Economic Systems xxx (xxxx) xxx

Contents lists available at ScienceDirect

Economic Systems

journal homepage: www.elsevier.com/locate/ecosys

Where does the EU cohesion policy produce its benefits? A model analysis of the international spillovers generated by the policy

Francesca Crucitti[a], Nicholas-Joseph Lazarou[a], Philippe Monfort[b], Simone Salotti[a,*]

[a] European Commission, JRC Seville, Spain
[b] European Commission, DG REGIO, Belgium

A R T I C L E I N F O

JEL classification:
C53
E62
O30
O41

Keywords:
Cohesion policy
General equilibrium
Spatial spillovers

A B S T R A C T

In this paper, we investigate the macroeconomic effects of the 2007–2013 cohesion policy investments in the EU. First, we present a detailed overview of the EU budget and the contributions of the Member States for the specific policy under scrutiny. Then, we use a dynamic spatial general equilibrium model to assess the overall impact of the policy both in the short and the long run. Finally, we focus on the spatial spillovers generated by the policy programmes and highlight a number of policy-relevant findings with regard to the debate over the financing of the policy and the divide between its net contributors and net beneficiaries. Our main findings suggest that cohesion policy programmes have had a positive and significant impact on the economies of EU Member States and regions, particularly in the poorest regions of the EU. Spatial spillovers imply that the programmes implemented in the main beneficiaries of the policy also benefit its main contributors. For some of these Member States, spillovers constitute the main source of benefits from cohesion policy.

1. Introduction

According to the Treaty on European Union (EU), the objective of the European cohesion policy is to strengthen economic, social, and territorial cohesion, notably by reducing disparities in the levels of development between regions. Accordingly, cohesion policy supports interventions aimed at enhancing the structure of the regional economies, fosters social inclusion, and promotes sustainable development. The EU allocates considerable financial means to cohesion policy. Today, it is the second largest item in the EU budget after the common agricultural policy, being allocated around €355 billion for the 2014–2020 programming period, around one third of the multiannual financial framework.

Cohesion policy is supposed to support the process of convergence, through which the less developed EU countries and regions catch up with the more developed ones. Thus, most of the policy resources target the former group of regions. At the same time, the EU budget is largely financed by the contributions of the Member States, which are proportionate to their gross national income (GNI). As a result, cohesion policy implies a transfer of resources from the richest to the poorest EU Member States and regions.

* Correspondence to: Calle Inca Garcilaso 3, 41092 Sevilla, Spain.
E-mail address: simone.salotti@ec.europa.eu (S. Salotti).

https://doi.org/10.1016/j.ecosys.2023.101076
Received 22 March 2022; Received in revised form 21 July 2022; Accepted 5 September 2022

Please cite this article as: F. Crucitti, N.-J. Lazarou, P. Monfort et al., Where does the EU cohesion policy produce its benefits? A model analysis of the international spillovers generated by the policy, Economic Systems, https://doi.org/10.1016/j.ecosys.2023.101076

This partly explains why cohesion policy is one of the most debated and evaluated policies of the EU. While some Member States are net beneficiaries of the policy, others are net contributors, and the policy is constantly scrutinised regarding the use of funds and its capacity to deliver results. This has led to a vast literature trying to assess the impact of the policy and its value for money with a wide variety of techniques, including various econometric analyses, theory-based evaluations, and counterfactual impact evaluations (see, for instance, Fratesi and Wishlade, 2017). Another strand of the literature has analysed the process of institutional convergence in the EU with interesting implications for cohesion policy (Beyaert et al., 2019).

A question keeps recurring in discussions of how the benefits and costs of the policy are shared among the Member States: what are the returns to the net contributors from policy interventions in the net beneficiary countries and regions? Cohesion policy is likely to produce important spatial spillovers, with the programmes implemented in a given region having an impact for the rest of the EU. For instance, the economic activity generated by interventions in the net beneficiaries may lead to an increase in disposable income and, therefore, in imports, some of which could originate from the net contributors. Interventions also increase the competitiveness of the recipients, thereby affecting the spatial distribution of business and factors of production (capital and workers) throughout EU territories. This type of mechanism can have a considerable impact on the costs–benefits balance of the policy and, as a result, the net contribution or the benefits of the Member States cannot be properly assessed by simply looking at the amounts they pour into, and receive from, the community budget.

Quantifying these indirect effects of the policy is not a simple task, and only a few analytical instruments can actually provide credible estimates. In this paper, we use a spatial dynamic computable general equilibrium model to analyse the spillovers associated with the EU cohesion policy for the 2007–2013 programming period. We focus particularly on the extent to which the benefits of the interventions implemented in the net beneficiaries spread out to the net contributors. This is a key point in the debate surrounding cohesion policy, as some Member States are concerned about the use of national resources to finance interventions elsewhere in the EU, while others question the true geographical distribution of its benefits (see, for instance, Bartkiewicz et al., 2011).

The results of our model simulations suggest that in the medium to long run, there are substantial benefits originating in the regions targeted by the policy, which disseminate to the rest of the EU. In particular, by 2030, we find that more than 40% of the macroeconomic impact of the policy in the net contributor countries is due to spillovers generated by interventions implemented in the policy's main beneficiaries, and this share continues to grow in the long run, reaching more than 45% in 2040. This makes the programmes beneficial even for the territories that contribute the most to the financing of the interventions themselves. The analysis reveals that the magnitude of the spillovers depends on the degree of openness of the economies to international trade and the specific trade flows within the EU, as well as on the amount of policy funds.

The remainder of the paper is organised as follows. Section 2 contains a brief literature review regarding evidence of the macroeconomic impact of cohesion policy. Section 3 sets the scene regarding the EU budget and the contributions of the Member States to cohesion policy, mainly using information from the programming period 2007–2013, on which the analysis is based. Section 4 provides a brief description of the model, while Section 5 explains how cohesion policy interventions are factored into the model as policy shocks. Section 6 discusses the results of the simulations and Section 7 provides a conclusion.

2. The literature on the macroeconomic impact of cohesion policy

Most existing studies that attempt to quantify the macroeconomic impact of the European cohesion policy make use of econometric techniques, with a minority of contributions being based on modelling frameworks. The vast majority of the econometric studies follow the neoclassical growth model (Barro and Sala-i-Martin, 2004) and use growth regressions (Durlauf, 2009) in order to investigate the role played by cohesion funds in determining GDP growth. This approach presents several issues that are worth discussing. First, the econometric findings are based on reduced-form regressions. Thus, they are silent about the channels activated by the EU transfers, and incapable of providing policy-relevant insights in terms of recommendations for policymakers to improve the design of the policy under analysis (Berkowitz et al., 2020). Second, the growth regressions estimate the impact of spending without controlling for how the policy is financed. Third, there is a danger of biased estimates due to reverse causality, since the structural funds are allocated according to criteria that are likely to be highly correlated with economic growth (Mohl and Hagen, 2010). Studies assessing the impact of other place-based policies that are not subject to such endogeneity issues may help shed light on the actual impact of this type of intervention. Wang (2013) assesses the impact of the creation of the Special Economic Zones (SEZ) policy on municipalities in China, finding a positive effect. More specifically, the SEZ program increased foreign direct investment through firm relocation and other mechanisms, with no evidence of crowding out. Wu et al. (2021) report consistent findings on the same programme. To the best of our knowledge, there are no general equilibrium analyses dealing with territorial policies outside the EU.

Related to this literature, but with a slightly different perspective and closer to the aim of this paper, spatial econometrics account for the externalities created by the programmes implemented in a region on its neighbours via trade, technology, or production factor flows, as discussed above. This strand of literature generally finds that cohesion policy is likely to generate substantial positive spatial spillovers (see, for instance, Mohl and Hagen, 2010, and Fidrmuc et al., 2019), that are possibly larger in the core than in the periphery (Bourdin, 2019). On the other hand, Breidenbach et al. (2019) suggest that spillovers may be negative due to intensified competition for scarce production factors. Puškárová and Piribauer (2016) concentrate on knowledge spillovers in the Vienna-Budapest-Bratislava region with interesting implications for cohesion policy.

It is possible to identify two main groups of studies on specific types of spillovers, although these are not directly related to cohesion policy. Keller (2002) and Greunz (2003) study technological spillovers. Keller (2002) estimates the effects of a country's R&D on its own productivity and that of other countries, while Greunz (2003) focuses on European regions. The evidence suggests that the spillovers decline with distance, and that technology proximity and geographical proximity coincide, at least partially. The second group analyses trade spillovers, paying particular attention to the role played by transport costs. Ho et al. (2013) empirically examine the spread of international spillovers of economic growth through bilateral trade. The results, based on a spatially augmented version of the Solow model, suggest that economic growth generates positive spillovers from a country to its trade partners. The inclusion of spatial terms leads to a higher rate of convergence. From a slightly different perspective, Clark et al. (2004) study the importance of transport infrastructure and transport costs for income growth. According to the authors, the primary benefit of a reduction in transport costs is the impact on firms' competitiveness and trade. For small regions whose dynamics have little impact on equilibrium prices, the lower the transport costs, the less the firms in those regions pay for imported intermediate goods, and the more they receive for their exports. As will become clear in the following sections, our model provides results that are consistent with this mechanism.

A fundamentally different approach to the examination of cohesion policy relies on quantitative general equilibrium models. This type of analysis offers more consistent results on the impact of the European regional policy. In fact, the use of these models may help overcome many of the drawbacks of the empirical studies discussed above, although some limitations must be taken into account. First, though integrating geography elements is necessary to produce credible estimates of the impact of cohesion policy, building up a regional general equilibrium model might be challenging, mainly due to data availability and computational complexity. Indeed, the models used by In 't Veld (2007), Bradley et al. (2007), Allard et al. (2008), and Varga and In 't Veld (2010, 2011) only present either EU- or country-level analyses. A regional dimension exists in the models used by, for example, Brandsma et al. (2015) and Varga (2017), making their models more suitable to analyse cohesion policy as well as other place-based initiatives. Di Comite et al. (2018) provide an impact assessment of the 2007–2013 cohesion policy structural investments, but do not investigate the existence of spillover effects, nor do they discuss the redistributive implications of the policy at the EU level. Blouri and von Ehrlich (2020) use a general equilibrium model with some parameters calibrated for the regions of the EU in order to assess the impact of cohesion policy, concentrating on three main channels: wage subsidies, local productivity amenities, and local transportation infrastructure. According to their results, the latter is the channel most likely to generate positive spillover effects across the EU regions; however, they do not provide any quantitative evaluation of these spillovers.

Another aspect regarding general equilibrium modelling is that it relies heavily on assumptions regarding the fundamental parameters governing the behavioural equations that describe the functioning of the economy. Economic theory and empirical estimates can guide the researchers at the time of parametrizing the models, but to a certain degree the results depend on the choices made at this stage. Moreover, the construction of scenarios to study actual policies requires additional assumptions. For instance, there is an important debate surrounding cohesion policy on the ability of national and regional institutions to manage the funds. General equilibrium models often assume that the funds are spent efficiently on all projects, which may not be the case in all countries and regions due to difficulties in finding reliable data on the policy governance and incorporating them into a modelling framework.

Overall, the theoretical macroeconomic literature examining cohesion policy mostly focuses on the direct impact of this instrument, with little attention paid to the policy debate on the benefits of the programmes in net contributor countries. Our analysis, through the lens of a tractable general equilibrium model, provides a quantitative estimate of the indirect effects of the interventions. In particular, we examine the spillovers generated by interventions in the territories mainly targeted by cohesion policy that materialise in the countries contributing the most to its financing. Thus, our paper contributes significantly not only to the academic discussion, but also to the vivid policy debate on territorial cohesion. To the best of our knowledge, no previous study has addressed this question.[1] Our analysis focuses on the 2007–2013 cohesion policy programmes for which data on actual expenditure is available. As explained in more detail below, these programmes were implemented between 2007 and 2017.

3. The EU budget and the contribution of the member states

Most of the EU budget comes from traditional own resources and national contributions. The former consist of duties and levies, while the latter mostly consist of value added tax (VAT)-based and GNI-based national contributions.

Duties and levies included in the traditional own resources are mainly sugar levies and customs duties on imports from outside the EU. The Member States are responsible for the collection of these resources and retain 20% of the traditional own resources paid to the EU budget to compensate for the collection costs.

The VAT-based national contribution is a percentage of the VAT base of each Member State, which, for both the 2007–2013 and the 2014–2020 multiannual financial frameworks, corresponded to a call rate of 0.30% of the national VAT base. The GNI-based national contribution corresponds to a call rate applied to the GNI of each Member State, calculated to provide the revenue necessary to cover expenditure in excess of the other revenues, thereby ensuring that the annual EU budget is always balanced. The rates vary accordingly from one financial year to another, and various mechanisms exist to correct financial contributions considered as excessive for some Member States.[2]

The national contributions represent by far the largest source of revenue of the EU budget. Between 2007 and 2017, national contributions amounted to 79% of the total financing on average (12% accruing to the VAT-based contribution, and 67% to the GNI-based resources). The biggest EU economies contribute more to the community budget than the smallest ones due to the correlation of these contributions with GNI (by design). During the 2007–2017 period, Germany, France, Italy and Spain represented, respectively, 20.1%, 17.5%, 13.2% and 8.9% of the total national contributions.

[1] The working paper by Monfort and Salotti (2021) studying this issue is an earlier version of the present study.

[2] These correspond to the United Kingdom rebate, a reduction of the national contribution for Austria, Denmark, the Netherlands and Sweden and a reduction of the VAT call rates for Germany, the Netherlands and Sweden.

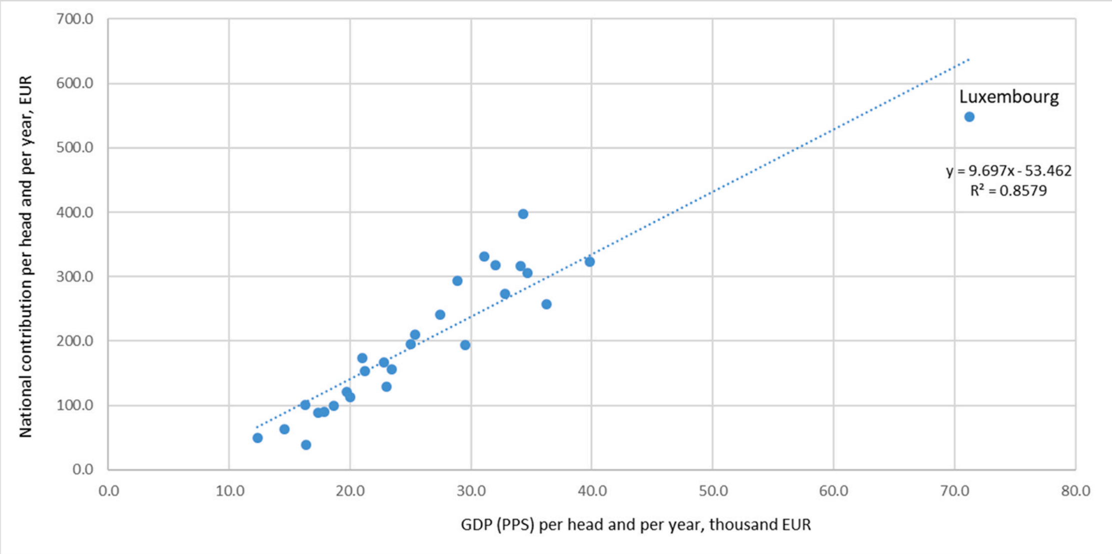

Fig. 1. National contribution to operating expenditure per capita vs GDP per capita (yearly average 2007–2017, Source*:* Own calculations based on European Commission data.

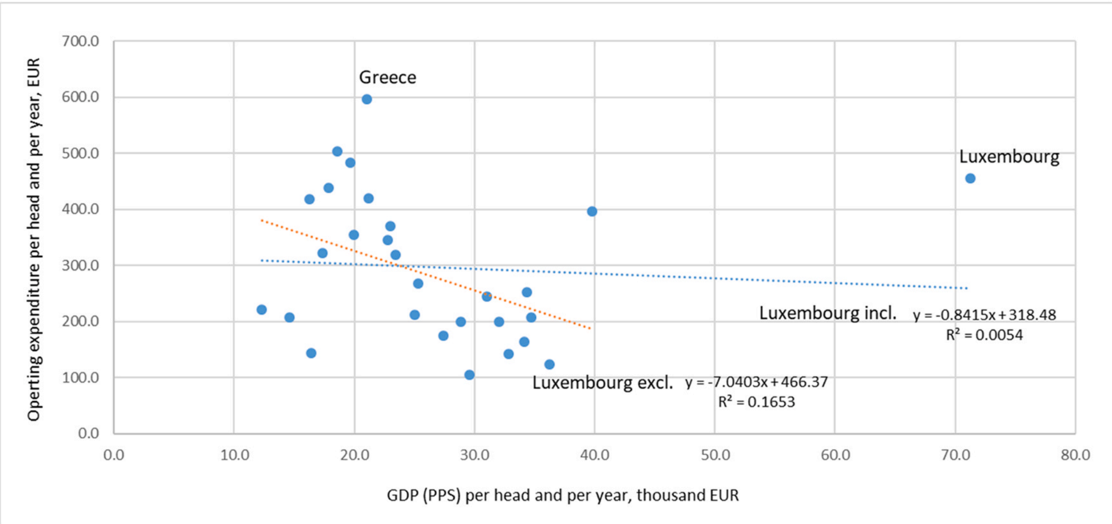

Fig. 2. Operating expenditure per capita vs GDP per capita (yearly average 2007–2017),
Source: Own calculations based on European Commission data.

Given these characteristics, the EU budget is redistributive, both on the revenue and expenditure sides. As highlighted by Figs. 1 and 2, there is a strong correlation between Member States' gross domestic product (GDP) per capita and their contribution to the operating expenditure of the community budget.[3] On the contrary, operating expenditure per capita is negatively correlated to GDP per capita, although not as significantly.[4]

In contrast, the correlation between cohesion policy expenditure and GDP per capita is much stronger (Fig. 3). This reflects the legal basis of the policy to reduce development gaps in the EU, which operationally implies that the funding is concentrated in the less developed Member States and regions of the EU.

[3] The operating expenditure excludes administration costs. These are concentrated in the Member States hosting the EU institutions and hence introduce a bias in the geographical distribution of expenditure. The national contributions to the operating expenditure are calculated as the national contribution multiplied by the share of operating expenditure over total expenditure in each Member State.

[4] However, this result is strongly influenced by Luxembourg, which stands as an outlier. When excluding this country from the analysis, the negative relationship between GDP per capita and operating expenditure becomes much clearer and more significant.

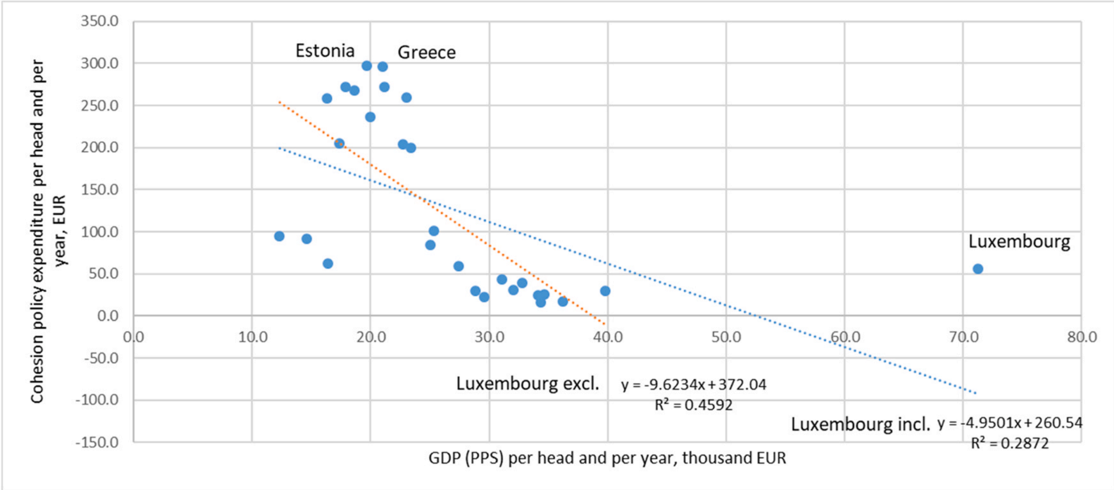

Fig. 3. Cohesion policy expenditure per capita vs GDP per capita (yearly average 2007–2017),
Source: Own calculations based on European Commission data.

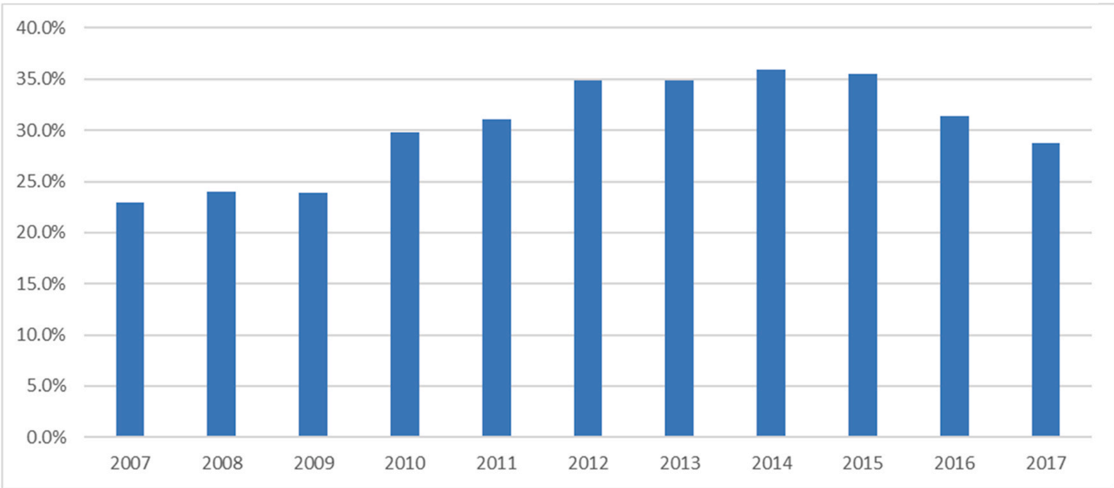

Fig. 4. Redistribution through the EU budget as a percentage of operating expenditure,
Source: Own calculations based on European Commission data.

The operating budgetary balance is the difference between the national contribution to the operating expenditure and these expenditures in each Member State. The community budget being at equilibrium, the balance at the EU level is zero. The amount of funding redistributed then corresponds to the sum of the positive national balances (which corresponds to the absolute value of the sum of the negative balances). Between 2007 and 2017, redistribution among Member States ranged between 23.0% and 35.9% of operating expenditure, with an average of 30.3% for the whole period, as shown in Fig. 4.

Cohesion policy plays a key role in the redistribution implemented through the EU budget. The balance between the contribution of the Member States to cohesion policy[5] and cohesion policy expenditure is shown in Fig. 5 below.[6] The countries with a positive cohesion policy balance correspond to those eligible for the cohesion fund for that period and we will refer to them as cohesion countries (CCs). The other group is the rest of the EU and will be referred to as non-cohesion countries (NCCs).

On average, between 2007 and 2017, almost €22 billion were redistributed each year via cohesion funding, corresponding to 64.2% of the total amount redistributed through the EU budget.

However, the EU budget national contributions and expenditures are likely not to be the only source of redistribution linked to cohesion policy. The programmes implemented in a given country also affect the rest of the EU due to the many spillovers generated

[5] The contribution of the Member States to cohesion policy corresponds to the national contribution multiplied by the share of cohesion policy in the operating expenditure.

[6] In fact, the Member States for which the balance is positive are those eligible for the cohesion fund for 2007–2013.

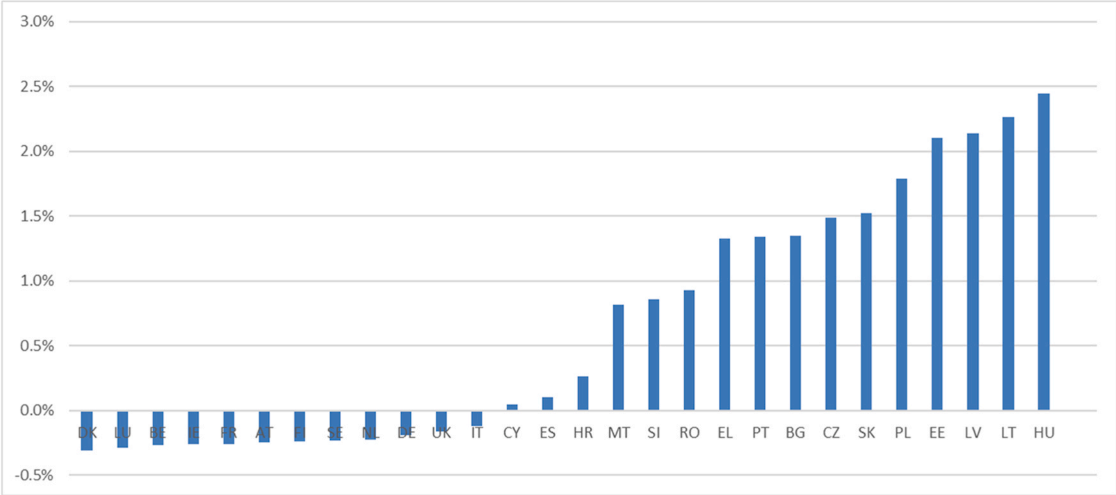

Fig. 5. Cohesion policy balance (average 2007–2017, % of GNI),
Source: Own calculations based on European Commission data.

by this type of policy. The sources of these spillovers could be numerous. Notably, they stem from the fact that the net recipient countries are often small open economies with narrow industrial bases, where many goods or services critical for the implementation of cohesion policy programmes are not produced domestically. Thus, the implementation of the programmes generates demand for these goods and services which is satisfied via imports, notably from other countries and regions of the EU. The induced process of development also triggers demand for imports of a wide range of goods and services from their main, and more advanced, trading partners.

One additional spillover source lies in research and development (R&D) investments: the effects of an innovation hardly remain confined to a specific territory since other regions can benefit through processes of imitation or technological externalities (Bottazzi and Peri, 2003). Finally, some of these spillovers may also be negative. Cohesion policy investments boost the competitiveness of the beneficiaries, which can then gain market shares at the expense of the others.

This implies that the EU budget figures cannot be used to infer how the benefits and costs linked to cohesion policy are shared among the Member States. In what follows, we use a spatial dynamic general equilibrium model accounting for a number of those spillovers to assess the impact of cohesion policy on the EU Member States, and to uncover which share of the total impact of the policy is attributable to spillovers and how they are distributed across the EU Member States.

4. A brief description of the model

In this section, we briefly describe the general equilibrium model used in the analysis to help identify the key drivers and determinants of the spatial outcomes generated by it. More details on the model can be found in Lecca et al. (2018, 2020). In this paper, we use a version with an updated treatment of transport costs based on Persyn et al. (2022).

The model represents a decentralised market economy based on the assumption that producers maximise their profits and households consume out of their disposable income, with market prices adjusting endogenously to keep supply and demand balanced in all markets.

The domestic economy consists of the 267 endogenous NUTS 2 regions of the EU28. The rest of the world is an exogenous external economy. The model includes the following 10 NACE rev.2 economic sectors: agriculture, forestry and fishing; energy; manufacturing; construction; trade and transport; information and communication; financial activities; R&D; public administration; and other services. Firms operate under perfect competition in all sectors.

All the final goods produced in the economy are used for investment purposes by firms, and for consumption purposes by households and the government. Love of variety is assumed by adopting a consumption function with constant elasticity of substitution (CES). Government expenditure comprises current spending on goods and services and net transfers to households and firms. Government revenues are generated by labour and capital income taxes, and indirect taxes on production. The cost of cohesion policy is modelled via a contribution of each Member State proportional to its GDP financed by lump sum taxes.

The firms' production technology is represented by a multilevel CES function combining value added and intermediate inputs, net of fixed costs. Total factor productivity is modelled via a conventional Hicks neutral technical change parameter. Public capital enters the production function as an unpaid factor of production for which congestion effects are taken into account, as in Edwards (1990), Turnovsky and Fisher (1995) and Fisher and Turnovsky (1998).

Goods and services can either be sold in the domestic market or exported to other regions. At the same time, firms and consumers can purchase inputs within the region or from external markets. Traded goods are differentiated by origin of production within the EU as per Armington (1969) and by sector of production. There is homogeneity in production within sectors and thus the domestic price of the traded good is a constant markup over the marginal cost, with an elasticity of substitution set to 4.[7] The final price that importers pay is the domestic price augmented by the cost of transport, which is represented as an iceberg cost *à la* Krugman (1991). These costs are sourced from Persyn et al. (2022).

The model incorporates imperfect competition into the labour market modelled with a long-run wage curve wherein the real wage is solely affected by the unemployment rate, assuming that the unemployment parameter is equal to 0.1 (Nijkamp and Poot, 2005).

Private investments are modelled according to the neoclassical firm's profit maximisation theory (maximising the present value of firms). The aggregated level of investments is defined as the gap between a desired level of private capital and its actual level, adjusted by depreciation. Thus, the investment capital ratio is a function of the rate of return to capital and the user cost of capital, allowing the capital stock to reach its desired level smoothly over time. This is a typical accelerator model *à la* Jorgenson and Stephenson (1969) and is consistent with the capital adjustment rules of Uzawa (1969). The user cost of capital is a function of the interest rate, the depreciation rate, the investment price index and an exogenous risk premium. In the long run, changes in capital returns in all regions should equalise, which means that the allocation of investments between regions is driven by the differences between regional and EU average return, ensuring capital flow mobility between regions. The EU is assumed to be a price-taker on the world financial market, which determines the level of the interest rate.

The model is calibrated so as to reproduce the base year data represented by the interregional Social Accounting Matrices (SAMs) for year 2013, constructed by Thissen et al. (2019). The choice of the year 2013 for the calibration is based on data availability, as it is the most recent year for which regional SAMs can be built with a sufficient degree of reliability. The SAMs include all the bilateral trade flows among regions, corrected for re-exports and re-imports, and they are consistent with the existing international trade flows.

The structural parameters of the model are either borrowed from the literature or estimated econometrically. The parameters related to the elasticities of substitution both on the consumer and the producer side are either based on similar models or derived from the econometric literature. We assume a 0.4 elasticity of substitution in production (in line with Chirinko, 2008, and Leon-Ledesma et al., 2010), and a relatively low elasticity of substitution in consumption of 0.3. The interest rate (faced by producers, consumers and investors) is set at 0.04, while the rate of depreciation applied to the private capital equates to 0.15 (that of public capital is set at 0.05).

The model calibration process assumes that the economies are initially in steady-state equilibrium. This means that the capital stock is calibrated to allow depreciation to be fully covered by investments. The steady-state equilibrium calibration implies that the data observed should provide unbiased information about preferences and technologies in each region and therefore relative magnitudes should not vary in the baseline scenario. We assume that there is no natural population change and do not make any assumptions about the economic growth of regions due to external factors.

5. Modelling cohesion policy investments

5.1. *Cohesion policy funding*

In this analysis, we focus on the programmes funded by the European Regional Development Fund (ERDF), the Cohesion Fund (CF) and the European Social Fund (ESF) during the 2007–2013 programming period, for which data on actual expenditure exist. Given the N + 3 rule,[8] interventions were actually implemented between 2007 and 2017 and amounted to almost €320 billion in total.

The interventions funded during this period were broken down into 86 categories of expenditure for monitoring purposes. Spending data for the ERDF and CF by year and by categories were provided at the NUTS 2 level by Work Package 13 of the ex post evaluation for 2007–2013 (European Commission, 2015). For the ESF, data at the regional level are not available and the amounts at the national level have been distributed across NUTS 2 regions in proportion to their population.

The resources mobilised by cohesion policy tend to be invested in the less developed parts of the EU (mostly located in the CCs). As highlighted by Fig. 6, which shows the amount invested as a percentage of regional GDP, the policy channelled considerable resources to central and eastern European regions, and to a number of southern European regions, particularly in Greece and Portugal. For instance, between 2007 and 2017, cohesion policy expenditure corresponded on average to about 3.3% of GDP in Região Autónoma dos Açores (PT20), 4.6% in Észak-Alföld (HU32) and 4.2% in Dél-Alföld (HU33). For more developed regions, investments were much more limited, as in Inner London – West (UKI1) or Luxembourg (LU00), where cohesion policy expenditure corresponded on average to around 0.01% of GDP.

5.2. *Translating actual expenditures into model shocks*

In order to introduce cohesion policy into the model, we grouped the 86 categories of expenditure into the following six fields of interventions: transport infrastructure investments (TRNSP); other infrastructures (INFR); investments in human capital (HC); investments in research and innovation (RTD); aid to the private sector (AIS); and technical assistance (TA). We used a model shock to simulate each category with an appropriate economic transmission mechanism, except for the AIS and INFR categories, which are associated with more than one model shock due to the specific nature of these interventions.

[7] This is based on empirical estimates of European data by Németh et al. (2011) and Olekseyuk and Schürenberg-Frosch (2016).

[8] The Member States' cohesion policy allocations are divided into annual amounts that must be spent within 2 or 3 years, depending on the country. This rule is known as the 'N + 2 or N + 3′ rule, with N being the start year when the money is allocated.

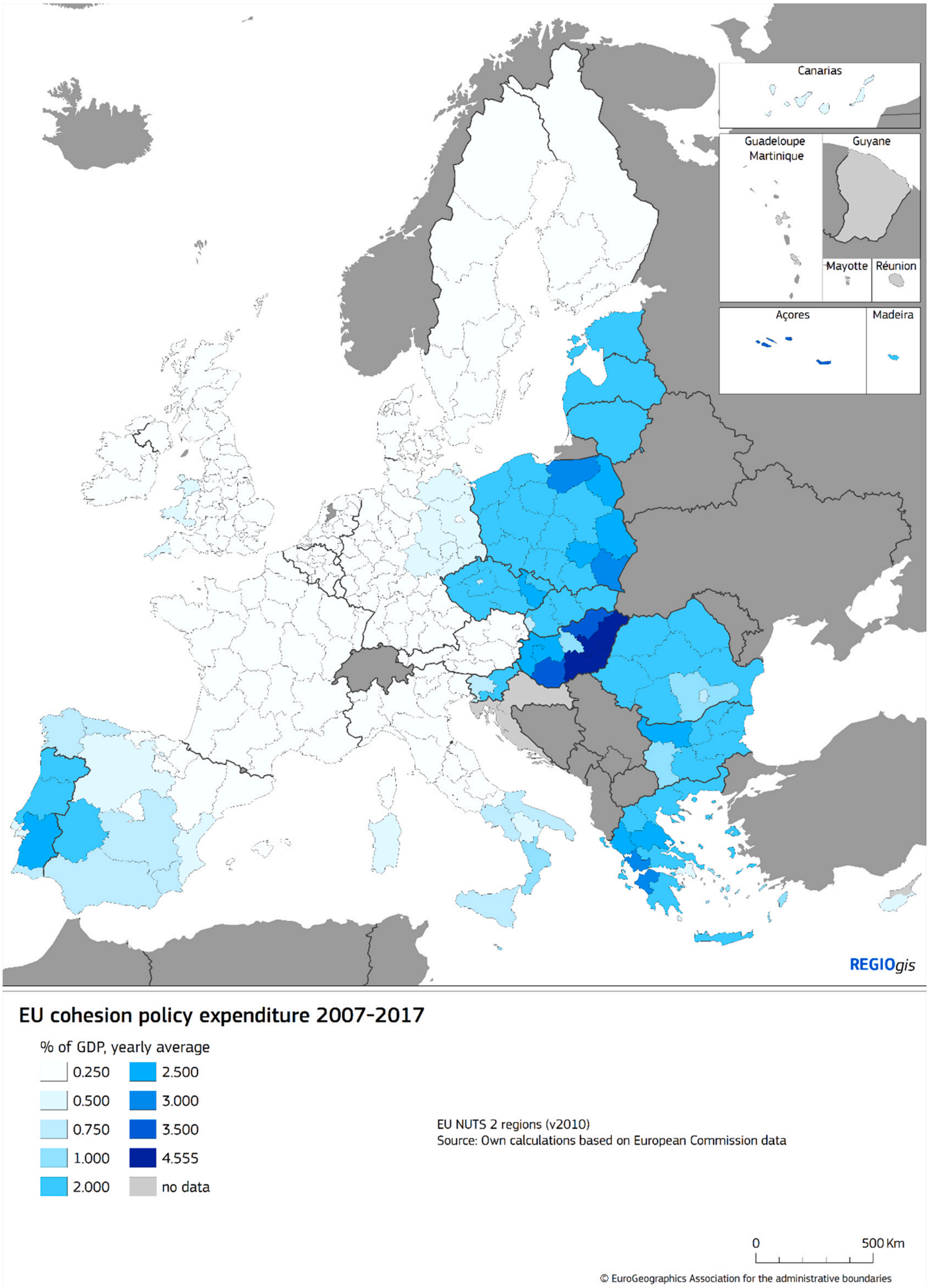

Fig. 6. EU cohesion policy expenditure 2007–2017, EU NUTS 2 regions (% of 2013 GDP, yearly average).

Table 1 illustrates the combinations of model shocks used for each of the six fields of intervention listed above, together with some brief explanations of the associated economic mechanisms at work both in the short and the long run. The list of the 86 spending categories of expenditure and their tags is reported in Table A.1 in the Appendix.

Table 1
Description of the model shocks by field of intervention.

Field of intervention	Code	Model shock	Short-run (demand side) effects	Long-run (supply side) effects
Transport infrastructures	TRNSP	TRNSP	Increase in government consumption	Decrease in transportation costs
Other infrastructures	INFR	IG G	Increase in public investment Increase in government consumption	Increase in the stock of public capital
Human capital	HC	HC	Increase in government consumption	Increase in labour productivity
Research and development	RTD	RTD	Stimulates private investment in R&D	Increase in total factor productivity (TFP)
Aid to private sector	AIS	RPREMK G	Reduction in risk premium stimulating private investment Increase in government consumption	Increase in the stock of private capital
Technical assistance	TA	G	Increase in government consumption	

Source: Own modelling assumptions based on the composition of the 2007–2013 cohesion policy expenditure categories.

As explained above, the 2007–2013 cohesion policy programmes were actually implemented between 2007 and 2017. We therefore simulated the interventions over a period of 11 years, according to country-specific time profiles based on the data provided by Work Package 13 of the ex post evaluation for 2007–2013 (European Commission, 2015). Most of the money was spent in the middle of the time period, as shown in Table A.2 in the Appendix.

The model shocks can be broadly distinguished between demand-side shocks (with temporary effects) and supply-side shocks (with more permanent structural effects on the economy). The relationship between the shocks and the fields of intervention is as follows:

- Transport infrastructures (TRNSP) – Investments in transport infrastructure are assumed to generate both demand- and supply-side effects. Demand-side effects are produced by the temporary increases in government consumption accounting for the purchase of goods and services required to build the actual infrastructures. On the supply side, these investments are assumed to reduce the transport costs, hence decreasing the prices of goods and stimulating trade flows. The policy injection is converted into transport cost changes using information on the cost of building new roads, which is heterogeneous across regions. This estimation is based on the transport model by Persyn et al. (2022), where the change in transport cost reflects region-specific variables such as the quality of the existing transport network, the number of additional lanes, the maximum speed, etc. Figure A.2 in the Appendix shows how results in the model change using an alternative estimation of regional initial transport costs and conversion parameters. These alternative estimations are based on TRANS-TOOLS, a transport network model for Europe, developed by the European Commission (Brandsma et al., 2015).
- Other public infrastructures (INFR) – Investment in non-transport infrastructures, such as electricity networks, water treatment plants and waste management facilities, are modelled as public investments when associated with industrial processes, and as government consumption otherwise (only temporary demand-side effects are produced in the latter case). Public investments not only trigger an increase in demand, but also entail supply-side effects, since they increase the stock of public capital and therefore foster the production of goods and services. We set the output elasticity of public capital equal to 0.1, in line with Ramey (2020), and slightly below the average of 0.12 found by the meta-study by Bom and Lightart (2014). We set the congestion parameter of public capital equal to 0.5, equivalent to a medium level of congestion (Alonso-Carrera et al., 2009 – a value of zero would make public capital a pure public good).
- Research and development (RTD) – Investments in research and development are modelled as increases in private investments via a reduction in the risk premium, which increase the stock of private capital. Moreover, these investments are assumed to increase total factor productivity (TFP) according to an elasticity which depends on the importance of spending in research and development in the region relative to GDP and is based on the study by Kancs and Siliverstovs (2016).
- Human capital (HC) – Investments in human capital are assumed to increase demand via government current expenditure. They are also assumed to have two alternative supply-side effects, depending on the nature of the interventions. The spending categories associated to human capital development, such as training, re- and up-skilling and other active labour market policies, are assumed to generate an increase in labour productivity. The main assumption behind this effect lies in the productivity increase caused by an additional training year, which we set at 7% based on the literature (De la Fuente and Ciccone, 2003; Canton et al., 2018). The cost of education per pupil is used to calculate the amount of training implied by the HC funds of cohesion policy, with country-specific efficiency corrections based on PISA scores. On the other hand, the interventions aimed at promoting the socio-economic integration of marginalised communities, participation in the labour market, or the modernisation of labour market institutions, are assumed to generate an increase in the aggregate labour supply. In this case we assume a higher cost per trainee, and that it takes two to three years of training to integrate a worker into the labour supply.
- Aid to private sector (AIS) – Aid to the private sector is modelled, depending on the nature of the interventions, as either government consumption or an increase in private investments via a reduction in the risk premium, like the RTD investments, but without any impact on TFP.
- Technical assistance (TA) – This type of intervention is modelled as a demand-side shock increasing public current expenditure with no supply-side effects.

We further assume that all the long-run supply-side effects decay over time. Thus, the changes in labour productivity and supply, TFP, and transport costs are all assumed to decay at a 5% yearly rate. Moreover, the stocks of private and public capital have a depreciation rate of 15% and 5%, respectively. This implies that, in the absence of further investments, the structural effects related to the policy gradually vanish and the economy returns back to its initial steady state.

The model simulations take into account the fact that cohesion policy is financed by the Member States' *pro rata* contribution to the EU budget, which is assumed to be proportional to the weight of their GDP in EU GDP. The Member States' contribution to the funding of cohesion policy is assumed to be financed by a lump-sum tax, thereby decreasing household disposable income, thus adversely affecting the economic performance and partly offsetting the positive impact of the programmes.[9] This implies that a larger share of the Member States' contributions to cohesion policy comes from the more developed parts of the EU, while the bulk of the interventions takes place in its less developed territories.

The mapping of expenditure categories into the fields of intervention reported in Table A.1 in the Appendix determines the policy mix of each Member State, that is, the distribution of cohesion funding among the various fields of interventions. Table 2 reports the distribution of expenditures per field of intervention at the Member State level.

At the EU level, the highest share of payments goes to infrastructure (24.4%) and transport (23.8%), followed by support for the development of human capital (21.9%). The share of the first two fields is generally much higher in the Member States that joined the EU after 2004, while in the EU-15 (Member States that were in the EU before 2004), investments in R&D, human capital and aid to the private sector are predominant.

6. Results

6.1. Impact of the 2007–2013 programmes

This subsection reports the results based on a scenario simulating the full cohesion policy package both on the spending and on the financing side. Results are expressed as deviations from a hypothetical (baseline) scenario in which no cohesion policy is implemented, thus allowing us to interpret the results as the 'pure' impact of the policy.

Fig. 7 reports the impact of the policy on some key macroeconomic variables over time. In the short run, a substantial part of the impact stems from the increase in demand, which is partly crowded out by an initial increase in prices. This is particularly the case during the early stage of the implementation period when supply-side effects are quasi-absent. In the medium to long run, the productivity-enhancing effects of cohesion policy investments materialise, leaving room for GDP to increase free of inflationary pressures. The impact of the interventions remains long after the termination of the programmes, which is to be expected from a policy that is meant to improve the structure of the economies via long-term effects on productivity, labour supply and transport costs.

Another interesting finding highlighted by Fig. 7 is that the policy leads to improvements in the trade balance as soon as supply-side effects kick in. The structure-enhancing effects of the policy result in EU firms becoming more competitive, therefore gaining shares on extra-EU markets.

According to the simulations, EU GDP at the end of the implementation period (2017) is almost 0.3% higher as a result of cohesion policy interventions. The annual impact then stabilises and starts decreasing due to the depreciation of the new stocks generated by these investments, although at a rather low pace. In 2030 and 2050, the impact of the policy on GDP is still at + 0.23% and + 0.12%, respectively.

The impact strongly varies from one country to another and is higher for the main beneficiaries of the policy, all of them pertaining to the group of CCs (see the regional mean GDP impacts in Table 3). For example, at the end of the implementation period in 2017, GDP in Latvia is 3.7% higher due to cohesion policy investments, while in Lithuania and Hungary it is about 2.5% and 2.9% higher, respectively. The impact is much smaller in the NCCs, and especially in the EU-15 Member States. This is attributed to (i) cohesion policy spending being generally low relative to the size of the economies and (ii) most of these countries being net contributors to the policy. In the short run, the impact is even negative in some Member States where the costs of financing the policy (which corresponds to a transfer of resources out of the domestic economy) outweigh its benefits, at least initially.

However, in the medium (the results for 2024 and 2030 are presented in Table 3) and long run (see the 2050 GDP impact in Table 3), the impact of the policy becomes positive for all Member States. After the end of the implementation period, the programmes are terminated and therefore no longer generate costs, but their benefits are still present. This is particularly true for the more developed Member States, where investments tend to be relatively more concentrated in the fields of R&D and human capital, intervention fields which produce most of their effects long after their implementation. Moreover, spatial spillovers fully materialise and tend to redistribute these benefits among Member States, in particular from the CCs (where most of the direct effects of the policy take place) to the NCCs.[10] Lastly, we also observe substantial variation in GDP impact within countries. The GDP impacts differ across

[9] This means that, in the model, the EU regions are not constrained to run a balanced budget and can experience either deficits or surpluses. The EU budget is exogenously constrained to be balanced, as the amount of spending incurred by regions, and financed through the programmes, is repaid with an equal amount of lump-sum transfers from the households.

[10] The spatial distribution of the results shows even more variation at the regional level. The model we use is calibrated at the NUTS 2 level, so regional results are available, but they are not the main focus of the current analysis. We report some additional findings in Figure A.2 in the Appendix, together with the related explanations.

Table 2
Distribution of funds per field of intervention (% of total expenditure).

	RTD	AIS	TRNSP	INFR	HC	TA	Total
AT	22.5	25.5	0.1	4.9	42.9	4.1	100
BE	12.4	26.4	2.7	5.0	51.5	2.0	100
BG	3.5	14.4	29.3	30.5	15.2	7.0	100
CY	5.9	32.8	17.5	20.7	18.3	4.8	100
CZ	11.5	13.2	30.0	28.0	13.8	3.5	100
DE	18.0	20.6	12.5	10.2	36.3	2.4	100
DK	26.1	19.3	0.0	2.8	48.4	3.4	100
EE	15.8	10.3	21.1	42.2	9.9	0.7	100
EL	4.3	18.9	27.3	25.5	21.0	3.1	100
ES	12.7	11.3	29.2	22.0	22.4	2.4	100
FI	23.1	20.2	4.6	8.3	39.7	4.1	100
FR	19.8	13.1	4.2	19.6	39.8	3.5	100
HU	4.1	17.8	24.7	35.7	13.2	4.4	100
IE	15.3	11.0	14.0	9.5	49.9	0.3	100
IT	20.1	15.4	13.6	22.2	24.7	4.0	100
LT	11.2	11.6	24.6	36.2	12.2	4.2	100
LU	24.1	3.0	0.0	21.5	48.6	2.7	100
LV	15.4	9.8	25.8	34.3	12.2	2.5	100
MT	7.0	15.6	16.9	45.3	11.6	3.6	100
NL	19.7	17.6	2.2	5.6	52.8	2.0	100
PL	12.1	9.9	36.4	23.8	14.5	3.4	100
PT	16.2	12.3	8.0	28.6	31.9	3.0	100
RO	4.4	12.2	33.0	28.1	16.5	5.9	100
SE	21.4	21.9	9.0	4.7	40.9	2.1	100
SI	18.8	13.2	19.7	30.0	15.8	2.6	100
SK	8.1	8.9	29.9	37.1	11.9	4.1	100
UK	15.5	23.7	3.8	9.3	46.2	1.5	100
EU	**12.4**	**14.0**	**23.8**	**24.5**	**21.9**	**3.4**	**100**

Source: Own calculations based on European Commission data.

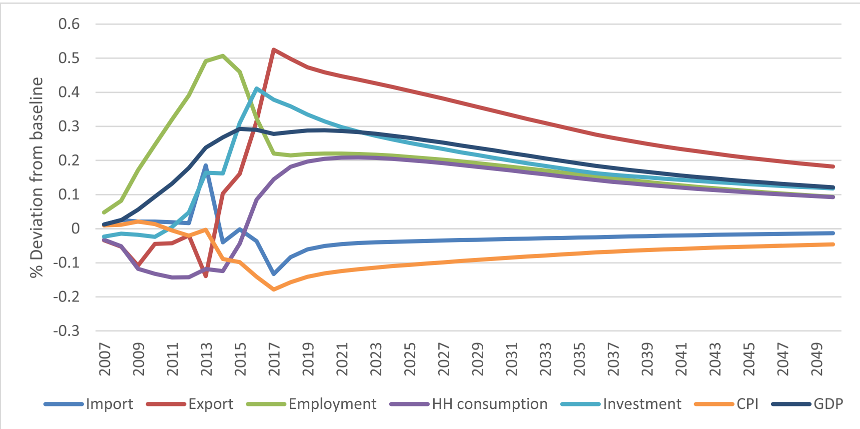

Fig. 7. Impact of 2007–2013 programmes at EU level,
Source: Own modelling simulations.

developing and developed regions irrespective of the countries they are in. The variation appears to be larger in cohesion countries than in non-cohesion countries. For the former countries, the difference is mainly between the capital region and the rest of the regions. The capital region tends to experience the lower GDP impact as it is relatively more developed than the non-capital regions.

6.2. Spillovers

The cohesion policy interventions affect the performance of the Member State or region where they are implemented, but their impact is also likely to spill over into the other countries or regions of the EU. To glean insights on this effect, we exploit the distinction between CCs and NCCs. It would be impossible to disentangle the direct effect of cohesion policy on a region from the indirect effect coming from elsewhere in the EU by simply looking at the actual investment data. However, economic modelling can be used to quantify the two effects separately. To isolate the spillover effects of the policy, we rely on two additional scenarios: one in which we only consider cohesion policy investments taking place in the CCs, and one in which we only consider those taking place in

Table 3
Regional mean GDP impact of 2007–2013 programmes at Member State level in percentage deviation from baseline, selected years.

NCCs					CCs				
Countries	**2017**	**2024**	**2030**	**2050**	**Countries**	**2017**	**2024**	**2030**	**2050**
UK	-0.01 (0.10)	0.08 (0.06)	0.07 (0.05)	0.04 (0.03)	ES	0.84 (0.61)	0.64 (0.46)	0.52 (0.36)	0.24 (0.15)
NL	-0.03 (0.01)	0.06 (0.01)	0.07 (0.01)	0.05 (0.01)	CY	0.73	0.57	0.45	0.20
LU	-0.03	0.06	0.06	0.03	PT	2.18 (0.93)	1.74 (0.66)	1.42 (0.52)	0.76 (0.22)
SE	0.00 (0.03)	0.09 (0.02)	0.09 (0.02)	0.05 (0.01)	SI	1.82 (0.47)	1.45 (0.36)	1.14 (0.29)	0.59 (0.08)
DK	-0.02 (0.01)	0.07 (0.01)	0.07 (0.01)	0.04 (0.00)	CZ	1.89 (0.52)	1.36 (0.38)	1.09 (0.29)	0.56 (0.16)
IE	0.04 (0.09)	0.13 (0.07)	0.13 (0.05)	0.08 (0.02)	MT	1.52	1.19	0.94	0.41
BE	0.03 (0.05)	0.13 (0.03)	0.12 (0.02)	0.07 (0.01)	BG	1.86 (0.39)	1.60 (0.37)	1.40 (0.33)	0.76 (0.17)
AT	0.04 (0.06)	0.10 (0.03)	0.09 (0.02)	0.05 (0.01)	PL	1.91 (0.37)	1.42 (0.25)	1.17 (0.20)	0.58 (0.09)
FR	0.07 (0.07)	0.16 (0.04)	0.14 (0.03)	0.08 (0.01)	EL	2.56 (0.83)	1.78 (0.68)	1.45 (0.58)	0.69 (0.31)
FI	0.07 (0.05)	0.12 (0.05)	0.11 (0.04)	0.07 (0.03)	RO	1.91 (0.34)	1.38 (0.36)	1.15 (0.34)	0.60 (0.19)
DE	0.14 (0.24)	0.16 (0.14)	0.13 (0.10)	0.07 (0.04)	EE	2.03	1.54	1.20	0.55
IT	0.18 (0.37)	0.16 (0.20)	0.13 (0.15)	0.07 (0.06)	SK	2.05 (0.54)	1.47 (0.34)	1.19 (0.27)	0.56 (0.11)
					HU	2.87 (0.84)	2.14 (0.60)	1.71 (0.47)	0.83 (0.20)
					LT	2.51	2.09	1.70	0.80
					LV	3.70	2.28	1.68	0.76

Source: Own modelling simulations. Standard deviations in parentheses for non-single-country regions, country means are calculated using unweighted regional GDP impacts.

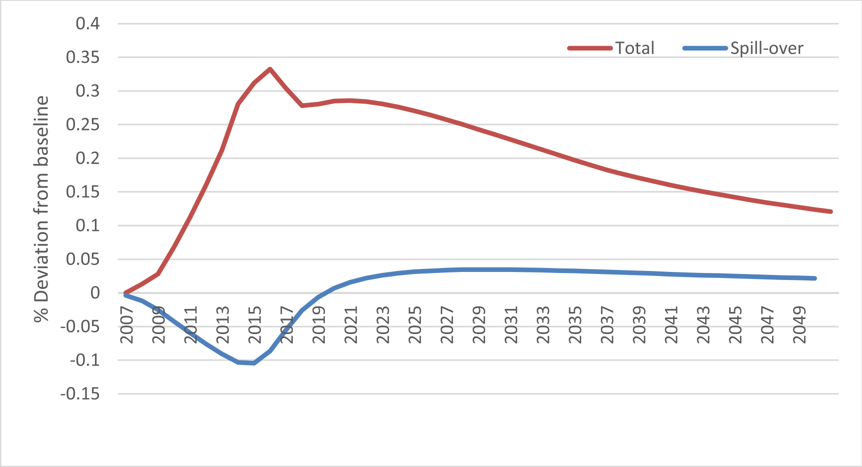

Fig. 8. Total cohesion policy impact and spillovers on EU GDP, 2007–2050,
Source: Own modelling simulations.

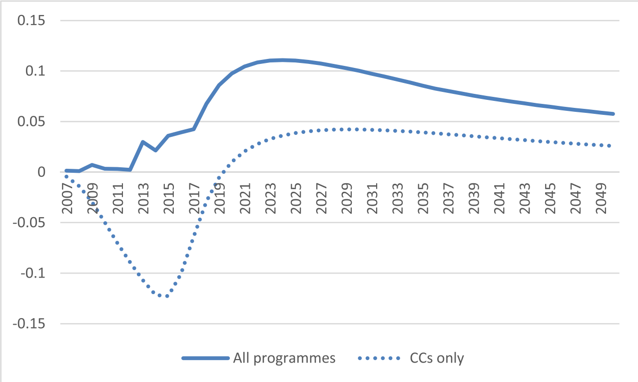

Fig. 9. Total impact on NCCs' GDP and spillovers from CCs programmes, 2007–2050,
Source: Own modelling simulations.

the NCCs. For each scenario (as well as for the full policy scenario illustrated above), we can identify the impact at the EU level, at the group level, and at the country level. In the model, spillovers are generated by trade interactions among regions, which could be either negative (due to adverse competitiveness effects) or positive (due to market expansions resulting from the interventions).[11]

The impact for each group can be broken down as follows: $I^{CC} = i_{CC}^{CC} + i_{NCC}^{CC}$ and $I^{NCC} = i_{NCC}^{NCC} + i_{CC}^{NCC}$, where I^{j} $(j = \{CC, NCC\})$ designates the total impact of the policy on group j and $i_{j}^{x}(x = \{CC, NCC\})$ designates the direct impact of the policy (when $j = x$) and the spillovers stemming from the programmes implemented elsewhere (when $j \neq x$). Fig. 8 shows the magnitude of spillover effects over time $(i_{CC}^{NCC} + i_{NCC}^{CC})$ in comparison to the total impact of the policy at the EU level $(I^{NCC} + I^{CC})$.

During the implementation period, spillovers are negative due to the fact that NCCs have to raise taxes in order to finance the programmes implemented in the CCs. However, once the implementation period is over, this negative impact disappears and the spillovers rapidly become positive in both groups of countries. By 2030, around 15% of the total policy impact in the EU is actually due to spillovers.

This can be further illustrated by focusing on the NCCs that are net contributors to the policy. Fig. 9 shows the total impact of the policy on NCCs' GDP and the spillovers stemming from the programmes implemented in the CCs over time.

At the beginning of the period, the impact on the NCCs' economies is negative, as the positive effects of cohesion policy investments implemented there are unable to offset the negative impact of the taxes levied to finance the policy (a substantial share of which is actually implemented in the CCs). However, after 2017, the positive impact on the CCs increases and spills over to the NCCs. By 2030, more than 40% of the policy's impact on the NCCs corresponds to spillovers originating in the CCs. This share continues to grow in the long run as the impact of the NCCs programmes decays, reaching more than 45% in 2040.

[11] The model does not account for specific spillovers linked to R&D or technological transmission mechanisms. Also, the model takes into account the cost of financing the policy, which alters the market allocation of resources. The model does not account for the opportunity cost of alternative policy use of the revenues raised to finance cohesion policy. For instance, the NCCs could use those resources to deploy public investments in their own territories but, in the absence of information concerning alternative usage of these resources, the analysis does not consider such scenario.

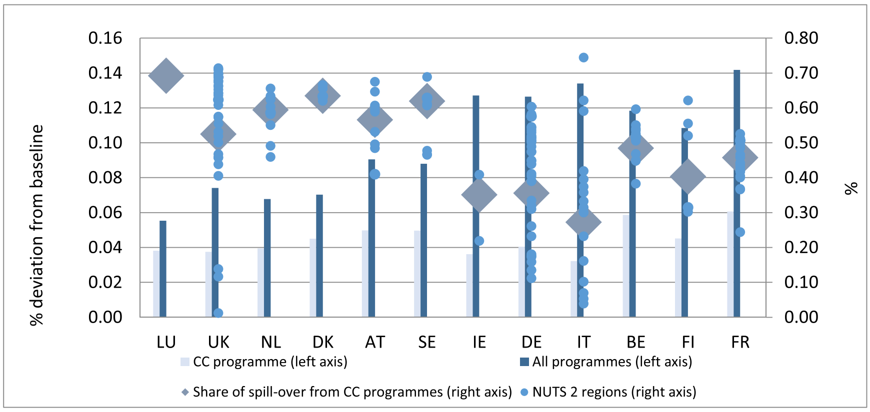

Fig. 10. Total impact on NCCs' GDP and spillovers from CCs, 2030,
Source: Own modelling simulations. NUTS 2 regions of Italy with spillover shares in excess of 100% were removed to enable legibility.

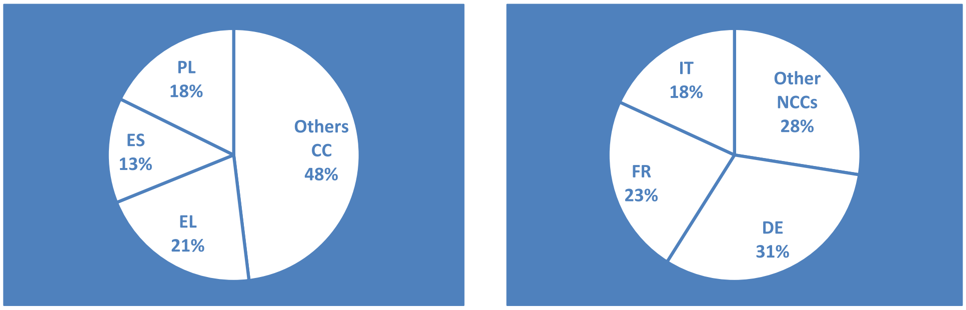

Fig. 11. Share of total spillovers generated by the CCs (left panel); share of total spillovers received by the NCCs (right panel) – 2030,
Source: Own simulations.

NCCs are not all affected by these spillovers in the same manner. For a given country, the magnitude of the spillovers depends on its specific contribution to the financing of the CCs programmes, as well as on the trade links with the CCs countries. Fig. 10 shows the total GDP impact of the policy for each NCC in 2030, and the spillover coming from the CCs.

In some NCCs, most of the impact of cohesion policy actually stems from the programmes implemented in the CCs. The share of these spillovers is particularly high in countries that trade extensively with CCs partners, like Austria, where almost 60% of the policy impact consists of spillovers, or France, where this share is slightly above 40%. That share is also large in highly developed and very open economies where the domestic programmes are rather modest, like Luxembourg (almost 70%), Denmark (more than 60%) or the Netherlands (62%). On the other hand, the share of spillovers is smaller in countries like Germany (36%) or Italy (27%), due to some of their regions receiving substantial cohesion policy investments. We also observe a substantial variation of regional spillover shares within each NCC. The highest upward variation is in regions that trade the most with the CCs, which are normally characterised by i) a low influx of cohesion policy funding and ii) high GDP per capita. In these situations any change in GDP impact predominantly occurs through spillovers, and hence the share becomes very high.

Some additional scenarios, in which the cohesion policy investments in the CCs are simulated separately one country at a time, permit the investigation of the precise origin of the spillovers enjoyed by the NCCs. The results suggest that the CCs are heterogeneous in this respect. Fig. 11, left panel, shows the composition of total spillovers. According to the model simulation, three countries, Greece, Poland and Spain, account for more than 50% of the total spillovers generated in the CCs. Not surprisingly, they are among the countries receiving the highest shares of cohesion funds, with more than €20, €30 and €60 billion, respectively (out of €320 billion in total).

The right panel of Fig. 11 shows a decomposition of the spillovers received by the NCCs, with the shares of total spillovers by NCC. The three biggest NCC economies account for the largest part of total spillovers received: Germany, France, and Italy. They also happen to be the countries with the largest trade links with the CCs as measured by exports towards them, which seems to be the main reason driving the result (the correlation between spillovers and NCCs' imports from the CCs stands at 0.43 and is statistically significant at standard levels). According to Eurostat data (ext_tex03 series for the year 2013), almost 20% of the German and French exports, and 15% of the Italian ones, go to the CCs, and their volumes are substantial, given the size of the economies. All the other NCCs export less to the CCs, and as a result enjoy less of the spillovers generated by the programmes implemented in those countries. These trade data are consistent with the ones used in the model and based on the regional trade flows estimated by Thissen et al. (2019), as explained in Section 4.

Finally, the Appendix reports the results of additional simulations carried out to test the robustness of the findings presented above. In particular, the sensitivity checks deal with the parameters that are key for the analysis at hand, namely those that could affect the amount of spillovers generated by the cohesion policy intervention. Figure A.2 contains the results presented in Fig. 9 above (the GDP impact on NCCs generated by the full cohesion policy package as well as by the interventions in the CCs only) obtained with two alternative values of the Armington elasticity (6 and 2, that is +/−50% of the standard value of 4 assumed in the model), with alternative transport costs (generated by the Transtools model rather than by the model by Persyn et al., 2022), and assuming perfect competition in all sectors rather than imperfect competition à la Dixit-Stiglitz. These different parametrizations lead to different quantitative outcomes, but the main findings are unaltered, as the simulations yield results that are qualitatively consistent with those in the main text.

7. Conclusion

Cohesion policy is a key instrument of the EU, used to reinforce the economies of the Member States and their regions and to reduce territorial disparities. Cohesion policy is an important channel through which the EU redistributes wealth within the Union. Its resources are highly concentrated on the less developed Member States and regions. Since the national contributions to the financing of the policy are highly correlated to GNI, almost 64% of the redistribution of funds taking place via the EU budget is actually due to cohesion policy.

However, this is not the only form of redistribution linked to the policy. Interventions implemented in a given region or country have different kinds of effects in the rest of the EU. These spillover effects need to be taken into account when assessing where the impact of cohesion policy at the macroeconomic level actually materialises. In this paper, we have used a spatial dynamic general equilibrium model to analyse this question and provide an estimate of the importance of spillovers in the total impact of the policy on the economies of the Member States.

According to our analysis, between 2007 and 2017, cohesion policy programmes had a positive and significant impact on the economies of the EU Member States. The impact is higher in the main beneficiaries, but in the long run, it is also positive in more developed countries, despite the fact that they are net contributors to the policy.

Spillovers account for a substantial share of the total impact of the policy. In the long run, around 15% of the impact on EU GDP stems from international spillovers which benefit all Member States' economies. Spillovers are particularly important for the main contributors to the policy. In the long run, more than 45% of the impact in the countries not eligible for the cohesion fund come from countries benefiting from it. For some Member States, spillovers constitute the main source of benefits from cohesion policy. This is particularly true in the countries for which the main beneficiaries are a major destination of their exports or in countries where cohesion policy programmes are small. However, it is worth noticing that the increase in GDP in the main contributor countries is generally much smaller than in the net beneficiaries. Thus, even though spillovers tend to increase the positive impact of the policy in the NCCs, they are not large enough to offset the capacity of cohesion policy to foster convergence across regions.

Overall, this evidence suggests that the debate on who benefits from cohesion policy should not concentrate on the financing side of the policy but should rather take into account the territorial distribution of the benefits going beyond the direct injection of funds.

Disclaimer

The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.ecosys.2023.101076.

References

Allard, C., Choueiri, N., Schadler, S.M., and van Elkan, R. (2008). Macroeconomic effects of EU transfers in new member states. IMF Working Papers No. 223.

Alonso-Carrera, J., Freire-Serén, M.J., Manzano, B., 2009. Macroeconomic effects of the regional allocation of public capital formation. Reg. Sci. Urban Econ. 39 (5), 563–574.

Armington, P.S., 1969. A theory of demand for products distinguished by place of production. Staff Papers, 16 (1), 159–178.

Barro, R., Sala-i-Martin, X., 2004. Economic Growth, *Second edition.,*. MIT Press, Cambridge, MA.

Berkowitz, P., Monfort, P., Piénkowski, J., 2020. Unpacking the growth impacts of European Union Cohesion Policy: transmission channels from Cohesion Policy into economic growth. Reg. Stud. 54 (1), 60–71.

Bartkiewicz, P., Cukrowska-Torzewska, E., Gebka, J., Regulski, A., Zawistowski, J., Zub, M., Rosik, P., Szczygielski, K., and Szpor,A., (2011). Evaluation of benefits to the EU-15 countries resulting from the implementation of the Cohesion Policy in the Visegrad Group countries, IBS Research Reports 02/2011, Instytut Badan Strukturalnych.

Beyaert, A., García-Solanes, J., Lopez-Gomez, L., 2019. Do institutions of the euro area converge? Econ. Syst. 43 (3–4), 100720.

Blouri, Y., von Ehrlich, M., 2020. On the optimal design of place-based policies: a structural evaluation of EU regional transfers. J. Int. Econ. 125, 103319.

Bom, P.R., Lightart, J.E., 2014. What have we learned from three decades of research on the productivity of public capital? J. Econ. Surv. 28 (5), 889–916.

Bottazzi, L., Peri, G., 2003. Innovation and spillovers in regions: evidence from European patent data. Eur. Econ. Rev. 47 (4), 687–710.

Bourdin, S., 2019. Does the cohesion policy have the same influence on growth everywhere? A geographically weighted regression approach in Central and Eastern Europe. Econ. Geogr. 95 (3), 256–287.

Bradley, J., Untiedt, G., and Mitze, T. (2007). Analysis of the impact of Cohesion policy. A note explaining the HERMIN-based simulations. Mimeo.

Brandsma, A., Kancs, D.A., Monfort, P., Rillaers, A., 2015. RHOMOLO: a dynamic spatial general equilibrium model for assessing the impact of cohesion policy. Pap. Reg. Sci. 94, S197–S221.

Breidenbach, P., Mitze, T., Schmidt, C.M., 2019. EU Regional policy and the neighbour's curse: analyzing the income convergence effects of ESIF funding in the presence of spatial spillovers. JCMS: J. Common Mark. Stud. 57 (2), 388–405.

Canton, E., Thum-Thysen, A., Voigt, P., 2018. Economist' musing on human capital investment: how efficient is public spending on education in EU Member States? Eur. Econ. Discuss Paper 081.
Chirinko, R.S., 2008. σ: The long and short of it. J. Macroecon. 30 (2), 671–686.
Clark, X., Dollar, D., Micco, A., 2004. Port efficiency, maritime transport costs, and bilateral trade. J. Dev. Econ. 75 (2), 417–450.
De la Fuente, A., Ciccone, A., 2003. Human capital in a global and knowledge-based economy Vol. 918 Luxembourg: Office for Official Publications of the European Communities,.
Di Comite, F., Lecca, P., Monfort, P., Persyn, D., and Piculescu, V. (2018). The impact of Cohesion Policy 2007–2015 in EU regions: Simulations with the RHOMOLO interregional dynamic general equilibrium model. JRC Working Papers on Territorial Modelling and Analysis No 3/2018, European Commission, Seville, JRC114044.
Durlauf, S.N., 2009. The rise and fall of cross-country growth regressions. Hist. Political Econ. 41(Suppl_1), 315–333.
Edwards, J.H.Y., 1990. Congestion function specification and the "publicness" of local public goods. J. Urban Econ. 27 (1), 80–96.
European Commission, 2015. *Ex post* evaluation of cohesion policy programmes 2007–2013 financed by the ERDF and the cohesion fund. *Work Package 13: Geography of Expenditure*, Luxembourg. Publications Office of the European Union,.
Fidrmuc, J., Hulényi, M., and Zajkowska, O. (2019). The elusive quest for the holy grail of an impact of EU funds on regional growth. CESifo Working Paper No. 7989.
Fisher, W.H., Turnovsky, S.J., 1998. Public investment, congestion, and private capital accumulation. Econ. J. 108 (447), 399–413.
Fratesi, U., Wishlade, F.G., 2017. The impact of European cohesion policy in different contexts. Reg. Stud. 51 (6), 817–821.
Greunz, L., 2003. Geographically and technologically mediated knowledge spillovers between European regions. Ann. Reg. Sci. 37, 657–680.
Ho, C.Y., Wang, W., Yu, J., 2013. Growth spillover through trade: a spatial dynamic panel data approach. Econ. Lett. 120 (3), 450–453.
In 't Veld, J. (2007). The potential impact of the fiscal transfers under the EU cohesion policy programme. European Economy Economics Papers No. 283.
Jorgenson, D.W., Stephenson, J.A., 1969. Issues in the development of the neoclassical theory of investment behaviour. Rev. Econ. Stat. 51 (3), 346–353.
Kancs, D., Siliverstovs, B., 2016. R&D and non-linear productivity growth. Res. Policy 45 (3), 634–646.
Keller, W., 2002. Geographic localization of international technology diffusion. Am. Econ. Rev. 92 (1), 120–142.
Krugman, P., 1991. Geography and Trade. MIT Press, Cambridge, Massachusetts.
Lecca, P., Barbero, J., Christensen, M.A., Conte, A., Di Comite, F., Diaz-Lanchas, J., Diukanova, O., Mandras, G., Persyn, D., and Sakkas, S. (2018). RHOMOLO V3: A spatial modelling framework. EUR 29229 EN, Publications Office of the European Union, Luxembourg, ISBN 978–92-79–85886-4, doi:10.2760/671622, JRC111861.
Lecca, P., Christensen, M., Conte, A., Mandras, G., Salotti, S., 2020. Upward pressure on wages and the interregional trade spillover effects under demand-side shocks. Pap. Reg. Sci. 99 (1), 165–182.
Leon-Ledesma, M.A., McAdam, P., Willman, A., 2010. Identifying the elasticity of substitution with biased technical change. Am. Econ. Rev. 100 (4), 1330–1357.
Mohl, P., Hagen, T., 2010. Do EU structural funds promote regional growth? New evidence from various panel data approaches. Reg. Sci. Urban Econ. 40, 353–365.
Monfort, P., and Salotti, S. (2021). Where does the EU Cohesion policy produce its impact? Simulations with a regional dynamic general equilibrium model. DG REGIO Working Papers No. 2/2021.
Németh, G., Szabó, L., Ciscar, J.C., 2011. Estimation of Armington elasticities in a CGE economy–energy–environment model for Europe. Econ. Model. 28 (4), 1993–1999.
Nijkamp, P., Poot, J., 2005. The last word on the wage curve? J. Econ. Surv. 19 (3), 421–450.
Olekseyuk, Z., Schürenberg-Frosch, H., 2016. Are Armington elasticities different across countries and sectors? A European study. Econ. Model. 55, 328–342.
Persyn, D., Díaz-Lanchas, J., Barbero, J., 2022. Estimating road transport costs between and within European Union regions. Transp. Policy 124, 33–42.
Puškárová, P., Piribauer, P., 2016. The impact of knowledge spillovers on total factor productivity revisited: new evidence from selected European capital regions. Econ. Syst. 40 (3), 335–344.
Ramey, V.A. (2020). The macroeconomic consequences of infrastructure investment. National Bureau of Economic Research No. w27625.
Thissen, M., Husby, T., Ivanova, O., Mandras, G., 2019. European NUTS 2 regions: construction of interregional trade-linked supply and use tables with consistent transport flows. JRC Working Papers on Territorial Modelling and Analysis No 1/2019. European Commission,, Seville JRC115439.
Turnovsky, S.J., Fisher, W.H., 1995. The composition of government expenditure and its consequences for macroeconomic performance. J. Econ. Dyn. Control 19 (4), 747–786.
Uzawa, H., 1969. The preference and Penrose effect in a two-class model of economic growth. J. Political Econ. 77 (4), 628–652.
Varga, A., 2017. Place-based, spatially blind, or both? Challenges in estimating the impacts of modern development policies: the case of the GMR policy impact modeling approach. Int. Reg. Sci. Rev. 40 (1), 12–37.
Varga, J., and In 't Veld, J. (2010). The potential impact of EU Cohesion policy spending in the 2007–2013 programming period: A model-based analysis. European Economy Economic Papers No. 422.
Varga, J., In 't Veld, J., 2011. A model-based analysis of the impact of Cohesion Policy expenditure 2000-06: simulations with the QUEST III endogenous R&D model. Econ. Model. 28, 647–663.
Wang, J., 2013. The economic impact of special economic zones: evidence from Chinese municipalities. J. Dev. Econ. 101, 133–147.
Wu, M., Liu, C., Huang, J., 2021. The special economic zones and innovation: evidence from China. China Econ. Q. Int. 1 (4), 319–330.