Monetary Policy during Unbalanced Global Recoveries

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Abstract

We study optimal monetary policy during times of exceptionally high global demand for tradable goods, relative to non-tradable services. The optimal monetary response entails a rise in inflation, which helps rebalance production toward the tradable sector. While the inflation costs are fully beared domestically, however, part of the gains in terms of higher supply of tradable goods spill over to the rest of the world. National central banks may thus fall into a coordination trap, and implement an excessively tight monetary policy during tradable goods-driven recoveries.

JEL Codes: E32, E44, E52, F41, F42.

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1 Introduction

A salient feature of the ongoing recovery from the Covid-19 recession is its unbalanced nature. Throughout the world, demand for goods is buoyant, while demand for contact-intensive services is subdued. Considering that goods are typically traded across countries, while most services are not, the global economy is effectively experiencing a reallocation of demand away from non-tradable services and toward tradable goods (Figure 1). Unsurprisingly, this rebalancing of demand is associated with rising goods prices, and stress on the global supply chains. Against this background, it is natural to ask how international spillovers - including those arising from policy interventions - are shaping the global recovery.

In this paper, we study the optimal conduct of monetary policy during times of exceptionally high demand for tradable goods, and show that national monetary authorities may fall prey of a coordination failure. In a nutshell, the reason is that the optimal monetary response entails a rise in the price of tradables, which helps rebalance production toward the tradable sector. While the inflation costs are fully beared domestically, however, part of the gains in terms of higher supply of tradable goods spill over to the rest of the world. In absence of international cooperation, national central banks do not internalize this positive spillover, and may thus implement an excessively tight monetary policy, compared to the one that would maximize global welfare.

We formalize this insight with the help of a multi-country Keynesian model with multiple sectors. Our economy is composed of a continuum of small open economies. Each country employs labor to produce a tradable good, common to every country, and a non-tradable one. Due to the presence of nominal wage rigidities, monetary policy has real effects. We study the response of the economy to a global reallocation shock, that is a temporary rise in consumers' demand for the tradable good, relative to the non-tradable one. The shock is global, in the sense that it hits symmetrically every country in the world.

Under the optimal monetary policy, global inflation rises in response to the reallocation shock. To see why, recall that the reallocation shock depresses demand for non-traded goods. In absence of nominal rigidities, lower demand for non-tradables would simply translate into a drop in their price. Since nominal wages are rigid, however, lower demand induces firms in the non-traded sector to reduce production and fire part of their workforce. To contain the ensuing increase in unemployment, monetary policy has to facilitate a shift of employment toward the traded sector, or to boost demand for non-tradable goods. A rise in the price of the traded good, fostered by a monetary expansion, achieves both objectives. First, higher prices induce firms in the traded sector to hire more workers and increase production. Second, higher production allows agents to increase their consumption of tradable goods. As consumers satisfy their demand for tradables, also their demand for non-traded goods rises. Through this aggregate demand effect, a monetary expansion lifts employment in the non-traded sector too.[1]

The optimal monetary policy trades off the inflation cost, captured by the disutility attached

[1] Our model also embeds a third effect. A rise in the price of tradables generates an expenditure switching effect from the tradable to the non-tradable good, thus sustaining employment in the non-traded sector.

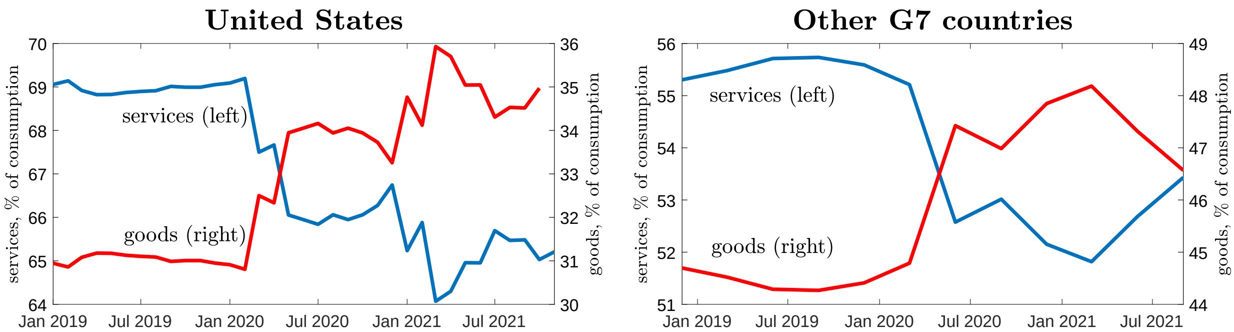

Figure 1: Goods and services share in total consumption expenditure. Notes: The figure shows the reallocation of consumption expenditure out of services and towards goods, that has characterized advanced economies since the start of the Covid-19 pandemics. Other G7 countries refer to the average of Canada, France, Germany, Italy, Japan and United Kingdom. Data sources: BEA (U.S.), OECD (U.K., Japan), Eurostat (France, Germany, Italy), Statistics Canada (Canada).

by agents to high inflation, against the employment gains. A reallocation shock thus acts as a cost-push shock, leading to a contemporaneous rise in inflation and unemployment. These results essentially extend to our setting the insights of the literature on inflation and reallocation shocks in closed economies (Olivera, 1964; Tobin, 1972; Guerrieri et al., 2021). What comes next, however, is new.

In open economies, the strength of the positive impact of a monetary expansion on aggregate demand depends on the degree of capital mobility. Under financial autarky, the aggregate demand effect is especially strong, because any increase in the production of tradable goods has to be consumed domestically.[2] With free capital mobility, the aggregate demand effect is much weaker. The reason is that when the domestic production of tradable goods increases domestic agents consume only part of it. The rest is sold to foreign consumers, and the receipts are invested in foreign assets. This effect weakens the positive impact of a monetary expansion on demand for domestic non-traded goods, and worsens the trade-off between inflation and employment faced by national central banks. As a result, the monetary policy response to a reallocation shock is tighter under free capital mobility, compared to financial autarky. International financial integration thus mitigates the impact of a rise in global demand for tradable goods on inflation, but exacerbates its effect on unemployment.

Moreover, in financially integrated world monetary interventions trigger international spillovers. Recall that we are considering periods in which the global demand for tradable goods is exceptionally high. Under free capital mobility, when a country implements a monetary expansion it increases its net exports of the tradable good toward the rest of the world, thus easing pressure on the global market for tradables. As global consumers gain access to a higher supply of tradables, their demand for non-tradable goods rises. Through this channel, a monetary expansion lifts aggregate demand and employment not only domestically, but in the rest of the world as well.

[2]Since our framework features a single tradable good, the equilibrium under financial autarky is isomorphic to the closed economy one.

The presence of this international aggregate demand spillover implies that the monetary policy response to a reallocation shock implemented by national central banks is too tight from a global perspective. The reason is simple. The inflation costs associated with monetary expansions are fully beared by domestic agents. The gains in terms of higher demand and employment, instead, are partly enjoyed by agents in the rest of the world. Since this positive spillover is not internalize by national authorities, lack of international cooperation leads to excessive unemployment during tradable goods-driven recoveries.

In the last part of the paper we discuss some implications for global rates and the international transmission of inflation. First, we show that, under the optimal policy, a reallocation of expenditure toward tradable goods is accompanied by a rise in nominal interest rates, especially if international capital mobility is high. Second, we show that a rise in tradable goods demand occurring in the rest of the world produces inflationary spillovers at home. But, perhaps surprisingly, during times of high global demand for tradables monetary expansions in the rest of the world give rise to deflationary spillovers at home.

This paper is related to two strands of the literature. First, it is connected to the literature studying the implications for monetary policy of shocks giving rise to a reallocation of demand across sectors. Olivera (1964) and Tobin (1972) are classic contributions to this literature, while Aoki (2001), Benigno and Ricci (2011) and Guerrieri et al. (2021) provide analyses based on modern Keynesian frameworks. All these works consider closed economies, and so abstract from interaction across different countries, which are the focus of our work. Fornaro (2018) studies the implications for monetary policy of a global deleveraging shock, using a multi-country model with multiple sectors. Here, instead, we consider a reallocation shock and we study the gains from international monetary cooperation, two dimensions which are absent in Fornaro (2018).

Second, our paper is related to the vast literature on international monetary policy cooperation. Obstfeld and Rogoff (2002), Benigno and Benigno (2003) and Corsetti and Pesenti (2005) study international monetary policy cooperation using new-Keynesian open-economy models.[3] In these frameworks, the gains from cooperation arise because individual countries have an incentive to manipulate their terms of trade at the expenses of the rest of the world. In our model, terms of trade are constant and independent of government policy, and hence terms of trade externalities are absent. Canzoneri et al. (2005) and Tille (2002) consider the gains from cooperation in multi-sector economies subject to sectoral shocks. Their focus is on asymmetric shocks, while we study a scenario in which the whole world is hit by a reallocation shock. Moreover, the source of gains from cooperation emphasized by our paper is, to the best of our knowledge, novel compared to the existing literature. Our model is also connected to some recent works studying international spillovers in times of secular stagnation (Caballero et al., 2021; Eggertsson et al., 2016; Fornaro and Romei, 2019). These papers consider a global economy in which demand is scarce and inflation is low. Instead, we study a scenario in which global demand is strong and inflation is high.

[3] See also Bodenstein et al. (2020), Egorov and Mukhin (2020) and Jeanne (2021) for some recent contributions to this literature.

The rest of the paper is composed of four sections. Section 2 introduces our model. Section 3 studies the macroeconomic adjustment to a reallocation shock under financial autarky. Section 4 considers the case of free capital mobility, and highlights the pitfalls from lack of international monetary cooperation. Section 5 discusses the response of interest rates to a global reallocation shock, as well as the international inflation spillovers. Section 6 concludes.

2 Model

We consider a world composed of a continuum of measure one of small open economies indexed by $i \in [0,1]$. Each economy can be thought of as a country. Time is discrete and indexed by $t \in \{1, ...\}$. Since the presence of risk is not crucial for our results, agents have perfect foresight.

Throughout, we will interpret period 1 as the short run, and periods $t \geq 2$ as the long run. In particular, we will assume that in period 1 the economy is hit by a reallocation shock, driving up the demand for tradable goods relative to non-tradable ones. Thereafter, the economy goes back to steady state. We are interested in understanding the role of international capital flows in shaping the adjustment to this reallocation shock, so we will compare two financial regimes: financial autarky and free capital mobility.

2.1 Households

Each country is populated by a continuum of measure one of identical infinitely-lived households. The lifetime utility of the representative household in a generic country i is

$$\sum_{t=1}^{\infty} \beta^{t-1} \left(\log \left(C_{i,t} \right) - \chi \left(\frac{P_{i,t}}{P_{i,t-1}} \right) \right), \tag{1}$$

where $0 < \beta < 1$ is the subjective discount. Households derive utility from aggregate consumption $C_{i,t}$, defined as

$$C_{i,t} = \left(\frac{C_{i,t}^T}{\omega_{i,t}} \right)^{\omega_{i,t}} \left(\frac{C_{i,t}^N}{1-\omega_{i,t}} \right)^{1-\omega_{i,t}}.$$

In this expression, $C_{i,t}^T$ and $C_{i,t}^N$ denote consumption respectively of a tradable and a non-tradable good, while $0 \leq \omega_{i,t} \leq 1$ is the share of tradable goods in the consumption basket.

Moreover, households experience disutility from inflation. Let $P_{i,t}$ denote the price of a unit of consumption basket, defined as

$$P_{i,t} = \left(P_{i,t}^T \right)^{\omega_{i,t}} \left(P_{i,t}^N \right)^{1-\omega_{i,t}}, \tag{2}$$

where $P_{i,t}^T$ and $P_{i,t}^N$ stand for respectively the price of a unit of tradable and non-tradable good in terms of country i currency. The convex function $\chi \left(P_{i,t}/P_{i,t-1} \right)$ captures some utility cost that households experience whenever inflation deviates from the central bank's target. We normalize this function so that $\chi(1) = \chi'(1) = 0$, which amounts to normalizing the inflation target to zero.

Literally, these costs could arise from some behavioral bias affecting consumers. More broadly, one could interpret these costs as related to the risk that the economy looses its nominal anchor if inflation deviates too much from the target.

Each household is endowed with $\bar{L}$ units of labor. There is no disutility from working, and so households supply inelastically their endowment of labor on the labor market. We introduce nominal rigidities by assuming that the nominal wage, denoted by $W_{i,t}$, is fixed in the short run. To simplify notation, we assume that $W_{i,1} = 1$ in every country i. From period 2 on, wages are fully flexible. The presence of nominal wage rigidities implies that involuntary unemployment may arise in the short run. In particular, when $L_{i,1} = \bar{L}$ the economy operates at full employment, while when $L_{i,1} < \bar{L}$ there is involuntary unemployment and the economy operates below capacity.

Households can trade in one-period real and nominal bonds. Real bonds are denominated in units of the tradable consumption good and pay the gross interest rate $R_{i,t}$. Under financial autarky $R_{i,t}$ may differ across countries. With free capital mobility, there is instead a single world interest rate, and so $R_{i,t} = R_t$ for all i. Nominal bonds are denominated in units of the domestic currency and pay the gross nominal interest rate $R^n_{i,t}$. $R^n_{i,t}$ is the interest rate controlled by the central bank, and thus can be thought of as the domestic policy rate.[4]

The household budget constraint in terms of the domestic currency is

$$P^T_{i,t}C^T_{i,t} + P^N_{i,t}C^N_{i,t} + P^T_{i,t}B_{i,t+1} + B^n_{i,t+1} = W_{i,t}L_{i,t} + \Pi_{i,t} + P^T_{i,t}R_{i,t-1}B_{i,t} + R^n_{i,t-1}B^n_{i,t}. \quad (3)$$

The left-hand side of this expression represents the household's expenditure. $P^T_{i,t}C^T_{i,t} + P^N_{i,t}C^N_{i,t}$ is the total nominal expenditure in consumption. $B_{i,t+1}$ and $B^n_{i,t+1}$ denote respectively the purchase of real and nominal bonds made by the household at time t.

The right-hand side captures the household's income. $W_{i,t}L_{i,t}$ is the household's labor income. $\Pi_{i,t}$ denote the income that the household derives from the ownership of firms. We assume that domestic households own all the firms in the country. $P^T_{i,t}R_{i,t-1}B_{i,t}$ and $R^n_{i,t-1}B^n_{i,t}$ represent the gross returns on investment in bonds made at time $t-1$.

The household's optimization problem consists in choosing a sequence $\{C^T_{i,t}, C^N_{i,t}, B_{i,t+1}, B^n_{i,t+1}\}_t$ to maximize lifetime utility (1), subject to the budget constraint (3) and a no Ponzi scheme constraint, taking initial wealth $P^T_{i,0}R_{i,-1}B_{i,0} + R^n_{i,-1}B^n_{i,0}$, a sequence for income $\{W_{i,t}L_{i,t} + \Pi_{i,t}\}_t$, and prices $\{R_{i,t}, R^n_{i,t}, P^T_{i,t}, P^N_{i,t}\}_t$ as given. The household's optimality conditions can be written as

$$\frac{\omega_{i,t}}{C^T_{i,t}} = R_{i,t}\frac{\beta\omega_{i,t+1}}{C^T_{i,t+1}} \quad (4)$$

$$R_{i,t} = \frac{R^n_{i,t}P^T_{i,t}}{P^T_{i,t+1}} \quad (5)$$

[4] Alternatively, we could allow households to trade nominal bonds denominated in foreign currencies. Given the structure of the economy, and in particular the fact that we are focusing on perfect-foresight equilibria, allowing households to trade foreign nominal bonds would not affect the equilibrium allocation of the model.

$$C_{i,t}^N = \frac{1-\omega_{i,t}}{\omega_{i,t}} \frac{P_{i,t}^T}{P_{i,t}^N} C_{i,t}^T, \tag{6}$$

plus the transversality condition. Equation (4) is the Euler equations for real bonds. Equation (5) is the no arbitrage condition between real and nominal bonds. Equation (6) determines the optimal allocation of consumption expenditure between tradable and non-tradable goods. Naturally, demand for non-tradables is decreasing in their relative price $P_{i,t}^N/P_{i,t}^T$. Moreover, demand for non-tradables is increasing in $C_{i,t}^T$, due to households' desire to consume a balanced basket between tradable and non-tradable goods.

2.2 Firms and production

Short run. In period $t = 1$ production takes place in both sectors. Though this is not crucial for our results, we assume that labor is perfectly mobile across the two sectors.

Non-traded output $Y_{i,t}^N$ is produced by a large number of competitive firms. Labor is the only factor of production, and the production function is $Y_{i,t}^N = L_{i,t}^N$, where $L_{i,t}^N$ denotes the labor allocated to the production of non-tradable goods. Profits are given by $P_{i,t}^N Y_{i,t}^N - W_{i,t} L_{i,t}$, and the zero profit condition implies that in equilibrium $P_{i,t}^N = W_{i,t}$. Hence, the price of the non-traded good fully inherits the nominal wage rigidity in the short run.

The tradable good is produced by competitive firms according to $Y_{i,t}^T = \left(L_{i,t}^T\right)^\alpha$. $L_{i,t}^T$ is the labor allocated to the production of traded goods. In equilibrium employment by households is equal to firms' labor demand, and so $L_{i,t} = L_{i,t}^T + L_{i,t}^N$. The labor share in the tradable sector is denoted by $0 < \alpha < 1$. The complement share $1-\alpha$ goes to firms as profits.[5] Profit maximization implies

$$Y_{i,t}^T = \left(\frac{\alpha P_{i,t}^T}{W_{i,t}}\right)^{\frac{\alpha}{1-\alpha}}. \tag{7}$$

Output of the tradable good is thus decreasing in the nominal wage deflated by its price. This expression also implies that the price of the traded good is partly flexible in the short run.[6]

Long run. In periods $t > 1$ households in each country receive a constant stream of endowments Y^T and Y^N. This assumption, which simplifies the derivation of some results, is meant to capture an environment in which whatever happens in the short run has a negligible impact on long-run output. Given that our baseline model abstracts from investment, this would be the case even if production took place in the long run as well.

[5] Decreasing returns to scale in production can derive from the assumption that production also requires the input of organizational capital, of which each firm has a fixed supply normalized to 1.

[6] Therefore, in our model nominal prices in the non-traded sector are more rigid than in the traded one. In fact, our model is essentially isomorphic to one in which the two sectors share the same production function, but in which the price of the non-traded good is sticky, while the price of the tradable good is flexible. This feature seems consistent with the empirical observation that nominal prices are stickier in the service sector, compared to agriculture and manufacturing (Nakamura and Steinsson, 2008).

2.3 Monetary policy

We are interested in deriving the optimal non-cooperative monetary policy. In the long run, since prices are fully flexible, the optimal monetary policy targets zero inflation, so that $P_{i,t} = P_{i,t-1}$ for $t \geq 2$. In the short run, it may be optimal to deviate from this zero inflation benchmark. Now recall that in the short run the price of the non-traded good is fixed, and so monetary policy affects short-run inflation only through the price of the traded good. The implication is that monetary policy in the short run amounts to setting a value for the nominal price of the traded good $P_{i,1}^T$.[7] As we will see, a rise in $P_{i,1}^T$ causes a rise in short-run aggregate demand. In what follows, we will then refer to monetary interventions leading to increases in $P_{i,1}^T$ as monetary expansions.

2.4 Market clearing and definition of competitive equilibrium

Since households inside a country are identical, we can interpret equilibrium quantities as either household or country specific. For instance, the end-of-period net foreign asset position of country i is equal to the end-of-period holdings of bonds of the representative household, $NFA_{i,t} = B_{i,t+1} + B_{i,t+1}^n / P_{i,t}^T$. Under perfect foresight, the composition of the net foreign asset position between real and nominal bonds is not uniquely pinned down in equilibrium. Throughout, we resolve this indeterminacy by focusing on equilibria in which nominal bonds are in zero net supply, so that $B_{i,t}^n = 0$ for all i and t. This implies that the net foreign asset position of a country is exactly equal to its investment in real bonds, i.e. $NFA_{i,t} = B_{i,t+1}$.

Market clearing for the non-tradable consumption good requires that in every country consumption is equal to production

$$C_{i,t}^N = Y_{i,t}^N. \tag{8}$$

Instead, market clearing for the tradable consumption good requires

$$C_{i,t}^T = Y_{i,t}^T + R_{i,t-1} B_{i,t} - B_{i,t+1}. \tag{9}$$

This expression can be rearranged to obtain the law of motion for the stock of net foreign assets owned by country i, i.e. the current account

$$NFA_{i,t} - NFA_{i,t-1} = CA_{i,t} = Y_{i,t}^T - C_{i,t}^T + B_{i,t} \left(R_{i,t-1} - 1 \right).$$

As usual, the current account is given by the sum of the trade balance, $Y_{i,t}^T - C_{i,t}^T$, and net interest payments on the stock of net foreign assets owned by the country at the start of the period, $B_{i,t}(R_{i,t-1} - 1)$.

Finally, in every period the world consumption of the tradable good has to be equal to world production, $\int_0^1 C_{i,t}^T \, \mathrm{d}i = \int_0^1 Y_{i,t}^T \, \mathrm{d}i$. This equilibrium condition implies that bonds are in zero net

[7] As it is standard, see for instance Galí (2009), the central bank can enforce a path for the price level by appropriately designing a rule for the policy rate $R_{i,t}^n$.

supply at the world level

$$\int_0^1 B_{i,t+1}\,\mathrm{d}i = 0. \tag{10}$$

We are now ready to define a competitive equilibrium as a path of real allocations $\{C^T_{i,t}, C^N_{i,t}, Y^T_{i,t}, Y^N_{i,t}, B_{i,t+1}\}_{i,t}$ and interest rates $\{R_{i,t}\}_{i,t}$, satisfying (4), (8), (9), (10), a path for the preference shock $\{\omega_{i,t}\}_{i,t}$, initial conditions $\{R_{i,0}B_{i,1}, P_{i,0}\}_i$ and $\{P_{i,t}\}_{i,t}$ set by monetary policy. The path of output for $t \geq 2$ is pinned down by the endowment process, while $\{Y^T_{i,1}, Y^N_{i,1}\}_i$ satisfy expressions (2), (6) and (7) given $W_{i,1} = P^N_{i,1} = 1$ for all i. Moreover, firms' labor demand cannot exceed households' supply and so $\left(Y^T_{i,1}\right)^{1/\alpha} + Y^N_{i,1} \leq \bar{L}$ for all i. Finally, under financial autarky $C^T_{i,t} = Y^T_{i,t}$ for all i and t, while under free capital mobility $R_{i,t} = R_t$ for all i and t.

2.5 A global reallocation shock

To study the macroeconomic adjustment to a global reallocation shock, we will consider the following path for the preference shock $\omega_{i,t}$. We assume that the economy starts from a steady state in which $\omega_{i,t} = \omega$ in every country. In period 1, demand for tradables is unusually high, so that $\omega_{i,1} = \omega_1 > \omega$ at least for some country. From period 2 on, $\omega_{i,t}$ goes back to its steady state value ω in every country. The shock occurring at date 1 is previously unanticipated, but from then on agents have perfect foresight.

We are interested in studying a scenario in which all the countries are symmetric. Hence, we assume that each country starts with a zero net foreign asset position, i.e. $B_{i,1} = 0$ for all i. Moreover, we assume that in every country $W_{i,0} = 1$ and

$$P^T_{i,0} = \frac{1}{\alpha}\left(\frac{\alpha\omega\bar{L}}{\alpha\omega + 1 - \omega}\right)^{1-\alpha}.$$

This ensures that in the initial steady state every country is on its flexible wage equilibrium, and that in the short run positive inflation ($P^T_{i,1} > P^T_{i,0}$) is associated with an increase in the production of tradable goods ($Y^T_{i,1} > Y^T_{i,0}$).

3 Optimal monetary policy under financial autarky

Let us start by deriving the optimal policy under financial autarky. In this case each country essentially behaves as if it was a closed economy. In particular, since no current account imbalances are allowed, in each country $C^T_{i,t} = Y^T_{i,t}$ for all t.

Under financial autarky, monetary policy actions in the short run have no impact on households' utility in the long run. The optimal monetary policy in a generic country i then consists in setting $P^T_{i,1}$ to maximize households' utility

$$\omega_1 \log Y^T_{i,1} + (1-\omega_1)\log Y^N_{i,1} - \chi\left(\frac{P_{i,1}}{P_{i,0}}\right), \tag{11}$$

where we have used the equilibrium conditions $C_{i,1}^T = Y_{i,1}^T$ and $C_{i,1}^N = Y_{i,1}^N$, subject to

$$Y_{i,1}^T = \left(\alpha P_{i,1}^T\right)^{\frac{\alpha}{1-\alpha}} \tag{12}$$

$$Y_{i,1}^N = \frac{1-\omega_1}{\omega_1} Y_{i,1}^T P_{i,1}^T \tag{13}$$

$$\left(Y_{i,1}^T\right)^{\frac{1}{\alpha}} + Y_{i,1}^N \leq \bar{L}. \tag{14}$$

Constraint (12) captures desired production by firms in the tradable sector, constraint (13) ensures that the output of non-traded goods is equal to households' demand, while constraint (14) guarantees that firms' labor demand does not exceed households' labor supply. Therefore, in absence of capital mobility, the central bank's problem is fully determined by domestic variables, and does not depend on what happens in the rest of the world.

To solve this problem, let us start by deriving the policy that would keep the economy at full employment, so that constraint (14) binds. This is the case if $P_{i,1}^T = \bar{P}_1^T$, defined by

$$\left(\alpha \bar{P}_1^T\right)^{\frac{1}{1-\alpha}} \left(1 + \frac{1-\omega_1}{\alpha\omega_1}\right) = \bar{L}. \tag{15}$$

From this expression, one can see that $\bar{P}_1^T$ is increasing in ω_1. Intuitively, a higher ω_1 means a higher demand for tradable goods relative to non-tradable ones. Facing lower demand, firms in the non-tradable sector fire workers, so that part of the labor force ends up being unemployed. To maintain full employment, monetary policy has to trigger an increase in the production of tradable goods, or to boost demand for non-tradable goods. It turns out that a rise in $P_{i,1}^T$ achieves both objectives. On the one hand, a rise in $P_{i,1}^T$ induces firms in the tradable sector to hire more workers and expand production. On the other hand, a higher $P_{i,1}^T$ generates an expenditure switch away from tradable goods and toward non-tradable ones, thus sustaining employment in the non-tradable sector.

There is also a third, more subtle, effect through which a monetary expansion increases employment in the non-traded sector. As $Y_{i,1}^T$ rises, households' income increases, inducing a rise in consumers' demand. This effect is particularly strong under financial autarky. With no capital mobility, in fact, a rise in $Y_{i,1}^T$ leads to a one for one increase in $C_{i,1}^T$. As $C_{i,1}^T$ increases, also demand for non-tradable goods rises (see (6)), and so does employment in the non-traded sector. One way to interpret this effect is that, with no capital mobility, a monetary expansion eases the pressure on the domestic market for tradable goods, leading to an overall increase in aggregate demand. As we will see, this effect will be crucial in shaping the gains from international monetary coordination under financial integration.

A reallocation shock boosting demand for tradables thus requires a rise in inflation to maintain the economy at full employment. Indeed, if the cost of inflation is sufficiently small, the optimal monetary policy maintains full employment. Otherwise, if the inflation cost linked to full employment is too high, the optimal monetary policy trades off the cost from inflation with the welfare

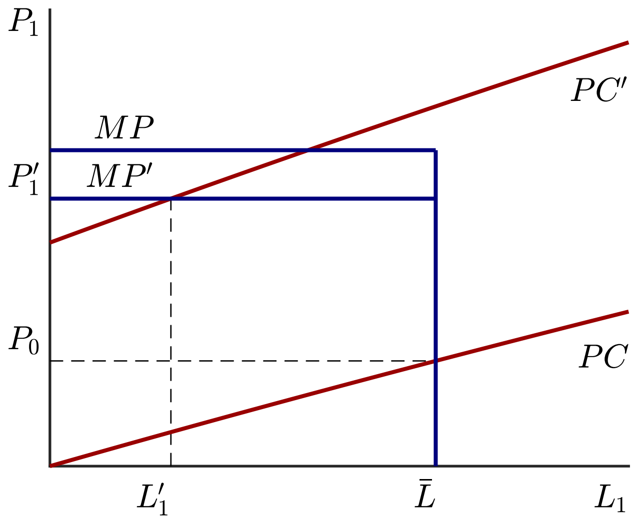

Figure 2: Macroeconomic impact of a reallocation shock under financial autarky.

losses due to involuntary unemployment. In this case, a shock to $\omega_{i,t}$ acts as a cost-push shock, leading both to a rise in inflation and unemployment.

More precisely, taking the first order condition with respect to $P_{i,1}^T$ gives that at an interior optimum

$$\chi'\left(\frac{P_{i,1}}{P_{i,0}}\right)\frac{P_{i,1}}{P_{i,0}} = \frac{1}{\omega_1}\left(\frac{\alpha}{1-\alpha}+1-\omega_1\right). \tag{16}$$

The left-hand side of this expression captures the marginal cost from increasing inflation, while the right-hand side captures the marginal benefit in terms of higher consumption of both tradable and non-tradable goods. Let's call $\tilde{P}_1^T$ the value of $P_{i,1}^T$ that solves the equation above. It is easy to see that the optimal $P_{i,1}^T$ is equal to $\min\left(\bar{P}_1^T, \tilde{P}_1^T\right)$. This is the case because, once the economy has reached full employment, there are no gains from increasing inflation further.

Figure 2 shows graphically the macroeconomic impact of a reallocation shock under financial autarky. The upward-sloped PC schedule captures the Phillips curve type of relationship between short-run inflation and employment implied by our model, given by[8]

$$P_{i,1} = \left(\frac{\alpha^{\frac{\alpha}{1-\alpha}}\omega_1}{\alpha\omega_1+1-\omega_1}L_{i,1}\right)^{\omega_{i,1}(1-\alpha)}. \tag{PC}$$

The logic behind this expression is quite different from the one underlying standard Phillips curves. In fact, here inflation is positively related to employment because a rise in the price of the tradable good increases production in the tradable sector, as well as demand and production in the non-traded one.[9] The MP schedule, instead, captures the monetary policy stance. Intuitively, it is optimal for central banks to tolerate any level of inflation necessary to attain full employment, as long as this is lower than the ceiling implicitly defined by expression (16).

[8]This expression is obtained using (12), (13) and $\left(Y_{i,1}^T\right)^{1/\alpha}+Y_{i,1}^N = L_{i,1}$, as well as the definition of the price level.

[9]Instead, our model abstracts from the standard Phillips curve transmission channel, based on the idea that higher employment leads to higher wage inflation.

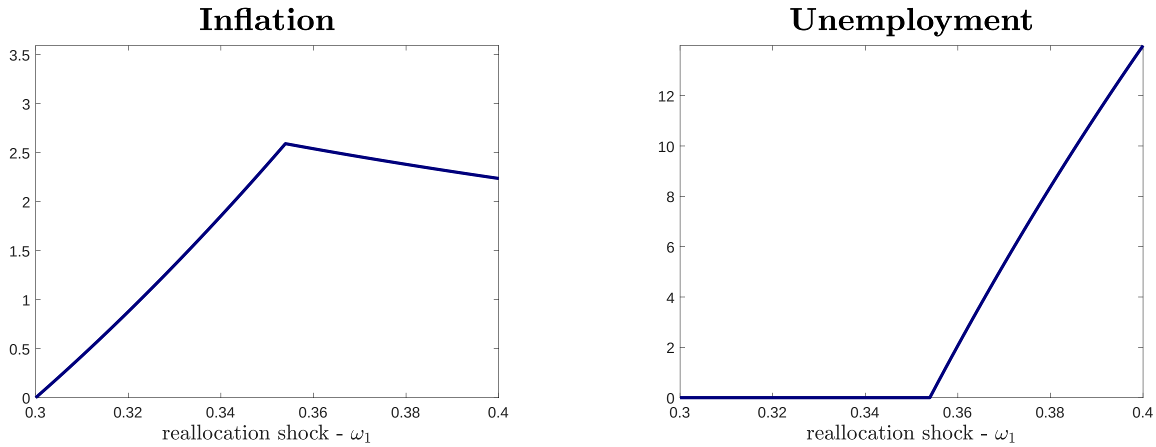

Figure 3: Inflation and unemployment response to a reallocation shock under financial autarky. Notes: This example uses a quadratic loss from inflation $\chi\left(P_{i,t}/P_{i,t-1}\right) = \bar{\chi}/2\left(P_{i,t}/P_{i,t-1} - 1\right)^2$, and $\alpha = .5, \beta = .99, \bar{L} = 1, \bar{\chi} = 175, \omega = .3$.

In absence of a reallocation shock, i.e. if $\omega_1 = \omega$, the economy operates at full employment ($L_1 = \bar{L}$) and there is zero inflation ($P_1 = P_0$). A rise in ω_1 triggers an upward shift of the PC schedule to PC′, because now higher inflation is needed to achieve a given level of employment. Hence, a reallocation shock corresponds to a cost push shock shifting the Phillips curve.[10] In the case shown in the figure, the optimal monetary policy accommodates the shock through a rise in inflation ($P_1 = P_1' > P_0$) and unemployment ($L_1 = L_1' < \bar{L}$).

Figure 3 tracks the inflation and unemployment response to different values of the reallocation shock. If the shock is small enough, the optimal monetary policy maintains full employment. As the shock gets larger, so does the amount of inflation needed to sustain full employment. Once the shock gets too large, the cost of inflation becomes sufficiently high so that it is optimal for the central bank to allow for some unemployment.

In this section, we have essentially extended the insights from the literature on inflation and reallocation shocks in closed economies to our setting (Olivera, 1964; Tobin, 1972; Guerrieri et al., 2021). In particular, this literature has shown that high inflation may arise during periods of sectoral reallocation, even in absence of overheating on the labor market. While this point is well understood, little is known about what happens when reallocation shocks take place in a financially integrated world, and whether in this case coordination failures among national central banks may arise. We tackle these issues next.

[10]The reallocation shock also induces a downward shift of the MP curve to MP′, because a higher ω_1 reduces the ceiling on inflation imposed by the optimal monetary policy.

4 Optimal monetary policy with free capital mobility

Under free capital mobility, households may use the international capital markets to smooth the impact of the reallocation shock on consumption. With a bit of algebra, short-run consumption of tradable goods in a generic country can be written as[11]

$$C_{i,1}^T = \frac{\omega_{i,1}(1-\beta)}{\omega_{i,1}(1-\beta)+\omega\beta}\left(Y_{i,1}^T + \frac{R}{R-1}\frac{Y^T}{R_1}\right). \tag{17}$$

Intuitively, in the short run households consume a fraction of the present value of the country's expected stream of tradable output. If consumption exceeds current output, the country finances the gap by running a current account deficit. Holding everything else constant, a higher preference for tradable consumption, i.e. a higher $\omega_{i,1}$, drives up short-run consumption of tradables and the trade deficit. A rise in R_1, instead, reduces $C_{i,1}^T$ and the trade deficit, because a higher world interest rate increases the cost of borrowing to consume.

The optimal policy problem is now slightly complicated by the fact that monetary interventions in the short run may have an impact on consumption of tradable goods in the long run. But the households' Euler equation (4) implies that long run consumption of tradable goods is proportional to $C_{i,1}^T$. Using this result, the central bank's problem reduces to setting $P_{i,1}^T$ to maximize[12]

$$\left(\omega_{i,1} + \frac{\omega\beta}{1-\beta}\right)\log C_{i,1}^T + (1-\omega_{i,1})\log Y_{i,1}^N - \chi\left(\frac{P_{i,1}}{P_{i,0}}\right), \tag{18}$$

subject to constraints (12), (14), (17) and

$$Y_{i,1}^N = \frac{1-\omega_{i,1}}{\omega_{i,1}} C_{i,1}^T P_{i,1}^T. \tag{19}$$

The key difference with respect to the case of financial autarky is that now $C_{i,1}^T$ may deviate from $Y_{i,1}^T$, and that the path of tradable consumption is dictated by households' saving decisions, as captured by constraint (17). Since tradable consumption depends on the world interest rate, there is now a link between the optimal policy problem and external factors. When setting monetary policy, however, national central banks take the path of the world interest rate as given. The reason is that each country is infinitesimally small, and so the impact of its monetary policy actions on the rest of the world is negligible.

As before, it may be optimal for the central bank to maintain the economy at full employment. This is the case if $P_{i,1}^T = \bar{P}_1^T$, which is now implicitly defined by

$$\left(\alpha \bar{P}_1^T\right)^{\frac{1}{1-\alpha}} + \frac{1-\omega_1}{\omega_1}\bar{P}_1^T C_{i,1}^T = \bar{L}. \tag{20}$$

If the inflation cost is high enough, it is instead optimal for the central bank to allow for some

[11] See Appendix A.
[12] See Appendix A.

unemployment in response to the reallocation shock. More formally, taking the first order condition with respect to $P^T_{i,1}$ gives that in an interior equilibrium

$$\chi'\left(\frac{P_{i,1}}{P_{i,0}}\right)\frac{P_{i,1}}{P_{i,0}} = \frac{1}{\omega_{i,1}}\left(\frac{Y^T_{i,1}}{C^T_{i,1}}\frac{\omega_{i,1}(1-\beta+\omega\beta)}{\omega_{i,1}(1-\beta)+\omega\beta}\frac{\alpha}{1-\alpha}+1-\omega_{i,1}\right). \tag{21}$$

Again defining $\tilde{P}^T_1$ the value of $P^T_{i,1}$ that solves (21), the optimal monetary policy sets $P^T_{i,1} = \min\left(\bar{P}^T_1, \tilde{P}^T_1\right)$.

We are now ready to derive the implications of free capital mobility for the macroeconomic adjustment to a reallocation shock. As an intermediate step, we will first consider a reallocation shock occurring in a single country. We will then turn to the case of a global reallocation shock.

4.1 An idiosyncratic reallocation shock

Let us start by considering a case in which the reallocation shock hits a single small open economy. Since the rest of the world is unaffected, the global interest rate remains equal to its steady state value, and $R_1 = R$. According to (17), consumption of tradable goods then rises in the country affected by the shock. This is the case even if monetary policy does not react, so that $Y^T_{i,1}$ remains constant. The reason is that households finance the increase in consumption with imports, and so the country accommodates the reallocation shock by running a trade balance deficit.

An interesting observation is that trade deficits reduce the inflation needed to maintain the economy at full employment. In fact, equation (20) implies that $\bar{P}^T_1$ is decreasing in the trade deficit, captured by the term $C^T_{i,1}/Y^T_{i,1}$. Trade deficits, intuitively, sustain short-run consumption of tradables. In turn, higher consumption of tradables boosts demand for non-tradable goods, and so employment in the non-traded sector. Hence, trade deficits mitigate the inflation costs associated with maintaining full employment after a rise in $\omega_{i,1}$.

If the optimum is interior, instead, monetary policy is described by expression (21). Comparing this expression with (16) shows that the marginal benefit derived from a rise in inflation is smaller than under financial autarky. This difference is due to two distinct effects. First, since trade deficits reduce the scarcity of tradable goods, the welfare impact of increasing the production of tradables through inflation is now smaller. This effect is captured by the term $Y^T_{i,1}/C^T_{i,1}$, which falls below one whenever the country runs a trade deficit.

The second, and most interesting, effect arises because free capital mobility reduces the positive impact of monetary expansions on aggregate demand and employment. The reason is that now households save most of the rise in income derived from an increase in the short-run production of tradable goods. In fact, differentiating (17) gives

$$\frac{\partial C^T_{i,1}}{\partial Y^T_{i,1}} = \frac{\omega_1(1-\beta)}{\omega_1(1-\beta)+\omega\beta} < 1.$$

Since $C^N_{i,1}$ is proportional to $C^T_{i,1}$, free capital mobility reduces the positive impact of inflation

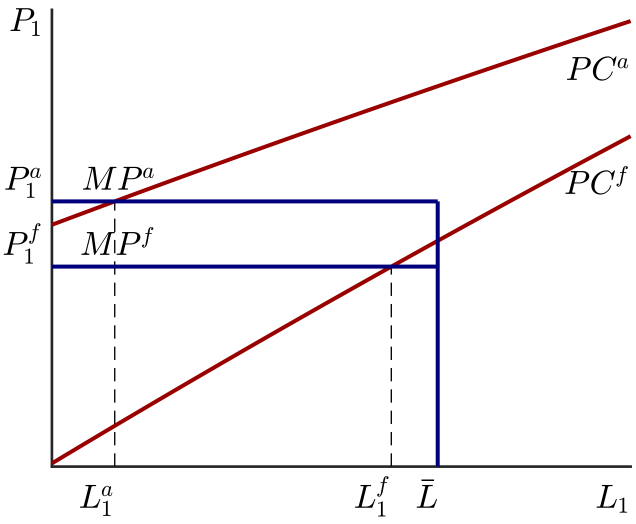

Figure 4: Macroeconomic impact of an idiosyncratic reallocation shock: financial autarky vs. free capital mobility.

on employment in the non-traded sector. This effect is captured by the term $\frac{\omega_1(1-\beta+\omega\beta)}{\omega_1(1-\beta)+\omega\beta} < 1$ in expression (21). Intuitively, with capital mobility a monetary expansion produces a small easing in the pressure on the domestic market for tradable goods, since most of the associated increase in tradable output ends up being sold to the rest of the world.

Figure 4 shows how capital mobility affects the adjustment to an idiosyncratic reallocation shock.[13] The first thing to notice is that the Phillips curve under free capital mobility (PC^f) is steeper than in a financially-closed economy (PC^a). This is the case because, as we have just seen, the positive impact of a given rise in inflation on domestic demand and employment is decreasing in the degree of capital mobility. This also explains why under free capital mobility central banks impose a lower inflation ceiling (compare MP^f with MP^a). However, under free capital mobility a given reallocation shock induces a smaller shift of the PC curve, because the ability to run current account deficits mitigates the endogenous cost push shock associated with the rise in demand for tradable goods relative to non-tradable ones. As a result, under free capital mobility an idiosyncratic reallocation shock generates a smaller rise in inflation ($P_1^f < P_1^a$) and unemployment ($L_1^f > L_1^a$).

Figure 5 also illustrates how access to the international credit markets improves the inflation-employment trade off associated with a reallocation shock. In fact, for any value of the reallocation shock ω_1 both inflation and unemployment never exceed their values under financial autarky. The reason is that trade deficits sustain aggregate demand, meaning that less inflation is needed to achieve a given level of employment. Hence, international financial integration facilitates the macroeconomic adjustment to idiosyncratic reallocation shocks. But what if the reallocation shock

[13] To derive the PC and MP curves under financial integration, we have used the fact that the trade deficit is determined by

$$\frac{C_{i,t}^T}{Y_{i,t}^T} = \frac{\omega_{i,1}(1-\beta)}{\omega_{i,1}(1-\beta)+\omega\beta}\left(1+\frac{R}{R-1}\frac{Y^T}{R_1\left(\alpha P_{i,t}^T\right)^{\frac{\alpha}{1-\alpha}}}\right).$$

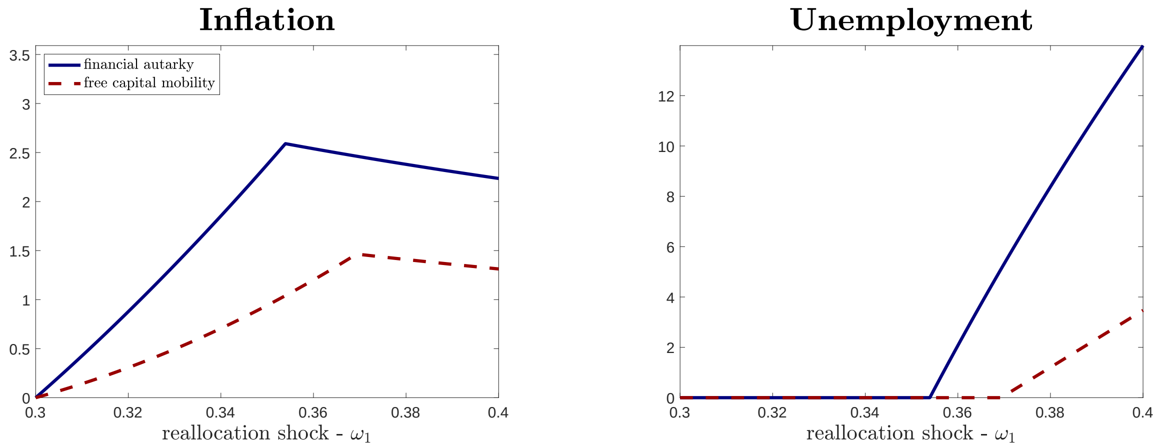

Figure 5: Inflation and unemployment response to an idiosyncratic reallocation shock. Notes: This example uses a quadratic loss from inflation $\chi\left(P_{i,t}/P_{i,t-1}\right) = \bar{\chi}/2\left(P_{i,t}/P_{i,t-1} - 1\right)^2$, and $\alpha = .5, \beta = .99, \bar{L} = 1, \bar{\chi} = 175, \omega = .3$.

is global?

4.2 A global reallocation shock

We now turn to a global reallocation shock, i.e. a synchronized rise in ω_1 affecting every country in the world. As global demand for tradables rises, all the countries seek to run a trade deficit by borrowing from the rest of the world. In response, the world interest rate increases until equilibrium on the global credit markets is restored. Since all the countries are symmetric, this happens when every country wishes to run a balanced current account. Hence, in equilibrium every country consumes exactly its production of tradable goods.

As in the case of an idiosyncratic shock, optimal monetary policy is characterized by expressions (20) and (21), but with the twist that in equilibrium $C_{i,1}^T = Y_{i,1}^T$. The first implication is that $\bar{P}_1^T$ now coincides with the one under financial autarky. The degree of capital mobility thus does not affect the amount of inflation needed to sustain full employment during a global reallocation shock.

This does not mean, however, that monetary policy is unaffected by international financial integration. Even during a global reallocation shock, in fact, free capital mobility reduces the marginal benefit attached by national central banks to a rise in inflation. This can be seen by comparing (16) and (21), evaluated at $C_{i,1}^T = Y_{i,1}^T$. As explained above, financial integration weakens the impact of unilateral monetary expansions on domestic demand and employment, because households end up saving most of the increase in income associated with a rise in the domestic production of tradable goods. Therefore, the monetary response to a global reallocation shock may be less expansionary under free capital mobility, compared to the case of financial autarky.

Figure 6 illustrates this result. In a symmetric equilibrium, the degree of capital mobility

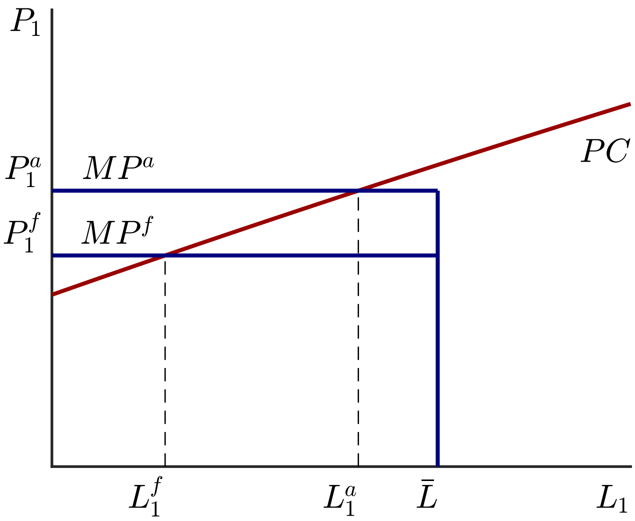

Figure 6: Macroeconomic impact of a global reallocation shock: financial autarky vs. free capital mobility

does not affect the relationship between *global* inflation and *global* employment captured by the PC curve. It does, however, affect monetary policy. In fact, from the perspective of national central banks free capital mobility worsens the trade off between *domestic* inflation and *domestic* employment, by steepening the country-level Phillips curve. This effect explains why the inflation ceiling imposed by central banks is lower under free capital mobility (MP^f schedule) compared to financial autarky (MP^a schedule). As a result, free capital mobility may mitigate the impact of a reallocation of global expenditure toward tradable goods on inflation ($P_1^f < P_1^a$), but exacerbate its impact on unemployment ($L_1^f < L_1^a$).

Figure 7 further clarifies this result. If the shock is small enough, regardless of whether capital is mobile or not, it is optimal for national central banks to maintain full employment. In this case, financial openness does not affect the inflation and unemployment response to a global rise in demand for tradables. If the shock is large enough, however, the monetary response under financial integration is characterized by lower inflation and higher unemployment. Free capital mobility is thus associated with a deflationary bias during periods of buoyant demand for tradable goods relative to non-tradable ones.

4.3 International spillovers and gains from cooperation

We are now ready to address one of the fundamental questions of the paper: are there gains from coordinating national monetary interventions? Let us begin by considering the international spillovers triggered by monetary actions. Under financial autarky there are no international spillovers from monetary interventions, since in this case inflation and employment are fully determined by domestic forces. International spillovers, however, arise under financial integration.

Recall that we are considering periods in which the global demand for tradable goods, relative to non-tradable ones, is exceptionally high. Now imagine that a generic country i implements a

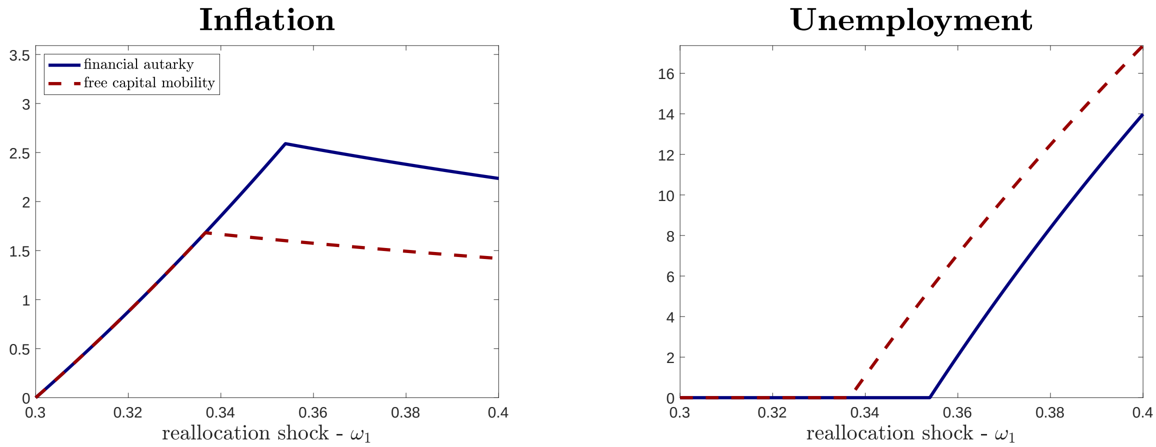

Figure 7: Inflation and unemployment response to a global reallocation shock. Notes: This example uses a quadratic loss from inflation $\chi(P_{i,t}/P_{i,t-1}) = \bar{\chi}/2\,(P_{i,t}/P_{i,t-1} - 1)^2$, and $\alpha = .5, \beta = .99, \bar{L} = 1, \bar{\chi} = 175, \omega = .3$.

monetary expansion, which leads to an increase in its production of tradable goods $Y_{i,t}$. As we have seen, under free capital mobility country i consumes just part of this increase in production ($\partial C^T_{i,1}/\partial Y^T_{i,1} < 1$), while the rest is sold to foreign consumers. Hence, a monetary expansion in country i increases consumption of tradable goods in any other country ($\partial C^T_{-i,1}/\partial Y^T_{i,1} > 0$), effectively easing pressure on the global market for tradables. By equation (19), as foreign households increase their consumption of tradables, also their demand for non-tradable goods and employment in the non-traded sector rise. Part of the rise in aggregate demand triggered by a monetary expansion thus spills over to the rest of the world.

This international spillover explains why the macroeconomic adjustment to a global reallocation shock is affected by capital mobility. Regardless of whether capital is mobile or not, the inflation cost linked to a monetary expansion is fully beared by domestic households. Under free capital mobility, however, the gains in terms of higher demand and employment in the non-traded sector are partly enjoyed by households in the rest of the world. Indeed, as the weight of non-tradable goods in the utility function vanishes ($\omega_1 \to 1$), the monetary policy response to a global reallocation shock under free capital mobility converges to the one under financial autarky.

To study the gains from international cooperation, imagine that monetary policy is set by a global central bank which maximizes global welfare, attaching the same weight to the utility of every household in the world. The global central bank sets $P^T_{i,1}$ in every country i, and it is subject to the same constraints imposed on national central banks. The difference is that the global central bank internalizes the impact of its actions on the world interest rate R_1. Given that each country is symmetric, the solution to this problem is such that each country features the same consumption and output paths. Using households' Euler equation, one can then see that the world interest rate in period 1 is given by

$$R_1 = \frac{Y^T}{\beta Y^T_1} \frac{\omega_1}{\omega}. \tag{22}$$

Plugging this expression in constraint (17), and using the fact that $R = 1/\beta$ and $Y_{i,1}^T = Y_1^T$, it is easy to see that the problem of the global central bank converges to the one of national central banks under financial autarky, described in Section 3.

The optimal cooperative monetary policy response to a global reallocation shock thus corresponds to the one derived under financial autarky. The policy implemented by self-oriented national central banks, therefore, suffers from a deflationary bias. National central banks fall prey of a coordination failure, because they do not internalize the fact that part of the benefits associated with a rise in domestic inflation spill over to the rest of the world. This effect induces national central banks to place an excessive weight on inflation as opposed to unemployment in their objective function.

Summing up, a smooth adjustment to a global rise in demand for tradable goods requires an expansion of the tradable sector. To achieve this objective, national central banks have to tolerate a temporary rise in inflation. However, under free capital mobility, increases in domestic production of tradables are partly exported toward the rest of the world, thus easing pressure on the global market for tradables. This positive spillover is not internalized by national monetary authorities, leading to an excessively tight monetary response in absence of international cooperation.

5 Interest rates and the international transmission of inflation

Having established our main result, we now derive the implications of the model for the behavior of interest rates and the international transmission of inflation.

5.1 Impact of the reallocation shock on global rates

As we have seen, under the optimal monetary policy, a global reallocation shock gives rise to an increase in inflation. But what about the response of interest rates? To make progress answering this question, start by considering that the no arbitrage condition between nominal and real bonds (5) implies

$$R_{i,1}^n = R_{i,1} \frac{P_{i,2}^T}{P_{i,1}^T} = \frac{Y^T}{\beta Y_{i,1}^T} \frac{\omega_1}{\omega} \frac{P_{i,2}^T}{P_{i,1}^T},$$

where the second equality derives from expression (22). A rise in ω_1 thus puts upward pressure on nominal rates. Intuitively, a rise in ω_1 creates excess demand on the global market for tradables. Now imagine for a second that central banks seek to fully stabilize inflation, so that $P_{i,1}^T$ and $P_{i,2}^T$ do not react to the reallocation shock. In this case, policy rate will have to rise, so as to cool down demand and restore equilibrium on the global market for tradables.

In reality, as we have shown, it is optimal for central banks to let $P_{i,1}^T$ rise in reaction to a global reallocation shock. For this reason, the rise in the policy rate is milder than what would occur under a strict inflation targeting regime. In fact, one could even think of cases in which nominal policy rates drop in response to a reallocation shock.

Figure 8 show the behavior of policy rates in our running numerical example. Interestingly, in

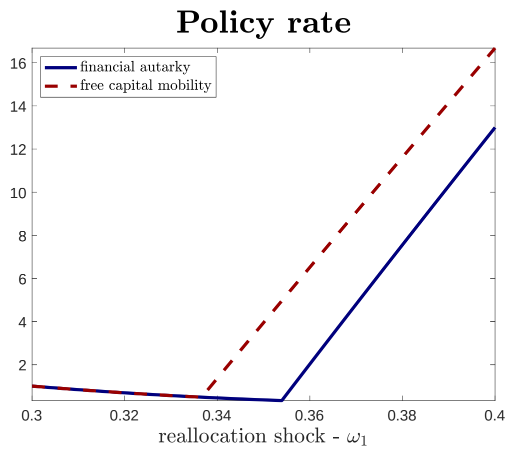

Figure 8: Response of nominal policy rates to a global reallocation shock. Notes: This example uses a quadratic loss from inflation $\chi\left(P_{i,t}/P_{i,t-1}\right) = \bar{\chi}/2\left(P_{i,t}/P_{i,t-1} - 1\right)^2$, and $\alpha = .5, \beta = .99, \bar{L} = 1, \bar{\chi} = 175, \omega = .3, Y^T = .42, Y^N = .82$.

this case the response of nominal rates is non-monotonic in the reallocation shock. For mild shocks, such that it is optimal to maintain the economy at full employment, nominal policy rates barely react. Large reallocation shocks, however, are associated with a sharp rise in nominal interest rates. The figure also shows how central banks hike interest rates by more under free capital mobility, compared to financial autarky. This is a manifestation of the coordination problem leading central banks to implement an excessively tight monetary policy under financial integration.

5.2 International transmission of inflation

We now turn to the international transmission of inflation. That is, we want to understand how developments in the rest of the world affect inflation in a generic country i. In particular, we consider a country i not directly affected by the reallocation shock, so that $\omega_{i,1} = \omega$, and refer to this country as home[14]. Of course, under financial autarky there are no spillovers, so the interesting case is free capital mobility.

Perhaps the best way to understand how inflation spillovers operate is to start from the Phillips curve, which under financial integration can be written as

$$P_{i,1} = \left(\frac{\alpha^{\frac{\alpha}{1-\alpha}} \omega_{i,1}}{\alpha \omega_{i,1} + (1 - \omega_{i,1}) \frac{C^T_{i,1}}{Y^T_{i,1}}} L_{i,1} \right)^{\omega_{i,1}(1-\alpha)} . \tag{PC}$$

This expression shows how global factors, encapsulated by the trade deficit term $C^T_{i,1}/Y^T_{i,1}$, shift around our model's Phillips curve. For instance, consider a global shock generating a rise in the world interest rate R_1. Agents at home react by decreasing their consumption of tradable goods, leading to a drop in the trade deficit $C^T_{i,1}/Y^T_{i,1}$ (see (17)). In turn, a lower trade deficit depresses

[14]The insights of this section, however, would apply to any value of $\omega_{i,1}$.

demand for domestic non-traded goods, meaning that now more inflation is needed to achieve a given level of employment. Because of this reason, global shocks increasing the world interest rate translate into higher home inflation.[15] The opposite logic applies to global factors depressing the world interest rate.

Let us now consider a scenario in which ω_1 rises in the rest of the world. We have already seen that a temporary rise in the global demand for tradables pushes up the equilibrium world interest rate R_1. This translates into a lower trade deficit and higher inflation in the home country. Hence, a rise in global demand for tradables generates inflation also in those countries not directly affected by the shock.

Under the optimal monetary policy, however, the countries affected by the reallocation shock also experience a rise in inflation, which boosts the global supply of tradable goods. In response, the world interest rate drops to restore equilibrium on the goods market. As a result, a rise in global inflation widens the trade deficit in the home country and, perhaps surprisingly, leads to lower inflation at home. Therefore, the endogenous surge in global inflation triggered by a reallocation of global expenditure toward tradable goods gives rise to deflationary international spillovers.

We find this last result particularly intriguing, because it contrasts with the insights from the literature on international monetary transmission during times of weak global demand. For instance, in Caballero et al. (2021) and Eggertsson et al. (2016) the fundamental problem faced by central banks is to stimulate demand enough to maintain full employment. A monetary expansion abroad reallocates global demand away from domestic goods. To prevent the rise in unemployment associated with lower demand, the domestic central bank reacts by implementing a monetary expansion. Therefore, in times of scarce global demand, monetary expansions in the rest of the world generate inflationary spillovers at home.

In the scenario that we consider, instead, the fundamental problem is excessive global demand for tradable goods relative to non-tradable ones. A monetary expansion abroad increases the global supply of tradable goods, allowing the home country to increase its trade deficit and ameliorate its inflation-employment trade off. Due to this reason, in our model central banks react to foreign monetary expansions by tightening domestic monetary policy. Hence, during times of global reallocation of expenditure from non-tradables to tradables monetary expansions in the rest of the world give rise to deflationary spillovers at home.

6 Conclusion

To conclude, let us bridge the insights of this paper to the current macroeconomic situation. Of course, our model focuses on a specific aspect of the recovery from the Covid-19 recession, and so cannot do justice to the complex reality that policymakers have to face. We do believe, however, that a salient feature of the ongoing recovery is an excess global demand for tradable goods, relative to its supply. In this respect, our paper suggests that policies that increase the supply of tradable

[15] Indeed, using (17), (20) and (21) it is easy to verify that under the optimal monetary policy a higher R_1 generates a rise inflation.

goods generate positive international spillovers. International cooperation, by helping national governments to internalize these spillovers, may thus play a role in ensuring a smooth recovery.

Appendix

A Additional derivations for Section 4

To derive the consumption function, iterate forward (9) and use the transversality condition to obtain

$$C^T_{i,1} + \frac{1}{R_1}\sum_{t=2}^{+\infty}\frac{C^T_{i,t}}{R^{t-2}} = Y^T_{i,1} + \frac{1}{R_1}\sum_{t=2}^{+\infty}\frac{Y^T_{i,t}}{R^{t-2}}, \tag{A.1}$$

where we have also used the fact that the world interest rate is equal to its steady state value from $t = 2$ on, and that each country starts with zero assets. Expression (17) is then obtained by combining the expression above with the Euler equation $\omega_{i,t+1}C^T_{i,t+1} = \omega_{i,t}\beta R_t C^T_{i,t}$, and using the fact that $Y^T_{i,t} = Y^T$ from $t = 2$ on.

Let us now turn to the monetary policy problem. The expected utility in country i is given by

$$\sum_{t=1}^{\infty}\beta^{t-1}\left(\omega_{i,t}\log\left(C^T_{i,t}\right) + (1-\omega_{i,t})\log\left(Y^N_{i,t}\right) - \chi\left(\frac{P_{i,t}}{P_{i,t-1}}\right)\right). \tag{A.2}$$

Notice that $Y^N_{i,t}$ does not depend from monetary policy and $P_{i,t} = P_{i,t-1}$ for $t = 2$ on. Using $\omega_{i,t+1}C^T_{i,t+1} = \omega_{i,t}\beta R_t C^T_{i,t}$, we can rewrite the expected utility as

$$\left(\omega_{i,1} + \omega\sum_{t=2}^{+\infty}\beta^{t-1}\right)\log\left(C^T_{i,1}\right) + (1-\omega_{i,1})\log\left(Y^N_{i,1}\right) - \chi\left(\frac{P_{i,1}}{P_{i,0}}\right). \tag{A.3}$$

Using $\sum_{t=2}^{\infty}\beta^{t-1} = \beta/(1-\beta)$ gives the objective function (18).

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