ARTICLE IN PRESS
JID: MONEC [m3Gsc;May 7, 2023;5:2]
Journal of Monetary Economics xxx (xxxx) xxx
Contents lists available at ScienceDirect
Journal of Monetary Economics
journal homepage: www.elsevier.com/locate/jmoneco

Inefficient international risk-sharing[☆]

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ARTICLE INFO

Article history:
Received 3 December 2021
Revised 26 April 2023
Accepted 27 April 2023
Available online xxx

JEL classification:
E52
F38
F41

Keywords:
Nominal rigidities
Risk-sharing
Autarky
Wealth effect
Welfare losses

ABSTRACT

Complete financial markets are widely believed to be beneficial for the international economy, since they enable cross-country risk-sharing. Using a two-country New Keynesian model, we show that this is not the case if the source of income fluctuations is a country-specific markup shock. When preferences involve the wealth effect on labor supply and imply that Home and Foreign goods are Edgeworth substitutes, the absence of risk-sharing in autarky acts like a favorable markup shock, reducing the variability of relative inflation and output gaps created by the shock. Thus, welfare can be higher under autarky than under complete financial markets, indicating that international risk-sharing can be undesirable. However, if the wealth effect on labor supply is absent or Home and Foreign goods are Edgeworth complements, welfare reversals do not occur.

1. Introduction

What are the welfare effects of financial integration? This long-standing question in international macroeconomics attracted renewed interest following the uneven global recovery from the recession driven by COVID-19. Some policymakers view this recovery as a reflection of imperfectly integrated international financial markets. For instance, the European Commission's High-Level Forum on the capital markets union emphasized that building a single market for capital is more important than ever to promote the balanced economic recovery of all member states from COVID-19 (EC, 2020). Implicit in the arguments made by the policymaking world is that countries can benefit from cross-country risk-sharing through financial integration.

One theoretical justification for risk-sharing in the international macroeconomics literature is that it shields consumption dynamics from income fluctuations. However, most studies analyze the welfare implications of risk-sharing in an endowment economy (Cole and Obstfeld, 1991; van Wincoop, 1994; 1999) or in a production economy with efficient shocks (Clarida et al., 2002; Corsetti et al., 2011).[1] In an endowment economy, perfectly insured consumption against exogenous

☆ We thank the editor Urban Jermann, the associate editor Vivian Yue, and an anonymous referee for their helpful comments and suggestions that have improved the paper substantially. This work was supported by the research fund of Hanyang University (HY-202300000001166).

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[1] In New Keynesian jargon, efficient shocks keep the distance between the welfare-efficient and the natural level of output constant. Examples of these shocks are productivity and demand shocks.

https://doi.org/10.1016/j.jmoneco.2023.04.005
0304-3932/

Please cite this article as: D. Cho, K.H. Kim and S.J. Kim, Inefficient international risk-sharing, Journal of Monetary Economics, https://doi.org/10.1016/j.jmoneco.2023.04.005

income shocks generates the greatest welfare. In a production economy with efficient shocks, it is well-known that under flexible exchange rates with optimal monetary policy, risk-sharing results in a form of open-economy divine coincidence, implying that complete asset markets are more preferable to incomplete ones. This rationale has served as the basis for the argument that the degree of risk-sharing is rather limited even among advanced industrial economies, leaving a considerable amount of unexploited potential welfare gains (Kose et al., 2009; Lewis, 1999).

However, little is known about the welfare effect of risk-sharing in an economy characterized by high inflation and low output. Indeed, this issue has become increasingly relevant due to recent supply chain disruptions, with the U.S. inflation hitting a three-decade high in July 2022 accompanied by relatively slow growth in output. The main result of our paper is that, in response to an inefficient shock that generates a trade-off between inflation and output gap, complete financial markets deliver a lower level of welfare compared to financial autarky, implying that risk-sharing can be detrimental to welfare. The precondition for this result is that the preference involves the wealth effect on labor supply and Home and Foreign goods are Edgeworth substitutes. Our finding reveals that identifying the source of country-specific income fluctuations is important in understanding the welfare effects of risk-sharing.

To demonstrate our result, we build on a standard two-country New Keynesian model as described in Corsetti et al. (2011) and Engel (2011), featuring asymmetric markup shocks.[2] We add home bias in consumption and assume that goods are substitutes in utility, as in Auray and Eyquem (2014) and Groll and Monacelli (2020). Using this model as a laboratory, we compare welfare under complete markets, which enable risk-sharing between countries, and under financial autarky, where there is no risk-sharing. We show that, under the assumption of symmetric price stickiness, the welfare rank between complete markets and financial autarky depends on the variability of relative inflation and output gaps, i.e., cross-country differences in inflation and output gaps. We find that financial autarky generates less volatile relative inflation and output gaps than a complete market, and therefore improves welfare. This outcome is what we label welfare reversals in an open economy, which indicate that risk-sharing can be undesirable.

To understand why relative inflation and output gaps are less volatile under financial autarky than under complete markets in the presence of asymmetric markup shocks, it is instructive to consider a case in which a positive markup shock hits the Home country but not the Foreign country. A positive Home markup shock generates a fall in output and consumption and a rise in inflation in Home relative to Foreign, creating a trade-off between relative inflation and output gaps. When financial markets are complete, risk-sharing allows the Home country to borrow from the Foreign country and makes Home households consume more than they produce. However, financial autarky limits Home from borrowing, so Home consumption is less than under complete markets. We call such a deviation of relative consumption from its level under complete markets as the demand imbalance, following Corsetti et al. (2011). The lower level of Home consumption under financial autarky makes Home households work more than they would under complete markets due to the wealth effect on labor, which dampens the fall in the Home output gap. In addition, the increased supply of labor under financial autarky puts downward pressure on nominal wages, producing a lower level of Home inflation than in complete markets. Therefore, the demand imbalance under financial autarky acts like a favorable endogenous Home markup shock, dampening the response of relative inflation and output gaps initiated by the Home markup shock.

The occurrence of welfare reversals does not depend on a particular exchange rate regime or an assumption of the monetary authority's ability to commit. However, it does rely on the intensity of the wealth effect on labor and trade elasticity. If preferences do not involve the wealth effect on labor supply or imply that Home and Foreign goods are Edgeworth complements, complete markets dominate financial autarky. Under preferences with no wealth effect, the demand imbalance's role as a favorable markup shock disappears, and the demand imbalance is a pure distortion that the social planner would like to minimize. If Home and Foreign goods are complements, unlike the case of substitutes, the demand imbalance acts like an endogenous unfavorable relative markup shock. This is because, under complements, Home households lend to the Foreign country and consume less than they produce. Financial autarky limits Home from lending, making Home consumption greater than under complete markets. Accordingly, relative consumption under autarky is higher than under complete markets, indicating an increase in the demand imbalance. The increased Home consumption discourages Home households from working due to the wealth effect on labor, thereby making relative inflation more volatile.

Although our paper is not the first to argue the potential cost of risk-sharing, we contribute to the literature by identifying a new condition under which risk-sharing is detrimental to welfare. Devereux and Smith (1994) show that, in a multi-country growth model, full risk-sharing reduces welfare as it reduces the savings rate and economic growth in each country. In contrast, the cost of risk-sharing in our paper is caused by inflation and output gap fluctuations at the business cycle frequencies. Baxter and Crucini (1995), like us, find that the output of a country that is hit by a productivity shock is more volatile under complete asset markets than under incomplete asset markets in a two-country model with flexible prices. However, they do not consider sticky prices and do not compare welfare between the two financial market structures. Auray and Eyquem (2014) find that, in a monetary union with sticky prices and asymmetric productivity shocks, financial autarky dominates complete markets in terms of welfare. Instead, we demonstrate that, following asymmetric markup shocks, this is the case under both flexible exchange rates and a monetary union. Acharya and Bengui (2018) point out that, when a region of the world economy faces a binding zero lower bound, the optimal policy is to subsidize capital outflows be-

[2] Other contributions that use a standard two-country New Keynesian model to answer different questions include Benigno (2004), Fujiwara et al. (2013), and Cook and Devereux (2013, 2016), among many others.

cause capital outflows are inefficiently low under the full risk-sharing condition. Our paper shows that the allocation under risk-sharing is inefficient in normal times, regardless of the occurrence of the zero lower bound.

Our paper relates to three additional works that conduct normative analysis subject to asymmetric markup shocks. Complementary to the present paper, Bengui and Coulibaly (2022) analytically identify distortions associated with capital flows and rationalize why fully closing capital accounts may be desirable. In contrast, we demonstrate the same result in numerical simulations, while emphasizing that the adverse effects of free capital flows depend on the intensity of the wealth effect on labor supply and the trade elasticity. Corsetti et al. (2011) introduce the asymmetric markup shock to provide an example that breaks the divine coincidence under complete markets but do not compare its welfare consequences under complete and incomplete financial markets. Groll and Monacelli (2020) compare the trade-off incurred by the relative markup shock under a flexible exchange rate regime and that under a monetary union, both under complete financial markets. They show that the trade-off is less severe under a monetary union than under flexible exchange rates. In contrast, we compare the trade-off under complete financial markets and financial autarky, conditional on the same exchange rate regime, and find that the trade-off is ameliorated under autarky.[3]

The paper is structured as follows. Section 2 presents a model and defines its equilibrium. Section 3 explains why welfare is higher for financial autarky than complete markets following relative markup shocks both theoretically and numerically. In Section 4, we investigate the role of preferences on welfare reversals. In Section 5, we show that welfare reversals do not occur in response to relative demand shocks, stressing that the relative importance of the markup or demand shock matters for welfare reversals. Section 6 concludes.

2. A two-country model

We incorporate incomplete risk-sharing in a standard two-country New Keynesian model that features producer currency pricing (Benigno and Benigno, 2006; Corsetti et al., 2011; Groll and Monacelli, 2020). The world economy consists of two countries, Home and Foreign, and the population of both countries is 1/2. Households in each country consume goods and supply labor. Firms hire labor, sell goods to households, and set prices subject to pricing friction. For the sake of brevity, we only describe the decision problem for Home. Foreign variables are marked with asterisks. The problem for Foreign can be described analogously.

2.1. Households

Household h in the Home country derives positive utility from the consumption basket C_{t+k} and negative utility from supplying labor $N_{t+k}(h)$. The present discounted value of lifetime utility is given by:

$$U_t^h = \mathbb{E}_t \sum_{k=0}^{\infty} \beta^k \left(\xi_{t+k} \frac{C_{t+k}^{1-\rho} - 1}{1-\rho} - \frac{N_{t+k}(h)^{1+\eta}}{1+\eta} \right), \tag{1}$$

where β is the discount factor, ρ is the inverse of the elasticity of intertemporal substitution, and η is the inverse of Frisch elasticity of labor supply. ξ_{t+k} is a preference shock or a demand shock. We assume that consumption risk is perfectly pooled among households within a country, so we may eliminate the household index h for consumption. The household consumes products from both home and abroad, and its consumption basket at time t is denoted by:

$$C_t = \left[\left(\frac{\nu}{2}\right)^{\frac{1}{\theta}} C_{H,t}^{\frac{\theta-1}{\theta}} + \left(1 - \frac{\nu}{2}\right)^{\frac{1}{\theta}} C_{F,t}^{\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}},$$

where $C_{H,t}$ and $C_{F,t}$ denote the composite consumption of Home goods and of Foreign goods, respectively. θ is the trade elasticity of substitution between these two composite consumption aggregates, and $\nu \in [1, 2]$ is the degree of home bias, which measures the degree of trade openness.

Consumption aggregates $C_{H,t}$ and $C_{F,t}$ are defined over a range of Home and Foreign differentiated goods, with the elasticity of substitution between goods being σ. That is,

$$C_{H,t} = \left[2^{\frac{1}{\sigma}} \int_0^{1/2} c_{H,t}(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}} \quad \text{and} \quad C_{F,t} = \left[2^{\frac{1}{\sigma}} \int_{1/2}^{1} c_{F,t}(i)^{\frac{\sigma-1}{\sigma}} di \right]^{\frac{\sigma}{\sigma-1}},$$

where $c_{j,t}(i)$ is consumption of good i produced in country $j \in \{H, F\}$. The price index of composite consumption $C_{H,t}$ and $C_{F,t}$ is:

$$P_{H,t} = \left[2 \int_0^{1/2} P_{H,t}(i)^{1-\sigma} di \right]^{\frac{1}{1-\sigma}} \quad \text{and} \quad P_{F,t}^{*} = \left[2 \int_{1/2}^{1} P_{F,t}^{*}(i)^{1-\sigma} di \right]^{\frac{1}{1-\sigma}}, \tag{2}$$

[3] The channel that weakens the trade-off in our paper is different from the one presented in Groll and Monacelli (2020). The alleviation of the trade-off under a monetary union in their work comes from inertia in the terms of trade. However, in our paper, the alleviated trade-off under autarky comes from the movement of the demand imbalance that counteracts the relative markup shock, a channel absent in Groll and Monacelli (2020).

while the price index of the Home consumption basket C_t is:

$$P_t = \left[\frac{\nu}{2}P_{H,t}^{1-\theta} + (1-\frac{\nu}{2})P_{F,t}^{1-\theta}\right]^{\frac{1}{1-\theta}}, \tag{3}$$

where $P_{j,t}(i)$ is the price of good i produced in country $j \in \{H, F\}$, quoted in the Home currency. The law of one price holds for each good, so $P_{j,t}(i) = S_t P^*_{j,t}(i)$, where S_t is the nominal exchange rate, which is the Home price of Foreign currency. The Home terms of trade is $T_t = \frac{P_{F,t}}{P_{H,t}} = \frac{S_t P^*_{F,t}}{P_{H,t}}$.

Finally, we allow incomplete cross-country risk-sharing following the procedure described in Devereux and Yetman (2014). There is a complete set of financial assets that can be traded between countries, but the returns on these assets can be taxed. We assume that, without loss of generality, only the Home country taxes the returns on its securities. The taxes are financed by lump-sum transfers. In this environment, the optimal risk-sharing condition is:

$$U_C(C_t^*, \xi_t^*) = U_C(C_t, \xi_t) Q_t f_t, \tag{4}$$

where $Q_t = \frac{S_t P_t^*}{P_t}$ is the real exchange rate. f_t is the gross tax rate on state-contingent securities that are issued by the Home country and captures the degree of imperfect risk-sharing. We assume that f_t is given by:

$$f_t = \left(\frac{P_t C_t}{P_{H,t} Y_{H,t}}\right)^{\frac{\lambda}{1-\lambda}}. \tag{5}$$

Eq. (5) implies that the tax depends on the Home country's trade balance $P_{H,t}Y_{H,t} - P_t C_t$. If there are trade deficits ($P_t C_t > P_{H,t} Y_{H,t}$), or equivalently capital inflows, there is a tax on returns on Home-issued securities. However, if there are trade surpluses ($P_t C_t < P_{H,t} Y_{H,t}$), or equivalently capital outflows, there is a subsidy on returns on Home-issued securities. λ captures the degree of capital control between the two countries. $\lambda = 0$, or equivalently $f_t = 1$, corresponds to complete financial markets, while $\lambda = 1$ corresponds to financial autarky.

In the open macroeconomics literature, f_t is often labeled as the demand imbalance. Its log-linearized form is:

$$\hat{f}_t = (\hat{U}_C(C_t^*, \xi_t^*) - \hat{U}_C(C_t, \xi_t)) - \hat{Q}_t.$$

where $\hat{\omega}_t \equiv \log(\frac{\omega_t}{\omega})$ for variable ω_t. This gap measures the extent to which cross-country marginal utility differential deviates from its level under complete markets at the current real exchange rate. The gap is zero under complete markets but not under incomplete markets. A positive demand imbalance means that the difference between Foreign and Home marginal utilities is higher than that under complete markets at the current real exchange rate.

The consumption Euler equation for the Home household is:

$$\frac{U_C(C_t, \xi_t)}{P_t} = \beta(1+R_t)\mathbb{E}_t \frac{U_C(C_{t+1}, \xi_{t+1})}{P_{t+1}}, \tag{6}$$

where $1 + R_t$ is the gross return on nominal bonds and is set by the monetary authority.

2.2. Producers

Each household is also a monopolistic producer of one of the differentiated goods with technology $y_{H,t}(i) = N_t(i)$. As a monopolistic producer, a household sets its price according to Calvo pricing, with the probability of adjusting prices equal to $1 - \alpha_H$ for Home and $1 - \alpha_F$ for Foreign. Assuming that subsidies, or equivalently negative taxes on sales, are given to achieve an efficient allocation in the nonstochastic steady state, the optimal price set by producers that can adjust their price is given by:

$$P^o_{H,t}(i) = \frac{\sigma}{(1-\tau_{H,t+k})(\sigma-1)} \frac{\mathbb{E}_t \sum_{k=0}(\beta\alpha_H)^k y^o_{H,t+k}(i)^{1+\eta}}{\mathbb{E}_t \sum_{k=0} m_{t+k}(\beta\alpha_H)^k y^o_{H,t+k}(i)}, \tag{7}$$

where $m_{t+k} = \frac{U_C(C_{t+k}, \xi_{t+k})}{P_{t+k}}$ represents the real marginal utility of consumption. $y^o_{H,t+k}(i)$ represents the world demand of good i, given by:

$$y^o_{H,t+k}(i) = 2\left(\frac{P^o_{H,t}(i)}{P_{H,t+k}}\right)^{-\sigma}\left(\frac{P_{H,t+k}}{P_{t+k}}\right)^{-\theta}\left[\frac{\nu}{2}C_{t+k} + (1-\frac{\nu}{2})Q^{\theta}_{t+k}C^*_{t+k}\right],$$

where $\tau_{H,t}$ denotes the time-varying tax on producers. As in Groll and Monacelli (2020), let $\mathcal{M}_{H,t} = \frac{\sigma}{(1-\tau_{H,t})(\sigma-1)}$ denote the markup charged by firms. In the steady state, $\mathcal{M}_H = 1$ and thus $\tau_H = -\frac{1}{\sigma-1}$. We assume that the markup is subject to an exogenous shock due to the time-varying tax on producers.

In a given period, a fraction $1 - \alpha_H$ of producers will set the same optimal price, since they share identical preferences and face the same demand curves. For a fraction α_H of producers, the price from the previous period remains effective. Thus, the aggregate price index of the Home good is:

$$P_{H,t} = [(1-\alpha_H){P^o_{H,t}}^{1-\sigma} + \alpha_H P^{1-\sigma}_{H,t-1}]^{\frac{1}{1-\sigma}}. \tag{8}$$

2.3. Market clearing

Market clearing in the Home good is given by:

$$Y_{H,t} = \frac{\nu}{2}\left(\frac{P_{H,t}}{P_t}\right)^{-\theta} C_t + \left(1 - \frac{\nu}{2}\right)\left(\frac{P_{H,t}}{S_t P_t^*}\right)^{-\theta} C_t^*, \tag{9}$$

where $Y_{H,t} = [2^{\frac{1}{\sigma}} \int_0^{1/2} y_{H,t}(i)^{\frac{\sigma-1}{\sigma}} di]^{\frac{\sigma}{\sigma-1}}$ is aggregate Home output. To close the model, one needs to specify the policy instruments for both flexible exchange rates and a monetary union. The policy instruments are determined by the optimal monetary policy, which we describe in the following subsection.

2.4. Optimal monetary policy

In this section, we formulate the optimal monetary problem under flexible exchange rates and that under a monetary union, following the body of literature on the linear quadratic approach for open economies (Benigno and Benigno, 2006; Benigno, 2004; Engel, 2014). To do so, we first describe the relevant set of equilibrium conditions in a log-linearized form. Define $\tilde{\omega}_t \equiv \log(\frac{\omega_t}{\omega_t^{fb}})$, where ω_t^{fb} is the efficient level of ω_t.[4] Moreover, let $\pi_{H,t} \equiv \ln(P_{H,t}/P_{H,t-1})$, $\pi_{F,t}^* \equiv \ln(P_{F,t}^*/P_{F,t-1}^*)$, $\epsilon_t \equiv \ln \xi_t$, $\epsilon_t^* \equiv \ln \xi_t^*$, and $\mu_{j,t} \equiv \ln \mathcal{M}_{j,t}$ for $j = H, F$.

Equilibrium conditions under flexible exchange rates Given the path of the two policy instruments $\{\hat{R}_t, \hat{R}_t^*\}$, the equilibrium under flexible exchange rates consists of endogenous variables $\{\hat{Y}_{H,t}, \hat{Y}_{F,t}, \pi_{H,t}, \pi_{F,t}^*, \hat{C}_t, \hat{C}_t^*, \hat{T}_t, \hat{Q}_t, \hat{f}_t\}$ and exogenous variables $\{\epsilon_t, \epsilon_t^*, \mu_{H,t}, \mu_{F,t}\}$ that satisfy conditions (A.1)–(A.9) in Appendix A.

Once the solution for $\pi_{H,t}$, $\pi_{F,t}^*$, and $\hat{T}_t$ is obtained, one can derive the dynamic equation for nominal exchange rates using the definition of the terms of trade, expressed in log-deviations:

$$\hat{S}_t - \hat{S}_{t-1} = \hat{T}_t - \hat{T}_{t-1} + \pi_{H,t} - \pi_{F,t}^*. \tag{10}$$

We assume that the markup shock $\mu_{j,t}$ $(j = H, F)$ follows the AR(1) process:

$$\mu_{j,t} = \rho_\mu \mu_{j,t-1} + \varepsilon_{j,t}^\mu \quad \text{with} \quad \varepsilon_{H,t}^\mu, \varepsilon_{F,t}^\mu \overset{iid}{\sim} \mathcal{N}(0, {\sigma_\mu}^2). \tag{11}$$

Similarly, the demand shocks follow:

$$\epsilon_t = \rho_\epsilon \epsilon_{t-1} + \varepsilon_t^\epsilon, \quad \epsilon_t^* = \rho_\epsilon \epsilon_{t-1}^* + \varepsilon_t^{\epsilon*} \quad \text{with} \quad \varepsilon_t^\epsilon, \varepsilon_t^{\epsilon*} \overset{iid}{\sim} \mathcal{N}(0, {\sigma_\epsilon}^2). \tag{12}$$

Equilibrium conditions under a monetary union Two main differences exist between equilibrium under a monetary union and under flexible exchange rates. Because the monetary authority sets the common policy instrument under a monetary union, we only need one aggregate demand equation, which is (A.1). Moreover, one needs to impose the fixed exchange rate condition, which is Eq. (10) with $\hat{S}_t = 0$:

$$\hat{T}_t - \hat{T}_{t-1} = \pi_{F,t}^* - \pi_{H,t}. \tag{13}$$

Hence, given the path of common policy instrument $(\hat{R}_t = \hat{R}_t^*)$ and shock processes (11) and (12), the equilibrium under a monetary union consists of a set of endogenous variables $\{\hat{Y}_{H,t}, \hat{Y}_{F,t}, \pi_{H,t}, \pi_{F,t}^*, \hat{C}_t, \hat{C}_t^*, \hat{T}_t, \hat{Q}_t, \hat{f}_t\}$ and exogenous variables $\{\epsilon_t, \epsilon_t^*, \mu_{H,t}, \mu_{F,t}\}$, satisfying conditions (A.1), (A.3)-(A.9) along with (13).

Optimal monetary policy problem The characterization of optimal monetary policy requires the specification of the welfare loss function. Because we assumed that firms receive a subsidy financed by lump-sum taxes, there is no inefficiency associated with monopolistic competition in the steady state. In addition, we assume that a benevolent planner maximizes world welfare, which is a weighted average of the two countries' welfare. In the Technical Appendix, we show that, under these assumptions, the welfare losses of deviating from the efficient allocation, up to a second-order, can be derived as:

$$\mathcal{L}_t^W - (\mathcal{L}_t^W)^{fb} = -\frac{1}{4}\left\{(\rho + \eta)(\tilde{Y}_{H,t}^2 + \tilde{Y}_{F,t}^2) + \frac{\sigma}{\kappa_H}\pi_{H,t}^2 + \frac{\sigma}{\kappa_F}\pi_{F,t}^{*2} - \frac{\nu(1 - \frac{\nu}{2})}{\Delta}\left[\rho(\rho\theta - 1)(\tilde{Y}_{H,t} - \tilde{Y}_{F,t})^2 - \theta \hat{f}_t^2\right]\right\}, \tag{14}$$

where $\Delta = (\nu - 1)^2 + \rho\theta\nu(2 - \nu)$ and $\kappa_j = \frac{(1-\alpha_j\beta)(1-\alpha_j)}{\alpha_j(1+\sigma\eta)}$ for $j = H, F$. This expression states that the welfare losses depend on the output gap in each country, the deviation of each country's inflation from its efficient level of zero, the cross-country difference in the output gaps, and the demand imbalance term, which is zero under complete financial markets. Taking

[4] The efficient level of ω_t is the value of ω_t that prevails under flexible prices, no monopolistic competition, and complete financial markets.

Table 1
Baseline Calibration.

Parameter	Value	Description
ρ	1	Inverse of the elasticity of intertemporal substitution
β	0.99	Discount factor
η	0.67	Inverse of Frisch elasticity of labor supply
ν	1.50	Home bias (degree of trade openness)
σ	7.66	Elasticity of substitution between differentiated goods
θ	2	Elasticity of substitution between goods across countries
α_H	0.75	Home Calvo parameter
α_F	0.75	Foreign Calvo parameter
λ	[0,1]	Degree of financial control
ρ_μ	0.9	Persistence of markup shocks
ρ_ϵ	0.9	Persistence of demand shocks
σ^2_μ	1	Variance of markup shocks
σ^2_ϵ	1	Variance of demand shocks

unconditional expectations of the loss function (14) and letting $\beta \to 1$, we can express unconditional welfare losses in terms of the variances:

$$\mathbb{W} = \frac{1}{4}\Bigg\{(\rho+\eta)var(\tilde{Y}_{H,t}) + (\rho+\eta)var(\tilde{Y}_{F,t}) + \frac{\sigma}{\kappa_H}var(\pi_{H,t}) + \frac{\sigma}{\kappa_F}var(\pi^*_{F,t}) - \frac{\nu(1-\frac{\nu}{2})}{\Delta}\Big[\rho(\rho\theta-1)var(\tilde{Y}_{H,t}-\tilde{Y}_{F,t}) - \theta var(\hat{f}_t)\Big]\Bigg\}. \quad (15)$$

Having specified the equilibrium conditions and the welfare loss function, we are now ready to describe optimal monetary policy. Optimal monetary policy requires a social planner to minimize the present discounted welfare loss:

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t (\mathcal{L}^W_t - (\mathcal{L}^W_t)^{fb})$$

subject to the constraints that characterize the competitive equilibrium: (A.1)-(A.9) under flexible exchange rates and (A.1), (A.3)–(A.9) and (13) in the monetary union case. We present the full derivation of the optimal policy problem in the Technical Appendix.

A special case arises when the degree of nominal price rigidity is identical across countries ($\kappa_H = \kappa_F = \kappa$). Then, Eq. (15) can be written as:

$$\mathbb{W}_{|\alpha_H=\alpha_F} = \frac{1}{8}\Bigg\{[(\rho+\eta)\ var(\tilde{Y}^W_t) + \frac{\sigma}{\kappa}var(\pi^W_t) + (\frac{\rho}{\Delta}+\eta)\ var(\tilde{Y}^R_t) + \frac{\sigma}{\kappa}var(\pi^R_t) + \frac{\nu(2-\nu)\theta}{\Delta}var(\hat{f})\Bigg\}, \quad (16)$$

where $\tilde{Y}^W_t = \tilde{Y}_{H,t} + \tilde{Y}_{F,t}$, $\pi^W_t = \pi_{H,t} + \pi^*_{F,t}$, $\tilde{Y}^R_t = \tilde{Y}_{H,t} - \tilde{Y}_{F,t}$, and $\pi^R_t = \pi_{H,t} - \pi^*_{F,t}$ are the world output gap, world inflation, the relative output gap, and relative inflation, respectively. For the baseline calibration, we will assume symmetric price rigidity and thus use Eq. (16) to compare welfare between complete markets and financial autarky. Under this assumption, we will show that world output gaps and world inflation do not affect the welfare ranking between the two financial market structures. Therefore, the welfare ranking will depend on how each financial market structure shapes the variance of relative output gaps, relative inflation and demand imbalances.

2.5. Calibration

We now discuss the baseline parameter values that will be used in numerical experiments. Most of these values follow Groll and Monacelli (2020). We assume $\beta = 0.99$, which is consistent with an annual real interest rate of 4%. The inverse of Frisch elasticity of labor supply η is 0.67. The elasticity of substitution between differentiated goods within a country σ is set to 7.66 to match the 15% markup at the steady state. The autocorrelation coefficients ρ_μ and ρ_ϵ are 0.9. The variance of markup and demand shocks is 1. We let the Home and Foreign Calvo parameter be 0.75, the degree of trade openness ν be 1.5. Regarding the value of the trade elasticity θ, the empirical literature has not seen a consensus. For instance, Lubik and Schorfheide (2005) estimate the value as low as 0.43, Simonovska and Waugh (2014) estimate the value to be 4.14, and Broda and Weinstein (2006) estimate the value to be as high as 4 to 6. Hence, the open economy macroeconomic literature usually sets this elasticity to intermediate values.[5] Following the literature, we set $\theta = 2$. The degree of financial control λ takes a value between 0 and 1. We summarize the parameter values in Table 1 for convenience. Because the central

[5] For example, Fujiwara et al. (2013) and Cook and Devereux (2013) assume unitary trade elasticity. Backus et al. (1994), Chari et al. (2002), Pappa (2004), and Auray and Eyquem (2014) set this value to 1.5, while Groll and Monacelli (2020) set this value to 2.

theme of our paper lies in markup shocks, we focus on the propagation and welfare consequences of markup shocks under both financial market structures in Sections 3 and 4. In Section 5, we illustrate how our main results are overturned in the presence of demand shocks.

3. Welfare reversal

In this section, we show that the level of welfare under financial autarky is higher than that under complete financial markets in response to relative markup shocks, indicating that international risk-sharing is not always desirable. This result stems from the difference in the volatility of relative output gaps and inflation between the two financial market structures. We analytically show that relative output gaps and inflation are less responsive to relative markup shocks for financial autarky than complete markets under flexible exchange rates with discretion. We then show numerically that this is also the case under the two alternative regimes: flexible exchange rates with commitment and a monetary union. During the verification process, two propositions will provide a useful benchmark.[6]

Proposition 1. *Assuming $\alpha_H = \alpha_F$, the underlying financial market structure is irrelevant for the equilibrium behavior of world inflation π_t^W and the world output gap $\tilde{Y}_t^W$.*

Proof. Refer to Appendix C. □

From Proposition 1, in the case of symmetric price rigidity, it follows that the welfare ranking between complete financial markets and financial autarky only depends on the behavior of relative variables such as relative output gaps, relative inflation, and demand imbalances. Therefore, for each exchange rate regime and monetary policy, it suffices to compare the variations of the three relative variables under complete financial markets and those under financial autarky to determine the welfare rank. The following proposition provides further convenience for ranking the welfare.

Proposition 2. *Assuming $\alpha_H = \alpha_F$, in a monetary union, the relative variables $\hat{Y}_t^R$, π_t^R, and $\hat{C}_t^R$ are independent of the underlying monetary policy assumption (i.e., discretion or commitment), where $\hat{Y}_t^R = \hat{Y}_{H,t} - \hat{Y}_{F,t}$ and $\hat{C}_t^R = \hat{C}_t - \hat{C}_t^*$.*

Proof. Refer to Appendix C. □

The essence of Proposition 2 is that, in a monetary union, relative variables are the same for both discretion and commitment policies. Given that only relative variables matter for the welfare ranking between the two financial market structures (Proposition 1), Proposition 2 implies that the welfare differences between the two are the same for both discretion and commitment policies in a monetary union. Therefore, to show that the level of welfare under financial autarky is higher than that under complete financial markets regardless of exchange rate regimes and monetary policy authority's ability to commit, we only need to perform the welfare ranking for three regimes: a flexible exchange rate with discretion, a flexible exchange rate with commitment, and a monetary union (with discretion).[7]

3.1. Analytical results

We now analytically compare the magnitude of the responses of relative output and inflation under financial autarky and those under complete markets. In particular, we provide analytical expressions for relative output and inflation as a function of the relative markup shock and compare the magnitude of the impact coefficients under complete markets and those under financial autarky. Because of tractability, we do this only for one regime: flexible exchange rates with discretion. We emphasize that the analytical results that we present below only apply to relative markup shocks. The full derivation of these expressions is described in Appendix B.

Let $\mu_t^R = \mu_{H,t} - \mu_{F,t}$ be the relative markup shock. Under flexible exchange rates with discretion, the log-linearized expression for relative inflation is:

$$\begin{cases} \pi_t^R = \dfrac{\kappa}{\left[(1-\beta\rho_\mu) + \frac{\Omega^{cpt}}{\Gamma_\pi^{cpt}}\right]} \cdot \mu_t^R & \text{[Complete]} \\ \pi_t^R = \dfrac{\kappa}{\left[(1-\beta\rho_\mu) + \frac{\Omega^{aut}}{\Gamma_\pi^{aut}}\right]} \cdot \mu_t^R, & \text{[Autarky]} \end{cases} \tag{17}$$

where

$$\Gamma_\pi^{cpt} = \frac{[\nu(\theta-1)(2-\nu)+1]}{\sigma},$$
$$\Gamma_\pi^{aut} = \left[1 + \left(\frac{\nu(\theta-1)}{1+\nu(\theta-1)}\right)^2 \left(\frac{(2-\nu)\nu\theta}{1+\eta\Delta}\right)\right](\nu(\theta-1)+1)/\left\{\sigma\left[1 + \left(\frac{\nu(\theta-1)(2-\nu)}{1+\eta\Delta}\right)\right]\right\},$$

[6] Proposition 2 is an extension of Proposition 2 of Groll and Monacelli (2020).

[7] As a result of Proposition 2, we assume discretionary policy for a monetary union throughout the paper.

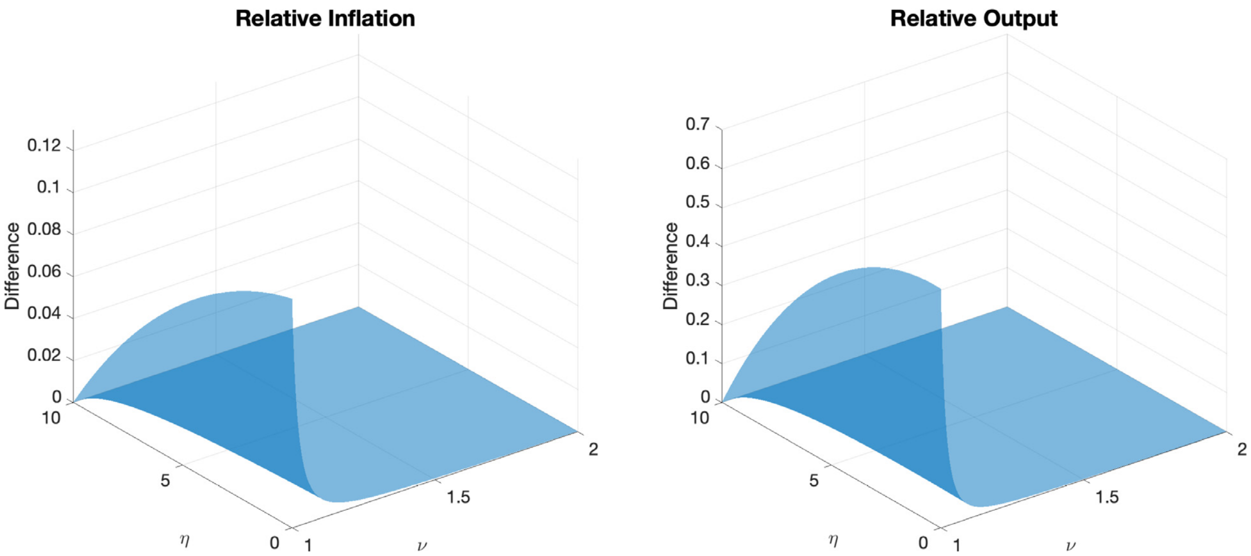


Fig. 1. Markup Coefficients. *Note:* η is the inverse of Frisch elasticity of labor supply, and ν is the home bias parameter. The z-axis represents the difference between the markup coefficients under complete markets and those under financial autarky (see Eqs. (17) and (18)). A positive value indicates that the response of relative inflation (left panel) and output gaps (right panel) is larger for complete markets versus financial autarky.

$\Omega^{cpt} = \kappa\{1+\eta(\nu(\theta-1)(2-\nu)+1)\}$, and $\Omega^{aut} = \kappa\{(1+\eta)(\nu(\theta-1)+1)\}$. The expression for relative output is:[8]

$$\begin{cases} \tilde{Y}_t^R = -\dfrac{\sigma\kappa}{\left[(1-\beta\rho_\mu)+\frac{\Omega^{cpt}}{\Gamma_\pi^{cpt}}\right]}\cdot\mu_t^R & \text{[Complete]} \\ \tilde{Y}_t^R = -\dfrac{\Gamma_y^{aut}\kappa}{\Gamma_\pi^{aut}\left[(1-\beta\rho_\mu)+\frac{\Omega^{aut}}{\Gamma_\pi^{aut}}\right]}\cdot\mu_t^R, & \text{[Autarky]} \end{cases} \tag{18}$$

where $\Gamma_y^{aut} = \Big(\nu(\theta-1)+1\Big)$.

The coefficients of the relative markup shock μ_t^R in Eq. (17) and (18) govern the magnitude of the response of relative inflation and output on impact. Fig. 1 illustrates the difference between these coefficients under complete markets and those under financial autarky for $\eta \in [0, 10]$ and $\nu \in [1, 2]$, holding $\theta = 2$ and $\alpha_H = \alpha_F = 0.75$. The left panel depicts the difference between the coefficients that determine the response of relative inflation, while the right panel depicts the difference between the coefficients that determine the response of relative output. A positive value along the z-axis means that the value of these coefficients is larger in absolute value under complete markets than under financial autarky. From the two panels, we observe that, when Home and Foreign goods are substitutes in utility ($\theta > 1$), financial autarky leads to smaller responses in relative output and inflation than a complete market does for a plausible range of calibration.[9]

3.2. Inspecting the mechanism

We provide a deep analysis of where the stabilized relative inflation and output gaps under autarky come from when goods are substitutes. We show that the demand imbalance $\hat{f}_t$ under autarky acts like a favorable endogenous relative markup shock, which dampens the response of relative output gaps and inflation initiated by the exogenous relative markup shock μ_t^R. We unveil the process by which the demand imbalance leads to less volatile relative output gaps and inflation under autarky, using the movement of the relative Phillips curve and targeting rule. As evident below, the movement of the relative Phillips curve due to the changes in the demand imbalance captures the wealth effect on labor supply, and the movement of the targeting rule characterizes the planner's optimal plans in response to the demand imbalance. The intersection of these two objects delivers the equilibrium relative output gaps and inflation.

Again, we present the targeting rule and the relative Phillips curve under discretionary policy with flexible exchange rates for tractability. Moreover, we assume no home bias, financial autarky, and log-utility (i.e., $\nu = 1$, $\lambda = 1$, and $\rho = 1$) to

[8] In response to markup shocks, the relative output gap and output are the same. Accordingly, we use the output gap and output interchangeably under markup shocks.

[9] Auray and Eyquem (2014) find that relative inflation is less volatile under financial autarky than under complete markets in a monetary union. We show that their results generally hold under flexible exchange rates as well.

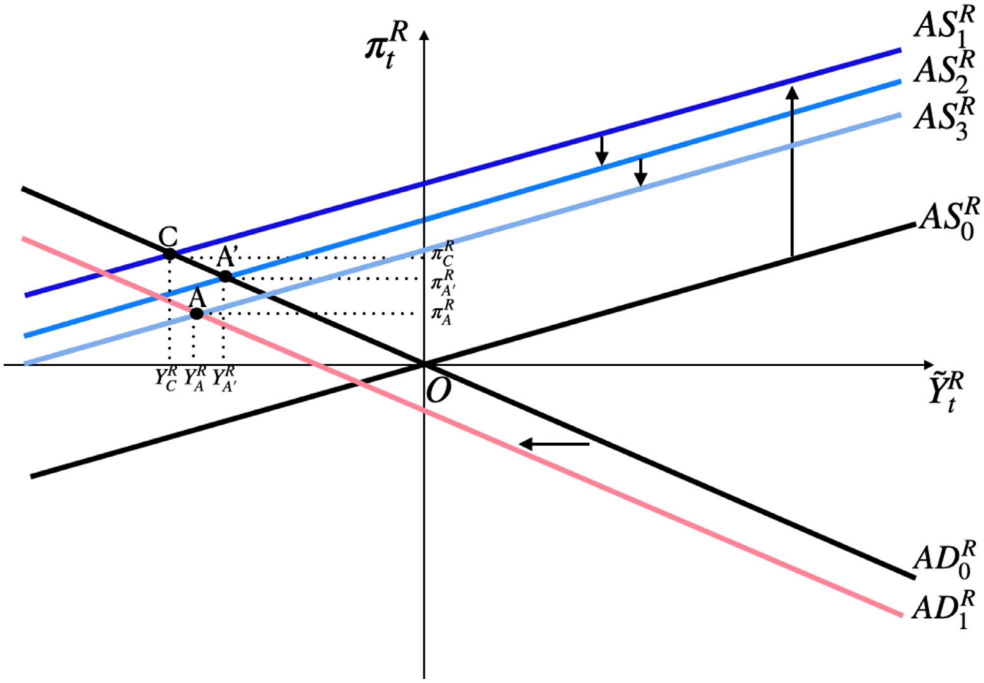


Fig. 2. Relative Inflation and Output under the Separable Preference (Substitutes). *Note:* $\tilde{Y}_t^R = \tilde{Y}_{H,t} - \tilde{Y}_{F,t}$ and $\pi_t^R = \pi_{H,t} - \pi_{F,t}^*$ are the relative output (gap) and relative inflation, respectively. AD^R and AS^R are the targeting rule and relative Phillips curve, respectively.

simplify the coefficients of the targeting rule and the relative Phillips curve, which are given by:

$$\begin{cases} \pi_t^R = -\frac{1}{\sigma}\tilde{Y}_t^R + \frac{1}{\sigma\theta(1+\eta)}\hat{f}_t & \text{[Targeting Rule (Separable)]} \\ \pi_t^R = (\frac{\kappa}{1-\beta\rho_\mu})\left[(\eta + \frac{1}{\theta})\tilde{Y}_t^R + \hat{f}_t + \mu_t^R\right]. & \text{[Relative PC (Separable)]} \end{cases} \tag{19}$$

The targeting rule curve comes from (B.18), which describes the relationship between relative inflation and output gaps set by a benevolent planner to maximize the separable preference. The relative Phillips curve comes from (B.16), where we have used the relationship $\mathbb{E}_t\pi_{t+1}^R = \rho_\mu\pi_t^R$ and equation (B.6). The equilibrium is where these two curves intersect. Notice that, Eqs. (17) and (18) with $\nu = 1$ are simply the solution of system (19), where $\hat{f}_t$ is replaced with Eq. (B.7).

Fig. 2 illustrates the determination of relative inflation and output gaps, using the movements of the two curves. First, under complete markets ($\hat{f}_t = 0$), a positive relative markup shock, or a positive Home markup shock, shifts in the relative Phillips curve (i.e., from AS_0^R to AS_1^R), leading the economy to point C. Here, Home becomes a net debtor because of the expenditure-switching effect of the Home terms of trade appreciation: The world demand shifts away from expensive Home goods to inexpensive Foreign goods, thereby contracting Home production and its revenue. This effect makes Home borrow from Foreign to consume inexpensive Foreign goods in order to smooth relative consumption. Under autarky, in which borrowing is absent, the Home households have to reduce consumption more than they would under complete markets. Therefore, relative consumption (the difference between Foreign and Home marginal utilities) is lower than under complete markets for a given real exchange rate, implying a fall in the demand imbalance ($\hat{f}_t < 0$). The fall in the demand imbalance counteracts the positive markup shock: It shifts the relative Phillips curve closer to its original position (i.e., from AS_1^R to AS_2^R), acting like a favorable relative markup shock. Intuitively, the reduced Home consumption under autarky makes the Home households work more due to the wealth effect on labor. The increased labor supply puts downward pressure on nominal wages and inflation in Home. Hence, this wealth effect leads to a decline in relative inflation.

Since the negative demand imbalance term is beneficial as it counteracts the adverse relative markup shocks, the optimal discretionary policy is to have the demand imbalance $\hat{f}_t$ more negative, that is, more contraction in relative consumption. To attain this allocation, the planner guides monetary authorities to induce contraction in Home production to further increase the relative price of Home goods (i.e., Home terms of trade appreciation). The more appreciated Home terms of trade generates a stronger expenditure-switching effect, which results in further reduced Home consumption due to depressed Home revenue. The leftward shift of the targeting rule (i.e., from AD_0^R to AD_1^R) in the figure reflects the monetary authorities' optimal action, which is characterized by a fall in Home production, or relative output. Moreover, the further reduced demand imbalance achieved under the optimal policy pushes the Phillips curve even further down (i.e., from AS_2^R to AS_3^R), thereby leading the economy to point A. Thus, autarky delivers less volatile relative output and inflation than complete markets.

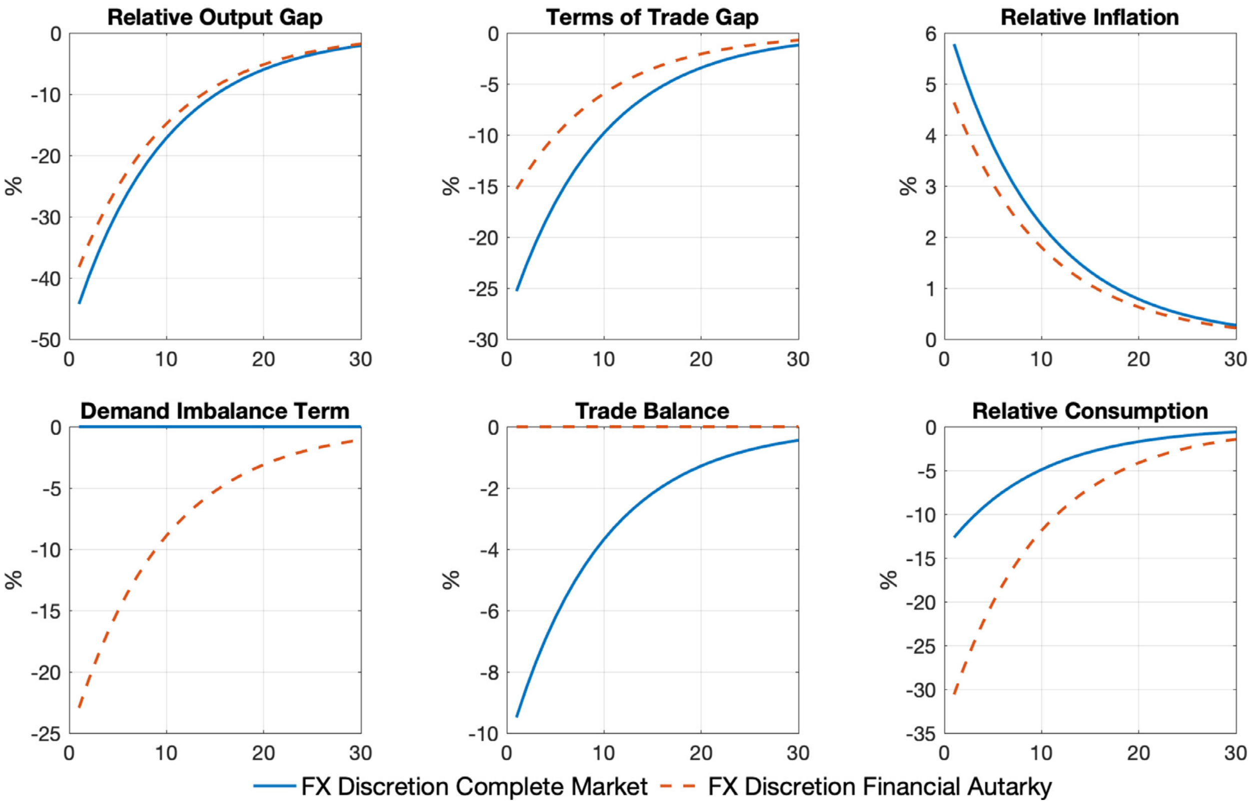


Fig. 3. IRFs to a Home Markup Shock. *Note:* IRFs are plotted under flexible exchange rates with optimal discretionary policy.

3.3. Numerical results

We verify whether the theoretical analysis in the previous subsection is consistent with the numerical results under the baseline calibration. Fig. 3 compares the responses to a positive Home cost-push shock under both financial market structures, where the regime in place is flexible exchange rates with optimal discretionary policy. The responses under complete markets and those under autarky correspond to points C and A of Fig. 2, respectively. Consistent with our theoretical analysis, the figure shows that financial autarky leads to more stable relative output gaps and inflation than a complete market at the cost of a more volatile demand imbalance, represented by more volatile relative consumption.[10]

So far, we have demonstrated that the demand imbalance acts like a favorable endogenous markup shock in the regime with flexible exchange rates and discretionary monetary policy. This result carries over to the two alternative regimes, namely flexible exchange rates with commitment and a monetary union. Fig. 4 portrays the responses of relative variables following a positive Home markup shock under the two alternative regimes. It shows that even under the alternative regimes, the demand misalignment emanated from financial autarky stabilizes relative inflation and output gaps.

Although we have shown that the variability of relative inflation and output gaps is reduced under financial autarky, it is not clear that financial autarky leads to a higher level of welfare than a complete market does. This is because financial autarky introduces a change in the demand imbalance term, which itself leads to a welfare loss, as shown in the loss function (15). To conclude that autarky improves welfare, one must show that the benefit from stabilized relative inflation and output gaps exceeds the cost of volatile demand imbalance. Table 2 reports the gain of financial autarky relative to complete markets measured by $\mathbb{W}$(complete) - $\mathbb{W}$(autarky) for each regime as well as the contribution of each component of the loss function, where $\mathbb{W}$(.) is the periodic unconditional loss. For all three regimes, there are gains from moving to financial autarky from complete markets, because the gains from more stabilized relative inflation and output gaps dominate the loss associated with demand misalignment.

[10] The complete market benchmark in our paper involves ex-ante risk-sharing against asymmetric markup shocks, as households trade state-contingent securities to smooth consumption across states before the shocks are realized. Moreover, because these securities pay off in the next period after the shocks are realized, households can smooth consumption across time. In this regard, consistent with the notion of complete markets described by Sorensen and Yosha (1998), our complete markets allow agents to smooth consumption not only across states (ex-ante insurance) but also across time (ex-post intertemporal trade). In Appendix D, we show that consumption smoothing across states and across time are both destabilizing by comparing the impulse responses under complete markets, a one-bond market, and autarky.

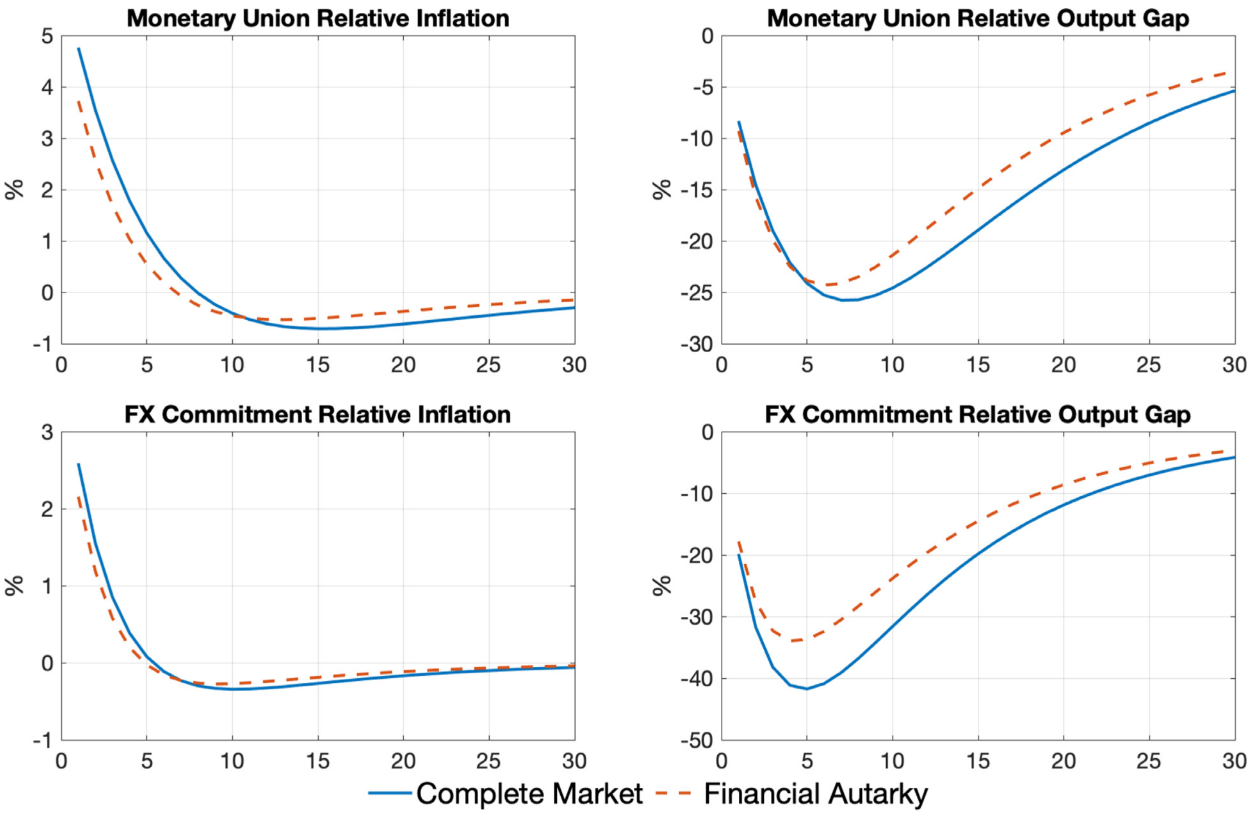


Fig. 4. IRFs to a Home Markup Shock under Alternative Regimes.

Table 2
Welfare Comparison. *Note:* Row (1) reports the welfare gain of financial autarky measured by $\mathbb{W}$(complete) - $\mathbb{W}$(autarky), where $\mathbb{W}$(.) is the periodic unconditional loss. Rows (2)–(4) report the contribution of each welfare-relevant variable to the welfare gain of autarky. A positive value indicates that the welfare level is higher for autarky versus complete markets.

	FX Discretion	FX Commitment	Monetary Union
Gain of Autarky	0.4405	0.0901	0.1824
Relative Output $\hat{Y}_t^R$	0.0406	0.1048	0.0337
Relative Inflation π_t^R	0.4296	0.0277	0.1761
Demand Imbalance $\hat{f}_t$	-0.0297	-0.0424	-0.0275

Role of Commitment Power The monetary authority's ability to commit plays a significant role in determining the magnitude of the responses of relative output gaps and inflation, and thus the welfare gain of autarky. Comparing Figs. 3 and 4, one notable difference between the regime with flexible exchange rates and discretionary policy and the two alternative regimes (flexible exchange rates with commitment and a monetary union) is that the responses of relative inflation and output gaps in the latter two regimes are smaller on impact than those in the regime with flexible exchange rates and discretionary policy for complete markets. This is because, in the two alternative regimes, the monetary authority has commitment power. Under flexible exchange rates with commitment, it can take advantage of the agent's expectations to alleviate current relative inflation and output gaps. Its ability to manage expectations is also present in a monetary union, even under discretion. This is because the terms of trade become an endogenous state variable that the monetary authority can use to affect future expectations. For example, Groll and Monacelli (2020) show that inertia in the terms of trade stabilizes relative inflation following a markup shock in a monetary union under discretion.

The dependence of the response of the relative variables on the monetary authority's ability to commit has important consequences for the welfare gain of autarky. Table 2 reveals that, among the three regimes, the welfare gain of financial autarky is the highest under flexible exchange rates with discretionary policy. The majority of the gain in this regime arises from the stabilization of relative inflation. This is because, with discretionary policy, the monetary authority cannot adjust agents' expectations to alleviate current relative inflation. As a result, the adverse effect of Home markup shocks is borne during the short time horizon with large variations in relative inflation. By virtue of the second-order loss function, the marginal welfare gain of stabilizing inflation increases in the magnitude of the inflation response. Therefore, the welfare gain of financial autarky through inflation stabilization is much larger under flexible exchange rates with discretionary policy than under the two alternative regimes, in which the monetary authority can take advantage of expectations to mitigate the response of current relative inflation.

4. Role of preferences

In the previous section, we argued that the wealth effect on labor supply is key for welfare reversals to arise. In this section, we evaluate the welfare gain of autarky under the preference proposed by Greenwood et al. (1988) (GHH preference). Because the GHH preference does not involve the wealth effect on labor supply, the experiment allows us to confirm the importance of the wealth effect on labor supply in delivering the welfare gain of autarky. Moreover, we discuss that, under the baseline separable preference, the intratemporal trade elasticity plays a crucial role in generating welfare reversals.

4.1. GHH Preference

Under the GHH preference, the present discounted value of lifetime utility is:

$$\mathbb{E}_t \sum_{k=0}^{\infty} \beta^k \left(\frac{(C_{t+k} - \frac{1}{1+\eta} N_{t+k}^{1+\eta})^{1-\rho} - 1}{1-\rho} \right). \tag{20}$$

We show that our main result is overturned when the assumed preference is the GHH preference: Complete markets dominate financial autarky. We show this striking result using the movements of the targeting rule and the relative Phillips curve. Again, we assume no home bias, financial autarky, log-utility, and discretionary policy under flexible exchange rates (i.e., $\nu = 1$, $\lambda = 1$, and $\rho = 1$) for tractability. The targeting rule and the relative Phillips curve under the GHH preference are:[11]

$$\begin{cases} \pi_t^R = -\frac{1}{\sigma}\tilde{Y}_t^R + \frac{1}{\sigma(1+\theta\eta)}\hat{f}_t & \text{[Targeting Rule (GHH)]} \\ \pi_t^R = (\frac{\kappa}{1-\beta\rho_\mu})\left[(\eta + \frac{1}{\theta})\tilde{Y}_t^R + \mu_t^R\right]. & \text{[Relative PC (GHH)]} \end{cases} \tag{21}$$

The targeting rule is the plan set by a social planner that maximizes the GHH preference. The relative Phillips curve is from (B.15), where we have used the fact $\mathbb{E}_t\pi_{t+1}^R = \rho_\mu \pi_t^R$ and equation (B.6). Notice that, unlike the separable preference, the demand imbalance term $\hat{f}_t$ does not enter the Phillips curve, and thus there is no force that can offset the leftward shift of the Phillips curve initiated by the Home markup shock. The absence of the demand imbalance arises from the property of the GHH preference, which does not involve the wealth effect on labor supply. In this case, a change in the demand imbalance under autarky does not appear as a benefit. Instead, it is a pure distortion that the social planner would like to minimize.

To understand how the social planner manages the demand imbalance, it is useful to note the difference in the demand imbalance under the GHH preference and the separable preference. The difference arises from the specification of the marginal utility differential, which is $\frac{\rho(1+\eta)}{\eta}(\tilde{C}_t^R - \tilde{N}_t^R)$ under the GHH preference and $\rho\tilde{C}_t^R$ under the separable preference. Thus, a positive demand imbalance under the GHH preference indicates that the gap between relative consumption and labor is inefficiently high at the current exchange rate, which implies that Home is consuming too much relative to its working hours compared to Foreign. Indeed, the meaning of a positive demand imbalance differs from that under the separable preference, which represents inefficiently high relative consumption.

With the specification of the demand imbalance under the GHH preference in mind, consider complete markets to understand the demand imbalance response. A positive relative markup shock implies that output, or labor, is higher in Foreign than in Home due to the expenditure-switching effect from Home to Foreign. Because the GHH preference implies a complementarity between consumption and labor, Foreign must achieve a high level of consumption by borrowing from Home. Under autarky, the Foreign households consume inefficiently less compared to their working hours as borrowing is impossible. Accordingly, the gap between relative consumption and labor is larger under autarky than under complete markets, indicating an increase in the demand imbalance. Recall that the demand imbalance decreased under our baseline separable preference.

Fig. 5 illustrates the determination of relative inflation and output gaps under the GHH preference, using the targeting rule and relative Phillips curve. Again, under complete markets, a positive relative markup shock shifts in the relative Phillips curve (i.e., from AS_0^R to AS_1^R), leading the economy to point C. Unlike the case of the separable preference, there is no additional movement in the Phillips curve under autarky, as there is no demand imbalance term in the Phillips curve. Since the increase in the demand imbalance is welfare-costly, the planner decides to ameliorate the increase in the demand imbalance by correcting the inefficiently high relative consumption compared to relative labor. She does so by having the monetary

[11] The targeting rule can be derived by combining the first-order conditions of the optimal discretionary policy problem, described in the Technical Appendix. The derivation of the relative Phillips curve is in Appendix B.2. The slope of the Phillips curve under the GHH preference is different from that under the baseline separable preference due to the assumption of market-wide labor: $\kappa \equiv \frac{(1-\alpha_H\beta)(1-\alpha_H)}{\alpha_H(1+\sigma\eta)} = \frac{(1-\alpha_F\beta)(1-\alpha_F)}{\alpha_F(1+\sigma\eta)}$ under the baseline preference and $\kappa \equiv \frac{(1-\alpha_H\beta)(1-\alpha_H)}{\alpha_H} = \frac{(1-\alpha_F\beta)(1-\alpha_F)}{\alpha_F}$ under the GHH preference.

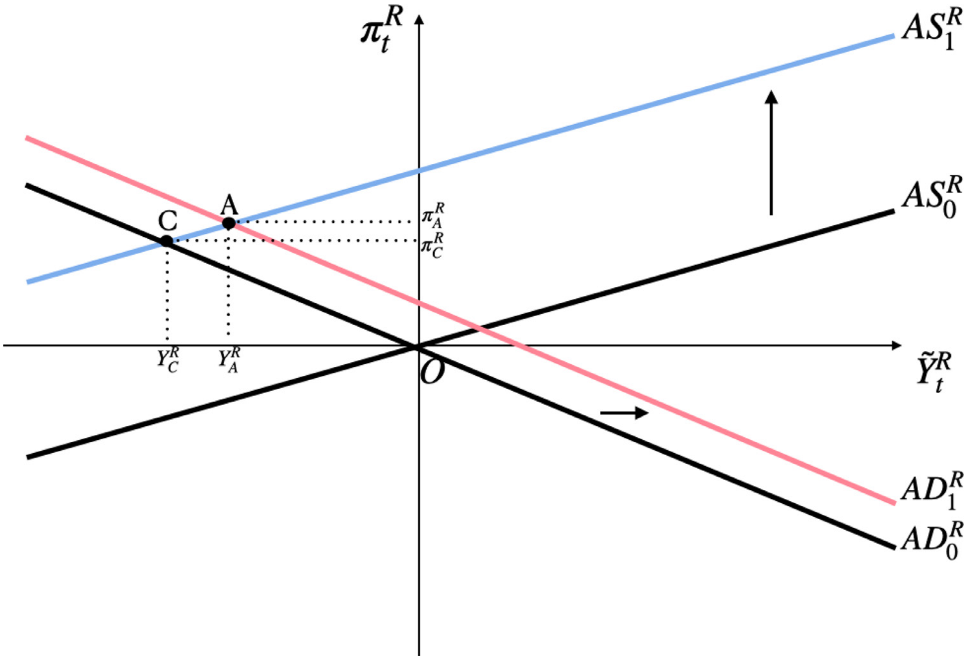


Fig. 5. Relative Inflation and Output under the GHH Preference. *Note:* $\tilde{Y}_t^R = \tilde{Y}_{H,t} - \tilde{Y}_{F,t}$ and $\pi_t^R = \pi_{H,t} - \pi_{F,t}^*$ are the relative output (gap) and relative inflation, respectively. AD^R and AS^R are the targeting rule and relative Phillips curve, respectively.

policy boost Home output, or labor, thereby reducing the gap between relative consumption and labor. The rightward shift in the targeting rule (i.e., from AD_0^R to AD_1^R) reflects the monetary policy's effort to expand relative output. Thus, under autarky, the equilibrium ends at point A, implying higher relative inflation and output than under complete markets. Because the cost from greater volatility of relative inflation and demand imbalance dominates the gain from reduced volatility in relative output gaps, the welfare loss is greater under autarky than under complete markets.[12]

4.2. Trade elasticity

In the baseline calibration, we assumed that the trade elasticity θ is larger than 1 (i.e., Home and Foreign goods are substitutes in utility). We now show that this is an important assumption for welfare reversals to arise by evaluating welfare reversals when θ is less than 1. Fig. 6 illustrates the welfare loss difference $\mathbb{W}$(complete) - $\mathbb{W}$(autarky) by varying the trade elasticity. When Home and Foreign goods are complements in utility ($\theta < 1$), welfare reversals do not arise under all three regimes, meaning that the level of welfare under autarky is lower than under complete markets. This is because, unlike the case of substitutes, the demand imbalance acts like an endogenous *unfavorable* relative markup shock, which makes relative inflation more volatile.

This role of the demand imbalance stems from its increase in response to a positive relative markup shock, which is the opposite response to what is observed in the case of substitutes. Although the positive relative markup shock directly increases the price of the Home goods, leading to an appreciation of the Home terms of trade regardless of the trade elasticity, the effect of the appreciation of the Home terms of trade on capital flows depends on this intratemporal elasticity. On the one hand, because the Foreign goods become relatively more inexpensive, Home increases the demand for the Foreign good, becoming a net debtor. This is the expenditure-switching effect. On the other hand, because of the willingness to smooth consumption over time, Home sells off its goods at a higher price and accumulates savings for future consumption. This is the intertemporal consumption smoothing effect, which makes Home a net creditor. When goods are substitutes, the expenditure-switching effect dominates, which was the case in Section 3.2. However, when goods are complements, the consumption smoothing effect dominates, so Home lends resources abroad. In the latter case, the Home households under autarky consume more than they would under complete markets due to the absence of international lending. Accordingly, relative consumption under autarky is higher than under complete markets, indicating an increase in the demand imbalance.

Fig. 7 paints the complete picture of the effect of the positive relative markup shock when goods are complements, using the framework of the targeting rule and the relative Phillips curve (i.e., Eq. (19)). First, under complete markets

[12] In Appendix E, we show the impulse responses under the GHH preference and show that the welfare loss is greater under autarky than under complete markets. In addition, we evaluate the welfare gain of autarky by changing the intensity of the wealth effect and show that the intensity required for welfare reversals to arise is not extremely high.

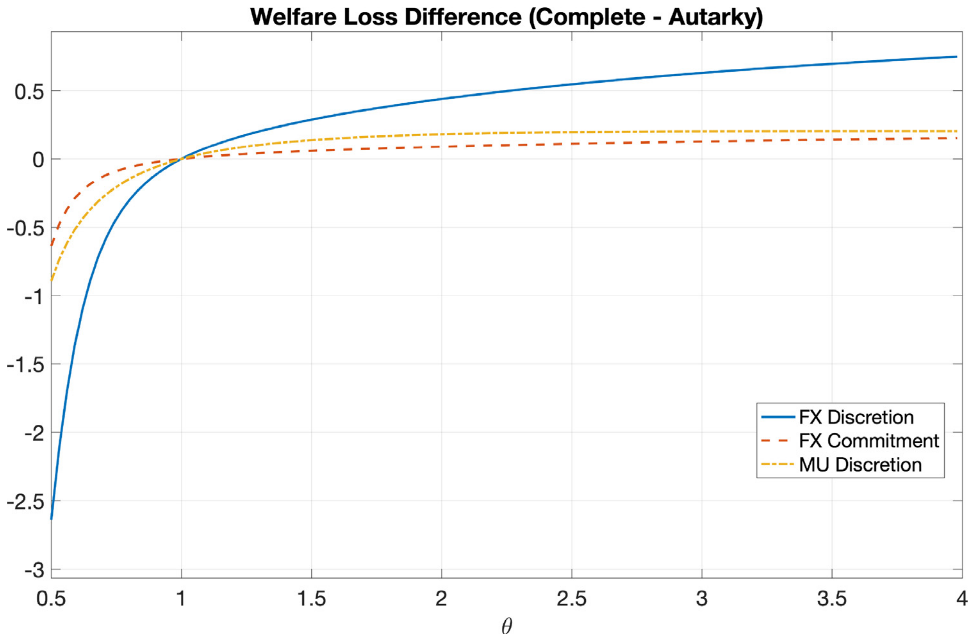


Fig. 6. Welfare Gain of Autarky and Trade Elasticity. *Note:* The panel shows the welfare gain of financial autarky as a function of the trade elasticity θ. A positive value indicates that autarky dominates complete markets.

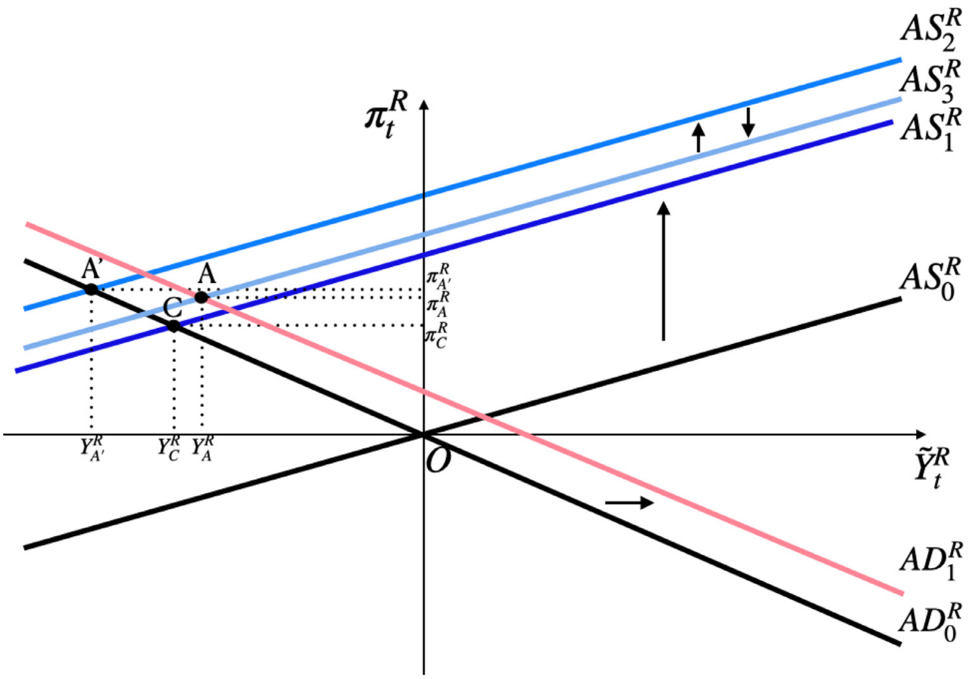


Fig. 7. Relative Inflation and Output under the Separable Preference (Complements). *Note:* $\tilde{Y}_t^R = \tilde{Y}_{H,t} - \tilde{Y}_{F,t}$ and $\pi_t^R = \pi_{H,t} - \pi_{F,t}^*$ are the relative output (gap) and relative inflation, respectively.

($\hat{f}_t = 0$), a positive relative markup shock shifts in the relative Phillips curve (i.e., from AS_0^R to AS_1^R), leading the economy to point C. Under autarky, the increase in the demand imbalance shifts in the Phillips curve further (i.e., from AS_1^R to AS_2^R), generating a further rise in relative inflation. Intuitively, the increased Home consumption under autarky discourages the Home households from working due to the wealth effect on labor, thereby putting upward pressure on nominal wages and inflation in Home. Thus, the increase in the demand imbalance manifests as an endogenous unfavorable relative markup shock that amplifies the effect of the positive relative markup shock on relative inflation.

Since the increased demand imbalance is costly to world welfare, the optimal discretionary policy is to curb the increase in the demand imbalance by reducing the inefficiently high relative consumption. The planner achieves such an allocation by guiding the monetary policy to stimulate Home output. As more Home goods are produced, the Home terms of trade is appreciated less. With less expensive Home goods, the Home households' purchasing power decreases, causing the Home households not to consume too much under autarky. The rightward shift of the targeting rule (i.e., from AD_0^R to AD_1^R) reflects the monetary authorities' effort to expand relative output. Moreover, the mild suppression of the demand imbalance achieved under the optimal policy shifts in the Phillips curve to a small degree (i.e., from AS_2^R to AS_3^R), thereby leading the economy to point A. Thus, the relative markup shock generates more volatile relative inflation but less volatile relative output gaps under autarky than under complete markets. Because the cost of increased volatility in relative inflation and demand imbalance outweighs the gain from more stabilized relative output gaps, the welfare loss is greater under autarky than under complete markets.[13]

5. Demand-pull and cost-push inflation

Throughout the paper, we have shown that financial autarky can be beneficial over complete markets in the presence of Home inflation, which is driven by Home markup shocks. This type of inflation is often interpreted as cost-push inflation. An alternative cause of inflation would be increased Home demand. One might wonder whether the source that drives inflation, i.e., demand or cost-push shock, matters for welfare reversals. In this section, we show that welfare reversals do not occur in the presence of demand shocks, implying that the desirability of risk-sharing crucially depends on the relative importance of the markup or demand shock.

5.1. Demand shocks

To illustrate that welfare reversals do not occur in response to a Home demand shock–a shock that increases the Home marginal utility of consumption relative to its Foreign counterpart– we plot impulse responses, shown in Fig. 8. We start with a discussion associated with complete markets. When prices are flexible, this type of shock increases the demand for Home goods more than the demand for Foreign goods in the presence of home bias. Thus, relative output increases, and the Home terms of trade appreciates. Under sticky prices with suboptimal monetary policy, such as an empirical Taylor rule, the Home terms of trade appreciates less, and thus the world demand for Home goods is higher than that under flexible prices, implying a positive terms of trade gap and a positive relative output gap.

Under flexible exchange rates, the optimal monetary policy is to have each country's monetary authority choose its own natural rate of interest (Corsetti et al., 2011). This policy leads to a sufficiently high Home real interest rate relative to its Foreign counterpart, generating a sharp Home exchange rate appreciation until the terms of trade reaches its efficient level. The closed terms of trade gap leads to the complete stabilization of relative output gaps and inflation. Such an outcome is attained for both commitment and discretionary policies, as observed in the upper two rows of the figure. However, in a monetary union, attaining the efficient allocation is infeasible as there is only one policy instrument: the union-wide interest rate. With the union-wide interest rate, closing the terms of trade gaps through the adjustment of exchange rates is no longer possible. Accordingly, the optimal policy in a monetary union is to allow some fluctuation in relative output gaps and inflation even under complete markets.[14]

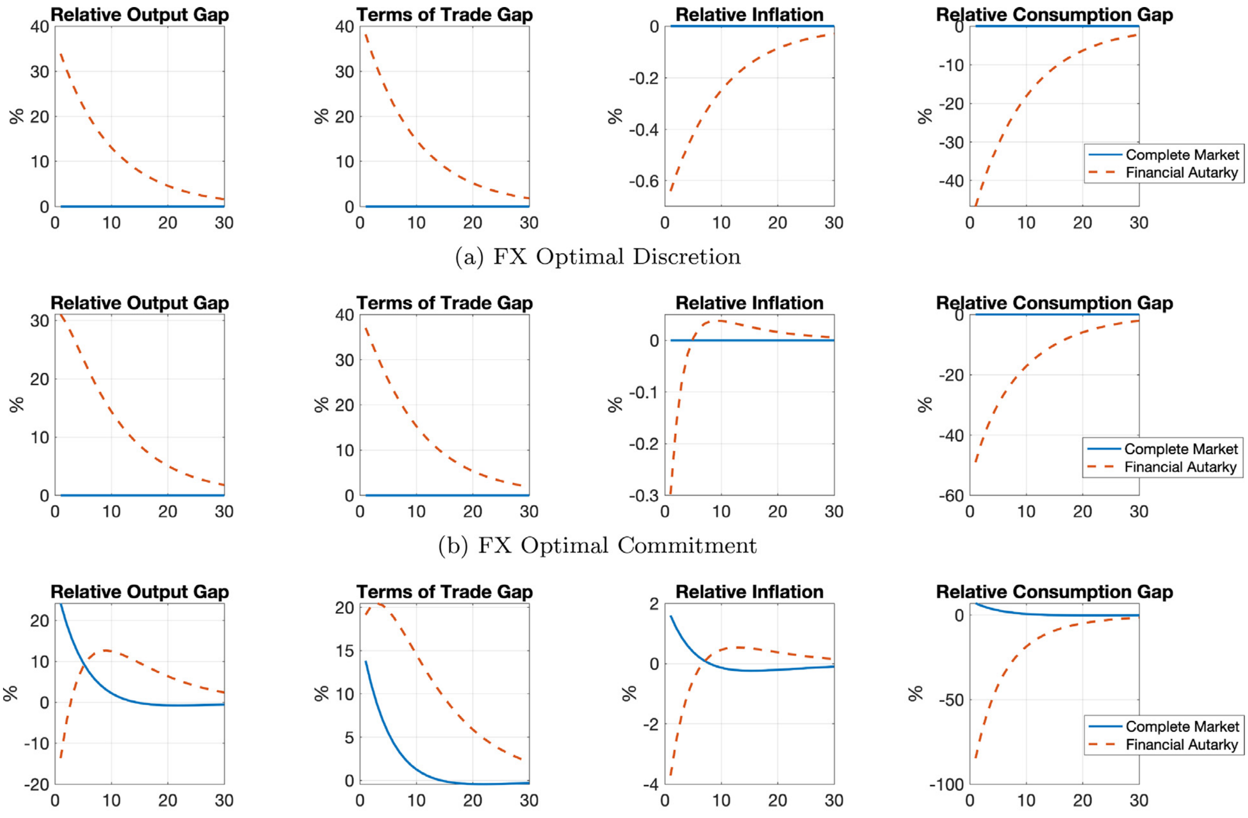
Under financial autarky, we observe that, for all three regimes, it is impossible to achieve the efficient allocation. Even for flexible exchange rates, in which there are two monetary policy instruments, the welfare-maximizing allocation is to have volatile relative output gaps and inflation and terms of trade gaps. To understand this outcome intuitively, it is useful to explain how Home consumption is determined under complete markets. In complete markets, relatively impatient Home households increase consumption by importing Foreign goods, allowing them to consume more than what the Home country can produce. Under financial autarky, in which zero trade balance must be achieved, the relative price of Foreign goods must be higher than under complete markets to reduce the consumption of Foreign goods, implying a rise in the terms of trade gap. The reduced consumption of Foreign goods decreases Home composite consumption relative to that under complete markets, as represented by a fall in relative consumption gaps. The inefficiently low Home consumption level induces Home households to supply more labor than they would under complete markets, causing a rise in relative output gaps.[15] At the same time, the inefficiently high Home labor supply reduces relative inflation by putting downward pressure on Home nominal wages. Accordingly, the distorted cross-border consumption misalignment, which does not prevail in complete markets, is the cause that prevents the efficient allocation.

As in the case of a positive Home markup shock, a positive Home demand shock under financial autarky leads to an inefficient fall in relative consumption, or equivalently, a negative demand imbalance. However, the role of demand imbalances

[13] In Appendix E, we show the impulse responses when goods are complements.

[14] In the presence of the equal price stickiness between countries, it is possible to close world output gaps and inflation in a monetary union but not relative output gaps and inflation, as identified by Benigno (2004).

[15] In a monetary union, there is a temporary fall in the relative output gap during the initial few periods. This can be explained from the hump-shaped dynamics of the terms of trade, which arises from the fact that the terms of trade is a state variable in a monetary union (Benigno, 2004; Pappa, 2004). The higher expected future terms of trade means the lower expected future relative price of Home goods than today. Thus, Home households delay their consumption of Home goods to the future, contributing to reduced Home production today.



(a) FX Optimal Discretion

(b) FX Optimal Commitment

(c) Monetary Union

Fig. 8. Response to a Positive Home Demand Shock.

differs substantially across the two shocks. In particular, a demand imbalance following a Home markup shock decreases the volatility of relative output gaps and inflation, improving world welfare. In this case, a demand imbalance behaves like a favorable shock and reduces welfare losses. In contrast, a demand imbalance following a Home demand shock acts like an adverse shock in the sense that it increases the volatility of relative output gaps and inflation, decreasing world welfare.

Our results suggest that the desirability of financial risk-sharing between countries depends on the source of business cycles. Risk-sharing is desirable if inflation in one country is higher than in the other due to demand shocks, but not if cost-push shocks drive inflation in that country.

5.2. Welfare reversals in the presence of two shocks

In the aftermath of the COVID-19 driven recession, many advanced economies implemented a mix of persistently loose monetary and fiscal policies to stimulate aggregate demand, causing an overheating of inflation. At the same time, due to the persistent supply bottlenecks, there is a growing concern that inflationary pressures may not be temporary and could lead to 1970s-style stagflation. Given the current state of the global economy, a more empirically relevant model would include both demand and markup shocks. In this subsection, we incorporate the two shocks in our model and discuss the extent to which autarky is beneficial by changing the relative importance of each shock. We also discuss which case is the most empirically plausible.

Fig. 9 illustrates the unconditional welfare loss difference $\mathbb{W}(\text{complete}) - \mathbb{W}(\lambda)$ as a function of the degree of capital control λ for alternative values of the variance of Home demand shocks σ_ϵ^2 and of Home markup shocks σ_μ^2. The first panel corresponds to our baseline case, in which the only shock is the markup shock in Home. This panel indicates that the welfare gain increases in the degree of financial control λ for all three regimes, with the magnitude being the largest under financial autarky ($\lambda = 1$). However, as we move to the middle and right panels, the degree of capital control that produces the largest welfare gain is not 1. This is because, in the case of Home demand shocks, the value of λ that yields the highest welfare is 0, which delivers efficient allocation under flexible exchange rates. Accordingly, in the presence of both markup and demand shocks, the value of λ that maximizes the welfare gain lies between the extremes. Focusing on the case of $\lambda = 1$, we observe that the benefit of autarky over complete markets decreases as the variance of demand shocks relative to

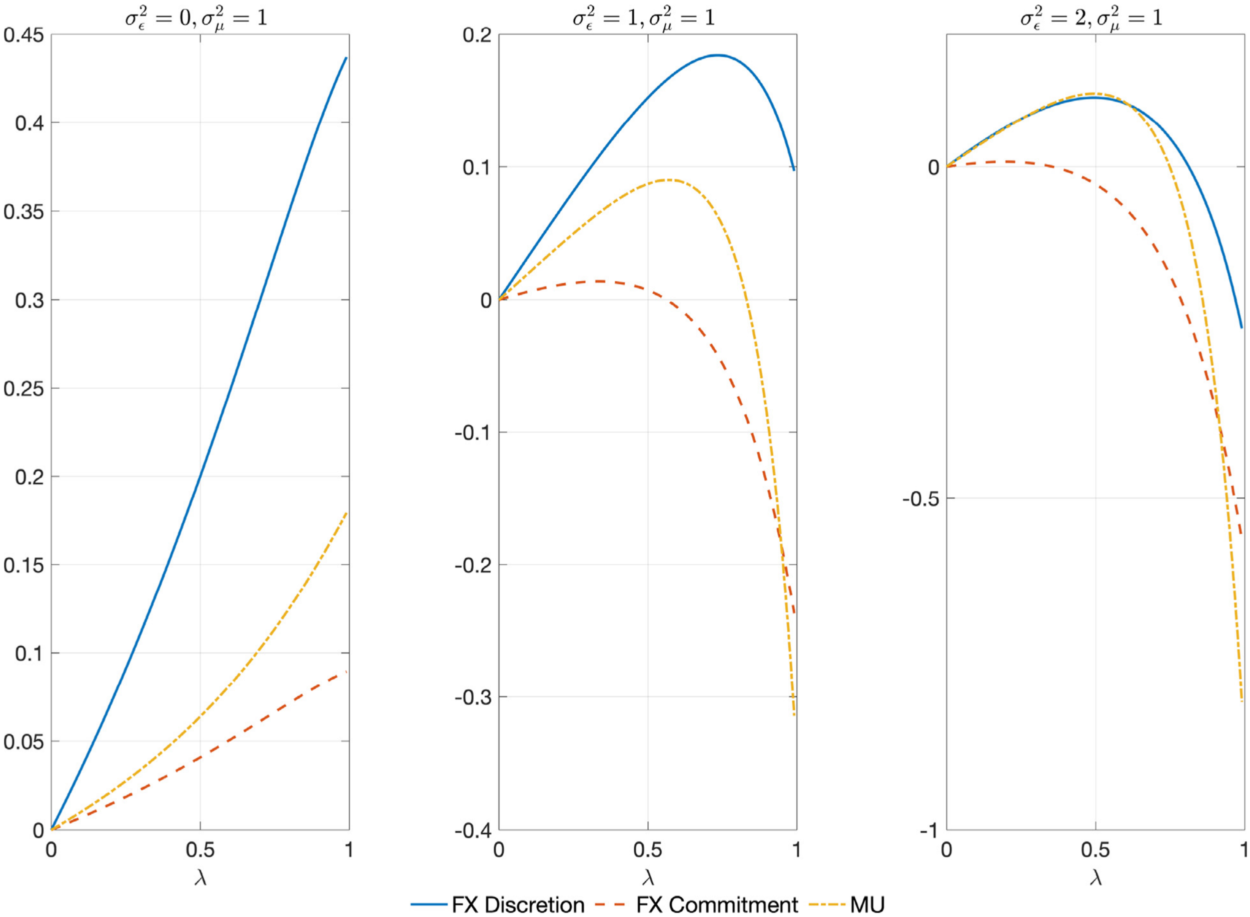


Fig. 9. Welfare Gain of Financial Controls in the Presence of Two Shocks. *Note:* Welfare loss difference $\mathbb{W}$(Complete) - $\mathbb{W}(\lambda)$ in the presence of both Home demand and Home markup shocks as a function of the degree of financial control λ. A positive value indicates that a market with degree of financial control λ dominates complete markets. σ_ϵ^2 denotes the variance of the demand shock, and σ_μ^2 denotes the variance of the markup shock.

the variance of markup shocks increases for all three regimes. This outcome is expected, recalling our result that financial autarky is welfare-detrimental in the case of demand shocks.

In Section 3, we found that the monetary authority's ability to commit is an important determinant of the magnitude of the welfare gain of autarky over complete markets in response to markup shocks. When the monetary authority lacks commitment, variations in relative output gaps and inflation are larger than in cases of commitment, and thus there is greater scope for reducing inefficiencies by restricting capital flows between the countries. As observed in Fig. 9, our previous finding is robust to the addition of demand shocks. Specifically, for all three pairs of shocks, the welfare gain of restricting capital flows is the largest for the regime with flexible exchange rates and discretionary policy than the other two regimes, in which the monetary authority can manage expectations.

We now discuss which scenario among the three cases in Fig. 9 is the most empirically plausible regarding the relative size of markup shocks. We assess the empirical relevance of shock combinations in the three panels as follows. First, we perform the variance decomposition for each panel to compute the contribution of Home markup shocks to the variance of Home inflation under complete markets with flexible exchange rates. We then identify which panel gives the contribution of markup shocks that is comparable to its empirical counterpart. The empirical contribution of shocks is taken from the classic studies that estimate DSGE models on the U.S. data (Justiniano et al., 2010; Smets and Wouters, 2007). Because the inefficient shocks in these studies are price and wage markup shocks, we treat the contribution of price and wage markup shocks in these studies as the empirical counterpart of our contribution of markup shocks.

When computing the variance decomposition of Home markup shocks to the variance of Home inflation, we assume that the monetary policy in both countries follows a standard Taylor rule with its inflation reaction coefficient equal to 2. We do the variance decomposition under a standard Taylor rule instead of optimal monetary policy for the following reasons. First, because the demand shocks lead to zero inflation and output gaps under optimal monetary policy with flexible exchange rates, as observed in Fig. 8, inflation is entirely explained by markup shocks, regardless of the standard deviation of demand shocks. Second, most existing studies that estimate the variance decomposition assumes a Taylor rule, in which the inflation reaction coefficient is estimated at around 2. Obviously, the left panel is an environment in which markup shocks entirely account for the inflation variability. In the middle panel, markup shocks explain 79% of the fluctuations in inflation under a Taylor rule, while demand shocks explain 21%. The right panel is the scenario in which markup shocks explain 65% and demand shocks explain 35%.

We next discuss the empirical contribution of markup shocks to the variance of inflation computed by Smets and Wouters (2007) and Justiniano et al. (2010). The main difference between these two studies comes from the measurement of observable variables, which affects the relative contribution of each shock. In particular, compared to Justiniano et al. (2010), Smets and Wouters (2007) include consumer durables in consumption and exclude the change in inventories from investment. Partly due to these differences, the contribution of price and wage markup shocks to the variance in inflation is 83% in Smets and Wouters (2007), but 73% in Justiniano et al. (2010).[16]

It turns out that the middle panel is the most empirically plausible in that the contribution of markup shocks, 79%, is between its two empirical counterparts–83% and 73%. The middle panel reveals that, under the empirically plausible relative size of markup shocks, some degree of market incompleteness enhances welfare in all three regimes of optimal monetary policy.

6. Conclusion

A widely believed argument in the international macroeconomics literature is that financial integration across countries is desirable, as it enables risk-sharing between countries that are subject to country-specific income fluctuations. We have revisited this classic issue, namely whether complete financial markets that allow cross-country risk-sharing lead to higher welfare than autarky, in which risk-sharing is limited. We have shown that the answer to this question hinges on the source of country-specific income fluctuations. In a two-country New Keynesian model with country-specific markup shocks, welfare reversals occur. That is, welfare is higher under autarky than under complete financial markets. This result stems from our finding that incomplete risk-sharing under financial autarky acts like a favorable markup shock, which tempers the response of relative output gaps and inflation created by the country-specific markup shocks. Welfare reversals arise under both flexible exchange rates and a monetary union and under both discretionary and commitment monetary policies. Our results highlight the importance of focusing on the state of business cycles when promoting financial integration across countries. In a period of stagflation, financial integration that enables international risk-sharing may not be desirable.

Data availability

No data was used for the research described in the article.

Supplementary material

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jmoneco.2023.04.005.

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