Sectoral Trade-offs, Labor Mobility and Exchange Rate Management

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Abstract

Many emerging market economies float their exchange rates while simultaneously managing them through capital controls or foreign exchange intervention. This paper rationalizes managed floating in a small open economy model with imperfect inter-sectoral labor mobility and nominal wage rigidities. These frictions generate a sectoral trade-off of monetary policy: monetary policy can stabilize the tradable sector but at the cost of destabilizing the non-tradable sector, and vice versa. Managing the exchange rate with an additional instrument to stabilize the tradable sector alleviates this trade-off. By separately calibrating the model to emerging market economies and advanced economies, we show that the welfare gains from exchange rate management are larger in emerging market economies due to lower inter-sectoral labor mobility and higher persistence and volatility of shocks. The paper also compares monetary autonomy gained from floating the exchange rate and using capital controls, two ways of achieving monetary autonomy in the Mundell-Fleming Trilemma. We find that in response to global financial shocks, effective monetary autonomy gained from capital controls is more valuable while in response to terms-of-trade shocks, the opposite holds.

Keywords: Mundell-Fleming Trilemma; managed floating; exchange rate management; capital controls; monetary policy; inter-sectoral labor mobility; sectoral trade-offs; global financial cycle.

JEL classification: F41, F31, F38, E52, F33

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1 Introduction

Many emerging market economies allow their exchange rates to float while simultaneously actively managing them through capital controls or foreign exchange intervention. This combination – a managed float – is at odds with the textbook Mundell-Fleming Trilemma which characterizes exchange rate policy as a choice between fixing and being fully flexible. Figure 1 shows the share of countries that have a managed float across quintiles of GDP per capita and indeed managed floating is more prevalent among emerging market economies than among advanced economies.[1] Why do emerging market economies choose to have a managed float? This paper develops a theory of managed floating based on labor-market frictions. The central idea is that when external shocks induce pressure for labor to move across sectors, imperfect labor mobility and nominal wage rigidities create a sectoral trade-off for monetary policy. Exchange rate management with capital controls or foreign exchange intervention provides an additional instrument that alleviates this trade-off.

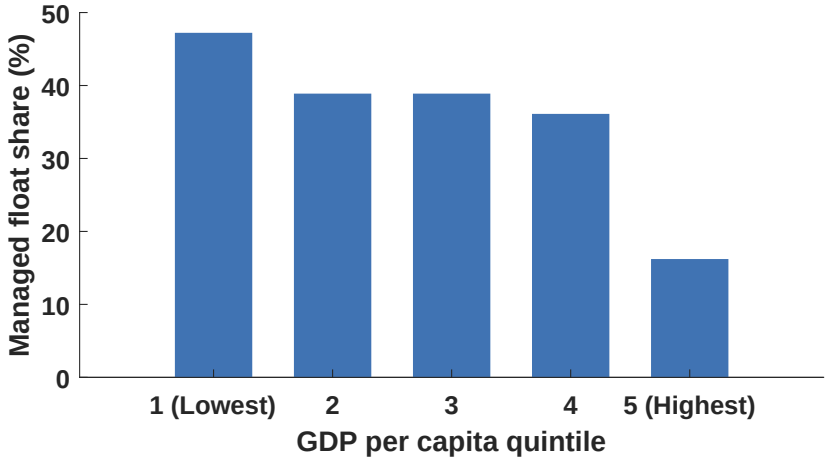


Figure 1: Distribution of countries with a managed float across GDP per capita

The central mechanism is motivated by a broad set of external shocks that generate not only aggregate fluctuations but also substantial pressure for labor to move across sectors. Changes in global financial conditions can trigger large capital flows, impact the exchange rate, and shift activity between tradable and non-tradable sectors. Terms-of-trade shocks can similarly change the relative profitability of sectors and induce substantial sectoral reallocation. Episodes such as the capital inflow boom in Spain (Benigno et al. 2015), the

[1] We use 2019 PPP-adjusted real GDP-per-capita from the IMF World Economic Outlook Database. We classify a country's exchange rate regime based on the criteria set forth by Ilzetzki et al. (2019). More specifically, countries classified as 2 or 3 under the coarse classification are considered to have a managed float.

mining boom in Australia (Fry-Mckibbin et al. 2025), and more recently the semiconductor boom in Korea and Taiwan illustrate this broader pattern.[2] These shocks affect the profitability of one sector, changing the relative sectoral demand for labor and creating pressure for labor to move across sectors.

Such inter-sectoral reallocation of labor is unlikely to be frictionless. A large literature studying sectoral adjustment emphasizes frictions in labor mobility across industries (Lee and Wolpin 2006; Dix-Carneiro 2014; Cardi and Restout 2015; Bertinelli et al. 2022) and that wages adjust only gradually (DiCecio 2009). These frictions are important for matching the observed response of employment to industry-specific shocks (Chodorow-Reich and Wieland 2020). In this paper, these frictions give rise to a distortion in the relative wage across the tradable and non-tradable sectors. Imperfect inter-sectoral labor mobility generates wages that can differ across sectors, but nominal wage rigidities prevent the relative wage from freely adjusting to shocks and distort the relative demand for labor.

The distorted relative wage creates a sectoral stabilization problem for monetary policy. Monetary policy can stabilize labor demand in the tradable sector by moving the exchange rate, but the associated change in domestic demand destabilizes labor demand in the non-tradable sector. Conversely, stabilizing the non-tradable sector can destabilize the tradable sector. Monetary policy must therefore choose how to allocate the effects of labor-market distortions across sectors resulting in a sectoral trade-off. Exchange rate management relaxes this trade-off. Capital controls and foreign exchange intervention give policymakers an additional margin for influencing the exchange rate and, in turn, another instrument to manage the tradable sector. Exchange rate management therefore complements monetary policy by allowing policymakers to use monetary policy focused on stabilizing the non-tradable sector and exchange rate management to manage the tradable sector. This provides a rationale for the managed float observed in many emerging market economies.

We formalize this mechanism in a tractable two-sector small-open-economy model with imperfect inter-sectoral labor mobility and constant wages. The model yields a simple characterization of the sectoral trade-off faced by monetary policy and of how capital controls alleviate it. A key implication is that the value of exchange rate management depends on the degree of labor mobility and the relative size of the sectors. When workers can move easily across sectors, the relative wage needed to efficiently allocate labor across sectors responds less to shocks, reducing the distortion caused by nominal wage rigidities. When labor mobility is low, the efficient relative wage responds strongly to shocks,

[2]See, for example, "Entry-Level Semiconductor Hiring Surges as AI Boom Widens the Door," *Korea JoongAng Daily*, July 20 2026; and "Taiwan's two-speed economy," *Taiwan News*, December 9 2015.

making it more difficult to achieve when wages are rigid. The welfare gains from exchange rate management are therefore larger when inter-sectoral labor mobility is lower. When the size of one sector becomes too small or large, there is also less need for labor reallocation, eliminating the welfare gains from exchange rate management.

We then assess the quantitative relevance of this mechanism using a richer version of the model with sticky wages calibrated separately to emerging market and advanced economies. The exercise is intended to evaluate whether the theoretical mechanism can generate economically meaningful differences across country groups rather than to provide a precise quantitative accounting of exchange rate management. The calibrated model implies larger welfare gains from exchange rate management in emerging markets than in advanced economies. Through the lens of the model, this difference is associated primarily with lower inter-sectoral labor mobility and more persistent and volatile shocks in emerging markets. The quantitative results suggest differences in labor market frictions across emerging market and advanced economies may also be an important factor in explaining why the former manage the exchange rate more than the latter. We also extend the model to incorporate foreign exchange intervention and find qualitatively similar results.

In addition, we use the framework to speak to the debate between the Trilemma and Dilemma view of monetary autonomy. Under the conventional Trilemma, a flexible exchange rate restores monetary-policy independence in the presence of free capital mobility. The Global Financial Cycle literature (Rey 2015; Miranda-Agrippino and Rey 2022) instead emphasizes that fluctuations in global financial conditions can constrain domestic policy even under flexible exchange rates and monetary autonomy can only be gained by using capital controls. Our mechanism provides a novel perspective on this argument. When the cost of using capital controls is sufficiently small, the effective monetary autonomy gained from capital controls, measured as the welfare gain from using capital controls, is larger than that gained from exchange rate flexibility when responding to global financial shocks. Using the quantitative model, we find that this is indeed the case, providing support to the Dilemma hypothesis. Interestingly, we find that the opposite holds when responding to terms-of-trade shocks, highlighting how the comparison is sensitive to the context of shocks.

Related literature. This paper is related to several strands of literature. First and foremost, this paper is related to the extensive literature on using multiple policy instruments to address externalities that emerge from having multiple frictions. Farhi and Werning (2016), Korinek and Simsek (2016), Schmitt-Grohé and Uribe (2016), and Bianchi and

Coulibaly (2026a) motivate the use of capital controls in environments where externalities arise as a result of nominal rigidities and frictions in the use of monetary policy. Alternatively, Costinot et al. (2014), Farhi and Werning (2014a), Devereux et al. (2019), Coulibaly (2023), Bianchi and Coulibaly (2026b), and Itskhoki and Mukhin (2023) motivate the use of either capital controls or foreign exchange intervention in models with nominal price rigidities and financial frictions such as credit constraints or incomplete financial markets. Basu et al. (2025) study a multitude of policy instruments in an environment with a wide range of frictions and shocks. We contribute to this literature by analyzing an environment with nominal wage rigidities and imperfect inter-sectoral labor mobility that generates an aggregate labor demand externality, similar in spirit to the aggregate demand externality discussed in Farhi and Werning (2016), and motivating the simultaneous use of monetary policy and capital controls.[3]

Second, the paper is related to the literature that studies sectoral reallocation of labor and its macroeconomic consequences. Using models with perfect labor mobility, Benigno and Fornaro (2014), Alberola and Benigno (2017), and Benigno et al. (2022) show how global financial shocks and commodity price shocks can lead to reallocation of labor across sectors, motivating the use of capital controls or reserve accumulation. Horvath (2000), Cardi and Restout (2015), and Bertinelli et al. (2022) develop models with limited inter-sectoral labor mobility to show how sectoral shocks can give rise to aggregate fluctuations, how the real exchange rate responds to sectoral shocks, and how labor reallocates across sectors in response to technology shocks biased towards the tradable sector respectively. Shi (2011), Petrella et al. (2019), and Cantelmo and Melina (2023) solve for the optimal monetary policy in a variety of environments with multiple sectors and imperfect inter-sectoral labor mobility. We contribute to this literature by developing a theory of exchange rate management based on distortions that arise as a result of imperfect labor mobility and nominal wage rigidities.

Lastly, this paper is related to the literature that studies the Trilemma versus Dilemma debate. Miranda-Agrippino and Rey (2020) show that the impact of the Global Financial Cycle on credit and financial conditions does not depend on a country's exchange rate regime, highlighting the importance of using capital controls to achieve monetary autonomy and hence a Dilemma. In contrast, Farhi and Werning (2014a) and Obstfeld et al. (2018) show that the exchange rate regime matters for the transmission of global finan-

[3] Jeanne (2022) and Farhi and Werning (2014b) also motivate using capital controls in a model with limited inter-sectoral labor mobility. This paper contributes to these papers by developing a model with a continuous measure of labor mobility, analyzing how the degree of labor mobility matters for the welfare gains from exchange rate management, and suggesting that emerging markets may benefit more from exchange rate management than advanced economies because of lower inter-sectoral labor mobility.

cial shocks to domestic macroeconomic variables. By measuring the effective monetary autonomy gained from using capital controls and having exchange rate flexibility as the welfare gain from these policy choices, we show that exchange rate flexibility is more valuable in responding to terms-of-trade shocks but capital controls are more valuable in dealing with shocks to global financial conditions. Therefore, we find that in the context of global financial shocks, there is support for Rey (2015)'s Dilemma hypothesis.

The paper is organized as follows. In Section 2, we develop a tractable model with the sectoral trade-off of monetary policy at its core. In Section 3 we generalize the results of the tractable model by developing a quantitative model and calibrating it separately to emerging markets and advanced economies. We extend the baseline quantitative model in Section 4 to incorporate foreign exchange intervention. Lastly, we conclude in Section 5.

2 Tractable Model

We develop a tractable model featuring imperfect inter-sectoral labor mobility and constant wages. These frictions give rise to a sectoral trade-off of monetary policy which can be alleviated by managing exchange rates with capital controls.

2.1 Setup

Consider a deterministic small open economy model with two sectors, home tradables H and non-tradables N. Time is infinite and the economy is initially in a steady state. In period 0, the economy is hit by unexpected shocks to the UIP wedge, the terms of trade, and sectoral productivity which return to their steady state values in period 1 onward. The policymaker has access to monetary policy and capital controls, subject to the policy regime.

Firms. Firms in sector $S \in \{H, N\}$ use production technologies given by

$$Y_{S,t} = A_{S,t} L_{S,t}^{\alpha_S} \tag{1}$$

where $Y_{S,t}$ is output, $L_{S,t}$ is labor, $A_{S,t}$ is sectoral productivity and $\alpha_S \in [0, 1]$. For tractability, we assume $\alpha_N = 1$. Perfect competition implies that labor demand satisfies

$$\frac{W_{S,t}}{P_{S,t}} = \alpha_S A_{S,t} L_{S,t}^{\alpha_S - 1} \tag{2}$$

where $W_{S,t}$ and $P_{S,t}$ denote the home currency wage and price of goods produced in sector S. The law of one price holds for tradable goods and the home currency price of home tradables is

$$P_{H,t} = E_t P^*_{H,t}$$

where $P^*_{H,t}$ is the dollar price of home tradables and E_t is the nominal exchange rate between the home currency and the US dollar denoted such that an increase represents a depreciation of the home currency. We assume $P^*_{H,t}$ is exogenous.

Note that exchange rates have a direct impact on labor demand in the home tradable good sector via the real wage. An appreciation of the home currency increases the real wage, thereby reducing labor demand. A depreciation has the opposite effect. Policy instruments that impact the exchange rate can therefore be used to control labor demand and the supply of goods in the tradable sector. This mechanism differs from other models where exchange rate management stabilizes the macroeconomy mainly through the expenditure switching channel as in Itskhoki and Mukhin (2023).

Households. The representative household's lifetime utility is given as

$$\sum_{t=0}^{\infty} \beta^t \left[u\left(C_t\right) - v\left(L_t\right) \right],$$

where β is the discount factor and utility takes the form of

$$u(C_t) = \frac{C_t^{1-\sigma} - 1}{1-\sigma} \quad \text{and} \quad v\left(L_t\right) = \xi \frac{L_t^{1+\psi}}{1+\psi}.$$

Households consume home tradable (H), foreign tradable (F), and non-tradable (N) goods. Aggregate consumption is

$$C_t = \left[\omega_c^{\frac{1}{\theta_c}} C_{T,t}^{\frac{\theta_c - 1}{\theta_c}} + (1-\omega_c)^{\frac{1}{\theta_c}} C_{N,t}^{\frac{\theta_c - 1}{\theta_c}} \right]^{\frac{\theta_c}{\theta_c - 1}}. \tag{3}$$

and tradable consumption is

$$C_{T,t} = \left[\gamma^{\frac{1}{\phi}} C_{H,t}^{\frac{\phi - 1}{\phi}} + (1-\gamma)^{\frac{1}{\phi}} C_{F,t}^{\frac{\phi - 1}{\phi}} \right]^{\frac{\phi}{\phi - 1}}. \tag{4}$$

For tractability, we assume $\sigma = \theta_C = \phi = 1$.

We introduce imperfect inter-sectoral labor mobility by letting aggregate labor be a CES aggregator of labor supplied to the two sectors:[4]

$$L_t = \left[\omega_\ell^{-\frac{1}{\theta_\ell}} L_{H,t}^{\frac{\theta_\ell+1}{\theta_\ell}} + (1-\omega_\ell)^{-\frac{1}{\theta_\ell}} L_{N,t}^{\frac{\theta_\ell+1}{\theta_\ell}} \right]^{\frac{\theta_\ell}{\theta_\ell+1}}. \tag{5}$$

When the elasticity of substitution of sectoral labor, θ_ℓ, is finite, there is a utility cost associated with shifting one unit of labor from one sector to another which decreases as θ_ℓ increases. Therefore, we interpret θ_ℓ to represent the level of inter-sectoral labor mobility. In the limit where there is full mobility ($\theta_\ell \to \infty$), aggregate labor becomes a simple sum of sectoral labor such that there is no cost associated with labor reallocation across sectors. A key feature of having imperfect inter-sectoral labor mobility is that wages can differ across sectors. Again, for tractability, we assume $\theta_\ell = 1/\psi$.

Households have access to a home currency bond and a dollar bond, which we call a home dollar bond to differentiate it from US treasuries. We denote the home currency value of home currency bonds held by households at the beginning of period t with B_t and denote the dollar value of home dollar bonds held by households at the beginning of period t with B_t^*. We assume only home dollar bonds are traded in international markets so that $B_t = 0$ in equilibrium.[5] The household budget constraint is

$$\sum_{S\in\{H,F,N\}} P_{S,t}C_{S,t} + B_{t+1} + E_t B_{t+1}^* = \sum_{S\in\{H,N\}} W_{S,t}L_{S,t} + (1+i_{t-1})B_t + E_t(1+i_{t-1}^*)B_t^* + \Pi_t$$

where Π_t is a lump-sum transfer of profits from firms and net tax revenue from the gov-

[4] We follow Horvath (2000), Iacoviello and Neri (2010) and Bertinelli et al. (2022) to model imperfect inter-sectoral labor mobility with a CES aggregator. This allows the model to capture imperfect inter-sectoral labor mobility in a representative agent model setting. An alternative way to model it in a representative agent model is to introduce a quadratic cost of sectoral labor adjustment as in Ju et al. (2014) and Shi (2011). A key distinction between these two assumptions is how the marginal disutility of labor in one sector is affected by labor in the other sector. With the CES aggregator there is a negative relationship under $\psi < \frac{1}{\theta_\ell}$ while with the quadratic costs there is always a positive relationship. This difference is however quantitatively minimal and the results are robust to modeling imperfect labor mobility with quadratic costs. Another way to model imperfect inter-sectoral labor mobility is to introduce heterogeneity in households and a cost for switching sectors.

[5] This is for two reasons. First, by allowing only dollar denominated assets to be traded internationally, we are able to disregard the insurance aspect of exchange rate management as discussed in Fanelli (2023). If Home currency bonds are traded internationally, the exchange rate can be managed to influence ex-post dollar returns on Home currency bonds which is not a motive we want to focus on in this paper. Second, it is realistic. Many emerging markets are better able to borrow internationally by issuing dollar debt, a phenomenon called the "Original Sin". Although the prevalence of the Original Sin has diminished (Onen et al. 2023), it is still present especially in the private issuance of debt.

ernment. i_t and i_t^* are the interest rates on home currency bonds and home dollar bonds respectively.

The first-order conditions for consumption goods imply

$$\frac{u_{N,t}}{P_{N,t}} = \frac{u_{T,t}}{P_{T,t}}, \quad \frac{u_{T,t}}{P_{T,t}} = \frac{u_{H,t}}{P_{H,t}}, \quad \text{and} \quad \frac{u_{T,t}}{P_{T,t}} = \frac{u_{F,t}}{P_{F,t}}$$

where $u_{S,t} \equiv \frac{\partial u(C_t)}{\partial C_{S,t}}$ for $S \in \{H, F, T, N\}$ and $P_{T,t} \equiv \left[\gamma P_{H,t}^{1-\phi} + (1-\gamma) P_{F,t}^{1-\phi}\right]^{\frac{1}{1-\phi}}$. The dollar price of foreign tradables is normalized to 1 so that the home currency price of foreign tradables satisfies $P_{F,t} = E_t$ and the dollar price of home tradables, $P_{H,t}^*$, captures the terms of trade in the model which we assume to be exogenous.[6]

Lastly, the Euler equations are

$$u_{N,t} = \beta(1 + i_t) \frac{P_{N,t}}{P_{N,t+1}} u_{N,t+1} \tag{6}$$

and

$$u_{T,t} = \beta(1 + i_t^*) \frac{P_{T,t}/E_t}{P_{T,t+1}/E_{t+1}} u_{T,t+1}. \tag{7}$$

Using linearized versions of the Euler equations and the first-order conditions for consumption gives the uncovered interest parity (UIP) condition

$$i_t - \Delta e_{t+1} = i_t^*, \tag{8}$$

where $\Delta e_{t+1} \equiv \frac{E_{t+1}}{E_t} - 1$.

Nominal wage rigidities. To model nominal wage rigidities, we assume nominal wages are fixed to their inherited steady state values:

$$W_{N,t} = W_N \quad \text{and} \quad W_{H,t} = W_H, \quad \forall t \geq 0.$$

This prevents the relative wage $\frac{W_{H,t}}{W_{N,t}}$ from adjusting in response to shocks. With wages unable to adjust, labor is determined by demand: households supply the quantity of labor demanded by firms at the prevailing wages.

[6] Although we could let the dollar price of Foreign tradables be stochastic, this would have minimal impact on welfare and the optimal policy equilibrium. The main inefficiencies in the model stem from fluctuations in labor demand. The price of Foreign tradables affects labor demand only indirectly through the substitution effects which are calibrated to be small in Section 3.

Constant wages are a source of monetary non-neutrality in the tractable model. In the quantitative model, we relax the assumption of having constant wages and assume sticky wages via quadratic wage adjustment costs à la Rotemberg (1982). The constant wages assumed here can be viewed as the limiting case in which wage adjustment costs are infinite.

Financial market structure. Foreign investors trade home dollar bonds with home households and require a time-varying excess return, ρ_t, over US treasuries representing fluctuations in external financing conditions. We interpret fluctuations in ρ_t to capture the Global Financial Cycle from Miranda-Agrippino and Rey (2022) such that high values of ρ_t represent times of global financial stress while low values of ρ_t represent times of global financial exuberance. In what follows, we refer to ρ_t as a UIP wedge shock.[7]

The home policymaker can impose capital controls in the form of a tax τ_t on purchases of home dollar bonds by foreign investors. The return on home dollar bonds satisfies

$$i_t^* = i^{US} + \rho_t + \tau_t. \tag{9}$$

The tax revenue is rebated as a lump-sum to home households. Combining this condition with Equation (8) gives the adjusted UIP condition:

$$i_t - \Delta e_{t+1} - i^{US} = \rho_t + \tau_t. \tag{10}$$

Equation (10) shows how monetary policy and capital controls jointly determine the exchange rate. Conditional on future exchange rates, a decrease in i_t or an increase in τ_t can depreciate the exchange rate. Capital controls can therefore substitute for monetary policy in managing the exchange rate.

Market clearing. Market clearing in the non-tradable sector requires

$$C_{N,t} = Y_{N,t}. \tag{11}$$

[7]The excess return, ρ_t, can be interpreted as representing levels of financial friction or market segmentation that foreign investors are exposed to. These foreign investors are investors who are specialized in trading home dollar bonds with the Home economy, and therefore operate in a segmented market. As a result, US treasuries and home dollar bonds differ in their liquidity and are not perfect substitutes, giving rise to different returns. In addition, we assume ρ_t is invariant to the exchange rate regime for tractability. Itskhoki and Mukhin (2023) instead study environments in which risk premia and exchange-rate dynamics respond endogenously to the policy regime.

Market clearing for home tradables is

$$Y_{H,t} = C_{H,t} + C^*_{H,t} \tag{12}$$

where $C^*_{H,t}$ is foreign demand for home tradables. We assume $C^*_{H,t}$ is perfectly elastic at the given dollar price of the home tradable good and absorbs the output of home tradable goods net of home demand for home tradable goods.[8]

The lump-sum transfer to households is the sum of profits by firms and the government's net tax revenue.

$$\Pi_t = P_{H,t}Y_{H,t} - W_{H,t}L_{H,t} + P_{N,t}Y_{N,t} - W_{N,t}L_{N,t} - \tau_t B^*_t$$

Combining the household budget constraint, market clearing conditions and transfers gives the aggregate budget constraint

$$C_{F,t} + P^*_{H,t}C_{H,t} + B^*_{t+1} = P^*_{H,t}Y_{H,t} + (1 + i^{US} + \rho_{t-1})B^*_t. \tag{13}$$

Policy instruments and regimes. The policymaker has access to two policy instruments: monetary policy, i_t, and capital controls, τ_t. Although both instruments can influence home tradable output via the exchange rate through Equation (10), they differ in what else they impact. Monetary policy impacts demand for non-tradable goods through Equation (6), while capital controls impact the demand for tradable goods through the second Euler equation, Equation (7). Therefore, monetary policy manages $Y_{H,t}$ and $Y_{N,t}$ while capital controls manage $Y_{H,t}$ and $C_{T,t}$.[9]

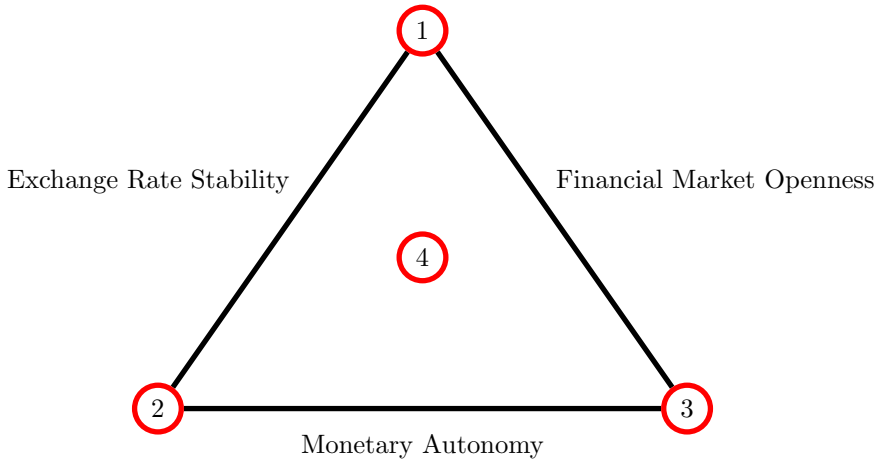
The freedom to use these policy instruments is constrained by the policy regime. We consider four policy regimes depicted in Figure 2. Regimes 1-3 located at the three vertices of the Trilemma are those described in the textbook Mundell-Fleming framework where two out of three policy objectives are achieved by forgoing the other. Regime 1 corresponds to the textbook fixed exchange rate regime with open financial markets.[10]

[8]Note that the terms of trade are exogenous in this model and not influenced by exchange rates. This is assumed for two reasons. First, this allows the policy maker to disregard the motive to manage the exchange rate for intertemporal consumption smoothing as studied in Costinot et al. (2014). Second, the assumption is realistic for small open economies which have small pricing power in international goods markets.

[9]In the tractable model, because we assume separability of utility, monetary policy does not impact $C_{T,t}$ and capital controls do not impact $Y_{N,t}$. This split disappears in the quantitative model where we allow substitution effects, but the main channels remain the same.

[10]We follow Rey (2015) and interpret financial market openness as implying no distortion between home and foreign investors. Capital controls discriminate home and foreign investors and therefore using capital controls implies financial markets are not open.

Regime 2 maintains a fixed exchange rate, but gains monetary autonomy by allowing capital controls. Regime 3, the pure float, maintains fully open financial markets, but gains monetary autonomy by allowing the exchange rate to float. Regime 4, the managed float, lies in the middle of the Trilemma and allows both exchange rate flexibility and capital controls.



Regime 1 (Fixed exchange rate regime): $\Delta e_t = 0$ and $\tau_t = 0$

Regime 2 (Fixed exchange rate regime with capital controls): $\Delta e_t = 0$

Regime 3 (Pure float): $\tau_t = 0$

Regime 4 (Managed float): No constraints

Figure 2: The Mundell-Fleming Trilemma and policy regimes

2.2 Optimal policy equilibrium

We first define the first-best allocation and solve for the optimal policy mix that minimizes welfare loss relative to the first-best allocation.

First-best allocation. The first-best allocation is defined as the social planner's allocation that maximizes household lifetime utility taking as given the resource constraints, imperfect inter-sectoral labor mobility and the structure of financial markets.

Definition. (First-best allocation) *The first-best allocation is the allocation of* $\{C_t, C_{T,t}, C_{H,t}, C_{F,t}, C_{N,t}, L_t, L_{H,t}, L_{N,t}, B^*_{t+1}\}_{t=0}^{\infty}$ *given an initial condition* $B^*_0 = 0$*, the definition of* C_t*,* $C_{T,t}$ *and* L_t *given by Equations (3) - (5), and exogenous processes* $\{\rho_t, P^*_{H,t}, A_{H,t}, A_{N,t}\}_{t=0}^{\infty}$ *that solves*

the following problem.

$$\begin{aligned} \max \quad & \sum_{t=0}^{\infty} \beta^t \left[u(C_t) - v(L_t) \right] \\ s.t. \quad & C_{N,t} = A_{N,t} L_{N,t}^{\alpha_N} \\ & C_{F,t} + P_{H,t}^* C_{H,t} + B_{t+1}^* = P_{H,t}^* A_{H,t} L_{H,t}^{\alpha_H} + (1 + i^{US} + \rho_{t-1}) B_t^* \end{aligned}$$

The *natural* allocation in which wages are flexible coincides with the first-best allocation since the only distortion relative to the first-best in the model is nominal rigidity in wages.[11] Labor supply under flexible wages is derived from the first-order conditions of the household's problem with respect to $L_{H,t}$ and $L_{N,t}$:

$$\frac{v_{H,t}}{W_{H,t}} = \frac{u_{H,t}}{P_{H,t}} \tag{14}$$

and

$$\frac{v_{N,t}}{W_{N,t}} = \frac{u_{N,t}}{P_{N,t}} \tag{15}$$

where $v_{S,t} \equiv \frac{\partial v(L_t)}{\partial L_{S,t}}$ for $\forall S \in \{H, N\}$.

From here on, we use variables without a time subscript to denote the steady state values and lower case variables to denote the log-deviation from the steady state (e.g. $y_{N,t} = \log Y_{N,t} - \log Y_N$). We use the superscript "n" to denote the value of the variable under the natural allocation and "hats" to denote gaps between the equilibrium value and the natural allocation value (e.g. $\hat{y}_{N,t} = y_{N,t} - y_{N,t}^n$).

Solving for the natural allocation and linearizing around the steady state gives

$$\ell_{N,0}^n = 0$$

and

$$\ell_{H,0}^n = \frac{1}{1 - \alpha_H + \frac{1}{\theta_\ell}} \left(\rho_0 + p_{H,0}^* + a_{H,0} \right).$$

Thus, shocks to the UIP wedge, terms of trade, or tradable productivity change the natural level of labor in the home tradable sector.[12] Under flexible wages, the relative wage

[11] The natural allocation is defined as the flexible-wage competitive equilibrium where the policymaker does not use capital controls and only home dollar bonds are traded.

[12] Shocks to productivity in the non-tradable sector do not impact the natural allocation of labor and

adjusts to implement this allocation with the implied natural relative wage satisfying[13]

$$w^n_{H,0} - w^n_{N,0} = \frac{\frac{1}{\theta_\ell}}{1 - \alpha_H + \frac{1}{\theta_\ell}} \left(\rho_0 + p^*_{H,0} + a_{H,0}\right). \tag{16}$$

The response in the relative wage to shocks is inversely scaled by labor mobility, θ_ℓ and converges to zero as labor mobility approaches infinity (i.e. $\lim_{\theta_\ell \to \infty} \left(w^n_{H,0} - w^n_{N,0}\right) = 0$).

Policymaker's problem. We are now ready to define the policymaker's problem and the optimal policy equilibrium. We use a linear-quadratic approach to solve for the optimal policy that minimizes welfare loss relative to the first-best. The policymaker's problem is defined such that the policymaker directly chooses the allocations to minimize the welfare loss function subject to the equilibrium conditions. The policy instruments that implement the optimal allocations are derived afterwards.

The policymaker's problem can be simplified to a static problem that only addresses welfare loss in period 0. This is because it is feasible for the policymaker to close all welfare relevant gaps in periods 1 onward up to a second-order regardless of the policy regime since there are no shocks and period 0 allocations can be chosen independent of allocations in future periods.[14] The optimal policy equilibrium is defined as follows.

Definition. (Optimal policy equilibrium) *The optimal policy equilibrium under policy regime R is the allocation of $\{\hat{y}_{H,0}, \hat{y}_{N,0}, \hat{c}_{T,0}\}$ given an exogenous realization of $\{\rho_0, p^*_{H,0}, a_{H,0}, a_{N,0}\}$ that solves the following optimization problem.*

$$\min \quad \gamma_H \hat{y}^2_{H,0} + \gamma_N \hat{y}^2_{N,0} + \gamma_T \hat{c}^2_{T,0} \tag{17}$$

$$s.t. \quad -\frac{1-\alpha_H}{\alpha_H}\hat{y}_{H,0} + \hat{y}_{N,0} - \hat{c}_{T,0} = -(w^n_{H,0} - w^n_{N,0}), \tag{18}$$

$$\frac{1-\alpha_H}{\alpha_H}\hat{y}_{H,0} = w^n_{H,0} - e^n_0 \quad if \quad R \in \{1,2\}, \tag{19}$$

$$\hat{c}_{T,0} = 0 \quad if \quad R \in \{1,3\}. \tag{20}$$

where $\gamma_H \equiv \frac{\omega_c}{\alpha_H}\left(\frac{1}{\theta_\ell} + 1 - \alpha_H\right)$, $\gamma_N \equiv (1-\omega_c)\left(1 + \frac{1}{\theta_\ell}\right)$, and $\gamma_T \equiv \omega_c$. The policies that imple-

simply change non-tradable output one-for-one as we assume separable log utility for tractability.

[13] Linearizing the labor supply condition, $\frac{v_{N,t}}{W_{N,t}} = \frac{v_{H,t}}{W_{H,t}}$, suggests there is a linear relationship between relative wage and labor that depends on inter-sectoral labor mobility: $w^n_{H,t} - w^n_{N,t} = \frac{1}{\theta_\ell}\left(\ell^n_{H,t} - \ell^n_{N,t}\right)$.

[14] To be more precise, shocks and policy choice in period 0 have a second-order impact on variables in period 1 onward through changes in the net foreign asset position. The per-period welfare effects of these future deviations are therefore fourth-order since welfare loss is a quadratic function, and the total present discounted value of these future deviations is third-order and neglected.

ment the allocations can be solved for with $i_0 = \left(\frac{1}{\beta} - 1\right) - \hat{y}_{N,0}$ *and* $\tau_0 = -\hat{c}_{T,0}$.

The first constraint, Equation (18), captures the entirety of the equilibrium conditions of the tractable model and highlights the role of nominal wage rigidities in the model.[15] Nominal wage rigidities prevent the relative wage, $w_{H,0} - w_{N,0}$, from adjusting resulting in a gap in the relative wage that shows up in the right hand side of Equation (18).[16] Equations (19) and (20) represent policy regime specific constraints. Under fixed exchange rates (i.e. Regimes 1 and 2), the real wage in the home tradable sector is exogenous, preventing the policymaker from being able to manage $\hat{y}_{H,0}$.[17] When financial markets are fully open (i.e. Regimes 1 and 3), capital controls cannot be used and $\hat{c}_{T,0}$ is exogenous.

In Regime 1, the policymaker has no flexibility in using any policy instrument since exchange rates are fixed and financial markets are kept fully open. In Regime 2, the policymaker gains monetary autonomy by being able to substitute monetary policy with capital controls in keeping the exchange rate fixed. When shocks create appreciation pressure, the policymaker leans fully against it with both instruments by lowering the interest rate and imposing taxes. In Regime 3, the policymaker gains monetary autonomy by allowing the exchange rate to float. Shocks that stimulate the tradable sector (e.g. a positive shock to the UIP wedge, terms of trade, or tradable productivity) generate excessive labor demand in the tradable sector and the policymaker leans against them by raising interest rates. In Regime 4, the policymaker gains both exchange rate flexibility and capital controls and leans against shocks that stimulate the tradable sector using both instruments. We derive the closed form solution under each policy regime in Appendix A.3.

The sectoral trade-off of monetary policy. The model generates a sectoral trade-off of monetary policy under a pure float (Regime 3). Without capital controls, $\hat{c}_{T,0} = 0$ and Equation (18) requires the policymaker to allocate the inefficiency between the tradable and non-tradable output gaps. Monetary policy can stabilize the tradable sector by moving the exchange rate, but doing so changes domestic demand and destabilizes the non-tradable sector and vice-versa.

[15] See Appendix A.1 for a derivation.

[16] The gap of the relative wage, $\hat{w}_{H,0} - \hat{w}_{N,0}$, is equal to $-(w^n_{H,0} - w^n_{N,0})$ since $w_{H,0} - w_{N,0} = 0$ under constant wages. Similarly, under fixed exchange rates and constant wages the gap of the real wage in the tradable sector, $\hat{w}_{H,0} - \hat{e}_0$, is equal to $-(w^n_{H,0} - e^n_0)$ since $w_{H,0} - e_0 = 0$.

[17] Solving for the first-best and natural allocation shows that

$$w^n_{H,0} - e^n_0 = -\frac{1-\alpha_H}{\frac{1}{\theta_\ell} + 1 - \alpha_H}\rho_0 + \frac{\frac{1}{\theta_\ell}}{\frac{1}{\theta_\ell} + 1 - \alpha_H}(p^*_{H,0} + a_{H,0}).$$

A managed float relaxes this trade-off. Capital controls provide an additional degree of freedom in managing the exchange rate and hence the tradable output gap, thereby alleviating the sectoral trade-off of monetary policy, but at the cost of distorting tradable consumption. The policymaker optimally allocates the inefficiency generated from nominal wage rigidities across the two output gaps and tradable consumption gap.[18]

The roles of the relative size of sectors and imperfect inter-sectoral labor mobility are also immediate from the definition of weights and Equation (18). The sectoral trade-off of monetary policy exists because there are two sectors and a relative wage gap. If the relative size of one sector converges to zero or labor becomes fully mobile so that the relative wage gap disappears, monetary policy can close all gaps under a pure float implying *divine coincidence*. This leads us to the first proposition.

Proposition 1. (Divine Coincidence) *As the relative size of one sector converges to zero (i.e.* $\omega_c \to 0$ *or* $\omega_c \to 1$*) or as labor becomes fully mobile (i.e.* $\theta_\ell \to \infty$*), the first-best allocation can be achieved with monetary policy under a pure float (Regime 3).*

Proof. This is immediate from the definition of the weights and the relative wage gap.

Welfare analysis. It is easy to see that because of the difference in constraints across policy regimes, welfare loss is highest in Regime 1 and lowest in Regime 4. More specifically, let $\mathscr{L}_R \equiv \gamma_H \hat{y}_{H,0}(R)^2 + \gamma_N \hat{y}_{N,0}(R)^2 + \gamma_T \hat{c}_{T,0}(R)^2$ where $\hat{y}_{H,0}(R)$, $\hat{y}_{N,0}(R)$, and $\hat{c}_{T,0}(R)$ represent the values of $\hat{y}_{H,0}$, $\hat{y}_{N,0}$ and $\hat{c}_{T,0}$ chosen optimally under Regime R. Then, we have the second proposition.

Proposition 2. (Welfare Ranking) $\mathscr{L}_1 \geq \mathscr{L}_2 \geq \mathscr{L}_4$ *and* $\mathscr{L}_1 \geq \mathscr{L}_3 \geq \mathscr{L}_4$.

Proof. This is immediate from the difference in constraints across policy regimes.

We quantify the welfare gains from exchange rate management as the difference between the welfare loss under a pure float and that under a managed float. The larger this gain is, the more economies are incentivized to manage the exchange rate and switch from a pure float to a managed float. We find that the welfare gains from exchange rate management decrease with labor mobility, leading to the third proposition.

[18] The first-best policy instrument is sectoral labor subsidies, which can directly address the distortion in sectoral labor demand. In reality, labor subsidies are difficult to change dynamically in response to shocks. Instead, we study exchange rate management policy tools that are second-best.

Proposition 3. (Comparative Statics) *The welfare gains from exchange rate management, measured as $\mathscr{L}_3 - \mathscr{L}_4$, are weakly decreasing in θ_ℓ.*

Proof. See Appendix A.4.

For economies with low levels of inter-sectoral labor mobility, the sectoral trade-off of monetary policy is large, and therefore being able to use capital controls to manage the exchange rate generates large improvements in welfare. In the quantitative model, we find that differences in inter-sectoral labor mobility across emerging market economies and advanced economies are one of the main drivers of why exchange rate management is more welfare enhancing in emerging market economies than advanced economies. In the limit where there is full labor mobility, divine coincidence holds, and both $\mathscr{L}_3$ and $\mathscr{L}_4$ converge to zero.

In addition to comparing welfare across Regimes 3 and 4 to quantify the welfare gains from exchange rate management, we compare welfare across Regimes 2 and 3. The Mundell-Fleming Trilemma identifies two alternative ways of recovering monetary autonomy. An economy can maintain financial market openness and allow the exchange rate to adjust, or it can keep the exchange rate fixed while limiting financial market openness through capital controls. We quantify the value of the monetary autonomy provided by each choice (capital controls and exchange rate flexibility) by measuring welfare in Regimes 2 and 3 relative to Regime 1. In particular, we define the value of monetary autonomy gained from capital controls as the reduction in welfare loss from moving from Regime 1 to Regime 2, $\mathscr{G}^{CC}$, and that gained from exchange rate flexibility as the reduction in welfare loss from moving from Regime 1 to Regime 3, $\mathscr{G}^{FX}$.[19] Thus, the exercise compares the welfare gains from moving from the top vertex of the Trilemma depicted in Figure 2 to each of its two alternative vertices. We find that the comparison depends on the nature of shocks, leading us to the fourth proposition.

Proposition 4. *Let us quantify the welfare gains from capital controls as $\mathscr{G}^{CC} \equiv \mathscr{L}_1 - \mathscr{L}_2$ and those from exchange rate flexibility as $\mathscr{G}^{FX} \equiv \mathscr{L}_1 - \mathscr{L}_3$. If $\rho_0 = 0$ and $|p^*_{H,0} + a_{H,0}| > 0$, then $\mathscr{G}^{FX} > \mathscr{G}^{CC}$. If $|\rho_0| > 0$ and $p^*_{H,0} + a_{H,0} = 0$, then $\mathscr{G}^{CC} > \mathscr{G}^{FX}$ if and only if $\frac{\gamma_T}{\gamma_N} < \zeta$ where $\zeta \equiv -\frac{1}{\alpha_H} + \frac{1}{2} + \sqrt{\frac{1}{4} + \frac{1}{\theta_\ell \alpha_H}}$.*

[19] Alternatively, we can define the value of monetary autonomy gained from capital controls as the sum of the reduction in welfare loss from moving from Regime 1 to 2 and from Regime 4 to 3 and define the value of monetary autonomy gained from exchange rate flexibility as the sum of the reduction in welfare loss from moving from Regime 1 to 3 and from Regime 4 to 2. The results are robust to this alternative definition.

Proof. See Appendix A.5.

When there are shocks to the terms of trade or tradable sector productivity, the welfare value of exchange rate flexibility is higher so that $\mathscr{G}^{FX} > \mathscr{G}^{CC}$. Intuitively, this is because shocks to the terms of trade and tradable sector productivity impact $\hat{y}_{H,0}$. With fixed exchange rates, the real wage is exogenous and policy instruments cannot influence tradable output. Therefore, the ability to let the exchange rate float and use instruments to manage tradable output is more welfare enhancing than being able to use capital controls.[20]

When there are shocks to the UIP wedge, the welfare value of being able to use capital controls is higher and $\mathscr{G}^{CC} > \mathscr{G}^{FX}$ if $\frac{\gamma_T}{\gamma_N}$, the weight of $\hat{c}_{T,0}$ relative to that of $\hat{y}_{N,0}$ in the welfare loss function, is sufficiently small. This provides conditional support to the Dilemma hypothesis of Rey (2015). When γ_T is sufficiently small relative to γ_N, exchange rate flexibility provides less effective monetary autonomy than managing the capital account with capital controls in response to UIP wedge shocks which are interpreted as fluctuations in the Global Financial Cycle. This is because UIP wedge shocks create distortions in the non-tradable sector in Regime 1 and it is less costly for the policymaker to trade these distortions with distortions in tradable consumption via capital controls than to trade them with distortions in tradable output via exchange rate flexibility. We find this to be the case in the calibrated quantitative model as well.

3 Quantitative Model

In this section we generalize the results of the tractable model using a quantitative model with sticky wages calibrated separately to emerging market economies and advanced economies.

3.1 Setup

We generalize the tractable model along four dimensions needed for the quantitative analysis. We replace fixed wages with gradual wage adjustment to generate meaningful dynamics, introduce a portfolio adjustment cost to ensure stationarity, allow general consumption and labor elasticities, and model the exogenous state variables as persis-

[20] In the tractable model, there are no welfare gains from being able to use capital controls in response to shocks to the terms of trade or tradable sector productivity in Regime 2.

tent stochastic processes. These extensions preserve the sectoral trade-off highlighted in Section 2 while allowing us to evaluate its quantitative importance.

Nominal wage rigidity. Instead of constant wages, we assume sticky wages by introducing a quadratic wage adjustment cost à la Rotemberg (1982) and monopolistic competition of labor similar to Schmitt-Grohé and Uribe (2005). Households supply sector-specific labor, $L_{S,t}$, to a unit mass of monopolistically competitive labor unions. Labor union $j \in [0,1]$ supplies type-j labor, $L_{S,t}(j)$, to firms in sector S that aggregate across different types of labor using $L_{S,t} = \left[\int_0^1 L_{S,t}(j)^{\frac{\varepsilon_w - 1}{\varepsilon_w}} dj\right]^{\frac{\varepsilon_w}{\varepsilon_w - 1}}$. Labor union $j \in [0,1]$ sets the nominal wage $W_{S,t}(j)$ to maximize household utility taking into account type-j firms' labor demand in sector S given by $L_{S,t}(j) = (\frac{W_{S,t}(j)}{W_{S,t}})^{-\epsilon_w} L_{S,t}$ and a quadratic cost associated with wage inflation, $\frac{\kappa_w}{2} P_{S,t} Y_{S,t} {\pi^w_{S,t}(j)}^2$ where $\pi^w_{S,t}(j) \equiv \frac{W_{S,t}(j)}{W_{S,t-1}(j)} - 1$. We assume households are provided a wage subsidy, $\tau_w = \frac{1}{\varepsilon_w - 1}$, to offset the constant markup from monopolistic competition and financed by a lump-sum tax on households.

Since the wage optimization problem is identical across all unions, $L_{S,t}(j) = L_{S,t}$, $W_{S,t}(j) = W_{S,t}$, and $\pi^w_{S,t}(j) = \pi^w_{S,t}$ in equilibrium for $\forall j \in [0,1]$ and $\forall S \in \{H, N\}$. The first-order conditions with respect to wages result in sectoral wage Phillips Curves:

$$\pi^w_{S,t} = \beta \mathbb{E}_t \left[\pi^w_{S,t+1}\right] + \frac{\varepsilon_w \alpha_S}{\kappa_w} \left(\frac{v_{S,t}/u_{S,t}}{W_{S,t}/P_{S,t}} - 1\right), \quad \forall S \in \{H, N\}. \tag{21}$$

In the limit where there is no nominal wage rigidity ($\kappa_w \to 0$), the sectoral wage Phillips Curves converge to the labor supply conditions in the natural allocation given by Equations (14) and (15).

Stationarity and market clearing. To introduce stationarity, we follow Schmitt-Grohé and Uribe (2003) and model a quadratic cost in adjusting the net foreign asset position away from its steady state value of 0, $P_{F,t} \frac{\kappa_B}{2} \left(\frac{B_{t+1}}{E_t} + B^*_{t+1}\right)^2$. With the wage and portfolio adjustment costs, the aggregate budget constraint in the quantitative model is

$$\begin{aligned} &C_{F,t} + P^*_{H,t} C_{H,t} + B^*_{t+1} \\ &\quad = (1 - \frac{\kappa_w}{2} {\pi^w_{H,t}}^2) P^*_{H,t} Y_{H,t} + (1 + i^{US} + \rho_{t-1}) B^*_t - \frac{\kappa_B}{2} {B^*_{t+1}}^2 \end{aligned} \tag{22}$$

and the market clearing condition for non-tradables is

$$C_{N,t} = (1 - \frac{\kappa_w}{2} {\pi^w_{N,t}}^2) Y_{N,t}. \tag{23}$$

Parameters. Next, we relax the constraints on key elasticities ($\sigma = \theta_c = \phi = 1$ and $\theta_\ell = 1/\psi$ assumed in the tractable model), allowing substitution effects to play a role. We also relax the constraint of $\alpha_N = 1$ so that labor demand in the non-tradable sector is elastic to the real wage as in the tradable sector.

Shocks. Lastly, instead of having perfect foresight and unexpected shocks in period 0, we assume uncertainty and an AR(1) process for the UIP wedge, terms of trade, and productivity in the home tradable and non-tradable sectors. More specifically, we define AR(1) processes for ρ_t, $p^*_{H,t}$, $a_{H,t}$ and $a_{N,t}$ as follows:

$$\rho_t = \zeta_\rho \rho_{t-1} + \varepsilon_{\rho,t}, \qquad \varepsilon_{\rho,t} \sim N(0, \sigma^2_\rho) \tag{24}$$

$$p^*_{H,t} = \zeta_{pH*} p^*_{H,t-1} + \varepsilon_{pH*,t}, \qquad \varepsilon_{pH*,t} \sim N(0, \sigma^2_{pH*}) \tag{25}$$

$$a_{H,t} = \zeta_{AH} a_{H,t-1} + \varepsilon_{AH,t}, \qquad \varepsilon_{AH,t} \sim N(0, \sigma^2_{AH}) \tag{26}$$

$$a_{N,t} = \zeta_{AN} a_{N,t-1} + \varepsilon_{AN,t}, \qquad \varepsilon_{AN,t} \sim N(0, \sigma^2_{AN}). \tag{27}$$

Optimal policy equilibrium. We solve for the optimal policy equilibrium similar to the tractable model by linearizing the equilibrium conditions of the model and minimizing a quadratic welfare loss function relative to the first-best allocation. We solve for the policymaker's problem assuming the policymaker is able to commit and does so under a timeless perspective. We state the definition of the first-best allocation and setup of the policymaker's problem in Appendix B.3.

3.2 Calibration

We calibrate the model separately to emerging market and advanced economy samples using data over 2000 – 2014. Quarterly series are used when available. In the baseline, emerging markets are calibrated under a managed float while advanced economies are calibrated under a pure float. We use common values for preference parameters and elasticities that are conventional in the literature, while separately estimating sector-specific weights and shares, inter-sectoral labor mobility, portfolio adjustment cost, and stochastic processes for each country group. Table 1 summarizes the two calibrations.[21]

[21] We consider countries that have sector level labor and output data, the terms of trade, sectoral TFP and UIP wedges available. We use the International Monetary Fund (IMF)'s 2023 April World Economic Outlook to categorize countries as "advanced" and "emerging." The set of emerging market economies includes BRA, CHL, COL, HUN, IND, IDN, MEX and PER and advanced economies includes AUS, AUT, BEL, CAN, CHE, CZE, DEU, DNK, ESP, FIN, FRA, GBR, HRV, IRL, ITA, JPN, KOR, NLD, NOR, PRT, SVK, SVN, and SWE. We assign each country an exchange rate regime based on its modal classification in Ilzetzki et al. (2019) over 2000 – 2019 - that is, the regime observed most frequently during this period. All emerging

Parameters calibrated following the literature. The first set of parameters are those that are calibrated to standard values used in the literature. The discount factor is set to $\beta = 0.99$, which implies an annual risk-free rate of 4%. We set relative risk aversion and the inverse Frisch elasticity to $\sigma = \psi = 2$, implying an intertemporal elasticity of substitution and a Frisch elasticity of 0.5. As in Born and Pfeifer (2020) the elasticity of labor demand across different types of labor within a sector is set to $\varepsilon_W = 11$. The elasticity of substitution between tradable and non-tradable goods is set to $\theta_c = 0.44$ following Stockman and Tesar (1995), and that between Home and Foreign tradables is set to $\phi = 2$ following Feenstra et al. (2018). The wage inflation cost parameter, κ_w, is set so that the first-order dynamics are equivalent to a Calvo model where households update their wages once per year.[22]

Sector weights and shares. A second set of parameters is calibrated to match the weight and shares of each sector. We use the World Input Output Database Socio Economic Accounts and KLEMS database for sector specific data on hours worked, labor compensation, capital input and value added at an annual frequency for 2000-2014. We classify sectors that have a high export to output ratio (agricultural, mining, manufacturing and tradable services) as tradable and others (non-tradable services) as non-tradable. The sectoral classification and data construction are described in Appendix B.4.

For each country group, the production elasticities α_H and α_N are set equal to the average labor-income shares in the tradable and non-tradable sectors. The tradable consumption weight ω_c is chosen to match the ratio of tradable to non-tradable value added, while the tradable sector labor weight ω_ℓ is chosen to match the ratio of hours worked in the two sectors. The home-bias parameter γ is set using the share of imported final

market economies in our sample are classified as having either a crawling peg or a managed float, whereas among non-euro-area advanced economies, only half (CHE, KOR, NOR, SWE) fall into these categories, with the remaining (AUS, CAN, GBR, JPN) classified as having a pure float.

[22] In a model with Calvo-type wage stickiness as in Schmitt-Grohé and Uribe (2005), where households supply homogeneous sectoral labor to labor unions that supply differentiated sectoral labor input to firms, the wage Phillips Curves are given by

$$\pi^w_{S,t} = \beta \mathbb{E}_t \left[\pi^w_{S,t+1}\right] + \frac{(1-\beta\tilde{\kappa}_W)(1-\tilde{\kappa}_W)}{\tilde{\kappa}_W}\left(\frac{v_{S,t}/W_{S,t}}{u_{S,t}/P_{S,t}} - 1\right), \quad \forall S \in \{N, H\}$$

where $\tilde{\kappa}_W$ is the fraction of households that cannot update the wage in each period. We calibrate κ_w such that the average slopes of the two sectoral Phillips Curves are equal to that under a model with Calvo-type wage stickiness where wages are updated once a year on average ($\tilde{\kappa}_w = 0.75$). This results in

$$\kappa_w = \frac{\tilde{\kappa}_w \varepsilon_w (\alpha_N + \alpha_H)/2}{(1-\beta\tilde{\kappa}_w)(1-\tilde{\kappa}_w)}.$$

Table 1: Parameter calibration

Parameter		Value (EME)	Value (AE)	Reference
From the literature				
β	Discount factor	0.99	0.99	4% annual real interest rate
σ	Relative risk aversion	2	2	Standard
ψ	Inverse of Frisch elasticity	2	2	Standard
ε_W	ES of labor across types	11	11	Born and Pfeifer (2020)
ϕ	ES across H and F goods	2	2	Feenstra et al. (2018)
θ_c	ES across N and T goods	0.44	0.44	Stockman and Tesar (1995)
κ_w	Wage adjustment cost	66.6985	76.0504	Match Calvo model
Sector weights and shares				
ξ	Labor disutility weight	0.5282	0.6031	Let $C=1$, $L=1$, $C_T=\omega_c C$
A_H	TFP of H sector	0.6900	0.6662	Let $C=1$, $L=1$, $C_T=\omega_c C$
A_N	TFP of N sector	0.7356	0.8312	Let $C=1$, $L=1$, $C_T=\omega_c C$
α_N	Labor share in N sector	0.5854	0.6195	Match $\frac{W_N L_N}{P_N Y_N}$
α_H	Labor share in H sector	0.4555	0.5673	Match $\frac{W_H L_H}{P_H Y_H}$
ω_c	Weight of C_T	0.4407	0.3149	Match $\frac{P_H Y_H}{P_N Y_N}$
γ	Weight of C_H	0.8972	0.7225	Match $\frac{P_F C_F}{P_H Y_H + P_N Y_N}$
ω_ℓ	Weight of L_H	0.3726	0.2524	Match $\frac{L_H}{L_N}$
Inter-sectoral labor mobility				
θ_ℓ	ES of labor across sectors	0.1735	0.5386	Estimated from sample
Stochastic processes				
κ_B	Portfolio adjustment cost	0.0003	0.0002	Match $Var(\frac{CA}{GDP})$, $Var(\frac{NFA}{GDP})$
ζ_ρ	Persistence of ρ_t	0.7359	0.7359	Estimated from sample
σ_ρ	SD of innovation to ρ_t	0.0111	0.0046	Estimated from sample
ζ_{pH*}	Persistence of $p^*_{H,t}$	0.7702	0.6441	Estimated from sample
σ_{pH*}	SD of innovation to $p^*_{H,t}$	0.0601	0.0378	Estimated from sample
ζ_{AH}	Persistence of $a_{H,t}$	0.8248	0.7660	Estimated from sample
σ_{AH}	SD of innovation to $a_{H,t}$	0.0183	0.0180	Estimated from sample
ζ_{AN}	Persistence of $a_{N,t}$	0.8309	0.7678	Estimated from sample
σ_{AN}	SD of innovation to $a_{N,t}$	0.0202	0.0121	Estimated from sample

consumption in total value added, calculated from the World Input Output Tables. Finally, the labor-disutility weight ξ and the steady state productivity levels A_H and A_N are set to normalize aggregate consumption and aggregate labor to one and set steady-state tradable consumption equal to its expenditure weight.

These moments are computed separately for emerging markets and advanced economies. Emerging markets in our sample tend to have a larger tradable sector and greater home bias in tradable consumption, while advanced economies have higher labor shares in both sectors.

Inter-sectoral labor mobility. The calibration of inter-sectoral labor mobility is particularly important and interesting because θ_ℓ governs the strength of the sectoral trade-off identified in the tractable model. Rather than assigning a value from the literature, we follow Horvath (2000), Cardi and Restout (2015), and Bertinelli et al. (2022) and directly esti-

mate θ_ℓ. Combining the sectoral labor demand and supply conditions given by Equations (2) and (21) and assuming away short-term wage stickiness yields a general equilibrium relationship between sectoral share of labor and sectoral share of labor compensation:

$$\Delta \ell_{S,t} - \Delta \ell_t = \frac{\theta_\ell}{1+\theta_\ell} \Delta \nu_{S,t}, \quad S \in \{H, N\} \tag{28}$$

where $\nu_{S,t} \equiv \ln \frac{\alpha_S P_{S,t} Y_{S,t}}{\alpha_H P_{H,t} Y_{H,t} + \alpha_N P_{N,t} Y_{N,t}}$ captures the labor compensation share of sector S since $\alpha_S P_{H,t} Y_{H,t} = W_{S,t} L_{S,t}$. Appendix B.4 shows the derivation of Equation (28). We derive an estimate for θ_ℓ by running a country-sector panel regression motivated by Equation (28):

$$\Delta \ell_{k,S,t} - \Delta \ell_{k,t} = \tilde{\theta} \Delta \nu_{k,S,t} + \tilde{\theta}_{EM} (EM_k \times \Delta \nu_{k,S,t}) + FE_k + FE_t + \varepsilon_{k,S,t} \tag{29}$$

where k is the index for country, S is the index for sector, and t represents the year. EM_k is an indicator function that takes the value of 1 if country k is an emerging market economy and 0 otherwise. The estimated coefficients, $\tilde{\theta}$ and $\tilde{\theta}_{EM}$, map to the structural labor mobility parameter such that $\theta_\ell = \frac{\tilde{\theta}}{1-\tilde{\theta}}$ for advanced economies and $\theta_\ell = \frac{\tilde{\theta}+\tilde{\theta}_{EM}}{1-(\tilde{\theta}+\tilde{\theta}_{EM})}$ for emerging market economies. FE_k and FE_t represent country and year fixed effects. We cluster standard errors by country. The same regression is used to estimate labor mobility in Horvath (2000), Cardi and Restout (2015), and Bertinelli et al. (2022) for advanced economies.

We estimate $\tilde{\theta} = 0.35$ and $\tilde{\theta}_{EM} = -0.202$ and find both to be statistically significant at the 1 percent level. These estimates imply $\theta_\ell = 0.174$ for emerging market economies and $\theta_\ell = 0.539$ for advanced economies. The advanced economy estimate is similar to estimates obtained for advanced economies in the literature.[23] Appendix B.4 reports alternative specifications, samples, and data sources that show that the finding of lower labor mobility in emerging markets is robust.

As a complementary exercise to compare inter-sectoral labor mobility between EMs and AEs, we use local projections following Jordà (2005) to estimate the impact of a terms-of-trade shock on relative labor, L_H/L_N, and relative wages, W_H/W_N, in Appendix C. We find that in response to terms-of-trade shocks, relative labor increases less in EMs

[23] Using the same method, Horvath (2000) finds an estimate of 1 for the US, and Cardi and Restout (2015) and Bertinelli et al. (2022) find values that range from 0.219 to 1.664 for 17 advanced economies, with a median value of 0.606, similar to the 0.539 that we estimate. There is also evidence in the literature that suggests labor mobility may be lower in emerging markets than advanced economies. For example, Bryan and Morten (2019) estimate higher internal migration frictions in Indonesia than in the US.

while relative wages increase more. Viewed through the lens of the model, the evidence suggests lower inter-sectoral labor mobility in EMs than in AEs.

Stochastic processes. The last set of parameters is related to the stochastic processes of the model. The portfolio adjustment cost is estimated via generalized method of moments to match the variance of the current account and the net foreign asset position as a percentage of GDP following Schmitt-Grohé and Uribe (2003). We estimate $\kappa_B = 0.0003$ for emerging markets and $\kappa_B = 0.0002$ for advanced economies.

The AR(1) processes of the UIP wedge, the terms of trade, and sectoral productivity are estimated separately for emerging markets and advanced economies. To construct the UIP wedge, we forecast excess dollar returns on short-term local-currency sovereign bonds using domestic interest rates and real exchange rates, following Koijen and Yogo (2020) and Jiang et al. (2024). We remove country-specific trends and estimate the persistence and innovation variance of the cyclical component.[24] The terms of trade are obtained from the World Bank World Development Indicators. Because the data is available at the annual frequency, we derive the parameters of the quarterly AR(1) process by matching the variance and first-order autocorrelation of the annual cyclical component. Sectoral productivity is constructed as the residual from sector-specific production function regressions using real value added, hours worked, and capital input. We use the same moment-matching procedure to obtain quarterly processes for tradable and non-tradable productivity from annual data.

Emerging markets face substantially more persistent and volatile shocks. The standard deviation of innovations to the UIP wedge is 1.1 percent in emerging markets and 0.5 percent in advanced economies, while terms-of-trade innovations have standard deviations of 6.0 and 3.8 percent, respectively. Non-tradable productivity shocks are also considerably more volatile in emerging markets. These shocks are at least as persistent in emerging markets as in advanced economies. Together with the difference in inter-sectoral labor mobility, these differences in stochasticity play a central role in explaining why the welfare gains from exchange rate management are larger in emerging markets.

Untargeted implications of the calibration. The model is deliberately parsimonious, considering only a subset of shocks and featuring a simple structure, and is not calibrated to match unconditional sectoral dynamics. Nevertheless, we examine several untargeted moments to assess whether the model reproduces the qualitative AE-EM patterns most relevant for its mechanism and qualitative implications. We find relative sectoral output

[24] An explanation of the method used to estimate the UIP wedge is provided in Appendix B.4.

volatility to be similar across emerging markets and advanced economies in both the data and the model, while relative wages are more volatile in emerging markets. The model also reproduces the lower labor-to-wage volatility ratio in emerging markets seen in the data. The model does not, however, reproduce the higher unconditional volatility of relative employment observed in emerging markets. Table B6 reports the full comparison of model and data moments.

3.3 Exchange rate management

In this section we analyze the benefits of exchange rate management by studying and comparing the dynamics of the quantitative model between a pure float and a managed float for emerging market economies. Using the same calibration for emerging markets, we solve for the optimal policy equilibrium under a pure float and managed float. We focus on the dynamics of the model following a negative shock to the UIP wedge (i.e. a capital inflow shock) and leave the analysis of other shocks in Appendix B.4.

Figure 3 illustrates the model's response to a one standard deviation negative UIP wedge shock, which generates capital inflow pressures akin to Spain's episode discussed in the introduction. The UIP wedge shock immediately appreciates the currency. Under a pure float, the policymaker responds by lowering the interest rate, partly offsetting the immediate appreciation. The appreciation is subsequently reversed as the UIP wedge dissipates, generating a modest exchange-rate overshooting. The appreciation reduces the competitiveness of the tradable sector, leading to a contraction in the tradable output gap, $\widehat{y}_H$. At the same time, the lower interest rate stimulates domestic demand and generates a substantial expansion in the non-tradable output gap, $\widehat{y}_N$. The capital inflow is also reflected in a sharp deterioration of the current account, which reaches approximately one percent of GDP on impact.

This response illustrates the sectoral trade-off faced by monetary policy under a pure float. Leaning more forcefully against the appreciation would help support the tradable sector, but it would also require a larger decrease in the interest rate and further stimulation of the non-tradable sector. Because labor cannot move freely across sectors and nominal wages are rigid, the policymaker is faced with a trade-off.

Under the managed float, the policymaker responds to the inflow by raising taxes on net capital inflows, τ. Capital controls offset a substantial portion of the appreciation and allow the policymaker to keep the interest rate close to its steady-state level. As a result, the exchange rate appreciates only modestly. Capital controls are gradually withdrawn as the UIP wedge dissipates.

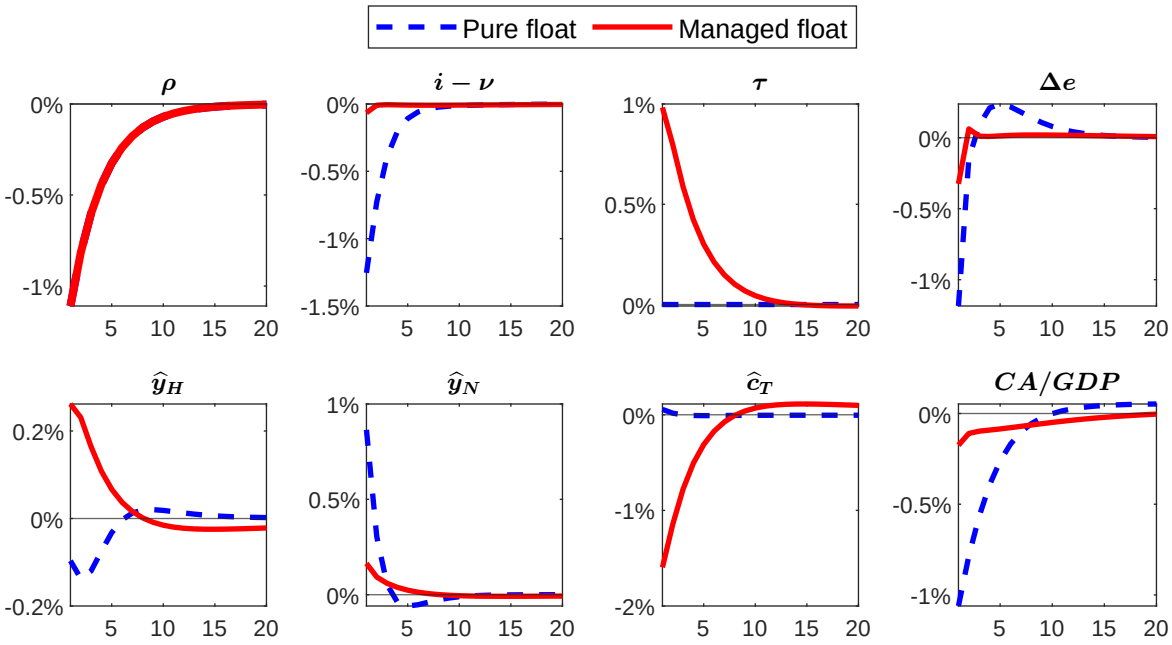


Figure 3: IRFs with respect to a negative UIP wedge shock

The more limited appreciation protects the tradable sector from the contraction observed under the pure float, going as far as stimulating the tradable sector. At the same time, since the policymaker can keep the interest rate stable, capital controls substantially reduce the stimulus to the non-tradable sector. In the figure, the increase in the non-tradable output gap is only a fraction of that under the pure float. The current account deterioration is similarly much smaller. All of this comes at the cost of lowering tradable consumption, $\widehat{c}_T$. As the policymaker taxes capital inflows and thus makes borrowing more expensive (or alternatively, saving cheaper), tradable good consumption falls. The welfare benefit of the managed float therefore does not arise from exchange-rate stabilization per se. Instead, it reflects the value of an additional instrument for addressing the sectoral consequences of shocks.

The implications of other shocks are similar. They create distortions in labor demand which the policymaker tries to stabilize using the policy instruments available. Using capital controls reduces the size of the sectoral trade-off of monetary policy.

We quantify the welfare gains from exchange rate management by comparing the level of welfare loss between a pure and managed float. We estimate the welfare gains from exchange rate management to be equivalent to a 0.855% permanent increase in consumption every period. This represents a sizable improvement in welfare and is larger than the 0.3% estimate from Bianchi and Mendoza (2018) that looks at the macro-prudential use of capital controls but smaller than the 2.2% from Schmitt-Grohé and Uribe (2016) that

analyzes capital controls in a model with fixed exchange rates and downward nominal wage rigidity.[25]

3.4 Emerging markets versus advanced economies

We quantitatively compare the welfare gains from exchange rate management across emerging markets and advanced economies by using separately calibrated models. Figure 4 reports the welfare gains from exchange rate management for emerging markets and advanced economies and decomposes the difference into three categories of parameters using a Shapley decomposition following Shorrocks (2013). The parameters that differ across the two calibrations are labor mobility, the stochastic processes governing the shocks and stationarity, and sector sizes and weights.

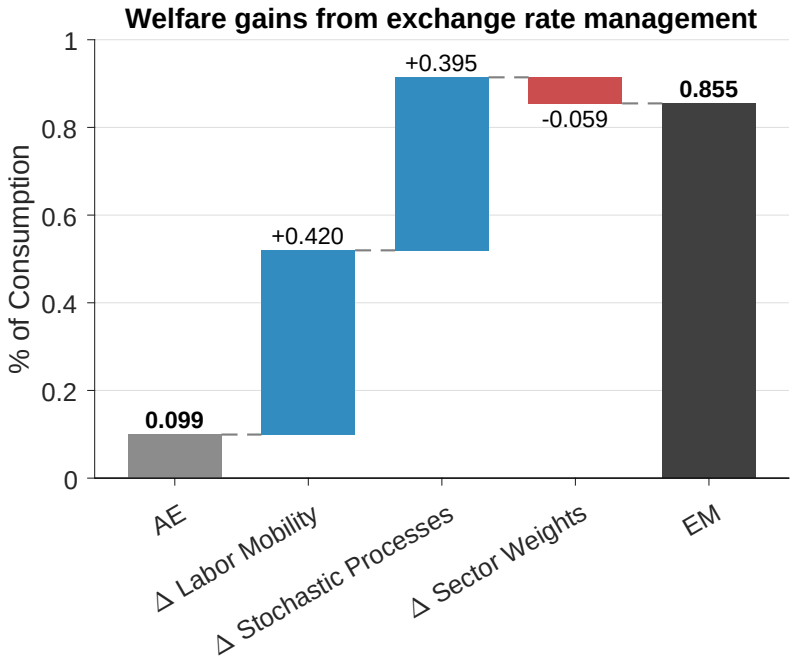


Figure 4: Decomposition of the difference in welfare gains from exchange rate management

Exchange rate management generates substantially larger welfare gains in emerging markets than in advanced economies. Under the advanced-economy calibration, moving from a pure float to a managed float produces a welfare gain equivalent to a permanent increase in consumption of 0.099 percent, approximately nine times smaller than that in emerging markets.

[25] See Rebucci and Ma (2020) for a review.

Replacing advanced economy labor mobility with its lower emerging market value increases the welfare gain by 0.420 percentage points on average. Replacing the stochastic processes with their emerging market counterparts adds a further 0.395 percentage points. Differences in sector sizes and welfare weights instead reduce the welfare gain by 0.059 percentage points, yielding the emerging market welfare gain of 0.855 percent. Relative to the 0.756 percentage point difference between the two calibrations, labor mobility accounts for approximately 56 percent and the stochastic processes for approximately 52 percent, while sector sizes and weights offset approximately 8 percent of the difference.

The large contribution of labor mobility reflects the quantitative nature of Proposition 3. When labor is less mobile across sectors, the natural relative wage becomes harder to achieve, magnifying the sectoral trade-off under a pure float and increasing the welfare benefit of the additional instrument available under a managed float. Although the model is calibrated using direct estimates of inter-sectoral labor mobility, it was not evident ex-ante that this parameter would account for such a large portion of the cross-country difference in welfare gains.

The large difference in the welfare gains from exchange rate management can help explain why emerging markets manage their exchange rates more actively than advanced economies. Suppose implementing exchange rate management entails a fixed cost, such as reputation costs from using capital controls or political costs from introducing new policy tools. If this cost is larger than the welfare gains in advanced economies but smaller than those in emerging markets, exchange rate management will be worthwhile for emerging markets but not for advanced economies.

3.5 Exchange rate flexibility versus capital controls

We also quantitatively verify Proposition 4. Simulating the model with all shocks under emerging market calibrations, we find that the welfare gain from exchange rate flexibility exceeds that from capital controls, shown in the left hand side chart of Figure 5. The welfare gains from exchange rate flexibility stem from being able to optimally respond to terms-of-trade shocks. The middle chart in Figure 5 compares the gains when there are only terms-of-trade shocks in the model. The advantage of exchange rate flexibility is especially pronounced, consistent with Proposition 4 in the tractable model.

The ranking is reversed in response to UIP wedge shocks, which are shown in the right hand side chart of Figure 5. The welfare gains from capital controls are more than double that gained from exchange rate flexibility, again consistent with Proposition 4 when the relative weight of the tradable consumption gap is sufficiently small. Interpreting

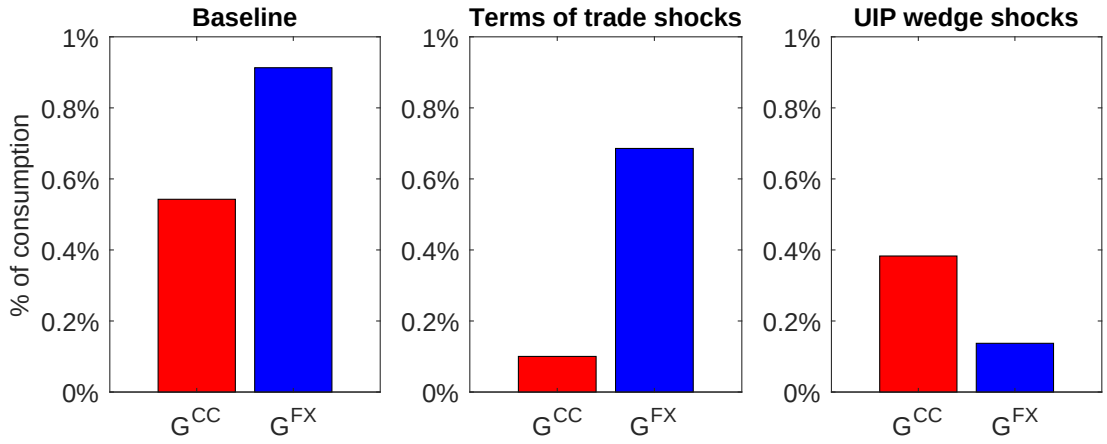


Figure 5: $\mathscr{G}^{CC}$ and $\mathscr{G}^{FX}$ under different shock environments.

UIP wedge shocks as capturing the Global Financial Cycle, this provides support for Rey (2015)'s Dilemma hypothesis. The effective monetary autonomy gained from capital controls exceeds that gained from exchange rate flexibility in response to the Global Financial Cycle.

Overall, we find quantitatively that exchange rate flexibility remains valuable for insulating the economy from movements in the terms of trade, but capital controls are more effective at insulating the economy from global financial shocks.

4 Foreign Exchange Intervention

In this section we extend the model by allowing the UIP wedge to be elastic to the amount of home dollar bonds held by the foreign investor, allowing foreign exchange intervention (FXI) to have an effect. Similar to Gabaix and Maggiori (2015), Cavallino (2019), and Itskhoki and Mukhin (2023), FXI is modeled as purchases of US treasuries by the policymaker financed by the selling of home currency bonds and therefore sterilized. This changes the composition of the external position of the home economy and the portfolio of foreign investors, impacting the UIP wedge.

4.1 Setup

To model imperfect substitutability of bonds held by foreign investors, we assume the premium that foreign investors require to hold home dollar bonds is elastic to the quantity

of home dollar bonds they hold, $-B^*_{t+1}$. This changes Equation (10) to

$$i_t - \mathbb{E}_t\left[\Delta e_{t+1}\right] - i^{US} = \rho_t + \tau_t - \varsigma B^*_{t+1}. \tag{30}$$

An increase in the holdings of home dollar bonds by foreign investors, captured by a decrease in B^*_{t+1}, increases the expected excess returns on home dollar bonds relative to US treasuries.[26]

The elasticity of the UIP wedge to the home dollar bond holdings of foreign investors creates an externality. Households do not internalize the impact of their portfolio choice on the UIP wedge because the UIP wedge responds to the aggregate portfolio position. Relative to the first-best allocation where the social planner internalizes the impact of the external portfolio position on the UIP wedge, this generates a gap in the Euler equation derived with respect to the home dollar bond, Equation (7).

The central bank conducts sterilized FXI by purchasing US treasuries, B^{US}_{t+1}, and issuing home currency bonds to the market, $-B_{CB,t+1}$, keeping the net value of these transactions equal to zero,

$$E_t B^{US}_{t+1} + B_{CB,t+1} = 0. \tag{31}$$

For ease of notation, we use a subscript to differentiate home currency bonds held by the policymaker, $B_{CB,t+1}$ and those held by home households, $B_{HH,t+1}$. Home households purchase the home currency bonds issued by the central bank and we maintain the assumption that home currency bonds are not traded internationally so that in equilibrium $B_{HH,t+1} + B_{CB,t+1} = 0$. Conditional on all else being equal, FXI affects the external portfolio of the home economy but it does not change the net foreign asset position as home households simultaneously adjust their home dollar bond position, B^*_{t+1}. In aggregate, the home economy's external portfolio consists of B^*_{t+1} home dollar bonds and B^{US}_{t+1} US treasuries. FXI works by changing the composition of this external portfolio. The realized returns on the portfolio position of the central bank are transferred as a lump-sum to

[26] In Itskhoki and Mukhin (2023), home and foreign bonds are imperfect substitutes due to exchange rate risk. In this paper, there is no exchange rate risk associated with the foreign investors' portfolio. We interpret the imperfect substitutability to represent financial frictions or costs associated with holding home dollar bonds in the foreign investors' balance sheet. These frictions or costs generate a premium relative to US treasuries that is elastic to the quantity of home bonds held by foreign investors.

households. The aggregate budget constraint is then

$$C_{F,t}+P^*_{H,t}C_{H,t} + NFA_{t+1} \\ = \left(1 - \frac{\kappa_w}{2}{\pi^w_{H,t}}^2\right) P^*_{H,t}Y_{H,t} + (1+i^{US})NFA_t + (i^*_{t-1} - i^{US})B^*_t. \tag{32}$$

where the net foreign asset position is $NFA_{t+1} \equiv B^*_{t+1} + B^{US}_{t+1}$.

In this extended model, because the home economy now has access to US treasuries, the first-best allocation is defined as the allocation achieved by the social planner that has access to home dollar bonds and US treasuries. Compared to the quantitative model developed in Section 3, the welfare loss function in this model has one extra term,

$$\sum_{t=0}^{\infty} \beta^{t+1} u_H(C) \cdot \varsigma {\widehat{B^*}^2}_{t+1},$$

that captures welfare loss due to different returns on the portfolio position of the home economy as the portfolio position of the foreign investor is distorted relative to the first-best. The derivation of the welfare loss function is shown in Appendix D.[27]

The strength of the portfolio balance channel is governed by ς. A larger value of ς implies that the UIP wedge is more sensitive to the quantity of Home bonds held by foreign investors and therefore that a given amount of FXI has a larger effect on the exchange rate. Following Cavallino (2019), we set $\varsigma = 0.2$.

4.2 Optimal policy equilibrium with FXI

With FXI, the policymaker has an additional instrument for managing exchange rates. Similar to capital controls, FXI affects the exchange rate through the UIP wedge, allowing monetary policy to focus more closely on stabilizing labor demand in the non-tradable sector. By accumulating US treasuries and selling home currency bonds, the policymaker forces households to accumulate home currency bonds and sell home dollar bonds to foreign investors, increasing the premium required for foreign investors to hold these bonds and depreciating the home currency. The home currency appreciates when the policymaker sells US treasuries and accumulates home currency bonds.

Managed float with FXI. We consider a negative UIP wedge shock as in Section 3.3. Figure 6 shows the impulse response functions with respect to a negative UIP wedge

[27] In the first-best allocation, the stock of home dollar bonds is given by $B^{*n}_{t+1} = \rho_t/(2\varsigma)$. This is derived by equating the utility gained from an additional unit of saving in US treasuries and home dollar bonds. The social planner takes into consideration the effect of home dollar bonds on the UIP wedge.

shock under a pure float in dashed red and a managed float with FXI in solid blue. With FXI, the policymaker responds by accumulating US treasuries and issuing Home currency bonds. The newly issued Home currency bonds are absorbed by home households by reducing their holdings of home dollar bonds. This increases the net long position of foreign investors in home dollar bonds, increasing the UIP wedge and partially offsetting the currency appreciation pressure. FXI therefore counteracts the exchange rate pressure without requiring the entire adjustment to occur through monetary policy. This reduces the overheating in the non-tradable sector and enables the policymaker to stabilize the tradable sector better. A similar mechanism is at play for other shocks as well.

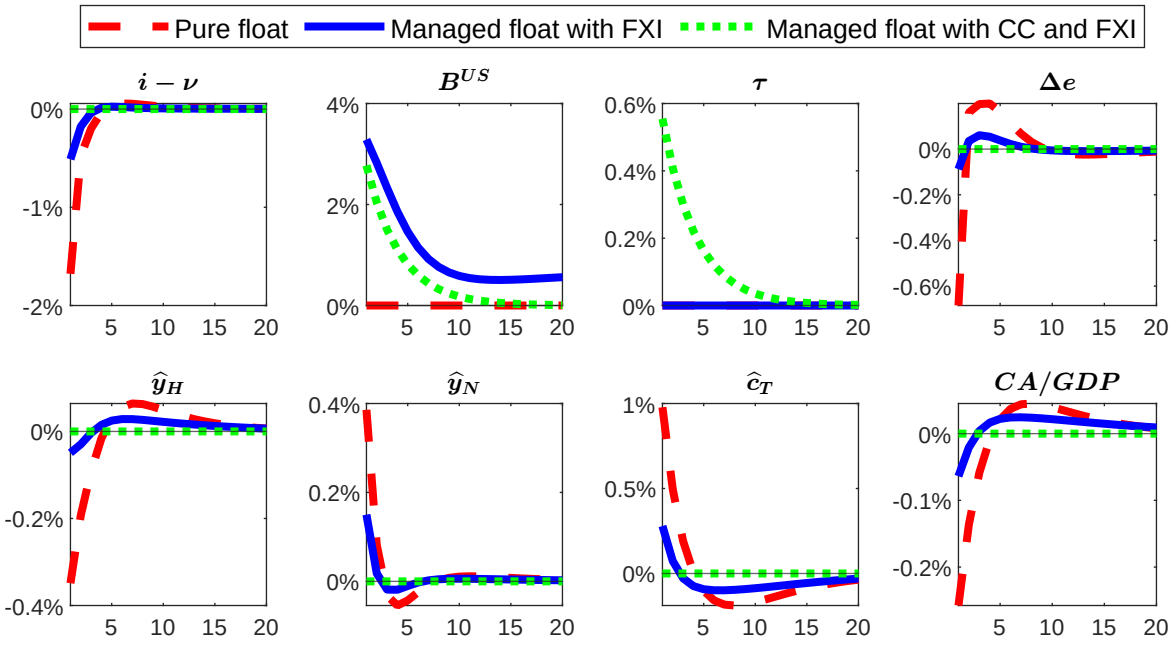


Figure 6: IRFs with respect to a negative UIP wedge shock with FXI

We note that there is a difference in the magnitude of the response in gross and net capital flows. The sudden rise in US treasuries is more than ten times the fall in the current account and captures the fact that despite volatile movements in gross capital flows, movements in net capital flows can be smoother.

Managed float with FXI and CC. Interestingly, when capital controls are also available, the policymaker is able to achieve the first-best in response to a UIP wedge shock. The dotted green line in Figure 6 shows the optimal policy equilibrium when the policymaker has access to capital controls and FXI. All welfare relevant gaps are closed and there is no exchange rate fluctuation. In the first-best allocation, a UIP wedge shock creates no impact on the real economy since the interest rate on the US treasury remains steady and

only changes the external portfolio position of the home economy. With capital controls and FXI, the policymaker is able to replicate this. Capital controls are used to fully offset the externality from households not being able to internalize the impact of their home dollar bond savings on the UIP wedge so that $\tau_t = -\varsigma B^{*n}_{t+1}$. FXI is used to replicate the first-best portfolio so that $\widehat{B}^{*}_{t+1} = 0$.

In response to other shocks, FXI and capital controls are used together as well. FXI is used to close the gap in home dollar bonds so that $\widehat{B}^{*}_{t+1} = 0$. Capital controls on the other hand are used to first address the UIP wedge externality but also to manage the exchange rate and alleviate the sectoral trade-off of monetary policy. This is because although FXI can also impact the UIP wedge, there is an extra cost of deviating from the first-best level of home dollar bonds. Therefore, it is optimal to manage the exchange rate via capital controls and manage the external portfolio composition with FXI.

4.3 Welfare gains across emerging and advanced economies

We next ask whether the extended model continues to generate larger welfare gains from exchange rate management with FXI in emerging markets than in advanced economies. Figure 7 reports the welfare gains and decomposes the difference between the two country groups using the same Shapley decomposition as in Section 3.4. As in the baseline model, the welfare gain is measured as the reduction in welfare loss when moving from a pure float to a managed float.

The welfare gain from exchange rate management is substantially higher in emerging markets than in advanced economies. Imperfect inter-sectoral labor mobility remains an important part of this difference as in the baseline model. Replacing the labor mobility parameter of the advanced economy with that of the emerging market raises the welfare gain by 0.046 percentage point. This accounts for roughly one-third of the AE–EM difference.

Quantitatively, however, labor mobility plays a smaller role than in the baseline model. Differences in the stochastic processes now account for the largest part of the AE–EM gap, increasing the welfare gain by 0.110 percentage point, while differences in sector weights contribute again only minimally. The extended model therefore preserves the qualitative mechanism of the baseline model—lower labor mobility raises the value of exchange rate management—but shifts some of the quantitative importance toward differences in the shocks faced by emerging and advanced economies.

The absolute welfare gains from exchange rate management are also smaller than in the baseline model. This difference mainly reflects a change in the first-best allocation

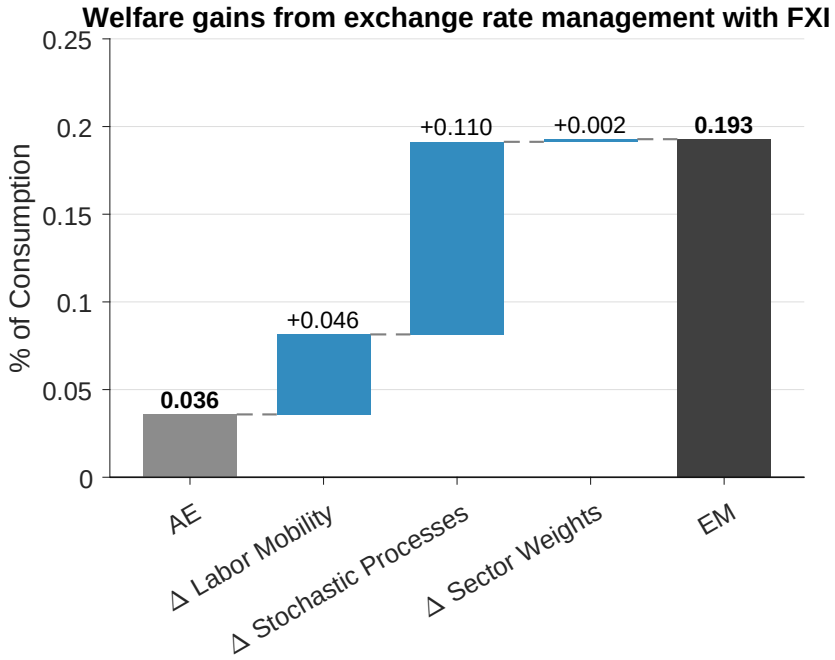


Figure 7: Decomposition of the difference in welfare gains from exchange rate management using FXI

due to the social planner now having access to US treasuries. Because US treasuries allow saving at an interest rate that is unaffected by the UIP wedge, the UIP wedge shock only creates changes in the composition of the external portfolio while labor and consumption remain constant. The first-best allocation is therefore considerably less volatile in response to UIP shocks than in the baseline model. This change in the benchmark reduces the welfare loss associated with a pure float. The optimal monetary policy equilibrium under a pure float can more closely approximate the relatively stable first-best allocation, leaving smaller gaps in consumption, output, and labor across sectors. Consequently, there is less welfare loss for exchange rate management to eliminate.

The main cross-country result nevertheless remains intact. Emerging markets benefit more from exchange rate management than advanced economies, and lower intersectoral labor mobility continues to contribute meaningfully to this difference. Allowing for FXI and an endogenous portfolio balance channel therefore changes the quantitative size of the gains, but not the central mechanism linking labor mobility to the value of exchange rate management.

5 Conclusion

We develop a tractable model where imperfect inter-sectoral labor mobility and nominal wage rigidities distort relative wages across sectors and monetary policy is used to balance stabilizing labor demand across the tradable and non-tradable sectors. Managing the exchange rate with capital controls or foreign exchange intervention can alleviate this sectoral trade-off and provides a new motivation for why emerging market economies should adopt a managed float. Calibrating a richer version of the model with dynamics separately to emerging markets and advanced economies, we find that through the lens of the model lower inter-sectoral labor mobility and greater persistence and volatility of shocks in emerging markets drive the higher welfare gains from exchange rate management. This suggests differences in labor market frictions may be an important factor in understanding why emerging market economies choose to have a managed float more so than advanced economies. Furthermore, the model is used to address the Dilemma hypothesis of Rey (2015). We find that capital controls provide more effective monetary autonomy than flexible exchange rates in response to global financial shocks, providing conditional support for the Dilemma hypothesis. Lastly, we extend the model by introducing foreign exchange intervention and show that the qualitative implications of the baseline model hold.

An aspect that we do not consider is financial stability, a key motivation for using capital controls in models with financial crises and sudden stops. It would be interesting to extend the comparison between advanced and emerging market economies by also incorporating financial stability concerns. Additionally, exploring different ways of modeling imperfect inter-sectoral labor mobility may provide more insight. Having a heterogeneous agent model with costs in switching sectors may yield new implications for the sectoral trade-off of monetary policy. Alternatively, while the paper focuses on stabilizing short-term fluctuations where labor mobility is assumed to be constant, extending the analysis to endogenize labor mobility and studying the long-term effects of policy and its impact on sectoral labor reallocation and labor mobility seems a promising avenue for future research. Lastly, we do not consider the reallocation of capital across sectors. Studying the sectoral reallocation of capital and the behavior of investment may provide a new perspective into the sectoral trade-off of monetary policy.

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A Tractable model

A.1 Linearized model

We linearize the model using first-order deviations from the steady state. The production technology given by Equation (1) is linearized to

$$y_{H,t} = a_{H,t} + \alpha_H \ell_{H,t}, \tag{33}$$

$$y_{N,t} = a_{N,t} + \ell_{N,t}. \tag{34}$$

Labor demand given by Equation (2) is linearized to

$$w_H - e - p_H^* = \frac{\alpha_H - 1}{\alpha_H} y_H + \frac{1}{\alpha_H} a_H \tag{35}$$

$$w_N - p_N = a_N \tag{36}$$

Households' first-order condition for consumption goods is linearized to

$$-c_{N,t} - p_{N,t} = -c_{T,t} - (e_t + \gamma p_{H,t}^*) \tag{37}$$

where we used $p_{T,t} = e_t + \gamma p_{H,t}^*$. The Euler equation with respect to local currency bonds, Equation (6), is linearized to

$$-c_{N,t} = (i_t - \nu) + p_{N,t} - p_{N,t+1} - c_{N,t+1}. \tag{38}$$

Constant wages imply

$$w_{H,t} = 0 \tag{39}$$

$$w_{N,t} = 0 \tag{40}$$

and the market clearing conditions and aggregate budget constraint given by Equations (11) and (13) are linearized to

$$c_{N,t} = y_{N,t}, \tag{41}$$

$$c_{T,t} + \frac{B_{t+1}^*}{\omega_c} = (1-\gamma) p_{H,t}^* + y_{H,t} + \frac{1}{\beta} \frac{B_t^*}{\omega_c}. \tag{42}$$

Given the choice of policy instruments, i_t and τ_t, we can derive $y_{H,t}$, $y_{N,t}$, $\ell_{H,t}$, $\ell_{N,t}$, $c_{N,t}$, $c_{T,t}$, $w_{H,t}$, $w_{N,t}$, e_t, $p_{N,t}$, B_{t+1}^* using Equations (33) - (42) and the adjusted UIP condition,

Equation (10).

Note under the natural allocation, the same system of equations applies except Equations (39) and (40) which is replaced with the labor supply conditions given by Equations (14) and (15) linearized to

$$\begin{aligned} \ell_{H,t} - \ell_{N,t} &= \theta_\ell(w_{H,t} - w_{N,t}) \\ \frac{1}{\theta_\ell}\ell_{N,t} - w_{N,t} &= -c_{N,t} - p_{N,t} \end{aligned}$$

Because wages are rigid, the relative wage, $w_{H,t} - w_{N,t}$, cannot adjust as it would under the natural allocation. This causes a wedge in the relative labor demand. Using the fact that exogenous state variables return to the steady state in period 1 onwards, which implies all variables except the net foreign asset position are at the steady state in the natural allocation and it is optimal and feasible for the policymaker to close all gaps, we can summarize the system of equations into one single equation, Equation (18).

A.2 Welfare loss function

We derive a second-order Taylor expansion of the household's lifetime utility around the first-best allocation which coincides with the natural allocation.

$$
\begin{aligned}
&\sum_{t=0}^{\infty}\beta^t\left[u\left(C_t\right)-v\left(L_t\right)\right]\\
=&\sum_{t=0}^{\infty}\beta^t\left[\frac{\partial u\left(C_t^n\right)}{\partial C_{T,t}^n}(C_{T,t}-C_{T,t}^n)+\frac{1}{2}\frac{\partial^2 u\left(C_t^n\right)}{\partial {C_{T,t}^n}^2}(C_{T,t}-C_{T,t}^n)^2\right]\\
&+\sum_{t=0}^{\infty}\beta^t\left[\frac{\partial u\left(C_t^n\right)}{\partial C_{N,t}^n}(C_{N,t}-C_{N,t}^n)+\frac{1}{2}\frac{\partial^2 u\left(C_t^n\right)}{\partial {C_{N,t}^n}^2}(C_{N,t}-C_{N,t}^n)^2\right]\\
&-\sum_{t=0}^{\infty}\beta^t\left[\frac{\partial v\left(L_t^n\right)}{\partial Y_{N,t}^n}(Y_{N,t}-Y_{N,t}^n)+\frac{1}{2}\frac{\partial^2 v\left(L_t^n\right)}{\partial {Y_{N,t}^n}^2}(Y_{N,t}-Y_{N,t}^n)^2\right]\\
&-\sum_{t=0}^{\infty}\beta^t\left[\frac{\partial v\left(L_t^n\right)}{\partial Y_{H,t}^n}(Y_{H,t}-Y_{H,t}^n)+\frac{1}{2}\frac{\partial^2 v\left(L_t^n\right)}{\partial {Y_{H,t}^n}^2}(Y_{H,t}-Y_{H,t}^n)^2\right]+t.i.p.\\
=&-\frac{1}{2}\left[\omega_c\widehat{c}_{T,0}^2+(1-\omega_c)\left(1+\frac{1}{\theta_\ell}\right)\widehat{y}_{N,0}^2+\frac{\omega_c}{\alpha_H}\left(\frac{1}{\theta_\ell}+1-\alpha_H\right)\widehat{y}_{H,0}^2\right]\\
&+\sum_{t=0}^{\infty}\beta^t\overbrace{\left[\frac{\partial u\left(C_t^n\right)}{\partial C_{N,t}^n}C_{N,t}-\frac{\partial v\left(L_t^n\right)}{\partial Y_{N,t}^n}Y_{N,t}\right]}^{=0}\\
&\qquad{\scriptstyle =\frac{\partial u(C_t^n)}{\partial C_{T,t}^n}/P_{T,t^*}(-B_{t+1}^*+(1+i^{US}+\rho_{t-1})B_t^*)}\\
&+\sum_{t=0}^{\infty}\beta^t\overbrace{\left[\frac{\partial u\left(C_t^n\right)}{\partial C_{T,t}^n}C_{T,t}-\frac{\partial v\left(L_t^n\right)}{\partial Y_{H,t}^n}Y_{H,t}\right]}+t.i.p.\\
=&-\frac{1}{2}\left[\omega_c\widehat{c}_{T,0}^2+(1-\omega_c)\left(1+\frac{1}{\theta_\ell}\right)\widehat{y}_{N,0}^2+\frac{\omega_c}{\alpha_H}\left(\frac{1}{\theta_\ell}+1-\alpha_H\right)\widehat{y}_{H,0}^2\right]\\
&+\sum_{t=0}^{\infty}\beta^t\overbrace{\left[-\frac{\partial u\left(C_t^n\right)}{\partial C_{T,t}^n}/P_{T,t}^*+\frac{\partial u\left(C_{t+1}^n\right)}{\partial C_{T,t+1}^n}/P_{T,t+1}^*(1+i^{US}+\rho_t)\right]}^{=0}B_{t+1}^*+(1+i^{US}+\rho_{-1})\overbrace{B_0^*}^{=0}\\
&+t.i.p.
\end{aligned}
$$

This utilizes the first-order conditions from the natural allocation: $\frac{\partial u(C_t^n)}{\partial C_{N,t}^n}=\frac{\partial v(L_t^n)}{\partial Y_{N,t}^n}$, $\frac{\partial u(C_t^n)}{\partial C_{T,t}^n}/P_{T,t^*}=\frac{\partial v(L_t^n)}{\partial Y_{H,t}^n}$, and $-\frac{\partial u(C_t^n)}{\partial C_{T,t}^n}/P_{T,t}^*+\frac{\partial u\left(C_{t+1}^n\right)}{\partial C_{T,t+1}^n}/P_{T,t+1}^*(1+i^{US}+\rho_t)$; the market clearing conditions from the competitive equilibrium; and the assumption that the net foreign asset position at the beginning of period 0 is 0. This leaves us with the welfare loss function in Section 2.

Note that if we do not impose $\psi=1/\theta_\ell$, then the term $2\frac{\partial^2 v(L_t^n)}{\partial Y_{N,t}^n\partial Y_{H,t}^n}(Y_{N,t}-Y_{N,t}^n)(Y_{H,t}-Y_{H,t}^n)$

would also be included, so that the welfare loss function becomes

$$\omega_c \widehat{c}_{T,0}^2 + (1 - \alpha_H + \frac{1}{\theta_\ell})\frac{\omega_c}{\alpha_H}\widehat{y}_{H,0}^2 + (1-\omega_c)(1+\frac{1}{\theta_\ell})\widehat{y}_{N,0}^2$$
$$+ (\psi - \frac{1}{\theta_\ell})\xi^{-1}L^{-1-\psi}(\omega_c \widehat{y}_{H,0} + (1-\omega_c)\widehat{y}_{N,0})^2$$

The assumption $\psi = 1/\theta_\ell$ allows us to disregard the interaction between the two output gaps, simplifying the algebra. This also shows how labor mobility matters for welfare. The θ_ℓ term in the weights for $\widehat{y}_{H,0}^2$ and $\widehat{y}_{N,0}^2$ captures disutility from imperfect labor mobility that is independent of the assumption on ψ.

A.3 Solution

Under Regime 1, the policymaker has no freedom in using any policy instruments. The allocations are given as

$$\widehat{y}_{H,0} = \frac{\alpha_H}{1-\alpha_H}\left(w_{H,0}^n - e_0^n\right), \quad \widehat{y}_{N,0} = w_{N,0}^n - e_0^n, \quad \widehat{c}_{T,0} = 0$$

Under Regime 2, the policymaker can use capital controls, but has to keep the exchange rate fixed.

$$\widehat{y}_{H,0} = \frac{\alpha_H}{1-\alpha_H}\left(w_{H,0}^n - e_0^n\right), \quad \widehat{y}_{N,0} = \frac{\gamma_T}{\gamma_N+\gamma_T}\left(w_{N,0}^n - e_0^n\right), \quad \widehat{c}_{T,0} = -\frac{\gamma_N}{\gamma_N+\gamma_T}\left(w_{N,0}^n - e_0^n\right)$$

Under Regime 3, the policymaker can use monetary policy to allocate the relative wage gap to the tradable and non-tradable output gaps.

$$\widehat{y}_{H,0} = \frac{\gamma_N\left(\frac{1-\alpha_H}{\alpha_H}\right)}{\gamma_H + \gamma_N\left(\frac{1-\alpha_H}{\alpha_H}\right)^2}\left(w_{H,0}^n - w_{N,0}^n\right)$$
$$\widehat{y}_{N,0} = -\frac{\gamma_H}{\gamma_H + \gamma_N\left(\frac{1-\alpha_H}{\alpha_H}\right)^2}\left(w_{H,0}^n - w_{N,0}^n\right)$$
$$\widehat{c}_{T,0} = 0$$

Under Regime 4, the relative wage gap is split across all three gaps.

$$\widehat{y}_{H,0} = \frac{\gamma_N\gamma_T\left(\frac{1-\alpha_H}{\alpha_H}\right)}{\gamma_H\gamma_N + \gamma_H\gamma_T + \gamma_N\gamma_T\left(\frac{1-\alpha_H}{\alpha_H}\right)^2}\left(w^n_{H,0} - w^n_{N,0}\right)$$
$$\widehat{y}_{N,0} = -\frac{\gamma_H\gamma_T}{\gamma_H\gamma_N + \gamma_H\gamma_T + \gamma_N\gamma_T\left(\frac{1-\alpha_H}{\alpha_H}\right)^2}\left(w^n_{H,0} - w^n_{N,0}\right)$$
$$\widehat{c}_{T,0} = \frac{\gamma_H\gamma_N}{\gamma_H\gamma_N + \gamma_H\gamma_T + \gamma_N\gamma_T\left(\frac{1-\alpha_H}{\alpha_H}\right)^2}\left(w^n_{H,0} - w^n_{N,0}\right)$$

A.4 Proof of Proposition 3

Let $\mathscr{L}_3 - \mathscr{L}_4 = \kappa \cdot \mathscr{L}_4$ where $\kappa \equiv \frac{\mathscr{L}_3}{\mathscr{L}_4} - 1 = \frac{\gamma_N\gamma_H}{\gamma_T\gamma_H + \gamma_N\gamma_T(\frac{1-\alpha_H}{\alpha_H})}$. We prove proposition 3 by showing that $\frac{\partial\mathscr{L}_4}{\partial\theta_\ell} \leq 0$ and $\frac{\partial\kappa}{\partial\theta_\ell} \leq 0$.

Using the solutions for Regime 4, the welfare loss can be derived as $\mathscr{L}_4 = \frac{1}{\frac{1}{\gamma_T} + \frac{1}{\gamma_H}(\frac{1-\alpha_H}{\alpha_H})^2 + \frac{1}{\gamma_N}}(w^n_{H,0} - w^n_{N,0})^2$. Given Equation (16), $(w^n_{H,0} - w^n_{N,0})^2$ is weakly decreasing in θ_ℓ. In addition, γ_H and γ_N are decreasing in θ_ℓ following their definitions. Therefore, $\frac{\partial\mathscr{L}_4}{\partial\theta_\ell} \leq 0$.

Substituting out the welfare loss function weights using their definitions,

$$\kappa = \frac{(1-\omega_c)(1+\frac{1}{\theta_\ell})\frac{\omega_c}{\alpha_H}(\frac{1}{\theta_\ell} + 1 - \alpha_H)}{\omega_c\frac{\omega_c}{\alpha_H}(\frac{1}{\theta_\ell} + 1 - \alpha_H) + (1-\omega_c)(1+\frac{1}{\theta_\ell})\omega_c(\frac{1-\alpha_H}{\alpha_H})^2}.$$

Taking the derivative with respect to $\frac{1}{\theta_\ell}$,

$$\frac{\partial\kappa}{\partial\frac{1}{\theta_\ell}} = \frac{(1-\omega_c)\omega_c\frac{\omega_c}{\alpha_H}\left[\frac{\omega_c}{\alpha_H}(\frac{1}{\theta_\ell} + 1 - \alpha_H)^2 + (1-\omega_c)(1+\frac{1}{\theta_\ell})^2(\frac{1-\alpha_H}{\alpha_H})^2\right]}{\left[\omega_c\frac{\omega_c}{\alpha_H}(\frac{1}{\theta_\ell} + 1 - \alpha_H) + (1-\omega_c)(1+\frac{1}{\theta_\ell})\omega_c(\frac{1-\alpha_H}{\alpha_H})^2\right]^2} > 0.$$

Therefore, $\frac{\partial\kappa}{\partial\theta_\ell} = \frac{\partial\kappa}{\partial\frac{1}{\theta_\ell}}\frac{\partial\frac{1}{\theta_\ell}}{\partial\theta_\ell} < 0$. □

A.5 Proof of Proposition 4

Solving for the optimal policy equilibrium gives us the following welfare loss under Regimes 2 and 3.

$$\mathscr{L}_3 = \frac{\gamma_H \gamma_N}{\gamma_H + \gamma_N (\frac{1-\alpha_H}{\alpha_H})^2} (w_H^n - w_N^n)^2$$
$$\mathscr{L}_2 = \gamma_H (\frac{\alpha_H}{1-\alpha_H})^2 (w_H^n - e^n)^2 + \gamma_N (\frac{\gamma_T}{\gamma_N + \gamma_T})^2 (w_N^n - e^n)^2 + \gamma_T (\frac{\gamma_N}{\gamma_N + \gamma_T})^2 (w_N^n - e^n)^2$$

When $\rho = 0$ and $|p_H^* + a_H| > 0$,

$$\mathscr{L}_3 = \frac{\gamma_H \gamma_N}{\gamma_H + \gamma_N (\frac{1-\alpha_H}{\alpha_H})^2} (\frac{1/\theta_\ell}{1-\alpha_H + 1/\theta_\ell} (p_H^* + a_H))^2$$
$$\mathscr{L}_2 = \gamma_H (\frac{\alpha_H}{1-\alpha_H})^2 (\frac{1/\theta_\ell}{1-\alpha_H + 1/\theta_\ell} (p_H^* + a_H))^2$$

and

$$\mathscr{L}_3 - \mathscr{L}_2 = \gamma_H (\frac{\alpha_H}{1-\alpha_H})^2 \overbrace{(\frac{\gamma_N}{\gamma_N + \gamma_H (\frac{\alpha_H}{1-\alpha_H})^2} - 1)}^{<0} (\frac{1/\theta_\ell}{1-\alpha_H + 1/\theta_\ell} (p_H^* + a_H))^2 < 0.$$

Therefore, if $\rho = 0$ and $|p_H^* + a_H| > 0$ then $\mathscr{G}^{FX} > \mathscr{G}^{CC}$.

When $p_H^* + a_H = 0$ and $|\rho| > 0$,

$$\mathscr{L}_3 = \frac{\gamma_H \gamma_N}{\gamma_H + \gamma_N (\frac{1-\alpha_H}{\alpha_H})^2} (\frac{1/\theta_\ell}{1-\alpha_H + 1/\theta_\ell} \rho)^2$$
$$\mathscr{L}_2 = \gamma_H (\frac{\alpha_H}{1-\alpha_H})^2 (\frac{1-\alpha_H}{\frac{1}{\theta_\ell} + 1 - \alpha_H} \rho)^2 + \gamma_N (\frac{\gamma_T}{\gamma_N + \gamma_T})^2 \rho^2 + \gamma_T (\frac{\gamma_N}{\gamma_N + \gamma_T})^2 \rho^2$$

Then, $\frac{\mathscr{L}_3}{\mathscr{L}_2} > 1$ can be reorganized to

$$\frac{1}{\theta_\ell \alpha_H} > \left(\frac{\gamma_T}{\gamma_N} + \frac{1}{\alpha_H}\right) \left(\frac{\gamma_T}{\gamma_N} + \frac{1-\alpha_H}{\alpha_H}\right)$$

using the definitions of γ_H, γ_N, and γ_T. Solving this inequality for $\frac{\gamma_T}{\gamma_N}$ gives

$$\overbrace{-\frac{1}{\alpha_H} + \frac{1}{2} - \sqrt{\frac{1}{4} + \frac{1}{\theta_\ell \alpha_H}}}^{<0} < \frac{\gamma_T}{\gamma_N} < -\frac{1}{\alpha_H} + \frac{1}{2} + \sqrt{\frac{1}{4} + \frac{1}{\theta_\ell \alpha_H}}. \quad \square$$

B Quantitative model setup

B.1 Linearized model

The production technology is

$$y_{H,t} = a_{H,t} + \alpha_H \ell_{H,t}, \tag{43}$$

$$y_{N,t} = a_{N,t} + \alpha_n \ell_{N,t}. \tag{44}$$

Labor demand is

$$w_H - e - p_H^* = \frac{\alpha_H - 1}{\alpha_H} y_H + \frac{1}{\alpha_H} a_H, \tag{45}$$

$$w_N - p_N = \frac{\alpha_N - 1}{\alpha_N} y_N + \frac{1}{\alpha_N} a_N \tag{46}$$

Households' first-order condition for consumption goods is linearized to

$$-\frac{1}{\theta_c} c_{N,t} - p_{N,t} = -\frac{1}{\theta_c} c_{T,t} - (e_t + \gamma p_{H,t}^*) \tag{47}$$

where we used $p_{T,t} = e_t + \gamma p_{H,t}^*$. The Euler equation with respect to local currency bonds now includes the portfolio adjustment cost and is linearized to

$$\kappa_B B_{t+1}^* = \mathbb{E}_t \left[(-\sigma + \frac{1}{\theta_c}) \Delta c_{t+1} - \frac{1}{\theta_c} \Delta c_{N,t+1} + (i_t - \nu) - \Delta p_{N,t+1} \right]. \tag{48}$$

Two sectoral wage Phillips Curves are given by Equation (21) and the market clearing conditions and aggregate budget constraint are linearized to

$$c_{N,t} = y_{N,t}, \tag{49}$$

$$c_{T,t} + \frac{B_{t+1}^*}{\omega_c} = (1 - \gamma) p_{H,t}^* + y_{H,t} + \frac{1}{\beta} \frac{B_t^*}{\omega_c}. \tag{50}$$

The adjusted UIP condition is now given with an expectation due to uncertainty.

$$i_t - \mathbb{E}_t \left[\Delta e_{t+1} \right] - i^{US} = \rho_t + \tau_t \tag{51}$$

Given the choice of policy instruments, i_t and τ_t, we can derive the competitive equilibrium allocations using Equations (43) - (51).

B.2 Welfare loss function

We derive a second-order Taylor expansion of the household's lifetime utility around the first-best allocation with the quantitative model.

$$
\begin{aligned}
&\sum_{t=0}^{\infty}\beta^t\left[u\left(C_t\right)-v\left(L_t\right)\right]\\
=&\frac{1}{2}\sum_{t=0}^{\infty}\beta^t\left[\frac{\partial^2 u\left(C_t^n\right)}{\partial {C_{T,t}^n}^2}(C_{T,t}-C_{T,t}^n)^2+\frac{\partial^2 u\left(C_t^n\right)}{\partial {C_{N,t}^n}^2}(C_{N,t}-C_{N,t}^n)^2\right]\\
&-\frac{1}{2}\sum_{t=0}^{\infty}\beta^t\left[\frac{\partial^2 v\left(L_t^n\right)}{\partial {Y_{N,t}^n}^2}(Y_{N,t}-Y_{N,t}^n)^2+\frac{\partial^2 v\left(L_t^n\right)}{\partial {Y_{H,t}^n}^2}(Y_{H,t}-Y_{H,t}^n)^2\right]\\
&+\sum_{t=0}^{\infty}\beta^t\left[\frac{\partial^2 u\left(C_t^n\right)}{\partial C_{T,t}^n\partial C_{N,t}^n}(C_{T,t}-C_{T,t}^n)(C_{N,t}-C_{N,t}^n)-\frac{\partial^2 v\left(L_t^n\right)}{\partial Y_{N,t}^n\partial Y_{H,t}^n}(Y_{N,t}-Y_{N,t}^n)(Y_{H,t}-Y_{H,t}^n)\right]\\
&\qquad\qquad\overbrace{=-\frac{\partial u(C_t^n)}{\partial C_{N,t}^n}\frac{\kappa_w}{2}Y_{N,t}{\pi_{N,t}^w}^2+t.i.p.}\\
&+\sum_{t=0}^{\infty}\beta^t\overbrace{\left[\frac{\partial u\left(C_t^n\right)}{\partial C_{N,t}^n}(C_{N,t}-C_{N,t}^n)-\frac{\partial v\left(L_t^n\right)}{\partial Y_{N,t}^n}(Y_{N,t}-Y_{N,t}^n)\right]}\\
&\qquad\qquad\overbrace{=\frac{\partial u(C_t^n)}{\partial C_{T,t}^n}/P_{T,t^*}(-B_{t+1}^*+(1+i^{US}+\rho_{t-1})B_t^*-Y_{H,t}\frac{\kappa_w}{2}{\pi_{H,t}^w}^2-\frac{\kappa_B}{2}{B_{t+1}^*}^2)+t.i.p.}\\
&+\sum_{t=0}^{\infty}\beta^t\overbrace{\left[\frac{\partial u\left(C_t^n\right)}{\partial C_{T,t}^n}(C_{T,t}-C_{T,t}^n)-\frac{\partial v\left(L_t^n\right)}{\partial Y_{H,t}^n}(Y_{H,t}-Y_{H,t}^n)\right]}\qquad+t.i.p.\\
=&\frac{1}{2}\sum_{t=0}^{\infty}\beta^t\left[\frac{\partial^2 u\left(C\right)}{\partial {C_T}^2}C_T^2\widehat{c}_{T,t}^2+\frac{\partial^2 u\left(C\right)}{\partial {C_N}^2}C_N^2\widehat{y}_{N,t}^2-\frac{\partial^2 v\left(L\right)}{\partial {Y_N}^2}Y_N^2\widehat{y}_{N,t}^2-\frac{\partial^2 v\left(L\right)}{\partial {Y_H}^2}Y_H^2\widehat{y}_{H,t}^2\right]\\
&+\sum_{t=0}^{\infty}\beta^t\left[\frac{\partial^2 u\left(C\right)}{\partial C_T\partial C_N}C_TC_N\widehat{c}_{T,t}\widehat{y}_{N,t}-\frac{\partial^2 v\left(L\right)}{\partial Y_N\partial Y_H}Y_HY_N\widehat{y}_{H,t}\widehat{y}_{N,t}\right]\\
&-\sum_{t=0}^{\infty}\beta^t\left[\frac{\partial u\left(C\right)}{\partial C_N}\frac{\kappa_w}{2}Y_N{\pi_{N,t}^w}^2+\frac{\partial u\left(C\right)}{\partial C_T}\frac{\kappa_w}{2}Y_H{\pi_{H,t}^w}^2+\frac{\partial u\left(C\right)}{\partial C_T}\frac{\kappa_B}{2}{\widehat{B}_{t+1}^*}^2)\right]+t.i.p.
\end{aligned}
$$

The last line follows from $\widehat{y}_{N,t}=\widehat{c}_{N,t}$ and $(1+\kappa_B B_{t+1}^{*n})\frac{\partial u(C_t^n)}{\partial C_{T,t}^n}/P_{T,t}^*=(1+i^{US}+\rho_t)\frac{\partial u\left(C_{t+1}^n\right)}{\partial C_{T,t+1}^n}/P_{T,t+1}^*$. We express the period-by-period welfare loss function as $\mathscr{L}(\widehat{y}_{H,t},\widehat{y}_{N,t},\widehat{c}_{T,t},\pi_{H,t}^w,\pi_{N,t}^w,\widehat{B}_{t+1}^*)$.

B.3 Optimal policy problem

The policymaker's problem and the optimal policy equilibrium under the quantitative model is given as follows.

Definition. (Optimal policy equilibrium) *The optimal policy equilibrium under policy Regime R is the allocation of* $\{\hat{y}_{H,t}, \hat{y}_{N,t}, \hat{c}_{T,t}, \pi^w_{H,t}, \pi^w_{N,t}, \hat{B}^*_{t+1}\}_{t=0}^{\infty}$ *given an exogenous realization of* $\{\rho_t, p^*_{H,t}, a_{H,t}, a_{N,t}\}_{t=0}^{\infty}$ *that solves the following optimization problem.*

$$\min \quad \sum_{t=0}^{\infty} \beta^t \mathbb{E}_0 \left[\mathscr{L}(\widehat{y}_{H,t}, \widehat{y}_{N,t}, \widehat{c}_{T,t}, \pi^w_{H,t}, \pi^w_{N,t}, \widehat{B}^*_{t+1}) \right]$$

$$s.t. \quad \widehat{w}_{H,t} - \widehat{w}_{N,t} = \left(\frac{1}{\theta_c} + \frac{1-\alpha_N}{\alpha_N} \right) \widehat{y}_{N,t} - \frac{1-\alpha_H}{\alpha_H} \widehat{y}_{H,t} - \frac{1}{\theta_c} \widehat{c}_{T,t} \tag{52}$$

$$\pi^w_{H,t} = \beta \mathbb{E}_t \left[\pi^w_{H,t+1} \right] + \frac{\varepsilon_w \alpha_H}{\kappa_w} \left(\widehat{v}_{H,t} - \widehat{u}_{H,t} + \frac{1-\alpha_H}{\alpha_H} \widehat{y}_{H,t} \right) \tag{53}$$

$$\pi^w_{N,t} = \beta \mathbb{E}_t \left[\pi^w_{N,t+1} \right] + \frac{\varepsilon_w \alpha_N}{\kappa_w} \left(\widehat{v}_{N,t} - \widehat{u}_{N,t} + \frac{1-\alpha_N}{\alpha_N} \widehat{y}_{N,t} \right) \tag{54}$$

$$\pi^w_{H,t} - \pi^w_{N,t} = \pi^{w\ n}_{H,t} - \pi^{w\ n}_{N,t} + \widehat{w}_{H,t} - \widehat{w}_{N,t} - (\widehat{w}_{H,t-1} - \widehat{w}_{N,t-1}) \tag{55}$$

$$\omega_c \widehat{c}_{T,t} + \widehat{B^*}_{t+1} = \omega_c \widehat{y}_{H,t} + \frac{1}{\beta} \widehat{B^*}_t \tag{56}$$

$$\Delta \widehat{y}_{H,t} = -\frac{\alpha_H}{1-\alpha_H} \pi^w_{H,t} + \frac{\alpha_H}{1-\alpha_H} \Delta(w^n_{H,t} - e^n_t) \quad if \quad R \in \{1,2\} \tag{57}$$

$$\widehat{u}_{T,t} + \kappa_B \widehat{B^*}_{t+1} = \mathbb{E}_t \left[\widehat{u}_{T,t+1} \right] \quad if \quad R \in \{1,3\} \tag{58}$$

where $\widehat{v}_{S,t}$ *and* $\widehat{u}_{S,t}$ *denote the gap in marginal disutility with respect to sector* S *labor, and the gap in marginal utility of consuming* S *goods, respectively. They are linear functions of the two output gaps and tradable consumption gap.*

Equation (52) is the generalized version of Equation (18) in the tractable model that captures the inefficiency in the model due to nominal wage rigidities. Equations (53) - (56) represent the two wage Phillips Curves, the definition of wage inflation and the aggregate budget constraint. Equations (57) and (58) are the constraints that apply to policy regimes with fixed exchange rates and full financial openness, respectively. The policies that implement the allocations can be solved for with

$$\tau_t = \hat{u}_{T,t} + \kappa_B \hat{B^*}_{t+1} - \mathbb{E}_t \left[\hat{u}_{T,t+1} \right],$$
$$i_t = \tau_t + \mathbb{E}_t \left[\pi^w_{H,t+1} \right] + \frac{1-\alpha_H}{\alpha_H} \mathbb{E}_t \left[\Delta \hat{y}_{H,t+1} \right] + r^n_{H,t}$$

where $r^n_{H,t}$ is the natural real interest rate in terms of the tradable sector wage.[28]

[28]The natural real interest rate in terms of the tradable sector wage is given by $r^n_{H,t} = i^*_t + \rho_t - \mathbb{E}_t \left[\Delta(w^n_{H,t+1} - e^n_{t+1}) \right]$.

B.4 Calibration

Data source. The data used to calibrate the model is from the sources listed in Table B1.

Table B1: Data sources

Variable	Dataset	Frequency
Sector level hours worked	WIOD SEA, LA KLEMS, EU KLEMS	Annual
Sector value added (nominal and real)	WIOD SEA, LA KLEMS, EU KLEMS	Annual
Sector level capital input	WIOD SEA, LA KLEMS, EU KLEMS	Annual
Terms of trade	WB WDI	Annual
Sector level export to GDP ratio	WIOD NIOT	Annual
3M LC sovereign bond interest rate	Bloomberg	Quarterly
Nominal US exchange rate	BIS	Quarterly
CPI	IMF IFS	Quarterly
Current account	IMF IFS	Quarterly
External liabilities	IMF IFS	Quarterly
External assets	IMF IFS	Quarterly
Nominal GDP	IMF IFS	Quarterly

Classification of sectors. We follow the classification of sectors into tradable and non-tradable sectors from De Gregorio et al. (1994). De Gregorio et al. (1994) classify sectors based on export to output ratios. Those with high export to output ratios are defined as tradable and those with low ratios are defined as non-tradable. For each sector we derive the average export to output ratio across all countries in the sample using the National Input Output Tables (NIOT) and find that the classification used in De Gregorio et al. (1994) holds. The export to output ratios and classification of the sectors is shown in Table B2.

Table B2: Classification of sectors (ISIC rev. 3)

Code	Sector	export/output	Classification
A-B	Agriculture, hunting, forestry and fishing	16.5%	Tradable
C	Mining and extraction	36.8%	Tradable
D	Total manufacturing	45.6%	Tradable
E	Electricity, gas and water supply	8.2%	Non-Tradable
F	Construction	1.6%	Non-Tradable
G-H	Commerce, hotels and restaurants	10.6%	Non-Tradable
I	Transport, storage and communications	18.8%	Tradable
J-K	Finance, insurance, real estate and business services	7.9%	Non-Tradable
L-Q	Social community and personal services	3.1%	Non-Tradable

Estimating θ_ℓ. Using the labor demand and supply conditions given by Equations (2) and (21) and the definition of aggregate labor, we can derive the following relationship:

$$\frac{L_{H,t}}{L_t} = \omega_\ell^{\frac{1}{1+\theta_\ell}} V_{H,t}^{\frac{\theta_\ell}{1+\theta_\ell}} \tag{59}$$

$$\frac{L_{N,t}}{L_t} = (1-\omega_\ell)^{\frac{1}{1+\theta_\ell}} V_{N,t}^{\frac{\theta_\ell}{1+\theta_\ell}} \tag{60}$$

where

$$\begin{aligned} V_{S,t} &\equiv \frac{\alpha_S VA_{S,t}(1+\Gamma_{S,t})}{\alpha_H VA_{H,t}(1+\Gamma_{H,t}) + \alpha_N VA_{N,t}(1+\Gamma_{N,t})}, && \forall S \in \{N,H\} \\ \Gamma_{S,t} &\equiv \frac{\kappa_w}{\varepsilon_w \alpha_S}\left(\pi^w_{S,t} - \beta \mathbb{E}_t\left[\pi^w_{S,t+1}\right]\right), && \forall S \in \{N,H\} \\ VA_{S,t} &\equiv P_{S,t} Y_{S,t}, && \forall S \in \{N,H\} \end{aligned}$$

We can take the log-difference of Equations (59) and (60) to derive

$$\Delta \ell_{S,t} - \Delta \ell_t = \frac{\theta_\ell}{1+\theta_\ell} \Delta \ln V_{S,t}, \quad \forall S \in \{N,H\}. \tag{61}$$

Equation (61) represents the general equilibrium relationship between value added and labor and is used to estimate θ_ℓ. Note that we need to find a data equivalent counterpart to $\Delta \ell_t$. We follow the literature and define $\Delta \ell_t$ as

$$\Delta \ell_t = V_{H,t} \cdot \Delta \ell_{H,t} + V_{N,t} \cdot \Delta \ell_{N,t}.$$

Because θ_ℓ governs the structural elasticity of sectoral labor allocation rather than the speed of short-run nominal adjustment, we estimate Equation (61) assuming flexible wages ($\kappa_w = 0$) and at the annual frequency. This allows us also to run the exact same regression used in Horvath (2000), Cardi and Restout (2015) and Bertinelli et al. (2022) to estimate inter-sectoral labor mobility. This gives us the foundation for Equation (28).

For the baseline, we use the sample of countries that have data in 2000-2014 for the terms of trade, UIP wedge, sectoral value added and sectoral hours worked. This results in a total of 31 countries. We classify countries as AEs and EMEs based on the IMF WEO's classification of countries in 2023. This results in 8 EMEs and 23 AEs in the sample.[29]

We report the results in Table B3. Column (1) represents the baseline case where we

[29] Our sample of EMEs includes BRA, CHL, COL, HUN, IDN, IND, MEX and PER. AEs include AUS, AUT, BEL, CAN, CHE, CZE, DEU, DNK, ESP, FIN, FRA, GBR, HRV, IRL, ITA, JPN, KOR, NLD, NOR, PRT, SVK, SVN and SWE. During the 21st century, the IMF has changed its classification for CZE, HRV, SVK and SVN from EME to AE. The results are robust to removing these countries from the sample.

find that EMs have significantly lower labor mobility than AEs.

Table B3: Estimates for $\tilde{\theta}$ and $\tilde{\theta}_{EM}$ in Equation (29)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta\nu_{k,S,t}$	.350***	.350***	.304***	.202***	.315***	.243***	.237***	.233***
	(.039)	(.039)	(.037)	(.035)	(.046)	(.047)	(.045)	(.043)
$eme_k \times \Delta\nu_{k,S,t}$	-.202***	-.233***	-.159**	-.091*	-.167**	-.104	-.126**	-.119**
	(.071)	(.052)	(.069)	(.047)	(.075)	(.064)	(.050)	(.046)
$eu_k \times \Delta\nu_{k,S,t}$						.121**	.127**	-.033
						(.057)	(.055)	(.048)
N	868	982	868	1378	756	868	982	1378
R^2	0.217	0.186	0.169	0.099	0.171	0.22	0.188	0.099

*** p<0.01, ** p<0.05, * p<0.1

We test the robustness of the result by modifying the regression and sample in various ways. First, we expand the sample such that all of the time periods that are available are used. This expands the time horizon for Mexico, Peru, Chile and Colombia to 1990-2017 as the LA KLEMS provides sector level labor and value added data from 1990 to 2017. This is reported in Column (2) of Table B3. Labor mobility is still lower in EMs. Second, for countries that also have sectoral data on the EU KLEMS, we switch the data and run the baseline regression.[30] The results are shown in Column (3). The statistical significance of θ_{EM} falls slightly, but it is still significant at the 5% level. Third, we expand the sample size and use the data from EU KLEMS, a combination of the first and second robustness exercises, and report the findings in Column (4). Again, the results show that emerging markets have lower inter-sectoral labor mobility though the significance now falls to the 10% level. Fourth, we drop AEs that were classified as EMEs in 2000, which are CZE, HRV, SVK and SVN. We report the results in Column (5) and find that the result still holds.

Next, we consider whether EU countries differ in their inter-sectoral labor mobility due to freer international labor mobility. Since most of the advanced economies in the

[30]The countries that are in both the WIOD SEA and EU KLEMS dataset are JPN, AUT, BEL, CZE, DEU, DNK, ESP, FIN, FRA, HRV, HUN, IRL, ITA, NLD, PRT, SVK, SVN and SWE.

sample are European countries and have free mobility of labor across countries within Europe, this may also drive the result that AEs have higher inter-sectoral labor mobility than EMs. To test this, we include another interaction term, $eu_k \times \Delta\nu_{k,S,t}$. eu_k takes the value of 1 if k is a country in the EU or is CZE, DNK, HUN, NOR, SWE, CHE or GBR which all have no restrictions on labor mobility with each other and the value of 0 otherwise. We report the findings in Column (6) and find that with the baseline sample, the story of European countries having higher labor mobility holds. $\tilde{\theta}_{EME}$ is still negative, but no longer statistically significant at the 10% level. Once we expand the sample though, the statistical significance returns (Column (7)). We also switch the data for countries that also have sectoral data in the EU KLEMS and find that the significance of $\tilde{\theta}_{EME}$ holds, but now the statistical significance of European countries falls. Overall, the results show that labor mobility is lower in emerging market economies and there is mixed evidence of European countries having higher inter-sectoral labor mobility.

Estimating ρ. To derive quarterly series for ρ_t we first derive the one quarter-ahead expected excess dollar returns by forecasting realized excess dollar returns of local currency three month sovereign bonds over the three month US treasury. We follow Jiang et al. (2024) and Koijen and Yogo (2020) and forecast excess dollar returns of local currency sovereign bonds by using the real exchange rate and local currency interest rate of three month local currency sovereign bonds. The local currency sovereign bond interest rates are from Bloomberg and the real exchange rate is derived using the nominal bilateral dollar exchange rate from the BIS and CPI from the IMF IFS database. The tickers for the bonds are shown in Table B4.

Table B4: Bloomberg tickers for 3-month local currency sovereign bonds

Country	**Ticker**	**Country**	**Ticker**	**Country**	**Ticker**
Australia	I00103M Index	France	I01403M Index	Norway	I07803M Index
Austria	I06303M Index	Germany	I01603M Index	Peru	I36103M Index
Belgium	I00603M Index	Hungary	I16503M Index	Portugal	I08403M Index
Brazil	I39303M Index	India	I23603M Index	Slovakia	I25603M Index
Canada	I00703M Index	Indonesia	I26603M Index	Slovenia	I25903M Index
Chile	I35103M Index	Ireland	I06203M Index	Spain	I06103M Index
Colombia	I21703M Index	Italy	I04003M Index	Sweden	I02103M Index
Croatia	I36903M Index	Japan	I01803M Index	Switzerland	I08203M Index
Czech Republic	I11203M Index	Korea	I17303M Index	United Kingdom	I02203M Index
Denmark	I01103M Index	Mexico	I25103M Index	United States	USGG3M Index
Finland	I08103M Index	Netherlands	I02003M Index		

We run the following panel regression:

$$\overbrace{i_{k,t} - i_t^{US} - \Delta e_{k,t+1}}^{\text{Realized excess returns}} = \beta_1 i_{k,t} + \beta_2 rer_{k,t} + \alpha_k + \sum_{j \in J} \gamma_j GFC_j + \varepsilon_{k,t} \tag{62}$$

where $i_{k,t}$ is the country k's three-month local currency sovereign bond interest rate from t to $t+1$, i_t^{US} is the three month US treasury rate from t to $t+1$, $\Delta e_{k,t+1}$ is the realized depreciation of currency k with respect to the dollar between t and $t+1$, $rer_{k,t}$ is the real exchange rate in terms of CPI for country k with respect to the US and denoted such that an increase is a real depreciation of currency k, α_k captures the country fixed effects, and GFC_j captures the fixed effects for the Global Financial Crisis from 2008Q1 to 2009Q2. We defined the periods between 2008Q1 and 2009Q2 as the period for the Global Financial Crisis since the NBER defines this period to be a recession for the US economy. We cluster standard errors by countries. Due to data limitations, the time sample is from 2007 Q1 to 2014 Q4.

The results from running the panel regression in Equation (62) is shown in Table B5. Column (1) shows the baseline results. The coefficient for the local currency interest rate is positive, implying that higher interest rates predict higher returns which is consistent with what theory predicts. The coefficient for the real exchange rate is positive, implying that a depreciated currency today predicts higher returns which is consistent with the long-run properties of Purchasing Power Parity (PPP). These coefficients have the same direction as those estimated in Koijen and Yogo (2020) and Jiang et al. (2024).

Table B5: Regression results for Equation (62)

	(1)	(2)	(3)	(4)
$i_{k,t}$	3.063***	1.919***	3.020***	1.630***
	(.401)	(.456)	(.397)	(.457)
$rer_{k,t}$	.086***	.066***	.097***	0.076***
	(.013)	(.016)	(.013)	(.013)
i_t^{US}		1.825***		2.200***
		(.433)		(.449)
VIX_t			.001***	.001***
			(.000)	(.000)
N	975	975	975	975
R^2	0.016	0.024	0.015	0.021

*** p<0.01, ** p<0.05, * p<0.1

We also conduct some robustness checks for the validity of these coefficients. We add the US 3 month interest rate as well as the VIX to Equation (62). We find that these are able to predict excess returns, but do not take away the significance of the baseline results.

We use the fitted values of equation (62) without the Global Financial Crisis controls as the expected excess returns on three month local currency sovereign bonds. We then detrend the expected excess returns using a linear time trend individually for all countries and estimate an AR(1) process together using the cyclical component of the expected excess returns. We find that the persistence is 0.7359 and the standard deviation of the innovations to the expected excess returns is 0.0111 for EMEs and 0.0046 for AEs. The persistence is not significantly different across EMEs and AEs, so we keep the persistence equal. Using an F-test we show that the standard deviation is significantly different.

The estimated UIP wedges for each country are shown in Figure B1. The upper graph shows the UIP wedges for emerging market economies and the lower graph shows the UIP wedges for advanced economies. The thick solid red lines show the median UIP wedge for each group of countries. For emerging markets, the UIP wedge has a mean of 1.2% with a standard deviation of 1.9%. For advanced economies the mean is 0.3% with a standard deviation of 1.1%. Both the level and volatility of the UIP wedge are higher for emerging markets than advanced economies.

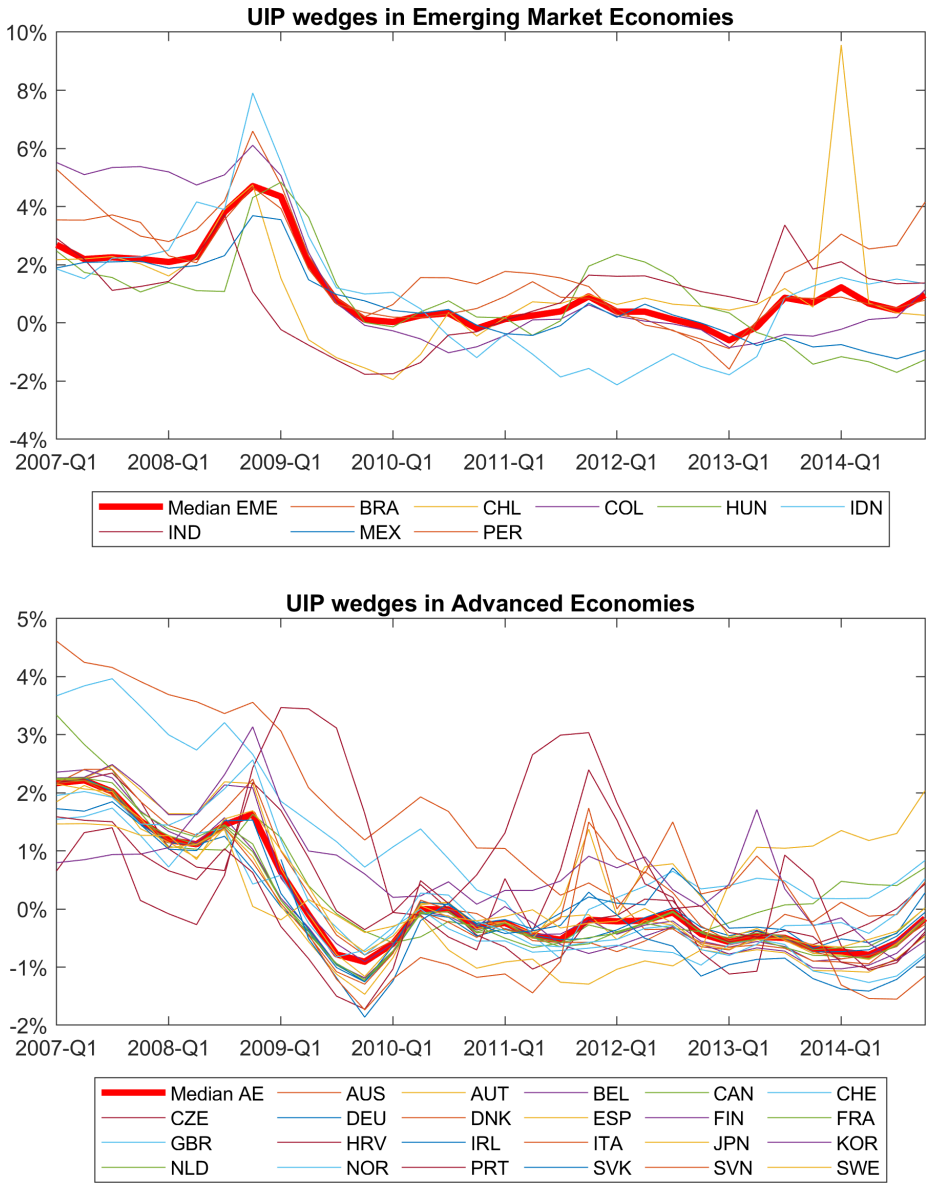


Figure B1: Estimated UIP wedges for emerging market economies and advanced economies

Unconditional moments. Table B6 shows the unconditional moments of the model and data for EMs and AEs.

Impulse response functions. Figures B2-B5 show the impulse response functions in response to a positive shock to the UIP wedge, the terms of trade and TFP in the tradable sector and non-tradable sector respectively. The qualitative features of the impulse response functions are all similar. They create a negative non-tradable output gap and a positive tradable output gap under a pure float. A positive shock to the UIP wedge,

Table B6: Comparative sectoral moments in the data and model

	Data			Model		
Moment	EM		AE	EM		AE
$SD(y_{H,t} - y_{N,t})$	0.0238	$\simeq$	0.0238	0.0424	$\simeq$	0.0424
$SD(\ell_{H,t} - \ell_{N,t})$	0.0173	$>$	0.0084	0.0086	$<$	0.0439
$SD(w_{H,t} - w_{N,t})$	0.0583	$>$	0.0210	0.0372	$>$	0.0346
$SD(\ell_{H,t} - \ell_{N,t})/SD(w_{H,t} - w_{N,t})$	0.2967	$<$	0.4000	0.2314	$<$	1.2674

Notes: For the data, cyclical components are obtained using the Hodrick-Prescott filter with a smoothing parameter of 100. We use sector level labor compensation and hours data from the Socio Economic Accounts of the World Input Output Database to derive sectoral wages. For the model, the corresponding moments are unconditional moments of annual counterparts of the model variables derived using quarterly moments to ensure comparability with the annual data.

terms of trade and TFP in the tradable sector all stimulate demand for labor in the tradable sector and therefore the optimal capital control curbs labor demand by appreciating the currency relative to the pure float. A positive shock to TFP in the non-tradable sector also creates qualitatively similar responses since non-tradable good prices adjust to clear the market. The lower price of non-tradable goods increases the real wage, lowering labor demand and more than offsetting the impact of higher TFP. This generates a negative output gap in the non-tradable sector so that the policymaker responds by lowering the real interest rate. With capital controls, the policymaker is able to lower interest rates even more and by offsetting the exchange rate impact of monetary policy with capital controls.

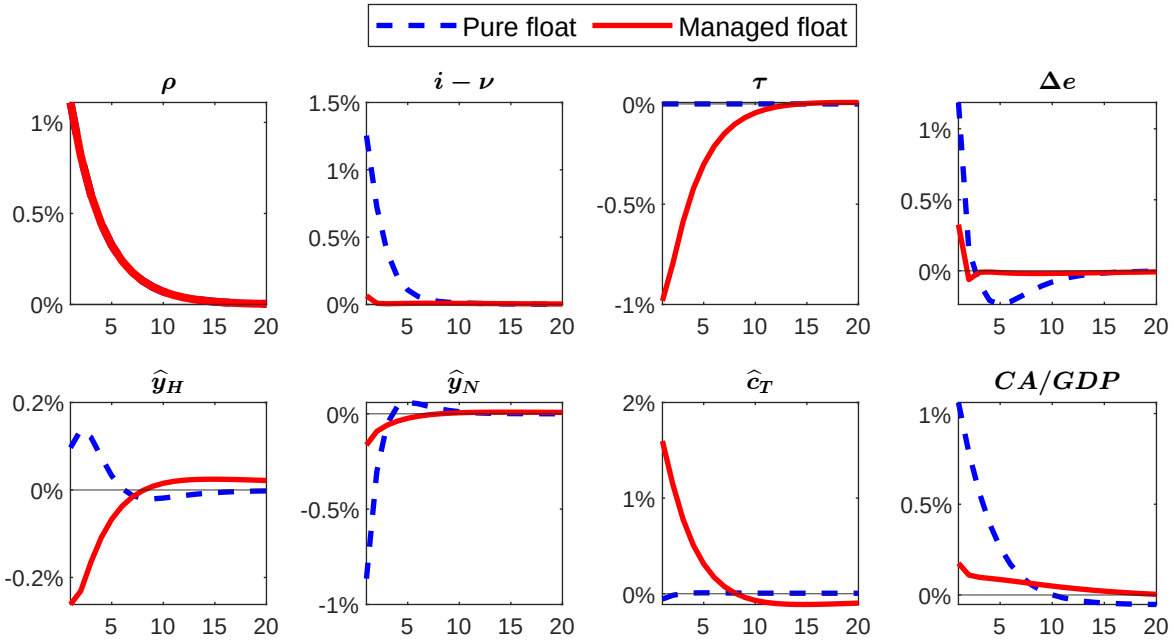


Figure B2: Impulse response function in response to a 1 SD shock to ρ

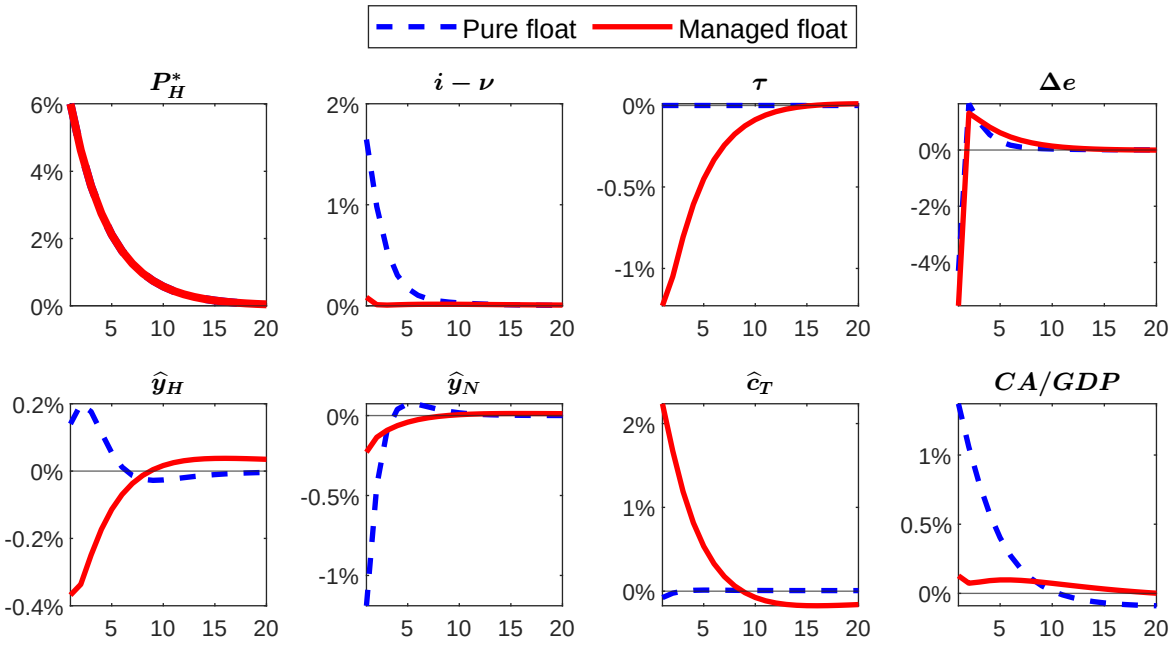


Figure B3: Impulse response function in response to a 1 SD shock to P^*_H

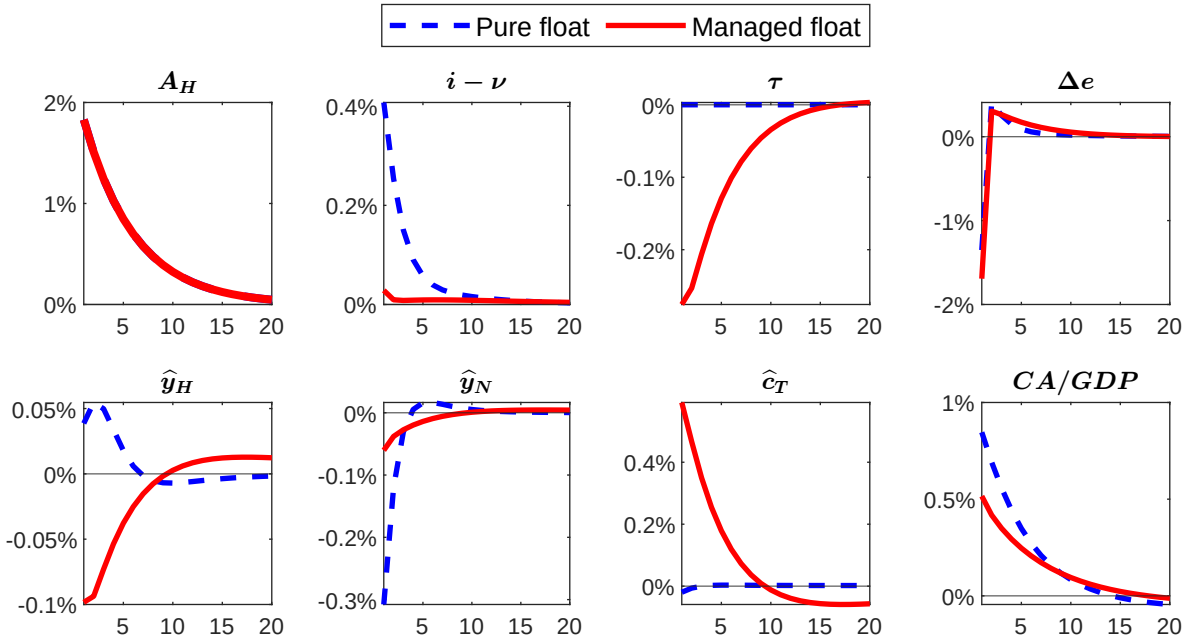


Figure B4: Impulse response function in response to a 1 SD shock to A_H

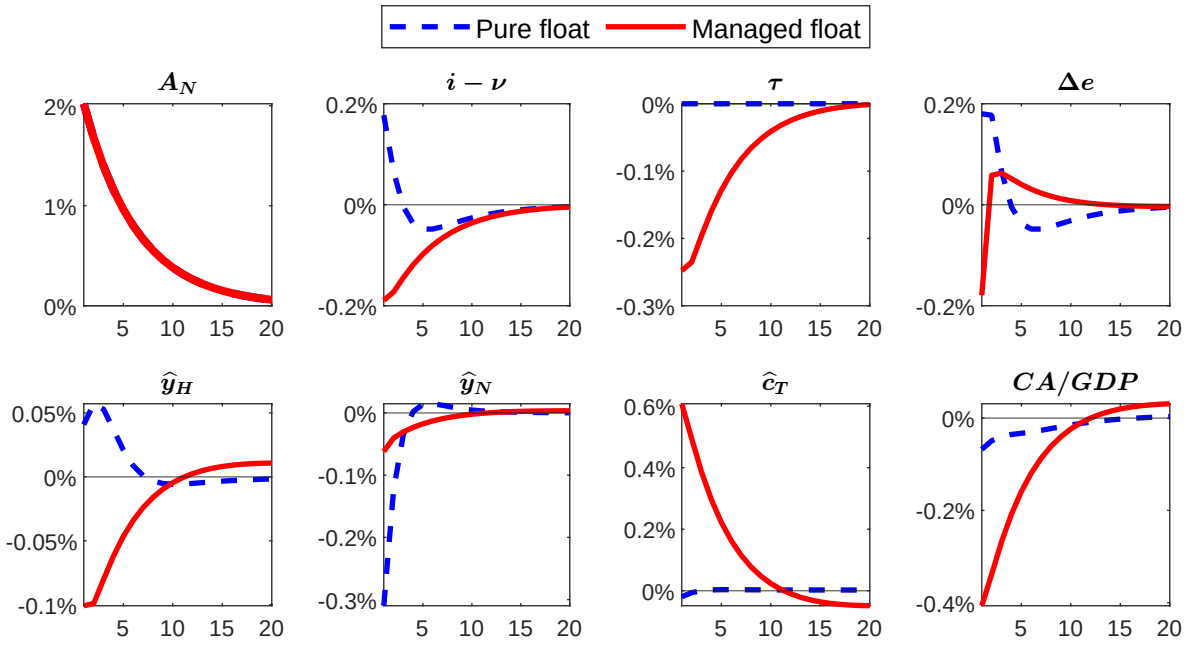


Figure B5: Impulse response function in response to a 1 SD shock to A_N

C Additional Evidence on Inter-sectoral Labor Mobility

This section provides complementary empirical evidence on differences in inter-sectoral labor mobility between EMs and AEs using a model-free reduced-form approach. The key insight from the model is that higher inter-sectoral labor mobility implies a larger reallocation of labor across sectors for a given change in relative wages. Conversely, when labor mobility is limited, a larger adjustment in relative wages is required to induce the same reallocation of labor. We test whether this prediction is consistent with the observed responses of relative sectoral hours worked and wages to terms-of-trade shocks.

We estimate local projections of relative hours worked and relative wages following innovations in the terms of trade. First, we detrend log terms of trade with a linear time trend and estimate an AR(1) process for the cyclical component for each country and extract the residuals as terms-of-trade shocks. We normalize the shocks by their standard deviation for each country. We then estimate the following local projection specification for horizons $h \in \{0, \ldots, 5\}$:

$$y_{k,t+h} - y_{k,t-1} = \alpha_k^h + \beta_h \varepsilon_{k,t} + \gamma_h(\varepsilon_{k,t} \times EM_k) + u_{k,t+h}, \tag{63}$$

where $y_{k,t}$ denotes either relative employment (L_H/L_N) or relative wages (W_H/W_N) between the home tradable and non-tradable sectors in year t, $\varepsilon_{k,t}$ is the normalized terms-of-trade shock, and EM_k is an indicator that takes the value of 1 if country k is an EM and 0 otherwise. We control for country fixed effects and standard errors are clustered at the country level. The coefficient γ_h captures the differential response of EMs relative to AEs. Wages are derived by dividing total labor compensation by hours worked.

Figure C1 shows the estimated γ_h over a five-year horizon, together with 90 and 95 percent confidence intervals. The results show that following a positive terms-of-trade shock, EMs exhibit a more negative response in relative labor but a larger positive response in relative wages compared with AEs. These patterns indicate that, relative to AEs, adjustment in EMs occurs to a greater extent through relative wages rather than through the reallocation of labor across sectors.

Through the lens of the model, these findings are consistent with lower inter-sectoral labor mobility in EMs. Although the reduced-form estimates do not directly identify the structural labor mobility parameter, the joint responses of relative labor and wages provide complementary and independent evidence supporting the calibration of lower labor mobility in EMs.

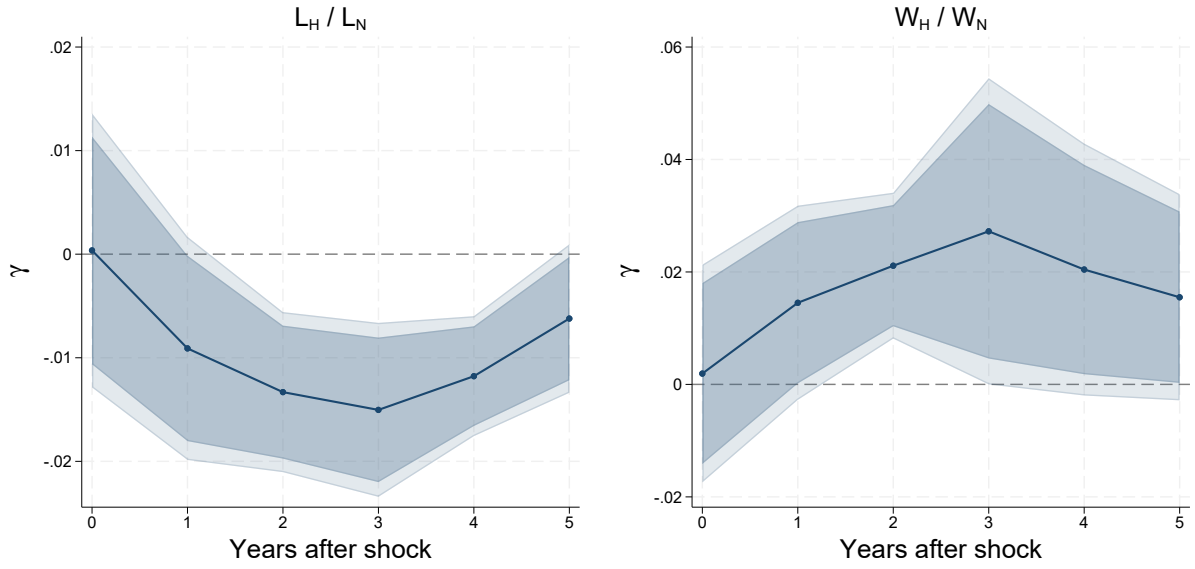


Figure C1: Estimates of γ_h in response to a terms-of-trade shock

Note: The shaded areas represent the 90 and 95 percent confidence intervals.

D Foreign Exchange Intervention

D.1 Welfare loss function

We derive a second-order Taylor expansion around the first-best allocation. The algebra used to derive the welfare loss function for the extended version of the model with FXI is similar to that used to derive the welfare loss for the baseline quantitative model. One difference is the first-order terms for the tradable sector are reorganized to

$$
\begin{aligned}
&\sum_{t=0}^{\infty} \beta^t \frac{\partial u\left(C_t^n\right)}{\partial C_{T,t}^n} / P_{T,t}^* \left(P_{T,t}^* C_{T,t} - P_{H,t}^* Y_{H,t}\right) \\
=&\sum_{t=0}^{\infty} \beta^t \frac{\partial u\left(C_t^n\right)}{\partial C_{T,t}^n} / P_{T,t}^* \left(-NFA_{t+1} + (1+i^{US})NFA_t - \frac{\kappa_B}{2} NFA_{t+1}^2 - \frac{\kappa_w}{2} Y_H {\pi_{H,t}^w}^2 + (\rho_{t-1} - \varsigma B_t^*) B_t^*\right) \\
=&-\sum_{t=0}^{\infty} \beta^t \frac{\partial u\left(C_t^n\right)}{\partial C_{T,t}^n} / P_{T,t}^* \left(\frac{\kappa_B}{2} \widehat{NFA}_{t+1}^2 + \frac{\kappa_w}{2} Y_H {\pi_{H,t}^w}^2 + \varsigma \widehat{B}_t^{*2}\right) \\
=&-\sum_{t=0}^{\infty} \beta^t \frac{\partial u\left(C\right)}{\partial C_T} \left(\frac{\kappa_B}{2} \widehat{NFA}_{t+1}^2 + \frac{\kappa_w}{2} Y_H {\pi_{H,t}^w}^2 + \beta\varsigma {\widehat{B}_{t+1}^*}^2\right)
\end{aligned}
$$

where we use, $\rho_t = 2\varsigma B_{t+1}^{*n}$, the first-best allocation of home dollar bonds.