Inflation and Capital Flows*

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Abstract

Over the latest monetary policy tightening cycle, capital has been flowing from jurisdictions with the least aggressive hiking profiles to those with the most aggressive ones. This pattern of capital flows is consistent with the predictions of an open-economy model with nominal rigidities where cost-push shocks generate an inflationary episode and capital flows freely across countries. Yet, by raising demand for domestic non-tradable goods and services, capital inflows cause unwelcome upward pressure on firms' costs in countries most severely hit by these shocks. We argue that a reverse pattern of capital flows would have improved the output-inflation trade-off globally, hence requiring a less aggressive monetary tightening in the most severely hit countries and delivering overall welfare gains.

Keywords: Cost-push shocks, current account adjustment, externalities, capital flow management policies

JEL Classifications: E32, E44, E52, F32, F41, F42

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1 Introduction

One of the most striking macroeconomic developments of the post-pandemic recovery has been an unprecedented and broad-based surge in inflation, shown in the left panel of Figure 1 for G7 economies. After a prolonged period of low interest rates, this inflation surge led many central banks to engage in their most aggressive tightening cycle in decades, as shown in the right panel of the figure. During this tightening cycle, capital has been flowing from jurisdictions with the lowest inflation and least aggressive hiking profiles to jurisdictions with the highest inflation and most aggressive hiking profiles. This fact is apparent in Figure 2, which shows that jurisdictions with higher inflation (panel a) and larger cumulative interest rate hikes (panel b) between October 2021 and March 2023 have tended to run more negative current account balances over this period. Most jurisdictions with flatter hiking profiles have been running current account surpluses, while most jurisdictions with steeper hiking profiles have been running current account deficits.[1] Has this observed pattern of capital flows been a stabilizing force for the global economy's adjustment to the shocks likely behind the recent inflation surge, or has it instead been destabilizing?

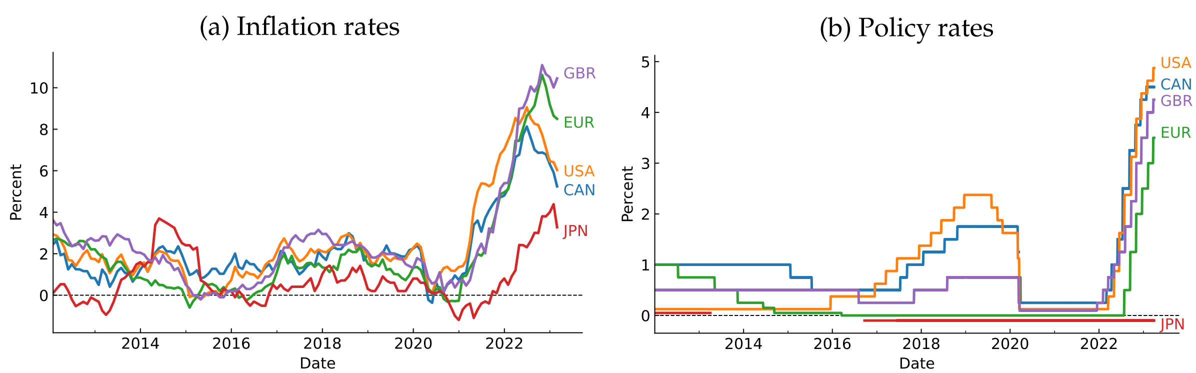

Figure 1: Inflation and policy rates in G7 countries.

Note: Data are from the BIS. The left panel shows annual (year-over-year) CPI inflation rates at monthly frequency. The right panel shows policy rates at daily frequency. See Appendix A for details.

In this paper, we argue that capital flows from low-inflation to high-inflation countries might be destabilizing and result in an excessive cross-country dispersion of monetary tightening. In other words, the pattern of capital flows observed in the latest tightening

[1]More precisely, among the bottom two quartiles of cumulative hikes, over 75% of jurisdictions have been running surpluses, while among the top two quartiles, over 75% of jurisdictions have been running deficits. A similar pattern holds for average inflation quartiles. See Figure A.2 in Appendix A.

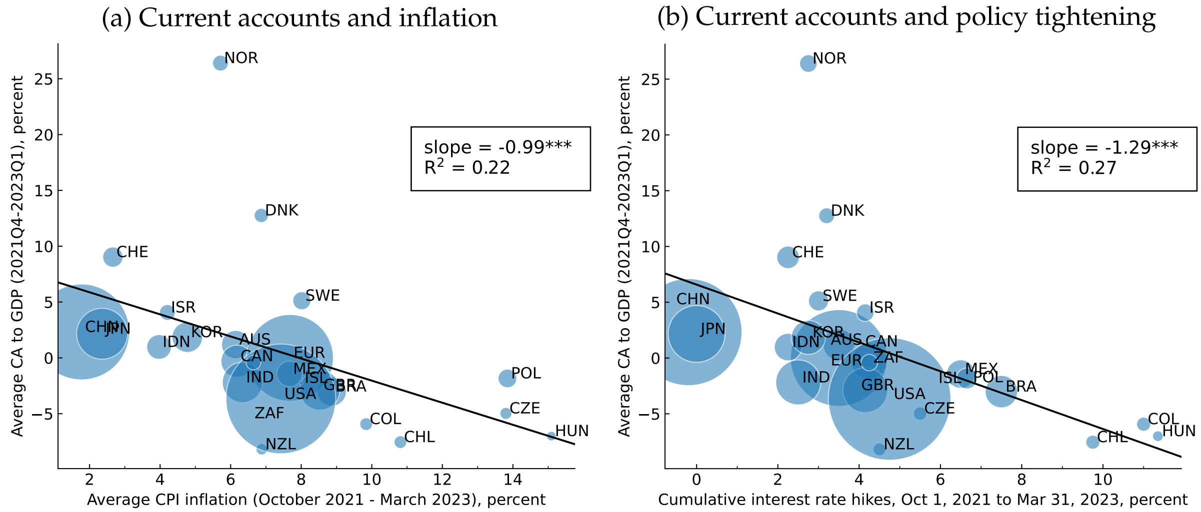

Figure 2: Capital flows, inflation, and monetary policy tightening.

Note: Data on CPI inflation rates and policy rates are from the BIS. Current account-to-GDP ratios are from the OECD's Main Economic Indicators. The size of the dots reflects the size of countries' dollar GDP in 2021, as reported in the World Bank's World Economic Indicators database. See Appendix A for details. *** indicates significance at the 1 percent level.

cycle likely resulted in excessive movements in inflation, as well as in low-inflation countries tightening too little and high-inflation countries tightening too much. Our argument builds on the insight that capital inflows exert upward pressure on the marginal costs of domestic firms by reducing the supply of non-tradable factors of production such as labor and by propping up the demand for non-tradable goods. In a high-inflation environment, this upward pressure on firms' marginal costs deteriorates the policy trade-off: to stabilize inflation at a given level, monetary policy needs to be more contractionary when capital is flowing in. Individual agents, who access international financial markets to smooth consumption when policy is contractionary, do not internalize the general equilibrium effects of their borrowing decision. As a result, they impose a macroeconomic externality on others and worsen the central bank's policy trade-off.

We formalize these ideas in a standard two-country general equilibrium model with nominal rigidities, whose building blocks form the backbone of more elaborate dynamic stochastic general equilibrium models used by most central banks for policy analysis. In the simplest version of the model featuring two tradable goods and identical consumption baskets across countries (Clarida, Gali and Gertler, 2002), the mechanism works through labor supply alone. By raising domestic consumption, capital inflows shift households' labor supply schedule up, thereby raising equilibrium wages. Higher wages in turn result in higher marginal costs for domestic firms. Hence, in times when monetary policy adopts a particularly tight stance to limit domestic inflation, the upward pressure on domestic marginal costs caused by additional capital inflows adds fuel to the fire. Either the central bank lets the rise in marginal costs translate into higher domestic inflation, or it is forced to depress economic activity further to achieve a given stabilization of inflation. Either way, the economy is worse off, and this adverse side effect of external borrowing is not adequately signaled to domestic agents by its price in an unregulated market.

In our baseline model, capital flows exert upward pressure on domestic costs only via the wealth effect on labor supply. But our insights apply more generally in the presence of non-tradable goods and/or factors of production. To make this point, we present a model extension featuring non-traded goods consumption. In this case, capital inflows also bid up the price of non-tradable goods relative to the economy's consumption basket. Since the relevant marginal cost measure for price setters in the tradable goods sector is now the real wage in terms of domestically produced tradable goods, an appreciation of non-tradable goods mechanically raises marginal costs. As a result, capital inflows raise domestic marginal costs irrespective of labor supply considerations.

In the presence of home bias in consumption, capital inflows also appreciate the terms of trade (i.e., the relative price of exports over imports). This appreciation of the terms of trade raises the purchasing power of domestic firms and attenuates the rise in their marginal costs caused by the wealth effect described above. However, under a condition weaker than the well-known Marshall-Lerner condition, the wealth effect outweighs the terms of trade effect.[2]

The mechanism we emphasize does not simply lead to inefficiencies at the margin. Indeed, it can be powerful enough to reverse the direction of capital flows. When the Marshall-Lerner condition holds, a free capital mobility regime features capital inflows into the region with the most acute inflationary pressures, while a managed capital flow regime accounting for the externality prescribes outflows from that region. Our analysis hence suggests that ostensibly wrong price signals in international financial markets can lead to *tospy-turvy* capital flows following cost-push shocks.

Going beyond describing optimal policy in target form and contrasting the behavior of the trade balance under alternative capital account regimes, we illustrate the quantitative relevance of our findings when central banks follow standard Taylor rules. Following an inflationary cost-push shock in the Home country, capital flows from Foreign to Home under free capital mobility. Home experiences a significant rise in inflation and a large fall

[2]This weaker condition states that the trade elasticity is larger than the degree of home bias, which is between zero and one. The Marshall-Lerner condition states that the trade elasticity is larger than one.

in output, while Foreign experiences a modest rise in output. Under a managed capital flow regime that instead features capital flows from Home to Foreign, Home inflation is reduced by 2 percentage points on impact, Foreign experiences a minor rise in inflation of about one percentage point, and the magnitude of the output gaps is reduced by one and a half percentage points in both countries. Free capital mobility also results in an excessive cross-country dispersion in monetary tightening. Under managed capital flows, the initial hike in the policy rate is 2 percentage points lower in Home than under free capital mobility, while in Foreign it is about one and half percentage points higher. Finally, owing to its stabilizing feature, the managed capital flow regime delivers average welfare gains of 0.8% of current consumption or equivalently, 0.03% of permanent consumption.

Related Literature. The externality we point to belongs to the class of aggregate demand externalities elegantly characterized in general terms by Farhi and Werning (2016).[3] It also relates to pecuniary externalities, whose welfare consequences in incomplete markets environment were first discussed in Stiglitz (1982), Greenwald and Stiglitz (1986), Geanakoplos and Polemarchakis (1986).[4,5] As in the aggregate demand externality literature, the externality we outline occurs in a demand-constrained setting. Yet it is primarily mediated through the price system, like pecuniary externalities. More importantly, its practical implications subtly differ from those of aggregate demand externalities arising from explicit constraints on monetary policy.

When constraints on monetary policy prevent goods-specific labor wedges from being closed, the general policy prescription arising from aggregate demand externalities is to incentivize agents to shift wealth toward states of nature in which their spending on goods whose provision is most depressed is relatively high (Farhi and Werning 2016). Boosting spending on these goods is something monetary policy would like to achieve but is unable to, owing to constraints such as a fixed exchange rate (Farhi and Werning 2012, 2017, Schmitt-Grohe and Uribe 2016) or a zero lower bound (Farhi and Werning 2016, Korinek and Simsek 2016). In contrast, in our setup with unconstrained monetary policy subject to an output-inflation trade-off, it is usually optimal to tilt spending *away* from the

[3] See also Schmitt-Grohe and Uribe (2016), Farhi and Werning (2017), Acharya and Bengui (2018), Fornaro and Romei (2019) and Bianchi and Coulibaly (2021).

[4] For recent articulations of these ideas, see Caballero and Krishnamurthy (2001), Gromb and Vayanos (2002), Korinek (2007, 2018), Lorenzoni (2008), Jeanne and Korinek (2010, 2019, 2020), Bianchi (2011), Benigno, Chen, Otrok, Rebucci and Young (2013), Bengui (2014), Davila and Korinek (2017), and Bianchi and Mendoza (2018), among others.

[5] See Fornaro (2015), Ottonello (2021), Coulibaly (2023) and Basu, Boz, Gopinath, Roch and Unsal (2020) for examples of studies combining pecuniary externalities arising from financial frictions with aggregate demand externalities.

country with the most depressed output. This is because rather than being designed to address demand shortages, policy interventions are motivated by a desire to relieve supply pressures. Our paper hence complements the existing literature by providing an insight specific to circumstances in which cost-push shocks may be creating policy trade-offs, as is the case at the current juncture.

The paper also relates to a large body of theoretical research suggesting that capital flows might be excessively volatile due to imperfections in financial, goods or labor markets (Bianchi 2011, Farhi and Werning 2014, Schmitt-Grohe and Uribe 2016). A common thread between this work and ours is the idea that externalities might lead to inefficient capital flows. An important distinction, however, is that the supply side channel we emphasize does not necessarily imply excessive capital flow volatility. Indeed, under a unitary elasticities parametrization often adopted in the literature for its analytical tractability (Cole and Obstfeld 1991), capital flows are positive under a managed regime in our model, even though they would be zero under free capital mobility. This suggests that market failures can occasionally lead to too little rather than too much capital flows. This insight is, to the best of our knowledge, new to the literature.

Finally, our paper relates to two further pieces of recent work. First, Cho, Kim and Kim (2023) show numerically that welfare under autarky might be higher than welfare under complete markets in a New Keynesian model with markup shocks. In this paper, we formally identify the underlying externality and solve for the constrained efficient capital flow regime that accounts for it. Second, Fornaro and Romei (2022) argue that national monetary policies may be excessively tight in response to shocks that reallocate demand toward tradable goods. Like us, they study the international ramifications of the ongoing recovery for policy. However, they focus on monetary policy spillovers, while we emphasize an externality associated with private capital flows.

The remainder of the paper is organized as follows. Section 2 describes the model environment, Section 3 presents the theoretical analysis, and Section 4 conducts a quantitative analysis. Section 5 discusses model extensions and Section 6 concludes.

2 Model

The world economy is composed of two countries of equal size, Home and Foreign. In each country, households consume goods and supply labor, while firms hire labor to produce output. Variables pertaining to Foreign are denoted by asterisks.

2.1 Households

The Home country is populated by a continuum of households indexed by $h \in [0, 1]$. An household h has an infinite life horizon and preferences represented by

$$\int_0^\infty e^{-\rho t} \left[\log C_t(h) - \frac{N_t(h)^{1+\phi}}{1+\phi} \right] dt, \tag{1}$$

where ρ is the subjective discount rate, $C_t(h)$ is consumption, $N_t(h)$ is labor supply, and ϕ is the inverse Frisch elasticity of labor supply.[6] The consumption good $C_t(h)$ is a composite of home and foreign goods, with a constant elasticity of substitution (CES):

$$C_t(h) \equiv \left[\left(\frac{1}{2}\right)^{\frac{1}{\eta}} \left(C_{H,t}(h)\right)^{\frac{\eta-1}{\eta}} + \left(\frac{1}{2}\right)^{\frac{1}{\eta}} \left(C_{F,t}(h)\right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}, \tag{2}$$

where $C_{H,t}(h)$ and $C_{F,t}(h)$ are themselves CES aggregates over a continuum of goods produced respectively in Home and Foreign, with elasticity of substitution between varieties produced within a country equal to $\varepsilon > 1$. The elasticity of substitution between domestic and foreign goods is $\eta > 0$. The equal weighting of domestic and foreign goods in (2) indicates an absence of home bias in consumption. We study the consequences of such home bias in Section 3.4.

Households can trade two types of nominal bonds: a domestic bond traded only domestically, and an international bond traded internationally. Domestic bonds are denominated in domestic currency, while the international bond is (arbitrarily) denominated in Home's currency (without loss of generality given perfect foresight). The household's budget constraint is given by

$$\dot{D}_t(h) + \dot{B}_t(h) = i_t D_t(h) + i_{B,t} B_t(h) + W_t(h) N_t(h) + \Pi_t - P_{H,t} C_{H,t}(h) - P_{F,t} C_{F,t}(h), \tag{3}$$

where $D_t(h)$ is domestic bond holdings, $B_t(h)$ is international bond holdings, i_t denotes the return on Home bonds, $i_{B,t}$ denotes the return on the international bond for Home households, $P_{H,t}$ is the price of the good produced domestically, $P_{F,t}$ is the price of imported good and $W_t(h)$ is household h's nominal wage.

Each household h is a monopolistically competitive supplier of its labor service and faces a CES demand function of $N_t(h) = \left(W_t(h)/W_t\right)^{-\varepsilon_t^w} N_t$, where ε_t^w is the elasticity of

[6] Our exposition focuses on Home's representative household, but the environment faced by Foreign's representative household is symmetric.

substitution among labor varieties, which is the same across households but may vary over time, W_t is the relevant (domestic) aggregate wage index, and N_t is aggregate employment. Wages are fully flexible and can be set at every instant. The household's optimal wage setting results in a wage markup over the marginal disutility of working per unit of consumption,

$$\frac{W_t(h)}{P_t} = \mu_t^w C_t(h) N_t(h)^{\phi}, \tag{4}$$

where $\mu_t^w \equiv \varepsilon_t^w / (\varepsilon_t^w - 1)$ is the gross wage markup. Variations in wage markups are the source of cost-push shocks that will give rise to a trade-off between stabilizing economic activity and inflation (see, e.g., Clarida et al., 2002 and Engel, 2011).

In addition to their labor supply, households choose consumption and bond holdings to maximize utility. Because all Home households are identical, we can drop the h index, and the Euler conditions for domestic bond holdings and international bond holdings are given by

$$\dot{C}_t = (i_t - \pi_t - \rho)\, C_t, \tag{5}$$

$$\dot{C}_t = (i_{B,t} - \pi_t - \rho)\, C_t, \tag{6}$$

where $\pi_t \equiv \dot{P}_t / P_t$ is the Home consumer price index (CPI) inflation rate. Home's CPI follows from standard expenditure minimization:

$$P_t = \left[\frac{1}{2} \left(P_{H,t}\right)^{1-\eta} + \frac{1}{2} \left(P_{F,t}\right)^{1-\eta} \right]^{1/(1-\eta)}, \tag{7}$$

where $P_{H,t}$ is Home's producer price index and $P_{F,t}$ is Home's price index of imported goods.

Foreign households face an environment symmetric to that of Home households. Variables pertaining to Foreign households are indexed by asterisks. To accommodate possible deviations from perfect capital mobility, we allow for (tax-induced) return differentials across countries on the international bond. Specifically, we assume that the return on the international bond has two components: a component that is common across countries $\underline{i}_t$ and a country-specific component (τ_t for Home and τ_t^* for Foreign) that captures taxes on international financial transactions financed by lump-sum taxes raised locally. We then define τ_t^D as being related to the wedge between the return on the international bond faced by Home and Foreign households via

$$\tau_t^D \equiv \frac{i_{B,t} - i_{B,t}^*}{2} = \frac{\tau_t - \tau_t^*}{2}. \tag{8}$$

Under free capital mobility, we will have $\tau_t^D = 0$ for all $t \geq 0$. But we will also consider situations in which $\tau_t^D \neq 0$ as a result of different taxes across countries ($\tau_t \neq \tau_t^*$).

Finally, we assume that countries have symmetric initial net foreign asset positions (i.e., equal to 0). The Euler equations of Foreign households are symmetric to (5)-(6) and given by

$$\dot{C}_t^* = (i_t^* - \pi_t^* - \rho)\, C_t^*, \tag{9}$$
$$\dot{C}_t^* = \left(i_{B,t}^* - \dot{e}_t - \pi_t^* - \rho\right) C_t^*, \tag{10}$$

where $\dot{e}_t$ denotes the depreciation rate of the nominal exchange rate E_t, defined as the Home currency price of the Foreign currency, and $\pi_t^* \equiv \dot{P}_t^* / P_t^*$ is the Foreign CPI inflation rate. Combining (5)-(10) with (8) leads to a distorted interest parity condition:

$$i_t = i_t^* + \dot{e}_t + 2\tau_t^D.$$

Under free capital mobility (i.e., when $\tau_t^D = 0$), standard interest parity holds. In contrast, when $\tau_t^D > 0$, the Home household faces a higher borrowing cost, while when $\tau_t^D < 0$, it is the Foreign household that faces a higher borrowing cost.

2.2 Firms

Final domestically produced goods are CES aggregates over a continuum of goods produced by firms in the domestic country, with elasticity of substitution between varieties produced within a country equal to $\varepsilon > 1$. While our description of the firm's problem focuses on Home firms, Foreign firms face a symmetric environment.

Technology. Home Firms, indexed by $l \in [0, 1]$, produce differentiated goods with a linear technology $Y_t(l) = N_t(l)$, where productivity is normalized to one for convenience and $N_t(l) \equiv \left(\int_0^1 N_t(h,l)^{(\varepsilon_t^w - 1)/\varepsilon_t^w} dh\right)^{\varepsilon_t^w / (\varepsilon_t^w - 1)}$ is a composite of domestic individual household labor. Variables are defined analogously in Foreign, where the production function is given by $Y_t^*(l) = N_t^*(l)$.

Price setting. Firms operate under monopolistic competition and engage in infrequent price setting à la Calvo (1983). Prices are set in producers' currency, and the law of one price holds for each good. Each firm has an opportunity to reset its price when it receives a price-change signal, which itself follows a Poisson process with intensity $\rho_\delta \geq 0$. As a result, a fraction δ of firms receives a price-change signal per unit of time. These firms reset their price, $P^r_{H,t}(l)$, to maximize the expected discounted profits

$$\int_t^\infty \rho_\delta e^{-\rho_\delta(k-t)} \frac{\lambda_k}{\lambda_t} \left[P^r_{H,t}(l) - P_{H,k} MC_k\right] Y_{k|t} dk,$$

subject to the demand for their own good, $Y_{k|t}(l) = \left(P^r_{H,t}(l)/P_{H,k}\right)^{-\varepsilon} Y_k$, taking as given the paths of domestic output Y, of the domestic PPI P_H, and of the domestic real marginal cost MC. The real marginal cost is defined as $MC_k \equiv (1-\tau^N)W_k/P_{H,k}$, where τ^N is a time-invariant labor subsidy.[7] The Home household's time k marginal utility of consumption is denoted by λ_k, so that the ratio λ_k/λ_t is the firm's relevant discount factor between time t and time $k \geq t$. The pricing environment is symmetric in Foreign. In the limiting case of flexible prices (i.e. $\rho_\delta \to \infty$), firms are able to reset their prices continuously and optimal price setting reduces to a markup over marginal cost $P_{H,t} = \mu^p(1-\tau^N)W_t$, where $\mu^p = \varepsilon/(\varepsilon-1)$.

2.3 Equilibrium

Given paths for interest rates and taxes on international financial transactions, an equilibrium is a constellation in which all households and firms optimize and markets clear.

International "risk" sharing. Combining the Home and Foreign households' Euler equations for the international bond yields an intertemporal sharing condition relating the two countries' marginal utility of consumption:

$$C_t = \Theta_t C_t^*, \tag{11}$$

where $\Theta_t \equiv \Theta_0 \exp\left[\int_0^t 2\tau_s^D ds\right]$ captures relative consumption, with Θ_0 being a constant related to initial relative wealth positions. Condition (11) indicates that under free capital mobility (i.e., in the absence of taxes on international financial transactions), Home and Foreign consumption are related to each other through a time-invariant coefficient of

[7] As is standard in the literature, we assume that this subsidy is set at the level that would be optimal in a steady state with flexible prices.

proportionality Θ_0. Taxes on international financial transactions alter capital flows between the two countries and make relative consumption Θ_t, sometimes referred to as *demand imbalance* in the literature, a time-varying object.

Output determination. Market clearing for a good l produced in Home requires that the supply of the good equals the sum of the demand emanating from Home and Foreign:

$$Y_t(l) = \underbrace{\frac{1}{2}\left(\frac{P_{H,t}(l)}{P_{H,t}}\right)^{-\varepsilon}\left(\frac{P_{H,t}}{P_t}\right)^{-\eta} C_t}_{C_{H,t}(l)\text{:Home demand for Home variety } l} + \underbrace{\frac{1}{2}\left(\frac{P_{H,t}(l)}{P_{H,t}}\right)^{-\varepsilon}\left(\frac{P_{H,t}}{P_t^*}\right)^{-\eta} C_t^*}_{C_{H,t}^*(l)\text{:Foreign demand for Home variety } l} .$$

At the level of Home's aggregate output, defined as $Y_t \equiv \left[\int_0^1 Y_t(l)^{(\varepsilon-1)/\varepsilon} dl\right]^{\varepsilon/(\varepsilon-1)}$, market clearing hence requires

$$Y_t = \left(\frac{P_{H,t}}{P_t}\right)^{-\eta} \frac{1}{2}\left(C_t + C_t^*\right). \tag{12}$$

Similarly, market clearing for foreign goods requires

$$Y_t^* = \left(\frac{P_{F,t}}{P_t}\right)^{-\eta} \frac{1}{2}\left(C_t + C_t^*\right). \tag{13}$$

Aggregate Home employment, defined as $N_t \equiv \int_0^1 N_t(l)dl$, relates to aggregate Home output according to $N_t = Y_t Z_t$, where $Z_t \equiv \int_0^1 (P_t^T(l)/P_t^T)^{-\varepsilon} dl$. An analogous relation holds between Foreign's employment and output.

2.4 Linearized Model

Following most of the literature, we focus on a first-order approximation of the equilibrium dynamics of the model around the non-distorted symmetric steady state. To ensure that the model's steady state is non-distorted, we assume that the time-invariant labor subsidy is set to $\tau^N = (\mu^p \mu^w - 1)/(\mu^p \mu^w)$ in both countries, so as to offset distortions from monopolistic competition.[8] Since the only shocks we consider are markup shocks, the efficient allocation is time-invariant and coincides with the non-distorted steady-state allocation. Therefore, log deviations of variables from their steady-state value can also be interpreted as gaps from the efficient allocation. Denoting such log deviations from steady state by hats on lower case letters, e.g., $\widehat{y}_t = y_t - \bar{y}$, and noting that our normalization implies that output,

[8] The steady-state wage markup is taken to be the same across the two countries: $\mu^w = \mu^{w*}$.

employment, consumption, and the terms of trade are all equal to one in steady state (see Appendix B.1), we have $\widehat{y}_t = y_t$. In what follows, we will therefore simply use lowercase letters to denote gaps from the efficient allocation.

Demand side. Approximations of the goods market-clearing conditions (12)-(13) yield

$$y_t = \frac{1}{2}\left(c_t + c_t^* + \eta s_t\right), \tag{14a}$$

$$y_t^* = \frac{1}{2}\left(c_t^* + c_t - \eta s_t\right), \tag{14b}$$

which indicate that output in each country rises with demand in both countries, and rises when the country's terms of trade deteriorate. A deterioration of the Home terms of trade, that is a fall in the price of Home goods relative to Foreign goods (s_t increases), leads households in both countries to shift their demand towards Home goods and away from Foreign goods, raising Home output at the expense of Foreign output. The intertemporal sharing condition (11) can be written in log deviations as

$$c_t - c_t^* = \theta_t. \tag{15}$$

We define Home's net exports (or its trade balance) in units of the Home good as $NX_t \equiv Y_t - P_t C_t / P_{H,t}$. Linearizing this relationship around the non-distorted steady state, and using market clearing conditions (14a)-(14b) and the intertemporal sharing condition (15), we can express the trade balance as

$$nx_t = \frac{1}{2}\left[(\eta - 1)s_t - \theta_t\right], \tag{16}$$

where nx_t denotes Home's trade balance normalized by Home's steady state level of output, $nx_t \equiv NX_t / \bar{Y}$. Thus, all else equal, a demand imbalance in favor of a particular country deteriorates its trade balance. Equation (16) also shows that the effect of a terms of trade depreciation on the trade balance depends on whether the elasticity of substitution between domestic and foreign goods η is larger or smaller than one. We make the following assumption on this parameter.

Assumption 1. $\eta > 1$.

Assumption 1 ensures that a deterioration of terms of trade improves the trade balance. This assumption, in favor of which there is compelling empirical evidence (see, e.g., Head and Ries 2001 and Imbs and Mejean 2015), is assumed to hold for the rest of the paper.[9,10] In our baseline model, this assumption is equivalent to the Marshall-Lerner condition.[11]

Supply side. Turning to the supply side, the dynamics of the inflation rate of producer prices in both countries, derived from a first-order approximation of firms' optimality conditions, are described by

$$\rho \pi_{H,t} = \dot{\pi}_{H,t} + \kappa mc_t, \tag{18a}$$

$$\rho \pi^*_{F,t} = \dot{\pi}^*_{F,t} + \kappa mc^*_t, \tag{18b}$$

where $\kappa \equiv \rho_\delta(\rho + \rho_\delta)$. mc_t and mc^*_t denote the log deviations of real marginal costs in Home and Foreign from their steady-state value. Using the linearized aggregate production function, $y_t = n_t$, and labor supply equation (4) in Home as well as their counterparts for Foreign, the marginal costs can be expressed as

$$mc_t = (1+\phi)y_t - \frac{\eta - 1}{2}s_t + \frac{1}{2}\theta_t + u_t, \tag{19a}$$

$$mc^*_t = (1+\phi)y^*_t + \frac{\eta - 1}{2}s_t - \frac{1}{2}\theta_t + u^*_t, \tag{19b}$$

where the cost-push shocks $u_t \equiv \mu^w_t - \bar{\mu}^w$ and $u^*_t \equiv \mu^{w*}_t - \bar{\mu}^w$ are deviations of wage markups from their steady-state value. Real marginal costs increase when domestic output increases or when there is an improvement in the country's terms of trade, under Assumption 1. Most importantly, real marginal costs are affected by the demand imbalance. Holding output and the terms of trade constant, a demand imbalance in favor of Home raises consumption by Home households and reduces consumption by Foreign households. As a result, Home households reduce their labor supply, raising Home's equilibrium real wage. At the same time, Foreign households increase their labor supply, reducing Foreign's

[9] Head and Ries (2001) document that the elasticity of substitution between U.S. and Canadian manufacturing goods η is between 7.9 and 11.4. Relying on the Tariff System of the United States (TSUSA), Broda and Weinstein (2006) find an average elasticity of subsititution of 7 at the three-digit (TSUSA) 17 at the seven-digit (TSUSA). Imbs and Mejean (2015) find that the *true* elasticity of substitution is more than twice larger than implied by aggregate data.

[10] In Section 3.4, we briefly discuss how the violation of this condition affects our results.

[11] The trade elasticity χ is defined as the sum of the absolute values of the price elasticity of imports and the price elasticity of exports, holding aggregate consumption constant. Formally,

$$\chi \equiv \left.\frac{-\partial \log C_{F,t}}{\partial \log P_{F,t}/P_{H,t}}\right|_{C_t} + \left.\frac{-\partial \log C^*_{H,t}}{\partial P^*_{H,t}/P^*_{F,t}}\right|_{C^*_t}. \tag{17}$$

In our baseline model $\chi = \eta$. In the model extension with home bias studied in Section 3.4, $\chi = 2(1-\alpha)\eta$ where $\alpha \in [0, \frac{1}{2}]$ is the relative weight on domestic goods in the consumer's basket.

equilibrium real wage. Accordingly, real marginal costs rise in Home and fall in Foreign.

Note that while in this baseline model, the effect of demand imbalances on marginal costs is only mediated through the price of leisure (i.e., via a wealth effect on labor supply), a similar logic applies more generally via the price of other non-tradable goods. We extend the model to include non-tradable goods and discuss this insight further in Section 5.1.

World and Difference formulation. Before we turn to a normative analysis of capital flows, we find it useful to follow Engel (2011) by rewriting the model in "world" and "difference" format. To this end, we respectively define the world output and the cross-country output differential as $y_t^W = \frac{1}{2}(y_t + y_t^*)$ and $y_t^D = \frac{1}{2}(y_t - y_t^*)$. Similarly, we define the world PPI inflation and cross-country PPI inflation differential as $\pi_t^W = \frac{1}{2}(\pi_{H,t}^T + \pi_{F,t}^{T*})$ and $\pi_t^D = \frac{1}{2}(\pi_{H,t}^T - \pi_{F,t}^{T*})$. Combining the expressions for inflation dynamics in Home and Foreign, (18a)-(18b), and noting by the market-clearing conditions (14a) and (14b) that the equilibrium terms of trade satisfies

$$\eta s_t = 2y_t^D, \tag{20}$$

we arrive at the following New Keynesian Phillips curves in world and difference formats:

$$\dot{\pi}_t^W = \rho\pi_t^W - \kappa(1+\phi)y_t^W - \kappa u_t^W, \tag{21}$$

$$\dot{\pi}_t^D = \rho\pi_t^D - \kappa\left[\left(\frac{1}{\eta} + \phi\right)y_t^D + \frac{1}{2}\theta_t\right] - \kappa u_t^D. \tag{22}$$

As we will see below, this formulation allows us to restrict the analysis of the effects of capital flows to a narrow subset of macroeconomic variables.

3 Cost-Push Shocks and Topsy-Turvy Capital Flows

We now argue that capital naturally flows toward the country with the most acute inflationary pressures, while efficiency considerations would require capital to flow away from that country.

3.1 Welfare Criterion and Optimal Policy Problems

In order to make clear that inefficiencies associated with capital flows are a consequence of the trade-off faced by monetary policy rather than of monetary policy's possible suboptimality, we choose to assume that monetary policy is set optimally under coordination and commitment.[12] Using a second-order approximation of the households' utility function, we obtain the following loss function:[13]

$$\frac{1}{2}\int_0^\infty e^{-\rho t}\left\{(1+\phi)(y_t^W)^2+\frac{\varepsilon}{\kappa}(\pi_t^W)^2+\left(\frac{1}{\eta}+\phi\right)(y_t^D)^2+\frac{\varepsilon}{\kappa}(\pi_t^D)^2+\frac{1}{4}(\theta_t)^2\right\}dt \tag{23}$$

The period-loss function in (23) represents the difference between the utility under the efficient allocations (i.e., the maximum utility achievable) and the utility under market-determined levels of consumption and leisure. The first four terms featuring squared output gaps and inflation reflect sticky price distortions familiar from the closed economy literature. The last term reflects distortions specific to the open economy context and captures welfare losses stemming from an inefficient cross-country distribution of consumption caused by the demand imbalance θ_t.

We will contrast two policy regimes. In the first one, labelled the *free capital mobility* regime, we will assume optimal monetary policy with the demand imbalance exogenously set to $\theta_t = 0$ at all times. In this regime, the optimal (monetary) policy consists in choosing a path for $\{y_t^W, \pi_t^W\}$ and $\{y_t^D, \pi_t^D\}$ to minimize (23) subject to (21) and (22) with $\theta_t = 0$ for all $t \geq 0$. In the second one, labelled the *managed capital flows* regime, we will assume jointly optimal monetary and capital flow management policy. In that case, the optimal policy consists in choosing a path for $\{y_t^W, \pi_t^W\}$ and $\{y_t^D, \pi_t^D, \theta_t\}$ to minimize (23) subject to (21) and (22).

Conveniently, the characterization of monetary policy is the same in both regimes. In this baseline two-country model, optimal monetary policy is well known to be characterized in target form by:

$$\dot{y}_t^W + \varepsilon\pi_t^W = 0, \tag{24}$$

$$\dot{y}_t^D + \varepsilon\pi_t^D = 0. \tag{25}$$

This description of optimal cooperative monetary policy is analogous to that commonly encountered in complete markets open economy models with producer currency pricing (PCP). Targeting rules (24) and (25) indicate that, in both "world" and "difference" terms, optimal monetary policy strikes a balance between losses due to inflation and losses arising from deviations of output from its efficient level. The two targeting rules can be combined

[12] In Section 4, we show that our main insight also applies when monetary policy follows a Taylor rule.

[13] To obtain this loss function, we take a second-order approximation of a symmetrically weighted average of households' utilities in Home and Foreign. (See Appendix B.1) for details.

to deliver targeting rules for each country that depend only on the domestic output gap and PPI inflation – that is, $\dot{y}_t + \varepsilon\pi_{H,t} = 0$ and $\dot{y}^*_t + \varepsilon\pi^*_{F,t} = 0$ – a feature often referred to as *inward looking* monetary policy in the open-economy literature. It is worth stressing that this characterization does not rely on any particular assumption regarding the path of θ_t (other than it being exogenous, or chosen by policy). In particular, it holds both under free capital mobility and under managed capital flows.

Remark (Inward versus outward looking monetary policy)**.** When the path of the demand imbalance θ_t deviates from zero, asset markets are no longer complete and the inward lookingness of monetary policy in (24)-(25) contrasts with the *outward looking* rules derived in studies assuming either other forms of market incompleteness (e.g., Corsetti, Dedola and Leduc 2010, 2018), or pricing to market (e.g., Engel 2011).[14] In these studies, demand imbalances are endogenous variables whose fluctuations depend on the interaction of shocks and other variables influenced by monetary policy, such as the cross-country difference in the output gap. As a result, monetary policy can influence distortions caused by market incompleteness or pricing to market, and generally chooses to do so, which results in outward looking rules. In our case, in contrast, the demand imbalance is either exogenous or directly controlled by policy, so there is no scope for monetary policy to manage the market incompleteness distortion, hence the inward looking rules.

A notable implication of the targeting rules (24)-(24) is the separation of "world" variables and "difference" variables, which mirrors that in the Phillips curves (21)-(22). Taken together, these separations mean that the "world" block of the model can be solved for independently from the behavior of the "difference" block, and most notably from that of the demand imbalance. This result is formalized in the Lemma below.

Lemma 1 (Irrelevance of capital flow regime for world variables)**.** *The paths of the world output gap and inflation $\{y^W_t, \pi^W_t\}$ are independent of the capital flow regime (i.e., the path of θ_t).*

Proof. In Appendix B.3 □

Lemma 1 implies that the capital flow regime matters only for the determination of cross-country "difference" variables.[15] Therefore, both from a positive and from a normative standpoint, an analysis of the role played by capital flows in the adjustment to shocks can legitimately center on the dynamics of cross-country difference variables y^D_t and π^D_t and the demand imbalance θ_t.

[14] The literature refers to outward looking monetary policy when targeting rules in open economy models also feature external variables, such as international relative prices or a demand imbalance term.

[15] See Groll and Monacelli (2020) for a similar result regarding the irrelevance of the exchange rate regime for the determination of "world" variables.

3.2 Free capital mobility

Under free capital mobility, the solution to the "difference" block of the model is obtained from the dynamic system consisting of the targeting rule (25) and the Phillips curve in difference (22) with the demand imbalance θ_t set to 0.

Since our primary interest is to understand how capital flows shape the macroeconomic adjustment to cost-push shocks, it is useful to characterize their behavior. Using the equilibrium terms of trade expression (20), the trade balance in (16) can be expressed as

$$nx_t = \frac{\eta - 1}{\eta} y_t^D. \tag{26}$$

The intuition for this relationship comes from standard neoclassical motives for intertemporal trade (Cole and Obstfeld 1991): a temporarily lower income creates an incentive to borrow, but the appreciation of the terms of trade accompanying this lower income generates an incentive to save. When Assumption 1 (Marshall-Lerner condition) holds, terms of trade movements are modest and the first effect dominates. As a result, the country with the lowest output runs a trade deficit and the other country runs a trade surplus. Since a more depressed output is associated with most acute inflationary pressures, capital flows from the country with the least acute inflationary pressures to the country with the most acute ones.[16]

3.3 Managed Capital Flows

To question the (constrained) efficiency of the free capital mobility regime just described, we ask under what circumstances θ_t is set to a value different from zero when it can be freely chosen by policy.[17] Our first proposition provides an answer to this question.

Proposition 1 (Targeting rule)**.** *The managed capital flow regime is characterized by the rule*

$$\theta_t = 2y_t^D. \tag{27}$$

Proof. In Appendix B.4 □

This targeting rule embodies our paper's main insight. To the extent that shocks generating an output-inflation trade-off generally result in a non-zero cross-country difference in

[16] A similar idea applies when monetary policy follows a Taylor rule, as the country with the strongest inflationary pressure tends to tighten monetary policy more strongly.

[17] See Appendix B.2 for a formal statement of the optimal policy problem.

output gaps, the rule indicates that optimal capital flow management should purposefully generate a demand imbalance in favor of the *least* depressed country, meaning that it should reallocate spending away from the most depressed country.[18] This outcome may appear counter-intuitive from an output stabilization perspective, but it makes perfect sense once the supply-side ramifications of capital flows are carefully considered.

A macroeconomic externality view. In the country with the most acute inflationary pressure, households borrow for consumption smoothing purposes as monetary policy attempts to curb inflation by depressing domestic output. A planner recognizes that capital inflows reduce local labor supply through a wealth effect. For a given level of activity, this reduced labor supply raises the real wage and therefore firms' marginal costs. But the level of firms' marginal costs is the main lever available to monetary policy to fight off cost-push shocks by stimulating or taming demand. In an economy subject to an inflationary cost-push shock, monetary policy reacts by weakening demand so as to lower firms' marginal costs and thereby reduce inflationary pressures. In such circumstances, capital inflows complicate the central bank's job by exerting unwelcome upward pressure on firms' marginal costs. Consequently, optimal capital flow management consists in distorting spending away from the country with the most acute inflationary problem, which turns out to be the country with the most depressed output. This could mean either reducing capital inflows into that country or raising capital outflows out of it.

Formally, consider a marginal increase in borrowing by Home from Foreign at date t, starting from the optimal monetary policy outcome under free capital mobility. This amounts to a perturbation $d\theta_t > 0$ at t (i.e., $\theta_t = \epsilon$ for some small $\epsilon > 0$, leaving $\theta_k = 0$ for all other $k \neq t$).[19] Using the envelope theorem, the change in the loss function $\mathcal{L}_t$ induced by this perturbation is given by

$$d\mathcal{L}_t = -\frac{1}{2}\kappa\varphi_t^D \, d\theta_t, \tag{28}$$

[18] An immediate implication of this result is that the free capital mobility regime is not (constrained) efficient when monetary policy faces an output-inflation trade-off. This inefficiency result may in itself not come as a surprise in light of the existing literature on aggregate demand externalities in economies with nominal rigidities (e.g., Farhi and Werning 2016). However, the supply-side channel responsible for it has distinct policy implications. We elaborate further on this in Section 3.5.

[19] For the sake of the argument, we assume that this increase in borrowing is compensated by a change in the date 0 implicit transfer. More generally, what matters for the externality to matter is that the balancing transaction occurs at a time when the government's multiplier on the Phillips curve (22) has a value different from the one at time t.

where φ_t^D is the co-state variable associated with the Phillips curves in differences (22).[20] Equation (28) shows that the welfare effect of a marginal increase in borrowing by Home is the product of three terms: the direct effect of this increase on the cross-country difference in marginal costs (1/2), the slope of the Phillips curve κ and the co-state variable φ_t^D, which measures the shadow cost of the Phillips curve in differences (22). Therefore, if the co-state variable $\varphi_t^D$is different from zero, the perturbation has a first-order effect on welfare. Heuristically, this co-state variable is different from zero when the stringency of the output-inflation trade-off differs across the two countries. And under the optimal monetary policy, this co-state variable happens to be equal to the cross-country difference in output gaps: $\varphi_t^D = y_t^D$. If activity is more depressed in Foreign and y_t^D is accordingly positive, the increase in borrowing by Home relaxes the constraint faced by monetary policy and therefore raises welfare. If, on the other hand, activity is more depressed in Home and y_t^D is negative, this increase tightens the constraint further and lowers welfare.

These effects of changes in external borrowing work in general equilibrium as prices adjust in goods and labor markets. As a result, they are ignored by atomistic agents and can be viewed as a macroeconomic externality associated with capital flows.

Topsy-Turvy capital flows. Using the equilibrium terms of trade expression (20) and the targeting rule (27), the trade balance in (16) can be expressed as

$$nx_t = -\frac{1}{\eta}\, y_t^D \tag{29}$$

under managed capital flows. Comparing (29) with its free capital mobility counterpart (26) points to qualitatively different patterns of trade imbalances under the two capital flow regimes, which we summarize in the following proposition.

Proposition 2 (Topsy-turvy capital flows)**.** *Suppose Assumption 1 holds. Then, the most depressed country runs a trade surplus in the managed capital flows regime $nx_t > 0$, while it runs a trade deficit in the free capital mobility regime $nx_t > 0$.*

Proof. The result follows directly from the expressions (26) and (29). □

Proposition 2 implies that in the presence of cross-country differences in the severity

[20] As detailed in Appendix B.2, this co-state variable satisfies

$$\dot{\varphi}_t^D = -\frac{\varepsilon}{\kappa}\pi_t^D \quad \text{and} \quad \varphi_0^D = 0.$$

of (cost-push shock induced) inflationary pressures, capital flows are *topsy-turvy* under free capital mobility. Hence, rather than simply causing capital flows to be excessive, the macroeconomic externality discussed above is strong enough to flip their direction.

To understand Proposition 2, it is useful to distinguish the various motives for intertemporal trade under each capital flow regime. As explained in Section 3.2, in the free capital mobility regime, these motives are purely neoclassical and ultimately reflect the benefits of consumption smoothing for private households. In the managed capital flows regime, an additional Keynesian macroeconomic stabilization motive is also present. This motive calls for relaxing the output-inflation trade-off in the country where it is the most stringent.[21] When the Marshall-Lerner condition is satisfied ($\eta > 1$), the neoclassical motives always call for a trade deficit for the country with the most depressed output. However, under managed capital flows, the Keynesian effect more than offsets these neoclassical motives and yields a trade surplus for that country.[22]

Excessive capital flow volatility? A large part of the normative literature on capital flows suggests that these might often be excessive, or excessively volatile (e.g., Bianchi 2011, Schmitt-Grohe and Uribe 2016). The macroeconomic externality we point to does not generally lead to the same conclusion. In the limiting case of a unit intratemporal elasticity ($\eta \to 1$), trade is balanced at all times under free capital mobility, but capital flows from the most depressed to the least depressed country under managed capital flows. Thus, in our model, external imbalances may be *insufficiently* (rather than *too*) volatile in response to shocks.

3.4 Consumption Home Bias and Purchasing Power Effects

The analysis so far assumed away home bias in consumption. However, the model can easily be extended to all for it. Suppose that agents place a higher weight in utility on goods produced domestically, as in

$$C_t(h) \equiv \left[(1-\alpha)^{\frac{1}{\eta}} \left(C_{H,t}(h) \right)^{\frac{\eta-1}{\eta}} + (\alpha)^{\frac{1}{\eta}} \left(C_{F,t}(h) \right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}, \tag{30}$$

[21] In Appendix C, we characterize the macroeconomic adjustment to a temporary cost-push shock.

[22] In the limit where $\eta \to \infty$, as long as $\alpha > 0$, the trade balance equals the difference in the output gap under free capital mobility, $nx_t = y_t^D$, but converges to zero in under managed capital flows, $nx_t = 0$.

where $\alpha \in [0, \frac{1}{2})$ and $1 - 2\alpha$ captures the degree of home bias. The intertemporal sharing condition in logs (15) now takes the form

$$c_t - c_t^* = (1 - 2\alpha)s_t + \theta_t, \tag{31}$$

where first term on the right-hand side reflects real exchange rate movements associated with differences in the composition of the two countries' consumption baskets. Combining (31) with the goods market-clearing conditions leads to an expression for the equilibrium terms of trade (analogous to (20)) given by

$$\omega s_t = 2y_t^D - (1 - 2\alpha)\theta_t, \tag{32}$$

where $\omega \equiv \eta - (\eta - 1)(1 - 2\alpha)^2$. Thus, in the presence of home bias ($\alpha < 1/2$), for a given difference in output gaps y_t^D, demand imbalances are associated with terms of trade movements. In particular, when there is a demand imbalance in favor of the Home country ($\theta_t > 0$), Home households increase their demand for both goods. But since they have a home bias for Home goods, that would lead to overproduction in the Home country, were it not for relative price adjustments – this is why terms of trade improve $s_t < 0$ for given outputs y_t^D. The optimal policy problem consists in choosing $\mathcal{A} \equiv \{y_t^W, \pi_t^W, y_t^D, \pi_t^D, \theta_t\}$ to solve[23]

$$\min_{\mathcal{A}} \frac{1}{2} \int_0^\infty e^{-\rho t} \left\{ (1+\phi)(y_t^W)^2 + \frac{\varepsilon}{\kappa}(\pi_t^W)^2 + \left(\frac{1}{\omega}+\phi\right)(y_t^D)^2 + \frac{\varepsilon}{\kappa}(\pi_t^D)^2 + \alpha(1-\alpha)\frac{\eta}{\omega}(\theta_t)^2 \right\} dt$$

subject to

$$\dot{\pi}_t^W = \rho\pi_t^W - \kappa(1+\phi)y_t^W - \kappa u_t^W,$$
$$\dot{\pi}_t^D = \rho\pi_t^D - \kappa\left[\left(\frac{1}{\omega}+\phi\right)y_t^D + \frac{\omega-(1-2\alpha)}{2\omega}\theta_t\right] - \kappa u_t^D.$$

The optimal monetary policy is still described by (24) and (25), while the optimally managed capital flows are now characterized by

$$\theta_t = \left[1 - \frac{1-2\alpha}{2(1-\alpha)\eta}\right] 2y_t^D. \tag{33}$$

The second term inside the square brackets of the targeting rule (33) reflects the influence of home bias on the externality underlying the optimal capital flow management policy. To interpret this term, note that the change in the loss function associated to a marginal

[23] See Appendix B.1 for a detailed derivation.

increase in borrowing by Home from Foreign at date t is now given by[24]

$$d\mathcal{L}_t = -\frac{2\alpha(1-\alpha)\eta}{\omega}\Bigg[\underbrace{1}_{\substack{\text{wealth}\\ \text{effect}}} - \underbrace{\frac{1-2\alpha}{2(1-\alpha)\eta}}_{\substack{\text{purchasing}\\ \text{power effect}}}\Bigg]\kappa\varphi_t^D d\theta_t, \tag{34}$$

In addition to a first term already present in (28) and reflecting a wealth effect on labor supply, the loss differential now also depends on a second term reflecting a purchasing power effect. With home bias, the increase in borrowing leads to an appreciation of Home's terms of trade, which lowers marginal costs for Home firms and raises them for Foreign firms. The strength of this effect is proportional to the ratio of the degree of home bias $1-2\alpha$ to the trade elasticity $2(1-\alpha)\eta$. On the one hand, the stronger the home bias, the more changes in relative spending affect the relative price between Home and Foreign goods. On the other hand, the higher the trade elasticity, the smaller are price movements associated with a given change in relative spending. Under Assumption 1, the said ratio is smaller than 1, so the wealth effect dominates the purchasing power effect in (34), and optimal capital flow management reallocates spending away from the most depressed country, as in our baseline model without home bias.

Turning to a characterization of capital flows, the trade balance is now given by $nx_t = \frac{\omega-1}{\omega}y_t^D$ under free capital mobility and by $nx_t = -\frac{2\alpha}{\chi}y_t^D$ under managed capital flows.[25] Thus, under Assumption 1, the most depressed country again runs a trade surplus in the managed capital flows regime, while it runs a trade deficit in the free capital mobility regime. Capital flows are hence topsy-turvy under free capital mobility, as in the absence of home bias.

A general characterization of capital flows as a function of the parameters α and η is provided in Figure 3. The thick horizontal Cole-Obstfeld line depicts unitary elasticity cases where capital flows are zero under free capital mobility. Above this line, Assumption 1 is satisfied and capital flows are topsy-turvy: they go from the least depressed country to the most depressed country under free capital mobility, but the other way around under managed capital flows.

Below the Cole-Obstfeld line, capital flows from the most depressed to the least depressed country under both capital flow regimes. Within this area, the blue concave

[24] The experiment is analogous to that considered with equation (28). We consider a marginal increase in borrowing by Home from Foreign at date t, starting from the optimal monetary policy outcome under free capital mobility.

[25] These expressions compare to (26) and (29) absent home bias.

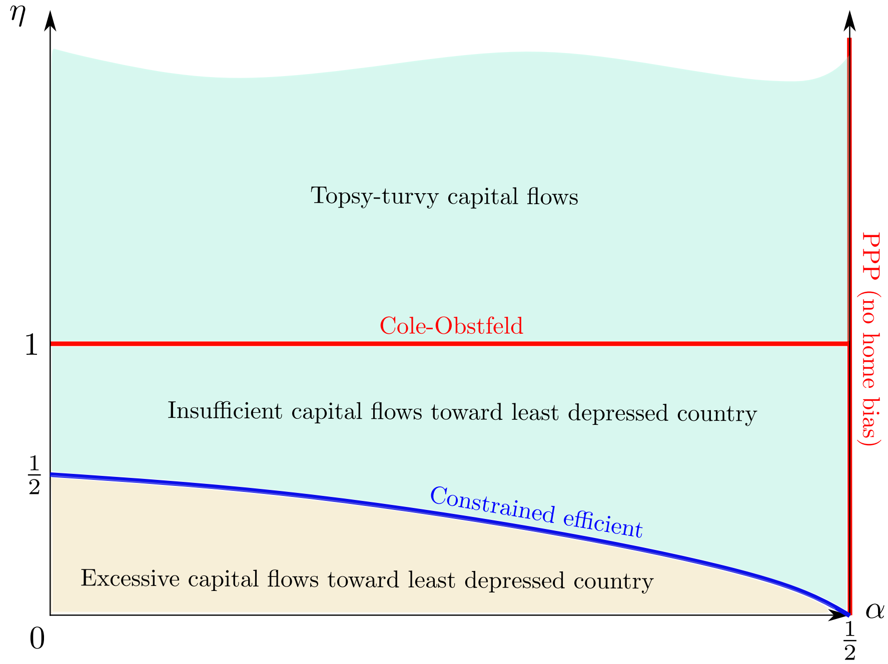

Figure 3: Characterization of capital flows in model with home bias.

curve depicts the knife-edge cases in which the free capital mobility regime is constrained-efficient as a result of the wealth and purchasing power effects in (34) exactly offsetting each other. In the area above the concave curve (but below the Cole-Obstfeld line), the wealth effect dominates the purchasing power effect and capital flows from the most depressed to the least depressed country are inefficiently small under free capital mobility. In contrast, in the area under the concave curve, the purchasing power effect dominates the wealth effect and capital flows from the most depressed to the least depressed country are excessive.

3.5 Supply Pressure vs. Demand Shortage

Although the inefficiency we point to is ultimately caused by a friction of the same type as the one emphasized by Farhi and Werning (2016), the insight coming out of our analysis is complementary to theirs. Broadly speaking, in their applications inefficiencies arise from demand shortages, while in ours they are due to supply pressures. To clarify this point and emphasize its relevance, we resort to a simple scenario in which a demand shortage would lead in our model to a situation similar the one prevailing in Farhi and Werning (2016)'s applications.

To simplify matters, we posit a unit elasticity of substitution between Home and Foreign goods ($\eta = 1$), while allowing for home bias ($\alpha \leq 1/2$). Under the unit elasticity condition, trade is balanced under free capital mobility in response to both the cost-push shocks considered in our analysis above and the productivity shocks considered below.

In the context of our analysis stressing inefficiencies arising from supply pressures caused by cost-push shocks, the optimal capital flow regime is characterized by the targeting rule and trade balance expressions

$$\theta_t = \frac{1}{1-\alpha} y_t^D \qquad \text{and} \qquad nx_t = -\frac{\alpha}{1-\alpha} y_t^D. \tag{35}$$

Hence, in the country featuring the most depressed output, households consume too much under free capital mobility and they accordingly run a trade surplus under the managed capital flow regime.

Now consider the same model but with an inefficiency arising from demand shortages rather than supply pressures. In particular, let us abstract from cost-push shocks and instead assume productivity shocks in a currency union context. For simplicity, further suppose that prices are fully rigid ($\rho_\delta \to 0$). When asymmetric productivity shocks drive differences in natural interest rates across countries, a common monetary policy stance cannot tailor stimulus to each country's need. As a result, there will generally be a demand deficit (negative output gap) in one country and a demand surplus (positive output gap) in the other country. In this case, Appendix B.6 shows that the optimal capital flow management policy solves

$$\min \frac{1}{2} \int_0^\infty e^{-\rho t} \left\{ (1+\phi)(\tilde{y}_t^D)^2 + \alpha(1-\alpha)(\theta_t)^2 \right\}$$

subject to

$$2\dot{\tilde{y}}_t^D = -(r_t^n - r_t^{n*}) + (1-2\alpha)\dot{\theta}_t.$$

where $\tilde{y}$ now denotes the output gap, and r^n, r^{n*} respectively denote the natural rates of interest in Home and Foreign. The managed capital flow regime is then characterized by the targeting rule and trade balance expressions

$$\theta_t = -\frac{1-2\alpha}{4\alpha(1-\alpha)} \tilde{y}_t^D \qquad \text{and} \qquad nx_t = \frac{1-2\alpha}{4(1-\alpha)} \tilde{y}_t^D. \tag{36}$$

Comparing the signs in (36) with those in (35) reveals a fundamental difference in insights between the case of demand shortage à la Farhi and Werning (2016) and our analysis pointing to the implications of supply pressures. The expressions in (36) indicate that the country with the most depressed demand should be running a trade deficit, as long as there is some degree of home bias. The mechanism works through the demand side: if households spend more on domestic goods, a transfer from the overheated country to the depressed country diverts demand away from the oversupplied good and toward the undersupplied good. In contrast, in our framework featuring supply pressures, the direction of the inefficiency is flipped: the expressions in (35) indicate that the country with the most depressed demand should be running a trade surplus, regardless of the degree of home bias. Irrespective of spending patterns, a transfer from the most depressed country to the least depressed country reduces asymmetries in supply pressures through the real wage.

This discussion clarifies the originality of the practical insight of our analysis. While demand-side arguments suggest insufficient capital flows toward depressed economies, we argue that when depressed activity results from a central bank's optimal response to cost-push shocks, capital flows toward depressed economies may be excessive instead of insufficient.

4 Quantitative Analysis

To further illustrate how a free capital mobility regime can exacerbate macroeconomic fluctuations following cost-push shocks, we compare quantitatively the response of macro variables to such shocks under free capital mobility to those under a managed capital flow regime. So as to emphasize that our insight does not critically depend on the assumption of optimal cooperative monetary policy, we assume standard Taylor rules in each country.

4.1 Calibration

Parameter values. The time period is one year. The calibration of the structural parameters of the model largely follows Groll and Monacelli (2020). The home bias parameter, α, is set to 0.25, which implies a degree of home bias of 0.5. The trade elasticity, $\chi = 2(1-\alpha)\eta$, which plays a key role for our results, is conservatively set to 3, near the lower bound of the range of empirical estimates.[26] This value of the trade elasticity implies an elasticity

[26] Simonovska and Waugh (2014) report a range of trade elasticity estimates from 2.7 to 4.4. Eaton and Kortum (2002) estimate the magnitudes of the sectoral trade elasticities for manufacturing to be between 3.6 and 12.8. Direct estimates of the elasticity of substitution η are found to be between 7 and 17 (see, e.g., Head and Ries, 2001 and Broda and Weinstein, 2006).

Table 1: Calibration

Parameter	Description	Value
ρ	Discount factor	0.04
α	Degree of trade openness	0.25
ε	Elasticity of substitution btw. differentiated goods	7.66
η	Elasticity of substitution btw. Home and Foreign goods	2
χ	Trade elasticity	3
ρ_δ	Probability of being able to reset price	$1–0.75^4$
ρ_μ	Persistence of Home markup shock	0.65
$\phi_\pi = \phi_\pi^*$	Taylor rule coefficient on inflation	1.50
$\phi_y = \phi_y^*$	Taylor rule coefficient on output gap	0.25

of substitution between domestic and foreign goods η of 2, for which it is worth noting that Assumption 1 is met. Both the discount rate parameter, ρ, and the parameter for the probability of adjustment of nominal prices, ρ_δ, are set to standard values: $\rho = 0.04$ and $\rho_\delta = 1-0.75^4$. The elasticity of substitution among differentiated intermediate goods ε is set to 7.66, corresponding to a 15% net markup, and the labor supply elasticity parameter ϕ is set to zero. Finally, we hit the Home country with an inflationary cost-push shock of 6% that mean-reverts at a rate of 0.42 per year, yielding an annual autocorrelation of 0.65. The shock is calibrated to generate a peak CPI inflation rate of about 7% in the Home country. The model parameters are given in Table 1.

Monetary policy and capital flow regimes. We depart from our assumption of optimal cooperative monetary policy and assume that monetary policy is instead set according to standard Taylor rules:

$$i_t = \rho + \phi_y y_t + \phi_\pi \pi_t, \tag{37}$$

$$i_t^* = \rho + \phi_y^* y_t^* + \phi_\pi^* \pi_t^*, \tag{38}$$

with coefficients set to the standard values $\phi_\pi = \phi_\pi^* = 1.5$ and $\phi_y = \phi_y^* = 0.25$. We then compare the dynamics of macroeconomic variables and welfare losses under two alternative capital flow regimes: a free capital mobility regime and a managed capital flow regime where countries impose taxes on financial transactions to comply with the targeting rule (33), which given our assumed parameter values, is equivalent to

$$\theta_t = \frac{5}{3}\, y_t^D. \tag{39}$$

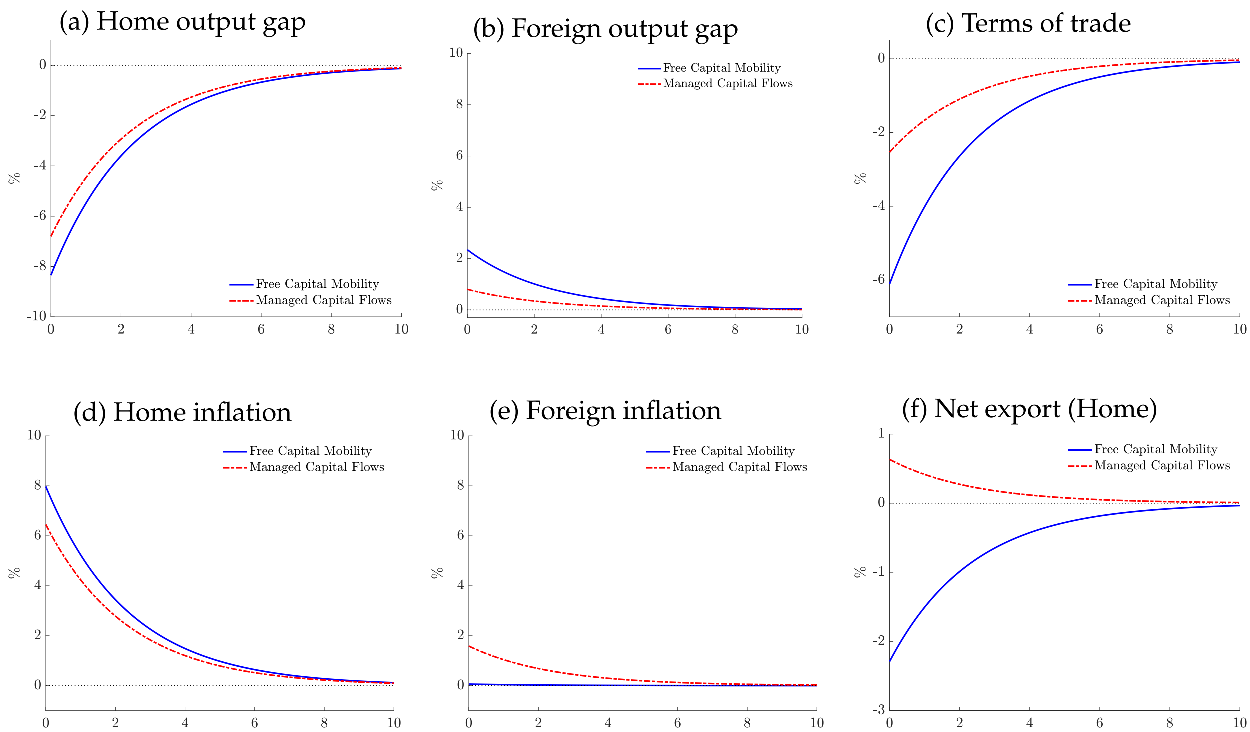

Figure 4: Impulse responses to an inflationary cost-push shock in Home.

Notice that while this targeting rule would be optimal under cooperative monetary policy, it is not necessarily optimal under the Taylor rules (37)-(38). However, as we will see, this rule still yields higher welfare than the free capital mobility regime.

4.2 Capital Flow Regimes and Macroeconomic Adjustments

We examine the role of capital flows in the macroeconomic adjustment to inflationary cost-push shocks by comparing the response of key macro variables in Home and Foreign to such shocks under the two capital flow regimes considered. Figure 4 shows the response under free capital mobility (blue solid lines) versus under managed capital flows (red dashed lines).

Under both regimes, the Home central bank responds to the rise in inflation by tightening monetary policy. This tightening reduces demand and activity, thereby reducing marginal costs and ultimately limiting the rise in inflation in Home. As expected from our theoretical analysis of Section 3, one of the main differences between the two regimes pertains to the severity of the output-inflation trade-off.

Under free capital mobility, in Home, inflation rises to 8% on impact and the contractionary monetary policy generates a negative output gap of nearly 8.4%. The appreciation of the Home currency generates positive demand spillovers in Foreign, where the output gap is positive and reaches close to 2.4%. Meanwhile, capital flows into the Home country, which runs a trade deficit of 2.5% of GDP on impact.

Under managed capital flows, Home runs a trade surplus instead of a trade deficit. This trade surplus reaches 0.6% of GDP on impact. The reversal of capital flows allows for a smoother macroeconomic adjustment. Capital outflows relieve cost pressures in Home, so inflation rises by less than under free capital mobility, despite a less contractionary monetary policy as evidenced by a less negative output gap. On impact, Home inflation reaches nearly 6% while the Home output gap reaches -6.8%. This contrasts with 8% and -8.4% under free capital mobility. Meanwhile, in Foreign, capital inflows exert some cost pressures, to which the central bank responds by tightening its stance. In turn, this stance, coupled with a less pronounced terms of trade deterioration, leads to a more stable output gap. The Foreign output gap reaches 0.8% versus about 2.4% under free capital mobility.

The smaller fluctuations in macroeconomic variables in the managed capital flow regime imply that welfare is higher in this regime than under free capital mobility. The managed capital flows regime indeed delivers an average welfare gain of about 0.03% of permanent consumption, or equivalently, 0.78% of a year's consumption.[27]

Implication for policy rates. The prevailing capital flow regime has stark implications for the cross-country dispersion of policy rates following a cost-push shock. Figure 5 plots the response of the nominal interest rate in the two countries to the shock under both capital flow regimes considered. Under free capital mobility, the Taylor rule dictates an initial interest rate hike of nearly 10% in Home and of less than 1% in Foreign, after which interest rates are gradually cut to their long-run levels. Under managed capital flows, in contrast, the initial hike is of only 8% in Home and but it is of 2.5% in Foreign. This suggests that the capital flows naturally occurring under a free capital mobility regime

[27]The welfare gain γ (in percentage of permanent consumption) of managed capital flows is defined as the percentage increase in permanent consumption required by an individual in an economy under free capital mobility to be as well off as an individual in an economy under managed capital flows. Formally, we have

$$\frac{1}{\rho}\log(1+\gamma)+\mathcal{W}^{\text{free}} = \mathcal{W}^{\text{managed}}, \quad \text{where } \mathcal{W} \equiv \int_0^\infty e^{-\rho t}\left[\log C_t - \frac{(N_t)^{1+\phi}}{1+\phi}\right] dt \approx -\mathcal{L}, \tag{40}$$

and *free* and *managed* respectively stand for free capital mobility and managed capital flows. The welfare gain $\tilde{\gamma}$ (in percentage of current consumption) is defined similarly and is given by, $\log(1+\tilde{\gamma}) = \frac{1}{\rho}\log(1+\gamma)$.

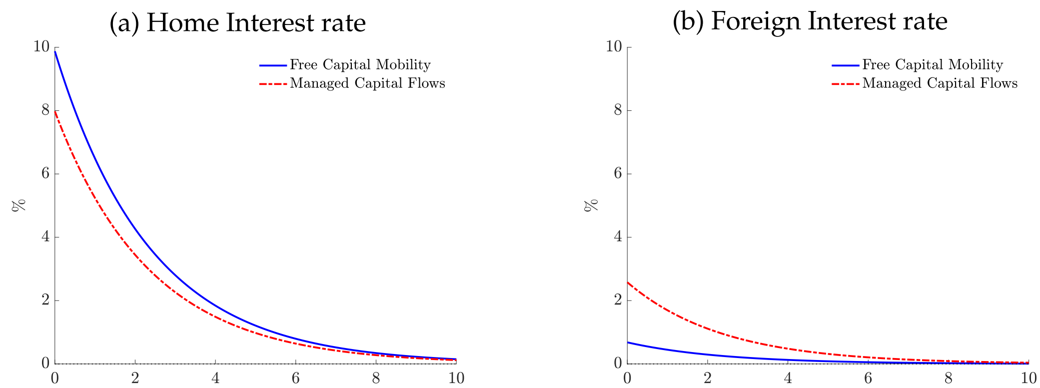

Figure 5: Interest rate path following an inflationary cost-push shock in Home.

lead to excessively dispersed policy rates across countries. Free movements of capital push central banks in countries facing more severe inflationary pressures to raise interest rates too aggressively, while making central banks in countries with less severe inflationary pressures react insufficiently.

Welfare. In our baseline calibration, we conservatively used a value for the elasticity of substitutions between domestic and foreign goods (η) near the lower bound of the estimates from the literature. Figure 6 shows that the welfare gains of managed capital flows (as defined in (40)) are increasing in η. We consider values of the elasticity between 2 and 10. For $\eta = 10$ (i.e. the value consistent with the one estimated by Yi (2003) to match bilateral trade flows),[28] the welfare gains of managed capital flows are about 0.08% of permanent consumption or equivalently, 1.9% of current consumption.

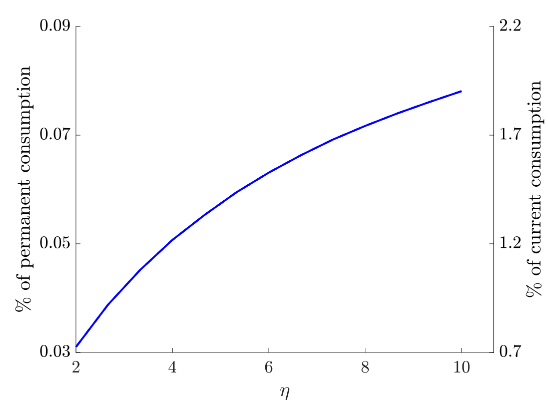

Figure 6: Welfare gains of managed capital flows.

[28] Yi (2003) finds that to match the bilateral trade flows in the data, Armington-type models need a value of trade elasticity of 15. In our environment, the trade elasticity is given by $\chi = 2(1-\alpha)\eta$.

5 Extensions

In our baseline model, capital flows exert upward pressure on domestic costs only via the wealth effect on labor supply. The idea, however, is more general and applies similarly in the presence of other non-tradable goods. In Section 5.1, we present a model extension that clarifies this point. In Section 5.2, we discuss further possible model extensions where additional sources of externalities and inefficiencies may be present, but our main insight regarding the poor functioning of international financial markets following inflationary cost-push shocks can be expected to apply.

5.1 Non-tradable Goods

Consider an environment where households consume two kinds of goods: tradable and non-tradable goods. Tradable goods can be shipped across borders, while non-tradable goods have to be consumed domestically. The composite consumption good, $C_t(h)$, is now an aggregate of non-tradable goods consumption $C_t^N(h)$ and a tradable goods consumption index $C_t^T(h)$, according to

$$C_t(h) = \left(C_t^N(h)\right)^{1-\gamma}\left(C_t^T(h)\right)^{\gamma},$$

where, as in Section 2, the tradable goods bundle is a CES aggregate of Home tradable goods and Foreign tradable goods,

$$C_t^T(h) \equiv \left[\left(\frac{1}{2}\right)^{\frac{1}{\eta}}\left(C_{H,t}^T(h)\right)^{\frac{\eta-1}{\eta}} + \left(\frac{1}{2}\right)^{\frac{1}{\eta}}\left(C_{F,t}^T(h)\right)^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}.$$

In addition to labor income, (tradable) firm profits and return on bond holdings, households now also receive a constant endowment of non-tradable goods Y^N at each instant t.[29] The preferences of household h in Home are now represented by

$$\int_0^\infty e^{-\rho t}\left[\log C_t(h) - \gamma\frac{N_t(h)^{1+\phi}}{1+\phi}\right] dt,$$

where the coefficient γ in the disutility of labor normalizes steady-state labor input to unity. The environment faced by Foreign households is symmetric.

[29] The problem of a firm in the tradable goods sector is identical to the firm's problem in Section 2.2 (see Appendix D for details).

In equilibrium, Home firms' marginal costs are now given by

$$mc_t = \underbrace{\phi y_t^T + \gamma \left[y_t^T - \frac{\eta}{2} s_t + \frac{1}{2}\theta_t \right]}_{\text{real wage}} + \underbrace{\frac{1}{2} s_t + (1-\gamma) \left[y_t^T - \frac{\eta}{2} s_t + \frac{1}{2}\theta_t \right]}_{\text{relative price}}, \tag{41}$$

where the first term represents the real wage in terms of the economy's consumption basket and the second term is the price of the consumption basket relative to the domestically produced tradable good. The demand imbalance now affects firms' marginal costs through two channels: a real wage channel (first term) and a real exchange rate channel (second term). The real wage channel, already present in our baseline model, arises from the wealth effect on labor supply. The real exchange rate channel, on the other hand, arises from a wealth effect on the demand for non-tradable goods. By this channel, capital inflows appreciate the real exchange rate and inflate domestic tradable goods firms' marginal costs, independently from labor supply considerations.

We lay out the optimal policy problem for this model with non-tradable goods in Appendix D. There, we show that the optimal capital flow management policy is isomorphic to that of our baseline model. But while the formalism of the two models coincide, the interpretation of the economic forces behind the results differs. In particular, in the model with non-tradable goods, the change in the loss function induced by a perturbation in the demand imbalance in equation (28) can be broken down into two effects in line with the marginal cost expression (41):

$$d\mathcal{L}_t = -\frac{1}{2} \Bigg[\underbrace{\gamma}_{\substack{\text{wealth effect on} \\ \text{labor supply}}} + \underbrace{(1-\gamma)}_{\substack{\text{wealth effect on demand} \\ \text{for non-tradable goods}}} \Bigg] \kappa \varphi_t^D d\theta_t. \tag{42}$$

The first effect, proportional to the share of tradable goods, reflects a wealth effect on labor supply, while the second effect, proportional to the share of non-tradable goods in the consumption bundle, reflects a wealth effect on the demand for non-tradable goods.

A key message from this model extension is that the wealth effect on labor supply is by no means necessary for our main insights to apply: Capital inflows are likely to exert pressure on firms' marginal costs in the tradable goods sector simply by raising the local currency price of non-tradable goods and appreciating the domestic real exchange rate.[30]

[30]Given the absence of a consensus on the strength of the wealth effect on labor supply (see, e.g., Raffo, 2008), the fact that this effect is not crucial to our results is worth mentioning. This result suggests that the worsening of policy trade-off caused by capital inflows identically applies to models with Greenwood, Hercowitz and Huffman (GHH) preferences that do not feature a wealth effect on labor supply.

5.2 Other Possible Extensions

Before concluding, we briefly discuss other possible model extensions in which additional sources of externalities and inefficiencies may be present.

Additional constraints on monetary policy. To streamline the implications of the output-inflation trade-off for the normative properties of a free capital mobility regime, we purposely abstracted from additional constraints on monetary policy. These include a lack of commitment to future policies (i.e., discretionary policy), a lack of international cooperation (i.e., non-cooperative policy setting), and a lack of monetary independence in the two countries (such as that resulting from a peg or a currency union). Such features would introduce extra constraints on stabilization policy, which capital inflows may contribute to loosening or tightening. Their presence would accordingly create distinct motives for financial market interventions, resulting in additional terms in the targeting rule for capital flow management (27).

Alternative goods pricing specifications and deviations from the law of one price. We assumed that export prices were sticky in producers' currency and that the law of one price held. Alternative assumptions regarding pricing currencies and deviations from the law of one price are known to place further constraints on monetary policy and accordingly give rise to more complex targeting rules than (24)-(25). Adopting these specifications would make other variables, such as the cross-country difference in consumer prices (also referred to as the average currency misalignment), relevant measures of the tightness of constraints on monetary policy, in addition to the output gap (see Engel, 2011). As a result, they would also yield additional terms in the targeting rule for capital flow management (27), without invalidating our main insight.

6 Conclusion

In this paper, we argue that the pattern of capital flows observed over the latest monetary policy tightening cycle may have led to an excessive cross-country dispersion in inflation and monetary tightening. Our argument builds on the insight that capital inflows raise firms' marginal costs by propping up the domestic price of non-tradable goods or factors of production. As a result, capital flows from low-inflation economies to high-inflation economies deteriorate policy trade-offs, leading to excessive macroeconomic fluctuations and lower welfare. Our analysis has implications beyond open economy macroeconomics. Indeed, the insight that privately optimal financial decisions may worsen policy trade-offs via externalities operating on the economy's supply side ought to apply more generally to other heterogeneous agents or multi-sector models with nominal rigidities. The studies of such phenomena are left for future research.

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APPENDIX TO "INFLATION AND CAPITAL FLOWS"

A Data

This Appendix provides details on the sources and definitions of data used for the figures, as well as additional figures.

Data source. We use four data sources:

- Current account balance to GDP data is quarterly and comes from the OECD's Main Economic Indicators (MEI).
- Data on countries' 2021 GDP in US dollars are from the World Bank's World Development Indicators.
- Data on inflation are annual (year-over-year) CPI inflation rates at monthly frequency from the BIS.
- Data on policy rates are at a daily frequency and from the BIS.

List of countries. The sample used for the scatterplots of Figure 2 and the boxplots of Figure A.2 consists of all countries simultaneously present in the BIS and OECD MEI datasets, excluding Argentina, Russia and Turkey.[31] The jurisdictions included in our sample are Australia, Brazil, Canada, Chile, China, Colombia, Czech Republic, Denmark, Finland, Hungary, Iceland, India, Indonesia, Israel, Japan, Korea, Mexico, New Zealand, Norway, Poland, South Africa, Sweden, Switzerland, United Kingdom, United States, and the Euro Area (composed of 19 countries).

Description of Figure 2. In panel (a), the x-axis measures the average of year-on-year CPI inflation rates between October 2021 and March 2023. In panel (b), the x-axis is the cumulative interest hikes between October 1, 2021 and March 31, 2023, defined as the difference in the policy rate between March 31, 2023, and October 1, 2021. In both panels, the y-axis measures the average of the quarterly current account to GDP ratio over the 6 quarters from 2021Q4 to 2023Q1. The size of the dots reflects the size of countries' dollar GDP in 2021.

Description of Figure A.1. Figure A.1 show the same variables and time frame as Figure 1, with the addition of non-G7 countries in light gray.

[31] Argentina and Turkey are excluded due to their extreme levels of inflation and unreliable official inflation figures, while Russia is excluded due to its monetary variables being largely driven by the war and associated sanctions over this period.

Description of Figure A.2. In panel (a), jurisdictions are grouped into four quartiles according to their average inflation from October 2021 to March 2023, while in panel (b), jurisdictions are grouped into four quartiles according to their cummulative rate hikes from October 1, 2021 to March 31, 2023. For each quartile, the box plot shows the mean (dot), the first quartile (bottom edge of the box), the second quartile (horizontal line inside the box) and the third quartile (top edge of the box) of the average current account to GDP ratio between 2021Q4 and 2023Q4.

(a) Inflation rates (b) Policy rates

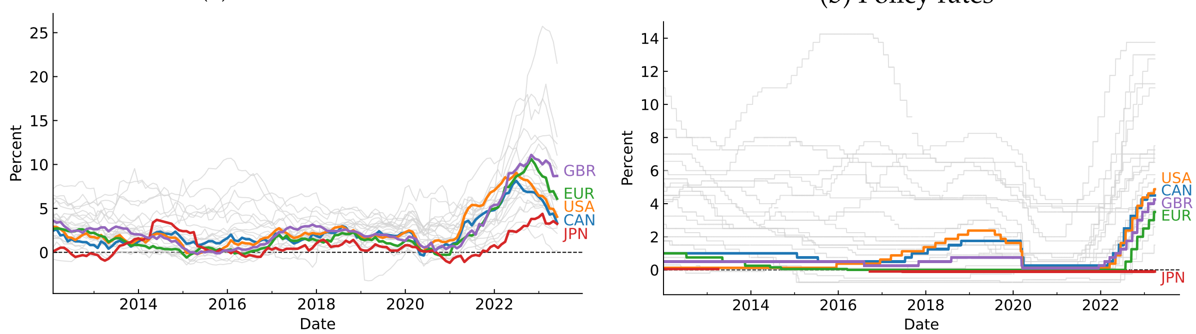

Figure A.1: Inflation and policy rates in G7 countries (bold) and remaining countries (light).

(a) Current accounts and inflation. (b) Current accounts and policy tightening.

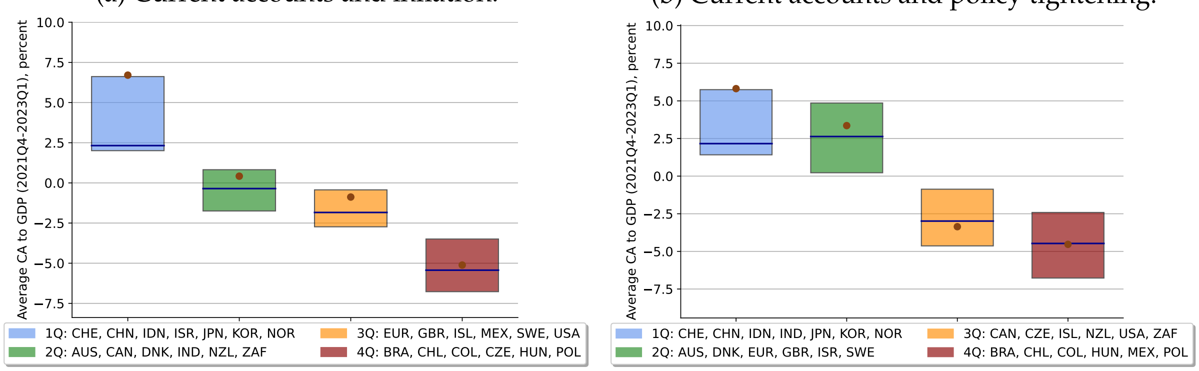

Figure A.2: Distribution of current accounts among inflation quartiles (left) and cumulative hikes quartiles (right).

B Proofs

B.1 Derivation of the Loss Function

The symmetrically weighted average of the period utility in the two countries is

$$v_t \equiv \frac{1}{2}\left[\log C_t - \frac{1}{1+\phi}(N_t)^{1+\phi}\right] + \frac{1}{2}\left[\log C_t^* - \frac{1}{1+\phi}(N_t^*)^{1+\phi}\right].$$

The loss relative to the efficient outcome is then $v_t - v^{max}$, where v^{max} is the maximized welfare, defined as welfare when C_t, C_t^*, N_t and N_t^* take on their efficient values. We derive the loss function for the general case with home bias in consumption (30) with $\alpha \in [0, \frac{1}{2}]$. We describe next the efficient allocation and then derive a second-order approximation of the objective function.

B.1.1 Efficient Allocation

The socially optimal allocation solves the following static problem at each instant:

$$\max_{C_{H,t}, C_{H,t}^*, C_{F,t}, C_{F,t}^*, N_t, N_t^*} \frac{\eta}{\eta-1}\log\left[(1-\alpha)^{\frac{1}{\eta}}(C_{H,t})^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}}(C_{F,t})^{\frac{\eta-1}{\eta}}\right] - \frac{1}{1+\phi}(N_t)^{1+\phi}$$
$$+ \frac{\eta}{\eta-1}\log\left[(1-\alpha)^{\frac{1}{\eta}}(C_{F,t}^*)^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}}(C_{H,t}^*)^{\frac{\eta-1}{\eta}}\right] - \frac{(N_t^*)^{1+\phi}}{1+\phi}$$

subject to

$$C_{H,t} + C_{H,t}^* = N_t, \tag{B.1}$$
$$C_{F,t} + C_{F,t}^* = N_t^*. \tag{B.2}$$

Let $\vartheta_{H,t}$ and $\vartheta_{F,t}$ denote the multipliers on (B.1) and (B.2). The first-order conditions are

$$[C_{H,t}] :: \quad \vartheta_{H,t} = (1-\alpha)^{\frac{1}{\eta}}(C_{H,t})^{-\frac{1}{\eta}}(C_t)^{\frac{1}{\eta}-1} \tag{B.3a}$$
$$[C_{F,t}] :: \quad \vartheta_{F,t}^* = \alpha^{\frac{1}{\eta}}(C_{F,t})^{-\frac{1}{\eta}}(C_t)^{\frac{1}{\eta}-1} \tag{B.3b}$$
$$[C_{H,t}^*] :: \quad \vartheta_{H,t} = \alpha^{\frac{1}{\eta}}(C_{H,t}^*)^{-\frac{1}{\eta}}(C_t^*)^{\frac{1}{\eta}-1} \tag{B.4a}$$
$$[C_{F,t}^*] :: \quad \vartheta_{F,t}^* = (1-\alpha)^{\frac{1}{\eta}}(C_{F,t}^*)^{-\frac{1}{\eta}}(C_t^*)^{\frac{1}{\eta}-1} \tag{B.4b}$$
$$[N_t] :: \quad (N_t)^{\phi} = \vartheta_{H,t} \tag{B.5a}$$
$$[N_t^*] :: \quad (N_t^*)^{\phi} = \vartheta_{F,t}^*. \tag{B.5b}$$

Combining (B.3a) and (B.3b) after multiplying the first equation by $C_{H,t}$ and the second one by $C_{F,t}$, and proceeding similarly with (B.4a) and (B.4b), we arrive at

$$\vartheta_{H,t} C_{H,t} + \vartheta^*_{F,t} C_{F,t} = 1, \tag{B.6a}$$

$$\vartheta_{H,t} C^*_{H,t} + \vartheta^*_{F,t} C^*_{F,t} = 1. \tag{B.6b}$$

Substituting (B.1) and (B.2) into (B.5a) and (B.5b) yields $(N_t)^{1+\phi} + (N^*_t)^{1+\phi} = \vartheta_{H,t}(C_{H,t} + C^*_{H,t}) + \vartheta^*_{F,t}(C_{F,t} + C^*_{F,t})$. Combining it with (B.6a) and (B.6b), we get

$$(N_t)^{1+\phi} + (N^*_t)^{1+\phi} = 2.$$

Using resource constraints (B.1) and (B.2) and by symmetry, we arrive at

$$C^e_t = C^{*e}_t = N^e_t = N^{*e}_t = 1,$$

where variables with a superscript e denote efficient values. Finally, from the aggregate production functions, we have $Y^e_t = 1$ and $Y^{*e}_t = 1$. In logs, we therefore have

$$c^e_t = c^{*e}_t = n^e_t = n^{*e}_t = y^e_t = y^{*e}_t = 0.$$

B.1.2 Loss Function

The second-order approximation of the period utility around the non-distorted steady state (using $\bar{N}^{1+\phi} = 1$) is given by

$$v_t = -\frac{1}{1+\phi} + \frac{1}{2}\left[(c_t + c^*_t) - (n_t + n^*_t) - \frac{1+\phi}{2}\left((n_t)^2 + (n^*_t)^2 \right) + o\left(||u||^3 \right) \right],$$

where $+o\left(||u||^3\right)$ indicate the 3^{rd} and higher order terms left out. In the efficient allocation $C^e_t = C^{*e}_t = N^e_t = N^{*e}_t = 1$, and thus $v^{max}_t = -1/(1+\phi)$. The period utility can be rewritten as

$$v_t - v^{max}_t = \frac{1}{2}\left[(c_t + c^*_t) - (n_t + n^*_t) - \frac{1+\phi}{2}\left((n_t)^2 + (n^*_t)^2 \right) + o\left(||u||^3 \right) \right] \tag{B.7}$$

We now need to substitute for c_t, c^*_t, n_t, n^*_t. Note that goods market-clearing are given by

$$Y_t = \left[(1-\alpha) + \alpha \left(S_t\right)^{1-\eta} \right]^{\frac{\eta}{1-\eta}} \left[(1-\alpha) + \alpha \Theta_t^{-1} Q_t^{\eta-1} \right] C_t.$$

$$Y^*_t = \left[(1-\alpha) + \alpha \left(S_t\right)^{\eta-1} \right]^{\frac{\eta}{1-\eta}} \left[(1-\alpha) + \alpha \Theta_t Q_t^{\frac{1}{\sigma}-\eta} \right] C^*_t$$

where we use the international sharing condition $C_t = \Theta_t Q_t C_t^*$. Taking a second-order approximation around the non-distorted steady state, we get

$$y_t = c_t - \alpha\theta_t + \frac{\omega - 1 + 2\alpha}{2} s_t + \frac{1}{2}\alpha(1-\alpha)\left\{(1-\eta)\eta(s_t)^2 + [\theta_t - (1-2\alpha)(\eta-1)s_t]^2\right\} + o(||u||^3) \quad \text{(B.8)}$$

$$y_t^* = c_t^* + \alpha\theta_t - \frac{\omega - 1 + 2\alpha}{2} s_t + \frac{1}{2}\alpha(1-\alpha)\left\{(1-\eta)\eta(s_t)^2 + [\theta_t - (1-2\alpha)(\eta-1)s_t]^2\right\} + o(||u||^3) \quad \text{(B.9)}$$

where $\omega = \eta – (\eta – 1)(1 – 2\alpha)^2$. We can combine (B.8) and (B.9) to get

$$c_t + c_t^* = y_t + y_t^* - \alpha(1-\alpha)\left\{(1-\eta)\eta(s_t)^2 + [\theta_t - (1-2\alpha)(\eta-1)s_t]^2\right\} + o(||u||^3). \quad \text{(B.10)}$$

Aggregate employment is given by $N_t = Y_t Z_t$, with $Z_t = \int_0^1 \left(P_{Ht(l)}/P_{Ht}\right)^{-\varepsilon} dl$ and we have

$$n_t + n_t^* = y_t + y_t^* + z_t + z_t^* + o(||u||^3) \quad \text{(B.11)}$$

Substituting (B.11) into (B.7) we obtain

$$v_t - v_t^{max} = \frac{1}{2}\left[(c_t + c_t^*) - (y_t + y_t^*) - (z_t + z_t^*) - \frac{1+\phi}{2}((y_t)^2 + (y_t^*)^2) + o(||u||^3)\right] \quad \text{(B.12)}$$

Next, plugging (B.8) and (B.9) into (B.12), we arrive at

$$\begin{aligned} v_t - v_t^{max} = -\frac{1}{2}\Big[&(z_t + z_t^*) + \frac{1}{2}(1+\phi)((y_t)^2 + (y_t^*)^2) + \alpha(1-\alpha)(1-\eta)\eta(s_t)^2 \\ &+ \alpha(1-\alpha)\left(\theta_t - (\eta-1)(1-2\alpha)s_t\right)^2\Big] + o(||u||^3). \end{aligned} \quad \text{(B.13)}$$

The objective of the policy maker is to minimize the loss function $\mathcal{L} = \int_0^\infty e^{-\rho t}(v_t - v_t^{max})dt$ where $v_t - v_t^{max}$ is given by (B.13). Then, using

$$\int_0^\infty e^{-\rho t} z_t dt = \int_0^\infty e^{-\rho t} \frac{\varepsilon}{2} \text{var}_l\left(P_{H,t}(l)\right), \quad \text{(B.14)}$$

$$\int_0^\infty e^{-\rho t} z_t^* dt = \int_0^\infty e^{-\rho t} \frac{\varepsilon}{2} \text{var}_l\left(P_{F,t}^*(l)\right) dt, \quad \text{(B.15)}$$

where it can be shown that

$$\int_0^\infty e^{-\rho t} \text{var}_l\left(P_{H,t}(l)\right) dt = \frac{1}{\kappa}\int_0^\infty e^{-\rho t}\left(\pi_{H,t}\right)^2 dt,$$

$$\int_0^\infty e^{-\rho t} \text{var}_l\left(P_{F,t}^*(l)\right) dt = \frac{1}{\kappa}\int_0^\infty e^{-\rho t}\left(\pi_{F,t}^*\right)^2 dt,$$

Finally, using our definition of world and difference variables we obtain

$$\mathcal{L} = \frac{1}{2}\int_0^\infty e^{-\rho t}\Big[\frac{\varepsilon}{\kappa}\left((\pi_t^W)^2+(\pi_t^D)^2\right)+(1+\phi)\left((y_t^W)^2+(y_t^D)^2\right)$$
$$+\alpha(1-\alpha)(1-\eta)\eta(s_t)^2+\alpha(1-\alpha)\left(\theta_t-(\eta-1)(1-2\alpha)s_t\right)^2\Big] \tag{B.16}$$

We then use the expression for the equilibrium terms of trade $\omega s_t = 2y_t^D–(1-2\alpha)\theta_t$ to simplify (B.16) and obtain

$$\mathcal{L} = \frac{1}{2}\int_0^\infty e^{-\rho t}\left\{\left[(1+\phi)(y_t^W)^2+\frac{\varepsilon}{\kappa}(\pi_t^W)^2\right]+\left[\left(\frac{1}{\omega}+\phi\right)(y_t^D)^2+\frac{\varepsilon}{\kappa}(\pi_t^D)^2+\alpha(1-\alpha)\frac{\eta}{\omega}(\theta_t)^2\right]\right\}.$$

Absent home bias. With $\alpha = \frac{1}{2}$, we arrive at

$$\mathcal{L} = \frac{1}{2}\int_0^\infty e^{-\rho t}\left[(1+\phi)(y_t^W)^2+\frac{\varepsilon}{\kappa}(\pi_t^W)^2\right]+\left[\left(\frac{1}{\eta}+\phi\right)(y_t^D)^2+\frac{\varepsilon}{\kappa}(\pi_t^D)^2+\frac{1}{4}(\theta_t)^2\right].$$

B.2 Optimal Monetary Policy

The optimal policy problem consists in choosing $\mathcal{C} \equiv \{\pi_t^W, y_t^W, \pi_t^D, y_t^D, \theta_t\}$ to solve

$$\min_{\mathcal{C}} \frac{1}{2}\int_0^\infty e^{-\rho t}\left[(1+\phi)(y_t^W)^2+\frac{\varepsilon}{\kappa}(\pi_t^W)^2\right]+\left[\left(\frac{1}{\eta}+\phi\right)(y_t^D)^2+\frac{\varepsilon}{\kappa}(\pi_t^D)^2+\frac{1}{4}(\theta_t)^2\right] \tag{B.17}$$

subject to

$$\dot{\pi}_t^W = \rho\pi_t^W-\kappa(1+\phi)y_t^W-\kappa u_t^W, \tag{B.18}$$
$$\dot{\pi}_t^D = \rho\pi_t^D-\kappa\left[\left(\frac{1}{\eta}+\phi\right)y_t^D+\frac{1}{2}\theta_t\right]-\kappa u_t^D \tag{B.19}$$

The first-order conditions for $\pi_t^W, y_t^W, \pi_t^D, y_t^D$ are given by

$$\left[\pi_t^W\right] :: \quad \dot{\varphi}_t^W = -\frac{\varepsilon}{\kappa}\pi_t^W, \tag{B.20}$$
$$\left[\pi_t^D\right] :: \quad \dot{\varphi}_t^D = -\frac{\varepsilon}{\kappa}\pi_t^D, \tag{B.21}$$
$$\left[y_t^W\right] :: \quad 0 = -(1+\phi)y_t^W+\kappa(1+\phi)\varphi_t^W, \tag{B.22}$$
$$\left[y_t^D\right] :: \quad 0 = -\left(\frac{1}{\eta}+\phi\right)y_t^D+\kappa\left(\frac{1}{\eta}+\phi\right)\varphi_t^D, \tag{B.23}$$

where φ_t^W, φ_t^D are the co-state variables associated with (B.18) and (B.19) with the initial conditions $\varphi_0^j = 0$ and transversality conditions $\lim_{t\to\infty} e^{-\rho t}\varphi_t^j = 0$ for any $j \in \{W, D\}$.

Differentiating (B.22) and (B.23) with respect to time and using (B.20) and (B.21), we obtain the following targeting rules

$$\dot{y}_t^W + \varepsilon \pi_t^W = 0, \tag{B.24}$$

$$\dot{y}_t^D + \varepsilon \pi_t^D = 0. \tag{B.25}$$

B.3 Proof of Corollary 1

We differentiate (B.24), that is $\ddot{y}_t^W + \varepsilon \dot{\pi}_t^W = 0$. and use (B.18) to obtain

$$\ddot{y}_t^W - \rho \dot{y}_t^W - \varepsilon\kappa(1+\phi) y_t^W = \varepsilon\kappa u_t^W. \tag{B.26}$$

The eigenvalues of the associated characteristic polynomial are

$$z_1 = \frac{1}{2}\left(\rho - \sqrt{\rho^2 + 4\kappa\varepsilon(1+\phi)}\right) < 0 \quad \text{and} \quad z_2 = \frac{1}{2}\left(\rho + \sqrt{\rho^2 + 4\kappa\varepsilon(1+\phi)}\right) > 0.$$

The solution of this second-order differential equation takes the form

$$y_t^W = \vartheta_0 e^{z_1 t} + \vartheta_1 \int_0^t e^{z_1(t-s)} u_s^W ds + \vartheta_2 \int_t^\infty e^{z_2(t-s)} u_s^W ds. \tag{B.27}$$

Differentiating (B.27) and relating each term to (B.26), we get $\vartheta_1 = \vartheta_2 = -\frac{\varepsilon\kappa}{z_2 - z_1}$. Next, from (B.27) for $t = 0$, we get

$$\vartheta_0 = y_0^W + \frac{\varepsilon\kappa}{z_2 - z_1} \int_0^\infty e^{-z_2 s} u_s^W ds.$$

From the initial condition for the co-state variable $\varphi_0^W = 0$, the relation $y_t^W = \kappa\varphi_t^W$ implies that $y_t^W = 0$. The solution to the optimal monetary policy problem is thus

$$y_t^W = -\frac{\varepsilon\kappa}{z_2 - z_1}\left[e^{z_1 t}\int_0^t \left(e^{-z_1 s} - e^{-z_2 s}\right) u_s^W ds + \left(e^{z_2 t} - e^{z_1 t}\right)\int_t^\infty e^{-z_2 s} u_s^W ds\right]. \tag{B.28}$$

Using (B.24), the path for the world inflation under the optimal monetary policy satisfies

$$\pi_t^W = \frac{\kappa}{z_2 - z_1}\left[z_1 e^{z_1 t}\int_0^t \left(e^{-z_1 s} - e^{-z_2 s}\right) u_s^W ds + \left(z_2 e^{z_2 t} - z_1 e^{z_1 t}\right)\int_t^\infty e^{-z_2 s} u_s^W ds\right]. \tag{B.29}$$

It follows that the paths of y_t^W and π_t^W are independent of the path of θ_t.

B.4 Proof of Proposition 1

The proof follows from combining the optimality condition for θ_t with the targeting rule in differences (B.21). The first order condition of (B.17) with respect to θ_t is given by

$$-\frac{1}{2}\theta_t+\kappa\varphi_t^D = 0 \tag{B.30}$$

Combining (B.21) and (B.25) to obtain $\kappa\varphi_t^D = y_t^D$ and plugging it into (B.30), we arrive at

$$\theta_t = 2y_t^D.$$

B.5 Proof of Topsy-Turvy Capital Flows with Home Bias

Recall that net export is defined as in units of the Home good as $NX_t = Y_t - P_t C_t / P_{H,t}$. Linearizing this relationship and substituting the linearized Home market clearing condition $y_t = c_t + 2\alpha(1-\alpha)s_t - \alpha\theta_t$, we obtain an expression for the trade balance,

$$nx_t = \frac{\omega-1}{2}s_t - \alpha\theta_t \tag{B.31}$$

where $\omega - 1 = 2\alpha(1-\alpha)(\eta-1)$. Under free capital mobility $\theta_t = 0$ for all $t \geq 0$ while under managed capital flows θ_t is given by (33). Accounting for each fact and substituting (32) into (B.31), we get

$$nx_t^{\text{free}} = \frac{2\alpha(1-\alpha)(\eta-1)}{\omega}y_t^D, \quad nx_t^{\text{opt}} = -\frac{\alpha}{(1-\alpha)\eta}y_t^D$$

where superscript "free" and "opt" denote net exports respectively under free capital mobility and under managed capital flows.

B.6 Proof of Section 3.5

We assume here time-varying productivity in both Home A_t and Foreign A_t^* and $\eta = 1$. We follow the same steps as in section B.1 to derive the loss function. First, it can be shown that the efficient allocation (with time-varying productivity) is given by

$$\begin{aligned}
&N_t^e = N_t^{*e} = 1, \\
&Y_t^e = A_t, \quad Y_t^{*e} = A_t^*, \\
&C_t^e = A_t^{1-\alpha}\left(A_t^*\right)^{\alpha}, \quad C_t^{*e} = A_t^{\alpha}\left(A_t^*\right)^{1-\alpha}.
\end{aligned}$$

For a given variable X_t, the lower-case letter x denotes the log of X_t. Because $\bar{X}_t = 1$, x_t also denotes deviations from the steady state. We let tildes on lower-case letters denote the log deviations from the efficient allocation, i.e. $\tilde{x}_t = x_t - x_t^e$. We rewrite the second-order approximation of the period utility around the non-distorted steady state here

$$v_t = -\frac{1}{1+\phi} + \frac{1}{2}\left[(c_t + c_t^*) - (n_t + n_t^*) - \frac{1+\phi}{2}\left((n_t)^2 + (n_t^*)^2\right) + o\left(||u||^3\right)\right],$$

which in deviations from the efficient allocation becomes

$$v_t - v_t^{max} = \frac{1}{2}\left[(\tilde{c}_t + \tilde{c}_t^*) - (\tilde{n}_t + \tilde{n}_t^*) - \frac{1+\phi}{2}\left((\tilde{n}_t)^2 + (\tilde{n}_t^*)^2\right) + o\left(||u||^3\right)\right] \tag{B.32}$$

Evaluating (B.10) and (B.11) at flexible prices and expressing (B.10) and (B.11) in deviations from the efficient allocation, we get

$$\tilde{c}_t + \tilde{c}_t^* = \tilde{y}_t + \tilde{y}_t^* - \alpha(1-\alpha)\,(\theta_t)^2 + o(||u||^3). \tag{B.33}$$

$$\tilde{n}_t + \tilde{n}_t^* = \tilde{y}_t + \tilde{y}_t^* + z_t + z_t^* + o(||u||^3) \tag{B.34}$$

Because prices are fully rigid $z_t = z_t^* = 0$. Defining $\mathcal{L} = \int_0^\infty e^{-\rho t}(v_t - v_t^{max})dt$ and substituting (B.33), (B.34) into (B.32), and noting that $(\tilde{y}_t)^2 + (\tilde{y}_t^*)^2 = 2[(\tilde{y}_t^W)^2 + (\tilde{y}_t^D)^2]$, we arrive at

$$\mathcal{L} = \frac{1}{2}\int_0^\infty e^{-\rho t}\left\{(1+\phi)\left[(\tilde{y}_t^W)^2 + (\tilde{y}_t^D)^2\right] + \alpha(1-\alpha)(\theta_t)^2\right\} dt$$

Next, we turn to deriving the implementability constraint. In the context of currency unions, the Euler equations are given by (6) and (10) with $\dot{e}_t = 0$. By (B.8) and (B.9), we have to a first-order $\tilde{c}_t = \tilde{y}_t - \alpha\theta_t + \alpha\tilde{s}_t$ and $\tilde{c}_t^* = \tilde{y}_t^* + \alpha\theta_t - \alpha\tilde{s}_t$. Substituting these expressions into (6) and (10) with $\dot{e}_t = 0$, we arrive at

$$\dot{\tilde{y}}_t^W = i_{Bt} - \frac{1}{2}(r_t^n + r_t^{n,*}) + \frac{1}{2}\dot{\theta}_t, \tag{B.35}$$

$$\dot{\tilde{y}}_t^D = -\frac{1}{2}(r_t^n + r_t^{n,*}) + \frac{1}{2}(1-2\alpha)\dot{\theta}_t. \tag{B.36}$$

where $r_t^n = \rho + \dot{a}_t$ and $r_t^{n*} = \rho + \dot{a}_t^*$. Because given quantities $\{\tilde{y}_t^W, \tilde{y}_t^D, \theta_t\}$, equation (B.35) can be used to back out i_{Bt}, the optimal policy problem reduces to

$$\min_{\tilde{y}_t^W} \frac{1}{2}\int_0^\infty e^{-\rho t}\left\{(1+\phi)(\tilde{y}_t^W)^2\right\} dt + \min_{\tilde{y}_t^D, \theta_t} \frac{1}{2}\int_0^\infty e^{-\rho t}\left\{(1+\phi)(\tilde{y}_t^D)^2 + \alpha(1-\alpha)(\theta_t)^2\right\} dt$$

subject to (B.36).

C Capital Flows Regimes and Output-Inflation Tradeoff

To further illustrate our results' implications for a stagflation episode, we analyze the world economy's adjustment to an unanticipated temporary markup shock that gives rise to an output-inflation trade-off of unequal stringency in the two countries.

For concreteness, suppose that Home is subject to an inflationary markup shock such that $u_t = 2\bar{u} > 0$ for some $\bar{u} > 0$ for $t \in [0, T)$ and $u_t = 0$ for $t \geq T$, while Foreign is not hit by any shock (i.e., $u_t^* = 0$ for $t \geq 0$). In world and differences format shocks, we have

$$u_t^W = u_t^D = \begin{cases} \bar{u} > 0 & \text{for} \quad t \in [0, T) \\ 0 & \text{for} \quad t \geq T. \end{cases} \tag{C.1}$$

As is well understood, monetary policy will not able to perfectly stabilize all variables under this scenario. Instead, it will trade off output gap and inflation distortions, according to (25) and (24). The main advantage of the step-function scenario is to allow for a sharp graphical characterization of the adjustment under the two capital flow regimes.

C.1 Free Capital Mobility

In the free capital mobility regime, $\theta_t = 0$. Accounting for this fact (22) becomes:

$$\dot{\pi}_t^D = \rho \pi_t^D - \kappa \left(\frac{1}{\eta} + \phi \right) y_t^D - \kappa u_t^D. \tag{C.2}$$

Meanwhile, differentiating the targeting rule (25) with respect to time yields

$$\dot{y}_t^D = -\varepsilon \pi_t^D. \tag{C.3}$$

(C.2) and (C.3) form a dynamical system in π_t^D and y_t^D whose solution encapsulates the dynamics of the cross-country block of the model. π_t^D is a jump variable, and although y_t^D could in principle jump, under the optimal plan it is predetermined at $y_0^D = 0$.The system is thus saddle-path stable and the solution can be conveniently represented in a phase diagram. The $\dot{y}_t^D = 0$ locus is described by $\pi_t^D = 0$, while the $\dot{\pi}_t^D = 0$ locus is described by $\rho \pi_t^D = \kappa \left(\frac{1}{\eta} + \phi \right) y_t^D + \kappa u_t^D$. Given our shock scenario, in the (y_t^D, π_t^D) space, the $\dot{y}_t^D = 0$ locus is therefore always a flat line at 0, while the $\dot{\pi}_t^D = 0$ locus is an upward sloping straight line with slope $\kappa \left(\frac{1}{\eta} + \phi \right) / \rho$ and intercept $\kappa \bar{u} / \rho > 0$ in the short-run (i.e., for $t \in [0, T)$) and intercept 0 in the long-run (i.e., for $t \geq T$).

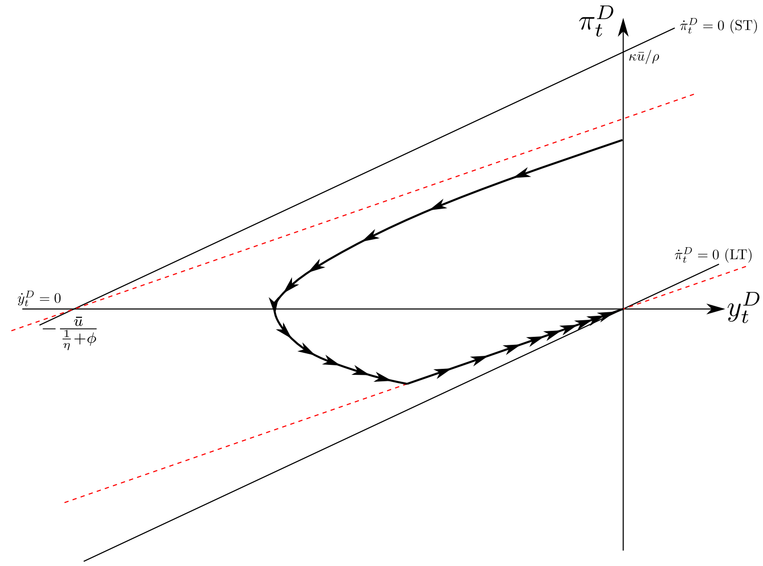

Figure A.3: Output-inflation trade-off under free capital mobility.
Note: (ST) denotes short-term $\dot{\pi}_t^D = 0$ locus, (LT) denotes long-term $\dot{\pi}_t^D = 0$ locus.

Figure A.3 represent the loci, where y_t^D rises (diminishes) south (north) of the $\dot{y}_t^D = 0$ locus and π_t^D rises (diminishes) west (east) of the $\dot{\pi}_t^D = 0$ locus. The fictional saddle-path associated with the system being permanently governed by the short-term loci is represented by the upper dashed upward-sloping line, while that associated with the system being permanently governed by the long-term loci is represented by the lower dashed upward-sloping line. The actual saddle path is represented by the thick curve with arrows.

The inflationary markup shock in Home causes a cross-country difference in inflation on impact. But the initial jump in inflation differential is limited by monetary policy's commitment to generate a more negative output gap in Home than in Foreign in the future, with the difference in output gaps displaying a hump shape. To support this path for the output gap differential, the terms of trade need to follow a similar hump shape, indicating persistently misaligned and appreciated terms of trade throughout the episode.

C.2 Managed Capital Flows

Under managed capital flows, the path of θ_t satisfies the targeting rule (27). Accounting for this fact and substituting it into (22) yields:

$$\dot{\pi}_t^D = \rho\pi_t^D - \kappa\left[\frac{1}{\eta}+\phi+1\right]y_t^D - \kappa u_t^D, \tag{C.4}$$

The last extra term (when comparing (C.4) to its counterpart (C.3) under free capital mobility) reflects the optimal management of the demand imbalance. (C.4) and (C.2) now form the dynamical system in π_t^D and y_t^D whose solution represents the dynamics of the cross-country block of the model. Again, π_t^D is a jump variable, and y_t^D is predetermined at $y_0^D = 0$ under the optimal plan. The system is again saddle-path stable and is represented with a phase diagram in Figure A.4.

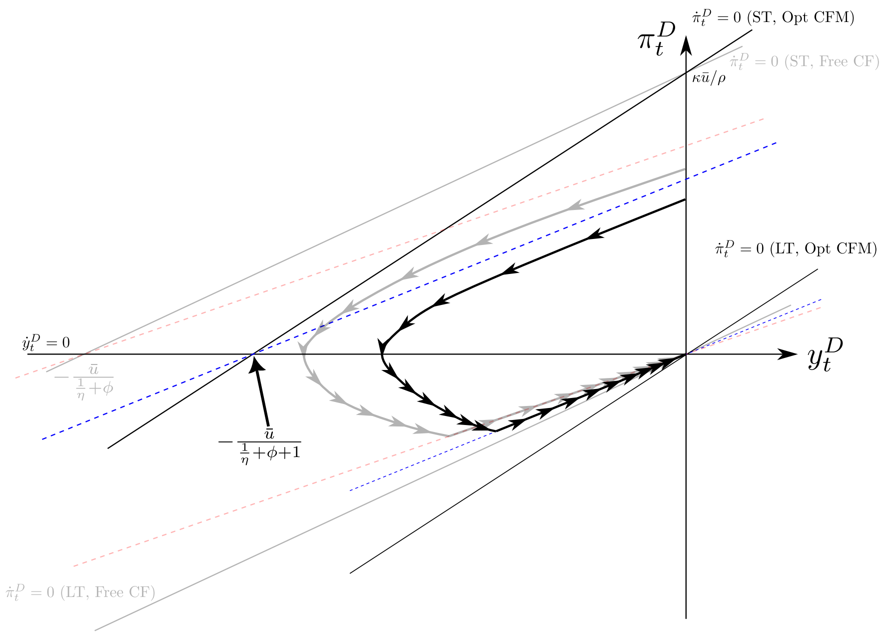

Figure A.4: Output-inflation trade-off under optimal CFM.
Note: (ST) denotes short-term $\dot{\pi}_t^D = 0$ locus, (LT) denotes long-term $\dot{\pi}_t^D = 0$ locus.

As under free capital mobility, the $\dot{y}_t^D = 0$ locus is described by $\pi_t^D = 0$. But this time, the $\dot{\pi}_t^D = 0$ locus is described by $\rho\pi_t^D = \kappa\left[\frac{1}{\eta}+\phi+1\right]y_t^D+\kappa u_t^D$. The only difference with the phase diagram of Figure A.3 is that the $\dot{\pi}_t^D = 0$ locus now has a steeper slope of $\kappa\left[\frac{1}{\eta}+\phi+1\right]/\rho$. This slope is strictly steeper. The phase diagram shows that optimal capital flow management results in a more favorable trade-off between the stabilization of the cross-country difference in the output gap and the cross-country difference in domestic inflation, regardless of the direction of the inefficiency.

As the path for the cross country difference in the output gap again displays a hump-shape, (29) indicates that a hump-shaped trade surplus arises. As a result, capital flows are topsy-turvy: throughout the stagflation episode, Home runs a trade deficit under free capital mobility, while it runs a trade surplus under managed capital flows.

D Extension with Non-tradable Goods

The Home country is populated by a continuum of households indexed by $h \in [0,1]$. An household h has an infinite life horizon and preferences represented by

$$\int_0^\infty e^{-\rho t} \left[\log C_t(h) - \gamma \frac{N_t(h)^{1+\phi}}{1+\phi} \right] dt. \tag{C.1}$$

The exposition focuses again on Home, but the environment faced by Foreign is symmetric. The aggregate consumption index, defined as

$$C_t(h) = \left(C_t^N(h)\right)^{1-\gamma} \left(C_t^T(h)\right)^{\gamma},$$

is a composite of a non-tradable goods consumption $C_t^N(h)$ and a tradable goods consumption $C_t^T(h)$. The latter is a CES aggregates over domestically produced tradable goods $C_{H,t}(h)$ and foreign produced tradable goods $C_{H,t}(h)$:

$$C_t^T(h) \equiv \left[(1-\alpha)^{\frac{1}{\eta}} \left(C_{H,t}^T(h)\right)^{\frac{\eta-1}{\eta}} + \alpha^{\frac{1}{\eta}} \left(C_{F,t}^T(h)\right)^{\frac{\eta-1}{\eta}} \right]^{\frac{\eta}{\eta-1}}. \tag{C.2}$$

Each household h receives a constant endowment of non-tradable goods Y^N normalized to one. The budget constraint is given by

$$\begin{aligned} \dot{D}_t(h) + \dot{B}_t(h) = {} & i_t D_t(h) + i_{B,t} B_t(h) + P_t^N Y^N + W_t(h) N_t(h) + \Pi_t \\ & - P_t^N C_t^N(h) - P_{H,t}^T C_{H,t}^T(h) - P_{F,t}^T C_{F,t}^T(h), \end{aligned} \tag{C.3}$$

First-order conditions with respect to C_t^T and C_t^N imply that

$$\frac{P_t^N}{P_t^T} = \frac{1-\gamma}{\gamma} \left(\frac{C_t^T}{C_t^N} \right), \tag{C.4}$$

A household h (as described in Section 2) is a monopolistically competitive supplier of its labor services. The optimal wage setting satisfies (4).

The problem of firms in the domestic tradable sector remains unchanged. Final domestically produced tradable goods are CES aggregates over a continuum of goods produced by firms, with an elasticity of substitution between varieties equal to $\varepsilon > 1$. Firms operate under monopolistic competition and engage in infrequent price setting á la Calvo (1983).

Linear-Quadratic representation. Given our normalization, it can be shown that the efficient allocation satisfies $C_t^{T,e} = C_t^{T*,e} = N_t^e = N_t^{*e} = 1$ and $C_t^e = C_t^{*e} = Y_t^e = Y_t^{*e} = 1$. Following the same steps as in section B.1, it is straightforward to show that the second-order approximation of loss relative to the efficient outcome is given by (B.16) scaled by γ. Since we can equivalently minimize an affine transformation of (B.16), the loss function is

$$\mathcal{L} = \frac{1}{2}\int_0^\infty e^{-\rho t}\left[(1+\phi)(y_t^W)^2 + \frac{\varepsilon}{\kappa}(\pi_t^W)^2\right] + \left[\left(\frac{1}{\eta}+\phi\right)(y_t^D)^2 + \frac{\varepsilon}{\kappa}(\pi_t^D)^2 + \frac{1}{4}(\theta_t)^2\right]. \quad \text{(C.5)}$$

The first-order approximation of firms' optimality conditions, is described by

$$\begin{aligned}
\dot{\pi}_{Ht}^T &= \rho\pi_{Ht}^T - \kappa\left[\phi y_t^T + \gamma\left(y_t^T + \frac{1}{2}\theta_t - \frac{\eta}{2}s_t\right) + (1-\gamma)\left(y_t^T + \frac{1}{2}\theta_t - \frac{\eta}{2}s_t\right) + \frac{1}{2}s_t\right], \\
\dot{\pi}_{Ft}^{T*} &= \rho\pi_{Ht}^{T*} - \kappa\left[\phi y_t^{T*} + \gamma\left(y_t^{T*} - \frac{1}{2}\theta_t + \frac{\eta}{2}s_t\right) + (1-\gamma)\left(y_t^{T*} - \frac{1}{2}\theta_t + \frac{\eta}{2}s_t\right) - \frac{1}{2}s_t\right].
\end{aligned}$$

where we use $mc_t = w_t - p_{Ht}^T = (w_t - p_t) + (p_t - p_{Ht})$ and the real wage satisfies $w_t - p_t = \phi y_t^T + c_t = \phi y_t^T + \gamma c_t^T$. We arrive at the following Phillips curves for world and differences:

$$\dot{\pi}_t^W = \rho\pi_t^W - \kappa(1+\phi)y_t^W - \kappa u_t^W, \quad \text{(C.7)}$$

$$\dot{\pi}_t^D = \rho\pi_t^D - \kappa\left[\left(\frac{1}{\eta}+\phi\right)y_t^D + \frac{1}{2}\theta_t\right] - \kappa u_t^D. \quad \text{(C.8)}$$

with $y_t^W = \frac{1}{2}(y_t^T + y_t^{T*})$ and $y_t^D = \frac{1}{2}(y_t^T - y_t^{T*})$. Similarly, $\pi_t^W = \frac{1}{2}(\pi_{H,t}^T + \pi_{F,t}^{T*})$, $\pi_t^D = \frac{1}{2}(\pi_{H,t}^T - \pi_{F,t}^{T*})$. The optimal policy problem consists of minimizing (C.5) subject to (C.7) and (C.8). The optimal policy problem is identical to (23) and thus yields the same solution

$$\theta_t = 2y_t^D$$

The first-order approximation of the country's budget constraint implies the following expression for the trade balance $nx_t = \frac{\eta-1}{\eta}y_t^D - \frac{1}{2}\theta_t$. Therefore, the trade balance under the managed capital flow regime is given by $nx_t = -\frac{1}{\eta}y_t^D$ while the trade balance under free capital mobility ($\theta_t = 0$) is given by $nx_t = \frac{\eta-1}{\eta}y_t^D$.