Monetary Cooperation during Global Inflation Surges

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Abstract

We study optimal monetary policy during times of global scarcity of tradable goods. The optimal monetary response entails a surge in inflation, which helps rebalance production towards the tradable sector. While the inflation costs are fully bore domestically, however, the gains in terms of higher supply of tradable goods partly 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 causing an unnecessarily sharp global contraction.

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1 Introduction

The recent inflation surge has been marked by a global scarcity of tradable goods, driven by a combination of demand and supply shocks (Fornaro and Romei, 2024). On the demand side, households reallocated their expenditure from non-tradable services towards tradable manufactured goods. On the supply side, global supply chains disruptions and high energy prices depressed productivity in the manufacturing sector. All these forces caused an imbalance in the traded goods market, with a strong demand chasing a weak supply, which manifested itself with a large increase in the price of goods relative to services. These dynamics seem typical of global inflation surges. Indeed, tradable goods were scarce and their relative price high also during the sustained inflation of the 1970s (Bruno and Sachs, 1985).

Motivated by these facts, in this paper we study monetary policy during times of global scarcity of tradable goods. We show that - under certain circumstances - 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 and mitigate their scarcity. While the inflation costs are fully bore domestically, however, the gains in terms of higher supply of tradable goods partly spill over to the rest of the world. Self-oriented national central banks do not internalize this spillover, and may thus go too far in their efforts to contain inflation, causing an unnecessarily harsh global slump.

We formalize this insight with the help of a multi-country Keynesian model with multiple sectors. Our world 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 and involuntary unemployment is possible. In line with empirical evidence (Boehm and Pandalai-Nayar, 2022), sectoral supply curves are convex because production is subject to capacity constraints. Prices thus rise sharply in sectors in which capacity constraints bind, while they do not fall much in sectors operating at a low level of capacity utilization. In our baseline scenario, we generate a global scarcity of tradable goods through a demand reallocation shock, that is a temporary rise in consumers' expenditure share on tradable goods. This shock mimics the global reallocation of expenditure from services to goods that characterized the recovery from the Covid-19 pandemic (Figure 1).[1] However, our main results hold also when negative productivity shocks curtail the global supply of traded goods.

Under the optimal monetary policy, global inflation rises in response to the demand reallocation shock. To see why, recall that the reallocation shock depresses demand for non-traded goods. Without 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 workers. To contain the ensuing increase in unemployment, monetary policy has to facilitate a shift of employment toward the traded sector, or to boost

[1] In this paper, we take the change in consumers' expenditure pattern as a primitive shock. In practice, several factors may have contributed to it. For sure, the pandemic itself induced households to move away from contact-intensive services in favor of physical goods that can be enjoyed at home. Especially in the case of the United States, fiscal transfers may have also played a role by boosting expenditure on durable goods (Fornaro, 2024).

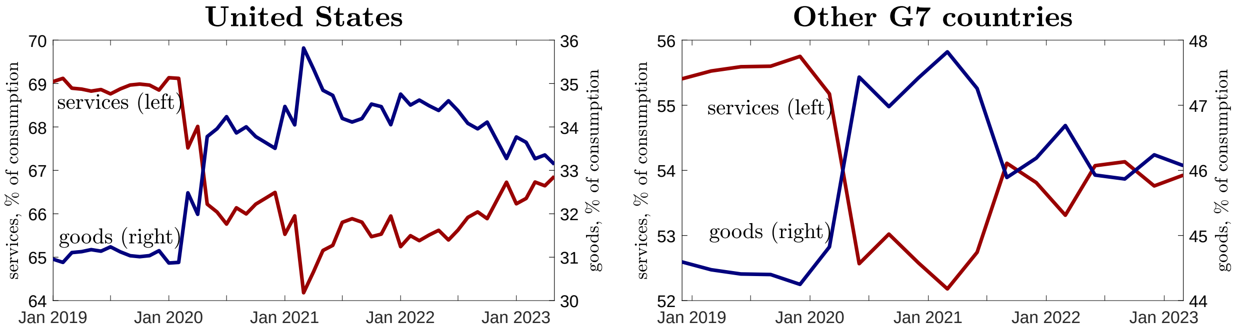

Figure 1: Goods and services share in total consumption expenditure. Notes: The figure shows the reallocation of consumption expenditure out of services and towards goods that has characterized advanced economies since the start of the Covid-19 pandemics. Other G7 countries refer to the average of Canada,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

demand for non-tradable goods. A rise in the price of the traded good achieves both objectives. First, higher prices induce firms in the traded sector to hire more workers and increase production. Second, higher production in the traded sector increases households' income, boosting their demand for the non-traded good. Through this aggregate demand effect, higher inflation in the traded sector lifts employment in the non-traded sector too.[2]

A demand reallocation shock thus acts as an adverse cost-push shock, worsening the trade off between inflation and employment faced by central banks. The optimal monetary policy response depends on the disutility attached by society to inflation. If the inflation cost is low enough, monetary authorities let inflation rise until full employment is restored. Otherwise, both inflation and unemployment increase in response to a reallocation shock. This stagflation scenario is more likely to materialize when the shock is large and central banks attach a high weight to their price stability mandate. 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, monetary interventions trigger international spillovers mediated by capital flows. Consider a country implementing a monetary contraction to cool down inflation. The monetary contraction appreciates the exchange rate, leading to lower domestic production of tradables, and attracts capital inflows. The resulting trade deficit sustains domestic consumption - therefore mitigating the impact of the monetary tightening on employment in the non-traded sector - but exacerbates the global scarcity of tradable goods. The rest of the world, in fact, suffers capital outflows and trade surpluses. Foreign central banks can react in two ways. They can either let their exchange rate depreciate, thus importing inflation. Or they can tighten monetary policy themselves, leading to a drop in demand and employment in the non traded sector. Through this channel, a monetary contraction exports inflation and unemployment to the rest of the world.[3]

[2] 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.

[3] The model thus captures the notion, popular in the 1980s, that trade deficits and exchange rate appreciations

Are there gains from international monetary cooperation? The answer is a qualified yes. If maintaining full employment is not too costly in terms of inflation, in fact, international cooperation is not needed. Instead, if monetary authorities are willing to sacrifice full employment to contain inflation, the cooperative equilibrium breaks down as national central banks engage in competitive appreciations. The reason is simple. The disinflation gains associated with monetary contractions are fully enjoyed domestically, while the losses in terms of lower demand are partly suffered by the rest of the world. Not internalizing this spillover, national central banks hike their policy rate in an attempt to reduce domestic inflation by appreciating the exchange rate and importing foreign capital. However, in a symmetric equilibrium the impact of monetary tightenings on exchange rates and capital flows washes out. All that is left is an excessively tight monetary stance, leading to an unnecessarily sharp global contraction.[4]

This paper is related to three strands of the literature. First, it is connected to the literature studying monetary policy during times of sectoral demand reallocation. Olivera (1964) and Tobin (1972) are classic contributions to this literature, while Aoki (2001), Benigno and Ricci (2011), Guerrieri et al. (2021) and Ferrante et al. (2023) provide analyses based on modern Keynesian frameworks. All these works consider closed economies, and so abstract from interactions across different countries, which are the focus of our work. Di Giovanni et al. (2023) provide a rich quantitative framework, encompassing several shocks, to examine the impact of the Covid-19 pandemic on global inflation. Our focus is instead on a simple model, useful to derive optimal policy prescriptions. We thus see Di Giovanni et al. (2023) as complementary to our paper. Fornaro (2018) investigates the implications for monetary policy of a global deleveraging shock, using a multi-country model with multiple sectors. Here, instead, we consider a demand 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 macroeconomic policy cooperation. Tinbergen (1952), Theil (1964) and Oudiz and Sachs (1984) are classic examples of this literature. Obstfeld and Rogoff (2002), Benigno and Benigno (2003) and Corsetti and Pesenti (2005) study international monetary policy cooperation using new-Keynesian open-economy models.[5] 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

shift part of the costs of a disinflation from the domestic economy to the rest of the world. For instance, Sachs (1985) argues that the combination of trade deficits and strong dollar eased the pain of the 1980s disinflation in the United States, but exported inflation abroad. This logic also suggests that, once again, during the recovery from Covid-19 trade deficits and a strong dollar helped to contain US inflation, but increased inflationary pressures in the rest of the world.

[4] Note the contrast with the notion of competitive depreciations. Competitive depreciations, however, are typically an issue when global demand is weak and inflation is low, such as the Great Depression or the Great Recession. We study a different scenario, characterized by global scarcity of tradable goods and high inflation. This explains why in our model competitive appreciations pose a challenge to international cooperation.

[5] See also Bodenstein et al. (2020), Egorov and Mukhin (2020), Jeanne (2021) and Auclert et al. (2023) for some recent contributions to this literature.

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. In an interesting recent paper, Bianchi and Coulibaly (2024) generalize our framework in several dimensions, and provide further insights on the gains from monetary policy cooperation. 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 analyse a scenario in which global demand is strong and inflation is high.

Third, a recent empirical literature shows that monetary contractions by major central banks cause tightenings of global credit market conditions, and emanate contractionary spillovers towards the rest of the world (Kalemli-Özcan, 2019; Degasperi et al., 2020; Miranda-Agrippino and Rey, 2020; Corsetti et al., 2021). Our model offers a simple way to rationalize these facts.

The rest of the paper is composed of four sections. Section 2 introduces our model. Section 3 studies the macroeconomic adjustment to a demand reallocation shock under international cooperation. Section 4 shows that self-oriented national central banks may fall prey of a coordination failure. Section 5 concludes by drawing some lessons for the global inflation surges of the 1970s and 2020s.

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 $t \in \{0, ...\}$. Since the presence of risk is not crucial for our results, agents have perfect foresight.

Throughout, we will interpret period 0 as the short run, and periods $t \geq 1$ as the long run. In particular, we will assume that in period 0 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.

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

$$\sum_{t=0}^{\infty} \beta^t \left(\log\left(C_{i,t}\right) - \chi\left(\frac{P_{i,t}}{P_{i,t-1}}\right)\right), \tag{1}$$

where $0 < \beta < 1$ is the subjective discount factor. 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 $\chi(\cdot)$ captures some utility cost that households experience whenever inflation deviates from the central bank's target.[6] We assume that $\chi(1) = \chi'(1) = 0$, which amounts to normalizing the inflation target to zero. These costs could capture in reduced form welfare losses from imperfect price adjustment, or liquidity costs from inflation. They could also encapsulate inflation costs arising from households' behavioral biases (Stantcheva, 2024), conflict on the labor market (Guerreiro et al., 2024), or the risk that the economy looses its nominal anchor if inflation deviates too much from target. One could also interpret these costs as measuring the strength of the inflation mandate assigned by society to central banks.[7]

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 market in exchange for the nominal wage $W_{i,t}$. We introduce nominal rigidities by assuming that in the short run the nominal wage $W_{i,0}$, is fixed to its value in the initial steady state $W_{i,-1}$. To simplify notation, we assume that $W_{i,0} = W_{i,-1} = 1$ in every country i. The presence of nominal wage rigidities implies that involuntary unemployment may arise in the short run. In particular, when $L_{i,0} = \bar{L}$ the economy operates at full employment, while when $L_{i,0} < \bar{L}$ there is involuntary unemployment and the economy operates below capacity. From period 1 on, wages are fully flexible and so $L_{i,t} = \bar{L}$.

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_t. This interest rate is common across countries, and can be interpreted as the world interest rate. Nominal bonds are denominated in units of the domestic currency and pay the gross nominal interest rate $R_{i,t}^n$. $R_{i,t}^n$ is the interest rate controlled by the central bank, and thus can be thought of as the domestic policy

[6] More precisely, the function $\chi(\cdot)$ is twice-differentiable everywhere and $\chi''(\cdot) > 0$.

[7] We prefer to remain agnostic about the precise source of welfare losses from inflation, given the large disagreement characterizing the existing literature (see footnote 22 below). That said, in Appendix C we introduce an endogenous inflation cost by following the modeling approach proposed by Bianchi and Coulibaly (2024), based on price adjustment costs in the spirit of Rotemberg (1982). There we show that the basic insights of our framework extend to this setting.

rate.[8]

The household budget constraint in terms of the domestic currency is

$$P_{i,t}^{T}C_{i,t}^{T}+P_{i,t}^{N}C_{i,t}^{N}+P_{i,t}^{T}B_{i,t+1}+B_{i,t+1}^{n}=W_{i,t}L_{i,t}+\Pi_{i,t}+P_{i,t}^{T}R_{t-1}B_{i,t}+R_{i,t-1}^{n}B_{i,t}^{n}. \tag{3}$$

The left-hand side of this expression represents the household's expenditure. $P_{i,t}^{T}C_{i,t}^{T}+P_{i,t}^{N}C_{i,t}^{N}$ is the total nominal expenditure in consumption. $B_{i,t+1}$ and $B_{i,t+1}^{n}$ 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. $P_{i,t}^{T}R_{t-1}B_{i,t}$ and $R_{i,t-1}^{n}B_{i,t}^{n}$ represent the gross returns on investment in bonds made at time $t-1$.

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

$$\frac{\omega_{i,t}}{C_{i,t}^{T}}=R_t\frac{\beta\omega_{i,t+1}}{C_{i,t+1}^{T}} \tag{4}$$

$$R_t=\frac{R_{i,t}^{n}P_{i,t}^{T}}{P_{i,t+1}^{T}} \tag{5}$$

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

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

Empirical evidence suggests that sectoral supply curves are convex (Boehm and Pandalai-Nayar, 2022). This means that sectors facing big increases in demand react mostly through rises in prices, while prices do not fall much in sectors hit by large negative demand shocks. This behavior can be rationalized with the presence of technological capacity constraints, limiting firms' ability to scale up production swiftly.

[8] Alternatively, we could allow households to trade nominal bonds denominated in foreign currencies. Given the structure of the economy, allowing households to trade foreign nominal bonds would not affect the equilibrium allocation of the model.

To capture these notions while preserving tractability, we introduce an asymmetry in the production function between the two sectors. We assume that in the short run firms in the tradable sector - i.e. the sector with high demand pressures - face stronger diminishing returns to employment than those producing non-traded goods. In Appendix B we microfound this approach with the presence of capacity constraints, which bite when firms seek to ramp up production quickly.

Both sectors use labor to produce, and there is perfect intersectoral labor mobility.[9] Non-traded output $Y_{i,t}^N$ is produced by a large number of competitive firms using labor $L_{i,t}^N$. The production function is $Y_{i,t}^N = L_{i,t}^N$. 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

$$P_{i,t}^N = W_{i,t}. \tag{7}$$

Hence, in the short run the price of the non-traded good fully inherits the nominal wage rigidity.

The tradable good is produced by a unit mass of identical competitive firms. In the short run, their production function is

$$Y_{i,0}^T = \left(\frac{L_{i,0}^T - (1-\alpha)\bar{Y}^T}{\alpha \bar{Y}^T} \right)^{\alpha} \bar{Y}^T, \tag{8}$$

where $L_{i,t}^T$ is the labor allocated to the production of traded goods, $\bar{Y}^T$ denotes tradable output in the initial steady state, and $\alpha > 0$ determines the degree of diminishing returns in the tradable sector. This production function implies that increasing quickly sectoral production above its steady state value generates productivity losses. Profit maximization implies that

$$P_{i,0}^T = W_{i,0} \left(\frac{Y_{i,0}^T}{\bar{Y}^T} \right)^{\frac{1-\alpha}{\alpha}}. \tag{9}$$

The price of the traded good is thus increasing in output.[10] This expression also implies that the price of the traded good is partly flexible in the short run. Hence, nominal prices in the non-traded sector are more rigid than in the traded one.[11]

[9]However, as we will see, in our economy reallocating labor in the short run toward the tradable sector generates productivity losses. These productivity losses can capture in reduced form costs linked to intersectoral labor reallocation, for instance due to the need to retrain workers.

[10]To be more precise, as we discuss in Appendix B, the production function in the traded sector is

$$Y_{i,0}^T = \begin{cases} L_{i,0}^T & \text{if } Y_{i,0}^T < \bar{Y}^T \\ \left(\frac{L_{i,0}^T - (1-\alpha)\bar{Y}^T}{\alpha \bar{Y}^T} \right)^{\alpha} \bar{Y}^T & \text{if } Y_{i,0}^T \geq \bar{Y}^T, \end{cases}$$

so it is linear when output is below $\bar{Y}^T$, and concave thereafter. $\bar{Y}^T$ can then be interpreted as the level of output after which capacity constraints start binding. The price of the traded good is then given by

$$P_{i,0}^T = \begin{cases} W_{i,0} & \text{if } Y_{i,0}^T < \bar{Y}^T \\ W_{i,0} \left(\frac{Y_{i,0}^T}{\bar{Y}^T} \right)^{\frac{1-\alpha}{\alpha}} & \text{if } Y_{i,0}^T \geq \bar{Y}^T, \end{cases}$$

and so the sectoral Phillips curve is convex, consistent with the evidence provided by Boehm and Pandalai-Nayar (2022). Throughout the paper we streamline the analysis by focusing on scenarios in which $Y_{i,0}^T \geq \bar{Y}^T$.

[11]This feature is consistent with the empirical observation that nominal prices are stickier in the service sector, compared to agriculture and manufacturing (Nakamura and Steinsson, 2008).

In the long run, the production function for tradable goods is linear, and so

$$Y_{i,t}^T = L_{i,t}^T \quad \text{and} \quad P_{i,t}^T = W_{i,t} \quad \text{for} \quad t \geq 1. \tag{10}$$

This assumption captures the idea that over time firms can adjust their production process to adapt to shifts in the sectoral composition of demand.[12]

Finally, the law of one price applies to the traded good and hence

$$P_{i,t}^T = S_{i,t} P_t^T,$$

where $P_t^T = \exp\left(\int_0^1 \log P_{j,t}^T dj\right)$ is the average world price of tradables, while $S_{i,t}$ is the effective nominal exchange rate of country i, defined so that an increase in $S_{i,t}$ corresponds to a nominal depreciation.

2.3 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 tradable consumption good thus requires

$$C_{i,t}^T = Y_{i,t}^T + R_{t-1} B_{i,t} - B_{i,t+1}. \tag{11}$$

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

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

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, $B_{i,t}(R_{t-1} - 1)$.

Moreover, 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 supply at the world level

$$\int_0^1 B_{i,t+1} \, \mathrm{d}i = 0. \tag{12}$$

[12] This happens, for instance, in the model proposed by Fornaro (2024).

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

$$C^N_{i,t} = Y^N_{i,t} = L^N_{i,t}. \tag{13}$$

Finally, equilibrium on the labor market requires that employment is equal to firms' labor demand, which cannot exceed households' labor supply

$$L_{i,t} = L^T_{i,t} + L^N_{i,t} \leq \bar{L}. \tag{14}$$

Since wages are flexible in the long run, the expression above holds as an equality in any period $t \geq 1$.

We are now ready to define a competitive equilibrium as a path of real allocations $\{C^T_{i,t}, C^N_{i,t}, Y^T_{i,t}, Y^N_{i,t}, L^T_{i,t}, L^N_{i,t}, B_{i,t+1}\}_{i,t}$, prices $\{P^T_{i,t}, P^N_{i,t}\}_{i,t}$ and world interest rate $\{R_t\}_t$, satisfying (2), (4), (6), (7), (8), (9), (10), (11), (12), (13), (14) and standard transversality conditions, given a path for $\{\omega_{i,t}\}_{i,t}$, initial conditions $\{R_{-1}B_{i,-1}, P_{i,-1}\}_i$ and $\{P_{i,t}\}_{i,t}$ set by monetary policy. In period 0 the nominal wage is fixed and equal to $W_{i,0} = 1$ for all i, while $\{W_{i,t}\}_{i,t}$ adjusts so that (14) holds with equality for $t \geq 1$.

2.4 Monetary policy

We are interested in deriving the optimal monetary policy, both with and without international cooperation. We will frame monetary policy in terms of a target path for the price level $P_{i,t}$.[13] In the long run, since wages and prices are fully flexible, the optimal monetary policy targets zero inflation, so that $P_{i,t} = P_{i,t-1}$ for $t \geq 1$. In the short run, it may be optimal to deviate from this zero inflation benchmark. As we will see, a rise in $P_{i,0}$ causes a rise in short-run aggregate demand. In what follows, we will then refer to monetary interventions leading to increases in $P_{i,0}$ as monetary expansions. Symmetrically, monetary interventions causing declines in $P_{i,0}$ can be interpreted as monetary contractions.

2.5 A demand reallocation shock

We study the macroeconomic adjustment to a temporary reallocation shock, which creates a global scarcity of tradable goods by increasing their demand.[14] The economy starts from a steady state in which $\omega_{i,-1} = \omega$ in every country. In period 0 the reallocation shock hits and demand for tradables is unusually high. For most of the paper we will focus on a symmetric global reallocation shock, such that in every country $\omega_{i,0} = \omega_0 > \omega$, but we will also consider other possibilities. Thereafter, $\omega_{i,t}$ goes back to its steady state value ω in every country. The shock occurring at date 0 is previously unanticipated, but from then on agents have perfect foresight. Given these

[13] 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 $R^n_{i,t}$.

[14] In Appendix E, we consider a scenario in which the global scarcity of tradable goods is driven by a negative supply shock. All the key insights of the analysis apply also to this shock.

assumptions, in period $t = 1$ the economy jumps to its final steady state, in which all the variables are constant, and interest rates are given by $R^n_{i,t} = R_t = 1/\beta$.

Throughout, we consider a symmetric scenario in which all the countries start with a zero net foreign asset position ($B_{i,0} = 0$ for all i). In the initial steady state wages are flexible and firms face no capacity constraints, and so $Y^T_{i,-1} = \bar{Y}^T = \omega \bar{L}$ and $Y^N_{i,-1} = (1-\omega)\bar{L}$ for all i.[15] These assumptions, coupled with the normalisation $W_{i,-1} = 1$, imply that $P_{i,-1} = P^T_{i,-1} = P^N_{i,-1} = 1$. Hence, $P_{i,0}$ denotes both the price level and the inflation rate in period 0.

3 Optimal monetary policy under international cooperation

We now derive the optimal policy under international cooperation. While in reality cooperation among national monetary authorities is limited, this case represents a useful starting point to illustrate the adjustments triggered by a global reallocation shock, and offers a benchmark against which to contrast the uncooperative equilibrium that we will derive later.

Imagine that monetary policy is set by a global central bank maximizing global welfare, simply defined as the sum of the lifetime utility enjoyed by every world citizen.[16] We focus on symmetric equilibria in which every country is hit by the same reallocation shock ($\omega_{i,0} = \omega_0 > \omega$). The global central bank then sets monetary policy as if each country was a closed economy, because it internalizes that no trade imbalances can arise among identical countries ($C^T_{i,t} = Y^T_{i,t}$ for all i and t). This isomorphism with respect to a closed economy simplifies considerably the analysis.

The optimal monetary policy under international cooperation consists in setting $P_{i,0}$ to maximize households' utility

$$\omega_0 \log Y^T_{i,0} + (1-\omega_0) \log Y^N_{i,0} - \chi\left(P_{i,0}\right), \tag{15}$$

where we have used the equilibrium conditions $C^T_{i,0} = Y^T_{i,0}$ and $C^N_{i,0} = Y^N_{i,0}$, and the fact that under balanced trade monetary policy actions in the short run have no impact on households' utility in the long run. The constraints faced by the central bank are

$$P^T_{i,0} = \left(\frac{Y^T_{i,0}}{\bar{Y}^T}\right)^{\frac{1-\alpha}{\alpha}} \tag{16}$$

$$Y^N_{i,0} = \frac{1-\omega_0}{\omega_0} Y^T_{i,0} P^T_{i,0} \tag{17}$$

$$\alpha \left(Y^T_{i,0}\right)^{\frac{1}{\alpha}} \left(\bar{Y}^T\right)^{1-\frac{1}{\alpha}} + (1-\alpha)\bar{Y}^T + Y^N_{i,0} \leq \bar{L} \tag{18}$$

[15] To solve for equilibrium output in the initial steady state, consider that since there are no capacity constraints $Y^T_{i,-1} = L^T_{i,-1}$, $Y^N_{i,-1} = L^N_{i,-1}$, and so $P^N_{i,-1} = P^T_{i,-1} = W_{i,-1}$. Moreover, since trade is balanced (6) implies $\omega Y^N_{i,-1} = (1-\omega) Y^T_{i,-1}$. Finally, since wages are flexible $L^T_{i,-1} + L^N_{i,-1} = \bar{L}$. Combining these conditions gives $Y^T_{i,-1} = \omega \bar{L}$ and $Y^N_{i,-1} = (1-\omega)\bar{L}$.

[16] More formally, global welfare is defined as

$$\int_0^1 \sum_{t=0}^{\infty} \beta^t \left(\log\left(C_{i,t}\right) - \chi\left(\frac{P_{i,t}}{P_{i,t-1}}\right)\right) di.$$

$$P_{i,0} = \left(P_{i,0}^T\right)^{\omega_0}. \tag{19}$$

Constraint (16) captures desired production by firms in the tradable sector, constraint (17) ensures that the output of non-traded goods is equal to households' demand, constraint (18) guarantees that firms' labor demand does not exceed households' labor supply,[17] while constraint (19) is just the definition of the short-run inflation rate.

To solve this problem, let us start by deriving the policy that would keep the economy at full employment, so that constraint (18) binds. This is the case if $P_{i,0} = P_{i,0}^{fe}$, defined by

$$P_{i,0}^{fe} = \left(\frac{\omega_0}{\omega}\frac{1-\omega(1-\alpha)}{1-\omega_0(1-\alpha)}\right)^{\omega_0(1-\alpha)}, \tag{20}$$

where we have used $\bar{Y}^T = \omega \bar{L}$. From this expression, one can see that $P_{i,0}^{fe}$ is increasing in ω_0. Intuitively, a higher ω_0 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 inflation, or equivalently a higher $P_{i,t}^T$, achieves both objectives. On the one hand, given that the nominal wage is fixed, a rise in $P_{i,0}^T$ induces firms in the tradable sector to hire more workers and expand production. On the other hand, a higher $P_{i,0}^T$ 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 $Y_{i,0}^T$ rises, households' income increases, inducing a rise in consumption of tradable goods $C_{i,0}^T$. As $C_{i,0}^T$ increases, also demand for non-tradable goods rises (see (6)), and so does employment in the non-traded sector. From the perspective of a global central bank this effect is particularly strong, because the global central bank internalizes that in equilibrium households immediately spend on consumption all the additional income coming from the tradable sector. As we will see, this will not be the case when we turn to self-oriented national central banks.

Maintaining full employment during a demand reallocation shock thus requires a rise in inflation. Intuitively, changing quickly the economy's production mix entails productivity losses. To prevent labor demand and employment from falling, real wages have to decline. Since nominal wages are rigid, the only way for real wages to drop is through a burst of inflation. If the cost of inflation is sufficiently small, the optimal monetary policy allows sufficient inflation to maintain full employment. Otherwise, if the inflation needed to maintain full employment is too costly, the optimal monetary policy strikes a balance between containing inflation in the tradable sector and

[17] In principle, the central bank could set the inflation rate high enough so that firms' labor demand exceeds households' labor supply. However, in our framework it would never be optimal for a central bank to do so, because this policy would generate an inflation cost without any benefit in terms of higher output and consumption. We thus streamline the analysis by imposing directly constraint (18) on the central bank's problem.

unemployment in the non-tradable one. In this case, an increase in ω_0 acts as a cost-push shock, leading both to a rise in inflation and slack in the labor market.

More precisely, taking the first order condition with respect to $P_{i,0}$ gives that at an interior optimum

$$\chi'\left(P_{i,0}\right)P_{i,0} = \frac{1}{\omega_0}\left(\frac{\alpha}{1-\alpha} + 1 - \omega_0\right). \tag{21}$$

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 $\bar{P}_{i,0}$ the value of $P_{i,0}$ that solves equation (21). It is easy to see that the optimal $P_{i,0}$ is equal to $\min\left(P_{i,0}^{fe}, \bar{P}_{i,0}\right)$, because there are no gains from increasing inflation further once the economy has reached full employment. Hence, under the optimal policy either the economy operates at full employment, or inflation is equal to the optimal upper bound $\bar{P}_{i,0}$. The following proposition collects these results.[18]

Proposition 1 *Under international cooperation, the optimal monetary policy response to a rise in* ω_0 *entails a rise in inflation* $P_{i,0} > 1$*. Moreover, if*

$$\chi'\left(P_{i,0}^{fe}\right)P_{i,0}^{fe} \leq \frac{1}{\omega_0}\left(\frac{\alpha}{1-\alpha} + 1 - \omega_0\right),$$

with $P_{i,0}^{fe}$ *defined by* (20) *then* $L_{i,0} = \bar{L}$*, otherwise* $L_{i,0} < \bar{L}$ *and* $P_{i,0} = \bar{P}_{i,0}$*, where* $\bar{P}_{i,0}$ *is implicitly defined by* (21)*.*

Figure 2 shows graphically the macroeconomic impact of a reallocation shock under international cooperation. The upward-sloped PC schedule captures the Phillips curve type of relationship between short-run inflation and firms' labor demand implied by our model, given by[19]

$$P_{i,0} = \left(\frac{\omega_0}{\omega}\frac{L_{i,0}/\bar{L} - \omega(1-\alpha)}{1-\omega_0(1-\alpha)}\right)^{\omega_0(1-\alpha)}. \tag{PC}$$

The logic behind this expression is quite different from the one underlying standard Phillips curves. In fact, our model abstracts from the standard Phillips curve transmission channel, based on the idea that higher employment leads to higher wage inflation. Instead, here inflation is positively related to employment because a higher price of the tradable good fosters labor demand in both sectors, through the three channels explained above. The MP schedule captures the monetary policy stance. Intuitively, it is optimal to tolerate any level of inflation necessary to attain full employment, as long as this is lower than the ceiling implicitly defined by expression (21).

In absence of a demand reallocation shock, i.e. if $\omega_0 = \omega$, the economy operates at full employment ($L_{i,0} = \bar{L}$) and there is zero inflation ($P_{i,0} = P_{-1}$). A rise in ω_0 triggers an upward

[18] All the proofs can be found in Appendix A.

[19] This expression is obtained using (16), (17) and $\alpha\left(Y_{i,0}^T\right)^{\frac{1}{\alpha}}\left(\bar{Y}^T\right)^{1-\frac{1}{\alpha}} + (1-\alpha)\bar{Y}^T + Y_{i,0}^N = L_{i,0}$, as well as the definition of the price level. Notice that, since we are focusing on labor demand by firms, we don't impose the equilibrium requirement $L_{i,0} \leq \bar{L}$ when drawing the Phillips curve.

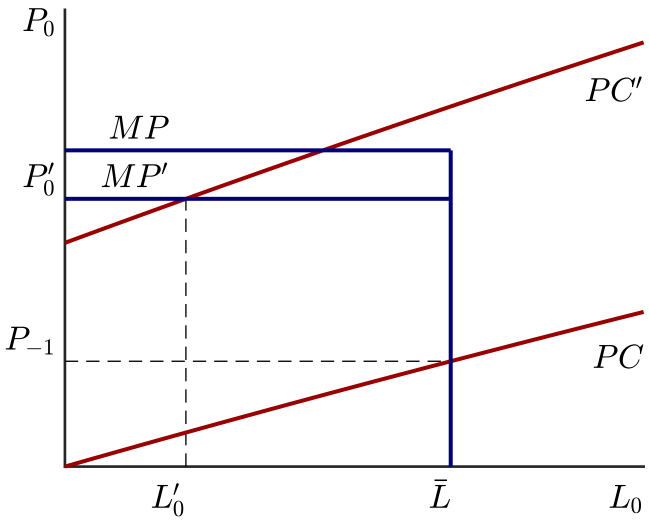

Figure 2: Macroeconomic impact of a global demand reallocation shock under cooperation.

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.[20] In the case shown in the figure, the shock is large enough so that the optimal monetary policy accommodates it through a rise in inflation ($P_{i,0} > P_{-1}$) and unemployment ($L_{i,0} < \bar{L}$).

Figure 3 shows, using a numerical example, the inflation and unemployment response to different values of the reallocation shock. While our model is too simple to perform a careful quantitative analysis, we try to pick reasonable values for the parameters. The key parameter in our model is α, which measures the convexity of the supply curve characterizing the tradable sector. We set $\alpha = .64$, which implies that a 1% increase in $Y_{i,0}^T$ is associated with a rise in $P_{i,0}^T$ by 0.57%. This elasticity is in the ballpark of the estimates provided by Boehm and Pandalai-Nayar (2022) for sectors operating at a high level of capacity utilization.[21] We assume that in the initial steady state $\omega = .3$, close to its value in the United States at the onset of the pandemic. Given the large disagreement characterizing the literature on the costs of inflation,[22] taking a stance on the precise shape of the function capturing the welfare losses from inflation is a difficult task. For illustrative purposes, we assume a quadratic cost of 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 set $\bar{\chi} = 300$. This choice implies that empirically relevant reallocation shocks, i.e. roughly in line with those experienced by the US and other G7 countries during the pandemic, push inflation close to the maximum ceiling that the global central bank is willing to tolerate without sacrificing

[20]The reallocation shock also induces a downward shift of the MP curve to MP′, because a higher ω_0 reduces the ceiling on inflation imposed by the optimal monetary policy.

[21]In particular, Boehm and Pandalai-Nayar (2022) find an elasticity of 0.57 of prices with respect to quantity produced for sectors at the 85th percentile of the capacity utilization distribution (see Table 3 of the paper).

[22]Nakamura et al. (2018) describe how several popular ways of modeling price rigidities lead to wildly different inflation costs. Benati and Nicolini (2024) make a similar point about money demand and the liquidity cost from inflation. Moreover, an emerging literature is studying novel sources of welfare losses from inflation. For instance, the evidence provided by Stantcheva (2024) suggests that the public has a strong dislike for inflation due to behavioral biases, while Guerreiro et al. (2024) estimate large welfare costs from inflation due to higher conflicts on the labor market. Finally, let us note that central banks often refer to large welfare losses that would occur if inflation expectations were to disanchor, a topic understudied by the academic literature.

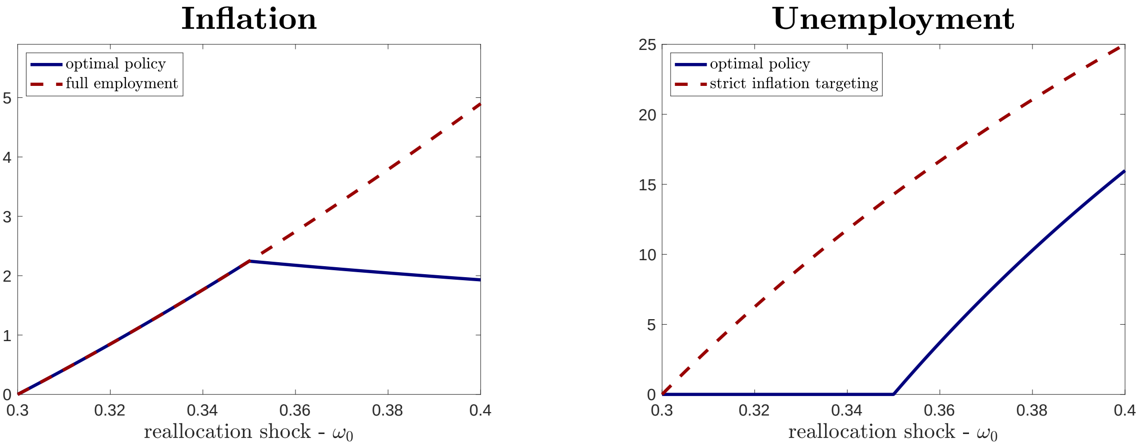

Figure 3: Inflation and unemployment response to a global reallocation shock under cooperation. Notes: solid lines represent the cooperative optimal policy, the dashed line in the left panel represents the amount of inflation needed to maintain the economy at full employment ($L_{i,0} = \bar{L}$), while the dashed line in the right panel represents the unemployment associated with a policy of strict inflation targeting ($P_{i,0} = P_{i,-1}$).

full employment.[23] This strikes us as a reasonable scenario, since during the latest inflation cycle monetary policy was sufficiently accommodative to maintain full employment, but at the same time central banks were extremely worried about inflation.

The solid lines in Figure 3 refer to the monetary stance chosen by a benevolent global bank. 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 term of quantities, the model implies that realistic values of the reallocation shock imply a significant trade off between inflation and economic slack.[24] For instance, suppose that the share of tradables in consumption expenditure rises from 0.3 to 0.33, roughly in line with the three percentage points increase seen in the US during the pandemic. Then a rise in inflation of around 1.5 percentage points would be needed to maintain full employment. Absent any increase in inflation, the economy would experience a large rise in unemployment of around 8 percentage points (see the dashed lines in the right panel).[25]

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

[23] More precisely, this parametrization implies that if $\omega_0 = .35$ then $P^{fe}_{i,0} = \bar{P}_{i,0}$. To give an idea of the implied welfare costs of inflation, under this parametrization an increase in inflation by 1 percentage point above target is equivalent to a 1.5% drop in steady state consumption. Nakamura et al. (2018) report welfare losses of a similar order of magnitude for New Keynesian models with Calvo pricing.

[24] Unemployment in our model should be broadly interpreted as a measure of economic slack, since our model abstracts from variable capital utilization and labor hoarding.

[25] In Appendix F, we discuss what happens once the reallocation shock dissipates. There we show that the disinflation process is characterized by a temporary overshooting of wage and non-tradable goods price inflation above their target. These dynamics are consistent with the fact that in the United States and in the euro area the recent burst of inflation originated in the goods sector, and only later migrated to wages and to the service sector (Lane, 2023; Fornaro and Romei, 2024).

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.

4 The uncooperative optimal monetary policy

Let us turn to the more realistic scenario in which each national central bank sets monetary policy to maximize domestic welfare. Self-oriented national central banks do not internalize that global credit markets have to clear. Rather, each central bank perceives that its country can run trade imbalances against the rest of the world. To solve for the uncooperative equilibrium we thus have to take fully on board the open-economy dimension of our model, and the fact that in the short run domestic consumption of tradable goods may deviate from domestic production.

Lemma 1 *Short-run consumption of tradable goods is equal to*

$$C_{i,0}^T = \frac{\omega_{i,0}}{\omega_{i,0}(1-\beta)+\beta}\left(Y_{i,0}^T(1-\beta)+\frac{\bar{Y}^T}{\omega R_0}\right). \tag{22}$$

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 trade deficit. Holding everything else constant, a higher preference for tradable consumption, i.e. a higher $\omega_{i,0}$, drives up short-run consumption of tradables and the trade deficit. A rise in R_0, instead, reduces $C_{i,0}^T$ 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 affect the country's stock of net foreign assets and consumption in the long run. In Appendix A.3, we show that self-oriented national central banks set $P_{i,0}$ to maximize

$$\left(\omega_{i,0}+\frac{\beta}{1-\beta}\right)\log C_{i,0}^T+(1-\omega_{i,0})\log Y_{i,0}^N-\chi\left(P_{i,0}\right), \tag{23}$$

subject to constraints (16), (18), (19), (22) and

$$Y_{i,0}^N = \frac{1-\omega_{i,0}}{\omega_{i,0}}C_{i,0}^T P_{i,0}^T. \tag{24}$$

The key difference with respect to the case of cooperative policymaking is that now $C_{i,0}^T$ may deviate from $Y_{i,0}^T$, and that the path of tradable consumption is dictated by households' saving decisions, as captured by constraint (22). Since tradable consumption depends on the world interest rate, there is now a link between the optimal policy problem and external factors.

Throughout this section, we will focus on non-cooperative Nash equilibria. In our model, this implies that national central banks set monetary policy taking 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. In the scenarios that we will consider $R_0 \geq 1/\beta$, and hence we impose this condition from now on.

As before, it may be optimal for the central bank to maintain the economy at full employment. This is the case if $P_{i,0} = P_{i,0}^{fe}$, which is now implicitly defined by

$$P_{i,0}^{fe} = \left(\frac{\omega_{i,0}}{\omega} \frac{\alpha\omega + 1 - \omega}{\alpha\omega_{i,0} + (1 - \omega_{i,0}) \frac{C_{i,0}^T}{Y_{i,0}^T}} \right)^{\omega_{i,0}(1-\alpha)}. \tag{25}$$

If the inflation cost is high enough, instead, the optimal monetary response to the reallocation shock entails a rise in unemployment. Taking the first order condition with respect to $P_{i,0}$ gives that at an interior optimum

$$\chi'(P_{i,0}) P_{i,0} = \frac{1}{\omega_{i,0}} \left(\frac{\alpha}{1-\alpha} \frac{\omega_{i,0}}{\omega_{i,0} + \beta(1 - \omega_{i,0})} \frac{Y_{i,0}^T}{C_{i,0}^T} + 1 - \omega_{i,0} \right). \tag{26}$$

It turns out that both sides of equation (26) are increasing in $P_{i,0}$, meaning that in principle multiple values of $P_{i,0}$ may solve it. From now on, we will assume that conditions are such that at most one solution to (25) satisfies $P_{i,0} \leq P_{i,0}^{fe}$.[26] Then, defining by $\bar{P}_{i,0}$ the smallest value of $P_{i,0}$ that solves (26), the optimal monetary policy sets $P_{i,0} = \min\left(P_{i,0}^{fe}, \bar{P}_{i,0}\right)$.

Proposition 2 *Assume that $R_0 \geq 1/\beta$ and that parameters are such that at most one solution to (26) satisfies $P_{i,0} \leq P_{i,0}^{fe}$. Then, in a Nash equilibrium national central banks set $P_{i,0} = \min\left(P_{i,0}^{fe}, \bar{P}_{i,0}\right) \geq 1$, where $P_{i,0}^{fe}$ solves (25), while $\bar{P}_{i,0}$ is the smallest value of $P_{i,0}$ that solves (26).*

Before moving on, let us observe that in open economies trade imbalances and capital flows affect the trade off between inflation and employment faced by national central banks. This can be seen by deriving the open-economy version of the Phillips curve[27]

$$P_{i,0} = \left(\frac{\omega_{i,0}}{\omega} \frac{L_{i,0}/\bar{L} + (1-\alpha)\omega}{\alpha\omega_{i,0} + (1 - \omega_{i,0}) \frac{C_{i,0}^T}{Y_{i,0}^T}} \right)^{\omega_{i,0}(1-\alpha)}. \tag{PC}$$

This expression implies that an increase in the trade deficit, i.e. a rise in $C_{i,0}^T/Y_{i,t}^T$, allows a country to achieve a higher level of employment for given inflation. Intuitively, trade deficits 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. Because of this effect, capital

[26]This property holds in all the numerical simulations that we have tried. In fact, while we were able to find some parametrizations under which (26) has multiple solutions, we also found that every solution except the smallest one is associated with implausibly high levels of inflation, violating constraint (18).

[27]This expression is obtained using (16), (24) and $\alpha \left(Y_{i,0}^T\right)^{\frac{1}{\alpha}} \left(\bar{Y}^T\right)^{1-\frac{1}{\alpha}} + (1-\alpha)\bar{Y}^T + Y_{i,0}^N = L_{i,0}$, as well as the definition of the price level.

inflows effectively act as a positive cost-push shock, ameliorating the trade off between inflation and employment faced by the central bank. Conversely, capital outflows and trade surpluses act as an adverse cost-push shock, worsening the trade off between inflation and employment. Through these effects, as it will become clear shortly, trade imbalances and capital flows play a key role in the international transmission of inflation and economic activity.

We are now ready to derive the implications of 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 $R_0 = 1/\beta$. According to (22), consumption of tradable goods then rises in the country affected by the shock. Part of the increase in tradable consumption is satisfied through higher imports, so that the country accommodates the reallocation shock by running a trade balance deficit financed with capital inflows.

Lemma 2 *A country hit by an idiosyncratic reallocation shock runs a trade deficit in the short run ($C^T_{i,0} > Y^T_{i,0}$).*

An interesting observation is that trade deficits reduce the inflation needed to achieve full employment. Equation (25), in fact, implies that $P^{fe}_{i,0}$ is decreasing in $C^T_{i,0}/Y^T_{i,0}$. As explained above, this happens because capital inflows increase demand for non-traded goods and employment in the non-traded sector.

If the optimum is interior, instead, monetary policy is described by expression (26). Comparing this expression with (21) shows that capital mobility reduces the marginal welfare cost associated with a drop in inflation.[28] This difference is due to two distinct effects. First, since trade deficits reduce the scarcity of tradable goods, the welfare impact of lower production of tradables caused by a disinflation is now smaller. This effect is captured by the term $Y^T_{i,0}/C^T_{i,0}$.

The second, and most interesting, effect arises because under free capital mobility containing inflation has a smaller cost in terms of lower domestic employment. Recall that lower inflation reduces domestic production of tradable goods. In closed economies, domestic consumption of tradables falls one-for-one with domestic production. In open economies, instead, tradable consumption is less sensitive to drops in domestic tradable output. In fact, differentiating (22) gives

$$\frac{\partial C^T_{i,0}}{\partial Y^T_{i,0}} = \frac{\omega_{i,0}(1-\beta)}{\omega_{i,0}(1-\beta)+\beta} < 1.$$

[28]Recall that the optimal policy under cooperation corresponds to the one that national central banks would choose if their economies were closed.

This happens because households react to monetary contractions by increasing external borrowing. Moreover, since $C^N_{i,0}$ is proportional to $C^T_{i,0}$, capital inflows mitigate the negative impact of lower inflation on domestic demand for non-tradables and on employment in the non-traded sector. Therefore, from the perspective of individual countries, containing inflation entails a lower sacrifice ratio - i.e. a lower cost in terms of foregone employment and output - if capital is mobile. This effect is captured by the term $\frac{\omega_{i,0}}{\omega_{i,0}(1-\beta)+\beta} < 1$ in expression (26).

Taking stock, trade deficits lower the inflation rate associated with a given level of employment. Moreover, capital mobility reduces the sensitivity of output to changes in inflation. Both effects mitigate the rise in inflation triggered by an idiosyncratic reallocation shock.[29] The impact of capital mobility on employment is instead ambiguous. On the one hand, lower inflation points toward lower employment. On the other hand, capital inflows increase the employment rate associated with a given level of inflation. If the second force dominates, openness to capital flows leads to both lower inflation and higher employment in periods of unbalanced demand.

4.2 A global reallocation shock

We now turn to a global reallocation shock, i.e. a synchronized rise in $\omega_{i,0}$ affecting symmetrically all the countries 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[30]

$$R_0 = \frac{\bar{Y}^T}{\beta Y_0^T} \frac{\omega_0}{\omega}, \tag{27}$$

where $Y_0^T \equiv \int_0^1 Y_{i,0}^T di = Y_{i,0}^T$. Since all the countries are symmetric, this happens when trade is balanced, so that every country consumes exactly its production of tradable goods.

As in the case of an idiosyncratic shock, the optimal monetary policy is characterized by expressions (25) and (26), but with the twist that in equilibrium $C^T_{i,0} = Y^T_{i,0}$. The first implication is that $P^{fe}_{i,0}$ now coincides with the one derived under international cooperation. International cooperation thus does not affect the amount of inflation needed to sustain full employment during a global reallocation shock.

This does not mean, however, that lack of international cooperation has no economic consequences. Compared to a benevolent global bank, in fact, self-oriented national central banks attach a lower marginal cost to a drop in inflation. This can be seen by comparing (21) and (26), evaluated at $C^T_{i,0} = Y^T_{i,0}$. As explained above, this happens because from the perspective of a single small open economy capital inflows weaken the negative impact of a monetary contraction on domestic

[29]Seen through the lens of these results, the trade deficits run by the United States during the recovery from the Covid recession helped to contain US inflation. This result is also related to an old view, very well exemplified by Sachs (1985), stating that the combination of trade deficits and strong dollar facilitated the 1980s disinflation in the United States. Sachs (1985) also argued that these same factors exported inflation from the United States toward the rest of the world. As we will see, our model rationalizes this insight.

[30]To derive this expression, we have used the fact that in a symmetric equilibrium the final steady state is equal to the initial one. Hence, $C^T_{i,1} = Y^T_{i,1} = \bar{Y}^T$. Plugging this condition in the households' Euler equation (4) gives (27).

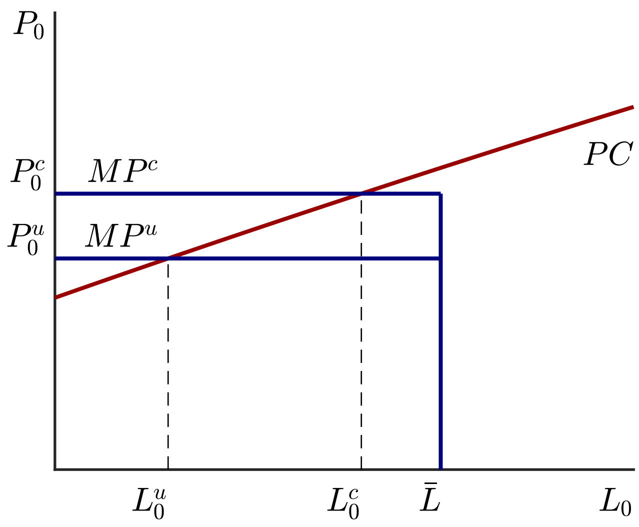

Figure 4: Macroeconomic impact of a global reallocation shock: the role of cooperation.

demand and employment.

Proposition 3 *Consider a global reallocation shock, i.e. $\omega_{i,0} = \omega_0 > \omega$ for all i. Absent international cooperation, the optimal monetary policy response to a rise in ω_0 entails a rise in inflation $P_{i,0} > 1$. Moreover, if*

$$\chi'\left(P_0^{fe}\right)P_0^{fe} \leq \frac{1}{\omega_0}\left(\frac{\alpha}{1-\alpha}\frac{\omega_0}{\omega_0+\beta(1-\omega_0)}+1-\omega_0\right), \tag{28}$$

with P_0^{fe} defined by (20) then $L_{i,0} = \bar{L}$ and the allocation coincides with the cooperative one. Otherwise $L_{i,0} < \bar{L}$, and the uncooperative allocation is characterized by lower inflation and lower employment compared to the cooperative one.

Figure 4 illustrates this result. In a symmetric equilibrium, international cooperation does not affect the relationship between global inflation and global employment captured by the PC curve. But the inflation ceiling imposed by central banks is lower in the uncooperative equilibrium (MP^u schedule) compared to the cooperative one (MP^c schedule), because self-oriented national monetary authorities are more inflation averse than a benevolent global central bank. As a result, lack of cooperation may reduce the impact of a reallocation of global expenditure toward tradable goods on inflation ($P_0^u < P_0^c$), but at the cost of higher unemployment ($L_0^u < L_0^c$).

Figure 5 goes back to our numerical example.[31] If the shock is small enough, regardless of whether central banks cooperate or not, it is optimal to maintain full employment. In this case, international cooperation does not affect the inflation and unemployment response to a global rise in demand for tradables. If the shock is large enough, however, the uncooperative monetary response is characterized by lower inflation and higher unemployment. For instance, if $\omega_0 = .33$

[31] To draw this picture, we set $\beta = .99$ to target a yearly steady interest rate of $R = 1/\beta = 1.01$, and keep all the other parameters as in Section 3.

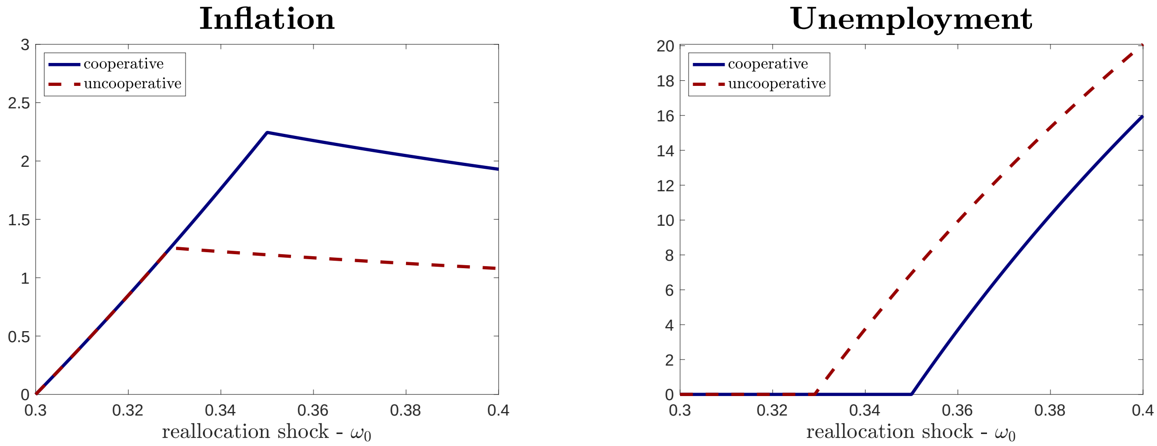

Figure 5: Inflation and unemployment response to a global reallocation shock: the role of cooperation. Notes: solid lines refer to the cooperative optimal monetary policy. Dashed lines refer to the uncooperative optimal monetary policy.

there are no gains from international cooperation. However, when $\omega_0 = .35$ self-oriented central banks choose to reduce inflation by around one percentage point compared to the cooperative benchmark, even though this entails a rise in unemployment to almost 7 percent.[32]

We can now address the fundamental question of the paper: are there gains from coordinating national monetary interventions? The answer is a qualified yes. If macroeconomic conditions are such that national central banks choose to maintain full employment ($L_{i,t} = \bar{L}$), which happens if condition (28) holds, then the monetary stance implemented by national central banks is optimal from a global perspective.

But now consider a scenario in which condition (28) is violated, so that national central banks sacrifice full employment to contain inflation ($L_{i,t} < \bar{L}$). Then the policy implemented by self-oriented national central banks suffers from a deflationary bias, which leads to an excessive global slump. Why are national central banks choosing an excessively contractionary monetary stance? To answer this question, we turn to the international spillovers triggered by monetary interventions.

4.3 International spillovers, capital flows, and competitive appreciations

Perhaps the best way to understand how international monetary spillovers operate is to consider a scenario in which every country in the world, except for a generic country i, implements a monetary contraction. The global monetary contraction causes a drop in P_0^T and in the global supply of traded goods Y_0^T. By equation (27), the world interest rate R_0 then rises, which induces capital outflows from country i. In turn, capital outflows depress demand for domestic non-traded goods, meaning that now more inflation is needed to achieve a given level of employment (see equation (PC)). Through this channel, a global monetary contraction leads to a combination of

[32] In our model, all the agents have access to international credit markets. Though we have not proven this result formally, we conjecture that the distance between the uncooperative equilibrium and the cooperative one would be smaller if only part of the households participated in international financial transactions. This would be the case, for instance, if some hand-to-mouth agents were present.

lower employment and/or higher inflation in country i.[33]

The gains from cooperation arise precisely because - due to a coordination failure - national central banks do not internalize these negative international spillovers. To see this point, start from the optimal cooperative monetary policy. Now let national central banks choose unilaterally their preferred monetary stance, so as to reach the Nash equilibrium. If national central banks find in their best interest to maintain full employment - i.e. if condition (28) holds - lack of coordination does not undermine the cooperative equilibrium.

But if condition (28) is violated, the cooperative equilibrium unravels as monetary authorities embark on an inefficient monetary contraction. Each central bank, in fact, seeks to reduce domestic inflation - while incurring a small cost in terms of lower output - by hiking its policy rate to attract capital inflows.[34] However, since all the countries behave symmetrically, the synchronized monetary contraction has no impact on capital flows in equilibrium. All that is left is an excessively tight monetary policy, causing an unnecessarily sharp global economic slump. These negative outcomes would be avoided if national central banks correctly internalized the global output losses associated with their disinflationary policies. But they don't, because part of the output losses caused by a domestic disinflation are exported abroad.

Effectively, cooperation breaks down because self-oriented national central banks engage in competitive appreciations. In fact, recall that the exchange rate in country i is equal to

$$S_{i,t} = \frac{P_{i,t}^T}{P_t^T},$$

where P_t^T is the average price of the traded good in the rest of the world. If (28) is violated, the cooperative equilibrium cannot be sustained because each central bank tries to disinflate by appreciating its currency, i.e. by pushing the domestic price of tradables below the one of its trading partners. However, the effort to appreciate the exchange rate is frustrated by the fact that all the countries in the world implement a synchronous monetary contraction.

We find this result intriguing, because it contrasts with the notion of competitive depreciations. When countries engage in competitive depreciations, they seek to attract foreign demand and sustain domestic employment by depreciating their exchange rate. Competitive depreciations, however, are typically an issue during periods of weak global demand and low inflation, such as the Great Depression or the aftermath of the 2008 global financial crisis.[35] We study a different scenario, characterized by global scarcity of tradable goods and high inflation. This explains why

[33] Albeit in a stylized way, our model is thus consistent with the empirical observation that when major central banks engineer a monetary contraction global credit market conditions get tighter, and economic activity in the rest of the world drops (Kalemli-Özcan, 2019; Degasperi et al., 2020; Miranda-Agrippino and Rey, 2020; Corsetti et al., 2021).

[34] More precisely, national central banks try to attract capital inflows because they boost employment in the non-tradable sector, which is characterized by a flat Phillips curve. In Appendix D, we show that there are no welfare gains from cooperation when the Phillips curve is symmetric across the two sectors. In this case, in fact, capital inflows have no impact on the aggregate inflation/employment trade-off faced by national central banks, and so self-oriented monetary authorities have no incentives to deviate from the cooperative equilibrium.

[35] See Caballero et al. (2021), Eggertsson et al. (2016) and Fornaro and Romei (2019) for models capturing the gains from cooperation in times of weak global demand.

in our model competitive appreciations pose a challenge to international cooperation.

5 Conclusion

We conclude with a few remarks. First, all the fundamental insights of the model apply to scenarios in which negative supply shocks - such as supply chain disruptions - hit firms producing traded goods (see Appendix E). Our results about the gains from monetary cooperation thus do not depend on whether the global scarcity of traded goods originates from demand or supply factors.

We do believe, as we argued in the introduction, that a global scarcity of traded goods was a salient feature of the recovery from the Covid-19 recession.[36] So what about the gains from monetary cooperation during this episode? Our model suggests that they were likely to be small. Indeed, throughout the latest inflation cycle the labor market was very strong in most advanced economies, implying that monetary and fiscal policies were sufficiently accommodative to maintain full employment. In this case, our model implies that there are no welfare gains to be reaped from international cooperation. It thus seems that this time the world has escaped the risk of competitive appreciations.[37]

This does not mean that the gains from monetary cooperation suggested by our model are of no practical relevance. Think about the global inflation cycle that started with the oil shocks of the 1970s and ended with the disinflation of the early 1980s. Back then, central banks were willing to sacrifice full employment in order to reduce inflation. In fact, the synchronized monetary tightening of the early 1980s was accompanied by a deep global slump. These are precisely the conditions under which our model predicts positive gains from international monetary cooperation. The model thus helps to rationalize the heated debate about the need for international cooperation that characterized the 1980s disinflation (Sachs, 1985), culminating in the Plaza Accord of 1985 (Frankel, 2015).

Looking forward, the world may soon enter another episode of global scarcity of tradable goods, this time driven by protectionist tariffs and trade wars. If so, our model may be useful to understand the trade-offs that central banks will face in the coming years.

[36] 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 had to face. See Gourinchas et al. (2021) and Di Giovanni et al. (2023) for more encompassing analyses.

[37] We reach this conclusion with the benefit of hindsight, since in real time it was far from clear that inflation would have declined without a significant rise in unemployment. In fact, some prominent commentators did highlight the risk that central banks could engage in competitive appreciations and reverse currency wars (Frankel, 2022; Obstfeld, 2022).

Appendix

A Proofs and additional derivations

A.1 Proof of Proposition 1

Substituting the constraints in the objective function reduces the global central bank's problem to

$$\max_{P_{i,0}} \frac{1}{\omega_{i,0}}\left(\frac{\alpha}{1-\alpha}+1-\omega_{i,0}\right)\log P_{i,0}-\chi\left(P_{i,0}\right)+t.i.p., \tag{A.1}$$

where t.i.p. collects all the terms not affected by monetary policy, subject to

$$P_{i,0} \leq \left(\frac{\omega_{i,0}}{\omega}\frac{1-\omega(1-\alpha)}{1-\omega_{i,0}(1-\alpha)}\right)^{\omega_{i,0}(1-\alpha)} \equiv P^{fe}_{i,0}, \tag{A.2}$$

where we have also used $\bar{Y}^T=\omega\bar{L}$, and intuitively $P^{fe}_{i,0}$ denotes the level of inflation consistent with full employment $L_{i,0}=\bar{L}$.

We start by proving that the solution features $P_{i,0}>1$. Imagine that the central bank sets $P_{i,0}\leq 1$. Then, since $\omega_{i,0}>\omega$, constraint (A.2) is slack. Moreover, recall that $\chi'\left(P_{i,0}\right)<0$ for $P_{i,0}<1$ and $\chi'(1)=0$, implying that the objective function is strictly increasing in $P_{i,0}$ when $P_{i,0}\leq 1$. This implies that it is optimal to set $P_{i,0}>1$.

Now notice that, since $\chi'\left(P_{i,0}\right)>0$ and $\chi''\left(P_{i,0}\right)>0$ for $P_{i,0}>1$, the objective function reaches its maximum at $P_{i,0}=\bar{P}_0$, defined by

$$\chi'\left(\bar{P}_{i,0}\right)\bar{P}_{i,0}=\frac{1}{\omega_{i,0}}\left(\frac{\alpha}{1-\alpha}+1-\omega_{i,0}\right). \tag{A.3}$$

Then if

$$\chi'\left(P^{fe}_{i,0}\right)P^{fe}_{i,0}\leq\frac{1}{\omega_{i,0}}\left(\frac{\alpha}{1-\alpha}+1-\omega_{i,0}\right), \tag{A.4}$$

it is optimal to set $P_{i,0}=P^{fe}_{i,0}$, i.e. and maintain the economy at full employment $L_{i,0}=\bar{L}$. Otherwise it is optimal to set $P_{i,0}=\bar{P}_{i,0}<P^{fe}_{i,0}$, which implies that $L_{i,0}<\bar{L}$.

A.2 Proof of Lemma 1

To derive the consumption function, start by considering that from period $t=1$ on the economy enters a steady state in which $R=1/\beta$ and in every country consumption and output of both goods are constant. Let us denote by C^T_i and Y^T_i the consumption and output of tradable good in the final steady state in country i. Now iterate forward (11) and use the transversality condition to obtain

$$C^T_{i,0}+\frac{1}{R_0}\frac{C^T_i}{1-\beta}=Y^T_{i,0}+\frac{1}{R_0}\frac{Y^T_i}{1-\beta}, \tag{A.5}$$

where we have also used the fact that each country starts with zero assets. Now using the fact that

$$C_i^T = \beta R_0 C_{i,0}^T \frac{\omega}{\omega_{i,0}} \tag{A.6}$$

and rearranging the expression above gives

$$C_{i,0}^T = \frac{\omega_{i,0}(1-\beta)}{\omega_{i,0}(1-\beta+\omega\beta}\left(Y_{i,0}^T + \frac{1}{R_0}\frac{Y_i^T}{1-\beta}\right). \tag{A.7}$$

Since in the final steady state each country operates at full employment and both sectors have a linear production function, it is easy to check that

$$C_i^N = \frac{1-\omega}{\omega} C_i^T, \tag{A.8}$$

and

$$Y_i^T = \bar{L} - \frac{1-\omega}{\omega} C_i^T. \tag{A.9}$$

Combining this expression with (A.6), (A.7) and $\bar{Y}^T = \omega \bar{L}$ and rearranging gives expression (22).

A.3 Central bank's objective function under free capital mobility

Households' expected utility in country i is given by

$$\sum_{t=0}^{\infty} \beta^t \left(\omega_{i,t} \log\left(C_{i,t}^T\right) + (1-\omega_{i,t}) \log\left(C_{i,t}^N\right) - \chi\left(\frac{P_{i,t}}{P_{i,t-1}}\right)\right). \tag{A.10}$$

Now consider that starting from period 1 on the economy enters a steady state with $C_i^N = C_t^T(1-\omega)/\omega$ and $P_{i,t} = P_{i,t-1}$. Hence, households' lifetime utility can be written as

$$\omega_{i,0} \log C_{i,0}^T + (1-\omega_{i,0}) \log C_{i,0}^N - \chi\left(P_{i,0}\right) + \frac{\beta}{1-\beta} \log C_i^T + t.i.p, \tag{A.11}$$

where t.i.p. encapsulates all the terms not affected by monetary policy. Finally, using the expression above, $C_i^T = \beta R_0 C_{i,0}^T \omega/\omega_{i,0}$ and $C_{i,0}^N = Y_{i,0}^N$ gives the objective function (23).

A.4 Proof of Proposition 2

Substituting some constraints in the objective function reduces the central bank's problem to

$$\max_{P_{i,0}, C_{i,0}^T, Y_{i,0}^T} \frac{1}{1-\beta} \log C_{i,0}^T + \frac{1-\omega_{i,0}}{\omega_{i,0}} \log P_{i,0} - \chi\left(P_{i,0}\right) + t.i.p., \tag{A.12}$$

where t.i.p. collects all the terms not affected by monetary policy, subject to

$$C_{i,0}^T = \frac{\omega_{i,0}(1-\beta)}{\omega_{i,0}(1-\beta)+\beta}\left(Y_{i,0}^T + \frac{\bar{L}}{R_0(1-\beta)}\right). \tag{A.13}$$

$$P_{i,0}^{\frac{1}{\omega_{i,0}}} = \left(\frac{Y_{i,0}^T}{\bar{Y}^T}\right)^{\frac{1-\alpha}{\alpha}} \tag{A.14}$$

$$\alpha \left(Y_{i,0}^T\right)^{\frac{1}{\alpha}} \left(\bar{Y}^T\right)^{1-\frac{1}{\alpha}} + (1-\alpha)\bar{Y}^T + \frac{1-\omega_{i,0}}{\omega_{i,0}} C_{i,0}^T P_{i,0}^{\frac{1}{\omega_{i,0}}} \leq \bar{L}. \tag{A.15}$$

We start by proving that the solution features $P_{i,0} \geq 1$. Imagine that the central bank sets $P_{i,0} < 1$. Then, since $\omega_0 \geq \omega$ and $R_0 \geq 1/\beta$, constraint (A.2) is slack. Moreover, recall that $\chi'(P_{i,0}) < 0$ for $P_{i,0} < 1$ and $\chi'(1) = 0$, implying that the objective function is strictly increasing in $P_{i,0}$ when $P_{i,0} < 1$. This implies that it is optimal to set $P_{i,0} \geq 1$.

Notice that the left-hand side of constraint (A.15) is increasing in $P_{i,0}$, since both $Y_{i,0}^T$ and $C_{i,0}^T$ are increasing in $P_{i,0}$. Define by $P_{i,0}^{fe} \geq 1$ the unique value of $P_{i,0}$ that makes (A.15) hold as an equality. In the main text, $P_{i,0}^{fe}$ is implicitly defined by equation (25).

Now imagine that the solution is such that constraint (A.15) is slack. Then the optimal $P_{i,0}$ satisfies

$$\chi'(P_{i,0}) = \frac{1}{\omega_{i,0} P_{i,0}} \left(\frac{\alpha}{1-\alpha} \frac{\omega_{i,0}}{\omega_{i,0}(1-\beta)+\beta} \frac{Y_{i,0}^T}{C_{i,0}^T} + 1 - \omega_{i,0}\right). \tag{A.16}$$

Intuitively, at an interior optimum the marginal disutility from increasing inflation is equated to the marginal benefit in terms of higher output and consumption. Notice that both sides of equation (A.16) are increasing in $P_{i,0}$. However, we are focusing on scenarios in which all the solutions to (A.16), except the smallest one, violate constraint (A.15). Then defining by $\bar{P}_{i,0}$ the smallest solution to (A.16), the optimal monetary policy is such that $P_{i,0} = \min\left(P_{i,0}^{fe}, \bar{P}_{i,0}\right) \geq 1$.

A.5 Proof of Lemma 2

Since the reallocation shock is idiosyncratic $\omega_{i,0} > \omega$ and $R_0 = 1/\beta$. Now suppose that the trade balance is not in deficit, so that $C_{i,0}^T \leq Y_{i,0}^T$. Equation (22) then implies that $Y_{i,0}^T \geq \bar{Y}\omega_{i,0}/\omega$. But then constraint (18) is satisfied only if

$$\omega_{i,0}^{1-\alpha} \left(1 - \omega_{i,0}(1-\alpha)\right)^{\alpha} \leq \omega^{1-\alpha} \left(1 - \omega(1-\alpha)\right)^{\alpha}. \tag{A.17}$$

Notice that expression (A.17) holds as an equality if $\omega_{i,0} = \omega$, and the left-hand side of (A.17) is increasing in $\omega_{i,0}$. Then, since $\omega_{i,0} > \omega$, inequality (A.17) is violated. We have thus found a contradiction, implying that $C_{i,0}^T > Y_{i,0}^T$.

A.6 Proof of Proposition 3

These results can be derived following the same steps outlined in the proof to Proposition 1. The only difference is that with free capital mobility it is optimal to set $L_{i,0} = \bar{L}$ if

$$\chi'\left(P_0^{fe}\right) P_0^{fe} \leq \frac{1}{\omega_0} \left(\frac{\alpha}{1-\alpha} \frac{\omega_0}{\omega_0(1-\beta)+\beta} + 1 - \omega_0\right), \tag{A.18}$$

otherwise $L_{i,0} < \bar{L}$.

Moreover, it is easy to see that P_0^{fe} is not affected by cooperation. This implies that if condition (A.18) is satisfied then the uncooperative allocation coincides with the cooperative one. Instead, lack of cooperation lowers $\bar{P}_0$. This implies that whenever condition (A.18) is violated, the uncooperative allocation features less inflation and less employment than the cooperative one.

B Production with capacity constraints

There is a continuum of mass one of competitive firms in each sector $j = T, NT$. Each firm needs to perform two tasks, say A and B, to produce. Let L_A^j and L_B^j the amount of labor allocated respectively to tasks A and B by the representative firm in sector j. Final output Y^j is then[38]

$$Y^j = \left(\frac{L_A^j}{\alpha}\right)^{\alpha} \left(\frac{L_B^j}{1-\alpha}\right)^{1-\alpha}, \tag{B.1}$$

where $0 < \alpha < 1$ is a parameter determining the importance of the two tasks in the production process. Since labor is homogeneous, every worker is payed the same wage regardless of the task she fulfills.

Firms face a technological constraint, which limits the amount of labor that can be allocated to task B

$$L_B^j \leq (1-\alpha)\bar{Y}^j, \tag{B.2}$$

where the parameter $\bar{Y}^j > 0$ determines the severity of the capacity constraint. Notice that this constraint applies to period 0 only, and so should be understood as a short-run capacity constraint.

Denote by $L^j = L_A^j + L_B^j$ the total amount of labor employed in sector j. Now suppose that the capacity constraint does not bind in sector j. Since every worker is payed the same wage, the optimal allocation of labor by firms between the two tasks implies $L_A^j = \alpha L^j$, $L_B^j = (1-\alpha)L^j$ and $Y^j = L^j$. One can then see that the capacity constraint does not bind if $Y^j \leq \bar{Y}^j$. If this condition is violated, instead, $L_B^j = (1-\alpha)\bar{Y}^j$ and

$$Y^j = \left(\frac{L_A^j}{\alpha}\right)^{\alpha} \left(\bar{Y}^j\right)^{1-\alpha} = \left(\frac{L_{i,0}^j - (1-\alpha)\bar{Y}^j}{\alpha\bar{Y}^j}\right)^{\alpha} \bar{Y}^j, \tag{B.3}$$

where the second equality makes use of $L_A^j = L^j - (1-\alpha)\bar{Y}^j$.

The sectoral production functions thus take the form

$$Y^j = \begin{cases} L^j & \text{if } Y^j \leq \bar{Y}^j \\ \left(\frac{L^j - (1-\alpha)\bar{Y}^j}{\alpha\bar{Y}^j}\right)^{\alpha} \bar{Y}^j & \text{if } Y^j > \bar{Y}^j. \end{cases} \tag{B.4}$$

Output is thus linear in labor up to the threshold $\bar{Y}^j$. Once output exceeds $\bar{Y}^j$, labor productivity

[38] To simplify notation, in this appendix we omit the country and time subscripts.

declines in the quantity produced. The implication is that sectoral Phillips curves are non-linear

$$P^j = \begin{cases} W & \text{if } Y^j \leq \bar{Y}^j \\ \left(\frac{Y^j}{\bar{Y}^j}\right)^{\frac{1-\alpha}{\alpha}} W & \text{if } Y^j > \bar{Y}^j. \end{cases} \tag{B.5}$$

Intuitively, due to perfect competition sectoral prices are equal to sectoral marginal costs. When capacity constraints do not bind, marginal costs are constant and prices fully inherit the nominal wage rigidity. When capacity constraints bind, marginal costs - and so prices - become increasing in the quantity produced. Hence, sectoral Phillips curves have a flat part corresponding to levels of output below $\bar{Y}^j$, and become upward-sloped thereafter. Sectoral supply curves are therefore convex, as documented empirically by Boehm and Pandalai-Nayar (2022).

In the main text we focus on scenarios in which $Y_{i,0}^T \geq \bar{Y}^T$ and $Y_{i,0}^N \leq \bar{Y}^N$, so that capacity constraints bind in the tradable sector, but not in the non-tradable one. Given that in our experiments production in the tradable sector expands - while production in the non-tradable sector contracts - compared to their steady state values, a sufficient condition for this to be the case is to assume $\bar{Y}^T = \omega \bar{L}$ and $\bar{Y}^N = (1-\omega)\bar{L}$.

C Endogenous inflation cost

In this appendix, we introduce an endogenous inflation cost. We do so by assuming that firms need to pay a cost to adjust their prices, in the spirit of Rotemberg (1982). As is known at least since Erceg et al. (2000), the combination of prices adjustment costs and nominal wage stickiness breaks down the divine coincidence characterizing the baseline New Keynesian framework (Galí, 2009). In the context of our model, this implies that the optimal monetary policy may deviate from targeting full employment. This insight has been exploited by Guerrieri et al. (2021) in their analysis of reallocation shocks. In what follows, we adopt the modeling approach proposed by Bianchi and Coulibaly (2024).

To anticipate the bottomline of this analysis, we find that the presence of prices adjustment costs doesn't modify the results described in the main text. In fact, the optimal monetary policy problem ends up being very similar to the one derived under an exogenous utility cost from inflation.

Suppose that households' aggregate consumption is defined as

$$C_{i,t} = \left(\int_0^1 C_{i,t}(j)^{\frac{\epsilon-1}{\epsilon}} dj\right)^{\frac{\epsilon}{1-\epsilon}},$$

where $C(j)$ denotes consumption of consumption good j, while $\epsilon > 1$ denotes the elasticity of substitution across these differentiated consumption goods. Optimal demand for each good j implies

$$C_{i,t}(j) = \left(\frac{P_{i,t}}{P_{i,t}(j)}\right)^{\epsilon} C_{i,t},$$

where $P(j)$ is the price of good j, while the consumption price index is defined as $P_{i,t} = \left(\int_0^1 P_{i,t}(j)^{1-\epsilon} dj\right)^{\frac{1}{1-\epsilon}}$.

Each good j is produced by a monopolistic retailer, by aggregating tradable $(C(j)^T)$ and non-tradable $(C(j)^N)$ intermediate goods according to

$$C_{i,t}(j) = \left(\frac{C^T_{i,t}(j)}{\omega_{i,t}}\right)^{\omega_{i,t}} \left(\frac{C^N_{i,t}(j)}{1-\omega_{i,t}}\right)^{1-\omega_{i,t}}. \tag{C.1}$$

Cost minimization implies that the marginal production costs faced by retailers is given by

$$MC_{i,t} = \left(P^T_{i,t}\right)^{\omega_{i,t}} \left(P^N_{i,t}\right)^{1-\omega_{i,t}}. \tag{C.2}$$

Monopolistic retailers set the price of their good to maximize profits. Following Rotemberg (1982), we assume that in period $t = 0$ retailers face a quadratic adjustment cost from changing their price, specified as

$$\frac{\chi}{2}\left(\frac{P_{i,0}(j)}{P_{i,-1}(j)} - 1\right)^2 C_{i,t}, \tag{C.3}$$

in units of the final consumption good.[39] Though this does not affect the analysis, to parallel our assumption about wages stickiness we assume that firms do not incur any cost from changing prices from period $t = 1$ onward.

As it is standard in the literature, we assume that retailers set their price, and then commit to satisfy customers' demand for their products. Under these assumptions, each retailer sets its price by solving

$$\max_{P_{i,0}(j)} \left(P_{i,0} - MC_{i,0}\right)\left(\frac{P_{i,0}}{P_{i,0}(j)}\right)^{\epsilon} C_{i,0} - \frac{\chi}{2}\left(P_{i,0}(j) - 1\right)^2 C_{i,0}, \tag{C.4}$$

where, in accordance with the model of the main text, we have normalized $P_{i,-1}(j) = 1$. The optimality condition from price setting, evaluated in a symmetric equilibrium in which every retailer charges the same price, implies

$$P_{i,0} = \frac{\epsilon MC_{i,0}}{\epsilon - 1 + \chi P_{i,0}\left(P_{i,0} - 1\right)} = \frac{\epsilon \left(P^T_{i,0}\right)^{\omega_{i,0}} \left(P^N_{i,0}\right)^{1-\omega_{i,0}}}{\epsilon - 1 + \chi P_{i,0}\left(P_{i,0} - 1\right)}, \tag{C.5}$$

where the second equality makes use of the definition of retailers' marginal costs.

With respect to the expression for the CPI of the model in the main text, equation (2), there are two differences. Due to the presence of monopolistic power, retailers now charge a mark-up over their marginal production costs. Given the structure of our economy, and in particular the assumption of an inelastic labor supply, this difference does not affect our analysis. Second, due to the presence of pricing frictions, the consumer price index is less responsive to changes in the marginal production costs, i.e. to changes in $P^T_{i,0}$ and $P^N_{i,0}$.

[39]Notice that, as in Guerrieri et al. (2021) and Bianchi and Coulibaly (2024), we assume that prices adjustment costs are proportional to aggregate consumption. This assumption simplifies the algebra, but it is by no means crucial for our results. It could be justified on the ground that the costs of adjusting prices are increasing in the economic size, and so in the complexity, of the economy.

An interesting special case is the limit $\epsilon \to +\infty$, in which consumption goods are close to perfect substitutes and the retailers' monopoly power vanishes. In this case, the consumer price index is identical to its definition in the main text (i.e. $P_{i,0} = \left(P^T_{i,0}\right)^{\omega_{i,0}} \left(P^N_{i,0}\right)^{1-\omega_{i,0}}$). Intuitively, when monopoly power is infinitesimally small, retailers have to charge a price equal to marginal costs to remain in the market.[40]

The rest of the framework is identical to the one in the main text (except that now there is no exogenous utility loss from inflation).

How does the presence of price adjustment costs affect households' utility? Intuitively, inflation now entails a productivity loss for the economy, which opens up a wedge between the intermediate goods used in production and the consumption enjoyed by households. More precisely, households' utility in the short run is now given by

$$\omega_{i,0} \log C^T_{i,0} + (1 - \omega_{i,0}) \log C^N_{i,0} + \log \left(1 - \frac{\chi}{2} \left(P_{i,0} - 1\right)^2\right), \tag{C.6}$$

where the last term captures the fact that a fraction of the intermediate inputs ends up being used to pay for the prices adjustment costs. The optimal monetary policy problem now consists in maximizing (C.6), subject to the same constraints specified in the main text, with the exception that constraint (19) is replaced by

$$P_{i,0} = \frac{\epsilon \left(P^T_{i,0}\right)^{\omega_{i,0}}}{\epsilon - 1 + \chi P_{i,0} \left(P_{i,0} - 1\right)}. \tag{C.7}$$

When setting the optimal policy, the central bank will now face the following trade-off. On the one hand, increasing inflation may be good for welfare, insofar as it leads to higher employment and so higher production of intermediate goods. On the other hand, higher inflation reduces labor productivity, and so creates a wedge between the amount of intermediate goods produced and final consumption. If the productivity losses from inflation are small enough, it will be optimal for the central bank to let inflation rise as much as needed to maintain full employment. Otherwise, the optimal inflation rate corresponds to the one that maximizes consumption, by optimally trading off employment and labor productivity.

Notice that the productivity losses due to prices adjustment costs play the same role as the convex utility losses from price inflation that we assumed in the main text. In fact, under the approximation $\epsilon \to +\infty$ the two models are essentially identical. Moving away from that approximation, the analysis becomes a bit more algebraically involved, because it is no longer possible to express $P_{i,0}$ as a closed-form function of $P^T_{i,0}$. That said, the two models retain exactly the same economic intuition.

[40] One undesirable feature of this approximation is that retailers may make negative profits in the short run, because the cost of adjusting prices may be larger than the (infinitesimally small) profits earned. However, one could think that firms may accept some losses in the short run, in order to retain their customers base in the long run. Or one could assume that the government compensates firms for these short-run losses through lump-sum subsidies.

D A symmetric cost-push shock

Throughout the paper, we have focused on scenarios in which inflationary pressures are concentrated in the sector producing tradable goods. Self-oriented national central banks then have a strong incentive to tighten monetary policy to attract capital inflows, so as to reallocate production towards the low-inflation non-tradable sector. This is precisely the reason behind the coordination failure described in Section 4.3.[41]

In this appendix, we consider a case in which the global economy is hit by a cost-push shock inducing symmetric inflationary pressures in two sectors. We will show that in this case there are no gains from international monetary cooperation, intuitively because capital inflows no longer have a first-order impact on the inflation/employment trade-off faced by national central banks.

We consider an economy in which the slope of the Phillips curve is the same in both sectors. To do so, we assume that the production function in the non-tradable sector is

$$Y_{i,0}^{N} = \left(\frac{L_{i,0}^{N} - (1-\alpha)\bar{Y}^{N}}{\alpha \bar{Y}^{N}} \right)^{\alpha} \bar{Y}^{N}, \tag{D.1}$$

so that the price of the non-traded good is now given by

$$P_{i,0}^{N} = W_{i,0} \left(\frac{Y_{i,0}^{N}}{\bar{Y}^{N}} \right)^{\frac{1-\alpha}{\alpha}}. \tag{D.2}$$

To ensure symmetry across the two sectors, we set $\omega \bar{Y}^{N} = (1-\omega)\bar{Y}^{T}$. Moreover, to make things interesting, we consider a case in which capacity constraints bind when inflation is on target. This happens if $\bar{Y}^{T} < \omega \bar{L}$, which we assume to hold from now on.

We abstract from reallocation shocks by maintaining households' expenditure shares constant, that is $\omega_{i,t} = \omega$ for all i and t. Instead, we generate global inflationary pressures by considering an increase in the short-run nominal wage. More precisely, we assume that all the countries have the same short-run nominal wage $W_{i,0} = W > 1$, and consider what happens as W increases.

International cooperation. Let us start from deriving the equilibrium under international monetary cooperation. Just as in the main text, in this case central banks internalize that in every country trade has to balance, so that $C_{i,0}^{T} = Y_{i,0}^{T}$. Since the two sectors have symmetric production functions, with a bit of algebra one can show that output and consumption of both goods move proportionally (i.e. $\omega C_{i,0}^{N} = (1-\omega) C_{i,0}^{T}$), and that the relative price of the two goods is constant

$$P_{i,0}^{T} = P_{i,0}^{N} = P_{i,0}. \tag{D.3}$$

[41] For simplicity, in our baseline model we have taken the extreme assumption of a flat Phillips curve in the non-tradable sector. But the coordination failure result holds as long as the Phillips curve is flatter in the non-traded sector than in the traded one.

Hence, the consumer price index is pinned down by

$$P_{i,0} = W \left(\frac{Y_{i,0}^T}{\bar{Y}^T} \right)^{\frac{1-\alpha}{\alpha}}. \tag{D.4}$$

The optimal monetary policy under cooperation then consists in setting $P_{i,0}$ to maximize households' utility

$$\log Y_{i,0}^T - \chi\left(P_{i,0}\right), \tag{D.5}$$

subject to (D.4) and

$$\alpha \left(Y_{i,0}^T\right)^{\frac{1}{\alpha}} \left(\bar{Y}^T\right)^{1-\frac{1}{\alpha}} + (1-\alpha)\bar{Y}^T \leq \omega \bar{L}. \tag{D.6}$$

Combining the two constraints implies that the price level consistent with full employment is

$$P_{i,0}^{fe} = \frac{W}{\alpha} \left(\frac{\omega \bar{L} - (1-\alpha)\bar{Y}^T}{\alpha \bar{Y}^T} \right)^{1-\alpha}. \tag{D.7}$$

Naturally, a higher nominal wage calls for a higher price level to maintain full employment. If the optimum is interior, instead, the optimal inflation rate is implicitly defined by

$$\chi'\left(\bar{P}_{i,0}\right) \bar{P}_{i,0} = \frac{\alpha}{1-\alpha}. \tag{D.8}$$

The optimal monetary policy under cooperation then consists in setting $P_{i,0} = \min\left(P_{i,0}^{fe}, \bar{P}_{i,0}\right)$.

Uncooperative equilibrium. We next turn to the equilibrium without international cooperation. For the same reasons described in the main text, there are no gains from cooperation when self-oriented national central banks choose to maintain their economies at full employment. We then focus on scenarios in which in the uncooperative equilibrium constraint (D.6) does not bind.

Following the same approach as in the main text, one can then show that self-oriented national central banks choose $P_{i,0}$ to maximize

$$\left(\omega + \frac{\beta}{1-\beta}\right) \log C_{i,0}^T + (1-\omega_{i,0}) \log Y_{i,0}^N - \chi\left(P_{i,0}\right), \tag{D.9}$$

subject to constraints

$$P_{i,0}^T = W \left(\frac{Y_{i,0}^T}{\bar{Y}^T} \right)^{\frac{1-\alpha}{\alpha}} \tag{D.10}$$

$$P_{i,0}^N = W \left(\frac{Y_{i,0}^N}{\bar{Y}^N} \right)^{\frac{1-\alpha}{\alpha}} \tag{D.11}$$

$$Y_{i,0}^N = \frac{1-\omega}{\omega} \frac{P_{i,0}^T}{P_{i,0}^N} C_{i,0}^T \tag{D.12}$$

$$P_{i,0} = \left(P_{i,0}^T\right)^{\omega} \left(P_{i,0}^N\right)^{1-\omega} \tag{D.13}$$

$$C_{i,0}^T = \frac{\omega}{\omega(1-\beta)+\beta}\left(Y_{i,0}^T(1-\beta)+\frac{\bar{L}}{R_0}\right). \tag{D.14}$$

After some algebra, one can show that the optimal monetary policy satisfies

$$\chi'\left(P_{i,0}\right)P_{i,0}\left(\frac{1-\alpha}{\alpha}-(1-\omega)(1-\alpha)\left(1-\frac{Y_{i,0}^T}{C_{i,0}^T}\frac{\omega(1-\beta)}{\omega(1-\beta)+\beta}\right)\right)= \tag{D.15}$$

$$=(1-\omega)(1-\alpha)+\frac{Y_{i,0}^T}{C_{i,0}^T}\frac{\omega\left(1-(1-\beta)(1-\alpha)(1-\omega)\right)}{\omega(1-\beta)+\beta}.$$

Evaluated around a symmetric equilibrium, this expression collapses to (D.8). Hence, the uncooperative equilibrium coincides with the cooperative one, and there are no welfare gains from international cooperation.

To understand the logic behind this result, consider that the aggregate Phillips curve can be written as

$$L_{i,0}=\bar{Y}^T\left(\frac{1-\alpha}{\omega}+\alpha\left(\frac{P_{i,0}}{W}\right)^{\frac{1}{1-\alpha}}\left(\left(\frac{C_{i,0}^T}{Y_{i,0}^T}\right)^{\omega-1}+\frac{1-\omega}{\omega}\left(\frac{C_{i,0}^T}{Y_{i,0}^T}\right)^{\omega}\right)\right). \tag{D.16}$$

Differentiating this expression with respect to $C_{i,0}^T/Y_{i,0}^T$ gives that around a symmetric equilibrium marginal changes in the trade deficit have no impact on the employment/inflation trade off faced by national central banks. This explains why self-oriented national central banks do not have an incentive to deviate from the cooperative optimal monetary policy. The key message is that the coordination failure that we describe arises when capital inflows ameliorate the domestic trade-off between inflation and employment, by reallocating production towards the sector with the flatter Phillips curve.

E Supply disruptions

Since the start of the pandemic, the global economy has been harmed by several negative supply shocks - hitting particularly hard the tradable sector. First, the pandemic itself disrupted global supply chains and hampered international trade. Second, Russia's invasion of Ukraine caused a sharp spike in energy prices, disrupting production in the energy-intensive manufacturing sector.[42] Motivated by these facts, in this section we study the economy's response to a negative productivity shock affecting the tradable sector. As we will see, many of the insights that we derived for demand reallocation shocks also apply to this alternative disturbance. This result is not surprising, once one realizes that tradable-biased supply disruptions - just like surges in demand for tradables - generate global scarcity of traded goods.

[42] Of course, high energy prices have broader implications for to economy, besides disrupting production in the manufacturing sector. See Auclert et al. (2023) for an interesting recent paper studying several channels through which a rise in the price of energy affects open economies.

To introduce supply shocks, we replace the production function in the tradable sector with

$$Y_{i,0}^T = \left(\frac{L_{i,0}^T - (1-\alpha)\xi \bar{Y}^T}{\alpha \xi \bar{Y}^T} \right)^{\alpha} \xi \bar{Y}^T.$$

The parameter ξ determines productivity in the tradable sector in the short run. When $\xi < 1$ the tradable sector is hit by a supply disruption driving productivity below its steady state value. Profit maximization gives the pricing function

$$P_{i,0}^T = W_{i,0} \left(\frac{Y_{i,0}^T}{\xi \bar{Y}^T} \right)^{\frac{1-\alpha}{\alpha}}.$$

So a fall in ξ - holding everything else constant - causes a rise in the price of tradables. Intuitively, lower productivity increases marginal costs and induces firms to charge higher prices.

We study a global supply disruption, i.e. a scenario in which every country is identical and ξ unexpectedly falls below 1 in period $t = 0$. To isolate the impact of this negative supply shock, we abstract from demand reallocation by setting $\omega_{i,0} = \omega$. Since the analysis is very similar to what we have already seen, in this section we limit ourselves to sketch out a few results.

International cooperation. The optimal monetary policy problem under international cooperation is identical to the one derived in Section 3, with the exception that the term $\bar{Y}^T$ in constraints (16) and (18) is replaced by $\xi \bar{Y}^T$. The Phillips curve, which recall we define as the relationship between firms' labor demand and inflation, now takes the form

$$P_{i,0} = \left(\frac{L_{i,0}/(\xi \bar{L}) - \omega(1-\alpha)}{1-\omega(1-\alpha)} \right)^{\omega(1-\alpha)}. \tag{E.1}$$

A drop in ξ thus acts as a negative cost-push shock, worsening the trade off between inflation and employment faced by monetary authorities. The reason is simple. Lower productivity drags profits in the tradable sector down. To prevent a reduction in employment real wages need to fall to restore profitability.[43] Since nominal wages are rigid, a drop in real wages can only be attained through a rise in inflation.

If the inflation cost is small enough, the global central bank chooses to maintain full employment by setting $P_{i,0}$ equal to

$$P_{i,0}^{fe} \equiv \left(\frac{1/\xi - \omega(1-\alpha)}{1-\omega(1-\alpha)} \right)^{\omega(1-\alpha)}. \tag{E.2}$$

Otherwise, it is optimal to equate the marginal welfare benefit from a rise in inflation to its marginal cost

$$\chi'(P_{i,0}) P_{i,0} = \frac{1}{\omega} \left(\frac{\alpha}{1-\alpha} + 1 - \omega \right). \tag{E.3}$$

[43]Even though the supply disruption hits exclusively the tradable sector, it may lead to a decline in employment in the non-traded sector too. In fact, lower economic activity in the tradable sector decreases households' income, and so their demand for non-traded goods. In turn, lower demand leads to a reduction in production and employment in the non-traded sector. A tradable-biased supply disruption thus depresses firms' demand for labor in both sectors.

The optimal monetary policy under international cooperation then consists in setting $P_{i,0} = \min\left(P_{i,0}^{fe}, \bar{P}_{i,0}\right)$, where $\bar{P}_{i,0}$ is the value of $P_{i,0}$ that solves equation (E.3).

Similar to a demand reallocation shock, a tradable-biased supply disruption thus causes a rise in inflation, and possibly a fall in employment.[44] The only substantial difference is that while a rise in ω_0 leads to an increase in employment and production in the tradable sector, after a drop in ξ production and employment in the traded sector contract.

Uncooperative equilibrium. Absent international cooperation, every country tries to smooth out the impact of the transitory negative productivity shock on consumption by borrowing from abroad, so as to run a trade deficit. However, in a symmetric equilibrium trade imbalances cannot arise. Instead, the world interest rate rises until the balanced-trade equilibrium - in which every country consumes exactly its own production of traded goods - is restored.

The implications for monetary policy are in line with those derived in Section 4.2. That is, lack of cooperation does not affect the amount of inflation needed to maintain full employment, which is still given by expression (E.2). But lack of cooperation reduces the marginal benefit attached by self-oriented central banks to a rise in inflation, because they perceive that access to international credit markets weakens the impact of higher inflation on domestic demand and employment. In fact, in the uncooperative equilibrium condition (E.3) is replaced by

$$\chi'\left(P_{i,0}\right)P_{i,0} = \frac{1}{\omega}\left(\frac{\alpha}{1-\alpha}\frac{\omega}{\omega+\beta(1-\omega)} + 1 - \omega\right). \tag{E.4}$$

Comparing (E.3) and (E.4) shows that - when the optimal monetary policy is interior - self-oriented national central banks adopt a more contractionary monetary stance and tolerate less inflation compared to a benevolent global central bank. The insights derived in Section 4.2 thus extend to tradable-biased negative supply shocks.

Gains from cooperation and international spillovers. Exactly for the same reasons described in Section 4.3, lack of cooperation may thus lead to an overly tight monetary response to a global supply disruption. Efforts to contain domestic inflation through monetary tightenings, indeed, exacerbate the global scarcity of traded goods and impose negative externalities toward the rest of the world.

Supply disruptions biased toward the tradable sector thus have effects very similar to shocks boosting the global demand for tradable goods. What makes the two shocks similar is that they both lead to a global scarcity of tradable goods. It is then not surprising that some of the issues highlighted by this paper - such as monetary coordination problems arising from competitive appreciations - were present in the economic debate of the 1970s/1980s (Bruno and Sachs, 1985), a period characterized by negative supply shocks affecting the tradable sector.

[44] To see this point, consider that if productivity is equal to its steady state value ($\xi = 1$), then the central bank can attain both full employment and zero inflation. It follows that if $\xi < 1$ it is optimal for the central bank to let inflation rise above its steady state value. Moreover, if the drop in ξ is sufficiently large, then $P_{i,0}^{fe} > \bar{P}_{i,0}$ and the optimal monetary policy entails a drop in employment below $\bar{L}$.

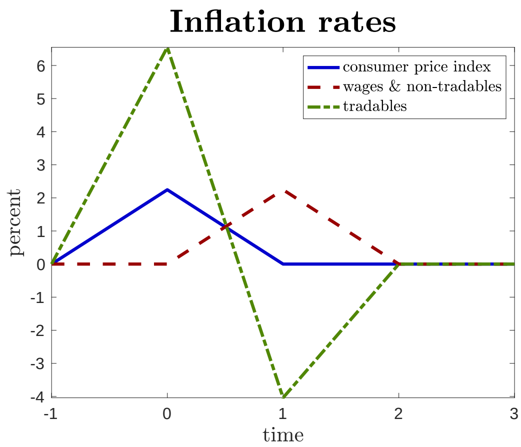

Figure 6: Inflation dynamics around a global demand reallocation shock. Notes: solid line refers to CPI inflation ($P_{i,t}/P_{i,t-1}$). Dashed line refers to wage inflation ($W_{i,t}/W_{i,t-1}$), which is equal to inflation in the non-traded sector ($P^N_{i,t}/P^N_{i,t-1}$). Dash-dotted line refers to inflation in the traded sector ($P^T_{i,t}/P^T_{i,t-1}$).

F Wages and prices during the disinflation phase

We have already shown that real wages decline when demand reallocates. But what happens next? In our framework, once the shock abates real wages fully recover their value in the initial steady state.[45] The demand reallocation shock is thus followed by a period in which nominal wages grow faster than prices, so that real wages regain the ground lost during the shock period.

Since prices in the non-tradable sector are equal to wages, this reasoning implies that sectoral inflation evolves according to

$$\frac{W_{i,1}}{W_{i,0}} = \frac{P^N_{i,1}}{P^N_{i,0}} > 1 > \frac{P^T_{i,1}}{P^T_{i,0}}.$$

In words, the disinflation that follows the period of the shock is driven by a drop in tradable inflation below its steady state value. Inflation in the non-traded sector, instead, overshoots its long-run value in period $t = 1$. This adjustment is needed so that relative prices go back to their steady state value.

Figure 6 displays the inflation dynamics around a global reallocation shock. To draw this figure, we have assumed that $\omega_0 = 0.35$, that monetary policy maintains full employment $L_0 = \bar{L}$, and kept all the other parameters as in our running numerical example. The figure shows that the shock period ($t = 0$) is characterized by a sharp rise in inflation in the traded sector. During the disinflation, i.e. in $t = 1$, wage and non-tradable price inflation overshoot their long-run value, while the tradable sector experiences a period of deflation. Interestingly, consistent with these predictions, both in the United States and in the euro area the recent burst of inflation originated in the goods sector, and only later migrated to wages and to the service sector (Lane, 2023; Fornaro and Romei, 2024).

[45]In reality, part of the decline in real wages caused by the reallocation shock may become permanent. For instance, this would happen if the demand reallocation shock was associated with a drop in investment, hurting future productivity growth. Benigno and Fornaro (2018) and Fornaro and Wolf (2023) provide frameworks in which temporary shocks may persistently affect real wages through this channel.

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