improving social welfare.

12.3 Model with Separate Reward and Cost Systems

We consider the wage level and the problem of the reward system for providers by referring to the model of two types of asymmetric information developed by Laffont and Tirole (1993).[1] Here, we assume that two reward system types are present. The first type involves the government disbursing provider rewards and costs separately (separating system), and the second type involves rewards and costs being disbursed together (lump-sum system). In the case of a separating system, Laffont and Tirole (1993) hypothesized that if provider costs are observable, they can be separated from the reward. If these costs were not observable, however, then the government can implement a lump-sum system. In this section and the next, we compare the two payment systems and describe their characteristics.

[1] In this section and next section, we analyze public childcare services in Japan following the Laffont and Tirole model. For details, see Chap. 1 of Laffont and Tirole (1993).

In the Japanese system, nursery school providers receive nursing fees and subsidies from the national and local government. The efficient amount of administrative expenses is set by the national government. A nursery school provider must hire teachers and a principal and pay a salary to the teachers and a reward to the principal. In the case of a private nursery school, the manager is the principal, as is typical.

We refer to the nursery school teacher salary as the wage. We define the cost parameter β, which represents the labor cost of nursery school teachers. If the provider reduces the wage, either the provider's profit or the principal's reward increases. Therefore, the utility of the provider increases. We also denote the effort level associated with reducing the wage as *e*. Reducing teachers' wages worsens the working environment and makes retaining and hiring employees difficult and, thus, incurs a disutility of $\varphi(e)$. The disutility increases with effort (i.e., $\varphi'^{(e)} > 0\ for\ e > 0$) at an increasing rate $\varphi''(e) > 0$ and satisfies $\varphi(0) = 0$, $\lim_{e \to \beta} \varphi(e) = +\infty$.

12.3.1 Model with a Separating Reward System Under Symmetric Information

The utility of provider U is presented below as a quasi-linear function.

$$U = R - \varphi(e) \tag{12.1}$$

R is the provider's reward, and e is the level of effort. The output is constant, and the labor cost β is an increasing function of wages. We can define the actual cost to the provider as is $C = \beta - e$.

Costs and rewards are financed by the government, and if the funds are raised from tax revenue, the social welfare function can be written as follows.

$$W = S - (1 + \lambda)(R + C) + R - \varphi(e) = S - (1 + \lambda)(C + \varphi(e)) - \lambda U \tag{12.2}$$

S represents the value of the childcare service to the consumer, and $\lambda > 0$ denotes the shadow cost of childcare. If β and *e* are observable, the maximization problem faced by the local government is

$$\max_{e,u} W$$

$$\text{s. t.} U \geq 0$$

The optimum condition is

$$\varphi'(e) = 1 \tag{12.3}$$

$$U = 0. \tag{12.4}$$

When Eq. 12.3 holds, the optimum level of effort $e*$ is achieved. If the reward is $R = \varphi(e^*)$, then if the reward does not change, even if the costs increase, the result is $dC = d\beta > 0$.

12.3.2 Model with a Separating Reward System Under Asymmetric Information

Next, we discuss cases with asymmetric information. The labor cost parameter for a provider paying high wages is β^H, and the labor cost parameter for a provider paying low wages is β^L. We assume that $\beta^H > \beta^L$, and we let $\Delta\beta \equiv \beta^H - \beta^L$. The local government knows that there are two types of wages, but it cannot observe the type associated with each nursery school. Let v be the probability that a nursery school is type β^L. We assume that the actual cost C^i and the utility U^i depend on the nursery school type (i = H, L).

Here, because the local government observes neither the type of wage nor the level of provider effort, we must establish a reward R^H that satisfies high provider wages. If this reward level can also be accepted by providers with low wages, then $U^L > 0$, and the incentive compatibility (IC) condition of providers with low wages is not satisfied. The local government solves the following optimization problem.

$$\begin{aligned}
&\max_{C^H,C^L,U^H,U^L}\left\{v[S-(1+\lambda)(C^L+\varphi(\beta^L-C^L))-\lambda U^L]\right.\\
&\left.+\ (1-v)[S-(1+\lambda)(C^H+\psi(\beta^H-C^H))]\right\}\\
&\text{s.t.}U^H \geq 0\\
&U^L \geq R^H-\varphi(\beta^L-C^H)\\
&\quad \geq U^H+[\varphi(\beta^H-C^H)-\varphi(\beta^H-C^H-\Delta\beta)]
\end{aligned}$$

The optimum reward condition in this asymmetric information case is exactly the same as that found by Laffont and Tirole (1993): $\varphi'\left(e^L\right) = 1, \varphi'\left(e^H\right) < 1, U^H = 0, U^L > 0, R^L > R^H$. Accordingly, providers with low wages receive information rents to satisfy the IC condition. Under this kind of asymmetry, a voluntary increase in wages by providers would not materialize even if the government wished to raise the wage level.

12.4 Model with a Lump-Sum Reward System

12.4.1 Model with a Lump-Sum Reward System Under Symmetric Information

Next, we consider a system in which the government disburses rewards and costs as a lump sum. In this case, the lump-sum reward system is

$$\overline{C} \equiv R + C. \tag{12.5}$$

The social welfare based on this lump-sum system is

$$W = S - (1 + \lambda)\overline{C} + R - \varphi(e) = S - (1 + \lambda)(C + \varphi(e)) - \lambda U. \tag{12.6}$$

Therefore, the optimum solution is the same as that for Eqs. 12.3 and 12.4, which represent the symmetric information case. However, in this system, even if the actual cost cannot be observed, it is enough if the level of effort can be controlled because the nursery school provider's individual rationality (IR) condition, $R - \varphi(e) \geq 0$, is satisfied at the optimum.

Moreover, to increase the wage level, the government simply needs to increase the reward. Specifically, $\mathrm{d}\bar{C} = d\beta$. Thus, the reward can be determined such that even if the wages increase, the level of effort does not change. However, under our definition of social welfare, an increase in wages only worsens welfare.

If the government considers nursery school teachers' wages and places a weight of $(1 + \lambda)$ or more on the utility of nursery school teachers, an increase in wage levels increases social welfare, insofar as the wages increase within the range of non-negative social welfare.

12.4.2 Model with Lump-Sum Reward System Under Asymmetric Information

We next consider the same model in cases of asymmetric information. Here, we consider provider behavior in circumstances in which the government cannot observe the level of effort or providers' costs. To do so, we use the same two-type model as in Sect. 12.3.2. First, the government establishes a lump-sum reward, C, that results in $U^H = 0$. However, we assume that $\varphi'\left(e^H\right) < 1$.

At this point, the utility of low-wage type providers is:

$$\begin{aligned} U^L = \overline{C} - C^L - \varphi\left(e^L\right) &= C^H + \varphi\left(e^H\right) - C^L - \varphi\left(e^L\right) \\ &= \left(\beta^H - \beta^L\right) - \left(e^H - e^L\right) + \left(\varphi\left(e^H\right) - \varphi\left(e^L\right)\right). \end{aligned} \tag{12.7}$$

Accordingly, under this lump-sum reward system, $U^L > 0, \varphi'\left(e^L\right) = 1$. However, the IC condition is not satisfied for low-wage providers. In this situation, if providers can choose the wage level, they can be expected to always provide a low wage. Alternatively, if the government approves new entries into the marketplace to increase market supply, a fixed lump-sum reward system can incentivize low-wage type providers to enter the market.

Next, we explain the optimum reward in the case of asymmetric information. We have shown that the IC condition is not satisfied with the reward of $\overline{C}$ discussed in the previous subsection. Therefore, we instead assume that the government can provide two rewards, $\left(\overline{C}^H, \overline{C}^L\right)$.

First, we establish that providing $\overline{C}^H$ leads to $U^H = 0$. If low-wage providers receive a reward of $\overline{C}^H$, then, as discussed above, the IC condition is not satisfied. Accordingly, establishing $\overline{C}^L > \overline{C}^H$ to satisfy the IC condition yields the same conditions and, therefore, the same optimum problem as that in Sect. 12.3.2.

Importantly, unlike in the symmetric information case, the reward for low-wage providers is higher than that for high-wage providers in asymmetric information case. Accordingly, in this case, providers do not voluntarily choose to pay high wages.

12.5 Validity of the Model

12.5.1 Comparison with the Japanese Case

This section examines whether some of the results of the previous sections are consistent with the operation of actual nursery schools in Japan.

First, we assess the abilities of national and local governments to observe whether nursery schools are operated in accordance with childcare subsidy estimates and are taking steps to lower the wages of nursery school teachers. Our analysis shows not only that a minimum number of nursery school teachers should be secured and that salary increases for nursery school principals should be curbed but also that an agreement needs to be reached regarding the financing of nursery schools' operation costs through either childcare fees or taxes.

Second, we analyze the case in which the public sector can only observe the balance of profits. In this case, we find that social welfare improves when each nursery school increases its supply to reduce the number of children on waiting lists, even if rents occur as a result. In short, the waiting list issue can be solved by decreasing nursery school teachers' wages and diverting money across expenditure items to improving principals' wages.

Third, we show that under a lump-sum reward system, if the government tries to increase the quantity of a public service, providers with low wage levels will enter the market. Because the private nursery school subsidy can be considered a lump-sum reward system, decreasing the waiting list requires checking whether the number of private nursery schools has increased.

We now check the first point regarding the subsidy calculation and the efficiency of nursery school management from the perspective of nursery school teachers' wages. Table 12.1 summarizes the information provided in the document "Survey Results on the State of Kindergarten and Nursery School Operations Income and Expenditures" (MHLW and MEXT 2013). The columns labeled "percentage of composition" show each cost as a proportion of total income. However, because labor costs in public nursery schools are paid from the general accounts of local governments, the actual income is the sum of labor expenditures and total income, and the proportion of total income that each cost comprises is calculated as a percentage of this sum.

Because the rewards for public nursery school principals and the labor costs for public nursery school administration are financed by taxes, the public nursery school reward system can be interpreted as the separating reward system in Sect. 12.3. However, because the rewards for private nursery school principals and the wages of private nursery school teachers are financed by the subsidy and nursing fees, the private nursery school system reward system can be interpreted as the lump-sum reward system in Sect. 12.4.

As shown in Table 12.1, public nursery schools in Japan have not been able to cover their expenditures owing to business activity income. Additionally, the percentage of business activity expenditures made up of income from childcare fees is only 12% for public nursery schools and 2% for private nursery schools. Thus, considerable public funds are being allocated to childcare service businesses. In particular, income from childcare fees is almost unable to cover private nursery schools' expenses from childcare service business activities, and, thus, it can be said that large amounts of taxes have been introduced in these schools.

As shown in Sect. 12.2, subsidies can be calculated by multiplying the unit price by the number of people to be accommodated. The unit price is determined by considering the area, capacity, certification category, age, and childcare time. In addition, wages depend on the years of experience of the nursery school teachers and the principal. Thus, a large amount of the subsidy is decided without considering management efforts.

Every year, the Welfare And Medical Service Agency performs a business analysis of the private nursery schools that are its loan customers. Welfare And Medical service Agency (2017) analyzes the results of fiscal year 2016 and indicates that loss-making nursery schools have higher labor cost ratios than profitable nursery schools do. See Table 12.2 for details.

The results presented in Tables 12.1 and 12.2 show that the rising share of labor costs, mainly in private nursery schools, is one reason that these companies do not earn profits. Because these nursery schools continue to operate even if they make a loss, we can conclude that business will still continue even if management efforts are not reflected in the calculation of subsidies and that even entrepreneurs who are failing stay in business. Thus, the subsidy system does not provide an incentive for efficient management.

Table 12.1 The state of nursery school income and expenditures by operation agent

State of income and expenditures		Public nursery schools number = 558		Private nursery schools number = 1317	
		Amount (thousand yen)	Percentage (%) of total	Amount (thousand yen)	Percentage (%) of total
1. Business activity income	Operational cost income	9243		89,738	
	Usage fee income	11,566		2445	
	Other income	3172		22,778	
2. Business activity expenditures	Labor expenditures	85,224	75.6	80,887	71.2
	Administrative expenditures	5255	4.7	9500	8.4
	Operational expenditures	9219	8.2	12,917	11.4
	Depreciation costs	29	0.0	5013	4.4
	Other expenditures	182	0.2	997	0.9
3. Income not from business activity		3527		601	
4. Expenditures not from business activity		196	0.2	1098	1
Total income		27,507		113,627	
Total expenditures		100,104	88.8	108,479	95.5
Remainder (total income—total expenditures)		12,627	11.2	5149	4.5

Source Compiled from "Survey Results on the State of Kindergarten and Nursery School Operations (Income and Expenditures)" in 2013

Table 12.2 Cost ratio of private nursery schools in 2016 (fiscal year)

	Profitable nursery schools number = 3725	Loss-making nursery schools number = 676
Labor cost ratio (%)	70.1	79.1
Expense ratio (%)	18.2	21.4
Depreciation rate (%)	2.9	3.7
Number of nursery school teachers and assistants	21.0	20.2

The data shown the table are the averages of each item
Source "Report for business condition of nursery school and the authorized kindergarten in 2016 (fiscal year)"

Next, these results confirm that managers receives rewards as rent in the case of a lump-sum reward system under asymmetric information.

Furthermore, comparing the labor costs of public and private nursery schools, as shown in Tables 12.1 and 12.2, indicates that public nursery schools have higher labor costs and that public nursery schools' labor costs make up a greater percentage of total costs. Thus, we can assume that private nursery schools tend to make efforts to reduce labor costs. In the model of the previous section, the labor cost reduction behavior is e, and, thus, it can be observed posteriorly that private nursery schools actually reduce personnel expenses.

Of the licensed child care services in Japan, 30% are public and 70% are private. Thus, it must be accepted that private nursery schools are reducing labor costs to maintain the supply of childcare services. As the second point discussed above in this subsection makes clear, assuming that the efficiency of national and local governments is below the desired level, the wages of childcare professionals must be reduced to ensure the supply of childcare services.

Furthermore, Table 12.3 compares the salary levels of facility managers using the same data as that used in Table 12.1. When the number of years of service are taken into consideration, the wages of nursery school teachers who transitioned to full-time positions are higher at public nursery schools. However, remuneration for facility managers is higher at private nursery schools when taking their lengths of service into account.

Finally, we confirm the third point discussed above. Figure 12.1, which is taken from the Ministry of Health, Labor, and Welfare (1996–2016) shows the annual trends in the numbers of publicly and privately managed nursery schools. The number of municipal nursery schools drastically decreased in 2003. In 2003, the operating expenses of public nursery schools were transferred to the general fund, which led to the privatization of public nursery schools. In 2013, small-scale nursery schools began to be established to eliminate the problem of waitlisted children, and more nursery schools were established by the Social Welfare Corporation.

As we have seen, teachers' wages are lower at private nursery schools than at public ones. Therefore, we can confirm that if the government directs a fixed subsidy

Table 12.3 Working situations of nursery school teachers and principals

	Public nursery schools			Private nursery schools		
	Salary (per worker, converted to full-time employment, monthly: yen)	Number of full-time employees	Average working year	Salary (per worker, converted to full-time employment, monthly: yen)	Number of full-time employees	Average working year
	297,989	18.3	13.0	259,385	22.1	9.4
Full-time principals	545,053	1.0	33.6	532,097	1.0	24.1
Full-time nursery school teachers	287,431	10.4	11.8	255,415	13.4	9.9
Part-time nursery school teachers	153,556	1.5	7.5	153,156	2.0	7.0

Source Compiled from "Survey Results on the State of Kindergarten and Nursery School Operations (Income and Expenditures)" in 2013

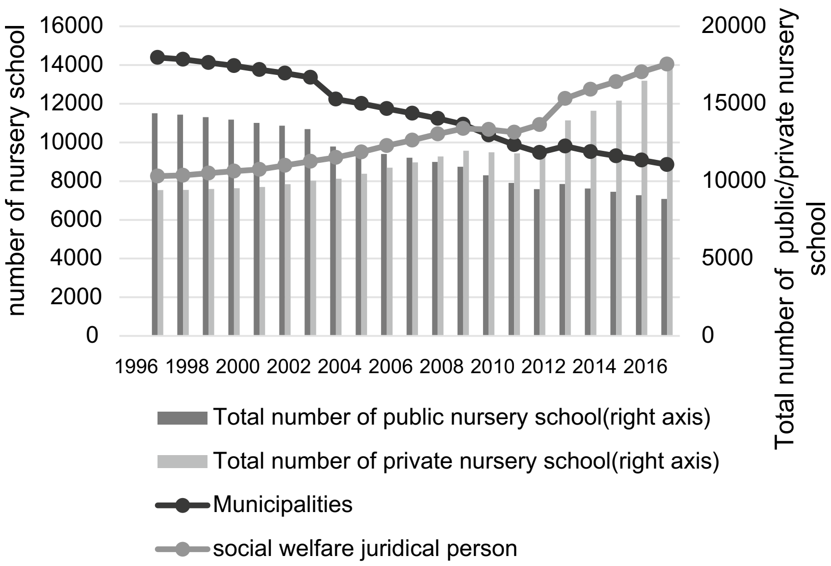

Fig. 12.1 Time trend of the number of public/private nursery schools (*Source* Compiled from "Report on Social Welfare Administration and Services" from 1996 to 2016 issued by the Ministry of Health, Labor, and Welfare)

amount to a lump-sum compensation plan aimed at reducing the number of waitlisted children, private nursery schools with lower-wage nursery school teachers would enter the market.

12.5.2 Discussion

Our analysis has revealed that the administrative expenses of public childcare services are supported mainly by taxation. The main cause of the deficits is that labor costs have increased but the number of nursery school teachers and childcare assistants has remained largely unchanged regardless of the profitability of private childcare centers. Thus, even nursery schools that lack robust management do not close immediately; they continue to operate even when making losses. In theory, if the government can operate under the principle of nursery school unit cost integration and can implement wage reductions among childcare workers, then all nursery school management expenses should be either covered by the revenue from childcare fees or fully supported by taxes.

However, it is difficult to conclude that nursery schools are being operated as planned by the system, as the facility managers' salary levels are above those that would be set using the principle of childcare unit cost integration. Thus, information asymmetry appears to be present in the context of nursery schools in Japan. In the presence of information asymmetry, when nursery schools charge no fees in an attempt to slow the decline in the birthrate, it is necessary to verify the impact of the current fixed subsidy system on the structure of society using empirical analyses.

Furthermore, the national average wage of childcare professionals in Japan supports the theoretical conclusion that the wages of nursery school teachers should be reduced to guarantee the supply of childcare services. However, waitlisted children are unevenly distributed in urban areas, and, thus, it is important to further confirm whether these theoretical consequences are supported in each region.

Finally, the trends depicted in Fig. 12.1 indicate that the number of municipal (public) nursery schools has declined, whereas the number of Social Welfare Corporation (private) nursery schools has increased. Thus, the prevailing situation in the mid-2000s has reversed. Owing to the transfer of public nursery school operating expenses to the general fund in 2003, the privatization of public nursery schools was encouraged in various locations, and the number of private nursery schools increased.

In addition, because this situation coincided with countermeasures taken to solve the problem of waitlisted children, more detailed analyses of the main factors would be helpful. In other words, if the government spends a fixed amount on subsidies in a lump-sum compensation plan to reduce the number of waitlisted children, then panel data from cities, towns, and villages can be used to check whether private nursery schools with lower wages for nursery school teachers can be introduced.

12.6 Conclusion

In this study, we examined the ideal state of regulations for licensed childcare service providers following the Laffont and Tirole (1993) model. Section 12.2 outlined the current Japanese public nursery school service system and previous applications of principal-agent theory. In Sects. 12.3 and 12.4, we found the following three results. First, if the government cannot survey nursery school management efforts and the wages of nursery school teachers, then even if nursery school manager remunerations and personnel expenses are paid separately, the IC conditions are not satisfied for managers who pay nursery school teachers low wages. In other words, if subsidies take the form of a fixed amount and are not linked to the efforts of nursery schools' managers, then managers have no incentive to minimize expenses. Second, if remuneration is given in a lump sum in the presence of asymmetric information, then managers who pay nursery school teachers low wages receive information rents. In other words, we showed that managers are rewarding themselves in the form of information rents by controlling labor costs. Third, if the government intends to provide more childcare services under a lump-sum fixed compensation plan, the market will include more low wage earners than high wage earners.

In Sect. 12.5, we looked at the summary data and considered whether the above three points could explain the management of public childcare services in Japan. Regarding the first point, we found that the current subsidy system is not linked to managerial efforts regardless of whether remuneration is paid separately or as a fixed lump sum. Moreover, even if nursery schools operate at a loss because of the insufficient efforts of their managers, they often remain in business. Thus, the subsidy system provides no incentive for efficient management. Furthermore, businesses operate at a loss in part because of high labor costs.

Regarding the second point, in the case of asymmetric information due to lump-sum fixed compensation, we were able to observe that an expansion on childcare services led to an increase in the salaries of nursery school principals even as the salaries of private nursery school teachers fell. Public nursery schools treat labor costs as an expenditure item in their general accounts, and, thus, the wages of nursery school teachers are never cut to finance the salary of the facility manager. However, at private nursery schools, gross earnings must be able to cover total expenses including labor costs, and, thus, it is unlikely that a contract that does not allow for raises in the facility manager's salary would be acceptable.

The third point relates to inviting private entrepreneurs to participate in the effort to expand childcare services under a lump-sum fixed compensation plan. We demonstrated that many public nursery schools were privatized under a lump-sum fixed compensation plan owing to the transfer of public nursery school operating expenses to the general fund in 2003. Because privately owned nursery schools account for 70% of Japan's licensed nursery school services, it is impractical for publicly funded labor costs to include publicly operated nursery schools. The second-best alternative is to approve the diversion of funds between different budgetary expense items and to lower the wages of nursery school teachers.

However, low salaries are a major factor contributing to the shortage of nursery school teachers, which urgently needs to be alleviated. As Sect. 12.5 confirms, income from childcare fees contribute only about 10% of the total income of childcare providers. As a social welfare program, childcare services must support low-income households; however, policymakers should consider requiring households at or above a certain fixed income threshold that use these services to share in the financial burden.

In this study, we used summary data to examine whether a supply behavior model of childcare providers based on Laffont and Tirole (1993) describes actual childcare services in Japan. However, in practice, little progress has been made toward the acceptance of younger children at such centers and, indeed, daycares for infants aged zero to one are non-existent, weakening social welfare. Future studies could refine the model to account for the age distribution of children and the capacity of childcare facilities. The quality of childcare service is also an important issue that merits further study. Finally, this analysis could also be applied to other regulated industries.

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Chapter 13
Efficiency of Italian Early Child Care Provision: A Bootstrapped DEA Assessment

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Abstract Socio-demographic changes and financial restrictions in the context of the economic downturn have stressed the importance of increasing the efficiency in the provision of local public services. Among them, early child care is regarded as a crucial service for the positive effect on children scholastic achievements, female labor market participation as well as aggregate fertility rates. This chapter aims at analyzing the efficiency in the provision of early child care in Italy and studying the impact of the demand-side factors. We apply a two-stage semi-parametric approach to a large sample of Italian municipalities in the period 2001–2005. First, a bootstrapped Data Envelopment Analysis (DEA) is used to estimate the performance in the provision of early child care; then, a semi-parametric truncated estimation is employed to study whether municipalities react to demand-side pressures, such as women participation to labor market, by increasing the efficiency in the provision. DEA results show a remarkable heterogeneity in the provision of child care across Italian municipalities. We also find that demand-side pressure affects the efficiency.

Keywords Local public services · Early child care · Efficiency · Two-stage · DEA

13.1 Introduction

In the last decades, as a consequence of both institutional and socio-demographic relevant changes, much attention has been devoted to local governments' efficiency and performance (Borge et al. 2008; Geys et al. 2008; Nakazawa 2014; Asatryan and De Witte 2015). On the other side, the EU has also stressed the importance of implementing high quality services in order to enhance social cohesion within the Union (see, for instance, the Lisbon Agenda).[1] As a result, the provision of local

[1] More details on the Lisbon Agenda can be found here: http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/00100-r1.en0.htm.

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public services has assumed an increasing consideration in the public debate, since local governments are called to provide high quality services under more severe budget constraints than in the past.

While this issue is relevant for any local context, it assumes a crucial role in a country such as Italy, characterized by large public debts both at central and local level. Furthermore, fiscal consolidation policies carried out in the last years by the Italian central government reduced significantly the intergovernmental transfers to local communities (Balduzzi and Grembi 2011).[2] In this context, not surprisingly, a recent strand of public finance reforms stressed the importance of the efficiency in the provision of local public services. Therefore, Italian municipalities need to increase the efficiency in the use of resources and, in particular, in the provision of public services, thus the efficiency assessment in such a context is currently of primary importance.

Among other important public services, EU programs devote a strategic role to early child care insofar as it is deemed to provide positive effects on children scholastic achievements as well as women labor force participation (WLFP). Indeed, a large literature investigates the effect of the provision or the financial support through subsidies of early child care on several outcomes, such as children's school achievement (Heckman 2006), upward intergenerational mobility (Chetty et al. 2014), women fertility rates (Bjorklund 2006) and WLFP (Del Boca et al. 2008), finding positive effects of high quality early child care. In this perspective, the Lisbon Agenda defined the 33% of coverage of potential demand as a key target to be achieved by 2010. Nonetheless, child care provision still appears highly heterogeneous both between and within countries in Europe.[3]

This chapter aims at studying the efficiency in the local provision of child care services in Italian municipalities and assessing the impact of demand side pressures. To measuring efficiency, we adopt a two-stage semi-parametric approach (Simar and Wilson 2000, 2007), using data from local governments' financial statement certificates (*Certificati dei conti consuntivi*—CCC) in the period 2001–2005. Firstly, we employ a bootstrapped Data Envelopment Analysis (DEA) in order to estimate a frontier envelopment surface and to compute efficiency scores for each municipality. Among the alternative approaches employed to study local governments' efficiency, DEA emerged as the most adopted method (Narbón-Perpiñá and De Witte 2018). Then, we perform semi-parametric truncated estimation (Simar and Wilson 2007) to test the effect of demand-side environmental variables on municipalities' performance.

Although there is a large literature exploring the efficiency of local governments in the provision of public services,[4] only few works attempted to study the efficiency

[2]The reduction of intergovernmental transfers as a consequence of fiscal consolidation policies is not only an Italian fact. Indeed, recent studies on fiscal consolidation have underlined the contribution of intergovernmental transfer reductions to fiscal consolidation in different countries (OECD 2013; Vammalle and Hulbert 2013; European Commission 2014).

[3]According to OECD, Denmark spent in 2007 for child care 0.8% of GDP, Finland 0.7%, UK 0.4%, France 0.4%, Italy 0.2%, Germany 0.1% (Chapple and Richardson 2009).

[4]For a recent survey on local governments' efficiency, see e.g. Narbón-Perpiñá and De Witte (2018).

of child care provision in local communities within European Union (Bjurek et al. 1992; Fazioli and Filippini 1997; Montén and Thater 2011; Gori and Fissi 2012). Moreover, to the best of our knowledge, there is no paper devoted to study the influence of demand-side pressures, such as WLFP and potential demand, on the efficiency of child care services.

Our efficiency results show a remarkable heterogeneity in the provision of early child care by Italian municipalities. Then, we find that the potential demand has a positive effect on municipalities' performance. Additionally, the share of not married people and of over 65 inhabitants in the municipality are also significant explanatory factors, while women labor force participation does not seem to play a role. Overall, our findings suggest that local governments react to demand-side pressures by increasing the efficiency in the provision of local public services.

The rest of this chapter is organized as follows. In Sect. 13.2, we provide the background for the study, with a brief review of the related literature and an overview of the Italian context related to early child care. Section 13.3 presents the two-step semi-parametric method and the data employed in our analysis. In Sect. 13.4, we discuss the DEA efficiency results and, then, the second-stage results on the impact of demand-side environmental variables. Finally, Sect. 13.5 provides some concluding remarks for further research.

13.2 Background

13.2.1 Related Literature

The previous literature on the performance in early child care provision is fairly limited.[5] In the pioneering work of Bjurek et al. (1992), they employ standard DEA to analyze cost efficiency in Gothenburg, Sweden, by using facility-level data and, then, estimate second-stage Tobit model to explain the differences in efficiency. Their results show that directors' skill and socio-demographic structure affect the efficiency of expenditure. More recent contributions focus on municipalities as relevant Decision-Making Units (DMUs). Fazioli and Filippini (1997) analyze cost efficiency in child care provision in 115 Italian municipalities in 1994 by adopting a parametric approach. Specifically, they apply a Displaced Ordinary Least Squares (DOLS) in order to estimate a best-practice cost frontier. Their work aims at studying the presence of economies of scale in child care provision and the trade-off between the quality of services and cost efficiency. Gori and Fissi (2012) also study the provision of early child care in Italian municipalities by a set of performance indicators.

[5]On the contrary, there is a large literature on the effect of child care on several outcomes, such as fertility rates (Del Boca 2002; Bjorklund 2006), children's school achievement (Carneiro and Heckman 2003; Heckman 2006; Havnes and Mogstad 2011a), upward intergenerational mobility (Chetty et al. 2014) and, especially, WLFP (Baker et al. 2008; Del Boca et al. 2008; Havnes and Mogstad 2011b; Brilli et al. 2016).

However, their descriptive approach has few elements in common with the other works. Nonetheless, this study is also based on the CCC dataset, that is probably the main available source of information on local public finance.

Similarly to our analysis, Montén and Thater (2011) study the efficiency in child care provision in the Land of Saxony, Germany, by adopting a two-step semi-parametric approach (Simar and Wilson 2007). Their cross-sectional dataset includes 213 municipalities for the year 2006. In the first stage, in order to estimate DEA efficiency scores, the authors consider a combination of 2 inputs (material expenditures and no. of personnel) and 5 outputs (legally allowed capacity in a given municipality, the number of facilities per 1000 inhabitants and a set of three weighted-per-class-of-age number of children receiving care variables). Then, in the second stage, explanatory variables include: the share of open-ended grants to own tax income, the status (full-time salaried or uncompensated) of the municipality's mayor, the Herfindahl index of political concentration, the total population and the share of population over 65 years old. The latter has been chosen in order to capture the effect of an aging population on the public interest in financing child care facilities. Their main results are that more elderly people negatively affects efficiency and larger municipalities may benefit from economies of scale, while the other explanatory variables do not exhibit significant effects on the efficiency.

On the other hand, our work is also related to the papers studying the global (i.e. not focused on a specific public service) efficiency of Italian local government, some of which include input and/or output variables related to early child care services. Barone and Mocetti (2011) employ a Stochastic Frontier Analysis (SFA) to estimate the efficiency of public spending in Italian municipalities and, then, to analyze the relationship between public spending inefficiency and individual tax morale, finding that the attitude towards paying taxes is better when public spending inefficiency is lower. Boetti et al. (2012) employ both DEA and SFA to estimate the efficiency of 262 municipalities in the province of Turin and, then, to assess whether spending performance of local governments is affected by the degree of vertical fiscal imbalance. Agasisti et al. (2016) evaluate through bootstrap DEA the efficiency in providing essential public services (e.g., general administration, waste collection, street lighting) of 331 municipalities in Lombardy, finding that there is room for substantial improvements. Finally, D'Inverno et al. (2018) employ a 3-stage DEA based approach to estimate the efficiency of municipal spending in Tuscany and, then, to investigate the determinants of local governments' performance.

Overall, previous results on the efficiency of Italian municipalities vary considerably, depending on the sample and the methodological approach employed in the specific study. Nonetheless, a general picture common to all previous works is the remarkable variation of the efficiency scores throughout the country. This would suggest that, on the one hand, there seem to be a large heterogeneity in the provision of public services across Italian municipalities; on the other hand, there seem to be much room for performance improvement.

13.2.2 The Italian Context

In Italy, increasing attention has been devoted to early child care as a key factor for both children development and women labor market participation. To this extent, the supply of nursery schools has significantly increased in the last decade, even if the National Institute of Statistics (ISTAT 2016) pointed out that the average coverage of child care provision is still relatively limited (22.5%) with respect to the potential demand (children between 0 and 3 years old) and, certainly, very far from the 33% target set by the EU in the Europe 2020 program.

Early child care system in Italy is decentralized, the municipalities being the main decision makers with regard to both the organization of the provision and the level of expenditure. In particular, municipalities can provide directly child care services or outsource them to third parties, often not-for-profit organizations that manage public structures, or lastly provide incentives to the private sector. Provision by the private sector has increased in recent times, though the system remains principally public.

As a result of such decentralization, the distribution of the coverage rate is very mixed across Italian municipalities, still reflecting the typical geographical heterogeneity along the North-South axis: in 2014 the average coverage was 28.2% in the Centre-North but only 11.5% in the South (ISTAT 2016). Finally, a similar geographical heterogeneity can be read in the level of local government expenditure devoted to early child care. In 2014, municipalities spending more per resident child were Trento, Bologna and Roma, all located in the Centre-North; on the other hand, those spending less per resident child were Reggio-Calabria, Vibo Valentia and Catanzaro, all located in the South (ISTAT 2016).

13.3 Methods and Data

13.3.1 Methods

The analysis of efficiency involves the estimation of the best-practice frontier and the evaluation of each DMU's relative performance as the distance from the frontier (Farrell 1957). In the efficiency literature two main approaches can be distinguished: the parametric approach (e.g., COLS, SFA) and the nonparametric approach (e.g., DEA, FDH). In studying the efficiency of public sector, nonparametric methods have received a considerable amount of interest, mainly because they do not require a priori specifications of a functional form for the production technology in contrast with parametric methods.[6]

[6]Nonparametric methods have been applied in many public sector activities, such as public library (De Witte and Geys 2013), judicial districts (Finocchiaro Castro and Guccio 2012), higher education (Johnes 2006; Guccio et al. 2016), healthcare (Cavalieri et al. 2018), care for the elderly sector (Borge and Haraldsvik 2009), heritage authorities (Finocchiaro Castro et al. 2011).

In this analysis, we employ a bootstrapped DEA approach to study the efficiency of Italian municipalities in the provision of early child care. The standard DEA follows the pioneering work of Charnes et al. (1978) that generalized the Farrell (1957) single input/output efficiency measure to a multiple-input/multiple-output framework. Specifically, the DEA computes a best-practice frontier for a set of DMUs, as well as the distance (i.e. efficiency score) from the frontier for each DMU. In the output-oriented DEA, as employed in our study, the distance from the frontier provides a measure of the radial improvement in outputs that can be achieved for a given level of inputs, thus suggesting the potential improvement that can be realized in the use of inputs.

Analytically, the DEA output-oriented efficiency score θ_i of the i-th DMU is computed, for each $i = 1, \ldots,$ n, solving the following program, assuming constant returns to scale (CRS):

$$\begin{aligned} & Max_{\lambda,\theta_i} \quad \theta_i \\ & subject\, to\, x_i \geq X\lambda \\ & \quad \theta_i y_i \leq Y\lambda \\ & \quad \lambda \geq 0 \end{aligned} \tag{13.1}$$

where x_i and y_i are respectively the inputs and outputs of the i-th DMU, X is the matrix of input vectors and Y is the matrix of output vectors, λ is a $n \times 1$ vector of variables. To account for the potential presence of variable returns to scale (VRS), the model (1) can be modified by adding the convexity constraint $e\lambda = 1$, where e is a row vector with all entries equal to one, which allows us to distinguish between technical efficiency and scale efficiency.[7]

The standard DEA model presents the well-known limitation of being deterministic, namely it does not contemplate any measurement error and, thus, attributes the whole distance from the frontier to inefficiency. As a result, it does not allow for any statistical inference in the efficiency scores. To account for such limitations, Simar and Wilson (1998, 2000) introduced a bootstrapping approach (i.e. bootstrapped DEA) to determine the statistical properties of DEA estimates.

As we already said, in this study the efficiency in the provision of early child care is explored in two stages. In the first stage, we estimate the efficiency of Italian municipalities through bootstrapped DEA. In the second stage, we employ the two-step bias-corrected semi-parametric estimator proposed by Simar and Wilson (2007)[8] to investigate the impact of demand-side factors on local governments' efficiency, according to the following general specification:

[7]For further analytical details on DEA models, see e.g. Fried et al. (2008).

[8]Simar and Wilson (2007, 2011) have shown that traditional estimators (e.g., OLS, Tobit) of the second-stage regression (2) yield to biased estimates due to serial correlation of efficiency scores, while their two-step bias-corrected semi-parametric procedure is the only method to consistently estimate the second-stage model (2).

Table 13.1 Model specifications

Variables	MOD_1	MOD_2	MOD_3
Inputs			
Costs	◆	◆	
Employees	◆	◆	◆
Nurses	◆	◆	◆
Outputs			
Children	◆	◆	◆
Available places	◆		

$$\theta_i = f(z_i) + \varepsilon_i \tag{13.2}$$

where θ_i represents the DEA efficiency score for each municipality resulting from the previous stage, z_i is a set of potentially relevant environmental factors (e.g., demand-side factors) at municipal level, and ε_i is a vector of error terms. In the next section, we describe in depth the input and output variables employed in the DEA model and the environmental factors included in the second-stage analysis.

13.3.2 Data

The selection of input and output is a critical aspect of efficiency analyses as the risk is the misspecification of the production frontier. To minimize such a risk, we follow the related literature for the identification of the most relevant variables defining the provision of early child care at municipal level.

As far as the inputs are concerned, we use total costs, the number of employees, and the number of nurses. Among the outputs, we include the number of children receiving care, which is commonly used in the previous studies (Montén and Thater 2011; Giordano and Tommasino 2013) and the total capacity (number of available places, i.e. the number of children that may receive care in all facilities). The latter measure is the most questionable. In fact, the number of available places can be considered fixed in the short run, being dependent on the number of facilities available, and adjusted in the long run. Additionally, given that total costs include the wage of employees and nurses (i.e. the other two inputs), estimates based on the full set of inputs could be biased due to misspecification. Thus, to provide robustness to our results, we employ three production models differing in the specification of the inputs and outputs set. More specifically, Model 1 is based on the full set of inputs and outputs. Then, in Model 2 we exclude the available places from the outputs set, and in Model 3 we also exclude total costs from the inputs set. Table 13.1 summarizes the variables used in the three models.

Then, in the second-stage we consider several variables indicating the potential pressures from the demand-side, measured as the share with respect to the

Table 13.2 Descriptive statistics—input variables

Year	Obs.	Costs		Employees		Nurses	
		Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
2001	447	338,460.40	360,799.40	4.43	5.06	8.39	8.71
2002	499	329,476.00	361,908.70	4.36	5.55	8.24	8.27
2003	504	333,983.20	386,506.60	4.56	7.05	8.35	8.94
2004	411	339,267.80	366,697.70	4.03	3.82	8.18	8.67
2005	479	338,004.80	358,167.60	4.01	4.49	7.98	7.72
Total	2340	335,628.70	366,926.10	4.29	5.37	8.23	8.46

Source Our computation on data drawn from the CCC dataset

total population: the potential demand (i.e. share of the population under 3 years old); the share of working women, given that the WLFP is acknowledged as a key factor influencing the demand for child care services; the share of not married/divorced/separated/widowed persons, which may capture additional social pressure on the local governments with respect to dedicated services; lastly, the share of inhabitants over 65 years old in the municipality. As Montén and Thater (2011) observe, this latter variable captures both a political and a demographic features related to the demand for child care provision that are relevant in western countries, given the average increase in population age in recent decades. First, the older is the median voter, the lower may be the public interest in financing child care services. Moreover, informal care by grandparents is extremely relevant in Italy, and can be viewed as a substitute of formal early child care. We also include among the controls a set of altimetry zone dummy variables, following the ISTAT code (5 areas: inner mountain, coastal mountain, plain, inner hill, coastal hill).

Data used in the empirical analysis have been drawn from two different sources. Data on the provision of early child care at municipal level have been taken from the "*Certificati dei conti consuntivi*" (CCC), an informative financial summary that municipalities must provide on a yearly basis. As for environmental variables representing the demand-side pressure, we draw data from the Italian National Institute of Statistics (ISTAT), the main producer of official statistics in Italy. While ISTAT provides high quality data, CCC suffers from missing values, outliers and data errors that may affect dramatically estimation outcomes, thus requiring much attention in the data cleaning process. The resulting dataset contains 2340 observation for 695 municipalities, for the period 2001–2005. By and large, all the Italian municipalities providing the service have been included, excluding those reporting missing values in a subset of variables and those showing data errors. Tables 13.2, 13.3 and 13.4 show descriptive statistics by year for inputs, outputs and demand-side variables, respectively.

From Table 13.2, total costs were relatively stable in the sample period, while the number of personnel (i.e. employees and nurses) decreased. In the same period, output levels did not change substantially, as shown in Table 13.3.

Table 13.3 Descriptive statistics—output variables

Year	Obs.	Available places		Children	
		Mean	St. Dev.	Mean	St. Dev.
2001	447	51.46	44.81	50.16	46.07
2002	499	50.92	46.72	48.46	44.00
2003	504	51.87	48.84	50.01	48.73
2004	411	49.73	40.65	48.14	41.42
2005	479	50.90	43.11	49.72	45.62
Total	2340	51.01	45.06	49.32	45.32

Source Our computation on data drawn from the CCC dataset

Table 13.4 Descriptive statistics—demand-side variables and controls

Variable	Obs.	Mean	Std. Dev.	Min	Max
Demand side					
Not married	2340	0.11	0.02	0.04	0.19
WLFP	2340	0.14	0.04	0.04	0.29
Over 65	2340	0.18	0.04	0.08	0.35
Potential demand	2340	0.04	0.01	0.02	0.15
Controls					
Inner mountain	2340	0.20	0.40	0.00	1.00
Coastal mountain	2340	0.02	0.13	0.00	1.00
Inner hill	2340	0.31	0.46	0.00	1.00
Coastal hill	2340	0.13	0.33	0.00	1.00
Plain	2340	0.35	0.48	0.00	1.00
2001	2340	0.19	0.39	0.00	1.00
2002	2340	0.21	0.41	0.00	1.00
2003	2340	0.22	0.41	0.00	1.00
2004	2340	0.18	0.38	0.00	1.00
2005	2340	0.20	0.40	0.00	1.00

Source Our computation on data drawn from ISTAT

13.4 Results

13.4.1 Efficiency Estimates

Standard and bias-corrected efficiency scores estimated assuming VRS are presented by year and geographic area in Tables 13.5 and 13.6, respectively. In general, estimation outcomes show that efficiency is relatively low on average. This result suggests

Table 13.5 Efficiency estimates by year

Year	Obs.	DEA_VRS		DEA_VRS_BIAS_CORR	
		Mean	St. Dev.	Mean	St. Dev.
MOD_1					
2001	447	0.4398	0.1458	0.4013	0.1180
2002	499	0.4470	0.1672	0.4050	0.1318
2003	504	0.4532	0.1642	0.4110	0.1322
2004	411	0.4490	0.1598	0.4075	0.1312
2005	479	0.4633	0.1608	0.4198	0.1278
Average	*2340*	*0.4506*	*0.1601*	*0.4091*	*0.1285*
MOD_2					
2001	447	0.3652	0.1501	0.3331	0.1249
2002	499	0.3700	0.1752	0.3356	0.1440
2003	504	0.3771	0.1656	0.3422	0.1374
2004	411	0.3739	0.1606	0.3401	0.1359
2005	479	0.3850	0.1677	0.3494	0.1389
Average	*2340*	*0.3744*	*0.1644*	*0.3402*	*0.1366*
MOD_3					
2001	447	0.3190	0.1335	0.2961	0.1147
2002	499	0.3184	0.1564	0.2941	0.1317
2003	504	0.3253	0.1532	0.3008	0.1299
2004	411	0.3229	0.1464	0.2996	0.1277
2005	479	0.3313	0.1497	0.3075	0.1310
Average	*2340*	*0.3235*	*0.1484*	*0.2996*	*0.1273*

Source Our computation on data drawn from the CCC dataset

that Italian municipalities could improve their performance in the provision of early child care substantially. In fact, low mean values for all the three models indicate that the very large majority of municipalities present comparable efficiency levels with the exception of few best performers. In addition, as can be seen in Table 13.5, low performance is rather persistent along time, though it slightly increased in the period.

Then, Table 13.6 shows that the efficiency distribution is rather heterogeneous within the country: not very surprisingly, it is relatively higher in central regions and generally lower in southern Italy. Finally, bias correction seems to have a rather limited effect on estimates, as can be seen from the comparison of descriptive statistics of uncorrected and bias-corrected efficiency scores.

The above conclusion on the role of bias correction are also evident from Fig. 13.1, where we compare the univariate kernel distributions for uncorrected and bias-corrected efficiency scores for the three models. The univariate kernel smoothing

Table 13.6 Efficiency estimates by geographic area

Year	Obs.	DEA_VRS		DEA_VRS_BIAS_CORR	
		Mean	St. Dev.	Mean	St. Dev.
MOD_1					
North east	802	0.4476	0.1544	0.4077	0.1233
North west	474	0.4536	0.1597	0.4115	0.1274
Centre	332	0.4799	0.1759	0.4309	0.1407
South and Islands	732	0.4387	0.1575	0.3991	0.1280
Average	*2340*	*0.4506*	*0.1601*	*0.4091*	*0.1285*
MOD_2					
North east	802	0.3681	0.1659	0.3354	0.1389
North west	474	0.3928	0.1711	0.3559	0.1384
Centre	332	0.4071	0.1742	0.3676	0.1420
South and Islands	732	0.3543	0.1501	0.3229	0.1274
Average	*2340*	*0.3744*	*0.1644*	*0.3402*	*0.1366*
MOD_3					
North east	802	0.3152	0.1428	0.2938	0.1241
North west	474	0.3428	0.1543	0.3163	0.1277
Centre	332	0.3533	0.1666	0.3233	0.1397
South and Islands	732	0.3063	0.1383	0.2846	0.1222
Average	*2340*	*0.3235*	*0.1484*	*0.2996*	*0.1273*

Source Our computation on data drawn from the CCC dataset

distributions (Wand and Jones 1995) have been estimated through reflection and the plug-in method for bandwidth selection (Sheather and Jones 1991). Evidently, uncorrected and bias-corrected distributions are partially overlapping and right skewed for both models, being the bulk of distributions concentrated on the left side.

13.4.2 Second-Stage Results

To investigate the effect of demand-side pressure on the provision of early child care in Italian municipalities, we employ the two-step semi-parametric estimator (Simar and Wilson 2007) using as covariates the demand-side variables described in the previous section, along with altimetry dummies, and a full set of yearly fixed-effects to control for time-variant common factors. Estimation outcomes from the three models are shown in Table 13.7. For all the models, we include the potential demand, over 65, not married population, and WLFP, measured as the share of the total population.

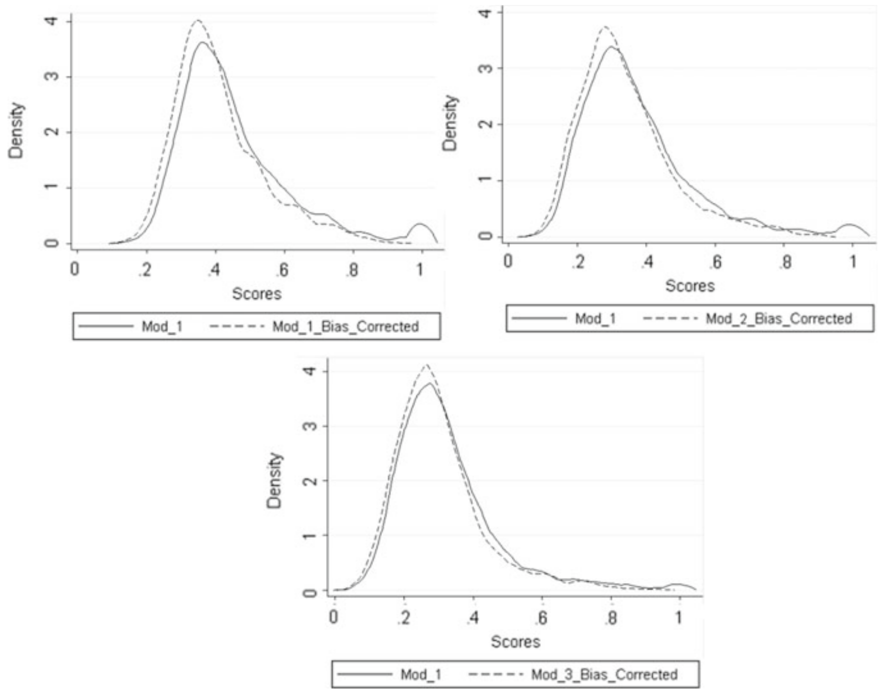

Fig. 13.1 Kernel density estimates. *Source* Our computation on data drawn from the CCC dataset

The estimates in Table 13.7 show that the direct pressure deriving from a larger share of potential demand is relevant and positive for all three models. In addition, the characteristics of the population in the municipality, indicating indirect demand-side pressure, appear to be relevant in explaining the efficiency as well. In particular, more elderly people result to be negatively associated with the efficiency, at least in model 2 and 3. This is not surprising, as a larger share of inhabitants over 65 years old in the municipality entails the presence of more informal care by grandparents, a substitute of child care especially relevant in the Italian context, and thus relieving pressure on the public provision.

Similarly, the share of not married inhabitants results strongly significant across all the models and positively associated with the municipalities' performance, consistently with the idea that higher social pressure on the local government for specific public services may induce higher efficiency in the provision. Conversely, the share of working women does not seem to play a role in the model, since its coefficient is not significant in all the estimates. Finally, the estimates on altimetry zone dummy variables (i.e. inner mountain) suggest that cost structure is relevant as well in explaining efficiency.

Table 13.7 Second-stage estimates

Variables	Mod_1	Mod_2	Mod_3
Not married	0.5267***	0.6535***	0.5607***
	(0.2039)	(0.2149)	(0.2148)
WLFP	0.0146	0.1197	0.1034
	(0.0797)	(0.0897)	(0.0853)
Over 65	−0.1291	−0.2285*	−0.2710**
	(0.1097)	(0.1202)	(0.1169)
Potential demand	0.9162**	0.7720*	0.8380*
	(0.4187)	(0.4615)	(0.4449)
Inner mountain	−0.0139*	−0.0202**	−0.0300***
	(0.0078)	(0.0088)	(0.0082)
Coastal mountain	0.0059	0.0181	−0.0037
	(0.0212)	(0.0237)	(0.0220)
Inner hill	−0.0109	−0.0063	−0.0135*
	(0.0071)	(0.0077)	(0.0070)
Coastal hill	0.0020	−0.0108	−0.0096
	(0.0094)	(0.0104)	(0.0095)
2001	−0.0190**	−0.0171*	−0.0126
	(0.0087)	(0.0095)	(0.0089)
2002	−0.0155*	−0.0152*	−0.0155*
	(0.0083)	(0.0092)	(0.0085)
2003	−0.0088	−0.0076	−0.0072
	(0.0084)	(0.0090)	(0.0086)
2004	−0.0117	−0.0092	−0.0080
	(0.0088)	(0.0096)	(0.0089)
Constant	0.3563***	0.2799***	0.2590***
	(0.0312)	(0.0343)	(0.0335)
Observations	2340	2340	2340

***, **, and * denote significance at the 1, 5, and 10% level

Overall, the results in Table 13.7 provide evidence of a positive effect of demand-side variables in affecting the municipalities' performance in the provision of early child care services. Generally speaking, our findings suggest that municipalities react to both direct and indirect demand-side pressures by increasing the efficiency in the provision of public services.

13.5 Concluding Remarks

Efficiency in the provision of local public services has acquired an increasing interest in the public debate, as socio-demographic changes and more severe budget constraints have forced both local and national governments to improve public sector's efficiency. This is especially true in Italy where public debt, both at central and local level, represents a strong limitation to public expenditure. In this chapter, we employed a two-stage semi-parametric approach to study the efficiency of Italian municipalities in the provision of early child care service. Under the methodological perspective, we argued that the employed methods allowed us, on the one hand, to estimate the efficiency of municipalities without relying on a priori assumptions on the functional form of production technology, which is important in the early child care where the production function is difficult to know; on the other hand, to consistently investigate the impact of demand-side factors on local governments' efficiency.

Our findings show a high heterogeneity in the provision of child care within the country, consistently with the previous literature on the efficiency of Italian local governments. With the exclusion of a minority of municipalities, Italian local governments may substantially increase their technical efficiency, especially in southern Italy. Then, we find that socio-demographic factors affects local governments' efficiency directly. The share of not married people and of over 65 inhabitants, as well as the potential demand, are significant explanatory factors of local governments' heterogeneity in the provision of child care services, suggesting that municipalities react to the demand-side pressure by increasing the efficiency in the provision. Cost structure, height and position of municipalities are also relevant in explaining the efficiency.

This study stimulates a few interesting directions for further improvement in this field. Firstly, an analytic comparison between estimation outcomes obtained by applying different estimation methods would allow for a more comprehensive understanding of the production process in the provision of early child care. Moreover, while we focus the attention on the effect that the socio-demographic structure may have on local governments' performance, other circumstances might indeed be relevant in affecting the efficiency of local public services. Therefore, future development should include a richer set of explanatory variable in the second stage analysis as well as robustness checks in the first stage estimation of municipalities' performance in the provision of early child care.

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Chapter 14
The Economics of Heritage: Some Implications of Devolution

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Abstract In this paper, we focus on the political economic consequences of devolution of policies dealing with heritage conservation and valorization. In particular, the existence of local policymakers' vested interests concerning the conservation of heritage—due to its positive effects on tourism—raises the issue of what set of functions, and class of heritage to devolve. Our political economic analysis shows that devolution may favor the conservation of heritage with 'outstanding characteristics' over more 'local' heritage, leading to an inefficient outcome. We then discuss different possible measures to correct for such a political inefficiency.

Keywords Fiscal competition · Heritage policies · Conservation · Regional coordination

14.1 Introduction

Conservation[1] and valorization[2] of built cultural heritage (CH) are relevant issues in our society. The appreciation of CH appears to be widespread. In fact, according to the Eurobarometer (2017), a large majority of citizens in the European Union take pride in CH and are in favor of larger public support. At the same time, the scope

[1] Lichfield (1988) provides a list of different activities regarded as conservation: prevention of deterioration, conservation, consolidation, restoration, rehabilitation, reproduction and reconstruction.

[2] Valorization refers to the activities put in practice to spread information and knowledge about cultural heritage and to enhance the attention toward its use.

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of what we consider CH tends to enlarge through time, and its positive effects on economic and social growth are increasingly recognized (Council of Europe 2005).

Public support to CH can be justified on the grounds of the well-known arguments of option demand, bequest demand, national prestige and merit goods, as well as the public good characteristics of CH and the externalities it causes (Towse 1994).

Great attention is paid in the literature to the controversial aspects of public intervention, both with respect to its normative rationale, i.e. the extent of market failure (Frey 2011; Benhamou 2013), and to implementation issues (Mazza 2011; Holler and Mazza 2013). From a positive analysis perspective, we observe that often governments play a crucial role in supporting the conservation and valorization of CH, though with different scopes and intensities. Public action exhibits different institutional features across countries,[3] depending on the mix of tools employed, the roles of public and private actors (Klamer and Mignosa 2006; Klamer et al. 2013), and the level of government involved (Rizzo 2004).

In a political economic context, the valorization of CH (which may be profitable for the specific jurisdiction where that heritage stands, for example by attracting tourists) requires specific attention. It is widely claimed that CH is a powerful touristic attractor, generating a large amount of economic benefits. However, such a conclusion, although almost unanimously accepted in the political debate, is not necessarily supported by empirical evidence. For instance, the effects of outstanding CH on tourism, such as the CH included in the World Heritage List (WHL), have been widely discussed in a debate on the journal *Tourism Management* (Yang et al. 2009; Cellini 2011; Yang and Lin 2011) without reaching clear cut conclusions.

From another perspective, Cuccia et al. (2014, 2016) stress that the inclusion in the WHL is not enough to increase the competitiveness of a tourism destination since the expected increase of tourism flows does not occur, unless effective local cultural policies are put in practice. Looking at regional evidence, Cuccia and Rizzo (2013) show that UNESCO inscription does not seem to be effective in overcoming seasonality and in fostering cultural tourism. Overall, it is worth noting that the consumption of culture by tourists involves not only immovable CH, however outstanding it may be, but also a wider content including intangible CH and cultural experiences (Bonet 2013). Noonan and Rizzo (2017) provide an overview of different contributions offered in the literature, and suggest that tourism and CH are closely related, in one way or in another; for instance tourism flows are also found to affect cultural attendance (Borowiecki and Castiglione 2014).

In this paper, we claim that the economic benefits deriving from tourism may induce a local government to spend relatively more resources on outstanding CH, which attracts tourists, rather than on the local one, which only residents know in general. This potential bias of local policymakers raises the issue of reconsidering the impact of devolution on conservation. The utilization of CH for economic purposes may also raise some obvious conflicts between the objectives of valorization and conservation. The «conservationist» stance, often adopted by specialists and bureaucrats, has been criticized as an obstacle to valorization for compatible uses (Rizzo

[3] van der Ploeg (2006) discusses different approaches to cultural policy.

2011). In this study, we present a different view, claiming that the latter stance may be helpful to preserve *local* heritage, which risks not to receive adequate financial support by local governments. Their policies are likely to be biased towards outstanding CH because it is more visible and, therefore, more likely to generate political and economic gains.

This paper is organized as follows. Section 14.2 explores the pros and cons of devolution in order to identify the likely effects on conservation policies and public spending. Section 14.3 presents a simple economic model to derive some indications about the impact of devolution of policies of CH conservation and valorization. Section 14.4 provides some concluding remarks.

14.2 Devolution and Heritage Conservation

A peculiar feature of CH is that the area of public intervention constitutes a matter of discretion: the approach to identify CH is ambiguous. In such circumstances, the extent and priorities of public activity are mainly determined through the political decision-making process. Cultural goods, moreover, tend to be community goods that elicit social reaction. Although people are generally uninformed about the costs of provision, they appear to pay attention to the condition of their CH (Eurobarometer 2017). To meet such a demand, conservation should concern CH's aesthetic, social and historic values. These values should be recognized as such by a society to build its own cultural identity. Therefore, society can have a relevant role in determining the output of cultural policies, depending on the level of public participation in decision-making.[4] It is well known that such participation is improved by the devolution of political authority. People are better judge of their specific and local needs rather than national interests (Mignosa 2012). Moreover, the features and costs of local provision can be more easily observed by residents, and direct democracy can be more easily implemented when it concerns local issues. Therefore, devolution would allow the adoption of direct democracy tools, such as referenda, to assess public evaluation of heritage policies, if the rules underlying the decision-making process are properly designed (Rizzo 2004).[5] On the opposite side, according to the theory of fiscal federalism, the centralization of public intervention might be mainly justified by the benefits, derived from the conservation of CH, which go beyond the borders of a region or state, or by local budget constraints. Here, attention will be concentrated on these issues, and the pros and cons of devolution in the field will be examined within a specific political economic framework.

[4]Peacock (1994) proposes that public participation could be enhanced by greater openness of public appointments in the decision-making bodies and if citizens, who are active in heritage matters, would be allowed to vote for their own representatives within these bodies.

[5]Swiss referenda offer interesting evidence on public attitudes toward the arts. Frey (1997) examines the reasons for extending the use of such a method to cultural decisions.

The traditional theoretical argument that devolution increases the accountability of government seems particularly strong in the CH field because of the close links between regional/local communities and CH. In addition, it is reasonable to presume the presence of vested interests in the conservation and valorization of CH at the decentralized tier because of the beneficial external effects on local economy (via its positive effects on tourism). This claim raises the issue of what type of CH and what set of functions to devolve. The common argument in the literature on fiscal federalism is that the allocation of functions among the various tiers of government should take into account, among other things, the geographical coincidence between taxpayers and beneficiaries of a given good and service. This would imply a hierarchy of CH in terms of the geographical distribution of benefits deriving from conservation—whether it is national or regional or local—in order to decide for the appropriate level of decision-making.

The CH sector, however, shows specific aspects that weaken the rationale for the principles of subsidiarity and perfect correspondence put forward by the normative analysis of fiscal federalism (Rizzo and Throsby 2006). In fact, the external benefits to the local economy deriving from conservation and valorization of CH—for example, via tourism—are directly correlated to its cultural relevance and reputation (nation-wide or world-wide). This will enhance the local government interest in conserving CH according to its external relevance. Local sponsors too would be inclined to support CH for the same wide visibility. Therefore, the fact that there are political and economic reasons to internalize the above-mentioned national and international external benefits would call for devolving the functions of conservation and valorization of CH to sub-central levels of government. Nonetheless, central government may maintain control (for example through regulation, as it happens in Italy) over the most relevant CH items, because they could be so relevant that their external benefits cannot be fully internalized. Once such a «core» CH has been defined, it is necessary to decide which functions should be transferred.

In fact, the scope of devolution can vary not only with respect to the type of CH but also with respect to the functions to be transferred. Local governments could be given all the available means—regulation, expenditure and taxation—to pursue the objective of CH conservation and valorization, or only some of them.[6] Different issues arise with respect to different tools. For the aim of this work, attention will be concentrated on expenditure/taxation, leaving aside regulation.

The issue of devolution might have, however, some counterintuitive policy implications as far as expenditure and taxation are concerned. A first issue is that not all kinds of CH can be economically exploited to the same extent and that different regions may be not equally endowed. Moreover, different types of CH can be differently affected by devolution, and such an effect also depends on the jurisdiction's economic conditions and on its degree of financial autonomy. We can distinguish, in a very rough way, two classes of CH: one including historical buildings and mon-

[6] For instance, in Italy, the Code of Cultural Goods and Landscape (2004) assigns the functions related to conservation to the central government and valorisation to the Regions and Municipalities. Instead, total devolution applies to some Special Statute Regions.

uments with outstanding characteristics—such as, for instance, CH included in the WHL—and another including ‘minor’ CH relevant mainly for residents. Whether the conservation of this latter type affects those living outside the boundary of the jurisdiction is a matter of discussion.

In the following model, we claim that the effects of devolution on the conservation and valorization of these two classes of CH can be quite different. We can imagine a spectrum having on the one end total centralization (i.e. the conservation and valorization of both classes of CH is assigned to the central government), and on the other end total devolution (i.e. the conservation and valorization of both classes of CH is devolved to local governments). Different arrangements can be located in the middle, the most representative being a form of partial devolution implying centralization for the first class CH and the decentralization of the second class CH. For simplicity, in the model we assume that conservation and valorization functions are not split between different levels of government, i.e. devolution or centralization include both functions. In what follows, the policy implications deriving from total and partial devolution are going to be explored.

14.3 A Model of Heritage Conservation and Valorization

We consider a country constituted by two regions of population n_1 and n_2, respectively. Each region is endowed with some CH: conservation is costly and CH is consumed as long as it is conserved. We assume that expenditures for the conservation of CH does not cause spillovers. In this way, we refer to that kind of CH that has historical relevance for the region and constitutes an important patrimony for a town, but is not so outstanding to attract foreign visitors. The amount of CH conserved is defined as $g_i (i = 1, 2)$. Residents in each region are interested in the conservation of their own CH. In addition to g_2, region 2 only can also allocate resources for the conservation of a higher-class CH (G_2) that causes positive externalities to the residents of region 1. The latter can also spend a share of their income to visit region 2. The first-class CH, for example, could have remarkable artistic characteristics and/or particular relevance in terms of national identity. The share of income transferred from region 1 to region 2 depends on the amount of expenditure for the top-class CH. For simplicity, we exclude flows from other countries. Conservation of CH is provided through a simple linear transformation of public revenue. The preferences of representative resident in each region are as follows:

$$\begin{aligned} u^1 &= v^1(g_1, G_2) + y_1(1 - t_1 - p(G_2)) \\ u^2 &= v^2(g_2, G_2) + (1 - t_2)\left(y_2 + p(G_2)\frac{n_1 y_1}{n_2} \right) \end{aligned} \tag{14.1}$$

where y_i and t_i denote the income and tax rate in region i, and $p(G_2)$ indicates the share of income transferred to region 2 by visitors from region 1. Reasonably, this share is non-negatively affected by the amount of public expenditure for conservation and may be positively affected within a limited range (in particular: $1/n_1 y_1 \geq p_{G_2} \geq 0$ and $p_{G_2 G_2} = 0$). Moreover, we assume v^1 and v^2 concave in their respective arguments (cross-derivatives equal to zero), zero mobility costs and that all residents in region 1 visit region 2 (no corner solutions). We can then aggregate the utility functions over the number of residents, obtaining: $U^1 = V^1(g_1, G_2) + n_1 y_1 (1 - t_1 - p(G_2))$ and $U^2 = V^2(g_2, G_2) + (1 - t_2)(n_2 y_2 + p(G_2) n_1 y_1)$. We now compare the outcomes under centralized and decentralized decision-making.

Centralized Decision-Making

The national policymaker will maximize the aggregate utilities of the residents in both regions, subject to the balanced budget constraint: $g_1 + g_2 + G_2 = t(Y + p(G_2) n_1 y_1)$, where $Y \equiv n_1 y_1 + n_2 y_2$.[7] Therefore, he will have the following program:

In an interior equilibrium we obtain:

$$V^2_{g_2} = V^1_{g_1} = 1$$

$$V^1_{g_1}\left(t p_{G_2} n_1 y_1 - 1\right) + V^1_{G_2} + V^2_{G_2} = t p_{G_2} n_1 y_1 \tag{14.2}$$

Thus $V^1_{G_2} + V^2_{G_2} = 1$: the sum of the marginal benefits from conservation will be equal to the social marginal cost.

Decentralized Decision-Making

If the conservation of local CH is entirely financed by its regional government, i.e. $g_2 + G_2 = t_2(n_2 y_2 + n_1 y_1 p(G_2))$, region 2 will choose t_2 and G_2 such that:

$$\begin{aligned} &V^2_{g_2} = 1 \\ &V^2_{g_2}\left(t_2 p_{G_2} n_1 y_1 - 1\right) + V^2_{G_2} + (1 - t_2) p_{G_2} n_1 y_1 = 0 \end{aligned} \tag{14.3}$$

therefore: $V^2_{G_2} = 1 - p_{G_2} n_1 y_1$. Region 1's optimal choice of G_2 is such that benefits and costs are equal at the margin: $V^1_{G_2} = p_{G_2} n_1 y_1$. Accordingly, we obtain that, in the extreme case that all residents in that region visit region 2 and mobility costs are zero (such that income is perfectly transferable to the destination region), the external benefits are internalized by region 2 and the efficient outcome is reached. However, the preferences for the lower-class CH in region 2, g_2, could also extend outside the regional borders, for example for reasons of national identity (for example the location where a treaty was signed), and yet that CH is not so outstanding to attract tourists. In this case, local expenditure does not internalize the external benefit of preserving g_2 and the decentralized choice of conservation is therefore inefficient.

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[7]In our model. analytical results would be equivalent if we exclude the inter-regional transfers from taxation. Notice that we do not consider a possible interest of the federal policymaker for redistribution. This issue could be of some relevance when important historical sites are located in relatively poor regions.

Political Economic Approach
The policymaker of region 2 could have a personal interest in the conservation of the local higher-class CH. For example, this type of expenditure may improve his/her prestige and popularity not only within the constituency, but also at the national level. Alternatively, the flows of tourists attracted by CH would improve the local economy and, therefore, the political consensus for the government. Accordingly, we assume that the objective function that the regional policymaker will maximize, subject to the balanced budget constraint $t_2(n_2y_2 + p(G_2)n_1y_1) = G_2 + g_2$, is: $P = \vartheta\left[V^2(g_2, G_2) + (1 - t_2)(n_2y_2 + p(G_2)n_1y_1)\right] + (1 - \vartheta)F(\alpha G_2, (1 - \alpha)g_2)$ with F_1, $F_2 > 0$ for $1 > \alpha > 0$. With α we indicate the relative preference of the policymaker for G_2 with respect to g_2, and with $1 - \vartheta$ his/her personal interest for CH. In general, we can suppose that the policymaker is more interested in the conservation of the outstanding CH, because that captures a larger attention from the media and visitors, than the low-class CH. However, it can be the case that there is no remarkable CH in the jurisdiction, or that conservation cannot be afforded because of limited regional resources. In this situation, we would have $\alpha = 0$. Substituting for the budget constraint and maximizing over t_2 and G_2, we obtain in equilibrium:

$$
\begin{aligned}
&\vartheta\left(V^2_{g_2} - 1\right) + (1 - \vartheta)(1 - \alpha)F_2 = 0\\
&\vartheta\left[V^2_{g_2}\left(t_2p_{G_2}n_1y_1 - 1\right) + V^2_{G_2} + (1 - t_2)p_{G_2}n_1y_1\right] + (1 - \vartheta)[\alpha F_1\\
&\quad + (1 - \alpha)F_2\left(t_2p_{G_2}n_1y_1 - 1\right)\big] = 0
\end{aligned}
\tag{14.4}
$$

From (14.4), we obtain that: $\vartheta\left(V^2_{G_2} + p_{G_2}n_1y_1 - 1\right) + (1 - \vartheta)\alpha F_1 = 0$. If $\vartheta = 1$, the local policymaker is not interested in the conservation of CH because of personal prestige and the outcome is the same as that presented earlier, whereas, if $\vartheta = 0$ then $t_2 = 1$. Consider the intermediate case of $1 > \vartheta > 0$. Then, if $\alpha = 1$, the conservation of the high-class CH, G_2, is higher than in the case when $\vartheta = 1$, while the amount of conservation of the low-class CH, g_2, stays the same. We then find that we could have under-provision of G_2 (although less than in the earlier case), if the number of visitors is low and mobility costs are high. Instead, we would have an efficient solution or even *over*-provision in the case of no mobility costs with all residents in region 1 visiting region 2. In the opposite case when $\alpha = 0$ there would be no change in G_2, with respect to the case when $\vartheta = 1$, but we would obtain over-provision of g_2, if that provision does not cause positive spillovers. Clearly, with $1 > \alpha > 0$ we obtain intermediate results.

From the above results, we see that in the case of total devolution top class CH could receive at least as much support as in a centralized system. In fact, local jurisdictions will be inclined to spend public money not only because of the historic and cultural values linking the CH to the community but also because of the political and economic benefits deriving from tourism. Moreover, we have not consider here the additional support to valorization and conservation of any type of local CH that private sponsors could offer due to its national visibility and/or community values. It is also worth mentioning that CH with more evident characteristic of uniqueness would also face a quite inelastic demand, allowing for high admission fees. In conclusion, devolution seems to cause no particular arm to top class CH.

Actually, the above argument speaks in favor of the largest possible degree of autonomy and devolution. In fact, the central policymaking will not take into account the effect that cultural expenditure may have in attracting *domestic* tourists. Moreover, it is also likely to fix rather homogeneous admission prices to be applied in the whole national territory, without taking into account the specificity of CH and regions. On the contrary, devolution allows each region to allocate resources for CH conservation and choose admission fees to maximize the economic return. The decentralized solution should, in general, improve the amount of resources invested in the conservation of first class CH and lead to efficient solutions, since each jurisdiction will equate at the margin the costs and benefits deriving from spending in CH.

The main problems deriving from total devolution concern the conservation of second class CH. As previously mentioned, decentralized decision-making is likely to concentrate resources on the type of CH with higher economic return, penalizing the CH of the second class. Such an impact is likely to vary according with the economic conditions and the social environment characterizing each jurisdiction, such as the income level in each jurisdiction and the existence of non-profit organizations (NPO) in the area. The features of the institutional framework can also be crucial.

Devolution may be partial rather than falling in one of the two polar cases we examined. Moreover, decision-making power can be split between politicians (government) and bureaucrats (executive bureaus) who may influence the allocation of funds. In what follows, these and other issue are briefly outlined.

Jurisdiction Income Level

The second class CH located in rich jurisdictions will suffer less, in terms of conservation, (or even does not suffer at all) than the equivalent class of CH located in poorer jurisdictions. The displacement effect in favor of outstanding CH could be compensated in the long-run by the higher local income generated by a larger tourism, but it is likely that, at the beginning, devolution might threaten the conservation of CH of lower class. In practice, in poorer jurisdictions, for economic reasons, the government will be naturally biased towards outstanding CH and a cross-subsidy from this type to the lower class one may not take place adequately, even threatening the conservation of cultural local identity (as represented by the second class CH).

From the above considerations, when total devolution occurs, almost paradoxically, public intervention for CH conservation, motivated by market failures, should concentrate on supporting the conservation of those assets that could not be efficiently financed by the market (via tickets and sponsorships).

Non-profit Organizations

With respect to the above considerations, it should be mentioned the countervailing effect of spontaneous and voluntary local associations which could invest efforts and money to preserve the lower-class CH, because of their relevance for the local identity. This latter argument gets further support if an inter-generation perspective is adopted. Moreover, the outcome depends upon the size of the «third sector» (NPO), and the tax incentives available to local governments to facilitate NPO support. If devolution takes place in a context where local governments are entitled with a low degree of tax autonomy and/or local taxes are unsuitable to be used for such a purpose, there are weak economic incentives for the third sector support to the conservation of local and minor CH.

"Political" Bias and Separations of Power

There are further political elements that induce to believe that outstanding CH will be privileged relatively to local CH, in particular when the former is located where the political power is concentrated (for example the capital of the region). The level of conservation and valorization, in this case, bears a string visibility and therefore is very likely to affect the popularity the local policy-maker(s). This political bias suggests that devolution, while improving the local effort for the conservation of CH by multiplying the centers of expenditure, might result inefficient because the resources would not be allocated in order to maximize the economic but rather the political return (Guccio and Mazza 2014).

From these considerations, it follows that the existence of "political" bias is likely to enhance the negative impact that devolution might exert on local and lower-class CH. A solution to this problem can come from a separation of powers. In fact, bureaucrats may be entitled to influence the allocation of funds to the local CH. Since they are not elected, they are not necessarily interested in the 'attention' of the voters on the conservation and valorization of top class CH. And if they are experts having a 'conservationist stance', aiming at preserving rather than exploiting, their reaction may correct for the political bias and come to rescue the local, less prestigious CH.[8]

Partial Decentralization

Let us now shift the attention to the intermediate case of partial decentralization, i.e. when central government is entitled to the conservation of outstanding CH, while local government is entitled to the conservation of local lower-class CH, and each level of government financing its activity with state and local taxes, respectively.

First, it is worth noting that this type of allocation of functions has an automatic re-distributive impact: jurisdictions with outstanding CH will be favored, regardless of their level of income, because the national community of taxpayers will finance the external economic benefits deriving from the tourist flows.

Second, the effect on the two types of CH critically depends on which hypotheses are made on the behavior of the central government and local jurisdictions. More precisely, if these different levels of government are assumed to act independently, no differences arise with respect to the total devolution case: the conservation of both classes of CH will be carried out, at each level, until its marginal costs and benefits are equal. If, on the contrary, central government and local jurisdictions behaviors are interdependent, the effect will be different depending on whether central and local conservation are complement or substitute. In the former case, the level of

[8] For a more detailed analysis of this situation of separation of powers, see Mazza and van Winden (2002).

conservation of outstanding CH is supposed to increase because the local jurisdiction increases its intervention, while in the latter case the opposite situation occurs.

14.4 Concluding Remarks

This paper has paid attention to the features of the decision-making process in the CH field and to their implications on CH policies, namely on the impact of devolution on CH conservation and valorization.

In principle, the peculiar feature of public intervention for CH—i.e. the area of intervention is not clearly defined—would suggest that the process by which CH decisions are taken is crucial. Attention, therefore, should be given to the features of the decision-making process. In this respect, an important issue is how the degree of public participation in decision-making on CH varies according with the distribution of responsibilities between different levels of government.

In the paper, the *pros* and *cons* of devolution in the field have been examined with specific reference to expenditure and taxation and the implications of total devolution and partial decentralization have been dealt with.

A tentative conclusion stemming from the paper is that total devolution might reduce the quantity of public spending for the conservation of 'minor' CH, i.e. with only local relevance. The size of such an effect, however, depends on the jurisdiction income level, on the extent of the NPO activity, on the existence of "political bias" in favor of outstanding CH, and on the separation of powers between biased politicians and 'conservationist' bureaucrats.

When partial decentralization is considered, the relative impact on the two classes of CH cannot be assessed *a priori*, depending on whether central intervention can be considered independent, complement or substitute to local government conservation activity.

Further developments should try to test the main results of the model. Italy might offer an interesting case study because of its institutional features (i.e. partial decentralization for most Regions and total devolution for some Special Statute Regions), marked economic differences across North and South areas and the peculiar characteristics of its CH endowment. In fact, Italy has substantial CH scattered all over the country, often in very small municipalities, and at the same time, a very high concentration of CH included in the WHL. These conditions, if data are available, offer a suitable case study to test for the impact of devolution versus partial decentralization, on CH conservation and valorization.

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Part III
Application of Political Economics and Empirical Analysis

Chapter 15
Political Economics of Public Pricing of Final and Intermediate Goods

Tsuyoshi Shinozaki and Mitsuyoshi Yanagihara

Abstract In this chapter, we study the effect of lobbying by special interest groups on the optimal pricing rule of publicly produced final and intermediate goods. We show that when the weight that the government places on campaign contributions from a special interest group organized by workers increases, the price of publicly produced final goods decreases and that of intermediate goods increases. However, when the weight that the government places on campaign contributions from a special interest group organized by capitalists increases, the effect on the prices of final and intermediate goods depends on capitalists' roles as both consumers and owners of firms. The effects of lobbying by workers and capitalists are asymmetric because the public enterprise must adhere to its budget constraint and because the roles of capitalists and workers in the economy differ.

Keywords Publicly produced private goods · Optimal pricing rule · Public enterprise · Lobbying activity

15.1 Introduction

We study the effect of lobbying by special interest groups organized by either workers or capitalists on the optimal pricing rule of publicly produced final and intermediate goods.

Necessary goods for daily life, such as water, gas, and electricity, are supplied under government intervention or, perhaps, by a public enterprise. One reason that governments must operate or intervene in such industries (referred to as public enterprises, hereafter) is that these industries require large initial investments and decreasing average costs, which implies that they are natural monopolies. These properties

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hinder efficient resource allocation. Furthermore, stable supplies of these goods are required for people's peace of mind. Thus, governments regulate or directly supply such goods and services.

Previous studies have tried to identify the most desirable regulation for efficient resource allocation. One possible regulation is average cost pricing, and the other is marginal cost pricing. Under the former regulation, the monopolistic firm earns zero profits, but a deadweight loss prevails. Under the latter regulation, the firm earns a negative profit that the government must offset with a subsidy, but an efficient resource allocation can be achieved.

Baumol and Bradford's (1970) pioneering work derives an optimal pricing rule maintaining the budget constraint of the public enterprise based on the principles of Ramsey (1927). They clarify that prices should deviate from marginal costs in inverse proportion to the price elasticity of demand and should also depend on the income elasticity of demand. Yang (1991) tackles this problem using a general equilibrium model in which a public enterprise produces both intermediate and final goods and shows that the uniform pricing rule for publicly produced final and intermediate goods is determined by the distributional characteristics of both the demand for publicly produced final goods and the demand for publicly produced intermediate goods. Moreover, Yang (1993) analyses the optimal pricing rule when two types of households, capitalists and workers, coexist and shows that the distributional characteristic of heterogenous households, a concept is introduced by Feldstein (1972), determines the optimal pricing rule.[1]

As the above literature shows, the importance of eliminating the harmful effects of natural monopolies is widely recognized. However, few studies have focused on the relationship between political economics and public enterprises. In the policy-making process, a politician can set the user charge for public services. In particular, in practice, politicians may propose lower prices for publicly produced final and intermediate goods to gain support from a special interest group organized by the firms. That is, firms may lobby to reduce the price of publicly produced intermediate goods. In this case, prices are set not only to achieve the an efficient resource allocation but also to win elections. In Japan, for example, politicians often offer discounts on public services to attract factories to their region. This fact indicates also that the price has never been determined solely by the objective for raising the efficiency of resource allocation. Thus, from a theoretical viewpoint, it is important to investigate not only how the deadweight loss from a natural monopoly but also how the activity of politicians could affect this resource allocation, as this question has not been yet discussed in the literature.

The landmark study on the effect of lobbying by special interest groups is that of Grossman and Helpman (1994). This study shows the effect of lobbying activities by special interest groups on politicians' policy decisions. Their approach has been applied to various situations, such as political competition between local or national governments, international trade policy, and environmental policies. However, to the

[1] De Borger (1997) extends this argument in the direction of the existence of externalities, and further research has applied this concept to various economic environments.

best of our knowledge, no previous study analyzes the relationship between lobbying activity and the optimal pricing rule for publicly produced goods. Therefore, we analyze the optimal pricing rule of publicly produced final and intermediate goods when special interest groups can lobby a public enterprise using Grossman and Helpman's (1994) approach.

The analyses conducted in this chapter obtain the following results. First, lobbying activity by a special interest group organized by workers (capitalists) decreases the price of publicly produced final goods (intermediate goods). Second, when a politician cares more about campaign contributions from special interest groups organized by workers (capitalists) than that those from groups organized by capitalists (workers), then on one hand, the price of publicly produced final (intermediate) goods decreases (increases), but, on the other hand, the price of the intermediate (final) goods increases to meet the budget constraint of a public enterprise.

The remainder of this chapter is organized as follows. In the next section, we construct a basic model of goods produced by public enterprises based on Yang (1993). In Sect. 15.3, we extend this model to incorporate lobbying activity. Section 15.4 concludes.

15.2 The Model

Consider an economy with four types of agents: a government, a monopolistic public enterprise, a fixed number of private firms, and households, which are divided into workers and capitalists. The economy has three kinds of goods: final goods produced by a public enterprise, intermediate goods produced by a public enterprise, and final goods produced by a private firm. The government can set the prices of final and intermediate goods produced by the public enterprise according to the budget constraint.

The following subsections describe Yang's (1993) basic model.

15.2.1 Settings

A monopolistic public enterprise supplies goods z, some of which are final goods, z^h, and some of which are intermediate goods, z^f, such that $z = z^h + z^f$ holds. These goods are sold at the price of final goods, p^h, and that of intermediate goods, p^f, respectively. These two goods are produced by labor, which is supplied by workers.

15.2.1.1 Private Firms

Our setting includes a large number of competitive private firms. Each private firm purchases public intermediate goods from a public enterprise and sells final goods,

y, produced by using labor, L_y, to households at price q. As in Yang (1993) and De Borger (1997), we assume that this production is subject to a production plan $(y, z^f, L_y) \in Y$. Without a loss of generality, by setting wages as the numeraire, the profit maximization problem of a firm can be formulated as

$$max \quad \pi = qy - p^f z^f - L_y, \quad s.t. \quad (y, z^f, L_y) \in Y.$$

Solving this problem, we obtain the factor demand function, z^f; the labor demand function, L_y; and the profit function, π, as follows:

$$\begin{aligned} z^f &= z^f(q, p^f), \\ L_y &= L_y(q, p^f), \\ \pi &= \pi(q, p^f). \end{aligned} \tag{15.1}$$

From Eq. 15.1, the supply function for private final goods is

$$y = y(q, p^f).$$

15.2.1.2 Households

There are two types of homogenous agents, workers and capitalists. Workers provide labor to private firms, L_y, and a public enterprise, L_z, to obtain wages. Capitalists earn profits, π, because they own private firms.

The budget constraint of a capitalist is $qy^C + p^h z^{h,C} = \pi$, and that of a worker is $qy^L + p^h z^{h,L} = L_y + L_z$, where y^i and $z^{h,i}$ are private goods and publicly produced goods demanded by households ($i = C, L$). The utility functions of workers and capitalists are $u^L = u(y^L, z^{h,L}, L_y + L_z)$ and $u^C = u(y^C, z^{h,C})$, respectively. Maximizing these utility functions allows us to obtain the demand functions of privately produced final goods of workers and capitalists (y^L and y^C, respectively), the demand functions of publicly produced final goods of workers and capitalists ($z^{h,L}$ and $z^{h,C}$, respectively), and the labor supply function of a worker, L, as follows:

$$\begin{aligned} y^L &= y^L(q, p^h), \\ y^C &= y^C(q, p^h, \pi), \\ z^{h,L} &= z^{h,L}(q, p^h), \\ z^{h,C} &= z^{h,C}(q, p^h, \pi), \\ L &= L(q, p^h). \end{aligned} \tag{15.2}$$

Substituting Eq. 15.2 into the utility function, we can obtain the indirect utility functions of workers and capitalists:

$$v^C\left[q, p^h, \pi\left(q, p^f\right)\right]$$
$$v^L\left[q^*, p^h\right]. \tag{15.3}$$

15.2.1.3 Equilibrium Price of Privately Produced Final Consumption Goods

The equilibrium output and price are determined by the market equilibrium condition, $y^L\left(q, p^h\right)N_L + y^C\left(q, p^h, \pi\left(q, p^f\right)\right)N_C = y\left(q, p^f\right)$, where N_L and N_C are the numbers of workers and capitalists. Solving this equilibrium condition for q, we obtain the equilibrium price of privately produced final goods,

$$q^* = q\left(p^h, p^f; N_L, N_C\right).$$

The equilibrium price is a function of publicly produced final and intermediate goods and the numbers of workers and capitalists. For simplicity, the numbers of both workers and capitalists are normalized to one, that is, $N_L = N_C = 1$ is assumed.

15.2.2 Optimal Price of Publicly Produced Goods

In this section, following Yang (1991, 1993) and De Borger (1997), we derive the optimal pricing rule of a benevolent government that maximizes social welfare. Specifically, the government chooses p^h and p^f to maximize social welfare subject to the budget constraint of a public enterprise in the goods market equilibrium.

A public enterprise produces consumption goods, $z^{h,i}\,(i = L, C)$, and intermediate goods, z^f. When the cost function of a public enterprise is given by $C\left(z^{h,L} + z^{h,C} + z^f\right)$, we can define the profit as

$$\pi^* = p^h\left(z^{h,L} + z^{h,C}\right) + p^f z^f - C\left(z^{h,L} + z^{h,C} + z^f\right). \tag{15.4}$$

Moreover, given the indirect utility functions of capitalists and workers and assuming a Bergson-Samuelson social welfare function, as in Yang (1991, 1993) and De Borger (1997), the objective function of the government becomes $W\left[v^C\left[q^*, p^h, \pi\left(q, p^f\right)\right], v^L\left[q^*, p^h\right]\right]$.

Thus, the maximization problem of the government can be formulated as

$$\max_{p^h, p^f} W\left[v^C\left[q\left(p^h, p^f\right), p^h, \pi\left(q\left(p^h, p^f\right), p^f\right)\right], v^L\left[q\left(p^h, p^f\right), p^h\right]\right]$$

$$\begin{aligned} s.t.\quad \pi^* = {} & p^h\left(z^{h,L}\left(q\left(p^h, p^f\right), p^h\right) + z^{h,C}\left(q\left(p^h, p^f\right), p^h, \pi\left(q\left(p^h, p^f\right), p^f\right)\right)\right) \\ & + p^f z^f\left(q\left(p^h, p^f\right), p^f\right) - C\left(z^{h,L}\left(q\left(p^h, p^f\right), p^h\right)\right. \\ & \left. + z^{h,C}\left(q\left(p^h, p^f\right), p^h, \pi\left(q\left(p^h, p^f\right), p^f\right)\right) + z^f\left(q\left(p^h, p^f\right), p^f\right)\right) \\ = {} & 0. \end{aligned}$$

The first-order conditions are

$$\lambda_1\left(\frac{\partial\pi^*}{\partial p^h}+\frac{\partial\pi^*}{\partial q^*}\frac{\partial q^*}{\partial p^h}\right)=\alpha z^h+\gamma_1\frac{\partial q^*}{\partial p^h}, \tag{15.5}$$

$$\lambda_1\left(\frac{\partial\pi^*}{\partial p^f}+\frac{\partial\pi^*}{\partial q^*}\frac{\partial q^*}{\partial p^f}\right)=\beta_1 z^f+\gamma_1\frac{\partial q^*}{\partial p^f}, \tag{15.6}$$

where λ_1 is a Lagrange multiplier and $\alpha\equiv\left(\frac{\partial W}{\partial v^L}\right)\left(\frac{\partial v^L}{\partial I^L}\right)\left(\frac{z^{h,L}}{z^h}\right)+\left(\frac{\partial W}{\partial v^C}\right)\left(\frac{\partial v^C}{\partial I^C}\right)\left(\frac{z^{h,C}}{z^h}\right)$, $\beta\equiv\left(\frac{\partial W}{\partial v^C}\right)\left(\frac{\partial v^C}{\partial I^C}\right)$, and $\gamma\equiv\left(\frac{\partial W}{\partial v^C}\right)\left(\frac{\partial v^C}{\partial I^C}\right)y^C+\left(\frac{\partial W}{\partial v^L}\right)\left(\frac{\partial v^L}{\partial I^L}\right)y^L-\left(\frac{\partial W}{\partial v^C}\right)\left(\frac{\partial v^C}{\partial I^C}\right)y$.[2] α and β represent distributive characteristics of z^h and the profit, respectively.γ represents the difference between the profit share, $\left(\frac{\partial W}{\partial v^C}\right)\left(\frac{\partial v^C}{\partial I^C}\right)y$, and $\left(\frac{\partial W}{\partial v^C}\right)\left(\frac{\partial v^C}{\partial I^C}\right)y^C+\left(\frac{\partial W}{\partial v^L}\right)\left(\frac{\partial v^L}{\partial I^L}\right)y^L$, and I^i, $i=C,L$, is the income of group i.

The left-hand side of the optimal pricing rule in Eqs. 15.5 and 15.6 can be decomposed into two distinguishable effects, one of which is brought about by the profit constraint of a public enterprise. The first term on the left-hand side represents the effect of increases in p^h and p^f given by the price of privately produced final goods. Increases in p^h and p^f affect the revenue and cost of publicly produced goods through z. The second term on that side represents the general equilibrium effect. Increases in p^h and p^f affect the price of privately produced final goods through the changes in the demand and supply in the private sector.

On the right-hand side, the first and the second terms of these expressions represent the direct and indirect effects of increases in p^h and p^f on the utility levels of capitalists and workers, respectively. Equations 15.5 and 15.6 constitute the optimal pricing rule for publicly produced final and intermediate goods. To interpret this rule, we add the assumption that the cross elasticity of demand and the general equilibrium effect are both zero, $\frac{\partial q^*}{\partial p^i}=0$, as in De Borger (1997), and we rewrite the optimal pricing rule of final and intermediate goods for publicly produced goods as follows:

$$\frac{p^h-\frac{\partial C\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}}{p^h}=\frac{\alpha-\lambda_1}{\lambda_1}\left(\frac{1}{\varepsilon^h}\right), \tag{15.7}$$

$$\frac{p^f-\frac{\partial C\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}}{p^f}=\frac{\beta-\lambda_1}{\lambda_1}\left(\frac{1}{\varepsilon^f}\right), \tag{15.8}$$

where $\varepsilon^h=\frac{p^h}{z^h}\frac{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial p^h}<0$ and $\varepsilon^f=\frac{p^f}{z^f}\frac{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial p^f}<0$. The reason that the price of publicly produced goods cannot equal the marginal cost is that (i) the Lagrange multiplier, which reflects the shadow price of a public enterprise, λ_1, is different from the marginal utility of privately produced goods α or β and (ii) the own price elasticity of demand, $\varepsilon^i\,(i=h,\,f)$, is negative.

[2] A detailed calculation is provided in Appendix section "The Optimal Pricing Rule of a Benevolent Government".

As discussed in the interpretation of De Borger (1997), consider the case in which the welfare cost of the budget constraint of a public enterprise exceeds the marginal utility of income, that is, $\alpha < \lambda_1$ and $\beta < \lambda_1$ in Eqs. 15.7 and 15.8. In this case, we can observe that the difference between the price and marginal costs depends on the price elasticity of demand. More concretely, as the price elasticity of demand increases (decreases), this gap becomes decreases (increases), so that the price is lower (higher).

Here, λ_1 can be interpreted as the social evaluation of the increase in the profit of the public enterprise driven by publicly produced final goods, that is, the increase in benefit, and α can be interpreted as the social evaluation of the decreasing utility of both types of households, that is, the increase in cost. In other words, λ_1 is a Lagrange multiplier representing the marginal profit evaluated by the social welfare function, and α is the distributive characteristic, as defined by Feldstein (1972). These characteristics are reflected by the social welfare level, which is a function of workers' and capitalists' utility, both of which are weighted by the ratios of their consumption to the total consumption of publicly produced final goods, $\left(\frac{z^{h,L}}{z^h}\right)$ and $\left(\frac{z^{h,C}}{z^h}\right)$. Finally, β is a distributive characteristic defined by Yang (1993) that reflects the social welfare level as evaluated by capitalist utility.

Thus, $\lambda_1 > \alpha$ ($\lambda_1 > \beta$) means that a social planner sets a higher price than the marginal cost of a publicly produced final (intermediate) good because the social planner places more weight on the marginal profit of a public enterprise than on the weighted average of utility (capitalist utility) obtained from that good.

15.3 Effect of Lobbying for Publicly Produced Final and Intermediate Goods

In this subsection, we demonstrate the optimal pricing rules of publicly produced final and intermediate goods when politicians receive lobbying pressure from special interest groups of workers and capitalists.

15.3.1 Special Interest Groups and Politicians

We assume that two special interest groups organized by either workers or capitalists provide campaign contributions, $Z(i = C, L)$, to politicians to encourage politicians to set the desirable prices, p^h and p^f, for each group. As in Grossman and Helpman (1994), the two special interest groups first offer contribution schedules, $Z^L\left(p^h; p^f\right)$ and $Z^C\left(p^f; p^h\right)$. The special interest groups then maximize the total welfare of the group members. We take the objective function for lobbying by the group of workers to be

$$G^L = v^L\left[q^*, p^h\right] - Z^L\left(p^h; p^f\right)$$

and that for lobbying by the group of capitalists to be

$$G^C = v^C\left[q^*, p^h, \pi\left(q, p^f\right)\right] - Z^C\left(p^f; p^h\right).$$

The interest of the politician depends not only on the amount of campaign contributions but also on public endorsements, which can be represented by the weighted sum of the welfare of both groups. The objective function of the politician consists of the sum of the levels of social welfare of the two groups and the amount of campaign contributions, as follows:

$$G = W\left[v^C\left[q^*, p^h, \pi\left(q^*, p^f\right)\right], v^L\left[q^*, p^h\right]\right] + \theta^L Z^L\left(p^h; p^f\right) + \theta^C Z^C\left(p^f; p^h\right).$$

Thus, maximization problem of group i is

$$\begin{aligned} & max\ v^i - Z^i \\ s.t\quad & W\left[v^C\left[q^*, p^h, \pi\left(q^*, p^f\right)\right], v^L\left[q^*, p^h\right]\right] + \theta^L Z^L\left(q^*, p^f\right) \\ & +\theta^C Z^C\left(p^f; p^h\right) \geq W\left[v^{C,-i}, v^{L,-i}\right] + \theta^{-i} Z^{-i}. \end{aligned}$$

Here -*i* represents another group of group *i*. The constraint of group *i* is the participation constraint of the government. As a result, as in Grossman and Helpman (1994), this maximization problem can be rewritten as:

$$\begin{aligned} G = {} & W\left[v^C\left[q^*, p^h, \pi\left(q^*, p^f\right)\right], v^L\left[q^*, p^h\right]\right] + \theta^L v^L\left(q^*, p^f\right) \\ & + \theta^C v^C\left[q^*, p^h, \pi\left(q, p^f\right)\right], \end{aligned} \tag{15.9}$$

where $\theta^i (i = L, C)$ represents the weight on campaign contributions from each group.

Moreover, we focus on a truthful contribution schedule, $Z^L(p^h; p^f) = max\left\{0, v^L\left[q^*, p^h\right] - B^L\right\}$ and $Z^C(p^f; p^h) = max\left\{0, v^C\left[q^*, p^h, \pi\left(q, p^f\right)\right] - B^C\right\}$, where $B^i (i = L)$, represents the net benefit to group i. Thus, the special interest group of capitalists must satisfy

$$\frac{\partial G^C}{\partial p^h} = \frac{\partial v^C}{\partial q^*}\frac{\partial q^*}{\partial p^h} + \frac{\partial v^C}{\partial p^h} + \frac{\partial v^C}{\partial \pi}\frac{\partial \pi}{\partial q^*}\frac{\partial q^*}{\partial p^h} - \frac{\partial Z^C}{\partial p^h} = 0 \tag{15.10}$$

$$\frac{\partial G^C}{\partial p^f} = \frac{\partial v^C}{\partial q^*}\frac{\partial q^*}{\partial p^f} + \frac{\partial v^C}{\partial \pi}\left(\frac{\partial \pi}{\partial q^*}\frac{\partial q^*}{\partial p^f} + \frac{\partial \pi}{\partial p^f}\right) - \frac{\partial Z^C}{\partial p^f} = 0. \tag{15.11}$$

The special interest group of workers must satisfy

$$\frac{\partial G^L}{\partial p^h} = \frac{\partial v^L}{\partial q^*}\frac{\partial q^*}{\partial p^h} + \frac{\partial v^L}{\partial p^h} - \frac{\partial Z^L}{\partial p^h} = 0, \tag{15.12}$$

$$\frac{\partial G^L}{\partial p^f} = \frac{\partial v^L}{\partial q^*}\frac{\partial q^*}{\partial p^f} - \frac{\partial Z^L}{\partial p^f} = 0. \tag{15.13}$$

We consider a two-stage game. In the first stage, each special interest group offers a campaign contribution schedule for the prices of publicly produced final and intermediate goods. In the second stage, the politician determines these prices. The game is solved by backward induction.

15.3.2 Optimal Pricing of Publicly Produced Final and Intermediate Goods Under Lobbying Pressure

As described above, in the second stage of the game, the politician chooses the optimal price of publicly produced final and intermediate goods. Then, in the first stage, special interest groups determine their campaign contribution schedules.

The politician sets the price to maximize Eq. 15.8 subject to Eqs. 15.10, 15.11, 15.12 and 15.13. The optimal pricing rule of publicly produced final goods is given by

$$\begin{aligned}\lambda_2\left(\frac{\partial \pi^*}{\partial p^h} + \frac{\partial \pi^*}{\partial q^*}\frac{\partial q^*}{\partial p^h}\right) &= \alpha z^h + \gamma\frac{\partial q^*}{\partial p^h} \\ &+ \left\{\theta^C\frac{\partial v^C}{\partial I^C}\left(y^C - y\right) + \theta^L\frac{\partial v^L}{\partial I^L}y^L\right\}\frac{\partial q^*}{\partial p^h} \\ &+ \left(\theta^C\frac{\partial v^C}{\partial I^C}z^{h,C} + \theta^L\frac{\partial v^L}{\partial I^L}z^{h,L}\right),\end{aligned} \tag{15.14}$$

and that of publicly produced intermediate goods is

$$\begin{aligned}\lambda_2\left(\frac{\partial \pi^*}{\partial p^f} + \frac{\partial \pi^*}{\partial q^*}\frac{\partial q^*}{\partial p^f}\right) &= \beta z^f + \gamma\frac{\partial q^*}{\partial p^f} \\ &+ \left\{\theta^C\frac{\partial v^C}{\partial I^C}\left(y^C - y\right) + \theta^L\frac{\partial v^L}{\partial I^L}y^L\right\}\frac{\partial q^*}{\partial p^f} \\ &+ \theta^C\frac{\partial v^C}{\partial I^C}z^f,\end{aligned} \tag{15.15}$$

where λ_2 is a Lagrange multiplier. In Eqs. 15.14 and 15.15, the third term on the right-hand side, $\left\{\theta^C\frac{\partial v^C}{\partial I^C}\left(y^C - y\right) + \theta^L\frac{\partial v^L}{\partial I^L}y^L\right\}\frac{\partial q^*}{\partial p^i}(i = h, f)$, represents the indirect effect of lobbying through the general equilibrium effect, which means that the price faced by the public enterprise affects the price of final goods. The fourth term on the right-hand side of Eq. 15.14, $\theta^C\frac{\partial v^C}{\partial I^C}z^{h,C} + \theta^L\frac{\partial v^L}{\partial I^L}z^{h,L}$, represents the direct effect of lobbying, which causes both interest groups to want to reduce p^h as consumers. In

Eq. 15.15, the fourth term, $\theta^L \frac{\partial v^L}{\partial I^L} z^f$, also represents the direct effect of lobbying by capitalists. Capitalists have characteristics of both consumers and owners of firms.

To see the effect of lobbying on the prices of final and intermediate goods, consider the case in which the price elasticity of demand and the general equilibrium effect are both zero, $\frac{\partial q^*}{\partial p^i} = 0$, as in the last subsection. Then, we can rewrite Eqs. 15.14 and 15.15 as

$$\frac{p^h - \frac{\partial C\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}}{p^h} = \frac{\alpha - \lambda_2}{\lambda_2}\left(\frac{1}{\varepsilon^h}\right) + \left(\frac{\theta^C}{\lambda_2}\frac{z^{h,C}}{\left(z^{h,L}+z^{h,C}\right)}\frac{\partial v^C}{\partial I^C} + \frac{\theta^L}{\lambda_2}\frac{z^{h,L}}{\left(z^{h,L}+z^{h,C}\right)}\frac{\partial v^L}{\partial I^L}\right)\left(\frac{1}{\varepsilon^h}\right), \tag{15.16}$$

$$\frac{\left(p^f - \frac{\partial C\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}\right)}{p^f} = \frac{\beta - \lambda_2}{\lambda_2 \varepsilon^f} + \theta^C \frac{1}{\lambda_2 \varepsilon^f}\frac{\partial v^C}{\partial I^C} \tag{15.17}$$

respectively.[3] Comparing Eq. 15.16 with 15.7 (or Eq. 15.17 with 15.8), we can observe that the effects of lobbying appear in the second terms on the right-hand sides of these equations, $\left(\frac{\theta^C}{\lambda_2}\frac{z^{h,C}}{\left(z^{h,L}+z^{h,C}\right)}\frac{\partial v^C}{\partial I^C} + \frac{\theta^L}{\lambda_2}\frac{z^{h,L}}{\left(z^{h,L}+z^{h,C}\right)}\frac{\partial v^L}{\partial I^L}\right)\left(\frac{1}{\varepsilon^h}\right)$ and $\theta^C \frac{\partial v^C}{\partial I^C}\frac{1}{\lambda_2 \varepsilon^f}$. As in the last subsection, we consider the case in which the welfare cost of the budget constraint of the public enterprise exceeds the marginal utility of income, that is, $\alpha < \lambda_2$ and $\beta < \lambda_2$. Thus, the first terms are positive, that is, $\frac{\alpha - \lambda_2}{\lambda_2}\frac{1}{\varepsilon^h} > 0$ and $\frac{\beta - \lambda_2}{\lambda_2}\frac{1}{\varepsilon^f} > 0$. Note that because ε^h and ε^f are negative, stronger lobbying activity tends to decrease the markup prices of the final and intermediate goods relative to those obtained by the Ramsey rule in the previous section.

From the above discussion, we can obtain Proposition 1.

Proposition 1 *When $\alpha < \lambda_2$, $\beta < \lambda_2$, and the general equilibrium effect is zero, stronger lobbying activity tends to decrease the markup prices of final and intermediate goods relative to the prices determined by the Ramsey rule.*

Next, we investigate the effect of lobbying on the prices of final and intermediate goods through the budget constraint of the public enterprise. To see this effect, we evaluate the effect of an increase in θ^L, which reflects the politician's level of interest in campaign contributions, on the prices of final and intermediate goods in the case of $\frac{\partial q^*}{\partial p^i} = 0$ and a zero cross-price elasticity of demand, as in De Borger (1997). The results are as follows[4]:

$$\frac{dp^h}{d\theta^L} = -\frac{\frac{\partial v^L}{\partial I^L} z^{h,L}\left(\pi^*_{p^f}\right)^2}{D} < 0, \tag{15.18}$$

[3] A detailed calculation is provided in Appendix section "The Optimal Pricing Rule with Lobbying Activities".

[4] A detailed calculation is provided in Appendix section "The Effect of Interest on the Price of Publicly Produced Goods".

$$\frac{dp^f}{d\theta^L} = \frac{\frac{\partial v^L}{\partial I^L} z^{h,L} \pi^*_{p^h} \pi^*_{p^f}}{D} > 0, \tag{15.19}$$

where $D = G_{p^h p^f} \pi^*_{p^h} \pi^*_{p^f} + G_{p^f p^h} \pi^*_{p^h} \pi^*_{p^f} - G_{p^h p^h} \left(\pi^*_{p^f}\right)^2 - G_{p^f p^f} \left(\pi^*_{p^h}\right)^2 > 0$. When θ^L increases, the politician reduces p^h, as in Eq. 15.16. However, because the public enterprise must satisfy its budget constraint, the politician must increase p^f. This result reflects the fact that lobbying activity by a special interest group of organized workers leads to a desirable price for workers. Thus, even if $\lambda_2 - \alpha = \left(\theta^C \frac{z^{h,C}}{(z^{h,L}+z^{h,C})} \frac{\partial v^C}{\partial I^C} + \theta^L \frac{z^{h,L}}{(z^{h,L}+z^{h,C})} \frac{\partial v^L}{\partial I^L}\right)$ is established, that is, if the marginal cost pricing policy for publicly produced final goods, $p^h = \frac{\partial C(z^{h,L}+z^{h,C}+z^f)}{\partial (z^{h,L}+z^{h,C}+z^f)}$, is chosen optimally, the politician still increases p^f to adhere to the budget constraint of the public enterprise.

Next, to evaluate the effect of θ^C, we maintain the same assumptions that $\frac{\partial q^*}{\partial p^i} = 0$ and that the cross-price elasticity of demand is zero, we obtain

$$\frac{dp^h}{d\theta^C} = \frac{1}{D}\left[\pi^*_{p^f} \frac{\partial v^C}{\partial I^C}\left(z^f \pi^*_{p^h} - z^{h,C} \pi^*_{p^f}\right)\right], \tag{15.20}$$

$$\frac{dp^f}{d\theta^C} = -\frac{1}{D}\left[\pi^*_{p^h} \frac{\partial v^C}{\partial I^C}\left(z^f \pi^*_{p^h} - z^{h,C} \pi^*_{p^f}\right)\right]. \tag{15.21}$$

As we have mentioned, capitalists have two roles in this economy, as they are both consumers and owners of private firms. Then, first, we consider the case of a large $\pi^*_{p^f}$ ($\pi^*_{p^h}$), which corresponds to higher marginal profit in the publicly produced intermediate (final) goods sector. It is better to increase the price of intermediate (final) goods than that of final (intermediate) goods. Thus, the politician increases p^f (p^h) and decreases p^h (p^f).

Second, consider the case of a large $z^{h,C}$ (z^f), which corresponds to a large demand for publicly produced final (intermediate) goods. In this case, because politicians place more weight on capitalist preferences and want to reduce their burdens, they decrease p^h (p^f).

To summarize, we obtain Proposition 2.

Proposition 2

1. *When the political weight on the special interest group of organized workers increases, the price of publicly produced final goods necessarily decreases, and price of publicly produced intermediate goods necessarily increases.*
2. *When the political weight on the special interest group of organized capitalists increases, households have more demand for publicly produced final goods, and the marginal profit in the publicly produced intermediate goods sector is higher, the price of publicly produced final goods decreases and the price of publicly produced intermediate goods increases.*

15.4 Conclusion

In this chapter, we studied the effect of lobbying by special interest groups on the optimal pricing rule of publicly produced final and intermediate goods. We showed when the lobbying is organized by workers (capitalists), the price of publicly produced final goods (intermediate goods) decreases. Then, we also showed that when a politician has more interest in campaign contributions from special interest groups organized by workers (capitalists) than that in those from special interest groups organized by capitalists (workers), the price of publicly produced final (intermediate) goods decreases (increases) and the price of publicly produced intermediate (final) goods increases to maintain the budget constraint of the public enterprise.

Although we could use more realistic assumptions for the political process for the determination of prices of publicly produced goods, there remains some room to develop this work further. First, our analysis does not include an incentive mechanism for an efficient allocation of publicly produced goods. Typically, production costs of public enterprise tend to be inefficiently high because public enterprises have little motivation to maximize profits. When the budget constraint of the public enterprise does not guarantee the optimal price, the central government must finance this deficit, which creates further inefficiency owing to the resulting moral hazard. Second, our framework does not incorporate firms' location choices. If multiple regions are considered, the decrease in the price of publicly produced goods would attract private firms to that region. Such an extension should be tackled within the framework of tax competition to clarify how such a distortion would affect optimal pricing rule.

Regardless of the above reservations, this analysis provides a plausible pricing rule in the case of lobbying activities. Further extensions are of course expected to reflect more realistic economic circumstances.

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Appendix

The Optimal Pricing Rule of a Benevolent Government

By solving the maximization problem for the government, the first-order conditions can be obtained, as follows:

$$\frac{\partial W}{\partial p^h} + \lambda_1 \left(\frac{\partial \pi^*}{\partial p^h} + \frac{\partial \pi^*}{\partial q^*} \frac{\partial q^*}{\partial p^h} \right) = 0, \tag{15.22}$$

$$\frac{\partial W}{\partial p^f} + \lambda_1 \left(\frac{\partial \pi^*}{\partial p^f} + \frac{\partial \pi^*}{\partial q^*} \frac{\partial q^*}{\partial p^f} \right) = 0. \tag{15.23}$$

Here, as mentioned in the body of this chapter, λ_1 represents the Lagrange multiplier. Eq. 15.23 can be rewritten as

$$\frac{\partial W}{\partial v^C}\left(\frac{\partial v^C}{\partial q^*}\frac{\partial q^*}{\partial p^h}+\frac{\partial v^C}{\partial p^h}+\frac{\partial v^C}{\partial \pi^*}\frac{\partial \pi^*}{\partial q^*}\frac{\partial q^*}{\partial p^h}\right)+\frac{\partial W}{\partial v^L}\left(\frac{\partial v^L}{\partial q^*}\frac{\partial q^*}{\partial p^h}+\frac{\partial v^L}{\partial p^h}\right)$$
$$+\lambda_1\left(\frac{\partial \pi^*}{\partial p^h}+\frac{\partial \pi^*}{\partial q^*}\frac{\partial \mathrm{q}^*}{\partial p^h}\right)=0.$$

Define $I^L \equiv \pi$ and $I^C \equiv L_y + L_z$. Noting that $\frac{\partial v^i}{\partial q^*} = -\frac{\partial v^i}{\partial I^i} y^i$ and $\frac{\partial v^i}{\partial p^h} = -\frac{\partial v^i}{\partial I^i} z^{h,i}$ hold from Roy's identity, $\frac{\partial \pi^*}{\partial q^*} = y$ holds from the feature of profit maximization, and $\frac{\partial v^i}{\partial \pi^*} = \frac{\partial v^i}{\partial I^i}$, we can further rewrite the above expression as follows:

$$\frac{\partial W}{\partial v^C}\frac{\partial v^C}{\partial I^C}\left\{\left(y-y^C\right)\frac{\partial q^*}{\partial p^h}-z^{h,C}\right\}+\frac{\partial W}{\partial v^L}\frac{\partial v^L}{\partial I^L}\left\{\left(-y^L\right)\frac{\partial q^*}{\partial p^h}-z^{h,L}\right\}+\lambda_1\frac{\partial \pi^*}{\partial p^h}=0.$$

Therefore,

$$\frac{\partial W}{\partial v^C}\left(\frac{\partial v^C}{\partial I^C}\left(y^C-y\right)+\frac{\partial v^L}{\partial I^L}y^L\right)\frac{\partial q^*}{\partial p^h}+\frac{\partial W}{\partial v^L}\left(\frac{\partial v^C}{\partial I^C}z^{h,C}+\frac{\partial v^L}{\partial I^L}z^{h,L}\right)=\lambda_1\frac{\partial \pi^*}{\partial p^h} \tag{15.24}$$

can be obtained.

Similarly, Eq. 15.23 can be rewritten as

$$\frac{\partial W}{\partial v^C}\left(\frac{\partial v^C}{\partial q^*}\frac{\partial q^*}{\partial p^f}+\frac{\partial v^C}{\partial \pi^*}\frac{\partial \pi^*}{\partial q^*}\frac{\partial q^*}{\partial p^f}+\frac{\partial v^C}{\partial \pi^*}\frac{\partial \pi^*}{\partial p^f}\right)+\frac{\partial W}{\partial v^L}\left(\frac{\partial v^L}{\partial q^*}\frac{\partial q^*}{\partial p^f}\right)+\lambda_1\frac{\partial \pi^*}{\partial p^f}=0.$$

Again, from Roy's identity, $\frac{\partial v^i}{\partial q^*} = -\frac{\partial v^i}{\partial I^i} y^i$ and $\frac{\partial v^i}{\partial p^h} = -\frac{\partial v^i}{\partial I^i} z^{h,i}$ hold, and from Hotelling's lemma, $\frac{\partial \pi^*}{\partial p^f} = -z^f$ holds. Therefore,

$$\frac{\partial W}{\partial v^C}\frac{\partial v^C}{\partial I^C}\left(\left(y-y^C\right)\frac{\partial q^*}{\partial p^f}-z^f\right)+\frac{\partial W}{\partial v^L}\frac{\partial v^L}{\partial I^L}\left\{\left(-y^L\right)\frac{\partial q^*}{\partial p^f}\right\}+\lambda_1\frac{\partial \pi^*}{\partial p^f}=0$$

also holds. Finally, we obtain

$$\frac{\partial W}{\partial v^C}\left(\frac{\partial v^C}{\partial I^C}\left(y^C-y\right)+\frac{\partial W}{\partial v^L}\frac{\partial v^L}{\partial I^L}y^L\right)\frac{\partial q^*}{\partial p^h}+\frac{\partial W}{\partial v^C}\frac{\partial v^C}{\partial I^C}z^f=\lambda_1\frac{\partial \pi^*}{\partial p^f}. \tag{15.25}$$

The Optimal Pricing Rule with Lobbying Activities

Politicians determine the optimal price to maximize Eq. 15.8 given Eqs. 15.10, 15.11, 15.12 and 15.13. When we ignore the general equilibrium effect, the first-order condition can be written as

$$\lambda_2\left(\left(z^{h,L}+z^{h,C}\right)+p^h\frac{\partial\left(z^{h,L}+z^{h,C}\right)}{\partial p^h}\right.$$
$$\left.-\frac{\partial C\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}\frac{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial p^h}\right)$$
$$=\alpha z^h+\left(\theta^C\frac{\partial v^C}{\partial I^C}z^{h,C}+\theta^L\frac{\partial v^L}{\partial I^L}z^{h,L}\right),$$

As in the previous section, we rewrite the expression as the difference between prices and marginal costs,

$$\frac{(\alpha-\lambda_2)\left(z^{h,L}+z^{h,C}\right)+\theta^C\frac{\partial v^C}{\partial I^C}z^{h,C}+\theta^L\frac{\partial v^L}{\partial I^L}z^{h,L}}{\lambda_2}$$
$$=\left\{p^h-\frac{\partial C\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}\right\}\frac{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial p^h}$$
$$\frac{(\alpha-\lambda_2)+\theta^C\frac{z^{h,C}}{\left(z^{h,L}+z^{h,C}\right)}\frac{\partial v^C}{\partial I^C}+\theta^L\frac{z^{h,L}}{\left(z^{h,L}+z^{h,C}\right)}\frac{\partial v^L}{\partial I^L}}{\lambda_2\frac{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial p^h}\frac{p^h}{\left(z^{h,L}+z^{h,C}\right)}}$$
$$=\frac{1}{p^h}\left\{p^h-\frac{\partial C\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}\right\}$$
$$\frac{p^h-\frac{\partial C\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}}{p^h}=\frac{1}{\lambda_2}\left(\frac{1}{\varepsilon^h}\right)\left\{(\alpha-\lambda_2)+\theta^C\frac{z^{h,C}}{\left(z^{h,L}+z^{h,C}\right)}\frac{\partial v^C}{\partial I^C}\right.$$
$$\left.+\theta^L\frac{z^{h,L}}{\left(z^{h,L}+z^{h,C}\right)}\frac{\partial v^L}{\partial I^L}\right\},$$
$$\frac{p^h-\frac{\partial C\left(z^{h,L}+z^{h,C}+z^f\right)}{\partial\left(z^{h,L}+z^{h,C}+z^f\right)}}{p^h}=\frac{\alpha-\lambda_2}{\lambda_2}\left(\frac{1}{\varepsilon^h}\right)$$
$$+\left(\frac{\theta^C}{\lambda_2}\frac{z^{h,C}}{\left(z^{h,L}+z^{h,C}\right)}\frac{\partial v^C}{\partial I^C}+\frac{\theta^L}{\lambda_2}\frac{z^{h,L}}{\left(z^{h,L}+z^{h,C}\right)}\frac{\partial v^L}{\partial I^L}\right)\left(\frac{1}{\varepsilon^h}\right). \tag{15.26}$$

The effect of lobbying activities on the price of publicly produced intermediate goods can be obtained similarly.

The Effect of Interest on the Price of Publicly Produced Goods

Totally differentiating the first-order condition and the budget constraint of the public enterprise with respect to p^h and p^f gives

$$\begin{bmatrix} G_{p^h p^h} & G_{p^h p^f} & \pi^*_{p^h} \\ G_{p^f p^h} & G_{p^f p^f} & \pi^*_{p^f} \\ \pi^*_{p^h} & \pi^*_{p^f} & 0 \end{bmatrix} \begin{bmatrix} dp^h \\ dp^f \\ d\lambda_2 \end{bmatrix} = \begin{bmatrix} -G_{p^h \theta^L} \\ -G_{p^f \theta^L} \\ -\pi^*_{\theta^L} \end{bmatrix} d\theta^L + \begin{bmatrix} -G_{p^h \theta^C} \\ -G_{p^f \theta^C} \\ -\pi^*_{\theta^C} \end{bmatrix} d\theta^C.$$

The determinant of the matrix on the left-hand side, $D = G_{p^h p^f}\pi^*_{p^h}\pi^*_{p^f} + G_{p^f p^h}\pi^*_{p^h}\pi^*_{p^f} - G_{p^h p^h}\left(\pi^*_{p^f}\right)^2 - G_{p^f p^f}\left(\pi^*_{p^h}\right)^2$, is positive from the second-order condition for maximization.

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Chapter 16
Harmful Negativity Bias Under a Decentralized System: Retrospective Voting in Japanese Mayoral Elections 1983–2015

Masashi Nishikawa

Abstract The analysis described in this chapter considers retrospective voting in Japanese mayoral elections from the perspective of negativity bias and decentralization. This study has three main findings. (1) Retrospective voting is prominent for mayoral elections when the economic growth rate is lower, implying that macroeconomic conditions can affect even mayoral elections. (2) The probability of re-election tended to decline for incumbent mayors if the local indicators deteriorated, which is a healthy signal. (3) After decentralization, voters' attitudes toward monitoring incumbents clearly changed in periods of low economic growth, as incumbents who presided over periods of declining local indicators were more favored in subsequent elections. Thus, voters' messages to incumbents shifted such that our second result was partly offset after decentralization. We conclude with some implications of these results regarding uncritical faith in both representative democracy and decentralization.

Keywords Clarity of responsibility · Voter attitudes · Local politics

16.1 Introduction

A common belief holds that democratic systems can move society in a better direction. Although the notion that the public must control members of parliament via elections in states with representative democracies is broadly held, it is not necessarily clear that the current election system works well. The purpose of this study is to provide facts to address these questions by focusing on Japanese mayoral elections.

Fiorina (1978) states that retrospective voting based on the responsibility hypothesis is integral to elections because it allows voters to hold politicians responsible for their actions. He shows that voters' evaluations of incumbents drive US presidents to improve the national economy, although congressional elections are another

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matter. Subsequently, many further studies were conducted to prove this hypothesis in line with retrospective voting models. According to a comprehensive survey by Nannestad and Paldam (1994), these studies generally find that if the proxy variable for the size of the rewards and punishments received by members of parliament (e.g., election results, percentage of the vote, or public opinion polls) increases, then the indicators that voters consider when evaluating politicians' performances (e.g., macroeconomic indicators, their pocketbooks, diplomatic issues, or other social indicators) tend to improve. However, the surveys conducted by Lewis-Beck and Stegmaier (2000, 2008, 2013) indicate that although many studies do support the validity of such voting models, disparities remain in terms of the clarity and stability of the results in the empirical analysis. In other words, elections are most likely well-functioning, but their performance partly depends on economic conditions, the type of government, the metrics analyzed, and other related issues. In this study, we focus on the following two specific elements that create instability in the results of previous studies.[1]

The first element is "clarity of responsibility" (Powell and Whitten 1993), which varies depending on political parties' oppositional relationships and the structures of national and subnational governments. The more unclear responsibility for performance is, the more difficult it is for voters to actuate retrospective voting.[2] It may imply that the responsibility of mayors in local governments which are the focus of this study tend to be unclear, because their discretion is widely entangled with upper governments. In the case of a highly centralized unitary state, such as Japan, people expect to receive the same levels of public services wherever they live, regardless of whether these services are provided directly by the central government or are provided indirectly by local governments. Voters think they are ruled by central governments rather than by local governments. Accordingly, even if an indicator of a local public entity worsens, voters may perceive this change as the national government's error and may not decide to monitor the local government's behavior. Even in the case of a relatively decentralized federal system, the responsibility of local governments tends to be vaguer as the number of government tiers (e.g., federal, state, and local) increases because upper governments must provide some type of vertical fiscal transfers to mitigate fiscal gaps among lower governments.[3]

This lack of clarity regarding local government responsibility is expected to be partly resolved by decentralization, which transfers discretion to local governments. Because decentralization gives local governments direct responsibility for local public finance and services, voters can easily evaluate these governments' performances and punish or reward them with certainty. Brender (2003) states that retrospective

[1] Anderson (2007) discusses limits to the retrospective voting model due to systemic problems and individuals' recognition.

[2] Berry and Howell (2007) discuss elections of school boards, which are single-purpose public entities. Because they have a single purpose, school boards' performance indicators ought to be clear to citizens. However, if voters have insufficient information, retrospective voting models cannot function.

[3] Anderson (2006) conducts an international comparison of retrospective voting that controls for countries' multi-layer structures.

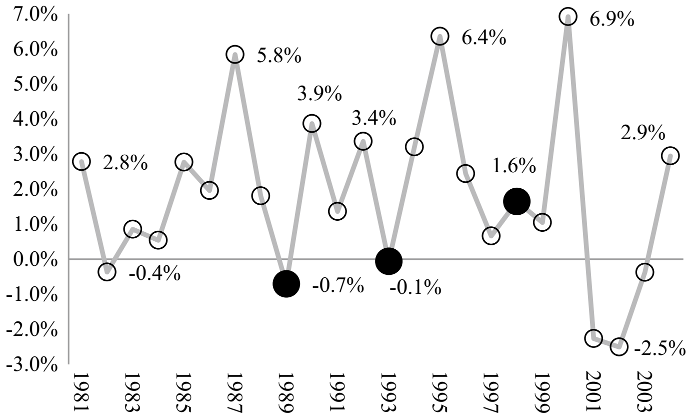

Fig. 16.1 GDP growth rate and the timing of elections in Israel. *Source* OECD Stats. *Note* Large black circles indicates the election years used by Brender (2003)

voting was more clearly used in local elections after a decentralization reform was enforced in Israel, supporting the notion that decentralization increases clarity of responsibility. Decentralization is therefore seen as increasing voters' responsibility and strengthened monitoring functions, but some analytical issues may affect this conclusion. As Fig. 16.1 shows, two of the sample elections used in Brender's (2003) analysis, the 1989 and 1993 elections, were held during the pre-decentralization period, which was also a period of economic downturn. The third same election, the 1998 election, was held after decentralization, but this period was also a time of economic stability. Thus, his conclusion likely unintentionally includes the influence of macroeconomic factors on the emergence of retrospective voting.

The influence of macroeconomic indicators on municipal elections is the second key element in this section. It creates instability in the results, and it is not straightforward. In second-order elections, such as mayoral election, the opposite result relative to expectations may occur to balance the results of the most important elections (Hix and Marsh 2007; Kousser 2004). For instance, in the case of the EU, if the ruling parties suffer a crushing defeat in the most important national elections, ruling party candidates may be favored in the European parliamentary election, a second-order election, to maintain a balance of political power. Such voting behavior cannot be seen as an sincere retrospective voting based on the responsibility hypothesis. On the contrary, Martins and Veiga (2013) take into account the impact of macroeconomic indicators on retrospective voting in Portuguese municipalities, and they note that when there the ruling party and regional politicians have strong relationships, economic indicators straightforwardly affected local government elections.[4] Thus,

[4]Peltzman (1992) and Lowry et al. (1998) also consider the impact of macroeconomic indicators on local elections bearing in mind the strong relationship between regional politicians and the ruling party in the federal government in the United States. Other relevant studies include that of Jerome and Lewis-Beck (1999), who look at France, and that of Numata (2006), who examines Japan.

the political responsibility hypothesis may potentially have spread to local elections. However, as far as Japanese mayoral elections are concerned, the relationship between mayors and national political parties is regarded as superficially weak. In fact, most effective candidates announced that they did not belong to any special national parties when elections were held (i.e., they were independent candidates), implying that national issues are likely detached from municipal politics.[5]

Furthermore, even if we cannot totally reject the existence of a ripple effect from national politics, it is plausible that voters assume that mayors cannot manipulate macroeconomic indicators, and, thus, that the outcomes of these indicators should be regarded as outside of mayoral responsibility. Such indicators should not be important factors in a retrospective voting model based on the responsibility hypothesis. However, in this study, we do consider macroeconomic indicators to be important factors in mayoral elections for the following rationale. If economic conditions worsen, the number of voters who need public support increases, and most people become more sensitive about public services, which are provided either centrally or locally. Past severe experiences therefore affect the electoral results more significantly, as economic downturns change voters' attitudes toward elections. If this rationale is correct, retrospective voting is more likely to occur in mayoral elections even though local leaders can not intervene in macroeconomics. Moreover, if central politicians are more likely incur mayors' displeasure and voters understand this political relationship, then voters may choose to punish mayors for worse economic outcomes.

In this case, the view that retrospective voting asymmetry emerges during economic downturns is the well-known "negativity bias." This idea holds that voters are likely to indicate their disgust with politicians via election results during economic slumps but are unlikely to express their gratitude during economic upswings (Bloom and Price 1975). This terminology does not indicate distrust in voters, but it does assume that voters are unintelligent and make biased decisions. At worst, unintelligent, biased voters may send bad signals to politicians via elections, as Caplan (2007) states. We do not get into the definition of intelligence (enlightenment) in this study, but we do consider that the outcomes of voting behavior look intelligent (i.e., economically rational) in some elections but unintelligent in other elections.

Japanese mayoral elections provide a suitable setting for an analysis that combines the notions of clarity of responsibility and negativity bias. First, Japan decentralized around 2000 but was previously a highly centralized country, enabling pre- and post-decentralization comparisons. Thus, assuming that decentralization increases the clarity of responsibility, Japan is likely a good setting to evaluate its role. Second, Japan has been through major economic changes, enabling comparisons between booms and busts, making it easy to analyze negativity bias.

There are also researches using municipal data [Martinussen (2004) examine Norway, Sakurai and Menezes-Filho (2008) examine Brazil].

[5]Most effective candidates must be related to the national parties, but these relationships are not clearly indicated during campaigns. This study does not (and cannot) consider the influence of political parties.

For the empirical analysis, we have the mayoral elections of municipalities in Fukuoka prefecture from 1967 to 2016. In Japan, the central government gave all municipalities local public agency numbers and initiated integrated statistical management in 1968. Therefore 1967 is sufficiently far in the past. The social economy variables used, which includes the data from national census used start in 1980, when data collection became reasonably possible. Because some independent variables are incorporated into the analysis after being transformed into average growth rates for the three years prior to the election, our database used for the empirical analysis starts in 1983. Latest national census was conducted at 2015, the period of our empirical analysis is restricted to 1983–2015. Note that national census is taken every five years, we create annual data as a simple linear interpolation.

Fukuoka prefecture currently has a population of more than five million and an area of almost 5000 km^2. Some municipalities in this prefecture experienced fiscal crises (i.e., the reconstruction of finance) even though such events were rare in Japan, which is an interesting feature for the purpose of our study.[6] Fiscal crises of neighboring municipalities might stimulate voters to monitor local public finance more seriously. All municipalities had their first elections in 1947, after World War II ended, and mayoral elections were planned to occur every four years in the same year. However, some terms have ended early because of scandal, death, and so on, and, thus, the timings (years) of mayoral elections have been diversifying. Mayoral elections therefore occur in every year of the sample at the present time.

Our analysis of mayoral elections in cities, towns, and villages in Japan using the retrospective voting framework has three main conclusions. First, retrospective voting is prominent when economic growth is lower, implying that macroeconomic conditions can affect mayoral elections. Second, the re-election probability tends to decrease for incumbent mayors who preside over decreases in local indicators, which is a healthy signal supporting the responsibility hypothesis. Third, voters' attitudes toward monitoring incumbents during periods of low economic growth clearly changed after decentralization. Incumbents who presided over worsening local indicators were instead favored in the subsequent election. Thus, voters' messages to incumbents changed unfavorably, implying that our second result was partly offset after decentralization. We show that these results are robust and reasonable in the following discussion.

16.2 Background and Related Literature

Japan's political structure consists of three tiers: the central (national) government, prefectural governments, and municipalities. Municipalities are generally categorized as cities, towns, or villages based basically on their respective populations. The populations of most cities range between 50,000 and 200,000, whereas those of towns and villages are less than 50,000 and tend to average around 10,000. The

[6] Seventeen municipalities have been under financial reconstruction in Japan since 1975, and seven of them are in Fukuoka prefecture.

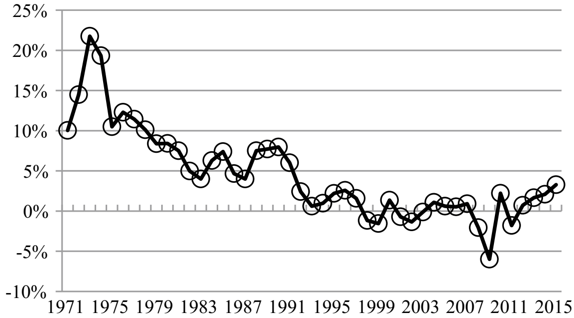

Fig. 16.2 GDP growth rate in Japan over time. *Source* OECD Stats

administrative functions of towns and villages are somewhat less extensive than those found in cities.

Figure 16.2 shows that although the Japanese economy maintained a growth rate of 5% from 1980 to 1990, which includes the boom from 1986 to 1991 known as the "bubble economy," it slumped into a major depression after the bubble burst. At that point, the average GDP growth rate was around zero, and it became negative in some years. Japan's general government debt-to-GDP ratio reached 234% at 2015,which was much larger that the corresponding value in Greece of 183%. Japan's central government initially tried to boost the economy via expansionary fiscal policy, but as the fiscal deficit ballooned, it had to reduce spending on public works. Furthermore, during this time, Japan's birthrate fell, and the aging population grew. Awareness that economic growth will be difficult to achieve in the future has become widespread, and the view that Japan will not improve its fiscal balance without administrative reform has been gaining ground.

Given these circumstances, the national government promoted decentralization to achieve efficiency gains by calling on local governments to achieve fiscal independence, partly because fiscal supplements to local governments had become a burden. In 1999, the Act on the Promotion of Decentralization Reform was passed along with other related laws that strengthen the local autonomy. Most of these laws were enforced starting in 2000. In 2003, own-source revenue of local governments was increased (¥3 tn) through devolution of the income tax base in return for the abort of vertical transfers (¥4 tn). Both of these measures were intended to expand local governments' administrative discretion. As part of this decentralization program, the central government established legislation to promote mergers among cities, towns, and villages, aiming to expand the size of the municipalities to which decision-making powers would be transferred. Thus, mergers among municipalities increased, and the number of municipalities, which had remained steady at around 3200 after World War II, sharply decreased to around 1700 in 2005.

As decentralization progressed, a fiscal crisis occurred in the city of Yubari in 2006, and the central government and Hokkaido prefecture intervened in the city's administration. This intervention was the first of its type in the last 15 years, and it resulted in renewed awareness among Japanese citizens that local governments can go bankrupt. The central government became concerned about sudden increases in requests for fiscal support when similar fiscal crises arose for other local governments, and it diversified the measures for monitoring local public finance and substantially revised the public accounting rules. These legislative reforms, which started in 2000, were expected to make municipal public finance transparent and independent, and they seem to have been succeeded in clarifying municipal responsivity.

16.2.1 Previous Studies Using Japanese Data

Some studies have considered Japanese elections using a traditional VP-function framework (Nannestad and Paldam 1994), although these studies focus on different topics from ours and mostly use national elections. Previous such studies include Inoguchi (1983), Reed and Brunk (1984), Suzuki (1996), Anderson and Ishii (1997), Doi and Ashiya (1997, Sect. 5), and Tanaka (2012).[7] Most of these studies consider national elections, with the exception of Tanaka (2012). The first four studies use aggregate national data and combine election data on the House of Representatives with election data on the House of Councilors to obtain a sizable sample. Inoguchi (1983) employs a time-series analysis using the data on elections to both houses on the same time axis between 1960 and 1970. This study cannot confirm the existence of retrospective voting. Reed and Brunk (1984) made a unique pseudo time-series data set for the analysis. They combine the series of lower house election results 1963–1980 and the series of upper house election results 1962–1980 sequentially rather than chronologically. Namely, two sets of time-series data points were arranged in series. This unique data set looks strange and must be problematic at the present time, but it was necessary for analysis to increase the observations at that time. In their study, they observed no economic voting when eight samples prior to the oil shock are used for analysis, but they confirmed economic voting when treating the whole period (14 samples in total) as the sample. However, their Table 1 in the pre-oil shock period shows that the sign of the coefficient on the unemployment rate is not as expected, and it seems to be significant at the 10% level (although they state that coefficient on the unemployment rate variable is not significant at 5% level). Thus, the results of their analysis involve some uncertainty.

Anderson and Ishii (1997) simply pool both houses of the Japanese Diet together in their analysis of elections from 1958 to 1992. They consider variables that measure market openness, such as trade volume. However, they cannot confirm a statistically significant relationship between the Liberal Democratic Party's vote share and employment, prices, or economic growth. Suzuki (1996) analyzes data from 1960 to 1993 using seemingly unrelated regression (SUR) estimation, which can consider interactions between the two houses of the Japanese Diet, that is, those that support retrospective voting in Japan. However, when Suzuki (1996) compares the results of

[7] Moreover, Hirano (1998) and Endo (2009) surveyed Japanese studies related to retrospective voting from the perspective of political science.

Table 16.1 The number of observations classified by the candidates' behavior

	Number of wins		Number of losses	Number of withdrawals
		(Without election)		
Incumbent	711	(362)	124	351
Non-incumbent	475	(76)	906	
Total number of elections	1186	(438)		

Note Mayoral elections in Fukuoka prefecture during 1967–2016

a simple ordinary least squares estimation with the results of the SUR estimation, the set of statistically significant variables are the same, and the signs of their coefficients are also the same. Moreover, the differences in the coefficients on the economic indicators used in retrospective voting are very minor. Thus, Suzuki's (1996) unique conclusions are more likely related to the periods of analysis and the selection of control variables, rather than to the analytical methodologies.

Doi and Ashiya (1997) also study national elections. Using aggregated prefectural data, they analyze each election from 1958 to 1990 in cross-sections and conclude that the distribution of subsidies from central to local governments did not positively influence the vote share of ruling party. Tanaka (2012) considers prefectures' gubernatorial election results in Japan from 2000 through 2011, which differs from previous studies that focused on national elections. The empirical analysis focuses on the effect of public education expenditures on gubernatorial elections and considers the financial burden share (i.e., the share of responsibility) as well. However, the interpretation of the results of his analysis, that is, the relationship between gubernatorial election results and public education expenditures, is difficult to accept intuitively. Because public education expenditures seem to be a minor issue in the gubernatorial elections and the study does not adequately consider attributes of governors, such as term in office and age, and given the results of this chapter, important missing variables may have resulted in biased results. Because these previous studies neither use Japanese municipal data nor consider the influence of decentralization after 2000, this study contributes to this literature by filling these gaps.

16.3 Framework of Empirical Analysis

Fundamentally, mayors are regarded by voters as being responsible for most aspects of local administration, and, thus, incumbents are evaluated according to their achievements on local issues. Incumbent mayors consider that voters democratically reward or punish them through elections, and they decide whether or not to run in the next election based on their own political performance. They may also consider the existence of strong competitors, their health, and so on.

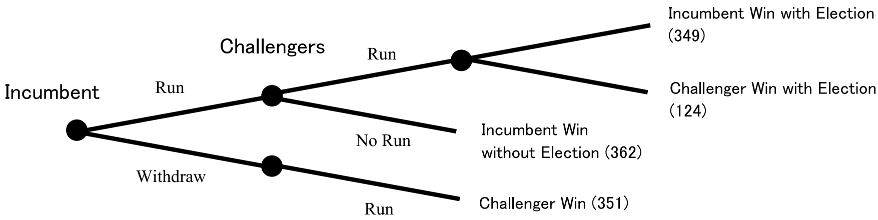

Fig. 16.3 Decision process and the results

When incumbents opt to run, an election is held if any challengers believe they have a chance to win, whereas incumbents can win without an election if no challengers believe they have a chance to win against the incumbent. Figure 16.3 shows the accumulated results of mayoral elections in Fukuoka prefecture from 1967 to 2016 in a tree diagram.[8] A total of 1186 elections occurred. Incumbents ran in 835 (349 + 124 + 362) of these elections and did not run in 351 of the elections, implying a participation ratio of 70%. In 362 elections, only incumbents opted to run, meaning that they were re-elected by default. In 473 elections, both incumbents and challengers (i.e., newcomers and former mayors) opted to run. In these elections, incumbents won 349 times, whereas challengers won 124 times. In total, incumbents won 711 (349 + 362) elections, implying a re-election probability of 60% (711/1186). Given that an incumbent runs for office, the re-election probability of incumbents is 85% (711/835). Table 16.1 also summarizes this data.

In this analysis, we are interested in the probability that an incumbent wins and the relationship between this probability and local indicators for which the mayor is responsible. Thus, we can conduct a probit analysis using a binary dependent variable such that an incumbent win is coded as unity and a loss is coded as zero. It is plausible that rational mayors withdraw from elections if they expect to lose, and, thus, so the dummy variable is set equal to zero if the incumbent does not run. A simple model can be written as follows.

$$\text{Prob}(\text{Win} = 1) = \Phi(X\beta), \tag{16.1}$$

where Φ is the cumulative normal distribution, X is a vector of explanatory variables, and β is a vector of parameters of X. This is the same estimation design used by Brender (2003). Unfortunately, this setting drops the information associated with from the number of votes the incumbents received. If stronger candidates who perform well receive higher vote shares, then the share of the vote indicates the intensity of a candidate's support, which provides richer information about the election than a simple binary treatment does.

When we employ the incumbent vote share as the dependent variable, the estimation model uses the least squares method,

[8]We collected election data from Fukuoka prefecture until election hand book 2017 that includes election result in 2016.

$$V^{all} = X\beta + \varepsilon, \tag{16.2}$$

where V^{all} is the incumbent vote share. It is set to zero if the incumbent withdraws from the election and to unity if incumbent is re-elected without a challenger. In our empirical analysis, the incumbent's vote share is calculated by dividing the number of his votes by the population of age 20 years and over (annual population data as a simple linear interpolation from national census). When we employ this dependent variable, we must consider the plausibility of the assumption that a retired incumbent would obtain zero votes. Although an incumbent's decision to withdraw implies an intentional election loss, his potential share of the votes must be larger than zero. Thus, setting the incumbent vote share to zero when the incumbent withdraws leads to an under-estimation of the effect.

To select a better model to address such challenges, it is natural to consider Heckman's two-step estimation. In the first branch of Fig. 16.3, an incumbent faces the binary choice to run in or withdraw from the next election. At the next branch, challengers also face a binary choice; they either opt to run in the next election if they have a sufficiently high chance of winning or withdraw if the incumbent is regarded as sufficiently strong. As a result, in the second step, strong incumbents who performed well in the past and won the election without voting are regarded as having received all votes, whereas other incumbents who ran in elections against challengers are regarded as receiving a certain percentage of votes depending on their past performance. However, if we merely utilize the observable incumbent vote share, the result tends to be an overestimation because we cannot observe the election results of incumbents who decide to withdraw. These unobserved incumbents who withdrew from elections would likely have taken the smaller vote shares.

To avoid such sample selection bias, Heckman suggested a proper two-step estimation process. In the first step, we estimate the probability that an incumbent runs in the next election using Eq. 16.3.

$$\text{Prob(Run} = 1) = \Phi(Z\gamma) \tag{16.3}$$

where the dependent binary variable is unity if the incumbent ran and zero otherwise. Z is a vector of explanatory variables, and γ is a vector of the parameters of Z. In the second step, we consider V to be the vote shares of incumbents who opted to run in the election, and the estimation model is written as (16.4).

$$V = X\beta + u \tag{16.4}$$

Election results are not observable if an incumbent does not run in the election, and, thus, the conditional expectation of the vote share given that the incumbent ran is as follows.

$$E[V|X, Run = 1] = X\beta + E[u|X, Run = 1] \tag{16.5}$$

If the error terms are jointly normal, the second term on the right-hand side of Eq. 16.5 can be rewritten as.

$$E[V|X, Run = 1] = X\beta + \beta_{\lambda}\lambda(Z\gamma) \tag{16.6}$$

In Eq. 16.6, $\lambda(Z\gamma)$ is the inverse Mills ratio.[9] β_{λ}, the coefficient on the inverse Mills ratio, is the products of ρ and σ_u, where ρ is the correlation between unobserved determinants of the propensity to run for office and unobserved determinants of the vote share and σ_u is the standard deviation of u. Although avoiding $Z = X$ is recommended in Heckman's two-step estimation, this guideline is difficult to satisfy because the incumbent's vote share and probability of running (or winning) are expected to be related to similar variables. Berry and Howell (2007) state that because they could not identify appropriate instrumental variables that are only included in Z, they could not use Heckman's estimation.

In our empirical analysis, we assume that the number of consecutive wins by the incumbent affects his decision to run in the next election but does not affect his vote share if he opts to run. Thus, we assume that this variable is only included in Z in Eq. 16.6. This assumption seems reasonable because the number of consecutive wins of the incumbent did not have explanatory power for V in a least squares model used in the pre-research to estimate Eq. 16.4. In fact, V is highly dependent on a variable reflecting the previous vote share of the winner (i.e., the incumbent's vote share in the last election) that we incorporated in X. We show the results of the probit, least squares, and Heckman's two-step estimations in parallel because each estimation has pros and cons.

We also discuss the rationale for choosing the sample used in our empirical analysis. Mayoral elections are generally held once every four years. As can be seen in Table 16.2, almost 90% (=959/1074) of the mayors our sample had terms of four years, whereas remaining 10% (=115/1074) of mayoral elections were held before four full years had passed. In some cases, the period between elections was less than one year. Table 16.2 also shows that the number of elections held less than four years after the last election that were won by incumbents is merely eight (=3 + 5), indicating a very low probability of an incumbent win. Some of these incumbent withdrawals were caused by deaths or health concerns,[10] whereas others were caused by political scandals, and still others were caused by municipal mergers. In all of these cases, incumbents' decisions to withdraw were based on reasons unrelated to

[9] This concept is introduced in Chap. 20 of Greene (2000).

[10] Some elections that were held before four-year terms ended should not be excluded. For example, the mayoral elections held in Iizuka City in 1978 and Katsuyama City in 1987 should not be excluded even though these elections were held fewer than four years after the previous one. In these cases, the incumbents resigned before their terms were up but were re-elected in subsequent elections and served out their remaining terms for a total four years altogether. Furthermore, the Oshima Village mayoral election in 1976, the Okagaki Town mayoral election in 2004, and the Kotake Town mayoral election in 1998 are unsuited for exclusion because although these elections seem to have been held only three years from the previous elections, the effective terms of service were for 48 months.

Table 16.2 The number of observations classified by the time since the last election

Time since the last election (years)	Number of non-incumbents		Number of incumbents		Number of elections
	Losses	Wins	Losses	Wins	
0	11	9	.	.	9
1	26	25	1	3	28
2	32	30	2	.	30
3	54	43	1	5	48
4	678	318	110	641	959
Total	801	425	114	649	1074
Missing values					112

Note Each municipality has a starting point (i.e., the first election present in our data). We cannot identify the time since the previous election in these starting points, and they are considered to be missing values

their administrative performance. Determining the details of specific resignations is difficult, and, thus, we drop from the following empirical analyses elections that were held before the full four-year terms had ended. We also drop elections held under the intervention of Ministry of Internal Affairs and Communications (MIC) or under prefecture intervention owing to the need to improve regional finances (perform fiscal restructuring) because mayoral discretion was limited.[11]

16.3.1 Classical Independent Variables

The explanatory variables classically used in retrospective voting models include the GDP growth rate, the inflation rate (purchasing index), indexes of public finance (e.g., the debt-service-to-GDP ratio), and unemployment. This study incorporates the first three of these variables into the analysis as macroeconomic indicators. Voters likely do not evaluate macroeconomic indicators over a short time frame but rather consider the trends that they experience over the longer term. To create the variables used in the empirical analysis, we use the special techniques described below to derive year-on-year growth rates for GDP, prices, and the debt-service-to-GDP ratio, and we convert the values into averages growth rates for the two years prior to an election. In other words, using the actual observed value h_i, we calculate X_t as $X_t = \left[(h_{t-2} - h_{t-3})\big/ h_{t-3} + (h_{t-1} - h_{t-2})\big/ h_{t-2}\right]\big/ 2$, the value for the three-year

[11] Some data are also omitted for other reasons. A total of 112 elections for which the interval after the previous election is missing and cannot be identified cannot be used in the empirical analysis. The interval between elections cannot be calculated for each local government's first election (t = 1st period) in our data because there is no information about the previous election (t = 0 period). Furthermore, the interval between elections cannot be calculated for the first elections in newly established local governments created via municipal mergers.

interval between two elections. This calculation may make it more difficult to detect retrospective voting because the latest influence of the variables is diluted, but it allows us to consider the overall performance of incumbents.

16.3.2 Measures of Local Issues

Voters likely consider local finance indicators when evaluating the performance of municipal governments. Among local finance indicators, the real balance ratio RBR, financial capability indicator (FCI), and ratio of total debt to revenue (RDR) can be compared over long time frames. These data are provided by central government.

The RBR is derived by dividing the account balance by the annual standard revenue.[12] A positive value indicates a surplus for local public finance, and a negative value signifies a fiscal deficit. The FCI reflects the discretion of public municipal finance and is calculated by dividing the amount of standard local revenue by the amount of standard local public needs. A value above 1.0 indicates that a local government can fulfill its standard responsibilities without a general subsidy from central government. The FCI is over 1.0 for only around 5–10% of the local governments in Japan. Local governments must report the RBR and the FCI to the MIC every year, meaning that local residents who intend to monitor municipal finance find these values easy to obtain. The RDR is a unique indicator of the relative burden of local public debt created for this study and obtained by dividing the balance of local debt in each municipality by total annual revenue. Balances of local debt and total annual revenues are publicly disclosed. We introduce these three variables into the analysis in the form of their average growth rates for the two years prior to each election.

Unemployment can be considered a macroeconomic indicator, but it is treated as a local economic indicator in this study. Unemployment differences across mayors can arise because mayors may create employment through polices such as increases in public works spending (e.g., by winning subsidies from higher tiers of government) and attracting companies. We can utilize data on the number of persons receiving public assistance (i.e., actual persons receiving welfare) as a more direct indicator than unemployment to evaluate the severity of economic conditions faced by residents. Public assistance refers to income guarantee systems for households with notably low incomes. Dividing the number of welfare recipients by the population in each local area gives the ratio of welfare recipients to the population (RWR), which allows us to understand local social and economic conditions. We also convert this value to the average growth rate for the two years prior to the election and incorporate it in the empirical analysis.

[12]Standard revenue is the technical term for Japanese public finance and is roughly same as annual local revenue.

16.3.3 Decentralization

Legislative reform implemented in 2000 created a major shift toward decentralization in Japan. It expanded municipal autonomy in many ways, including increasing local tax revenue, enlarging the average area and population of municipalities through amalgamation, extending administrative discretion, and so on. In this analysis, we define the period up to 1999 as "pre-decentralization" and that from 2000 to 2015 as post-decentralization. We introduce a decentralization dummy equal to zero for years up to 1999 and equal to one for 2000 and subsequent years. This dummy is used to consider the behavioral change in retrospective voting after decentralization.

Although decentralization has progressed since 2000, currently over 90% of Japanese municipalities still cannot meet their obligations to provide standard public services using only their own revenue. Finances disbursed by upper governments to municipalities include general grants (e.g., the Local Allocation Tax) and special purpose grants (e.g., national treasury and prefectural disbursements) and accounted for 36% of total annual revenues of local governments in 2017.[13]

Furthermore, discretion may not have increased all that much in a qualitative sense relative to expectations. Until the mid-1990s, fiscal transfers from the government to municipalities were largely comprised of investment-type expenses associated with public works spending. Municipalities had some discretion over investment-type spending, such as selecting locations for newly constructed roads and bridges or the building types of public facilities. Today, however, the dire state of public finances as a result of the economic slowdown has led public investment to substantially decline, and expenditures associated with social security have increased owing to factors such as the aging population and the prolonged economic slump. In Japan, most of the transfer expenses associated with social security are transferred to the target groups based on laws, and cities, towns, and villages have very little exercisable discretion. In other words, although municipal finances have increased in quantitative terms, their discretion to use these funds has not increased to the same extent.

In this study, we therefore include the welfare budget as a proportion of municipal expenditure as a control variable. The trend in this variable used in this paper is shown in Fig. 16.4. As welfare budgets mainly include expenses related to social security, they are a suitable indicator for special purpose transfers targeting people. Growth in the ratio of transfer-type welfare expenses implies a marginal decrease in fiscal discretion. In addition, as the purpose of this variable is to technically curb the degree of discretion in local finance, we take a one-year lag ($t - 1$) of this variable for an election in year t rather than using the average growth rate for the two years prior to the election.

[13]These data come from the White Paper on Local Public Finance 2017 by the MIC (http://www.soumu.go.jp/iken/zaisei/29data/chihouzaisei_2017_en.pdf).

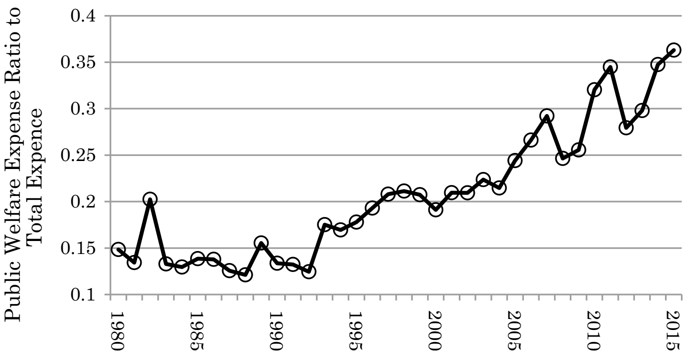

Fig. 16.4 Increase in the ratio of public welfare expenses to total expenses

16.3.4 Other Control Variables

As we consider local elections in Japan with a focus on election campaign styles, we notice differences in the behavior of politicians. According to Curtis (1971), who studied Japanese elections, small village elections tend to involve a "boss" who summarizes the residents' ballots and negotiates with candidates over votes and rewards; small city elections tend to involve groups of political supporters organized by candidates who effectively work to gather votes; and city elections tend to involve swing votes that play an important role in deciding the winner. From this standpoint, the influence of performance variables in response to municipal characteristics may differ.

We therefore employ a set of variables related to population to reflect municipality characteristics. First, we include population size in our empirical analysis. Second, we consider that daily population flows can be used to identify the characteristics of municipalities. In Japan, people tend to live away from their workplaces, and, thus, it is helpful to differentiate between areas with large daytime populations driven by business and consumption and areas with large nighttime populations where workers live. Thus, we include the daily in-flow population ratio, the number of commuters from another area divided by municipal population, in our analysis. Daily population movements due to commuting can be understood as a regional characteristic that relates to neighboring districts. For instance, business zones and service consumption areas have higher daily inflows, whereas suburbs (commuter towns) have lower daily inflows.

Taking a different perspective, in order, we also use the ratio of workers in primary industry sector to all workers to classify the municipal type. Because primary industry sector (mainly imaged as agriculture, forestry, and fishing industry sector) receives the largest subsidies per person from the government, workers in such industries are thought to be highly concerned about municipal policies as well. If so, when of such workers are more prevalent in a region, signs of retrospective voting are more likely to be detected. As the three population-related values are variables used to control for local government conditions, we take a one-year lag ($t-1$) of this variable for an election in year t rather than using the average growth rate for the two years prior to the election. Municipal population data can be obtained from national census.

We also use some data on incumbents (i.e., age, winner's vote share in the last election, and the number of consecutive wins) to control for incumbents' individual attributes. Age is an expected value based on adding the winner's age at the last election to the length of the interval since the previous election. The winner of the last election is the incumbent in current election, and, thus, the winner's vote share in last election is expected to indicate the strength of the incumbent. The number of consecutive wins is the sum of the number of consecutive wins at the last election and one. It specifically reflects the number of consecutive wins if the incumbent is re-elected. This value indicates the durability of incumbent, which likely affects the incumbents' decision to participate in the current election.

16.4 Basic Estimation Results

The quantitative analysis uses a sample of the results of 636 mayoral elections held in Fukuoka prefecture from 1983 through 2015. Most years have more ten elections, and each year has at least four mayoral elections. Table 16.3 shows the estimation results of the probit model (Model 1, Eq. 16.1), the least square model (Model 2, Eq. 16.2), the selection model that represents Heckman's first step (Model 3, Eq. 16.3), and the regression model used in Heckman's second step (Model 4, Eq. 16.6). The coefficient of the inverse Mills ratio in Model 4 shows that it is not necessarily to use Heckman's two-step process, as this value is not significantly different from zero. In this study, we wish to evaluate the validity of the retrospective voting hypothesis using a variety of results without saying which estimation is better or worse.

16.4.1 Elections Improve the Performance of Local Finance

The first focus areas are the coefficients on the measures of local finance: the RWR, RDR, FCI, and RBR. These four variables are regarded as performance indicators of local affairs for which municipal politicians are responsible. None of these variables has a statistically significant effect in all of the estimation models. However, the RBR has a statistically significant effect in three of the models, and a higher RBR indicates an improvement in fiscal conditions. Based on the direction of the coefficients, the estimation results imply a greater improvement in fiscal variables leads to a higher likelihood of incumbents winning and running in elections. Good performance in terms of these variables also serves to increase the incumbents' vote share. Furthermore, the coefficient on RWR in Model 4 indicates that a greater decrease in the RWR (i.e., a greater improvement in residents' quality of life) implies a higher

Table 16.3 Estimation results

Independent variable	Whether incumbent win or not (not running is defined as loss)			Incumbent's votes share (zero votes if incumbent does not run)			Whether incumbent run or not (Heckman's first step)			Incumbent's votes share (Heckman's second step)		
	Model 1: Probit (Win=1)			Model 2: LS			Model 3: Probit (Run=1)			Model4: LS with selection		
	dy/dx	Std. Err.		Coef.	Std. Err.		dy/dx	Std. Err.		Coef.	Std. Err.	
LOCAL INDICES												
Real Balance Ratio (RBR)	0.01357	0.00779	*	0.00958	0.00261	**	0.01312	0.00669	**	-0.00003	0.00045	
Financial Capability Indicator (FCI)	0.08020	0.73545		-0.09431	0.55991		0.02407	0.72340		0.04956	0.06434	
Ratio of Total Debt to Revenue (RDR)	-0.17569	0.20756		-0.01486	0.13126		-0.16924	0.18668		-0.01919	0.01925	
Ratio of Welfare Recipients to Population Ratio (RWR)	-0.39326	0.27142		-0.17091	0.16908		-0.21707	0.24335		-0.05847	0.02642	**
RBR X Decentralization Dummy	0.00025	0.01573		-0.00607	0.06442		-0.01382	0.01562		0.00122	0.00120	
FCI X Decentralization Dummy	-1.06475	1.39785		-0.31438	0.99248		-0.49201	1.21938		-0.14735	0.17232	
RDR X Decentralization Dummy	0.07320	0.44615		-0.09211	0.32296		0.21343	0.39264		-0.12473	0.08814	
RWR X Decentralization Dummy	0.05149	0.40065		0.02951	0.33109		0.17493	0.34560		0.00026	0.05256	
MACRO INDICES												
GDP Growth Rate	1.22980	0.80226		0.19587	0.54638		-0.60978	0.73845		0.24667	0.09511	***
Purchasing Index	-1.05249	1.65880		-0.16458	1.19163		0.39337	1.53320		-0.24347	0.21613	
Debt-service-to-GDP Ratio	0.99593	0.53509	*	0.39613	0.34677		0.21552	0.48041		0.14855	0.05708	***
OTHER INDICES												
Estimated Age of Incumbent	-0.00997	0.00237	***	-0.00794	0.00152	***	-0.01354	0.00238	***	0.00060	0.00046	
Number of Winner's Votes in the Last Election	0.78280	0.06156	***	1.07088	0.05599	***	0.35530	0.06799	***	1.04464	0.01233	***
Estimated Number of Continuous Wins	-0.06259	0.01324	***	-0.05449	0.01162	***	-0.06073	0.01195	***			
Public Welfare Expense to Total Expense (Lag 1)	-0.14851	0.22268		-0.21986	0.16392		-0.24444	0.20269		0.05014	0.02249	**
Population Share of Prim industry (Lag 1)	-0.30640	0.16435	*	-0.20733	0.11559	*	-0.21097	0.14984		-0.00042	0.02382	
Daily Inflow-population Ratio (Lag1)	0.01347	0.22516		-0.15473	0.16719		-0.12429	0.20163		0.01855	0.02405	
Population (million)	0.00086	0.00081		0.00097	0.00043	**	0.00223	0.00092	**	-0.00004	0.00011	
Inverse Mills Ratio										-0.02915	0.01937	
Constant				0.53959	0.13651	***				-0.10757	0.02977	***
	Number of obs	629		Number of obs	629		Number of obs	629		Number of obs	489	
	Wald chi2(18)	182.3		F(18, 610)	71.16		Wald chi2(18)	124.03		F(18, 470)	1531.77	
	Prob > chi2	0		Prob > F	0		Prob > chi2	0		Prob > F	0	
	Pseudo R-squared	0.2867		R-squared	0.5563		Pseudo R-squared	0.2419		R-squared	0.97	
	Log likelihood	-284.226		Root MSE	0.257		Log likelihood	-252.789		Root MSE	0.042	
	Incumbent Win	422					Incumbent Run	489				
	Incumbnet Loss	207					Incumbnet No-Run	140				

Note ***, **, and * denote statistical significance at the 1, 5, and 10% levels, respectively

incumbent vote share if the incumbent participates in the election. Considering the political implications of these results, we can interpret them as voters engaging in retrospective voting to demand healthy local finances and a better quality of residential life from the mayor. These results offer proof that voters exercise a monitoring function, which seems to provide favorable results for the institution of democracy.

Second, we focus on cross-terms by multiplying the decentralization dummy (=1 if year $\geq$ 2000) by each of these four variables. These cross-terms extract the impact that arises after decentralization. However, no cross-terms are statistically significant in Table 16.3. We expected that accountability for local performance would have increased as decentralization progressed, but Table 16.3 shows that we could not find evidence of such an increase. This finding is not consistent with Brender's results.

16.4.2 Results for Classical and Other Control Variables

We now discuss other control variables that show stable statistical significance. As far as the leaders of municipalities are concerned, the impact of trends in national economic indicators must be outside of mayoral responsibility. However, if GDP growth is trending upward, the expected vote share of an incumbent mayor will be higher if he opts to run (Model 4). Similarly, the greater the uptrend in the debt-service-to-GDP ratio is (i.e., the more finances are deteriorating), the more likely incumbents are to win (Model 1), and the incumbent vote share will increase accordingly (Model 4). In brief, even in the case of financial deterioration, higher spending help incumbent mayors get re-elected. This tendency is consistent with the intuition that myopic voters are more interested in current economic conditions than in the future condition of national finances. In this way, even municipal elections cannot be entirely divorced from national conditions.

Looking at incumbents' individual characteristics, older incumbents have lower chances of winning and lower vote shares (Models 1 and 2) as well as a lower likelihood of running for office (Modes 3). On the contrary, the older incumbents who do decide to run for office have higher incumbent vote shares, although this result is not statistically significant (Model 4). Old age may mean that an incumbent has a strong political network, and when such mature candidates opt to run for office, their higher age may not negatively affect their vote shares even though voters generally prefer younger politicians. The vote share of an incumbent in the previous election has a statistically significant positive effect in Models 1 through 4. It is a natural result that incumbents who were strong in the previous election are also strong in the current election. This finding is one of the most robust facts in our analysis.

Among the control variables reflecting municipal characteristics, the population share of primary industry has some statistical significance. To the extent that it has a statistically significant effect, we find that a higher population share of primary industry is associated with a lower probability of incumbents winning (Model 1) and a lower incumbent vote share (Model 2). This result contradicts the general intuition that voters in regions with a high proportion of workers in primary industry are conservative, giving incumbents an advantage in such regions.

This finding is not due to inappropriate estimation procedures. The mean value of the population share of primary industry is 0.1149 when incumbents opt to run in elections, whereas it is 0.1227 when incumbents opt to withdraw. In other words, incumbents tend to run in mayoral elections in municipalities with relatively lower population shares of primary industry. Comparing elections that incumbents won with elections that they lost, the mean value of the population share of primary industry for the former is 0.1154, and that for the latter is 0.120. Accordingly, the conclusion that a higher population share of primary industry serves as a headwind for incumbents emerges even a simple cross tabulation. This finding likely reflects that incumbents were exposed to a headwind that primary industry faced owing to the progress of globalization.

16.5 Negativity Bias Under a Decentralized System

On the one hand, we have assumed that voter's attitudes are influenced by economic conditions. When economic conditions worsen, more people become more seriously concerned about the behavior of governments (i.e., politicians). From this perspective, voters are more likely to exhibit retrospective voting under weaker economic conditions, even in mayoral elections. On the other hand, as Brender (2003) states, decentralization is likely to make the mayoral responsibility clearer, which also induces voters exhibit signs of retrospective voting in mayoral elections.

In this section, we divide the samples to three sub-samples depending on GDP growth rates (past two-year averages), and we separately analyze each sub-sample to separate the influence of economic conditions from the influence of decentralization with respect to retrospective voting. The mean value of the past two-year average GDP growth rate in each election year that is used in our empirical analysis (1983–2015) is 0.0515, and the bottom 25th percentile is 0.0278 or lower. Given the above discussion, we define an election year as belonging to a period of low growth (economic slowdown) if the past two-year average GDP growth rate is 0.027 or lower. We define an election year as belonging to a period of medium growth if the growth rate is in the range of 0.027–0.05, and we define an election year as belonging to a period of high growth if the growth rate is 0.05 or higher. The explanatory variables in the estimation of each sub-group are the same as those used in the basic estimation model. No years during the period of decentralization (i.e., years after 2000) correspond to periods of high growth, and, thus, we omit the decentralization dummy cross-terms from Models 1c, 2c, 3c, and 4c in Table 16.4.

The estimation results show that many variables have statistical significance in Models 1a, 2a, and 3a for periods of low growth. Comparing this result to those for periods of medium growth (Models 1b, 2b, 3b, and 4b) and periods of high growth (Models 1c, 2c, 3c, and 4c), signs of retrospective voting are clearer during periods of low growth. This finding can be interpreted as the existence of negativity bias, which

Table 16.4 Main variables in estimation results

Independent variable	Whether incumbent win or not (not running is defined as loss)			Incumbent's votes share (zero votes if incumbent does not run)			Whether incumbent run or not (Heckman's first step)			Incumbent's votes share (Heckman's second step)		
	Model 1a: Probit (Win=1)			Model 2a: LS			Model 3a: Probit (Run=1)			Model 4a: LS with selection		
Low growth rate of GDP	dy/dx	Std. Err.		Coef.	Std. Err.		dy/dx	Std. Err.		Coef.	Std. Err.	
Real Balance Ratio (RBR)	0.1829	0.2931		0.0272	0.0262		0.2356	0.1706		0.0001	0.0023	
Financial Capability Indicator (FCI)	10.1443	3.9247	***	5.7028	1.5923	***	11.9469	4.6312	***	0.1642	0.3751	
Ratio of Total Debt to Revenue (RDR)	0.0729	0.3547		0.1997	0.2729		-0.0702	0.2464		0.0110	0.0331	
Ratio of Welfare Recipients to Population Ratio (RWR)	-3.3905	1.1729	***	-1.4927	0.6283	**	-2.2956	1.1385	**	-0.1389	0.1084	
RBR X Decentralization Dummy	-0.1211	0.3063		-0.0212	0.0312		-0.2232	0.1721		0.0007	0.0061	
FCI X Decentralization Dummy	-9.2889	4.4528	**	-5.2077	1.8419	***	-11.1620	4.8361	**	-0.0529	0.4184	
RDR X Decentralization Dummy	0.7759	0.6776		0.1355	0.4855		0.6014	0.5653		-0.0675	0.0949	
RWR X Decentralization Dummy	2.8465	1.3066	**	0.4195	0.7464		0.9738	1.3170		0.1850	0.1212	
Observations	147			147			147			116		
Test ǀ Prob > Value	Wald chi2(18)	68.58	***	F(18, 128)	25.01	***	Wald chi2(18)	59.24	***	F(18, 97)	614.28	***
Pseudo R-squared / R-squared	Pseudo R-squared	0.3647		R-squared	0.6128		Pseudo R-squared	0.3912		R-squared	0.9825	
	Model 1b: Probit (Win=1)			Model 2b: LS			Model 3b: Probit (Run=1)			Model 4b: LS with selection		
Middle growth rate of GDP	dy/dx	Std. Err.		Coef.	Std. Err.		dy/dx	Std. Err.		Coef.	Std. Err.	
Real Balance Ratio (RBR)	0.0859	0.0990		0.0292	0.0909		0.0775	0.0778		0.0093	0.0106	
Financial Capability Indicator (FCI)	0.0010	1.2737		-0.2329	1.3169		-0.4964	1.2233		0.1774	0.1785	
Ratio of Total Debt to Revenue (RDR)	0.1526	0.3594		0.1381	0.2284		-0.0218	0.3155		-0.0251	0.0388	
Ratio of Welfare Recipients to Population Ratio (RWR)	-0.0945	0.6981		0.0363	0.4188		0.5208	0.5562		-0.2334	0.1305	*
RBR X Decentralization Dummy	-0.1722	0.1144		-0.1083	0.1091		-0.2168	0.0920	**	0.0059	0.0178	
FCI X Decentralization Dummy	-2.3178	2.0320		-1.0336	1.8268		-1.2177	1.8570		-0.1771	0.3447	
RDR X Decentralization Dummy	-0.7283	0.6290		-0.3931	0.4934		-0.2566	0.5645		-0.1883	0.1524	
WRPR X Decentralization Dummy	-0.5113	0.8511		-0.0053	0.5913		-0.2894	0.6093		0.1233	0.1516	
Observations	252			252			252			194		
Test ǀ Prob > Value	Wald chi2(18)	74.43	***	F(18, 233)	23.65	***	Wald chi2(18)	47.17	***	F(18, 175)	542.55	***
Pseudo R-squared / R-squared	Pseudo R-squared	0.2494		R-squared	0.4941		Pseudo R-squared	0.2192		R-squared	0.9539	
	Model 1c: Probit (Win=1)			Model 2c: LS			Model 3c: Probit (Run=1)			Model 4c: LS with selection		
High growth rate of GDP	dy/dx	Std. Err.		Coef.	Std. Err.		dy/dx	Std. Err.		Coef.	Std. Err.	
Real Balance Ratio (RBR)	0.0070	0.0035	**	0.0078	0.0158		0.0084	0.0033	**	-0.0004	0.0019	
Financial Capability Indicator (FCI)	0.0506	0.9066		-0.2133	0.7179		-0.3386	0.8847		0.0712	0.0644	
Ratio of Total Debt to Revenue (RDR)	-0.3191	0.2891		-0.0338	0.2360		-0.1252	0.2873		-0.0450	0.0347	
Ratio of Welfare Recipients to Population Ratio (RWR)	-0.3521	0.3417		-0.1781	0.2319		-0.4027	0.3367		-0.0050	0.0293	
RBR X Decentralization Dummy	0	(omitted)		0	(omitted)		0	(omitted)		0	(omitted)	
FCI X Decentralization Dummy	0	(omitted)		0	(omitted)		0	(omitted)		0	(omitted)	
RDR X Decentralization Dummy	0	(omitted)		0	(omitted)		0	(omitted)		0	(omitted)	
WRPR X Decentralization Dummy	0	(omitted)		0	(omitted)		0	(omitted)		0	(omitted)	
Observations	230			230			230			179		
Test ǀ Prob > Value	Wald chi2(14)	68.98	***	F(14, 215)	45.76	***	Wald chi2(14)	66.05	***	F(14, 164)	1690.49	***
Pseudo R-squared / R-squared	Pseudo R-squared	0.4006		R-squared	0.6562		Pseudo R-squared	0.3836		R-squared	0.9875	

Note ***, **, and * denote statistical significance at the 1, 5, and 10% levels, respectively

points to retrospective voting becoming apparent during worse economic conditions. Although GDP growth rate (a macroeconomic indicator) is outside the responsibility of municipal leaders, during periods of lower growth, it affects mayoral elections as citizens who changed their attitudes regarding political issues hold mayors more accountable for economic conditions.

Focusing on periods of low growth, we confirm the political implications of the estimation results. When FCI is higher (i.e., local governments are stronger in terms of public finance) and RWR is lower (i.e., voters' quality of life improves), incumbents are more likely to run in an election and be re-elected (Models 1a, 2a, and 3a). We can interpret this finding as indicating that the monitoring function of elections operates well. We stress that these healthy characteristics emerge when the GDP growth rate is low.

However, we must note that we observe different characteristics when considering the impact of decentralization. Looking at the variables with statistically significant effects among the cross-terms with the decentralization dummy, we find that a higher value for the FCI cross-terms corresponds to incumbents facing greater obstacles to running for office and being re-elected (Models 1a, 2a, and 3a). Furthermore, a higher cross-term of RWR implies that incumbents are more likely to run for re-election and be re-elected (Models 1a, 2a, and 3a). These results imply that mayors who made local finances and social conditions worse tend to have advantages in the subsequent election. Thus, after decentralization, the "healthy" signals sent to politicians, that is, the political implications described in the previous paragraph, are partly cancelled out.

We interpret this result as meaning that rational voters are likely to prefer more government expenditure even if FCI worsened. In this way, the clarity of responsibility for local public finance seems to be undermined. We also interpret this to mean that recipients of social assistant programs were increasingly placing high expectations on incumbents with strong political networks to influence national policy in the case of the recession after decentralization. Note that in Japan, as a unitary state, social assistance programs are controlled by the central government, and local governments merely provide them under central instruction. If this interpretation is true, mayors were recognized as windows to the central government, so clarity of responsibility of mayors was not related to the health of local public finance but rather to growth of expenditures. Retrospective voting thus became a malignant mechanism by negativity bias under decentralization. This point, which was not mentioned previous studies, is the main contribution of this study.

Fortunately, according to a comparison of the estimated coefficients or marginal effects, the unhealthy signals after decentralization (i.e., the estimated values of the cross-terms) are not large enough to fully cancel out healthy signals. For example, in Model 1a, a 0.1-point improvement in FCI increases the winning probability of the incumbent by one percentage point. After decentralization, in Model 1a, a 0.1-point improvement in FCI decreases the winning probability of the incumbent by 0.9 percentage points. In other words, the unfavorable effects offset a substantial part of the favorable effects, but not all.

16.5.1 Plausibility of Estimation Results

Retrospective voting was more clearly observed during periods of low growth. The retrospective voting observed here increased mayors' re-election chances if they improved social and financial conditions in municipalities, demonstrating the virtue of representative democracy. However, if we extracted only the impact of retrospective voting after decentralization, it had a less virtuous effect. In other words, in periods of low growth, decentralization makes it less likely for incumbent mayors who improved economic and financial conditions to be re-elected. However, we must consider whether the result that decentralization reduces the virtue of representative democracy in local governments is really plausible.

To check the accuracy of our estimation, we compare the actual observations with the estimated values calculated by Models 1a, 2a, 3a, and 4a. For simplification, we targeted periods of low GDP growth for comparison, as these periods are the most interesting. From Table 16.5, the mean value of the dummy for an incumbent winning the election (i.e., the probability of incumbent win, where elected = 1), which is the dependent variable in Eq. 16.1, is 0.671, whereas the mean value of each electoral district's incumbent winning probability calculated using Model 1a is 0.657. The observed mean value of the incumbent vote share, which is equal to zero if the incumbent does not run for office and is the dependent variable in Eq. 16.2, is 0.573, whereas the mean of the estimation results using Model 2a is 0.574, which is almost the same. The mean value of the incumbent participation dummy (i.e., the probability of an incumbent run), which is the observed dependent variable in Eq. 16.3 and corresponds to Heckman's selection model, is 0.793, whereas the mean value estimated using Model 3a is 0.786. The mean value of the incumbent vote share, which is treated as a missing value if the incumbent does not run and is the observed dependent variable in Eq. 16.6 that corresponds to Heckman's regression model, is 0.722, whereas the mean estimated value using Model 4a is 0.702. Thus, all of the estimation models generate estimations that are close to the observed values, and the mean values of the observation and estimation are not considered to differ from each other because their standard deviations are relatively large. Thus, we can conclude that the estimation results are broadly satisfactory.

In probit estimation, it is reasonable to set an expectation of one when the estimated probability exceeds 0.5, whereas expectations can be regarded as zero otherwise. Given this understanding, it is possible to confirm the accuracy of the estimation using a simple method. Table 16.6 shows the comparison of the observed and estimated results with respect to Models 1a and 3a. In the upper panel of Table 16.6, 96 incumbents actually won the election, whereas 80 of them were predicted to win the election (i.e., to have a 50% or higher probability of winning the election). On the contrary, 51 incumbents did not win the election, whereas 32 of them were predicted to lose the election (i.e., to have a 50% or lower probability of winning the election). These 80 and 32 election results, which comprise 76% of our sample (=112/147), can be said to have been correctly predicted by our estimation model. Similarly, the lower panel of Table 16.6 shows that the total number of correctly forecasted sam-

Table 16.5 Comparison between observations and estimated values

	Variable	Obs.	Mean	Std. Dev.	Min	Max
Observation	Dummy for incumbents winning the election (treating not running as a loss)	164	0.671	0.471	0	1
	Incumbent voting share (equal to zero if incumbent did not run)	164	0.573	0.360	0	1
	Incumbent participation dummy	164	0.793	0.407	0	1
	Incumbent vote share (treated as missing if incumbent did not run for office)	130	0.722	0.235	0.298	1
Prediction	Probability of incumbent win from Model 1a	147	0.657	0.307	0.015	1
	Predicted incumbent vote share from Model 2a	147	0.574	0.286	−0.040	1.097
	Probability that incumbent runs from Model 3a	147	0.786	0.265	0.033	1
	Predicted incumbent vote share from Model 4a	147	0.703	0.237	0.286	1.017

ples is 129, meaning that 87% of the samples (=129/147) are regarded to have been correctly estimated. These results suggest that the accuracy of the estimation models is not bad and that they can be given a certain amount of credence.

16.5.2 Plausibility of the Definition of a Low GDP Growth Rate

Thus far, we defined samples in which the average GDP growth rate over the past two years was lower than 2.75% as periods of low growth. However, the validity of this definition is worth considering. Models 1d, 2d, 3d, and 4d in Table 16.7 show the analysis results if periods of low growth are redefined as periods during which the average growth rate over the in past two years was less than 2%. The other conditions are the same as in the basic estimation model. In this estimation, the sample size is

Table 16.6 Goodness of fit of observations and estimation results (periods of low growth rate of GDP)

Model 1a	Observed number of incumbent wins	Observed number of incumbent losses (or run-offs)
Estimated probability of incumbent win at least 50%	80	19
Other	16	32

Model 3a	Observed number of incumbent runs	Observed number of incumbent run-offs
Estimated probability of incumbent run at least 50%	113	15
Other	3	16

small, and the analysis is biased toward periods of lower growth. Similarly, Models 1e, 2e, 3e, and 4e in Table 16.7 show the analysis results if periods of low growth are redefined as periods during which the average growth rate over past two years was less than 3.5%. In this case, the sample size is large and the sample includes periods of higher growth. These estimation models are basically the same as those in Table 16.4 except for the different definitions of low growth.

Comparing the analysis results when low growth is defined as periods during which the average GDP growth rate over the past two years was less than 2.75% and less than 2%, the number of variables with statistically significant effects was equal to 10, the estimated coefficients that retained statistical significance were broadly similar, and the signs of coefficients indicated the same directional effects. Our main conclusion remains the same even if low growth is defined as a growth rate below 2%.

However, if we define periods of low growth as periods during which the average GDP growth rate over the past two years was less than 3.5%, the number of variables with statistically significant effects declined sharply. Moreover, the tendencies of the sizes, signs, and statistical significance of coefficients were different from those when low growth is defined as a GDP growth rate below 2.75%. We therefore conclude that the specific findings for periods of low growth (i.e., negativity bias) are stable and robust as long as a period of low growth is defined as having a sufficiently low upper bound.

16.5.3 Checking the Outliers

The upper panel of Table 16.6 shows that 19 candidates lost the election despite having a 50% or higher chance of winning according to the estimation model. These

Table 16.7 Other definitions of a low growth rate of GDP

Independent variable	Whether incumbent win or not (not running is defined as loss)			Incumbent's votes share (zero votes if incumbent does not run)			Whether incumbent run or not (Heckman's first step)			Incumbent's votes share (Heckman's second step)		
	Model 1d: Probit (Win=1)			Model 2d: LS			Model 3d: Probit (Run=1)			Model 4d: LS with selection		
	dy/dx	Std. Err.		Coef.	Std. Err.		dy/dx	Std. Err.		Coef.	Std. Err.	
Less than 2% growth rate of GDP												
Real Balance Ratio (RBR)	0.1736	0.2006		0.0290	0.0510		0.3899	0.1524	**	-0.0004	0.0023	
Financial Capability Indicator (FCI)	8.6788	3.4621	**	5.6147	1.9301	***	10.5617	3.8466	***	0.1389	0.2437	
Ratio of Total Debt to Revenue (RDR)	0.2910	0.2726		0.1768	0.2845		0.0634	0.2214		0.0228	0.0347	
Ratio of Welfare Recipients to Population Ratio (RWR)	-2.2192	0.9430	**	-1.5134	0.7131	**	-1.3923	0.5703	**	-0.1042	0.1037	
RBR X Decentralization Dummy	-0.1973	0.1992		-0.0325	0.0551		-0.2015	0.1870		-0.0008	0.0036	
FCI X Decentralization Dummy	-12.1437	4.6421	***	-3.4546	2.7478		-12.3519	4.5896	***	0.2469	0.4577	
RDR X Decentralization Dummy	3.7625	1.2208	***	0.6171	0.8587		1.2513	1.1832		0.1447	0.1291	
RWR X Decentralization Dummy	0.3953	1.3481		-0.1015	0.8129		-1.1728	0.9940		0.1280	0.1608	
Observations	82			82			82			64		
Test | Prob > Value	Wald chi2(18)	50.32	***	F(18, 63)	23.3	***	Wald chi2(18)	67.61	***	F(18, 45)	1195.2	***
Pseudo R-squared / R-squared	Pseudo R-squared	0.6653		R-squared	0.775		Pseudo R-squared	0.7124		R-squared	0.9942	
	Model 1e: Probit (Win=1)			Model 2e: LS			Model 3e Probit (Run=1)			Model 4e: LS with selection		
Less than 3.5% growth rate of GDP	dy/dx	Std. Err.		Coef.	Std. Err.		dy/dx	Std. Err.		Coef.	Std. Err.	
Real Balance Ratio (RBR)	0.1145	0.1361		0.0267	0.0297		0.1961	0.1173	*	-0.0005	0.0044	
Financial Capability Indicator (FCI)	0.1144	1.6353		-0.4945	1.6964		-0.4679	1.2490		0.3662	0.1993	*
Ratio of Total Debt to Revenue (RDR)	0.2447	0.3371		0.2388	0.2398		0.0936	0.2931		0.0067	0.0266	
Ratio of Welfare Recipients to Population Ratio (RWR)	-0.7232	0.7061		-0.3316	0.4923		-0.4228	0.5493		-0.1216	0.0682	*
RBR X Decentralization Dummy	-0.0246	0.1697		-0.0185	0.0441		-0.1770	0.1197		0.0004	0.0065	
FCI X Decentralization Dummy	-0.2152	2.3064		0.7270	1.9768		0.6959	1.7707		-0.2884	0.2454	
RDR X Decentralization Dummy	0.3904	0.6435		-0.0415	0.4164		0.2878	0.5400		-0.0619	0.0813	
WRPR X Decentralization Dummy	0.6362	0.9167		-0.2631	0.5835		-0.3556	0.7787		0.1729	0.0962	*
Observations	231			231			231			182		
Test | Prob > Value	Wald chi2(18)	59.86	***	F(18, 212)	15.56	***	Wald chi2(18)	41.53	***	F(18, 163)	788.24	***
Pseudo R-squared / R-squared	Pseudo R-squared	0.2166		R-squared	0.4638		Pseudo R-squared	0.1914		R-squared	0.9809	

Note ***, **, and * denote statistical significance at the 1, 5, and 10% levels, respectively

candidates are examples of so-called forecast misses. The dependent variable used in Eq. 16.1, that is, Model 1, is set to unity if the incumbent wins the election and is set to zero otherwise. The definition of not winning includes not only elections in which incumbents participated in the election and lost, but also elections in which incumbents withdrew. In fact, 12 of the 19 incumbents with incorrect predictions in Table 16.6 withdrew from the election rather than losing. Thus, we need to sufficiently consider the differences between losing and withdrawing from an election.

To understand incumbents' choices to not compete in elections despite predictions that they had a 50% or greater chance of winning, we extracted and examined the 12 specific elections in which incumbents were estimated by Model 1a to have high winning probabilities (more than 50%) but still withdrew from the election. The results are summarized in Table 16.8. Among these 12 elections, incumbent clearly could not run in three cases because of death or serious health reasons (cases 1, 5, and 9). Cases of the sudden death of an incumbent should have been excluded from the analysis because these election intervals should have been less than four years. However, these elections did not meet the conditions for exclusion because the candidates resigned when their terms in office were almost over. According to our estimation models, if these incumbents had been candidates in these three elections, their estimated vote shares would have been 73.8, 67.3, and 50.3%, and winning probabilities would have been 92.5, 59.6, and 66.3%, respectively, according to Model 2a. We presume that these candidates would have run and won the election if they were healthy.

In four cases, incumbents withdrew their candidacy for reasons such as corruption and unethical attributes (cases 6, 8, 10, and 11). When we calculate their probabilities of winning using Model 1a, we obtain 77.3, 68.9, 54.9, and 50.6%, respectively. Because our estimation model cannot control for individual mayoral incidents, these four incumbents were assigned winning probabilities of more than 50%. We also estimate their vote shares using Model 2a as 66.3, 60.9, 43.7, and 43.5%. On average, the estimated vote shares of these candidates are smaller than those of the incumbents who could not run for health reasons.

It is interesting that incumbents who faced problems associated with their political attributes and corruption had relatively low probabilities of winning the next election according to our model. We can assume that incumbents facing a high risk of losing the next election may be more inclined to make administrative mistakes. Considering this fact is outside the scope of this analysis.

Table 16.8 Individual circumstance of twelve elections in which the win probability of the incumbent was estimated to be at least 50% in Model 1a, but the incumbent did not run in the election (the estimated values in the table are calculated basis on low economic growth)

Case	Year	Name	Probability of Incumbent Win (Model 1a) (%)	Estimated Incumbent Vote share (Model 2a) (%)	Probability of Incumbent Run (Model 3a) (%)	Note
1	2003	Town of Onga	92.5	73.8	83.1	*Incumbent died* near end of term, deputy elected without a vote
2	2003	Town of Ooki	68.5	70.9	62.7	No information.
3	2015	City of Oomuta	69.8	69.9	71.1	71-year-old incumbent announced he would not stand. *Deputy stood* and was elected without a vote
4	2010	Town of Kotake	83.8	67.7	66.8	75-year-old incumbent announced he would not stand. *Deputy stood and was* elected without a vote
5	2015	City of Nogata	59.6	67.3	57.1	*The incumbent died* close to the end of his term. The election was held as normal with the winner elected without a vote
6	2003	City of Nogata	77.3	66.3	96.3	*The incumbent was arrested* for bribery after resigning near the end of the term. The next election was held at its normal time

(continued)

Table 16.8 (continued)

Case	Year	Name	Probability of Incumbent Win (Model 1a) (%)	Estimated Incumbent Vote share (Model 2a) (%)	Probability of Incumbent Run (Model 3a) (%)	Note
7	2011	Town of Kasuya	75.3	63.5	93.2	Incumbent announced he would stand but withdrew due to health concerns after *others stood*
8	2009	City of Chikugo	68.9	60.9	97.4	*Political ethics conflict* in 2007. Announced he would not stand due to health concerns
9	1999	Town of Genkai	66.3	50.3	59.8	*Incumbent vomited blood* while in service and abandoned election bid to recuperate
10	2015	Town of Kawasaki	54.9	43.7	86.7	After *incumbent was arrested*, deputy served as representative and election was held according to its usual timing
11	2009	City of Fukutsu	50.6	43.5	86.3	*Mutual receptions among bureaucrats* and careless financial management arose, and incumbent gave up run
12	1999	Town of Nijyou	71.6	33.0	83.9	No information

Note Cases are sorted by estimated incumbent vote share

16.6 Conclusion

In general, mechanisms for monitoring local government decision-making include internal audit within local governments, external monitoring by higher-level organizations and professionals, evaluation via the municipal bonds market, and elections by the citizenry. Our analysis of local election outcomes is an attempt to confirm the effectiveness of citizen-based monitoring. We expected local fiscal health to play an important role in whether politicians are re-elected.

Brender (2003) shows that administrative reform related to decentralization clarifies the responsibility of local governments. Japan employs a highly centralized fiscal system in which the central government takes responsibility not only for macroeconomic indicators but also for local public finance to some extent. Thus, it is difficult for citizens to identify the substantial indexes for which mayors are expected to be responsible, and "unclarity of responsibility" tends to feature prominently in local elections. On the one hand, Japan's shift toward decentralization in 2000, an administrative reform, probably mitigated this lack of clarity to some extent. On the other hand, the low GDP growth rate at that time likely strengthened voters' incentives to monitor government performance, whereas citizens tend to care less about government performance (whether central or local) during periods of prosperous economic conditions. This asymmetric tendency is called negativity bias and may also affect mayoral elections.

The main conclusions of this chapter, in which we analyze retrospective voting in Japanese municipalities focusing on decentralization (improving the clarity of responsibility) and negativity bias, are as follows. First, retrospective voting was prominent when the economic growth rate was lower, implying that negativity bias related to macroeconomic conditions influenced mayoral elections. Second, the probability of re-election tended to drop for incumbents who presided over periods of worsening local indicators. This result supports a preferable type of responsibility hypothesis, which academic researchers expect to hold. Third, after decentralization, voters' attitudes toward monitoring incumbents clearly changed in periods of low economic growth. Incumbents who failed to manage local public finance well received more support, indicating a partial offset of the healthy signals sent by voters to politicians. In this way, the clarity of responsibility for public finance is undermined, and fiscal democracy does not work well in the case of local governments.

This result is certainly not surprising. According to Caplan (2007), voters are not concerned about public finance. Especially in periods of low growth, recipients of social assistance programs and beneficiaries of public procurement are likely to place high expectations on politicians. Under a centralized system, mayors may be viewed as "windows" to the central government, and, thus, mayoral responsibility for public finance is not clear even if voters' expectations for local public expenditures are clear. According to our empirical analysis, this tendency can be observed clearly after a policy of decentralization was enforced. Decentralization of Japanese municipalities clarified local responsibilities in terms of non-financial aspects. Neither decentralization nor negativity bias is necessarily a problem for a democratic state. Instead, the main role of this study is to show that the signals sent by voters via mayoral elections under a decentralized system are unfavorable under certain conditions and stress the danger of placing uncritical faith in both representative democracy and decentralization.

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Appendix

Descriptive Statistics

See Tables 16.9, 16.10 and 16.11.

Table 16.9 Descriptive statistics (Low economic growth)

Low economic growth	Observation	Mean	Standard deviation	Min	Max
Binary choice: incumbent run dummy (=1 if incumbent ran)	164	0.7927	0.4066	0	1
Binary choice: incumbent win dummy (=1 if incumbent won)	164	0.6707	0.4714	0	1
Incumbent vote share	164	0.5727	0.3603	0	1
Real Balance Ratio (RBR)	163	0.3181	2.2097	−1.6222	21.5682

(continued)

Table 16.9 (continued)

Low economic growth	Observation	Mean	Standard deviation	Min	Max
Financial Capability Indicator (FCI)	164	0.0086	0.0206	−0.0736	0.0988
Ratio of Total Debt to Revenue (RDR)	164	0.0158	0.0954	−0.1642	0.4566
Ratio of Welfare Recipients to Population (RWR)	148	0.0165	0.0622	−0.2725	0.2196
RBR X decentralization dummy	163	0.1556	1.4142	−1.6222	17.5000
FCI X decentralization dummy	164	0.0065	0.0193	−0.0736	0.0988
RDR X decentralization dummy	164	−0.0023	0.0641	−0.1642	0.2792
RWR X decentralization dummy	148	0.0188	0.0569	−0.2725	0.2196
GDP growth	164	0.0145	0.0139	−0.0186	0.0267
Purchasing index	164	0.0026	0.0106	−0.0113	0.0188
Debt-service-to-GDP ratio	164	0.0704	0.0355	0.0127	0.1164
Estimated age of incumbent	164	66.5915	7.3775	44	88
Estimated number of continuous wins	164	2.9268	1.2608	2	9
Votes for winner in the last election	164	0.7105	0.2219	0.3297	1

(continued)

Table 16.9 (continued)

Low economic growth	Observation	Mean	Standard deviation	Min	Max
Public welfare expense as a percent of total expense (Lag 1)	164	0.2475	0.0851	0.0730	0.4851
Population share of prim industry (Lag 1)	149	0.0783	0.0872	0.0030	0.5037
Daily inflow-population ratio (Lag1)	149	0.1812	0.0813	0.0498	0.4758
Population (million)	155	7.0744	19.2787	0.0909	146.3743

Table 16.10 Descriptive statistics (Middle economic growth)

Middle economic growth	Observation	Mean	Standard deviation	Min	Max
Binary choice: incumbent run dummy (= 1 if incumbent ran)	268	0.7836	0.4126	0	1
Binary choice: incumbent win dummy (=1 if incumbent won)	268	0.6530	0.4769	0	1
Incumbent vote share	268	0.5776	0.3734	0	1
Real Balance Ratio (RBR)	267	0.1502	0.4663	−2.0094	2.8958
Financial Capability Indicator (FCI)	268	0.0075	0.0278	−0.0694	0.1718
Ratio of Total Debt to Revenue (RDR)	268	0.0357	0.0855	−0.1376	0.3915
Ratio of Welfare Recipients to Population (RWR)	260	−0.0098	0.0837	−0.2009	0.8579

(continued)

Table 16.10 (continued)

Middle economic growth	Observation	Mean	Standard deviation	Min	Max
RBR X decentralization dummy	267	0.0934	0.3871	−2.0094	2.8958
FCI X decentralization dummy	268	0.0025	0.0205	−0.0694	0.1046
RDR X decentralization dummy	268	0.0120	0.0514	−0.1376	0.2871
RWR X decentralization dummy	260	0.0167	0.0637	−0.0945	0.8579
GDP growth	268	0.0382	0.0077	0.0278	0.0494
Purchasing index	268	0.0027	0.0084	−0.0091	0.0248
Debt-service-to-GDP ratio	268	0.0550	0.0281	0.0006	0.0847
Estimated age of incumbent	268	65.3694	7.4709	38	85
Estimated number of continuous wins	268	2.9701	1.1800	2	10
Votes for winner in the last election	268	0.7369	0.2233	0.2904	1
Public welfare expense as a fraction of total expense (Lag 1)	268	0.2181	0.0789	0.0646	0.4792
Population share of prim industry (Lag 1)	261	0.0977	0.1007	0.0029	0.5092
Daily inflow-population ratio (Lag 1)	261	0.1756	0.0939	0.0380	0.6050
Population (million)	254	6.7435	20.8922	0.0915	152.3694

Table 16.11 Descriptive statistics (High economic growth)

High economic growth	Observation	Mean	Standard deviation	Min	Max
Binary choice: incumbent run dummy (=1 if incumbent ran)	277	0.7870	0.4102	0	1
Binary choice: incumbent win dummy (=1 if incumbent won)	277	0.7220	0.4488	0	1
Incumbent vote share	277	0.6435	0.3872	0	1
Real Balance Ratio (RBR)	236	−0.2175	3.9553	−58.4009	11.2926
Financial Capability Indicator (FCI)	237	−0.0002	0.0329	−0.1333	0.0844
Ratio of Total Debt to Revenue (RDR)	237	0.0039	0.0907	−0.1962	0.2881
Ratio of Welfare Recipients to Population (RWR)	234	−0.0428	0.0772	−0.2233	0.4563
RBR X decentralization dummy	236	0	0	0	0
FCI X decentralization dummy	237	0	0	0	0
RDR X decentralization dummy	237	0	0	0	0
RWR X decentralization dummy	234	0	0	0	0
GDP growth	277	0.0971	0.0217	0.0583	0.1343
Purchasing index	277	0.0257	0.0156	0.0012	0.0646
Debt-service-to-GDP ratio	277	0.0401	0.0613	−0.0379	0.1762
Estimated age of incumbent	277	64.5632	7.8284	40	83
Estimated number of continuous wins	271	3.1845	1.3092	2	8

(continued)

Table 16.11 (continued)

High economic growth	Observation	Mean	Standard deviation	Min	Max
Votes for winner in the last election	277	0.7795	0.2189	0.3024	1
Public welfare expense as a fraction of total expense (Lag 1)	261	0.1369	0.0622	0.0291	0.3805
Population share of prim industry (Lag 1)	259	0.1604	0.1333	0.0048	0.5907
Daily inflow-population ratio (Lag1)	259	0.1240	0.0708	0.0216	0.4307
Population (million)	275	5.0036	16.0548	0.0957	123.7062

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Chapter 17
Federalism, Party Competition and Public Expenditure: Empirical Findings on Regional Health Expenditure in Italy

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Abstract Since the '90s, Italy has experienced a considerable decentralization of functions to the regions. This transformation has been especially relevant for the National Health System that has de facto assumed a federal system design. The federal reform aimed to discipline public health expenditure that drains a substantial share of the budget of Italian regions and is among the main causes of the regional deficits. Political economic analysis, however, suggests that the impact of federalism on public expenditure depends on central and local government strategies to win the electoral competition. Results derived in this chapter indicate that political competition actually works as a tool of fiscal discipline, as it shows a restraining effect on public health expenditure.

Keywords Fiscal federalism · Local budget · Multi-level policy-making · Public expenditure · Political competition · Health economics

17.1 Introduction

It is well known that public expenditure can be strongly influenced by political economic matters. The strategic utilization of public resources to support the re-election of political representatives has been extensively explored, among others, by the literature on political business cycles and on interest groups' lobbying (see Mueller 2003; Wittman and Weingast 2008). Moreover, the theoretical analysis has highlighted how the pursue of political goals may not only induce excessive spending but also the adoption of inefficient forms of transfers, even in presence of efficient (or less inefficient) ones (Acemoglu and Robinson 2001; Alesina et al. 2001; Coate and Morris 1995; Drazen and Limão 2008; Magee et al. 1989).

The scenario is further complicated by the existence of multiple layers of policy-making, as in the case of fiscal federalism. In fact, on the one hand centralization may

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trigger free-riding and local over-expenditure while, on the other hand, decentralization generates externalities related to horizontal and vertical competition (Persson and Tabellini 2000; Devereux et al. 2007).[1] Theoretical and empirical analyses suggest that the impact of decentralization on expenditure is likely to be ambiguous because of several counteracting effects. For example, while fiscal as well as political competition may constrain expenditure growth (see Mueller 2003), political decentralization may have a positive impact on public expenditure for several reasons. For example, local communities may decide to expand public services when they (and not the national government) control provision. Moreover, the multiplication of centers of policymaking is likely to determine additional costs. From a political economic perspective, a larger number of legislative districts may imply more redistribution and pork-barrel, causing public overspending (as shown by Weingast et al. 1981). Regarding this issue, some studies have pointed out that the impact of decentralization on the size of government depends on the specific institutional framework. In this respect, separation of powers and open rules of decision-making seem to limit over-expenditure under centralization.[2]

In a decentralized framework, the ways in which local expenditure is financed does have an impact on the magnitude of the public sector. A stream of literature has focused on the political determinants of intergovernmental grants. They represent a cost for the financing government, whereas the political benefits of their utilization often accrue to the spending (local) agents. This simple observation suggests that the political motivations of grants can be at least as fundamental as the efficiency and equity justifications. A growing number of studies indicate that intergovernmental grants are often assigned to maximize the political return for the donor.[3] Moreover grants are occasionally instrumental to bail-out local governments under financial troubles (Rodden et al. 2003).

Potential over-expenditure is clearly linked to an inadequate control of the electorate that allows a government to increase the size of the public sector in order to pursue its own goals. Public choice literature indicates that the design of a specific institutional framework, characterized by check and balances and adequate electoral competition, may help the community to tame the Leviathan and/or to hinder particularistic policies favouring interest groups (Wittman 1995). In this chapter, we concentrate on the latter aspect, namely a competitive political market.

In principle, the impact of political competition on the size of the public sector is ambiguous. On the one hand, we can presume that stronger competition will induce the government to behave more efficiently, even in case of particularistic policies

[1]Besley and Coate (2003) compare the costs of common pool effect with the benefits of internalization of spillovers deriving from centralization, showing that centralization leads a cooperative legislature to over-provide public goods. The reason is that local voters will strategically appoint representatives with high demand for spending. In Dur and Roelfsema (2005), that result is reverted when costs cannot be shared among districts (as in the case of environmental regulation or shelter provision to asylum seekers).

[2]See, for example, Migué (1997), Mazza and van Winden (2002), Dur and Roelfsema (2005).

[3]Guccio and Mazza (2005) provides a small survey of the empirical studies verifying the impact of political economic variables on the allocation and/or size of intergovernmental grants.

(Becker 1983, 1985). On the other hand, more competition could induce expansionary policies by the incumbent to reinforce his or her political position. However, such policies can be undertaken also through tax reduction, and not necessarily through an increase in expenditure. Furthermore, political consensus can be acquired also by improving the quality of the services, with a potentially positive impact on expenditure.

A highly cited study by Solé-Ollé (2006) investigates the impact of political competition on the local expenditure of 500 Spanish municipalities in the period between 1992 and 1999. He finds evidence that the size of the electoral margin of the incumbent has a positive influence on expenditure.

Building on that study, we attempt to verify the impact of political competition on health expenditure in Italy, which accounts for the largest share of regional budget and represents the main example of decentralization in the country. Specifically, regional health expenditures from 1990 to 2003 are taken as a case study, as the choice of this time span allows evaluating the effect of two important policy changes (see, Porcelli 2014, for a quite similar choice). First, in 1995 regional elections were held with a new electoral law that replaced the previous system of proportional representation with one based on a majoritarian rule, with the direct election of the president of the region. Secondly, in the period selected by the study, the most important decentralization reforms in the health sector occurred. Specifically, we refer to the 1998 reform, when new regional taxes replaced the previous intergovernmental grants earmarked for the health care sector, and the 2001 Constitutional reform that devolved to regions responsibilities for both the provision and financing of health care. In this respect, our dataset covers a reasonable period of time before and after all these events.

The chapter is organized as follows. Section 17.2 presents a synthetic but comprehensive description of the evolution of decentralization in Italy. This analysis is helpful to put in the right perspective the links between the growth of public sector and decentralization in the specific case of Italy. An analysis of potential tools to impose fiscal discipline is also provided. After a brief description of the Italian health care system, the decentralization of health responsibilities at a regional level and the relevant literature on the determinants of regional health expenditure, Sect. 17.3 illustrates the empirical framework for the investigation of the impact of political competition on health expenditure and describes the dataset. Section 17.4 discusses the estimation results. Finally, Sect. 17.5 concludes.

17.2 The Fiscal Discipline of the Intergovernmental Relations in Italy

17.2.1 The Italian State as a Unitary State

The Italian state was born in the second half of the XIX century through the unification of several existing states, under the monarchs of Piedmont. The founding fathers did not accept the scholars' proposal to adopt the model of a federation. Because of too many differences among institutions, laws, economies, customs and languages,[4] they believed that the model of a unitary state was necessary for nation building.

The organization of the State replicated the model of Piedmont, which, on turn, followed that of Napoleon's France. It included three levels of government: central, provincial, and municipal. This structure stayed in place until the endorsement of the Constitution of the Republic in 1948. The Constitution introduced a fourth level of government—the regional one—immediately subordinate to the central level. Five regions (Valle d'Aosta, Trentino Alto Adige, Friuli Venezia Giulia, Sardinia, and Sicily) obtained a special autonomy.

Functions related to the administration of local public services were assigned to provinces and municipalities, which had little power to actually rule the matter. The State retained most of the power: it decided which services local authorities had to provide, and which services they could discretionally decide to provide. At the end of the XIX century ruling classes shared the worry that socialist run municipalities would pursue redistribution policies. However, in the XX century many services provided by private companies through concessions passed to municipalities.

Consumption taxes on a great variety of goods were the main feature of municipal finance. They survived for more than a century, though they were modified several times.[5] In accordance with the *zeitgeist* of the time, the State did not have redistribution functions, for a long time; hence, there were not redistribution transfers in favour of the areas with a lower per capita tax contribution capacity. However, an implicit redistribution policy did take place as local authorities of poorer areas were allowed to run deficits and to accumulate debt.

Italian municipalities always complained about the scarcity of resources available as opposed to their tasks. They also complained about the fact that the State transferred them national tasks, especially at times of financial crises. Sometimes, their pressure led to the transfer back to the centre of some of these tasks.

Financial discipline was achieved through traditional instruments such as declaration of difficulties, national control, and the electoral mechanism. The electoral mechanism, however, was distorted for a long time as there were limits (linked to sex, social status and education) to the right to vote; thus, the institutions redistributing the fiscal burden did not represent lower classes.[6]

[4]At that time, lower classes of some areas did not know Italian and spoke only dialects.

[5]Revenue also derived from a tax on family income and the possibility to add, next to the national tax, a tax on income from land and buildings. This rule applied also to provinces and it represented the main source of tax return.

[6]In the South the percentage of people entitled to vote was half compared to Northeast. Only in 1912 universal suffrage was extended to the male population, and in 1946 also to the female population.

17.2.2 Intergovernmental Relations in the First and Second Post-war Periods

The upheaval in intergovernmental financial relations that followed WW1 led to their radical reform. The State centralized various tasks previously delegated to local authorities—especially concerning education—and normalized the tax system leading to the reduction of income. Local per capita expenditure, which in 1912 amounted to 1/3 of the national one, declined to less than 16%. The central commission for local finance (*CCFL—Commissione Centrale per la Finanza Locale*), which used to have only an advisory role, played an important part by intervening on the budget of each institution, reducing their expenditures and/or increasing their fiscal income.

During the WW2 and the post-war period, local expenditure further decreased.[7] Successively, it started to increase under the nation-wide expectation of good quality local services, supported by the pro-South policies of the national government, and the relaxation of the control system. The CCFL stopped being the guardian of fiscal discipline and became the executive board responsible for the result of the bargaining process between national and local politicians seeking electoral consensus.[8]

Deficit of local budgets were continuously approved and covered with mortgages from the loan institution *Cassa Depositi e Prestiti—CDP*. Debt was financed with further debts as the deficit included interests on previous debts. This strategy caused a long crisis of local finances worsened by the fact that the system of higher municipal tax was expensive[9] and surtaxes on buildings and land had limited contingence sensitivity.[10]

17.2.3 The Reform of 1971: The Introduction of a Derivate Local Finance

The above features explain the reason why, the reform of the Italian fiscal system that took place in the 1960s, focused on the need to regulate intergovernmental financial relations. The idea that expenditure autonomy instead of fiscal autonomy was sufficient to guarantee local autonomy prevailed. However, the Parliament neither approved the bill to reform local finance defined by the commission in charge, nor it accepted the government's proposals. Therefore, within the general reform of the fiscal system of 1971, only a partial reform of local finance took place. The reason was

[7]In 1949 it represented less than 13% of national expenditure.

[8]The right to vote had been extended to the whole population.

[9]In the 1960s the cost of collecting taxes on consumption, as a percentage of the total tax income, corresponded to more than 18%, six times more expensive than the cost to collect the homologous national tax on business.

[10]Tax bases on land and buildings were checked by the land register and were updated with delay and without connection to inflation, also because of the electoral pressure of interested taxpayers.

that the Parliament was still defining the powers of the Regions[11] and their financial relations with local authorities.

An income tax (excluding subordinate work earned income) was introduced to finance sub-national governments.[12] However, the State still collected that income waiting for the reform to be completed. The financing of the regions took place through quotas of national taxes corresponding to the cost of the national functions devolved to them, without introducing tax autonomy. The main local taxes and quotas of national taxes were abolished, ad hoc transfers (to be periodically adjusted) were introduced and Municipalities were given a tax on the increase of the value of buildings. Local authorities running deficits were given further resources as long as they would start programs of budgetary reclaim.

However, the objective to restore local authorities finance through taxes did not succeed: local authorities running deficits did not respect the over mentioned programs and increased in number. The inflation of the 1970's worsened the financial crisis. Thus, in 1977 the State intervened again with a new fiscal reform, which aimed to consider in advance the total needs of local finance. Limits to the increase of local current expenses, smaller than the rate of inflation, were introduced with consequent reduction of expenditure in real terms. Stricter rules about investment expenditures and the related loans came into force. Local authorities (with the exception of smaller municipalities) were not allowed to hire new personnel, and wages had to be approved by the Central Commission. Local taxes and tariffs increased and local authorities, which were legally bound to a balanced budget, could not get recur to debt financing current expenses. The State covered with ad hoc transfers the deficit of those local authorities that did not respect these measures.

These measures had two main pitfalls. The reorganization of local finance was based on the evaluation of financial needs that resulted insufficient when compared to reality. This did not stop negotiations for a favourable treatment; on the contrary, it perpetuated the same problem that it intended to solve. The local authorities that had mismanaged and those that had increased their expenditures beyond the need of their population were rewarded, whereas efficient local authorities were penalized. Local expenditure consolidated through time, with periodical increases to account for inflation.

At the same time, Regions became responsible for the administration of the national health system, though the central level of government fixed the needs according to the amount of services provided within the whole nation also to citizens who did not pay taxes. The taxes collected from companies and workers covered the cost.

[11] It took more than 20 years after their creation to have them implemented.

[12] Successively, the Constitutional Court extended the exclusion to self-employment earned income.

17.2.4 The Strengthening of Tax Autonomy in the 1990s

In the 1990s, the limits connected to the system of controls necessary for effective financial intergovernmental relations lead to the need to give tax authority to sub-national governments. The idea being that voters control on expenditure increase was more efficient than any other instrument. Furthermore, the constraints in the use of transfers prevented sub-national governments from having real expenditure autonomy.

In 1992, a municipal tax on buildings (*Imposta Comunale sugli Immobili—ICI*) was established.[13] Provinces became responsible for some national taxes. Also regions were allowed to raise a tax on productive activities (*Imposta Regionale sulle Attività Produttive—IRAP*) that substituted social contributions and other national taxes charged to companies. They were also entitled to add a surtax on personal income tax (*Imposta sul Reddito delle Persone Fisiche—Irpef*), with a minimum and maximum tax rate allowed.

As a consequence of these reforms, local tax revenue increased from less than 7% of total income in 1978 to 45% in 2002. Over the years the role of this revenue diminished because of the increase of transfers connected to the devolution of new functions on one side, and of the limits to the increase of tax rates on the other side. In 2008, in contrast with the previous measures favouring fiscal federalism, the municipal tax on buildings was abolished to reduce fiscal pressure.

At the beginning of 2000, a wider attempt to reform the regional finance, aiming at introducing fiscal federalism principles, did not succeed in spite of the Parliament's approval. The program planned to transfer to the regions 40% of the financing of the health system (instead of the amount corresponding to their needs). Poorest regions would obtain transfers to partially supplement their per capita tax income compared to the national average.

17.2.5 The Interior Stability Pact

Following the accession to the European Monetary Union and the Stability and Growth Pact, Italy could not overcome the annual limit of 3% of budget deficit for the whole public administration. The objective was that of reaching break even in the long term and of reducing the public debt to 80% of GDP.[14] These obligations required consistent behaviour from sub-national governments.

In 1999, the financial law introduced the Interior Stability Pact (*Patto di Stabilità Interno—PSI*) with the objective of controlling the public financial balances at sub-national level. The inclusion in the pact of ceilings or reductions of public expenditure seems in conflict with the principles of autonomy that the Italian Constitution

[13]There was a common tax rate of 4%, but in 1996 municipalities got the power to increase it (within the ceiling of 7%) and to allow for tax exemptions and tax breaks.

[14]In 1994, public debt reached 121.5% compared to 41% of 1970.

set.[15] Although the structure of the pact was revised many times, its success was limited because of the delay (two years) in the application of the penalties for those governments which did not comply.[16]

17.2.6 The 2001 Constitutional Reform

In 2001, a long political debate on the reform of the constitutional organization of financial intergovernmental relations, aiming at attributing wider administrative and legislative functions to sub-national governments, came to an end. The Constitution set the legislative functions of the State and the competing functions of the state and the regions, leaving to the latter all the matters not explicitly considered. The principle of subsidiarity become active for administrative functions.

As for the means of finance, sub-national governments can rely on their own taxes, as well as on shares of national taxes related to the area under their authority. Governments with lower per capita fiscal capacity become entitled to obtain equalisation transfers without destination constraint to finance all their functions. The reform also introduced extraordinary tools to finance single governments in need but running a deficit is allowed only to finance investment expenditures.

However, this reform has not been completed yet.

The main issues in the implementation of the constitutional reform relate to: the level of equalization the governments entitled to equalization, the relation between the regions and local authorities.[17] To evaluate the adequacy of the resources available to sub-national governments, it is necessary to consider the standard costs related to their functions. The most recent bill proposes to distinguish these functions in two categories: (a) those referring to services related to political and civil rights of citizens (health, education, and assistance); (b) all the others. As for the former category, governments with smaller per capita contributing power must receive redistributing transfers to cover the lack of resources deriving from taxes and other shares. For the other functions, there is a non-complete redistribution of funds.

The distinction of these two categories of functions has been criticized, as it is not based on the constitutional norms regulating redistribution. Other criticisms related to the determination of the regional expenses concerning the second category of functions. The calculation refers to the total amount of the current national transfers for those expenses. These transfers have to be abolished and substituted with new taxes, the average tax rate of which has to be calculated referring to this total amount (neglecting the amount of transfers received by each government/body). As a consequence, for poorer regions, i.e. the southern ones, which at present receive the highest

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[15] The Constitutional Court admitted them only as an extraordinary measure.

[16] Although, there are not official data about the respect of the rules set, in 2006 18% of municipalities, among those that provided information, were not complying with the rules of the Pact.

[17] This part does not take into account the law n. 42 of 2009, which is however not relevant for the empirical analysis in this chapter.

per-capita grants, the reference for redistribution will decrease. Moreover, for these regions per capita fiscal capacity is calculated referring to the national average and not to that of the richest region.

The limits of the planned redistribution system involve also the new national functions that in line with the constitutional reform will be devolved to the sub-national levels of government. These functions will be financed according to the rules mentioned above. As a result, the poorer regions, where now public services are financed by the state, will have to increase fiscal pressure to maintain the current level of services, or will have to accept a lower level of services. Local authorities criticise the present bill because of their subordination to regions and the reduction of their autonomy.

To ensure the respect of the EU regulation, a special technical body, composed by members of the various levels of government, will control the fiscal discipline of intergovernmental relations. The system envisages rewards for the efficient governments and penalties for those who do not respect the rules.[18]

17.2.7 The Tools to Impose Fiscal Discipline: Electoral Mechanism, Control and Bail-Out

Two objectives are behind the reforms of intergovernmental relations that have been taking place in Italy since the 90s. First, to increase collective welfare by expanding the autonomy of sub-national governments; in this way, the supply of public services can better respond to citizens' demand, taking into account local peculiarities. Second, to limit the continuous increase of public expenditure and debt burden by increasing administrators' responsibilities through the attribution to the local governments of taxing powers (in place of national transfers), in order to foster electoral control of the taxpayers.

The second objective has been widely debated. It has been argued that, to make sub-national governments fully responsible, taxes have to finance expenditure. In fact national transfers may induce the receivers to reduce taxes and to an inefficient management of transferred resources. Actually, this may be true for those subordinate governments that finance their activities first through taxes and, successively, using national transfers. However, if the framework is characterized by a derivate finance, as it is the case in Italy, the attribution of a higher degree of tax autonomy can stimulate administrators' efficiency. In fact, taxes (introduced because of the higher degree of autonomy), instead of national transfers, influence administrators' choices. Administrators have to choose whether to maintain the same degree of expenditure and services offered asking for new taxes, or to curtail the level of expenditure through better administration, which reduces pressure on taxpayers. Transfers, though reduced, are fix assets in their budgets; decisions relates only to taxes.

[18]Penalties include the automatic increase of tax rates, the impossibility to enrol personnel or to make discretionary expenses, as well as penalties for governmental or administrative bodies.

The Italian experience, as in other countries, has led to doubt the efficacy of the electoral mechanism as a tool to control fiscal discipline of intergovernmental relations. The literature has highlighted some aspects of the problem. Sub-national governments violating the discipline can get support from the central government, especially when on both levels the same parties or coalition are in charge. Bail-out reduces, if not eliminates, the negative effects of bad administration on taxpayers and then on political consensus.

In Italy, the electoral mechanism showed a further limit. In the poorer regions with slower development public expenditure represents a tool to get consensus; it allows the creation of assisted electoral clienteles to realize electoral exchange: public favours for political support. Electors consider these favours within a framework where there are few chances of earning through the market, and political support is useful to enter the public administration and have a career there (and sometimes also within private companies benefiting from public financing), and they do not consider the negative effect on the quality of public administration. In several cases of regional or municipal elections, administrations running deficits or providing poor-quality services, were re-elected from voters thanks to the nepotistic policies.

For electoral mechanism to function properly taxpayers-voters must have information about the relation between services quality and the responsibility of those providing them on the one side. On the other side, they must have information about the connection between tax load and the body imposing taxes. Apart from the cases of fiscal illusion that hide the real tax burden, it is worth highlighting that some forms of local tax collection may induce the taxpayers to interpret them as state taxes. However, when more governments of different levels are responsible for the provision of a public service, e.g. health, it is difficult for taxpayers to understand who is responsible in case of bad administration of the service.

17.2.8 The Role of the Market

The market is an additional instrument to promote fiscal discipline. First, in the capital market, sub-national governments can get funds to finance investments.[19] Local authorities can use derivatives to substitute existing debts, with initial gains

[19]It is still unclear how to define investment expenditures: wide definitions allow for inefficient behaviour, but strict definitions risk limiting investments in human resources. In the past, sub-national governments used to finance also current expenditure through debts, but now the Constitution forbids it. This prohibition, however, can be eluded, though temporarily, delaying the payment to firms providing goods and services to public administrations. Thus, governments with financial problems have highly increased their debt load for current expenditures especially in the health sector. Their difficulties have worsened and they have exerted strong pressure to get help from higher levels of government, worried about the spread of financial problems among firms for which public administrations are the main, if not unique, client. Another form of elusion of this prohibition results from the negative impact of disputes with creditor firms or employees about wage increases, which generate further costs.

from interests to be used for current expenditures. However, the state has disciplined this issue also because of the crisis that has characterized the market of these products.

Second, the market can also play an important role in imposing fiscal discipline to the provision of local public services whose costs are covered through tariffs paid by users. These services are often supplied within a natural monopoly and local authorities tend to neglect an efficient management, increasing the amount of employees for nepotistic reasons without introducing technological innovations. When private companies provide these services through concessions, the possibility to use tariffs to cover administrative inefficiencies does not stimulate public expenditure control. In this framework competition *in* the market cannot exist, but it is possible to have competition *for* the market, by imposing limits to the direct administration (in house) of services and introducing calls for tenders to assign the concessions.

In Italy, a reform following this line has been introduced, but it is not being implemented because of the resistance of local authorities and some political parties (belonging also to the majority). Local authorities want to keep control over public bodies, as this is a tool to obtain electoral consensus. Parties believe that in some cases, like water management, provision from a private firm, although regulated and under public control, does not respond to public interest.

17.3 Empirical Findings

17.3.1 The Decentralization of the Italian NHS

Italy has a National Health Service (NHS)—*Servizio Sanitario Nazionale, SSN*—which was established in 1978 to replace the previous system of health insurance funds. It provides all citizens and legal residents with comprehensive care throughout the country.[20] For a long time, the system has been characterized by inappropriate incentives to foster expenditure control given that spending responsibilities were allocated to regional governments while the financing was to be guaranteed by the State through centrally assigned budgets. This situation caused systematic expenditure overruns, resulting in frequent deficits that were covered *ex-post* by the national government, without imposing any credible sanction to the overspending regions.

In the 1990s, the need to curb spending so as to meet the Maastricht criteria has led to undertake a set of reforms with the threefold aim of introducing managerialism within the health system, creating an internal market for health services and increas-

[20]The SSN was originally organized on the basis of a strictly vertical three tier structure of government: central (Ministry of Health), regional (20 Regional Health Authorities, RHAs) and local (local health agencies, *Unità Sanitarie Locali*, USL). A National Health Fund (*Fondo Sanitario Nazionale*, FSN) was created and financed mainly from general taxation, employer and employee payroll contributions, and a health tax levied on self-employed. The latter was determined annually by the central government and allocated up to down.

ing the autonomy of regions in both the financing and delivery of health care. The devolution of political powers to regional governments was further strengthen with the 2001 Constitutional reform. The new article 117 reserves the State the exclusive right to determine "the essential levels of services concerning civil and social rights that must be guaranteed on the whole national territory" and introduces safeguard of health amongst the subjects concerning concurrent legislation between State and regions. As a result, health care responsibilities are shared between the State, which set the general objectives of health policies through the National Plan and defines the basic health benefit package (*Livelli Essenziali di Assistenza*, LEA)[21] to be provided uniformly across the country, and regions, which are in charge of guaranteeing the provision of LEAs but are also free to administer and organize the supply in accordance with their population needs.[22]

Parallel to the devolution process, the introduction of fiscal federalism resulted in an alignment between funding and spending powers, making regions financially accountable for any health deficit they incur by allowing them to raise local taxes (to a limited extent) and to introduce cost-sharing on drugs and services.[23] Starting from 2001, the National Health Fund is formally abolished and regional funds come from a regionally collected tax on productive activities (*Imposta Regionale sulle Attività Produttive*, IRAP), a regional share and surcharge of the centrally administered personal income tax (*Imposta Personale sul Reddito*, IRPEF), and a set amount of the per litre petrol excise. To pursue equity principles, an inter-regional equalisation mechanism (*Fondo di Perequazione Nazionale*, FPN), financed by a fixed proportion of the national VAT revenue, had to be developed to transfer funds to those regions unable to raise sufficient resources to meet population health care needs.[24]

As a consequence of all these reforms, regions have used their autonomy to introduce different organizational models of health care. Moreover, the increased decentralization and reliance on regional sources of finance has even exacerbated the interregional divergences in both funding and spending on health care.

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[21] LEA covers all medical care considered to be necessary, appropriate, and cost-effective.

[22] An overview of the Italian health care system, which includes the debate on the regional responsibilities is provided by France et al. (2005) and Ferrè et al. (2014).

[23] For further details on the Italian health care financing system, see Bordignon et al. (2002).

[24] The amount of funds transferred to or received from the FPN had to be determined according to a complex formula, allowing for the fiscal capacity of a region, its population size and age composition, its historic expenditure on health care, the size and the specific characteristics of its territory.

17.3.2 *The Determinants of Regional Health Expenditure: A Survey of Previous Empirical Literature*

A large literature has investigated the determinants of health expenditure in single countries with either a federal system (e.g. USA, Canada and Switzerland) or multiple autonomous jurisdictions (e.g. Spain and Italy).

Compared to the vast array of cross-country studies, within-country analyses allow reducing part of the existing heterogeneity across countries attributable to differences in the extent of health converge and internal design.

Following the ongoing international debate, most papers have focused on estimating the relationship between income and within-country public per capita health expenditure. As far as developed countries are concerned, empirical evidence supports the conclusion that health care is a necessary good in the short run[25] though it cannot be completely rejected the hypothesis of being a luxury good in the long run (Blazquez-Fernandez et al. 2014). Furthermore, it has been shown that dynamic adjustments in the models substantially lower income elasticities (Bilgel and Tran 2013) and that international income elasticities are generally larger than national or regional ones (Di Matteo 2003).

Apart from income, ageing population and structural characteristics of health care supply relating to economies of scale (number of beds per hospital) and productivity (the number of personnel per hospital) have also proved to be relevant drivers of regional per capita health expenditure both in Italy (Giannoni and Hitiris 2002) and in Spain (Cantarero 2005). Along with these determinants, health care technology significantly drives expenditures, especially in the USA (Murthy and Okunade 2016).

However, the role played by income and demographic variables in explaining health care expenditure of sub-levels of government has been questioned. Using US state-level and Canadian province-level data, Di Matteo (2005) shows that ageing population distributions and income explain a relatively small portion of health expenditures when a time trend variable, as a proxy for technological change, is added to the model. Crivelli et al. (2005) find that cantonal per capita socialized health expenditure in Switzerland seems to be income independent, because of the fixed package of health care benefits offered to all residents.

The decentralization framework does seem to be important in estimating health expenditure. Costa-Font and Rico (2006) conclude that devolution in Spain has not widen interregional inequalities in health expenditure but fiscally accountable Autonomous Communities exhibit a higher per capita health expenditure, once controlling for other determinants. By applying a multilevel hierarchical model to a unique sample of 110 regions in eight OECD countries in 1997, Lopez-Casasnovas and Saez (2007) find that, when there is decentralization, policies aimed at emulating diversity tend to increase national health care expenditure. Moreover, without fiscal decentralization, central monitoring of finance tends to reduce regional diver-

[25] For Italy: Fedeli (2015); for Canada: Di Matteo and Di Matteo (1998) and Ariste and Carr (2001); for USA: Freeman (2003), Moscone and Tosetti (2010) and Wang (2009); for Spain: Costa-Font and Pons-Novell (2007),

sity and therefore decreases national health expenditure. Similarly, Cantarero Prieto and Lago-Peñas (2012) assume that whenever the central government commitment toward fiscal equalization is strong and/or public health expenditure is financed by specific grants, the regional income elasticity of public health expenditure is lower. Consistently, they find that regional GDP growth is translated into more health care expenditure only in those Spanish regions enjoying higher tax autonomy. More recently, attention has been devoted to examine the impact of decentralization on the composition of public expenditures within a single country, finding that decentralization lower the share of investments in human capital, among which is health (for Italy: Grisorio and Prota 2015a, b).

Continuous developments in spatial econometric modelling have allowed to test the relationship between spatial effects and sub-national health expenditures. Evidence of spatial interactions between neighbouring Spanish regions in spending decisions is found by Costa-Font and Moscone (2008) as well as by Costa-Font et al. (2009). In Italy, Atella et al. (2014) find that the nature of the institutional connections between jurisdictions may significantly affect spatial spillovers, which, on their turn, affect health expenditures of Italian local health units.

Few papers have specifically taken into account the public budget mechanisms used to finance regional health care. For the Italian case, Levaggi and Zanola (2003) empirically demonstrate an asymmetry in the response to intergovernmental grants: local expenditure is highly responsive to increases in grants-in-aid from central government, but it is relatively insensitive to grants reduction (a "flypaper effect"). Furthermore, the introduction of a soft-budget constraint hypothesis results in a stronger effect of grants and a lower response of own resources which indicates that, before reducing expenditure, regional governments prefer to incur in some deficit. Bordignon and Turati (2009) contribute to the literature on soft budget constraints, by showing that the link between ex-ante funding and expenditure is stronger when regional expectations of future bailing out are lower. Moreover, they show that during the 1990s more autonomous Italian regions had lower expectations for future bailing out and that a political "alignment effect" existed, with regions ruled by politically "friendly" governments reducing health expenditure more than those run by "unfriendly" ones.[26]

Political factors (i.e. partisan ideology and electoral cycles) have proved to exert an influence on public health care decision-making at a sub-national level. As for Spain, Costa-Font and Pons-Novell (2007) find evidence suggesting that decentralization and the political ideology of the incumbent parties running the health system of the Autonomous Communities—in a context characterized by some inter-jurisdictional competition—may foster mechanisms leading towards the expansion of health care expenditure. On the same line, Costa-Font and Moscone (2008) stresses the need to consider the interaction between ideology and income. Indeed, regional left-wing incumbents raise public health expenditure in relatively richer regions, which is in part due to the increasing competition with the private sector in such areas. On the

[26] Solé-Ollé and Sorribas-Navarro (2008) provide empirical support for the impact of partisan alignment in the allocation of intergovernmental transfers in Spain in the decade 1993–2003.

opposite, a recent work by Stolfi and Hallerberg (2016) finds that political budget cycles are a particularly relevant issue in less developed Italian regions, leading to excessive health personnel spending. Finally, examining the determinants of the public-private balance of health care expenditures in Canada, Di Matteo (2009) finds that provinces governed by centre-left parties are associated with lower public shares in the physician and other health professional categories.

17.3.3 Empirical Strategy

In this Section we illustrate the proposed models and our empirical strategy.

(a) *Median voter health expenditure*

The starting point of our model is the level of per capita public health expenditure desired by the median voter. Following the previously described literature, this is assumed to be a linear function of real per capita income, the proportion of population aged 65 and over, supply variables and real per capita national transfer revenue to regions.[27] Therefore, the estimated model can be written as:

$$EXP_{it}^{V} = \beta_1 + \beta_2 P_{GDP_{it}} + \beta_3 OLD_{it} + \beta_4 F\_TRA_{it-1} + \beta_5 HB_{it} + \beta_6 PH_{it} + u_{it} \tag{17.1}$$

where the subscript *it* refers to region *i* in year *t*, *EXP* measures per capita public health expenditure at a regional level, *P_GDP* is per capita gross domestic product as a proxy of the median voter income; *F_TRA* indicates per capita intergovernmental grants; *OLD* is the percentage of population aged 65 and over; *HB* designates the number of hospital beds per 1000 inhabitants; *PH* is the number of physicians per 1000 inhabitants and u_{it} is the disturbance term.

(b) *Quality of public health services*

The above model assumes that the median voter is only interested in the level of public health expenditure and not also in the quality of the health services provided. If this is not the case, it might be that the median voter is willing to pay a higher price for better quality services. Therefore, Eq. (17.1) would become:

$$EXP_{it}^{*V} = EXP_{it}^{V} + \tau QUAL_{it-1} + \varphi PRIV\_EXP_{it} \tag{17.2}$$

This expression states that if the previous year quality of regional health services ($QUAL_{it-1}$) was high, the median voter is expected to pay for a fraction τ of it during the following year. It is also assumed that the quality of health services affects the level of private expenditure (*PRIV_EXP*).

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[27] Levaggi and Zanola (2003) take into account also private health expenditure as an independent variable to investigate the relationship between it and public spending.

(c) *Regional government target level of health expenditure*

We assume that each regional government pursues a target level of health expenditure, measured in per capita terms, which is generally higher than the one preferred by the median voter. The difference between the two levels depends on a portion λ (positive) of the regional per capita imbalance between target and actual per capita health expenditure in the previous year:

$$EXP_{it}^{T} = EXP_{it}^{V} + \lambda\, IMB_{it-1} \tag{17.3}$$

The regional per capita imbalance in year $t-1$ is given by the difference between health expenditure, grants from the central government (*F_TRA*) and locally raised revenue (*L_REV* = taxes and co-payments) in that year, all expressed in per capita terms:

$$IMB_{it-1} = EXP_{it-1} - F\_TRA_{it-1} - L\_REV_{it-1} \tag{17.4}$$

Rules of financing regional health expenditure in Italy have changed repeatedly during over time. In general terms, the share of regional financing through local taxes and co-payments has grown considerably. Therefore, considering the lagged level of regional deficit allows avoiding a potential overestimate of the marginal effect of this variable in the first period when regions received funds for health care only through grants-in-aid. Furthermore, this partial adjustment model accounts for the dynamic behaviour of budgetary decisions.

(d) *Effect of party competition*

Following Solé-Ollé (2006), we make two different hypotheses about the behaviour of politicians/parties: namely the *Leviathan* and the *Partisan* ones. Under the former hypothesis, it is assumed that the regional government, which acts as a power-maximizing agent, selects a target level of public health expenditure that is always higher than the one desired by the median voter. Under the *Partisan* hypothesis, the target level of public health expenditure depends on the party ideology about the public sector size. Therefore, it is predicted that a left-wing regional government will select a target level that is higher than the one preferred by the median voter. The opposite will happen in the case of a right-wing regional government. Under both hypotheses, however, the target level of public health expenditure is influenced by political competition.

In the literature, different ways of measuring the degree of party competition have been provided. One of the most used is the electoral margin obtained by the incumbent in the last round of voting (Tucker 1982; Boyne 1994). Following this approach, we measure the degree of political competition as the percentage of votes won by the actual party with the (relative) majority in the last election held (*P_COMP*): the higher (lower) this percentage, the lower (higher) the degree of political competition. In the Leviathan model (5), P_COMP is supposed to have a negative effect on expenditure growth, since a smaller electoral support for the majority party in power (suggesting more fragmentation and competition in the political arena) induces it to fulfil the level of expenditure wanted by the median voter. On the opposite, the *Partisan* model (6) predicts that increased competition reduces the level of public health expenditure for left-wing governments and increases it for right-wing ones.

Leviathan model

$$EXP_{it}^{T} = EXP_{it}^{V} + \lambda IMB_{it-1} + \partial P\_COMP_{it} \tag{17.5}$$

Partisan model

$$\begin{aligned} EXP_{it}^{T} = EXP_{it}^{V} + \lambda IMB_{it-1} + \partial P\_COMP_{it} + \xi LEFT_{it} \\ + \rho P\_COMP_{it} * LEFT_{it} \end{aligned} \tag{17.6}$$

An interesting aspect is given by the ability of voters to clearly identify the political responsibilities. In a proportional electoral system, with coalition governments, it might be difficult for the voter to assign political responsibilities for expenditure levels different from the desired ones (Powell and Whitten 1993; Anderson 1995). In such a case, political competition becomes less effective in restraining expenditure since coalition governments are less prompted to pursue the interests of voters (Solé-Ollé 2006).

In the 1990s, Italian regions have undertaken electoral and government system reforms, which have led to the direct election of the president.[28] In this context, it is easier for the voter to identify the political responsibility of each government choice. To account for this institutional change, the previous Leviathan and Partisan models are amended as follows:

Leviathan model

$$EXP_{it}^{T} = EXP_{it}^{V} + \mu MAJ_{it} + \lambda IMB_{it-1} + \partial P\_COMP_{it} \tag{17.7}$$

Partisan model

$$\begin{aligned} EXP_{it}^{T} = EXP_{it}^{V} + \mu MAJ_{it} + \lambda IMB_{it-1} + \partial P\_COMP_{it} + \xi LEFT_{it} \\ + \rho P\_COMP_{it} * LEFT_{it} \end{aligned} \tag{17.8}$$

where MAJ is a dummy variable which assumes value equal to 1 in the years in which the majority rule applies and 0 otherwise.

[28] This reform has not been implemented simultaneously in each region but in different years, according to regional constitutions.

(e) *Special interest politics*

If the government is interested not only in the target level of expenditure but also in the spending composition so as to favour lobbies, Eq. (17.2) can be transformed into:

$$EXP_{it}^{T} = EXP_{it}^{V} + \eta LOB + \lambda IMB_{it-1} \tag{17.9}$$

where η is expected to be positive and LOB is the ratio between public expenditure for private specialist and pharmaceutical care and total public health care expenditure.

17.3.4 Data

The data set employed in this study consists of a sample of cross-sectional and time series observations for the 19 Italian administrative regions.[29] Available information comes from several sources and covers the period 1989–2003. However, in the estimation process, only data for the period 1990–2003 are used as one year is needed to create the lagged variables. Therefore, the final simple results in 266 observations for 14 years. A detailed description of the variables used in the analysis, together with their summary statistics, is reported in Table 17.1.

Many of them do not require further explanations since their inclusion is standard in the literature on the determinants of regional health expenditure. Monetary variables are all expressed in real per capita terms, at 1995 constant prices. As a proxy of the average quality of public health services (*QUAL*) we use the interregional patient mobility. We assume that whenever a region has a positive financial balance from patient mobility, the quality of its public health care services is higher than the national average.[30]

The variable *P_COMP* measures the political competition, which results from the fragmentation of the government coalition. It has been already mentioned that this variable is computed as the electoral percentage support obtained in the last election by the incumbent party having the majority of votes. As this percentage decreases, the leading party reduces its political influence and the political scenario becomes more fragmented; thus, competition between parties increases. The opposite has also been assumed to be true.

As a proxy for special interest expenditure, we assume the ratio between public expenditure for private specialist and pharmaceutical care and total public health care expenditure (*LOB*). To account for the effect of rounds of voting on public health expenditure, the variable *E_YEAR* is added which assumes value 1 in the years of regional elections and 0 otherwise. Finally, a standard linear time trend

[29] We exclude Trentino Alto Adige, an autonomous region where the responsibility of public health care is devolved at a provincial level.

[30] In Italy, citizens have free choice of the region in which to obtain health care. Regions of residence financially cover their patients' mobility.

Table 17.1 Definition and summary statistics of the variables employed in the analysis

Variable	Meaning	Data source(s)	Mean	Standard deviation	Minimum	Maximum
EXP	Real per capita regional public health expenditure	Ministry of Health	995.04	135.22	708.20	1342.18
P_GDP	Real per capita GDP	ISTAT, Regional Accounts	16,232.54	4194.35	8901.36	24,145.34
OLD	Percentage of population aged 65 and over	ISTAT, Regional Accounts	17.94	3.19	10.82	26.18
F_TRA	Real per capita national transfers to regions	SANITEIA and ISTAT (Regional Accounts)	930.11	147.41	623.64	1358.29
HB	Regional number of hospital beds per 1000 inhab.	ISTAT, Italian Statistical Yearbook	5.70	1.32	3.03	9.04
PH	Regional number of physicians per 1000 inhab.	ISTAT, Italian Statistical Yearbook	6.67	1.29	3.30	14.44
QUAL	Dummy variable for regions with a strictly positive financial patient mobility balance	Ministry of Health	0.40	0.49	0.00	1.00
PRIV_EXP	Real per capita private (household) health expenditure	ISTAT (Regional Accounts)	283.80	74.56	136.15	443.75
IMB	Real per capita regional deficit	Ministry of Health	161.29	222.72	−396.43	1379.98
P_COMP	Electoral percentage obtained by the incumbent at the last election held	Istituto Cattaneo	34.65	8.81	17.00	47.20
LEFT	Dummy variable for regions with a left party in power	Istituto Cattaneo	0.40	0.49	0.00	1.00
MAJ	Dummy variable equal to 1 when regional elections are based on the majority rule	Istituto Cattaneo	0.58	0.49	0.00	1.00
LOB	Ratio of regional private expenditure for specialist and pharmaceutical care on total regional public expenditure	Ministry of Health	0.15	0.04	0.08	0.31
E_YEAR	Dummy variable for electoral years (regional elections)	Istituto Cattaneo	0.21	0.41	0.00	1.00

Note all monetary values are expressed in Euros, at 1995 prices variable is included in the model to capture health sector price growth. As for the estimation methodology, we follow the previous literature that assumes poolability of the data and linearity of the functional form. There are mainly two econometric approaches for analyzing the proposed models: the panel data approach (including pooled OLS, GLS random effects and panel fixed effects), and the cross-sectionally heteroskedastic and timewise autoregressive model, also known as the Parks-Kmenta approach.[31] Given the short time period considered in this analysis, previous literature suggests to employ GLS random effects (Bordignon et al. 2002).

17.4 Empirical Estimates and Discussion

In this Section we report the results of the models illustrated previously. Table 17.2 shows the estimation results of models (1) and (2). These are generally in line with previous expectations. According to the existing literature, a positive sign should be expected for the variable measuring the effect of per capita income in model (1). With regard to the aged population variable, a positive effect is expected in both models: all other things being equal, an increase in the regional proportion of population aged 65 and over is likely to determine an increase in regional per capita public health expenditure. The variable for the quality of services (column 2) has a rather strong and significant impact on health expenditure and indicates the existence of a substitution effect between public and private health care.

Table 17.3 illustrates the estimation results for the effect of party competition in both the Leviathan and Partisan models. We adopt the prudential approach of testing the model by introducing one political variable at a time. Therefore, the comparison between columns one and two indicates the impact of political competition. In column three, the dummy variable for the effect of the institutional transition to a majority system for regional election is inserted. The purpose is that of verifying whether this variable has an influence on the containment of public health expenditure due to a more visible responsibility of the winning party (or coalition). Column four shows the impact of the regional electoral year on public health expenditure, testing the possibility of a strategic use of deficit by the incumbent government. Column five reports the estimation results for the Partisan model.

As expected, results from column two show a negative impact of political competition/fragmentation on the health expenditure variable in the Leviathan model. That is, when political competition increases, the regional government target level approaches the level desired by the median voter. On the contrary, for lower levels of political competition, the government target level is higher than the median voter spending level.

Interestingly, the introduction of the majority system variable has a negative but not significant impact on regional public health expenditure. Similarly, the variable related to the election year is not statistically significant. Finally, in the Partisan

[31] See Greene (2003).

Table 17.2 Baseline median voter expenditure

Independent variable: EXP, in Euros at 1995 prices
Functional form: linear
Estimation period: 1990–2003
Estimator: GLS random effects

Variable		(1)	(1.1)
		EXP	EXP*
Constant		234.345***	291.897***
		(45.483)	(45.031)
P_GDP		0.007***	0.009***
		(0.002)	(0.002)
OLD		3.072	4.245**
		(1.906)	(2.000)
$F\_TRA_{(t-1)}$		0.451***	0.469***
		(0.034)	(0.032)
HB		15.907***	6.314
		(3.668)	(3.963)
PH		−0.808	−0.648
		(2.486)	(2.347)
QUAL			26.658***
			(7.047)
PRIV_EXP			−0.283***
			(0.079)
TREND		127.945***	113.397***
		(8.415)	(9.327)
R^2	*Within*	0.9047	0.9152
	Between	0.8422	0.8304
	Overall	0.8836	0.8892
Breusch-Pagan LM[(1)]		225.52***	247.76***
Observations		266	266
Number of regions		19	19

(1) Breusch-Pagan = Breusch-Pagan test OLS versus random effects

Notes White heteroskedasticity-consistent standard errors are reported in parentheses

***, ** and * denote significance at 1, 5 and 10% levels, respectively

Table 17.3 Government target expenditure and political competition

Independent variable: EXP, in Euros at 1995 prices
Functional form: linear
Estimation period: 1990–2003
Estimator: GLS random effects

	(1)	(2)	(3)	(4)	(5)
	EXP	EXP	EXP	EXP	EXP
Constant	205.072***	235.399***	243.452***	204.220***	208.637***
	(44.946)	(46.510)	(47.418)	(45.017)	(43.187)
Median voter expenditure					
P_GDP	0.006***	0.006***	0.006***	0.006***	0.006***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
OLD	4.922***	4.756***	5.548***	4.979***	4.813**
	(1.778)	(1.777)	(1.880)	(1.823)	(1.828)
$F\_TRA_{(t-1)}$	0.459***	0.460***	0.454***	0.460***	0.460***
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
HB	16.057***	18.834***	16.901***	16.157***	16.188***
	(3.575)	(3.576)	(3.916)	(3.583)	(3.404)
PH	−2.632	−3.655	−3.406	−2.802	−2.417
	(2.421)	(2.454)	(2.437)	(2.461)	(2.323)
TREND	125.124***	121.566***	122.077***	125.094***	124.187***
	(8.308)	(8.268)	(8.249)	(8.322)	(8.311)
Political variables					
$IMB_{(t-1)}$	0.051***	0.052***	0.052***	0.051***	0.051***
	(0.017)	(0.017)	(0.017)	(0.017)	(0.017)
P_COMP		−1.068***	−1.169***		1.031
		(0.341)	(0.353)		(0.917)
MAJ			−9.059		
			(6.703)		
E_YEAR				1.798	
				(6.643)	
LEFT					0.190
					(0.124)

(continued)

Table 17.3 (continued)

Independent variable: EXP, in Euros at 1995 prices
Functional form: linear
Estimation period: 1990–2003
Estimator: GLS random effects

		(1)	(2)	(3)	(4)	(5)
		EXP	EXP	EXP	EXP	EXP
P_COMP*LEFT						−1.171
						(0.727)
R^2	*Within*	0.9099	0.9117	0.9163	0.9117	0.9207
	Between	0.8534	0.8551	0.8412	0.8505	0.8591
	Overall	0.8912	0.8930	0.8919	0.8909	0.8903
Observations		266	266	266	266	266
Number of regions		19	19	19	19	19

Notes White heteroskedasticity-consistent standard errors are reported in parentheses
***, ** and * denote significance at 1, 5 and 10% levels, respectively

model, where different ideological positions exist, political competition does not show a significant effect, although the sign of the variable is positive. Also the variables LEFT and the interaction term seem do not extend a significant role on budget outcome.

Concerning the impact of quality (Table 17.4), results remain basically unchanged. Looking at the marginal effects of political competition and financial imbalance, these variables appear to have a more modest effect on regional public health expenditure than in previous estimates. This suggests that quality may be used by the electorate as an indirect (low-power) tool to control public expenditure.

In Table 17.5, column three confirms that interest groups exert a significantly positive influence on public health expenditure at a regional level. The variable for political competition (computed as the percentage of votes over the total) continues to show a negative sign. An interesting result is that of quality. By comparing columns one and two, it appears that whenever quality is evaluated by the voters, the influence of interest groups on public health expenditure is lower.

17.5 Concluding Remarks

This chapter offers some intriguing insights on the effects of political economic aspects on public health expenditure, regarding the Italian fiscal federalism context. Following the work by Solé-Ollé (2006), we make different hypotheses concerning the behaviour of politicians/parties as well as the role of party ideology and political competition in the size of regional public health expenditure. By testing empirically our theoretical models, we provide evidence that political competition—or fragmen-

Table 17.4 Government target expenditure and political competition when quality matters

Independent variable: EXP, in Euros at 1995 prices
Functional form: linear
Estimation period: 1990–2003
Estimator: GLS random effects

	(1)	(2)	(3)	(4)	(5)
	EXP*	EXP*	EXP*	EXP*	EXP*
Constant	259.152***	286.699***	284.142***	259.230***	257.271***
	(42.489)	(43.026)	(43.994)	(42.590)	(41.371)
Median voter expenditure					
P_GDP	0.009***	0.009***	0.010***	0.009***	0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
OLD	5.492***	5.593***	5.243***	5.625***	5.513***
	(1.645)	(1.575)	(1.665)	(1.700)	(1.591)
$F\_TRA_{(t-1)}$	0.480***	0.484***	0.492***	0.480***	0.497***
	(0.033)	(0.034)	(0.035)	(0.034)	(0.035)
HB	7.204*	9.561***	10.516***	7.194*	8.003**
	(3.791)	(3.615)	(3.753)	(3.817)	(3.718)
PH	−1.840	−2.584	−2.629	−2.080	−2.218
	(2.242)	(2.219)	(2.199)	(2.283)	(2.549)
TREND	111.135***	105.220***	102.622***	111.179***	109.728***
	(9.237)	(9.374)	(9.879)	(9.297)	(9.257)
Quality of public expenditure					
QUAL	23.217***	20.815***	21.095***	23.733***	21.575***
	(6.809)	(6.380)	(6.369)	(6.788)	(6.848)
PRIV_EXP	−0.267***	−0.300***	−0.346***	−0.268***	−0.261***
	(0.075)	(0.076)	(0.092)	(0.076)	(0.074)
Political variables					
$IMB_{(t-1)}$	0.047***	0.049***	0.049***	0.047***	0.048***
	(0.018)	(0.018)	(0.019)	(0.018)	(0.019)
P_COMP		−1.100***	−1.068***		0.973
		(0.333)	(0.336)		(0.820)
MAJ			7.958		
			(7.936)		
E_YEAR				1.213	

(continued)

Table 17.4 (continued)

Independent variable: EXP, in Euros at 1995 prices
Functional form: linear
Estimation period: 1990–2003
Estimator: GLS random effects

		(1)	(2)	(3)	(4)	(5)
		EXP*	EXP*	EXP*	EXP*	EXP*
					(6.277)	
LEFT						0.076
						(0.041)
P_COMP*LEFT						−1.273
						(0.706)
R^2	*Within*	0.9123	0.9169	0.9123	0.9123	0.9121
	Between	0.8560	0.8420	0.8513	0.8514	0.8595
	Overall	0.8930	0.8919	0.8909	0.8910	0.8937
Observations		266	266	266	266	266
Number of regions		19	19	19	19	19

Notes White heteroskedasticity-consistent standard errors are reported in parentheses
***, ** and * denote significance at 1, 5 and 10% levels, respectively

Table 17.5 Government target expenditure and special interests

Independent variable: EXP, in Euros at 1995 prices
Functional form: linear
Estimation period: 1990–2003
Estimator: GLS random effects

	(1)	(2)	(3)
	EXP	EXP*	EXP*
Constant	177.043***	230.527***	252.417***
	(42.870)	(44.018)	(44.409)
Median voter expenditure			
P_GDP	0.008***	0.010***	0.010***
	(0.002)	(0.002)	(0.002)
OLD	6.211***	6.352***	6.308***
	(1.703)	(1.733)	(1.680)
$F\_TRA_{(t-1)}$	0.395***	0.427***	0.431***
	(0.037)	(0.035)	(0.038)

(continued)

Table 17.5 (continued)

Independent variable: EXP, in Euros at 1995 prices
Functional form: linear
Estimation period: 1990–2003
Estimator: GLS random effects

		(1)	(2)	(3)	
		EXP	EXP*	EXP*	
HB		12.208***	5.507	8.091***	
		(3.541)	(3.718)	(3.087)	
PH		−2.507	−2.409	−3.407	
		(2.427)	(2.284)	(2.301)	
TREND		92.408***	88.540***	81.117***	
		(12.054)	(11.803)	(11.079)	
Quality of public expenditure					
QUAL			24.832***	21.507***	
			(6.827)	(6.721)	
PRIV_EXP			−0.211***	−0.235***	
			(0.077)	(0.080)	
Political variables					
$IMB_{(t-1)}$		0.040**	0.038**	0.039**	
		(0.016)	(0.017)	(0.018)	
LOB		0.903***	0.611***	0.602***	
		(0.137)	(0.149)	(0.151)	
P_COMP				−1.043***	
				(0.329)	
R^2	*Between*	0.9105	0.9207	0.9170	
	Overall	0.8405	0.8406	0.8507	
	Within	0.8887	0.8901	0.8750	
Observations		266	266	266	266
Number of regions		19	19	19	19

Notes White heteroskedasticity-consistent standard errors are reported in parentheses
***, ** and * denote significance at 1, 5 and 10% levels, respectively

tation—may be effective in curbing particularistic policies and, hence, in disciplining health expenditure.

More precisely, as the electoral support for the main incumbent party decreases (thus implying a more fragmented political scenario), regional government's target expenditure tends to approach that of the median voter (especially under the Leviathan hypothesis). Concerning the importance of the voting system, we find that the introduction of the majority system for the election of the regional government has a negative but not significant impact on public health expenditure. Therefore, we are not able to conclude that the majoritarian electoral system, which favours the citizen control over policymakers (i.e. accountability), is likely to restrain the regional level of public health expenditure. Similarly, the variable related to the election year—as a proxy for political budget cycle in fiscal policy instruments, is not significant. Consistently with previous theoretical and empirical works on lobbies, interest groups have a significantly positive influence on public health expenditure at a regional level. Other insightful results of the chapter have been derived relatively to the impact of quality of public (regional) health services as perceived by the voters. Particularly, the introduction of the quality variable (measured in terms of interregional patient mobility) in the estimation models makes the impact of the political variables (e.g. the influence of interest groups) marginally lower.

From a public policies perspective, the chapter has highlighted the importance of political competition, policies' transparency and voters' information (especially on quality of public services provided) as effective tools to counter political expenditure goals and particularistic policies favouring interest groups.

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Chapter 18
Linkage Between Benefit Expenditures and Premium Burdens: Long-Term Care Insurance in Japan

Katsuyoshi Nakazawa, Kota Sugahara and Minoru Kunizaki

Abstract The analysis described in this chapter considers the discretionary premium-setting behavior of municipalities in the Japanese system of long-term care insurance (LTCI) with respect to the link between benefit expenditures and premium burdens. Although the LTCI system is managed at the municipality level, the financial system is controlled by the central government, and municipalities seem to have no discretion over the financial system. However, our empirical analysis of benefit expenditures and premium-setting behavior shows that each municipality has a different premium-setting forecast. This result is contrary to the central government's initial intention for the LTCI system. Specifically, the adjustment subsidy does not function in line with the intention of the system, affecting the standard premium-setting process. Moreover, contrary to expectation, our empirical results show that municipalities seem to have some discretion in setting premiums. In particular, cities set premiums low, reflecting the political power of elderly people. In addition, premiums might be more influenced by the elderly when fewer neighboring municipalities are available for reference.

Keywords Long-term care insurance · Management discretion · Inter-jurisdictional interaction

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18.1 Introduction

In Japan, unlike in Germany or Korea where there is a national insurer of long-term care insurance (LTCI), LTCI is managed at the municipality level. However, because municipalities have limited budgets compared to that of the national insurer, maintenance of the pay-as-you-go principle in the LTCI budget is a concern. In addition, macroeconomic statistics exhibit limited linkages between benefit expenditures and premium burdens. In this study, we empirically analyze the factors that affect municipalities' benefit- and premium-setting behaviors and examine whether they are linked.

In most developed countries, the need for long-term care for the elderly has become a major problem as the aging population has increased. Japan has one of oldest populations in the world. Thus, LTCI was introduced for the elderly in FY2000 to address this problem. Under LTCI, the insurer is the municipality (i.e., the city, town, or village), and individuals aged 65 years or over (category I) and 40–64 years (category II) are covered. Insurers have established special accounts for LTCI and manage the program over a three-year "program management period." They forecast total benefits expenditures for the next period and maintain a constant ratio of total insurance benefits to the number of category I individuals insured.

An increase in long-term care benefits leads to a high category I premium. In contrast, premiums for category II individuals are collected by the national health insurers at a uniform rate. Thus, municipalities can only set premiums for category I individuals. These premiums must be set to balance the budget for the program management period, and the synchronization of benefits and premiums is very clear in the LTCI system. Campbell and Ikegami (2000) and Mitchell et al. (2004) emphasize the importance of the linkage between benefit expenditures and premium burdens and the discretion of municipalities in managing the LTCI program.

The central government has established a highly uniform LTCI management system. Specifically, it has set uniform rules regarding the age ranges covered by LTCI; the certification standards of long-term care needs; the certification procedures; the self-burden ratio and the upper bound, types, and contents of services covered by LTCI; and the prices of services (Shimizutani and Inakura 2006). However, whereas the LTCI system is managed at the municipality level, the financial system is controlled by the central government. Given these circumstances, it is unclear whether municipalities truly have discretion in LTCI management.

Only a few studies have examined the role of municipalities' discretionary behavior in the context of LTCI. Hayashi and Kazama (2008) and Shimizutani and Inakura (2006) conclude that municipalities control LTCI benefits by adjusting certifications to balance the LTCI budget. Certifications for long-term care and its processes are based on a nationwide system and require uniform application. However, these studies show that the municipalities facing tight fiscal conditions tend to decrease the number of persons or users eligible for certifications to reduce benefit expenditures. These results imply that the LTCI system is not fully institutionalized and that municipalities might play a discretionary role.

Whereas these studies focus on the certification side, which is under municipality control, we consider the linkage between benefit expenditures and premiums and argue that municipalities have leeway in premium setting as well. Examining nationwide data from FY2000 to FY2009, we find that category I premiums increased only by 43% (from 34,932 to 49,920 yen per year) on average despite a 59% increase in benefit expenditures per person insured under category I (from 160,556 to 255,904 yen per year). As we describe later, an official rule states that the revenue from category I premiums should cover a certain percentage of benefit expenditures. A category I premium set according to that rule would have been 51,181 yen per year on average.[1] Thus, it ought to have increased by 47% through FY2009. That is, the premium does not seem to be sufficiently linked to the increase in benefit expenditures at the macro level. Although a number of parameters and burden ratios are uniformly set by the central government, municipalities might set premiums differently from what the system envisages through its forecasting authority.

Municipalities' processes for forecasting and setting the next period's premium have not been explored in detail. Municipalities may forecast benefits and set premiums in a routine fashion, as envisaged under the LTCI system, but they may set premiums arbitrarily considering the uncertainty of the forecast and the characteristics of the municipality. Such municipality discretion has not previously been examined in the context of benefit and premium setting for LTCI.

Thus, in this study, we examine municipality discretion from this perspective. First, we design a financial structure for LTCI. Second, we estimate the equations that govern the benefit- and premium-setting decisions. Through these estimations, we check the linkage between benefit and premium setting and the effect of subsidies provided by the central government. Third, we focus on the influence of political and inter-jurisdictional interactions that the institutional design of the LTCI does not envisage.

We specifically focus on the benefit- and premium-setting behavior of municipalities regarding the premium revision from the first management period (FY2000–02) to the second management period (FY2003–05). We choose to focus on this time period because forecast uncertainty was higher in the first management period of the LTCI system.[2] In addition, some municipalities received a special measure to mitigate a sudden increase in premium burdens, particularly for low-income elderly persons, during the first program management period. According to the Ministry of Health, Labour, and Welfare (MHLW), 72 (Oct. 2000), 139 (Apr. 2001), 309 (Oct. 2001), 431 (Apr. 2002), and 695 (Apr. 2003) municipalities were given special reductions in the category I premium.[3] As we describe later, the premium revenue

[1] According to the LTCI institution, category I premium revenue should cover 20% of the benefit expenditures. Thus, 51,181 yen is the result of multiplying 255,904 by 0.2.

[2] Although it would be best to use premium levels from the first program management period, forecast data have not been made public for that period.

[3] These data are taken from the materials of meetings of the municipal chiefs of a section of the LTCI (June 4, 2002 and September 8, 2003) provided by the MHLW.

shortage was covered by loans from the special fund for the LTCI account. Thus, it is important for us to confirm whether we truly observe the discretionary management of the LTCI by municipalities in these periods.

Our empirical analysis has several key results. First, municipality forecasts are fundamentally based on the linkage between benefit expenditures and premium burdens, which is in line with the intention of the LTCI system. Second, the adjustment subsidy does not function as the system intended, which affects the standard premium-setting behavior. Third, municipalities seem to have some discretion in premium setting. Cities, in particular, set premiums low, reflecting the political power of the elderly. Finally, the premium rate might be more influenced by the political power of elderly people when few neighboring municipalities are available for reference.

The remaining sections of this chapter are structured as follows. In Sect. 18.2, we outline the details of the Japanese LTCI system and focus on the relationship between premium revenues and benefit expenditures. In Sect. 18.3, we set up the empirical model used to examine the effect of inter-jurisdictional interactions on premium setting, and we present the results in Sect. 18.4. Finally, in Sect. 18.5, we discuss future research topics regarding the linkage between benefit expenditures and premium burdens in the Japanese LTCI system.

18.2 Background and Motivation

18.2.1 Institutional Background

18.2.1.1 Benefits

Category I and II insured individuals can be grouped according to the nature of care required. When an insured individual requires long-term care, the Certification Committee for Long-term Care Needs of the municipality in which the individual resides evaluates the conditions requiring care. In other words, the long-term care needs are certified. The conditions requiring care can range from a mild to a serious case. A multistep approach is used such that an allowance is set for each stage. For example, the benefit limits for at-home long-term care range from approximately 50,000 JPY (620 USD) to 358,000 JPY (4420 USD) per month. Benefit limits are also set for the utilization of facility services by facility type according to the care need stage.[4]

Eligible insured individuals can purchase long-term care services at a fixed rate of 10% of the service cost.[5] The remaining 90% of the service cost is covered by LTCI benefits, which are financed by premium revenues; subsidies from upper-level

[4]Of course, insured individuals can purchase additional services above the limit at their own expense.

[5]Although benefits do not typically cover meals or residence expenses for hospitalized and institutionalized individuals, those from low-income households (i.e., incomes lower than the municipal tax exemption level) are granted coverage with a ceiling for extra benefits.

governments (i.e., the central and prefectural governments); and financial transfers from the general account of the municipality to the LTCI special account.

These institutional criteria ensure that universal service use and horizontal equity vis-à-vis eligibility for LTCI benefits are guaranteed regardless of the insured individual's income or place of residence.

18.2.1.2 Financing

The annual budget for each LTCI special account is required to balance on a three-year basis. The three-year period for budget planning is called the "program management period." When a municipality draws up its budget, it forecasts local LTCI expenditures for the full three years. It forecasts the next period's LTCI benefits based on recent results and estimations of the number of eligible persons, the number of LTCI certification applications, and long-term care costs. These costs are divided into costs for at-home care services and costs for welfare facilities.

After benefits are forecasted, revenues are considered. The revenues of an LTCI special account consist of subsidies from upper-level governments (i.e., central and prefectural governments), statutory financial transfers from the municipal general account, premiums directly paid by the category I insured individuals within the municipality, and premiums from category II insured individuals distributed via the national pool by, for instance, the National Health Insurance and the Health Insurance Society.

The central government covers 20% of the LTCI special account revenues on average across all municipalities through a long-term care benefit subsidy. This subsidy from the central government is available to all municipalities. The central government also covers a 5% adjustment subsidy that is allocated to disadvantaged municipalities. In addition, prefectural governments and municipalities each cover 12.5% of the revenues, and these subsidies are available to all municipalities as well.

The remaining revenues are essentially premium revenues. Category I and II individuals cover 21 and 29% of LTCI expenditures, respectively, according to the statutory standard. This ratio has changed over time; the shares of category I and II individuals were 17 and 33%, respectively, in the first three-year program management period (2000–02), 18 and 32% in the second period (2003–05), 19 and 31% in the third period (2006–08), and 20 and 30% in the fourth period (2009–11).

The premium rate based on the income of category II insured individuals is set by the respective national health insurer and is collected along with the health insurance premium. Thus, category II premium revenue is not under municipality control. However, the category I premium is set by each municipality based on the ability to pay of the insured, and, thus, different premium rates are set by each municipality. Typically, an individual's income is classified into one of six levels.[6] Municipalities

[6] An insured individual with income exempt from municipal tax is defined as being at the standard level (level 4) and is required to pay the standard premium rate. Level 1 insured individuals are beneficiaries of public assistance and are allowed to pay one-half the standard premium rate. Indi-

can therefore discretionally set the standard premium based on the income distribution of the insured and forecasts of benefit expenditures. The standard premium is revised at the start of the program management period and is fixed for the full three-year period.

If deficits occur, municipalities must be covered by withdrawals from its Long-term Care Benefits Fund or loans from the Fiscal Stabilization Fund managed by the prefecture. Loans borrowed in a management period need to be repaid in the next period.

18.2.1.3 Adjustment Subsidy

As discussed above, the burden ratios of the central government (20%), the prefecture government (12.5%), the municipality (12.5%), and category II insured individuals (29%) are constant among municipalities. However, the burden ratio of category I individuals is not fixed at 21% for every municipality. Instead, this percentage is the national average across all municipalities. Category I insured individuals have different abilities to pay for residential long-term care in each municipality. If a municipality has a high ratio of elderly individuals who need long-term care, the LTCI standard premium for category I insured individuals is higher because the benefits paid are higher. However, if a municipality has a high ratio of low-income elderly persons, the LTCI standard premium for category I insured individuals is higher because the elderly with standard income levels must cover the premium burdens of the low-income elderly.

To maintain horizontal equity with regard to the standard premium in each municipality, the central government provides a 5% adjustment subsidy to disadvantaged municipalities, as described above. This subsidy is distributed at a matching rate according to the share of individuals aged 75 years or over and the share of low-income insured individuals within the municipalities. Thus, the matching rates of this subsidy vary by municipality.

The MHLW explains that the differences in standard premiums across municipalities represents certification rate and amount-of-use differences among the insured because differences in municipalities' ratios of elderly persons requiring care and premium-bearing capacities are already adjusted to a nationwide mean value via the adjustment subsidy (MHLW 2017).

Thus, the linkage between the forecasted benefits and premium-setting for category I insured individuals is not completely synchronized. To examine this linkage, we need to consider the effect of the adjustment subsidy.

viduals at the highest level, level 6, have annual incomes of 1.9 million JPY and above and are required to pay 1.5 times the standard premium.

18.2.2 Discretion for Municipalities in LTCI Management

18.2.2.1 Linkage Between Benefits and Premiums

Based on the institutional design of LTCI, category I benefits and premiums are sure to have considerable linkages because a constant proportion of benefit expenditures is generally covered by premium revenues. The statutory ratio of category I premium revenues to benefit expenditures increased from 17% in the first management period to 18% in the second period, 19% in the third period, and 20% in the fourth period.

Figure 18.1 shows the actual ratios of category I premium revenues to benefit expenditures from the first to the third management period. This figure indicates that premium setting discretion has not been adequate to balance the LTCI budget in accordance with the national policy. The actual premium burden ratios in the first management period were considerably lower than the statutory required ratio because premium burdens were kept low in the first half of the period. The second period's premium burden ratios were also lower than the statutory required ratio. However, the third period's premium burden ratios were higher than the statutory required ratio. In addition, the premium burden ratios of cities were higher than those of towns and villages in all periods. Thus, the linkage between benefit expenditures and premium burdens was not maintained in any period or any type of municipality.

Figure 18.2 shows the distributions of the ratio of category I premium revenues to benefit expenditures for cities and for towns and villages in second and third

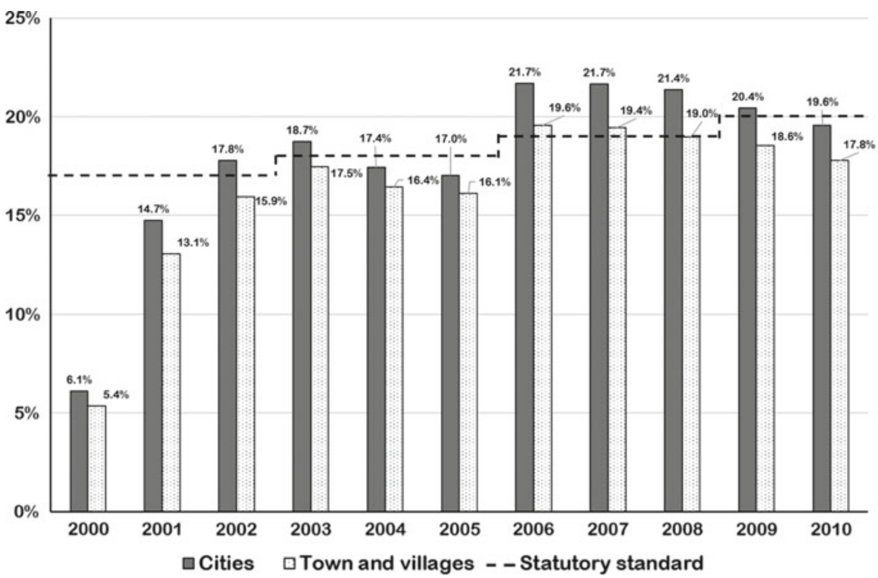

Fig. 18.1 The ratio of premium revenues to benefit expenditures. *Source* Annual report of the LTCI administration (MHLW; 2000–2010)

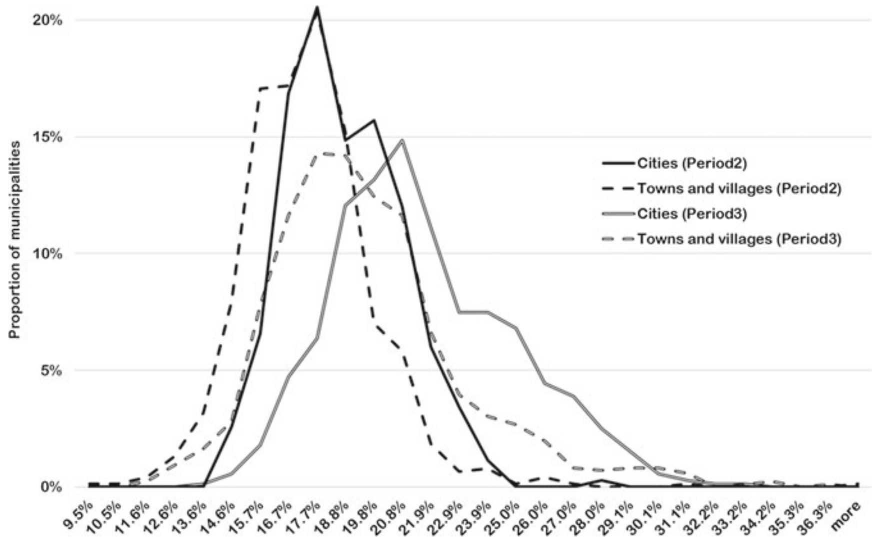

Fig. 18.2 Distribution of the ratio of category I premium revenues to benefit expenditures. *Source* Annual report of the LTCI administration (MHLW; 2003–2008)

management periods.[7] Although Fig. 18.1 shows that the average value of the ratio increased over time, we find that variation also increased over time for both types of municipalities. The coefficient of variation (CV) of the ratio for the sample of cities increased from 0.113 (second period) to 0.154 (third period), and that for the sample of towns and villages increased from 0.142 to 0.183. The maximum ratio across cities increased from 27.2 to 32.8%, but the minimum stayed about the same, shifting only from 13.7 to 13.1%. In contrast, the maximum ratio across towns and villages slightly decreased from 37.3 to 36.2%, and the minimum changed from 9.5 to 10.8%. From these facts, we recognize that the linkage between benefit expenditures and premium burdens tightened in some municipalities but did not tighten in others.

Although this result may be due to the demographic characteristics of each municipality, other factors may lead to a misinterpretation of the linkage. One possible factor is the influence of the adjustment subsidy. As stated in the previous sub-section, the adjustment subsidy was introduced to ensure horizontal equity in the per-person premium burden between municipalities. Figure 18.3 shows the distribution of the ratio of adjustment subsidy revenues to benefit expenditures among cities and among towns and villages in second and third management periods.[8] The average over the sample of cities almost corresponds with the nationwide average ratio, as it is 4.4% in the second period and 5.2% in the third period, the average over the sample of towns and villages is far from the nationwide average at 6.6% in the second period

[7]The value for each municipality is calculated as the average over the three years in the management period.

[8]These values are also calculated as averages over the three years in the management period.

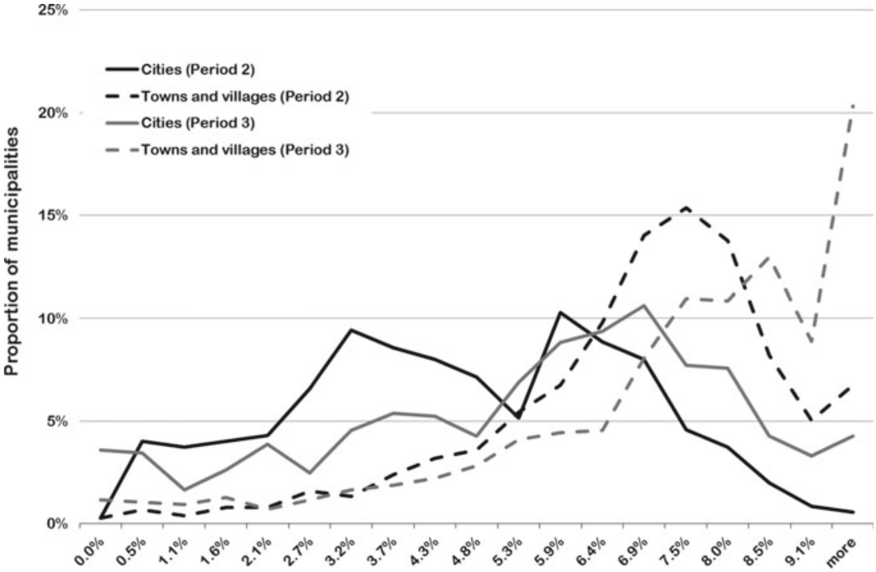

Fig. 18.3 Distribution of the ratio of adjustment subsidy revenues to benefit expenditures. *Source* Annual report of the LTCI administration (MHLW; 2003–2008)

and 7.2% in the third period. On the other hand, the CV of the ratio for cities (i.e., 0.492 in the second period and 0.484 in the third period) is larger than that for towns and villages (i.e., 0.286 in the second period and 0.342 in the third period).

If the adjustment subsidy functions as the LTCI system intended, the standard premium for category I insured individuals in each municipality should be influenced only by the certification rate and per-person amount-of-use differences. In contrast, if the adjustment subsidy is either excessive or deficient, it would also influence the standard premiums of municipalities with a high ratio of individuals aged 75 years and more or a high ratio of low-income individuals. Thus, when we examine the linkage between the benefits per insured individual and standard premiums, we should consider the influence of the adjustment subsidy.

18.2.2.2 Discretion in Premium Setting

The other possible factor in the misinterpretation of the linkage between benefit expenditures and premium burdens is the premium-setting discretion of municipalities. In setting LTCI premiums, municipalities should forecast the next program period's benefits and premiums for category I insured individuals based on the current period results. Thus, each municipality faces a trade-off between benefit expenditures and premium revenues.

Elderly residents who form a strong interest group prefer to increase their benefits and decrease their premium burdens, and, thus, create challenges for municipal politicians. According to a consciousness survey, voter turnout in regional elections is 81.9% among people in their 60s and 85% among people in their 70s (The Association for Promoting Fair Elections 2004). Moreover, "medical treatment and long-term care" was a consideration for about 50% of voters. Given this high voter turnout and strong awareness of the problems of long-term care for the elderly, LTCI revision is an important policy issue. Municipality leaders may therefore have an incentive to suppress premiums for category I insured individuals as much as possible to win elderly votes. If municipalities have leeway in setting LTCI premiums, they might set premiums lower than required by the system, reflecting the political power of the elderly.

If such discretion exists, then, in line with the literature on fiscal decentralization,[9] it may create externalities that bring about inter-jurisdictional interactions. Inter-jurisdictional interactions could conceivably affect variation in premium-setting behavior. Taking Besley and Case's (1995) seminal study as a starting point, the literature empirically analyzes yardstick competition on municipal property taxation in the Netherlands (Allers and Elhorst 2005), Italy (Bordignon et al. 2003), and Spain (Bosch and Solé-Ollé 2007) and on income taxation in Belgian municipalities (Heyndels and Vuchelen 1998).

Based on these studies, we can envision a scenario in which municipalities have leeway in premium-setting and face forecast uncertainty. In this situation, municipalities have an incentive to adjust to the levels of surrounding municipalities. From this perspective, Nakazawa et al. (2012) estimate the influences of cost and revenue factors, the political pressure of the elderly, and the circumstances of inter-jurisdictional interactions on premium-setting in the second management period and find several key results. First, the political power of the elderly strongly forces the suppression of premium increases. Second, cities engage in yardstick competition, whereas towns and villages engage in neither yardstick competition nor welfare competition.

It is important to understand how municipalities compensate for the revenue shortage associated with setting premiums lower than required by the system because additional transfers from the general account to the LTCI special account are prohibited. It seems that loans from the Fiscal Stabilization Fund played an important role in suppressing premium increases. Table 18.1 shows the number of municipalities borrowing from this fund and the loan amounts during the first to third management periods. The data in Table 18.1 indicate that some municipalities (25.2% of the total) borrowed from the fund in the first and second periods, in which the actual ratio of category I premium revenues to benefit expenditures was much lower than the statutory ratio. However, the number of borrowing municipalities decreased to 3.5% of the total in the third period. Thus, municipalities have shifted the premium burden to loan repayments in the next management period to suppress premium increases, especially in the first and second periods.

[9] Important works in this literature include those of Brueckner (2003) and Revelli (2005).

Table 18.1 Statistics of loans from the Fiscal Stabilization Fund

	First period		
	2000	2001	2002
No. of borrowing municipalities	78	398	735
Loan amount (billion yen)	668	11,638	40,370
	Second period		
	2003	2004	2005
No. of borrowing municipalities	170	341	423
Loan amount (billion yen)	4320	19,411	39,183
	Third period		
	2006	2007	2008
No. of borrowing municipalities	21	36	57
Loan amount (billion yen)	734	1347	2200

Source An inquiry regarding the situation of loans from the Fiscal Stabilization Fund (MHLW)

18.3 Empirical Strategy

18.3.1 Hypotheses and Estimation Models

We set some hypotheses based on a current statement, and we verify them using a simple empirical analysis. As mentioned in Sect. 18.1, we focus on the benefit- and premium-setting behavior of municipalities by considering premium revisions from the first management period (2000–02) to the second (2003–05). In this section, we set some hypotheses and show the empirical models. The municipality forecasts the benefits and premiums in the second program management period based on the first program management period's demographic and cost factors for providing long-term care service. Thus, we use second-period data as dependent variables and first-period data as explanatory variables.

First, we set the basic estimation equations:

$$b_i = \alpha_k \mathbf{X}_{i,k} + u_i \tag{18.1}$$

$$p_i = \beta_k \mathbf{X}_{i,k} + v_i. \tag{18.2}$$

We employ estimations with two types of dependent variables: long-term care benefits per insured elderly person (category I) in the second program management period (b) and the standard category I premium in the second program management period (p). $\mathbf{X}_{i,k}$ is a vector of explanatory variables, and α_k and β_k are vectors of coefficients. $\mathbf{X}_{i,k}$ includes variables representing the cost factors that affect the target LTCI benefit, which essentially take values from the first program management period. We employ the average cost of at-home care ($HOME_i$), that of facility care

($FACI_i$), the ratio of early-stage (age 65–74) eligible individuals ($RELI65_i$) to the total number of early-stage category I insured individuals, and the ratio of late-stage (age 75 and over) eligible individuals ($RELI75_i$) to the total number of late-stage category I insured individuals in a municipality as cost factors that are thought to increase benefit expenditures and, thus, premiums. The MHLW explains that the certification rate of late-stage elderly individuals is 7.5 times that of early-stage elderly individuals, and eligible late-stage elderly individuals use most of the LTCI services. Thus, late-stage eligible individuals are the main beneficiaries of LTCI benefits.

Because policymakers particularly forecast the costs of providing long-term care services based on those observed in the previous management period, the signs of α_k and β_k ought to be same in the above two equations. However, in this estimation, some coefficients may not have the same signs because Eqs. 18.1 and 18.2 do not take into account factors that influence the intermunicipal difference in benefit expenditures and premiums, which should be controlled by the adjustment subsidy.

Then, we define the following estimation equations to check Hypothesis 1.

Hypothesis 1 After controlling for the adjustment subsidy effect, we can find a linkage between premium burdens and benefit expenditures.

$$b_i = \alpha_k \mathbf{X}_{i,k} + \gamma_1 R75_i + \gamma_2 LOW_i + u_i \tag{18.3}$$

$$p_i = \beta_k \mathbf{X}_{i,k} + \delta_1 R75_i + \delta_2 LOW_i + v_i \tag{18.4}$$

As stated in the previous section, the adjustment subsidy serves to accommodate differences in the characteristics of municipalities that determine the standard premium. The proportion of late-stage elderly individuals ($R75_i$) and that of low-income elderly individuals (LOW_i) should be considered when the adjustment subsidy is determined. Therefore, from the perspective of the standard premium, represented by Eq. 18.4, both $R75_i$ and LOW_i ought to be insignificant if the adjustment subsidy regularly works because the adjustment subsidy's role is to offset the effects of these variables on the standard premium.

To compare the premium estimates, we use these two variables to estimate benefits in Eq. 18.3. On the benefit side, the signs of γ_1 ($R75_i$) and γ_2 (LOW_i) should be significantly positive. From the National Survey of Japan (2010), the general form of an elderly family is either a late-stage married couple or a late-stage husband and early-stage wife. Often, the married couple resides alone without children. In this situation, facility care, which is more expensive, is the only feasible option for care service when a family member needs long-term care. Thus, we expect the estimation result of Eq. 18.3 to show that an increase in $R75_i$ leads to an increase in the use of more expensive LTCI services and that LOW_i might also have a positive effect on the benefit side because of the policy of reducing the burden for low-income individuals who might have excessively large demands for care services. Finally, we define the equations to include a variable representing the political pressure of the elderly to check Hypothesis 2.

Hypothesis 2 If municipalities have discretion in premium setting, they decide their standard premiums by considering the political power of the elderly.

$$b_i = \alpha_k \mathbf{X}_{i,k} + \gamma_1 R75_i + \gamma_2 LOW_i + \gamma_3 MEDI\_V_i + u_i \tag{18.5}$$

$$p_i = \beta_k \mathbf{X}_{i,k} + \delta_1 R75_i + \delta_2 LOW_i + \delta_3 MEDI\_V_i + v_i \tag{18.6}$$

We adopt the median age of voters in each municipality ($MEDI\_V_i$) as a proxy variable for the political power of the elderly. If the municipality has discretion in premium setting and $MEDI\_V_i$ is high, we believe the municipality would be under high pressure to suppress the elderly premium. Thus, in Eq. 18.6, $MEDI\_V_i$ have a significantly negative effect on premiums and no significant effect benefits in Eq. 18.5.

The voter turnout rate in each municipality by age is not published. Therefore, we use the voter turnout rate according to age based on the results of a consciousness survey for regional elections (The Association for Promoting Fair Elections 2004). Thus, we assume that the voter turnout rate according to age is constant across municipalities. We calculate the turnout according to age by multiplying the population of each municipality according to age by the voter turnout rate according to age. Then, we calculate the median age of voters in each municipality.

Finally, we adopt a simple alternative method to check for discretion in premium setting. Fujimura (1999) uses surveys of the National Association of Towns and Villages to point out that municipalities consider other municipalities of the same population scale within the same prefecture in making welfare policy decisions. Considering this viewpoint, the number of municipalities of the same population scale in the same prefecture that are available for reference becomes an important issue for premium setting. Indeed, if a number of municipalities with the same population scale are located in the same prefecture, such references can be made, and premium-setting can be easily adjusted.

We calculate the number of neighboring municipalities with similar conditions as an index for such references by municipalities. According to the Similar Group Classification by the Ministry of Internal Affairs and Communications (MIAC), cities are classified by population into four groups: (A) under 50,000, (B) 50,000–100,000, (C) 100,000–150,000, and (D) 150,000 and over. Towns and villages are classified into five population groups: (a) under 5000, (b) 5000–10,000, (c) 10,000–15,000, (d) 15,000–20,000, and (e) 20,000 and over. We calculate the fraction of municipalities in prefecture at the same population scale ($RSPS_i$) based on this classification. Then, we divide the samples of cities and towns and villages into three quantiles using $RSPS_i$ and check Hypothesis 3 using the results from these divided-sample estimations.

Hypothesis 3 If municipalities have discretion in premium setting, they decide their standard premiums by considering the trends of neighboring municipalities.

18.3.2 Data

Our empirical estimation uses cross-sectional data on premium revisions from the first program management period (2000–02) to the second period (2003–05) for a sample of 548 cities and 1738 towns and villages. Standard premium data for the second period were obtained from the MHLW. Other long-term care data were obtained from the Annual Report on LTCI Programs 2002 and 2003 by the MHLW. The voter turnout rates according to age are based on consciousness survey results for regional elections from The Association for Promoting Fair Elections (2004). Table 18.2 provides the definition and computational method of each variable. Table 18.3 shows descriptive statistics for each variable.

The highest premium across municipalities is 3.3 times the lowest premium. The premium burden differs by about 50,000 JPY annually according to the municipality. The highest benefit per user is 4.4 times the lowest across municipalities. Thus, when the premium is compared with the benefit per user, the benefit difference across municipalities is larger.

Table 18.2 Definitions and computational methods of each variable

Variable	Year	Definition and computational method
b	2003	Total long-term care benefit/Number of category I individuals insured
p	2003	Standard premium for category I individuals
HOME	2002	Total cost of at-home care/Number of at-home care users
FACI	2002	Total cost of facility care/Number of facility care users
RELI65	2002	Number of eligible persons (ages 65–74)/Number of category I insured individuals (ages 65–74)
RELI75	2002	Number of eligible persons (ages 75 and over)/Number of category I insured individuals (ages 75 and over)
LOW	2003	Number of insured individuals of level 1 and 2 income levels/Number of category I insured individuals
R75	2002	Number of insured individuals aged 75 and over/Number of category I insured individuals
MEDI_V	2002	Size of population by age multiplied by turnout ratio by age
RSPS	2002	Fraction of municipalities of the same population scale in the prefecture

Note: *LOW* data can be captured from 2003

Table 18.3 Descriptive statistics (2300 observations)

	Mean	SD	Min	Max
(1) Long-term care benefits per elderly person (FY2003; 1000 JPY per year)	209.271	42.501	96.300	427.618
(2) Premium in the 2nd period (JPY per month)	3202	570	1783	5942
(3) *HOME*: Average cost of in-home care (1000 JPY per year)	32.894	4.731	15.038	56.157
(4) *FACI*: Average cost of facility care (1000 JPY per year)	344.781	20.536	165.454	426.892
(5) *RELI65*: Ratio of early-stage eligible people	0.026	0.008	0.003	0.085
(6) *RELI75*: Ratio of late-stage eligible people	0.116	0.033	0.025	0.486
(7) *LOW*: Ratio of low-income insured individuals	0.374	0.122	0.116	0.852
(8) *R75*: Ratio of late-stage elderly individuals	0.461	0.044	0.311	0.639
(9) *MEDI_V*: Median age of voters	56.316	4.237	44.000	67.000
(10) *RSPS*: Fraction of municipalities with the same population scale	0.306	0.143	0.022	1.000

18.4 Estimation Results

18.4.1 Linkage Between Benefits and Premiums

This section shows the estimation results for the hypotheses described above. To examine the effect of the explanatory factors on the dependent variable, we apply log transformations to the dependent and explanatory variables. First, we divide the dataset into two groups (cities; towns and villages) to estimate Eqs. 18.1 and 18.2. The ordinary least squares (OLS) method with heteroskedasticity-consistent standard errors is implemented. The results are summarized in Table 18.4.

In accordance with our predictions, the explanatory variables $HOME_i$, $FACI_i$, and $RELI75_i$ have significantly positive effects for all estimation results. This result implies that the linkage between benefits and premiums exists.

$RELI65_i$ has no significant effect for cities and a negative effect at the 10% significance level for towns and villages in the estimation of the benefit equation, Eq. 18.1. This result differs from our hypotheses. However, this variable has a significantly positive effect in the estimation of premium equation, Eq. 18.2. A reason for this discrepancy may be that early-stage elderly individuals are not the main users of LTCI services, as previously mentioned.

Second, we estimate Eqs. 18.3 and 18.4. The results are summarized in Table 18.5. Comparing Adj-R^2, AIC, and BIC between Tables 18.4 and 18.5, we can conclude that including LOW_i and $R75_i$ is a more appropriate model specification. The explanatory variables $HOME_i$, $FACI_i$, and $RELI75_i$ again have significantly positive effects in all estimation results, which is in line with our predictions, whereas $RELI65_i$ has no significant effect.

Table 18.4 Regression results for the basic estimation equations

Dependent variables	Cities		Towns and villages	
	Benefit	Premium	Benefit	Premium
	Coef.	Coef.	Coef.	Coef.
HOME	0.304*** (0.039)	0.308*** (0.046)	0.218*** (0.027)	0.198*** (0.026)
FACI	0.550*** (0.166)	0.549*** (0.189)	0.264*** (0.070)	0.226*** (0.075)
RELI65	−0.055 (0.040)	0.138*** (0.035)	−0.077* (0.022)	0.030* (0.015)
RELI75	0.788*** (0.335)	0.474*** (0.032)	0.529*** (0.025)	0.342*** (0.021)
Constant	2.553** (1.081)	5.313*** (1.206)	3.901*** (0.425)	6.899*** (0.453)
Adj-R^2	0.787	0.658	0.400	0.310
AIC	−1178	−1110	−1348	−1607
BIC	−1157	−1088	−1320	−1580
Sample	548	548	1738	1738

Note ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.1 levels, respectively. Standard errors are in parentheses

LOW_i has a significantly positive effect not only on benefits but also on premiums. This result is contrary to the intention of the adjustment subsidy, as the adjustment subsidy should offset the effect of an increase in the number of low-income elderly people on the standard premium. Thus, we can conclude that the low-income elderly effect was underestimated in determining the adjustment subsidy. As a result, an increase in the number of low-income elderly people eligible for discounted premium rates leads to an increase in the standard premium because the municipality becomes concerned about a premium revenue shortage. Thus, the adjustment subsidy does not function as the system intends, affecting the standard premium.

$R75_i$ has a significantly negative effect on premiums but no such effect on benefits. This result also indicates that the adjustment subsidy does not function as intended. The adjustment subsidy is excessive for standard premium setting. That is, an excessive subsidy for municipalities with more late-stage elderly people creates an incentive to set excessively low premium rates.

Overall, we can conclude that the results for the explanatory variables representing the cost factors ($HOME_i$, $FACI_i$, and $RELI75_i$) confirm the linkage between benefits and premium setting to some degree. However, the adjustment subsidy is either excessive or deficient with regard to standard premium setting.

Table 18.5 Regression results for the estimation controlling for the effect of the adjustment subsidy

Dependent variable	Cities		Towns and villages	
	Benefit	Premium	Benefit	Premium
	Coef.	Coef.	Coef.	Coef.
HOME	0.363*** (0.036)	0.319*** (0.042)	0.261*** (0.028)	0.233*** (0.025)
FACI	0.545*** (0.158)	0.459*** (0.168)	0.258*** (0.069)	0.183*** (0.068)
RELI65	0.020 (0.062)	−0.005 (0.049)	−0.052* (0.078)	−0.016 (0.018)
RELI75	0.633*** (0.042)	0.560*** (0.043)	0.461*** (0.035)	0.347*** (0.029)
LOW	0.088*** (0.033)	0.109*** (0.027)	0.090*** (0.014)	0.121*** (0.013)
R75	0.233*** (0.076)	−0.336*** (0.073)	0.099 (0.077)	−0.363*** (0.058)
Constant	0.233** (0.076)	5.321*** (1.049)	3.902*** (0.419)	6.717*** (0.410)
Adj-R^2	0.803	0.691	0.419	0.363
AIC	−1217	−1161	−1397	−1743
BIC	−1187	−1131	−1358	−1704
Sample	548	548	1738	1738

Note ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.1 levels, respectively. Standard errors are in parentheses

18.4.2 Estimation of Discretion in Premium Setting

Third, we estimate Eqs. 18.5 and 18.6 to check for political pressure by elderly voters. The results are summarized in Table 18.6.

The effects of the other variables largely do not differ from the previous estimation results. In the case of cities coefficient on the median age of the voter ($MEDI\_V_i$) is significantly negative for the premium estimation, whereas it is not significant for the benefit estimation. As stated earlier, because the central government has established a highly uniform LTCI management system, municipalities should not have leeway to increase benefits to elderly voters. However, this result seems to show that cities do have leeway in setting premiums, which is contrary to the intention of the system. However, the results are not significant for towns and villages.

Fourth, we estimate premium-setting behavior after dividing the sample into three quantiles. As mentioned in Sect. 18.3.1, we calculate the proportion of same-population-scale municipalities in the prefecture ($RSPS_i$). The cutoff points for the

Table 18.6 Results of regressions including the median age of voters

Dependent variable	Cities		Towns and villages	
	Benefit	Premium	Benefit	Premium
	Coef.	Coef.	Coef.	Coef.
HOME	0.346*** (0.038)	0.277*** (0.040)	0.267*** (0.029)	0.232*** (0.026)
FACI	0.541*** (0.160)	0.448*** (0.170)	0.262*** (0.069)	0.183*** (0.068)
RELI65	0.014 (0.062)	−0.019 (0.050)	−0.046* (0.027)	−0.017 (0.018)
RELI75	0.631*** (0.043)	0.557*** (0.042)	0.460*** (0.035)	0.348*** (0.029)
LOW	0.097*** (0.033)	0.130*** (0.028)	0.079*** (0.018)	0.122*** (0.015)
R75	0.279*** (0.079)	−0.227*** (0.077)	0.060 (0.088)	−0.358*** (0.066)
MEDI_V	−0.147 (0.102)	−0.353*** (0.115)	0.123 (0.105)	−0.018 (0.083)
Constant	3.286*** (1.127)	6.991*** (1.179)	3.331*** (0.674)	6.800*** (0.572)
Adj-R^2	0.804	0.697	0.420	0.363
AIC	−1217	−1171	−1397	−1741
BIC	−1183	−1137	−1353	−1697
Sample	548	548	1738	1738

Note ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.1 levels, respectively. Standard errors are in parentheses

city sample quantiles are 0.23, 0.35, and 0.50, and those of the town and village sample are 0.18, 0.29, and 0.38.[10] The results are summarized in Table 18.7.

The results show that on coefficients of $MEDI\_V_i$ become insignificant as $RSPS_i$ increases. The median voter age is significantly negative for cities with low $RSPS_i$ values. Thus, premium setting is more influenced by the political power of elderly when few neighboring municipalities are available for reference. As the number of reference municipalities increases, elderly political power does not influence premium setting. When many reference municipalities are available, the premium might not reflect the political demands of elderly voters in the municipality but rather the premium-setting behavior of reference municipalities. The results seem to indicate a "follow-the-crowd" mentality, the simplest and most frequently used mechanism for policy implementation, especially for Japanese bureaucracy. This method is easy to use when several neighboring municipalities of similar size are available.

[10]When we estimated the benefits equation using the same cutoff points, the coefficients on $MEDI\_V_i$ were not all significant.

Table 18.7 Regression results for the second program period standard premium (three quantiles)

	Cities			Towns and villages		
	1st quantile	2nd quantile	3rd quantile	1st quantile	2nd quantile	3rd quantile
	Coef.	Coef.	Coef.	Coef.	Coef.	Coef.
HOME	0.344*** (0.077)	0.311*** (0.086)	0.253*** (0.058)	0.262*** (0.053)	0.310*** (0.047)	0.188*** (0.039)
FACI	0.795*** (0.162)	0.211 (0.131)	0.750*** (0.134)	0.201 (0.169)	0.217** (0.097)	0.130 (0.102)
RELI65	−0.124 (0.109)	−0.004 (0.057)	0.085* (0.049)	−0.106*** (0.032)	−0.033 (0.033)	0.049* (0.026)
RELI75	0.565*** (0.076)	0.667*** (0.071)	0.456*** (0.058)	0.350*** (0.026)	0.360*** (0.052)	0.414*** (0.056)
LOW	0.125** (0.058)	0.120*** (0.037)	0.099*** (0.031)	0.157*** (0.026)	0.107*** (0.031)	0.088*** (0.023)
R75	−0.192 (0.156)	−0.273** (0.114)	−0.178 (0.121)	−0.402*** (0.103)	−0.347** (0.141)	−0.365*** (0.099)
MEDI_V	−0.562** (0.239)	−0.376* (0.193)	−0.116 (0.204)	−0.242* (0.134)	0.257 (0.175)	−0.022 (0.133)
Constant	5.211*** (1.616)	8.590*** (1.261)	4.521*** (1.315)	7.167*** (1.157)	5.166*** (1.055)	7.637*** (0.863)
Adj-R^2	0.690	0.746	0.715	0.361	0.394	0.396
AIC	−378	−390	−411	−561	−597	−621
BIC	−352	−365	−385	−526	−563	−586
Sample	185	179	184	565	554	619

Note ***, **, and * indicate statistical significance at the 0.01, 0.05, and 0.1 levels, respectively. Standard errors are in parentheses

18.5 Discussion of the Linkage Benefit and Premium

In this study, we examined the discretion of the municipalities in setting LTCI premiums. The LTCI system is designed to have strong linkages between benefits and premium setting. From this perspective, municipalities should not have leeway to set premiums. Previous studies clarify that municipalities control benefit expenditures by limiting the number of eligible individuals using certifications of long-term care needs. However, these studies do not examine municipalities' discretion in LTCI premium setting.

We set some hypotheses based on a current statement and verify them using simple empirical analyses. We obtain the following results.

First, municipalities basically made forecasts according to the linkage between benefit expenditures and premium burdens envisaged by the LTCI system. Because we apply log transformations to the dependent and explanatory variables, the estimated coefficients reflect the elasticity of the benefits per insured individual and that of the category I premium to changes in each explanatory variable. The results in Table 18.4 show that the elasticities of the premium to $HOME_i$ and $FACI_i$ are similar to those of the benefit. This finding might mean that municipalities can accurately forecast the basic cost of LTCI services. However, the elasticities of the premium and the benefit with respect to $RELI75_i$ differ. It seems to be difficult for municipalities to forecast the needs of late-stage eligible individuals for LTCI service, perhaps because of inter-municipal migration.[11]

Second, we found that the adjustment subsidy does not function as intended by the system, which affects the setting of standard premiums. The adjustment subsidy, which is intended to counterbalance an increase in the proportion of low-income elderly individuals (LOW_i), is underestimated. Thus, a municipality with a high proportion of low-income elderly individuals must set a higher standard premium to compensate for the revenue shortage caused by an increase in discounted premiums for low-income insured individuals without a corresponding increase in the standard premium. However, the effect of the proportion of late-stage elderly people ($R75_i$) on benefit expenditures seems to be overestimated in calculating the amount of the subsidy. Consequently, excessive subsidies for municipalities with more late-stage elderly people creates an incentive to set excessively low premium rates.

These incorrect estimations are considered to influence the equalization effect of the adjustment subsidy, which makes the disparity in the premium burden smaller than that in the benefit per insured individual. Therefore, we tentatively compute the CV of the benefit per insured individual and the standard premium for the samples of cities and towns and villages in the second management period. Table 18.8 shows that the CV of the premium is smaller than that of the benefit for the whole sample and that the difference in the CVs of benefit and the premium is larger for cities for towns and villages. That is, the equalization effect of the adjustment subsidy between cities might be excessively strong owing to the overestimation of the effect of the proportion of late-stage elderly people.

However, because we cannot judge the optimality of the equalization effect through such a simple test, further investigation is needed to tackle the misestimation problem and the equalization function of the adjustment subsidy. One possible

Table 18.8 CV of the per capita benefit and the standard premium

		2003	2004	2005
Cities	Benefit	0.176	0.167	0.163
	Premium	0.148		
Towns and villages	Benefit	0.224	0.207	0.194
	Premium	0.191		

Source Annual report of the LTCI administration (MHLW)

[11] Kawase and Nakazawa (2009) and Nakazawa (2017) reveal the magnetic effects of LTCI facilities on the migration of the elderly and the effect of this migration of the late-stage elderly on cost factors, such as, for instance, the ratio of eligible individuals.

approach might involve measuring the equalization effect and its trends across periods using inequality indices.

Third, our results show that municipalities seem to have discretion in premium setting. Cities, in particular, recognize the political power of the elderly and set premiums low. Then, premiums are influenced by the elderly when few neighboring reference municipalities are available. Municipalities appear to have some leeway in premium setting, contrary to the intention of the LTCI system.

The reason that this result differs from that of Nakazawa et al. (2012) suggesting yardstick competition among cities is that the dependent variable in our estimation is different from that used by Nakazawa et al. (2012). They employ an increase in the category I premium rate between the first and second management periods as the dependent variable. Therefore, our result does not necessarily contradict the finding of Nakazawa et al. (2012).

This analysis may be improved upon in that the relationship between the coefficient on $MEDI\_V_i$ and the degree of $RSPS_i$ may not be robust. Because the coefficients on other variables also become unstably insignificant as $RSPS_i$ increases, we cannot explain this phenomenon convincingly. For example, according to the estimation result for the sample of cities in Table 18.7, the coefficient on $FACI_i$ is significantly positive for the first and the third quantiles but not for the second quantiles. If cities can be assumed reference each other in forecasting the cost of facility care to set premiums, the results for the first quantiles should be insignificant because of the lack of reference municipalities. Therefore, in other words, we may not necessarily conclude that the insignificant result for the coefficient on $MEDI\_V_i$ in the third quantile is driven by the increase in the number of reference municipalities.

Whereas we focused only on the first periods of the LTCI, Nakazawa and Matsuoka (2016) investigate the interactions with respect to LTCI premium-setting among municipalities using data from the early to recent periods of the LTCI. They find that the strength of strategic interaction decreases from the early to later stages because the uncertainty around policymaking might become weaker as time elapses. Their findings coupled with our findings suggest that the LTCI premium-setting process was influenced by political pressure from the elderly when the system was immature, and, thus, mutual references among municipalities can be considered to have played an important role at the beginning of the LTCI.

Despite some lack of statistical concreteness in our analysis, it is worthwhile to investigate the linkage between benefit expenditures and premium burdens. Although this linkage is intended by the LTCI system in Japan, no previous study considers it. Future topics for the research in this field could include implementing a spatial econometric estimation of the strategic interactions considering political factors. This approach might make it possible to distinguish yardstick competition and reference behavior from political pressure.

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