Dollar Debt and the Inefficient Global Financial Cycle[*]

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Abstract

This paper proposes a tractable model of the Global Financial Cycle and studies its welfare implications for emerging market economies (EMEs). When local firms issue debt denominated in dollars, central banks must increase their policy rate as the U.S. tightens in order to offset balance sheet effects stemming from the depreciation of their currency. If global financial markets are imperfect, this synchronized policy response has negative spillovers: a greater quantity of capital flows must be intermediated, which leads to a higher premium on the dollar interest rate, exacerbating the Global Financial Cycle. This bottleneck externality requires further tightening and results in inefficiently low levels of output and employment in EMEs, and generates gains from coordination. On the contrary, discouraging debt issuance in dollars through macroprudential policy has positive spillovers. Its optimal use dampens the Global Financial Cycle and its inefficiencies.

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1 Introduction

In May 2013, the U.S. Federal Reserve announced it would start tapering its large-scale asset purchases. Financial conditions in emerging market economies (EMEs) immediately deteriorated: currencies depreciated, stock markets fell, and bond yields rose. This "taper tantrum" episode highlighted how EMEs may be severely affected by US domestic policy decisions: when private debt is denominated in dollars (Florez-Orrego, Maggiori, Schreger, Sun and Tinda 2023) a depreciation of the currency weakens balance sheets, which hurts financially constrained firms. To fight such depreciations, central banks in EMEs often rely on interest rate policy, putting a drag on aggregate demand (Calvo and Reinhart 2002).

Although it is now understood that central banks in EMEs are constrained by the actions of the Federal Reserve (Rey 2013, Bruno and Shin 2015b, Obstfeld, Ostry and Qureshi 2019, Kalemli-Özcan 2019), their synchronized response to the Global Financial Cycle raises new questions. First, under which conditions are there spillovers from EMEs' monetary policy response to the actions of the Federal Reserve? Second, are there eventual coordination gains for central banks in EMEs? And third, can macroprudential policies help smooth the inefficiencies associated with the Global Financial Cycle?

This paper proposes a tractable model that allows one to answer these questions. The central result of the paper is that, when global financial markets are imperfect (Gabaix and Maggiori 2015) a "bottleneck externality" appears in response to policy decisions in the U.S., exacerbating the global financial cycle: central banks in EMEs raise domestic policy rates to counter depreciationary pressures and balance sheet effects, and they do this by trying to attract more capital inflows. When this occurs in all EMEs at the same time, the global intermediary sector needs to intermediate a higher quantity of capital flows. When international financial markets are frictional, these intermediaries charge a higher premium to intermediate more flows. This feeds back into domestic conditions by creating additional depreciationary pressures in emerging economies, which require another round of tightening. A coordinated response from central banks can solve this bottleneck externality by tightening less in response to a Fed shock, resulting in higher employment and higher output in all EMEs. In contrast, discouraging debt issuance in dollars through macroprudential policy has positive spillovers. Issuing less in dollars ex-ante eases the trade-off faced by individual central banks in the future, such that there is less need for attracting capital flows in response to a Fed tightening shock. This also eases the job of other central banks, as there is now less congestion in capital flows. Thus, the optimal use of macroprudential policy in EMEs can dampen the Global Financial Cycle and its inefficiencies.

I start by developing in Section 2 a model of a small open economy that reflects the different forces at play, building on Bianchi and Lorenzoni (2022). The model is characterized by two key departures from the neo-classical benchmark: financial frictions and nominal rigidities. The presence of financial frictions implies that the net worth of entrepreneurs plays a crucial role (Tirole 2010 ; Bernanke and Gertler 1990): increasing this net worth allows entrepreneurs to level up more and invest more into productive assets. This channel naturally interacts with the existence of debt denominated in dollars. When entrepreneurs' revenues are in local currency, any movement in the exchange rate *vis-à-vis* the dollar impacts the net worth of entrepreneurs, leading to balance sheet effects.[1] An increase in the US interest rate provokes capital outflows that depreciate the local currency, weakening the balance sheet of entrepreneurs, forcing them to delever and invest less in productive capital, leading to lower output later on.[2]

The central bank can counter these depreciationary pressures by raising its domestic policy rate. But the existence of nominal rigidities — modeled as rigid wages — implies that there is a monetary policy trade-off, fleshed out in Section 3. By increasing its interest rate, the EME is able to attract capital inflows that will appreciate its currency, lowering the repayment burden imposed on entrepreneurs, and thus leading to higher investment through the net worth effect described above (a "fear-of-floating," Calvo and Reinhart 2002). This increase in the interest rate, however, also leads to a rebalancing of households' demand away from non-tradable goods, eventually leading to involuntary unemployment and lower output in this sector because of rigid wages. This optimal interest rate is naturally increasing in the size of dollar debt held by entrepreneurs and in the U.S.

[1] These effects have been documented in a host of different countries, see e.g. Harvey and Roper (1999), Aguiar (2005), Bruno and Shin (2020) and Rodnyansky, Timmer and Yago (2022). I do not take a stance on the fundamental reason behind dollarized liabilities in EMEs (see the literature review below).

[2] Caballero, Fernández and Park (2019) construct an external financial indicator for EMEs, using data on foreign financing by the corporate sector. They show that an adverse shock to this indicator "generates a long and prolonged decline in real output growth in these economies."

interest rate. The higher the Fed rate, the more difficult it is for the EM central bank to achieve full employment for a given level of dollar debt.

Since many EMEs are characterized by high levels of dollarized liabilities, all will hike in response to a Fed tightening at the same time. Section 4 looks at the general equilibrium effects of this synchronized policy response, which is the main contribution of the paper. In particular, I show that monetary policy spillovers in this context are a cause of concern, but only when global financial markets are imperfect. If global capital flows have to go through financial intermediaries that face financial frictions (Gabaix and Maggiori 2015 ; Coimbra and Rey 2024) or intermediation costs (Bianchi and Lorenzoni 2022 ; Fanelli and Straub 2021), then the aggregate size of capital flows affects the external interest rate faced by EMEs.[3] When central banks seek to counteract depreciationary pressures and balance sheet effects, they need to attract more capital inflows. This change in global capital flows, if it occurs in all EMEs at the same time, increases the interest rate they face because of the intermediation friction. This feeds back into domestic conditions by creating further depreciationary pressures: it weakens balance sheets, and thus requires another round of tightening. At the heart of this feedback is thus what I call a bottleneck externality: all individual EMEs seek to attract capital inflows when the Fed tightens, since all of their foreign-currency debt is denominated in the same currency: the dollar. But because they all draw capital from the same pool (the inelastic intermediary), they do so at the expense of one another, increasing the premium on the dollar interest rate. The Global Financial Cycle is therefore exacerbated, resulting in inefficiently low levels of employment and output in EMEs.[4]

This bottleneck externality generates gains from coordination. I show that the optimal interest rate implemented by central banks is lower when the response to an U.S. tightening is coordinated, and that the difference with the uncoordinated interest rate is increasing in the severity of the friction on global financial markets. This naturally leads to higher employment and higher output in EMEs, and

[3] Morelli, Ottonello and Perez (2022) show quantitatively that global financial intermediaries play a important role in driving borrowing costs in emerging market economies. Kekre and Lenel (2024a) suggest that global intermediation shocks matter more for the dollar/EM exchange rate than for advanced economies.

[4] Importantly, this effect goes through the balance sheet of global intermediaries. As such, it does not depend on whether the set of EMEs is large enough to influence the equilibrium determination of the world interest rate.

dampens the global financial cycle[5]

Since the driving force of my results is the presence of private debt issued in dollars, I pursue with a study of ex-ante policies in Section 5. The issuance of dollar-denominated debt naturally creates externalities when the central bank cannot commit to target only inflation in the future (Drenik, Kirpalani and Perez 2022), failing to take into account the general equilibrium policy response. This externality calls for macroprudential regulation ex-ante, albeit taking a specific form: only debt issued in dollar needs to be discouraged with the appropriate tax, rather than all type of short-term borrowing (Farhi and Werning 2016).[6] By taxing issuance in dollars, the social planner relaxes the trade-off faced by the central bank in the future, when the Fed tightens its policy rate.

Since frictional global capital markets create negative spillovers from monetary policy, a natural question is whether macroprudential policies suffer from the same issues. I show that, perhaps surprisingly, the implementation of such macroprudential policies has *positive* spillovers on the rest of the EMEs. This is because, taking as given the behavior of other central banks, reducing the amount issued in dollars in its own country allows the central bank to hike less in response to the Fed's actions. By tightening less, the country attracts less capital flows, reducing the premium that global intermediaries require as compensation. This marginally lowers the interest rate faced by other countries, reducing the depreciationary pressures that central banks are fighting against. By optimally lowering the amount of corporate debt issued in dollars, each country ameliorates the trade-off that all central banks face, resulting in higher output and employment levels in EMEs. It therefore dampens the global financial cycle and its associated inefficiencies.

Finally, Section 6 presents several extensions and in particular considers the welfare properties of using FX interventions, in addition to the domestic interest rate. When FX interventions are constrained in size, selling reserves is still valu-

[5]This force is related but different than the theory of dynamic terms-of-trade manipulation of Costinot, Lorenzoni and Werning (2014). In Costinot et al. (2014), a country has an incentive to manipulate the interest rate to promote savings if it grows faster than the rest of the world, or borrowing if it grows more slowly. In my theory, countries have an incentive to coordinate to manipulate the interest rate to appreciate their currencies, irrespective of their relative growth levels. See footnote 24 for a further discussion of this point.

[6]See Bianchi (2011), Bianchi and Mendoza (2018), Jeanne and Korinek (2019) and Ottonello, Perez and Varraso (2022) on macroprudential policy in small open economies with a pecuniary externality. See also Benigno, Chen, Otrok, Rebucci and Young (2013), Acharya and Bengui (2018), Schmitt-Grohé and Uribe (2021) on open-economy models that deliver under-borrowing.

able because it relaxes the trade-off faced by the central bank between aggregate demand and the exchange rate. These FX interventions have *positive* spillovers to the rest of the EMEs (Itskhoki and Mukhin 2023). FX interventions do, however, incentivize more issuance in dollars ex-ante, since firms anticipate an appreciated currency. This feeds back into the optimal monetary policy of the central bank and can even result in welfare losses. This result highlights the need for strong macro-prudential measures when FX interventions are part of the planner's toolkit.

Related Literature: The starting motivation of this paper is the conjunction of two well-established facts: the issuance of corporate debt in dollars in EMEs and the global financial cycle. First, a large amount of corporate borrowing in emerging markets is denominated in dollars and in an outsized proportion relative to the wealth share of the US in the world (Bruno and Shin 2015b ; McCauley, McGuire and Sushko 2015 ; Maggiori, Neiman and Schreger 2020).[7] Second, the US's domestic monetary policy drives a global financial cycle in capital flows, monetary policies, asset prices, and credit growth (Rey 2013 ; Kalemli-Özcan 2019 ; Miranda-Agrippino and Rey 2020 ; Miranda-Agrippino and Rey 2022 ; Di Giovanni, Kalemli-Özcan, Ulu and Baskaya 2022 ; Obstfeld and Zhou 2023 ; Cristi, Kalemli-Özcan, Sans and Unsal 2024). My paper explains the latter fact with the former, and draws normative implications for emerging markets. Being forced to respond in a synchronized manner to interest rate movements in the US, an *inefficient* Global Financial Cycle appears.[8]

[7] The literature has proposed several explanations for why firms in emerging markets tend to issue in dollars rather than in their domestic currency, exposing themselves to currency mismatches (McKinnon and Pill 1998 ; Burnside, Eichenbaum and Rebelo 2001 ; Jeanne 2002 ; Caballero and Krishnamurthy 2003 ; Bocola and Lorenzoni 2020 ; Coppola, Krishnamurthy and Xu 2023). My paper does not necessarily take a stance on why so many firms in emerging markets issue in dollars: rather, it takes this fact as given and explores its general equilibrium consequences for the global financial cycle. Relatedly, there is also a large literature on why sovereign debt is often issued in dollars — the so-called "original sin." See Eichengreen, Hausmann and Panizza (2007) for a review. My paper is only concerned with private debt.

[8] A large literature has proposed different models of the Global Financial Cycle, surveyed in Miranda-Agrippino and Rey (2022). In Bianchi, Bigio and Engel (2021), Gopinath and Stein (2021) and Jiang, Krishnamurthy and Lustig (2024), dollar safe assets are special. Farhi and Maggiori (2018) present a model in which the US is a monopolistic supplier of safe assets. In Kekre and Lenel (2024b) and Gourinchas and Rey (2022) the US is special because it is more risk tolerant than the rest of the world. Finally, Coimbra and Rey (2024) and Miranda-Agrippino and Rey (2022) also propose a model of intermediaries with heterogeneous risk-taking, where US monetary policy drives their funding costs. My model does not account for all the identified features of the Global Financial

The presence of dollar debt generates powerful balance-sheet effects. This has been studied in response to the East Asian crisis of the 1990s, by Krugman (1999), Caballero and Krishnamurthy (2003), Céspedes, Chang and Velasco (2004), Aghion, Bacchetta and Banerjee (2004), and Chamon and Hausmann (2005). Recent papers have focused on the determination of optimal policy under foreign-denominated debt in modern models. Ottonello (2021), Matsumoto (2021), and Coulibaly (2021) show that discretionary monetary policy is contractionary during crises, in order to mitigate balance sheet effects originating from exchange rate depreciations, and my model features the same forces.[9] Due to this dollar currency mismatch, monetary policy decisions in the US can have financial spillovers for other countries, as also shown by Bruno and Shin (2015b), Akinci and Queralto (2021), and Jiang et al. (2024). Closely related to my paper, Basu, Boz, Gopinath, Roch, Unsal and Unsal (2023) and Itskhoki and Mukhin (2023) study optimal policy in a small open economy with frictional global intermediaries, and focus on the use of FX interventions. More generally, Bianchi and Lorenzoni (2022) reviews the literature on optimal policy under "fear-of-floating."[10] My paper builds on this previous work, and pushes its implications further: my contribution is to show that the optimal response of EMEs to these US spillovers itself has spillover effects on other countries.[11]

My results are thus linked to a vast literature on international policy cooperation, starting with Obstfeld and Rogoff (2002), Devereux and Engel (2003) and Benigno and Benigno (2006). Importantly, the seminal work of Korinek (2017) sets out the conditions that must be violated to generate inefficiency and scope for cooperation. In my paper, this stems from the use of a single instrument (monetary

Cycle, as it is deliberately stylized. For instance, I do not study asset prices or risk-taking (see, e.g., Akinci, Kalemli-Özcan and Queralto 2022).

[9] More generally, this belongs to a literature studying deviations form inflation targeting in open NK models, surveyed in Corsetti, Dedola and Leduc (2010). See also Corsetti, Dedola and Leduc (2023), Fanelli (2024) and Bodenstein, Corsetti and Guerrieri (2024) for recent contributions.

[10] This is also related to a large literature studying optimal monetary policy under financial fragility (Boissay, Collard, Galí and Manea 2021 ; Farhi and Werning 2020 ; Asriyan, Fornaro, Martin and Ventura 2021 ; Kashyap and Stein 2023). See also Bianchi and Coulibaly (2023) for a theory of fear-of-floating because of a feedback loop between aggregate demand and credit conditions. Wang (2019) additionally shows that incomplete exchange rate pass-through to goods prices leads to a new form of balance sheet effects, and derives the associated optimal macroprudential policy.

[11] Basu et al. (2023) also show that FX mismatch regulations and domestic macroprudential measures can help the central bank focus on closing the output gap, a result also present in my framework. In addition, I show that these measures can have *positive* spillovers across EMEs.

policy) to control both employment and the exchange rate.[12] Fornaro and Romei (2022) study monetary policy when there is excessive demand for tradable goods. They show that the optimal response is to run a trade deficit in order to sustain tradable consumption, which boosts employment in the non-tradable sector. This entails negative spillovers to the rest of the world: each country seeks to create a trade deficit, but since trade has to be balanced, the world interest rate increases.[13] Relative to this literature, my paper emphasizes the response of central banks in EMEs to US monetary policy shocks and a different driving force (dollar debt).[14] As such, it allows me to study the optimal use of macroprudential policy and its positive spillovers, as well as the moral hazard implications of FX interventions. By contrast, Fornaro and Romei (2019) show that, in a global liquidity trap environment, capital account policies can have negative spillovers by exacerbating the zero lower bound constraint. My paper thus suggests that the coordination of macroprudential policies might be highly sensitive to the type of shocks and global conditions.[15] Finally, Das, Gopinath, Kim and Stein (2024) studies spillovers in ex-ante reserve accumulation: they show that central banks over-accumulate dollar assets, which lowers the dollar interest rate and encourage further issuance in dollars. This is an additional mechanism to the one I highlight, and that would also apply in my setup and reinforce the need for macroprudential policy.

[12] Section 6.1 studies the optimal use of FX interventions, in particular when the central bank has only a limited number of foreign reserves at its disposal. My paper is therefore also linked to a growing literature studying FX interventions, e.g., Ghosh, Ostry and Chamon (2016), Cavallino (2019), Amador, Bianchi, Bocola and Perri (2020), Fanelli and Straub (2021), Bacchetta, Benhima and Berthold (2023) and Ottonello, Perez and Witheridge (2023).

[13] Bianchi and Coulibaly (2024) further show that this depends on the differences in labor intensities across the tradable and non-tradable sectors. A notable difference in my framework is that spillovers go through the balance sheet of constrained intermediaries: as such, it does not require a condition of balanced trade among the set of EMEs considered, or necessitates that the group of countries is large enough to influence the determination of the world interest rate faced by all countries.

[14] Caldara, Ferrante, Iacoviello, Prestipino and Queralto (2024) build a model where synchronous monetary tightening has spillover effects because it tightens global financial intermediaries' financial constraints. They also show empirically that synchronous tightening episodes are associated with larger effects on output.

[15] On the interaction of macroprudential and monetary policies, see also Farhi and Werning (2020), Devereux, Young and Yu (2019), Fanelli (2023), Fontanier (2024), Egorov and Mukhin (2023), Bianchi and Coulibaly (2022).

2 A Small Open Economy Model

Structure We consider a small open economy that can be thought of as an emerging economy. The model is based on Bianchi and Lorenzoni (2022), but endogenizes "fear-of-floating" through the issuance of debt denominated in dollars by firms. Time is discrete and indexed by $t \in \{1, 2, 3\}$. Since the presence of risk only obfuscates my results, agents have perfect foresight. There are two types of agents. Households consume and provide labor in periods 2 and 3. Entrepreneurs issue debt in period 1 in order to finance investment in a capital stock that will produce domestic (non-tradable) goods in periods 2 and 3. Entrepreneurs simply seek to maximize profits, which are fully rebated to households. There is a non-tradable good and a single tradable good. The price of tradables is normalized to one in dollars, so using the law of one price, the price of tradable goods in pesos is:

$$p_t^T = e_t \tag{1}$$

where e_t is the nominal exchange rate, i.e. the price of a dollar in pesos.

The main insights of the paper come from the behavior of the equilibrium in the intermediate period, when entrepreneurs have some dollar debt to repay and need to make investments. This section thus describes the intermediate period, in order to characterize optimal monetary policy and spillovers between EMEs. The optimal issuance strategy at $t = 1$ and the implications for macroprudential policy are then presented in Section 5.[16]

2.1 The economy at $t = 2$

Entrepreneurs Entrepreneurs enter period 2 each with a capital stock K_1, as well as dollar and peso debts to repay. Their existing stock of capital produces η_2 units of non-tradable goods per unit of capital. The net worth of entrepreneurs is thus denoted by:

$$n_2 = \eta_2 K_1 - b_1 - e_2 b_1^* \tag{2}$$

[16] What ultimately matters for my model is that entrepreneurs find it optimal to issue at least some of their initial debt in dollars. This can be for a variety of reasons already highlighted in previous work (see the literature review above). In Section 5, the level of the interest rate on dollar debt depends on the size of the loan, such that entrepreneurs issue in dollars and in the domestic currency, up to the point where they are indifferent between both on the margin.

After η_2 is realized, a random fraction κ of firms are still productive and can produce in period 3 if they maintain their capital stock, and the remaining fraction $1-\kappa$ is unproductive: their capital depreciates entirely and they stop producing. Unproductive firms repay their debt, lend to other firms, and rebate the rest of their profits to households.

To maintain their existing stock of capital to continue producing non-tradable goods in period 3, productive entrepreneurs must invest s units of non-tradable goods per unit of capital: to maintain k_2 they need to pay $s \cdot k_2$, which will pay off $r_1 k_2$ units of non-tradables at $t = 3$. Unmaintained capital fully depreciates. To finance this investment, entrepreneurs can borrow b_2 from other unproductive firms at a 0 interest rate but are subject to a classic monitoring problem (Tirole 2010) that limits the amount they can borrow:

$$b_2 \leq r_0 k_2 \tag{3}$$

where r_0 is the pledgeable part of the project, with $r_0 < s < 1$.[17] Since entrepreneurs seek to maximize future output, their budget constraint is:

$$n_2 + b_2 = s k_2 \quad \text{s.t.} \quad k_2 \leq K_1 \, ; b_2 \leq r_0 k_2 \tag{4}$$

The case of interest will be when entrepreneurs are constrained by the pledgeability limit, which will imply that:

$$k_2 = \frac{n_2}{s - r_0} \tag{5}$$

As is common in these models, net worth plays a crucial role. Entrepreneurs can leverage their wealth with a multiplier $1/(s-r_0)$. By improving entrepreneurs net worth, monetary policy will thus be able to prop up investment in the capital stock. Since only a fraction κ of entrepreneurs are productive, the aggregate stock of capital used for production at $t = 3$, when entrepreneurs are constrained, will be given

[17] Appendix B.2 studies the case where the inter-firm interest rate is the nominal interest rate set by the central bank, i_2, instead of 0. This complicates the analysis, since the central bank also needs to take into account a third effect: by increasing the interest rate, it tightens the financial friction. However, Appendix B.2 shows that the exact same forces are at play: the optimal policy solution takes the same form, only with an additional term pertaining to this third effect. The cost of this extension is that the model looses tractability.

by:

$$K_2 = \kappa \frac{n_2}{s - r_0} \tag{6}$$

while the amount of non-tradable goods used for maintaining capital is $s \cdot K_2$.

Households Households receive an endowment of tradable goods y_2^T. They have the following utility function, Cobb-Douglas at $t = 2$ and linear at $t = 3$ for tractability:

$$U_2 = \frac{1}{1-\rho} \left((c_2^T)^\phi (c_2^N)^{1-\phi} \right)^{1-\rho} + \beta \left(c_3^N + c_3^T \right) \tag{7}$$

with $\rho \geq 1$. Households have an inelastic supply of labor $\bar{l}$ in each period. They can save and borrow in peso-denominated bonds (a_3) or dollar-denominated bonds (a_3^*), at respective interest rates i_2 and i_2^*. The central bank sets the domestic interest rate i_2. We keep the same convention as for entrepreneurs: a positive position $a_3^* > 0$ means that households are borrowing in dollars. They thus have the following budget constraint:

$$p^T c_2^T + p^N c_2^N = e_2 y^T + w_2 l_2 + \frac{1}{1+i_2} a_3 + \frac{1}{1+i_2^*} e_2 a_3^* + \Pi_2 \tag{8}$$

Under these conditions, the standard UIP condition holds:

$$1 + i_2 = (1 + i_2^*) \frac{e_3}{e_2} \tag{9}$$

Peso-denominated bonds are only traded domestically. Since households are symmetric and cannot lend to entrepreneurs, we have $a_3 = 0$ in equilibrium.

Production Perfectly competitive firms produce non-tradable goods using a linear technology $y_2^N = l_2$. Wages are fully rigid at $\bar{w} = 1$, so involuntary unemployment ($l_2 < \bar{l}$) occurs when the interest rate is too high. Firms are competitive, so the price of the non-tradable good is $p_t^N = \bar{w} = 1$.

2.2 The economy at $t = 3$

In the last period, productive entrepreneurs produce and rebate profits to households. Households receive an endowment of tradable goods y_3^T, provide labor to fully competitive firms, settle their foreign currency debt, and consume. Since there are no savings decisions to be made, there is full employment $l_3 = \bar{l}$. The budget constraint is simply:

$$p_3^N c_3^N + p_3^T c_3^T + a_3 + e_3 a_3^* = p_3^T y_3^T + \bar{w}\bar{l} + \Pi_3 \tag{10}$$

We can now formally define the competitive equilibrium.

Definition 1. *A competitive equilibrium is a path of real allocations $\{c_t^N, c_t^T, l_t\}_{(t=1,2)}$, capital K_2 and capital flows a_3^*, such that, given a domestic policy rate i_2, a dollar interest rate i_2^* and legacy debt b_1 and b_1^*: (i) households maximize (7) under the constraints (8) and (10) ; and (ii) entrepreneurs invest according to (6).*

Note that since the economy is "flexible" at $t = 3$, and preferences are linear, the exchange rate is pinned down at $e_3 = \bar{w} = 1$. An immediate implication will be that interest rate decisions at $t = 2$ will immediately translate into exchange rate movements of e_2, in order for the UIP condition to hold. In other words, interest decisions will only impact the spot exchange rate and not the forward rate, substantially simplifying the analysis.

In what follows, we restrict ourselves to situations where: (i) there is a unique equilibrium ; and (ii) productive entrepreneurs are against their borrowing constraint (3).[18] Unless stated otherwise, all derivations and proofs are in Appendix A.

3 Dollar Debt and Monetary Policy

This section studies the optimal policy problem, when the only available instrument is conventional monetary policy.

[18]This financial friction generates asymmetric effects in general: an appreciation of the currency when firms are not against the constraint does not have amplification effect. This is in line with the findings of Kalemli-Ozcan, Liu and Shim (2021), who find that the effects of depreciations are quantitatively larger than those of appreciations.

Planner's Problem The central bank seeks to maximize the welfare of the representative consumer by choosing i_2.:

$$\max_{i_2} \mathcal{W} := \max_{i_2} \frac{1}{1-\rho} \left((c_2^T)^\phi (c_2^N)^{1-\phi} \right)^{1-\rho} + \beta \left(c_3^N + c_3^T \right) \tag{11}$$

since entrepreneurs are rebating all of their profits to households. Supporting the wealth of entrepreneurs will, however, enter the central bank problem by increasing the output in period $t = 3$. The key premise of this model is that the presence of dollar debt creates a trade-off for the central bank. The first channel works through aggregate demand: changing the domestic interest rate rebalances demand between non-tradable and tradable goods, as can be seen from the following optimality condition:

$$c_2^N = \left(\frac{1-\phi}{\phi} \frac{(1+i_2^*)}{(1+i_2)} \right) c_2^T \tag{12}$$

When i_2 decreases, the demand for non-tradables rises relative to tradables which can increase non-tradable output (i.e. lower unemployment) since wages are rigid.

A decrease in i_2, for instance to increase employment and reach potential output, has an impact on the exchange rate through the usual UIP condition:

$$1 + i_2 = (1 + i_2^*) \frac{e_3}{e_2} \tag{13}$$

which mechanically increases e_2, i.e. depreciates the currency. Because of dollar debt repayments, however, this change in the exchange rate weakens the balance sheet of entrepreneurs that need to borrow subject to the financial friction (3) in order to maintain their capital stock:

$$\frac{dK_2}{di_2} = \frac{e_2 \kappa b_1^*}{s - r_0} \tag{14}$$

Thus, when entrepreneurs are constrained a depreciation of the domestic currency *vis-à-vis* the dollar results in a lower capital stock at $t = 2$. Finally, this decrease in capital has a negative impact on welfare, by lowering output at $t = 3$.

Optimal Monetary Policy The central bank needs to trade off these two channels. The following proposition characterizes that, when dollar debt is large enough, it becomes optimal to raise the interest rate above the natural rate, creating unemployment, in order to appreciate the currency.

Proposition 1 (Optimal Monetary Policy at $t = 2$)**.** *There exists a level of dollar debt $\tilde{b}^*$ such that, when $b_1^* > \tilde{b}^*$, the optimal monetary policy allows for underemployment ($l_2 < \bar{l}$) in order to appreciate the currency. When this is the case, the optimal interest rate i_2^{opt} is increasing in both: (i) the level of dollar debt, b_1^*, and (ii) the external interest rate i_2^*.*

All proofs are detailed in Appendix A. These comparative statics are intuitive: when b_1^* is high, the balance sheet effect is stronger, reinforcing the need to appreciate the currency. Similarly, a higher external interest rate i_2^* creates a stronger depreciationary pressure, which reinforces the balance sheet effect and thus also calls for a higher domestic interest rate. As a result, an increase in the Federal Reserve rate worsens the emerging market's monetary policy dilemma: it becomes harder to achieve full employment because of balance sheet effects.

These effects can be seen analytically by looking at the simplifying case where preferences are separable ($\rho = 1$).

Corollary 1 (Optimal Monetary Policy when $\rho = 1$)**.** *When $\rho = 1$, preferences are separable between tradable and non-tradable consumption. The domestic interest rate set by the central bank to maximize welfare when $b_1^* > \tilde{b}^*$ can then be expressed as:*

$$1 + i_2^{opt} = \frac{\beta}{1-\phi}\left(r_1 \kappa \frac{b_1^*}{s - r_0}\right)(1 + i_2^*) \tag{15}$$

This expression visually links the forces at play. The level of dollar debt directly matters to monetary policy. Its is amplified by the net worth multiplier $1/(s - r_0)$: when $s - r_0$ is low, a shock to net worth transmits to investment in capital more strongly, thus inflating the effects of a policy hike. At the same time, aggregate demand is hurt by an increase in the interest rate, and here this effect is disciplined by $1 - \phi$, the weight on non-tradable goods in the consumption basket at $t = 2$ of households. When $1 - \phi$ is larger, non-tradable consumption is relatively more important at $t = 2$, so the central bank puts more weight on aggregate demand, and implements a lower interest rate to minimize unemployment. Finally, the level of US interest rates matters: the domestic central bank is forced to follow the actions of the Fed to prevent excessive devaluation of the peso that results in adverse balance sheet effects, which is of course costly for aggregate demand.[19]

The Global Financial Cycle An immediate implication of Proposition 1 is that the presence of dollar debt creates a synchronization between the domestic policy decisions of emerging markets. Regardless of their own aggregate demand shocks, all central banks fearing balance sheet effects from dollar debt optimally tighten in the face of tighter financial conditions in the US. For example, Proposition 1 illustrates the "taper tantrum" episode of 2013, where the central banks of emerging markets hiked after the Fed hinted that it would raise rates in the near future (Sahay, Arora, Arvanitis, Faruqee, N'Diaye and Griffoli 2014). The following corollary provides an analytical expression for the cyclicality behavior, and also highlights that the strength of the response depends directly on the prevalence of b_1^*.

Corollary 2. *The sensitivity of the domestic interest rate in a EME with respect to the dollar interest rate i_2^* is given by:*

$$\frac{d(1+i_2)}{d(1+i_2^*)} \propto \left[(b_1^*)^{\rho}\,(1+i_2^*)^{1-\rho}\right]^{\frac{1}{\rho-1+\rho(1-\phi)+\phi}} \tag{16}$$

The fact that all countries privately act in a manner consistent with Proposition 1 can however create coordination issues. This is the focus of the next Section.

Discussion of Assumptions The model contains several assumptions to keep the results tractable, especially once we shift the focus to an equilibrium with a continuum of SOEs. In particular, the linearity of utility in the last period will allow for tractable expressions of capital flows, without altering the presence of a trade-off between balance sheet effects and aggregate demand. The fact that entrepreneurs

[19] Appendix A.5 additionally links to the aggregate demand externality literature (Korinek and Simsek 2016 ; Farhi and Werning 2016 ; Guerrieri and Lorenzoni 2017 ; Fornaro and Romei 2019). It shows that the interest rate necessary to achieve full employment is decreasing in b_1, the amount of domestic debt issued by entrepreneurs in the first period. In this literature, it is generally assumed that a zero lower bound constraint (ZLB) binds at period 2. In such a case, a higher debt in $t = 1$ translates into weaker aggregate demand at $t = 2$, and the policymaker is unable to stimulate the economy enough, resulting in unemployment and inefficiently low output. The effect is absent here, since I do not assume a ZLB constraint. In my paper, the problem faced by the central bank is rather the opposite: the presence of foreign debt makes the policymaker more likely to *hike* interest rates, not to restore full employment but to counter financial frictions.

need to borrow to finance production in period $t = 3$ while wages are rigid in period 2 allows for a clean separation of the two effects across time, resulting in analytical expressions. Finally, the fact that there is a single traded good (whose price is fixed by international conditions) eliminates terms-of-trade manipulation motives, such that the only reason to affect the exchange rate is because of the dollar debt revaluation channel. Similarly, the trade-off of the central bank is assumed to be between aggregate demand and investment, but Appendix B.3 studies a version of the model with flexible wages (no aggregate demand shortfalls), but where the central bank trades off a higher cost of investment for unconstrained firms with relaxing financial frictions through the exchange rate for constrained firms. This leads to a similar expression for optimal monetary policy, featuring the exact same forces.

I also assumed an extreme form of currency mismatch: entrepreneurs only have revenues in local currency, and cannot hedge their exposure.[20] It is straightforward to extend the framework to include a less extreme form of currency mismatch (see Appendix B.1), which only weakens the strength of the balance sheet effect. In a similar vein, it is assumed that the debt in dollars is due to foreigners: if the debt was due to households, the central bank should take into account the loss incurred to households by the appreciation of the currency. This would once again weaken the balance sheet effects, but given that entrepreneurs are constrained and households are not, an appreciation of the currency on the margin would still be desirable (in other words, redistribution from households to constrained entrepreneurs is valuable).

4 Spillovers

The previous analysis studies a small open economy in isolation, taking US interest rates as given. In practice, many emerging economies are characterized by a high level of corporate debt dollarization (Benetrix, Gautam, Juvenal and Schmitz 2019). This raises questions about coordination issues and possible spillovers: when the Federal Reserve hikes U.S. interest rates, they all face depreciationary pressures.

[20]See Alfaro, Calani and Varela (2021), Du and Huber (2023) , and Levin-Konigsberg, Stein, Averell and Castañon (2023) for work using micro-data to understand the heterogeneity of firms' hedging behavior.

Each of these countries would then find it optimal to increase their domestic rates in order to counter the net worth effects, as highlighted in Proposition 1. If global financial markets are frictional, this general movement towards higher rates will backfire through a novel bottleneck externality and create even further depreciationary pressures.[21]

4.1 The World Economy

We consider a similar setup as in Section 2, but this time with a continuum of identical and symmetric small open economies. Each country is indexed by j. In particular, country j at time $t = 2$ sets its nominal interest rate at $i_{2,j}$, taking all other interest rates as given. Small open economies are in mass of 1, and we denote the aggregate variables without the subscript j: $b^*_{1,j}$ thus refers to the dollar-denominated debt of country j, and b^*_1 to the aggregate dollar debt of emerging economies. Importantly, we still assume that this continuum of small open economies is small relative to the rest of the world, such that the decision of this continuum has no impact on the price of tradables in dollars, still set to 1.[22]

4.2 Global Financial Markets

We assume that global financial markets are frictional in the spirit of Gabaix and Maggiori (2015). Each country can only trade dollar-denominated bonds with a global arbitrageur that intermediates all capital flows from the continuum EMEs to the rest of the world. The global arbitrageur offers an interest rate i^*_2 that differs from the rate set by the Fed, $i^{\$}_2$, as compensation for intermediation. The key premise of Gabaix and Maggiori (2015) is that the *size* of capital flows drives this premium: in other words, intermediaries need to be compensated more if they do more intermediation. Appendix A.15 offers several micro-foundations follow-

[21] Korinek (2017) lays out the conditions that need to be violated to generate inefficiency and scope for cooperation. Here, this stems from the use of a single instrument (monetary policy) to control both employment and the exchange rate. If the policymaker could also use foreign exchange intervention at zero cost, we would be back to the Korinek (2017) benchmark of the "first welfare theorem." Section 6.1 studies FX interventions.

[22] This distinguishes the spillovers identified in this paper to the work of Itskhoki and Mukhin (2023), where spillovers go through tradables inflation. In my framework, spillovers can arise even if the set of EMEs is too small to affect the equilibrium world price of tradable goods. See Section 4.5 for a discussion of the mechanisms and assumptions.

ing Gabaix and Maggiori (2015), Fanelli and Straub (2021), Bianchi and Lorenzoni (2022) and Coimbra and Rey (2024) that all lead to the following expression for the rate offered by intermediaries:

$$i_2^* = i_2^\$ + \Gamma \cdot \int_j \left(c_{2,j}^T - y_{2,j}^T \right) dj \tag{17}$$

where $\int_j \left(c_{2,j}^T - y_{2,j}^T \right) dj$ is the aggregate net capital flow from the continuum of SOEs to the rest of the world. This expression simply states that, the larger the capital flows between our EMEs and the rest of the world, the larger the premium intermediaries need to charge individual countries for compensation. This can be because of financial frictions (Gabaix and Maggiori 2015 ; Coimbra and Rey 2024) or intermediation costs (Bianchi and Lorenzoni 2022 ; Fanelli and Straub 2021).

4.3 Limit Case: a No-Spillover Result

Before studying spillovers in response to the Global Financial Cycle, it is instructive to look at the limiting case where spillovers are absent even with frictional intermediation, and to understand why. Therefore, I start by studying the case where preferences are separable between tradable and non-tradable consumption, $\rho = 1$.

Since each country takes i_2^* as given, the optimal policy program is completely unchanged from the perspective of a single monetary authority. We thus know, thanks to Proposition 1 and corollary 1, that country j reacts to the dollar interest rate it faces, i_2^*, with a domestic rate of:

$$1 + i_2^{opt} = \frac{\beta}{1-\phi} \left(r_1 \kappa \frac{b_1^*}{s - r_0} \right) (1 + i_2^*) \tag{18}$$

Now, however, the part $(1 + i_2^*)$ is endogenous. It must be determined by the aggregation of all capital flows from EMEs, as explicitly stated in the next lemma.

Lemma 1 (Limit Case: Equilibrium Capital Flows)**.** *For $\rho = 1$, the aggregate capital flow from emerging economies towards the rest of the world at period $t = 2$ is given by:*

$$\frac{1}{\beta(1 + i_2^*)} - y_2^T \tag{19}$$

where the interest rate i_2^* can be approximated to, when small enough:

$$i_2^* = \frac{i_2^\$ + \Gamma\left(\frac{1}{\beta} - y_2^T\right)}{1 + \frac{\Gamma}{\beta}} \tag{20}$$

A high Γ indicates a large friction on global financial markets, such that global entrepreneurs must be compensated more for intermediating capital flows from emerging economies. This result in a higher i_2^* compared to the Fed nominal rate when the group of EMEs is a net borrower, and vice versa.

The key feature of Lemma 1, however, is that equation (19) (determining the capital flow of an EME) does not depend on the domestic interest rate, i_2. This is a consequence of separable preferences, rather than a robust and general result. Indeed, when $\rho = 1$, the willingness to switch consumption to tradable goods is exactly canceled by the willingness to defer consumption to the future (see Lane 2001, as well as Bianchi and Lorenzoni 2022). This, in turn, means that any variation in the domestic policy rates of emerging economies will have no impact on aggregate capital flows, and thus on the dollar interest rate offered by intermediaries.[23] In other words, there are no spillover effects on the exchange rates of other EMEs. The presence of dollar debt does create a global financial cycle in which all central banks act synchronously after a US monetary policy shock (Corollary 2), but this is an efficient outcome. Consequently, there is no need for coordination between EMEs.

4.4 Bottleneck Externalities

We are now ready to develop the main result of the paper. The previous part showed how aggregate capital flows were independent of the monetary policy stance of individual EMEs in the particular case of $\rho = 1$. However, as soon as $\rho > 1$, the opposite is true: an increase in the domestic policy rate, through the expenditure switching condition, increases the consumption of tradable goods. Through the lens of this model, this is equivalent to saying that the central bank seeks to appreciate its currency *via* a capital inflow. Since all central banks act in

[23]This is true whether central banks in EMEs are following the optimal policy result of Proposition 1 or not.

this way, each EME seeks to attract capital flows at the same time, in response to a US monetary policy shock. Due to global frictional capital markets, this results in spillovers.

The intuition for this result comes from the juxtaposition of the three main equilibrium conditions, linking the Fed policy rate to the domestic policy rate of each EME:

$$\frac{d\ln(1+i_{2,j})}{d\ln(1+i_2^*)} = \frac{\rho(1-\phi)+\phi}{\rho+(\rho-1)(1-\phi)} \tag{21}$$

$$c_{2,j}^T = \frac{\phi}{1-\phi}\frac{1+i_{2,j}}{1+i_2^*}c_{2,j}^N \tag{22}$$

$$i_2^* = i_2^{\$} + \Gamma\int_j \left(c_{2,j}^T - y_{2,j}^T\right) dj \tag{23}$$

The first equation, (21), links the domestic policy rate to the dollar interest rate by trading off balance sheet effects and aggregate demand. The second equation, (22), is the usual expenditure switching condition. The last equation, (23), links the U.S. domestic rate to the dollar interest rate charged by global intermediaries given the aggregate size of capital flows.

A shock to the US domestic policy rate then transmits through EMEs by trickling down these equilibrium conditions. The central bank from the emerging economy increases its domestic policy rate to counter depreciationary pressures and balance sheet effects, and attracts more capital inflows as a result. This change in global capital flows, if it occurs in all small emerging economies at the same time, increases the dollar interest rate faced by all EMEs because of frictions in international financial markets. This feeds back into domestic conditions by creating further depreciationary pressures in emerging economies, through UIP, requiring another round of tightening. At the heart of this feedback is a bottleneck externality: individual emerging countries do not internalize that their domestic policy rate decisions have spillovers on the aggregate size of capital flows, which impact the equilibrium determination of the dollar interest rate i_2^* through the balance sheet of global intermediaries.

Proposition 2 (Monetary Policy Spillovers)**.** *Individual central banks in emerging economies do not internalize that their domestic decisions spill over to the equilibrium* *determination of the dollar interest rate offered by global intermediaries:*

$$\mathscr{C}(i_2, i_2^*) = \frac{d\ln(1+i_2^*)}{d\ln(1+i_2)} = \Gamma(\rho - 1)\frac{c_2^T}{1+i_2^*}\frac{1-\phi}{\rho} \tag{24}$$

The result of Proposition 2 highlights why two features are necessary to give rise to spillovers. First, if $\rho = 1$, then changes in the domestic rate do not affect the size of global capital flows that need to be intermediated, leaving the dollar interest rate constant. Second, if $\Gamma = 0$, global arbitrageurs do not face intermediation costs or frictions, and changes in flows do not affect the dollar interest rate they offer to EMEs. It is the combination of those two ingredients that yields the spillover result.

Because of these spillovers, one can understand the monetary policy response of individual EMEs in rounds. At first, a US monetary policy shock translates one-for-one into a higher i_2^*, through the funding costs of intermediaries, which depreciates their currencies. Each country then optimally follows Proposition 1 to fight the depreciation, at the cost of lowering aggregate demand. This monetary policy response however translates into a higher i_2^* because of this bottleneck externality: every country seeks to appreciate its currency by attracting capital flows, but they all draw capital flows from the same pool: the intermediary, with an inelastic supply of funds. Once again, faced with a higher i_2^*, each country tightens further, and we repeat this until convergence to the new equilibrium i_2^*. The following Proposition highlights how monetary policy responses are more aggressive in response to a US monetary policy shock, when global financial markets are frictional ($\Gamma > 0$).

Proposition 3 (Spillovers and Tighter Monetary Policy)**.** *The response of individual EMEs is amplified by the intermediation friction* Γ *on global financial markets:*

$$\frac{d\ln(1+i_2)}{di_2^\$} = \frac{\frac{d\ln(1+i_2)}{di_2^*}}{1-\mathscr{C}(i_2, i_2^*)} \tag{25}$$

where $\frac{d\ln(1+i_2)}{d\ln(i_2^*)}$ *was expressed in Corollary 2, and is the optimal policy response of a single EME to a shock to* i_2^**.*

This proposition directly implies that the Global Financial Cycle is amplified by the friction on global intermediation of capital flows. Each individual EME responds more to a US monetary policy shock, resulting in higher unemployment in each EME. The bottleneck externality of Proposition 2 exactly quantifies this exacerbation of the Global Financial Cycle. The way it enters the expression has an intuitive explanation: $1/(1-\mathscr{C})$ represents the convergence of the feedback effect of domestic decisions on the interest rate offered by intermediaries.

What does this externality result imply in terms of possible coordination of monetary policies across EMEs? Were all individual SOEs to delegate their monetary policy to a supra-national authority, the optimal monetary policy response would be different. This is because the coordinated planner would internalize the impact of its interest rate decision on Equation (23): tightening creates an upward pressure on the interest rate that these EMEs face, which feeds back in the form of depreciationary pressures hurting the balance sheet of entrepreneurs. The next proposition formally characterizes optimal monetary policy when countries can (and commit to) coordinate.[24]

Proposition 4 (Coordinated Monetary Policy)**.** *Around an equilibrium where $a_3^* = 0$, and to the first-order in Γ, optimal monetary policy with coordination implements a lower interest rate, and reacts less to US monetary policy shocks. The difference between the optimal interest rate with coordination, i_2^C, and the decentralized interest rate i_2^{unC} is equal to:*

$$i_2^{unC} - i_2^C \approx \frac{\Gamma}{e_2} \frac{c_2^T (1-\phi)^2 (\rho-1)^2}{(2(1-\phi)(\rho-1)+1))^3} \tag{26}$$

Employment and output are thus higher in each emerging country in the coordinated equilibrium than in the un-coordinated one.

Once again, the gap between the two solutions is quantified by Γ and $\rho - 1$. This proposition and its implications for the global equilibrium can be seen graphically in Figure 1. This figure shows the best responses of central banks in the

[24] Once the continuum of EMEs are allowed to coordinate, the regional social planner acts as a monopolist on the external interest rate it faces: it takes into account equation (17). This creates an incentive to manipulate "dynamic terms-of-trade," as explained by Costinot et al. (2014) (see also Farhi and Werning 2014). In this two-period model, this is simply equivalent to limiting tradable consumption when there is a trade deficit at $t = 2$. The idea is that individual countries do not take into account that, by all running a trade deficit, they increase their borrowing costs. The regional planner takes this into account (and vice versa for running trade surpluses, which lowers the interest rate on their savings). To highlight that my coordination result comes from the feedback effect of individual interest rate decisions on exchange rates and balance sheets, the next proposition looks at the equilibrium around $a_3^* = 0$, such that there is no incentive to manipulate interest rates for dynamic terms-of-trade motives. In general, both forces are present. The crucial difference is that the force that I highlight is always going in the same direction, to appreciate the currency.

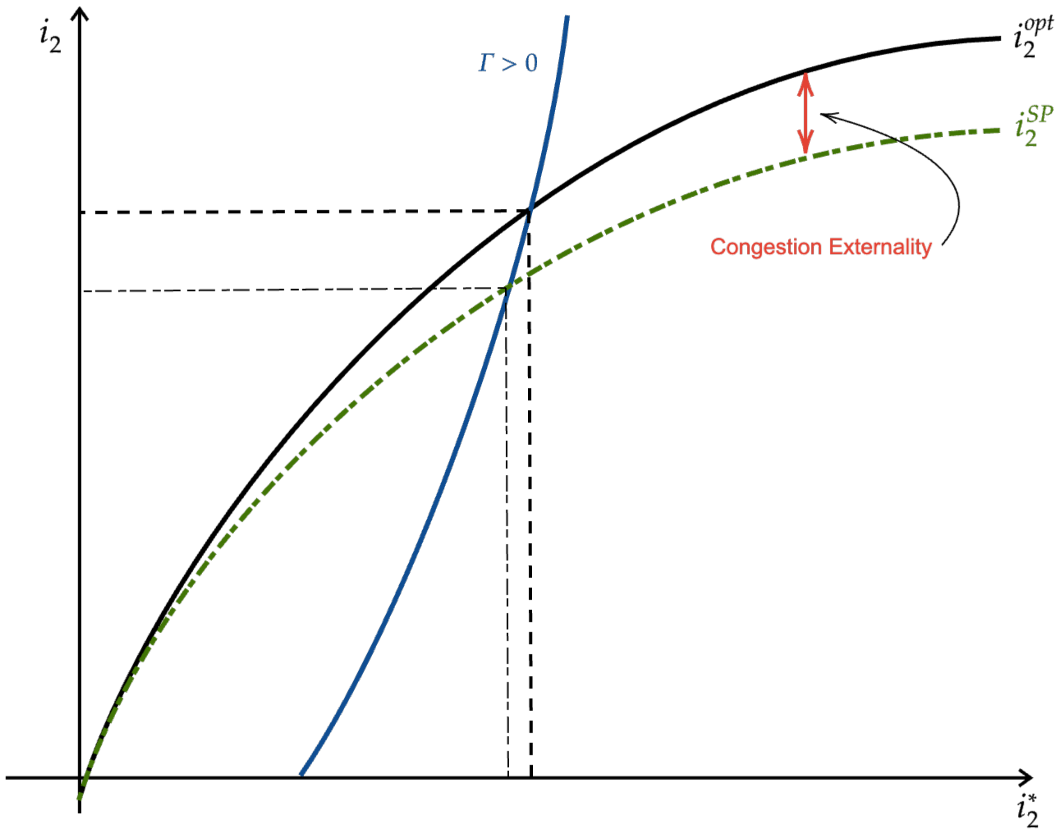
uncoordinated and coordinated equilibria. The difference between the two is the bottleneck externality highlighted above. The equilibrium is at the intersection of central banks' best response, and the "Γ locus" that traces the relation between the dollar premium faced by EMEs and the individual domestic rates in EMEs, given the intermediation friction given by equation (17). By internalizing how their capital inflow will create congestion and result in a higher dollar preimium offered by intermediaries, central banks in the coordinated equilibrium raise rates by less (in proportion to the externality in Proposition 2) leading to less depreciation and an equilibrium with higher employment and output. The intuition can also be understood as follows. The level of interest rate that guarantees full employment is an *absolute* level, independent of the actions of other countries. The exchange rate that mutes balance sheet effects stemming from dollar debt is a *relative* level, that depends on the quantity of capital flows of other countries. Thus, these two are conflicting when countries are hit by a global shock such as a Fed tightening.

Although the coordinated solution increases the welfare of all EMEs, each country has an incentive to deviate. That deviation is exactly quantified by the expression (26) in Proposition 4: given the equilibrium dollar interest rate achieved by the regional central banker, the private solution requires a further appreciation of the currency *via* an interest rate increase. Coordination is thus hard to achieve and unrealistic in this setup. For this reason, Section 5 instead studies macroprudential policy.

4.5 Discussion of Results

Mechanisms and Assumptions Because the model presented here is stylized and has many moving parts, it is useful to detail which assumptions matter and which do not matter for the results. The conceptual point made in this paper is straightforward: if several countries have to respond optimally to a tightening of the Fed funds rate by tightening their own domestic policy rates in order to appreciate their currencies, then pecuniary spillovers arise between these countries if two conditions are met: (i) increasing their policy rate results in a capital *inflow* ; and (ii) global financial markets are frictional, such that the size of *aggregate* capital flows determines the external interest rate at which these countries can finance themselves.

Figure 1: Coordinated and Uncoordinated Equilibria. The black line is the individual best response of an individual central bank for a given dollar interest rate i_2^*. The dashed green line is the best response of central banks taking into account the effect of their rate setting on aggregate capital flows and the resulting premium $i_2^* - i_2^\$$. The black line depicts the dollar interest rate determination for a given $\Gamma > 0$.



Condition (i) depends on parameters in a conventional model with non-separable preferences: it is the case when the elasticity of intertemporal substitution is lower than the elasticity of substitution between tradable and non-tradable good.[25] In the Cobb-Douglas/linear framework of my model, this is equivalent to $\rho > 1$.[26]

Condition (ii) is met when global arbitrageurs view capital flows from different symmetric SOEs as substitutes. This condition would not be satisfied if one were to write a model where markets are segmented *between each* symmetric SOEs. For instance, if we assume that each country faces a different arbitrageur that has

[25]See Bianchi and Coulibaly (2022) on how the prudential role of monetary policy depends on the relative value of these parameters in a model with aggregate demand externalities.

[26]This case seems more relevant for EMEs, who typically fight capital outflows by raising rates (Matschke, Sattiraju and von Ende-Becker 2023).

costs of intermediation, each country would face a different interest rate $i^*_{2,j}$ determined by its own capital flows, but would not create spillovers on the dollar premium faced by other countries. My paper thus highlights the importance of looking at the entire portfolio of intermediaries rather than a country-by-country view. The magnitude of these spillovers are then directly linked to *cross-elasticities*: how much a shock to flows from one EME impacts the price of other emerging market currencies. An and Huber (2024) show that these cross-elasticities can be large even across G10 currencies.[27]

My paper thus connects to the literature on the importance of investor base (Bertaut, Bruno and Shin 2021 ; Burger, Warnock and Warnock 2018) and highlights its central role in generating spillovers across EMEs. This brings a new perspective in the study of spillovers: in earlier models as in Fornaro and Romei (2022) and Bianchi and Coulibaly (2024) spillovers arise because all countries try to run a trade deficit, but in equilibrium trade has to be balanced. In my model, all economies in the continuum of EMEs can attract capital flows in equilibrium (and they do). But because of the friction in global financial markets, this can still entail inefficiencies among them, and call for coordination, through a quantity effect on the balance sheet of intermediaries.

I also assumed that the continuum of EMEs is small relative to the rest of the world, which implies that the price of tradable goods is fixed and exogenous. This served two purposes: first, it substantially simplifies the analysis. Second, it helps to demonstrate that my spillovers do not come from tradable price inflation (as in Itskhoki and Mukhin 2023). I discuss in Section 6 an extension that allows for tradable price inflation.

Synchronisation of Monetary Policies in EMEs In my model, the synchronization of policy rates arises because of the presence of dollar debt on the balance sheet

[27] Deviations from the frictionless benchmark are likely to be much greater for EMEs than for advanced economies. For example, Cerutti and Zhou (2024) and De Leo, Keller and Zou (2024b) show that CIP deviations in EMEs are larger and more volatiles than most G10 currencies. Of particular interest for my theory is the study of CIP deviations around the 2013 Taper Tantrum episode, where many EMES synchronously tightened their policy rates to contain the depreciation of their currencies. Cerutti and Zhou (2024) show that the average CIP deviation in their sample of EMEs increased to 300 basis points in September 2013. Furthermore, Kekre and Lenel (2024a) mention that intermediation shocks play a more important role for the dollar/EM exchange rate than for advanced economies.

of corporations.[28] This is of course not the only way to arrive at such a result: for instance, Fornaro and Romei (2022) consider a shock to the global demand for tradables. Using the prevalence of dollar debt in EMEs (see the literature review for the extensive evidence on this fact) as the main building block of the model serves two purposes. First, it creates synchronization specifically vis-a-vis US monetary policy shock, consistent with the Global Financial Cycle (Rey 2013 ; Cristi et al. 2024), and shifts the focus of monetary policy coordination between EMEs to the response to dollar shocks. Second, it allows me to study ex-ante policies, which is the focus of the next section. Finally, notice that it is not important for my results that EMEs actually *tighten* when the Fed does: what matters is that EMEs implement a relatively more restrictive monetary policy to avoid too much depreciation, compared to the case where they would only target full employment (De Leo, Gopinath and Kalemli-Ozcan 2024a). See Section 6.4 for further discussion.

5 Excessive Dollar Debt and Macroprudential Policy

Taking stock, the previous section derived the welfare implications of having an outstanding level of dollar debt b_1^* on the balance sheet of entrepreneurs. This level, however, is the result of a maximization problem by the same entrepreneurs at $t = 1$. The goal of this section is to characterize the equilibrium level of dollar debt issuance, as well as policy options at $t = 1$, when the central bank cannot commit to only target the output gap at $t = 2$.

5.1 The economy at $t = 1$

Supply of Funds Entrepreneurs must issue debt to finance an investment of fixed size, K_1. They can either issue in local currency, or in dollars to foreign investors.[29] Various papers in the literature have proposed theories that explain why firms issue debt in dollars, exposing themselves to a currency mismatch (McKinnon and Pill 1998 ; Burnside et al. 2001 ; Schneider and Tornell 2004 ; Caballero and Kr-

[28] Relatedly, the presence of dollar debt on private balance sheets generates a "fear-of-floating." Other models of fear-of-floating are developed by, e.g., Bianchi and Coulibaly (2023) and Itskhoki and Mukhin (2023).

[29] Whether the debt in local currency is due to foreign or domestic investors does not matter for the results. For dollar debt, see the discussion at the end of Section 3.

ishnamurthy 2003 ; Jeanne 2002 ; Bocola and Lorenzoni 2020). I remain agnostic about the underlying mechanism as my work focuses on the global consequences for monetary policy and the GFC. As such, I use a linear supply of funds for both peso and dollar liabilities:

$$\frac{b_1^*}{1+\hat{i}_1^*} = \omega^*(\hat{i}_1^* - i_1^*) \quad \text{and} \quad \frac{b_1}{1+\hat{i}_1} = \omega(\hat{i}_1 - i_1) \tag{27}$$

To issue b_1^* in dollars, investors need to compensate lenders with a premium over the dollar interest rate, promising a rate of $\hat{i}_1^*$ that is linearly increasing with the size of b_1^*. Similarly, entrepreneurs issue b_1 in pesos, compensating lenders with a premium over the domestic interest rate, $\hat{i}_1$. The slopes are, respectively, ω^* and ω.

Issuance Entrepreneurs then issue debt to minimize repayments, taking into account the equilibrium exchange rate at $t = 2$, e_2:

$$\min_{b_1, b_1^*} \quad b_1 + e_2 b_1^* \tag{28}$$

$$\text{s.t.} \quad \frac{b_1}{1+\hat{i}_1} + \frac{e_1 b_1^*}{1+\hat{i}_1^*} = K_1 \tag{29}$$

We ignore in the rest of the paper limit cases where all issuance is done in only one currency.[30]

Remark 1. Although I used the same class of financial frictions at time $t = 1$ and $t = 2$, their modeling purpose is entirely different. In the initial period where firm make their currency issuance choices, the point of the ω friction is to avoid corner solutions such that firms are indifferent on the margin between issuing in dollars or in domestic currency. In the second period, the Γ friction serves to introduce strategic complementarities in the actions of small countries: aggregate flows drive the wedge between i_2^* and the U.S. domestic policy rate. The derivations for the equilibrium issuance at $t = 1$ are detailed in Appendix A.10.

[30] It is immediate to characterize the equilibrium when we are in such corner solutions. If all debt is issued in peso, monetary policy does not face a trade-off at $t = 2$ in response to a Fed tightening, and so there are no bottleneck externalities or need for macroprudential policies. If all issuance is done in dollars, the social planner can only mitigate the previous externalities by discouraging dollar issuance so much that we are back to an interior solution, which is what we study here.

5.2 Externalities and Optimal Macroprudential Policy

We start by studying the externalities associated with dollar debt issuance from the perspective of a single SOE. The presence of issuance externalities can be simply understood by writing jointly the two key equilibrium relations of the model: first, the level of dollar debt issuance as a function of e_2, the equilibrium exchange rate at $t = 2$. And second, the optimal response of the central bank at $t = 2$ given the size of dollar debt to be repaid by entrepreneurs.

$$b_1^* = \omega^* \frac{K_1\big(K_1 + \omega^* e_1(1 + i_1^*) + \omega(1 + i_1)\big)}{\left(\omega \frac{e_2^{opt}}{e_1} + e_1\omega^*\right)^2} \tag{30}$$

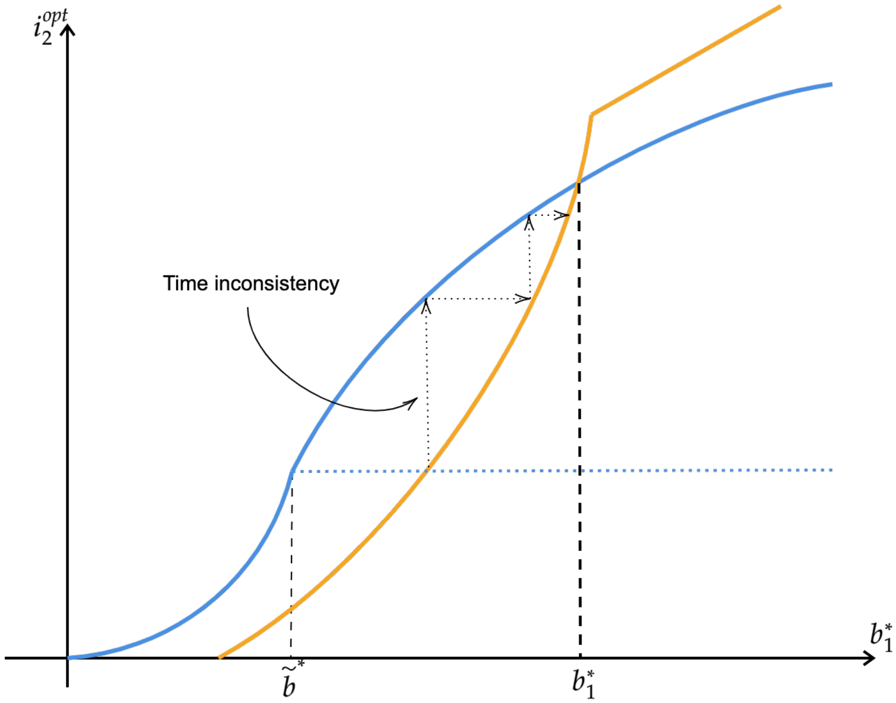
$$e_2^{opt} = \Omega^{-1} \left(r_1 \kappa \frac{b_1^*}{s - r_0}\right)^{\frac{-\rho}{\rho - 1 + \rho(1-\phi) + \phi}} (1 + i_2^*)^{-\frac{\rho - 1}{\rho - 1 + \rho(1-\phi) + \phi}} \tag{31}$$

The amount of foreign debt that needs to be repaid at $t = 2$ is clearly a decreasing function of the exchange rate e_2^{opt} implemented by the central bank. This is because a higher interest rate at $t = 2$ appreciates the currency, making it more attractive to issue in dollar. Conversely, as we demonstrated earlier, the optimal exchange rate at $t = 2$ is also a decreasing function of b_1^*: the more foreign debt outstanding there is in the economy, the stronger the incentive for the central bank to appreciate the currency in order to allow entrepreneurs to finance their productive investment more easily. The equilibrium determination of b_1^* is shown in Figure 2.[31]

An intuitive way to understand the time inconsistency problem faced by the central bank is to look at the blue dashed line in Figure 2. This line represents the hypothetical case where the central bank tries to commit to implement at time $t = 2$ a domestic rate that would be consistent with full employment for the threshold level of debt $\tilde{b}^*$. But even if entrepreneurs believe that this policy rate will be

[31] As is apparent in Figure 2, we can find parameters such that the issuance at $t = 1$ exhibits multiple equilibria. This will happen if strategic complementarities are strong enough: if everyone expects the central bank to tighten strongly in the future, all debt will be issued in dollars and the central bank will have to tighten aggressively. And if everyone expects the central bank to implement full employment, all issuance will be in peso, and the central bank will find it optimal to implement full employment. This possibility has been studied by Chang and Velasco (2006), which is why we focus here on the case where the equilibrium is unique. Coppola et al. (2023) also propose a theory with equilibrium multiplicity, where issuing in dollars endogenously increases the liquidity of dollar assets, incentivizing more issuance in dollars.

Figure 2: Equilibrium Dollar Debt Issuance. The blue line is the best response of the central bank (i_2^{opt}) for a given level of dollar-denominated debt b_1^*. The orange line is the optimal issuance strategy (b_1^*) of entrepreneurs at $t = 1$ given the expected exchange rate (coming from i_2^{opt} and the UIP condition) implemented by the central bank.



implemented, they still choose an equilibrium dollar debt level higher than this $\tilde{b}^*$. When time $t = 2$ comes, it is then optimal for the central bank to deviate from that planned interest rate, as can be seen from the dotted arrow going up to the line tracing the optimal policy rate, leading to an equilibrium with potentially large unemployment.

Proposition 5 (Dollar Debt Issuance Externalities)**.** *Entrepreneurs do not internalize that issuance denominated in dollars has a pecuniary effect on future interest rates, which then reduces aggregate demand and employment in equilibrium::*

$$\frac{dl_2}{db_1^*} < 0 \tag{32}$$

Making entrepreneurs internalize these externalities can be achieved through a simple tax on dollar debt issuance, whose proceeds are rebated lump-sum to entrepreneurs. It is important to note, however, that such a policy has a cost: entrepreneurs optimally issue debt in dollars up to the point where the interest rates are equalized. As such, forcing entrepreneurs to issue more in domestic currency will automatically result in a more expensive cost of debt and therefore in lower net worth in period $t = 2$. These costs must be balanced by the benefits or relaxing the constraint faced by the central bank at $t = 2$.

Proposition 6 (Macroprudential Trade-off)**.** *When $\rho = 1$, the optimal tax on dollar issuance reduces the amount issued in dollars, b_1^*, such that:*

$$\frac{1-\phi}{b_1^*} = -\beta \frac{r_1 \kappa}{s - r_0} \frac{db_1}{db_1^*} \tag{33}$$

The left-hand side of this expression encodes the benefits of a lower debt in dollars: less forced to resist the depreciation of its currency, the central bank can hike less and thus stay closer to full employment. The right-hand side expresses the other side of the trade-off: by discouraging dollar debt issuance, the social planner makes it more expensive for entrepreneurs to issue debt in general, resulting in lower net worth and thus lower investment in productive capital.

Consistent with these results, Bergant, Grigoli, Hansen and Sandri (2024) empirically show that tighter macroprudential regulation allows monetary policy in EMEs to respond more countercyclically to global financial shocks, but do not find evidence that capital controls provide similar benefits. In addition, they show that macroprudential measures targeted at FX exposure are particularly effective. Through the lens of my model, this is because the externalities constraining the central banks are rooted in the presence of dollar-denominated debt on private balance sheets, which in itself is orthogonal to the question of whether capital inflows are excessive.

5.3 Macroprudential Policies on the Global Scale

With a continuum of EMEs and frictional global financial markets, what is the impact of these macroprudential policies? The main insight of this section is that, while monetary policy has negative spillovers on other EMEs, macroprudential policies aimed at reducing dollar debt issuance have *positive* spillovers. Its implementation dampen the coordination problems of central banks. The following proposition expresses how a tax on dollar issuance spills over to the determination of the dollar interest rate faced by al EMEs, through a reduction of b_1^*.

Proposition 7 (Macroprudential Policy Spillovers)**.** *Individual policymakers in emerging economies do not internalize that their tax on dollar debt issuance spill over to the equilibrium determination of the external interest rate they face:*

$$\frac{d(1+i_2^*)}{db_1^*} = \Gamma(\rho-1)\frac{(1-\phi)}{\rho+(\rho-1)(1-\phi)}\frac{b_1^*}{c_2^T} \tag{34}$$

The reduction of b_1^* through the use of ex-ante macroprudential policies automatically allows the central bank to hike less at $t = 2$. As we have seen previously, by tightening less, the EME attracts less capital flows (as long as $\rho > 1$), reducing the premium that global intermediaries require as compensation (as long as $\Gamma > 0$). This marginally lowers the dollar interest rate when implemented on a global scale, reducing the depreciationary pressures that each central bank is trying to combat.[32] By implementing macroprudential policies aimed at lowering the amount of corporate debt issued in dollars, each country ameliorates the trade-off that all central banks face in the future. However, due to positive spillovers, the *globally optimal* level of macroprudential policy is even higher.[33]

6 Extensions

6.1 Foreign Exchange Interventions

As mentioned above, the inefficiencies highlighted in Section 4 are fundamentally generated from the use of a single instrument (monetary policy) to control both employment and the exchange rate (Korinek 2017). This extension considers the optimal use of a second instrument, FX interventions (FXIs). FX interventions are an attractive instrument in the setup studied here: they act on the exchange rate directly, thus allowing the interest rate to focus on aggregate demand management. By relaxing the trade-off faced by the central bank, FX interventions can intuitively improve welfare.

[32] See Jeanne (2014), Acharya and Bengui (2018) and Caballero and Simsek (2020) for other channels of macroprudential policy spillovers.

[33] Bergant et al. (2024) also find evidence of positive cross-country spillovers for macroprudential policy among emerging markets.

Appendix C provides an extension where the central bank has access to a predetermined level of reserves to influence the equilibrium determination of the exchange rate. When reserves are ample enough, the central bank can target full employment while using FXI to target balance sheet effects, leading to a constrained efficient equilibrium for the continuum of SOEs. When reserves are constrained, however, the central bank still allows for some output gap, but less than in the case without access to FXIs. In particular, if implemented by all EMEs, FX interventions have *positive* spillovers across countries, leading to a lower i_2^* and more appreciated currencies, as well as higher output and employment in EMEs.

From an *ex-ante* perspective, however, the welfare results are ambiguous. This is because the amount of dollar-denominated liabilities is endogenous to policy at $t = 2$, from the optimal issuance strategy of private firms (Section 5). By expecting FX interventions, firms expect an appreciated currency, which feeds back into their private decisions and reinforces balance sheet effects. This can go as far as lowering welfare: not having access to reserves would incentivize firms to issue more in local currency, easing the trade-off faced by the central bank when choosing its domestic policy rate. This reinforces the need for macroprudential measures to address the resulting moral hazard, highlighting an under-appreciated feature of FX interventions.

6.2 Intermediary Capacity and the Dollar

Although my model focuses on the interplay of dollar-denominated debt and US monetary policy shocks, recent empirical work has also demonstrated that dollar shocks are crucial for understanding fluctuations in global leverage (Shin 2016).[34] Appendix D proposes a variation of the main framework to account for these forces. Two main insights emerge from this exercise. First, tighter financial conditions due to a dollar appreciation (or a US tightening) exacerbate the spillovers highlighted above. Second, the model points towards asymmetric effects of such shocks. When the continuum of EMEs is a net saver relative to the rest of the world,

[34] Bruno and Shin (2015a) show that a US tightening shock leads to a fall in global banks' leverage. Bruno and Shin (2015b) build a model with local and global banks, where a dollar appreciation tightens financial conditions. Avdjiev, Du, Koch and Shin (2019) show that an appreciated dollar is associated with larger CIP deviations. This last fact is particularly interesting to my mechanism, since these deviations are the transmission mechanism of spillovers across EMEs.

they benefit from tighter financial conditions, as this appreciates their currencies. The opposite happens when the continuum of EMEs is a net borrower. Interestingly, it is irrelevant whether one particular country is a net saver or borrower. Since the external interest rate it faces, i_2^*, depends on aggregate capital flows, what matters is the *aggregate* current account position of EMEs that go through these intermediaries.

6.3 Tradable Price Inflation

In Section 4, the analysis was made considering that the price of tradable goods, in dollars, was fixed (and normalized to 1). This was the result of assuming that the continuum of EMEs considered is small relative to the rest of the world. Appendix E relaxes this assumption, by introducing a global market clearing condition for the tradable good. I characterize optimal policy and show that it takes a similar form. The main result of this extension is to show that spillovers are *reduced* by the tradable price inflation channel, but not eliminated.[35] This result serves two purposes. First, it helps support the robustness of my results: even in the worst-case scenario, the spillovers highlighted in Section 4 dominate the ones coming from tradable price inflation. Second, it demonstrates that the mechanism I highlight in this paper is fundamentally different from models where spillovers come directly from tradable price inflation.

6.4 Cyclicality of Emerging Markets' Policy Rates

Recent work by De Leo et al. (2024a) called into question the idea that emerging markets tighten their domestic policy rates in response to an increase in the Fed funds rate. Although the main model presented in the core of the paper does feature this synchronization of interest rates, it is not a necessary ingredient for the spillover and inefficiency results. Appendix F presents a simple extension that can account for the empirical results of De Leo et al. (2024a), while keeping all the other normative results unchanged.

The additional ingredient in Appendix F is to assume that a Fed tightening

[35] Formally, Appendix E shows that the size of spillovers across EMEs is multiplied by a factor greater than $1/(1+\phi)$. The exact size of this dampening factor depends on how sensitive the equilibrium price is to the demand for tradable goods in EMEs.

shock also has an impact through a trade channel. Specifically, an increase in $i_2^{\$}$ is accompanied by an increase in the price of tradable goods. This depresses aggregate demand in emerging economies. All else being equal, this leads individual central banks to want to implement a lower interest rate. If the trade channel is strong enough, the optimal monetary response in the face of the shock is indeed to lower the domestic policy rate, but not enough to implement full employment because of the trade-off with balance sheet effects.

Importantly, the spillovers identified in Section 4 are still at work, for the precise reason that the trade-off is identical. Emerging markets' currencies are still excessively depreciated. A regional central bank acting for all emerging economies would prefer to ease the policy rate even more, which would result in less aggregate capital inflows. As before, this would reduce the bottleneck externality working through global intermediaries, appreciating all currencies, and easing the trade-off faced by each EME. What matters is thus not that EMEs tighten with the Fed, but that the GFC forces EMEs to be away from full employment and to also care about the absolute level of their exchange rate.

Finally, De Leo et al. (2024a) also document that, in spite of this monetary easing by EMEs, *market rates* tend to increase in response to a Fed tightening. This can also be understood through the extension presented in Appendix D. Building on the work of Shin (2016), an increase in $i_2^{\$}$ now has three effects: (i) a depreciation of EMEs currencies ; (ii) an increase in the price a tradable goods through the trade channel ; and (iii) an increase in the global intermediation friction. This helps accounting for the fact that, while central banks in EMEs lower their domestic policy rates, the increase in the friction Γ results in a *higher* i_2^*, since intermediaries require a higher premium to intermediate capital flows to EMEs. Importantly, not only are the inefficiencies highlighted in this paper still present, they are amplified by the increase in the friction Γ since this exacerbates the bottleneck externality.

7 Conclusion

This paper shows that the presence of dollar debt in emerging markets has profound normative implications, not only for individual emerging markets themselves, but also for the global financial cycle. The presence of dollar debt forces all central banks to deviate from full employment when the Federal Reserve increases its interest rate. The key result of this paper is that this in turn initiates bottleneck externalities, since all central banks seek to maximize capital inflows in order to appreciate their currency. Intermediaries must intermediate a larger quantity of flows, resulting in a higher premium on the dollar interest rate. This feeds back into further depreciationary pressures in individual EMEs. It then leads to inefficiently high interest rates in emerging economies, and inefficiently low levels of employment, highlighting the need for coordination among central banks in the face of the global financial cycle. Importantly, this effect goes through the balance sheet of global intermediaries. As such, it does not depend on whether the set of EMEs is large enough to influence the equilibrium determination of the world interest rate faced by all countries. Finally, I showed that the anticipation of this (then optimal) behavior by individual central banks encourages even more dollar debt issuance in emerging countries, amplifying the global financial cycle and worsening central banks' dilemma. Macroprudential policy, by discouraging dollar issuance and encouraging issuance in other currencies, can be used to counter this issuance externality and has positive spillovers on the rest of the world, dampening the global financial cycle and relaxing the coordination problem faced by individual central banks when the Fed tightens its policy rate.

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A Proofs and Derivations

A.1 Equilibrium Setup and Useful Identities

The utility function of households in the SOE is given by:

$$U_2 = \frac{1}{1-\rho}\left((c_2^T)^{\phi}(c_2^N)^{1-\phi}\right)^{1-\rho} + \beta\left(c_3^N + c_3^T\right) \tag{A.35}$$

The budget constraints are:

$$p_2^T c_2^T + p_2^N c_2^N = p_2^T y_2^T + w_2 l_2 + \Pi_2 + \frac{1}{1+i_2} a_3 + \frac{1}{1+i_2^*} e_2 a_3^* \qquad (\lambda_2) \tag{A.36}$$

$$p_3^N c_3^N + p_3^T c_3^T + a_3 + e_3 a_3^* = p_3^T y_3^T + \bar{w}\bar{l} + \Pi_3 \qquad (\lambda_3) \tag{A.37}$$

with $p_t^T = e_t$ and $p_t^N = \bar{w} = 1$. We thus end up with the following first-order conditions for households:

$$\frac{\lambda_2}{1+i_2} = \beta\lambda_3 \tag{A.38}$$

$$\frac{\lambda_2}{1+i_2^*} e_2 = \beta\lambda_3 e_3 \tag{A.39}$$

$$\phi(c_2^T)^{-1}\left((c_2^T)^{\phi}(c_2^N)^{1-\phi}\right)^{1-\rho} = \lambda_2 p_2^T \tag{A.40}$$

$$(1-\phi)(c_2^N)^{-1}\left((c_2^T)^{\phi}(c_2^N)^{1-\phi}\right)^{1-\rho} = \lambda_2 p_2^N \tag{A.41}$$

$$1 = \lambda_3 p_3^N \tag{A.42}$$

$$1 = \lambda_3 p_3^T \tag{A.43}$$

By taking the ratio between the T and NT conditions, we can write non-tradable demand as:

$$c_2^N = \left(\frac{\phi}{1-\phi}\frac{p_2^N}{p_2^T}\right)^{-1} c_2^T = \left(\frac{\phi}{1-\phi}\frac{\bar{w}}{e_2}\right)^{-1} c_2^T \tag{A.44}$$

The savings/borrowing decisions in peso and dollar also yield the standard UIP condition since there is no uncertainty:

$$1 + i_2 = (1+i_2^*)\frac{e_3}{e_2} \tag{A.45}$$

Using the fact that the price of tradables is equal to the exchange rate, and that the price of non-tradables is $\bar{w} = 1$ since firms are perfectly competitive, we have the following demand function for non-tradable goods:

$$c_2^N = \frac{1-\phi}{\phi} e_2 c_2^T \tag{A.46}$$

Plugging the UIP condition we have the familiar condition for expenditure switching:

$$c_2^N = \left(\frac{\phi}{1-\phi} \frac{(1+i_2)}{(1+i_2^*)} \right)^{-1} c_2^T \tag{A.47}$$

We also have:

$$(1-\phi)(c_2^N)^{-1} \left((c_2^T)^{\phi} (c_2^N)^{1-\phi} \right)^{1-\rho} = \beta(1+i_2) \tag{A.48}$$

where the consumption composite is preventing us from having a simple expression only involving the interest rate and the consumption of non-tradables. This implies that the consumption levels can be expressed as:

$$(c_2^T)^{-1} = \frac{\beta(1+i_2^*)}{\phi} \left((c_2^T)^{\phi} (c_2^N)^{1-\phi} \right)^{\rho-1} \tag{A.49}$$

$$(c_2^N)^{-1} = \frac{\beta(1+i_2)}{1-\phi} \left((c_2^T)^{\phi} (c_2^N)^{1-\phi} \right)^{\rho-1} \tag{A.50}$$

These two equations determine (implicitly) the consumption of tradables, as a function of the domestic and international interest rates. Use the first-order condition for tradable consumption to write:

$$(c_2^T)^{-1-\phi(\rho-1)} = \frac{\beta(1+i_2^*)}{\phi} (c_2^N)^{(1-\phi)(\rho-1)} \tag{A.51}$$

$$\implies c_2^T = \left(\frac{\beta(1+i_2^*)}{\phi} \right)^{\frac{1}{\phi(1-\rho)-1}} (c_2^N)^{\frac{(1-\phi)(\rho-1)}{\phi(1-\rho)-1}} \tag{A.52}$$

Which, when incorporated in the non-tradable consumption first-order condition, gives:

$$(1-\phi)(c_2^N)^{-1+(1-\phi)(1-\rho)+\phi(1-\rho)\frac{(1-\phi)(\rho-1)}{\phi(1-\rho)-1}}\left(\frac{\beta(1+i_2^*)}{\phi}\right)^{\frac{\phi(1-\rho)}{\phi(1-\rho)-1}}=\beta(1+i_2) \quad (A.53)$$

After some algebra:

$$(1-\phi)(c_2^N)^{\frac{\rho}{\phi(1-\rho)-1}}\left(\frac{\beta(1+i_2^*)}{\phi}\right)^{\frac{\phi(1-\rho)}{\phi(1-\rho)-1}}=\beta(1+i_2) \quad (A.54)$$

The same can be done for T consumption, and the resulting following identity will be useful during derivations:

$$d\ lnc_2^T=\frac{(\rho-1)(1-\phi)}{\rho}d\ln(1+i_2)-\left(1+\frac{\phi(\rho-1)}{\rho}\right)d\ln(1+i_2^*) \quad (A.55)$$

Full employment arises thus when:

$$(1-\phi)\left(\bar{l}+\eta_2K_1-s\kappa\frac{\eta_2K_1-b_1-\frac{1+i_2^*}{1+i_2^{full}}b_1^*}{s-r_0}\right)^{\frac{\rho}{\phi(1-\rho)-1}}\left(\frac{\beta(1+i_2^*)}{\phi}\right)^{\frac{\phi(1-\rho)}{\phi(1-\rho)-1}}$$
$$=\beta(1+i_2^{full}) \quad (A.56)$$

Finally, the gross capital flow from a country is:

$$\frac{1}{1+i_2^*}a_{3,j}^*=c_{2,j}^T+b_{1,j}^*-y_{2,j}^T \quad (A.57)$$

and the net is:

$$\frac{1}{1+i_2^*}a_{3,j}^*-b_{1,j}^*=c_{2,j}^T-y_{2,j}^T \quad (A.58)$$

A.2 Proof of Proposition 1

Deviation from Full Employment: This proof rests on three argument: (i) keeping employment fixed at the full employment level, the benefits of appreciating the currency are unbounded above when b_1^* increases ; (ii) the costs of decreasing employment are getting arbitrarily close to 0 when b_1^* increases.

Start from point (i). The benefits of appreciating the currency, in terms of marginal utility, are given by:

$$\frac{dc_3^N}{de_2} = b_1^* \frac{r_1 \kappa}{s - r_0} \tag{A.59}$$

This comes from a decrease in the consumption of non-tradable at $t = 2$ to finance investment, in proportion:

$$\frac{dc_2^N}{de_2} = b_1^* \frac{s\kappa}{s - r_0} \tag{A.60}$$

where $r_1 > s$ (for investment to be profitable for entrepreneurs). But in terms of welfare, this change in the exchange rate (everything else being fixed) is beneficial if and only if:

$$U_{2,N} s < \beta r_1 \tag{A.61}$$

With optimality, we also have that $U_{2,N} = \beta(1 + i_2^{full})$ so we only have to compare $s(1 + i_2^{full})$ to ρ. Equation (A.56) however shows that, for b_1^* large enough, the full employment interest rate is negative. Since $r_1 > s$, for large enough b_1^* it implies that $s(1 + i_2^{full}) < r_0$. Since r_0 is fixed, the welfare benefits are growing towards $+\infty$ when i_2^{full} goes towards -1.

Going to point (ii), we now factor in the costs of allowing for under-employment on the margin. We can rewrite the equivalent of equation (A.56) outside of full employment with some function g simply as:

$$l_2 + \frac{s\kappa(1 + i_2^*)}{s - r_0} \frac{b_1^*}{1 + i_2} = g(i_2) \tag{A.62}$$

where g is a decreasing function that does not depend on b_1^*. Differentiating we get:

$$\frac{dl_2}{di_2} = \underbrace{g'(i_2)}_{<0} + b_1^* \frac{s\kappa(1 + i_2^*)}{(s - r_0)(1 + i_2)^2} \tag{A.63}$$

We can thus always find a b_1^* high enough such that the decrease in employment, provoked by the increase in the interest rate, is close enough to 0 such that the overall welfare benefits are strictly positive. □

Constrained Efficiency: The maximization program of the central bank is:

$$\max_{l_2, c_2^T, e_2} \frac{1}{1-\rho} \left[(c_2^T)^\phi \left(l_2 + \eta_2 K_1 - s\kappa \frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s - r_0} \right)^{1-\phi} \right]^{1-\rho} \\ + \beta \left(\bar{l} + r_1 \kappa \frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s - r_0} \right) \\ + \beta \left(y_3^T + (1 + i_2^*) \left(y_2^T - b_1^* - c_2^T \right) \right) \quad \text{(A.64)}$$

with the constraints:

$$l_2 \leq \bar{l} \quad \text{(A.65)}$$

$$e_2 c_2^T = \frac{\phi}{1-\phi} (l_2 + \eta_2 K_1 - s\kappa \frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s - r_0} - \frac{b_1}{\bar{w}}) \quad \text{(A.66)}$$

$$\beta \frac{1 + i_2^*}{e_2} = (1-\phi) \left(l_2 + \eta_2 K_1 - s\kappa \frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s - r_0} - \frac{b_1}{\bar{w}} \right)^{(1-\phi)(1-\rho)-1} (c_2^T)^{\phi(1-\rho)} \quad \text{(A.67)}$$

where the second constraint is the expenditure switching condition (A.46), and the third is the Euler equation (A.52), where in both case c_2^N is replaced by its value according to market clearing. Let us denote by ν the Lagrange multiplier associated with the slackness condition (A.65), m_T the Lagrange multiplier on (A.66), and ϵ the Lagrange multiplier on (A.67).

The first-order conditions are then given by (respectively for l_2, c_2^T, and e_2):

$$(1-\phi) \frac{\left((c_2^T)^\phi (c_2^N)^{1-\phi} \right)^{1-\rho}}{c_2^N} + \nu - m_T \frac{\phi}{1-\phi} \\ - \epsilon (1-\phi)((1-\phi)(1-\rho) - 1) \frac{\left((c_2^T)^\phi (c_2^N)^{1-\phi} \right)^{1-\rho}}{(c_2^N)^2} = 0 \quad \text{(A.68)}$$

$$\phi \frac{\left((c_2^T)^\phi (c_2^N)^{1-\phi} \right)^{1-\rho}}{c_2^T} - \beta(1 + i_2^*) \\ + m_T e_2 - \epsilon (1-\phi)(1-\rho) \frac{\left((c_2^T)^\phi (c_2^N)^{1-\phi} \right)^{1-\rho}}{c_2^N c_2^T} = 0 \quad \text{(A.69)}$$

$$s\kappa\frac{b_1^*}{s-r_0}(1-\phi)\frac{\left((c_2^T)^\phi(c_2^N)^{1-\phi}\right)^{1-\rho}}{c_2^N}-\beta r_1\kappa\frac{b_1^*}{s-r_0}+m_T\left(c_2^T-\frac{\phi}{1-\phi}s\kappa\frac{b_1^*}{s-r_0}\right)$$
$$-\epsilon\beta\frac{1+i_2^*}{e_2^2}-\epsilon(1-\phi)((1-\phi)(1-\rho)-1)s\kappa\frac{b_1^*}{s-r_0}\frac{\left((c_2^T)^\phi(c_2^N)^{1-\phi}\right)^{1-\rho}}{(c_2^N)^2}=0 \tag{A.70}$$

We are interested in the case where b_1^* is high enough such that it is optimal to allow for under-employment, hence $\nu=0$. We use the optimality condition (A.49) and (A.50) to simplify the constrained efficiency conditions as:

$$\beta(1+i_2)-m_T\frac{\phi}{1-\phi}-\epsilon((1-\phi)(1-\rho)-1)\frac{\beta(1+i_2)}{c_2^N}=0 \tag{A.71}$$
$$m_Te_2-\epsilon(1-\phi)(1-\rho)\frac{\beta(1+i_2)}{c_2^T}=0 \tag{A.72}$$

and

$$s\kappa\frac{b_1^*}{s-r_0}\beta(1+i_2)-\beta r_1\kappa\frac{b_1^*}{s-r_0}+m_T\left(c_2^T-\frac{\phi}{1-\phi}s\kappa\frac{b_1^*}{s-r_0}\right)$$
$$-\epsilon\beta\frac{1+i_2}{e_2}-\epsilon((1-\phi)(1-\rho)-1)s\kappa\frac{b_1^*}{s-r_0}\frac{\beta(1+i_2)}{c_2^N}=0 \tag{A.73}$$

We first need to substitute for the Lagrange multipliers. Using:

$$\frac{1+i_2}{c_2^N}=\frac{1+i_2}{c_2^T}\frac{c_2^T}{c_2^N}=\frac{1+i_2}{c_2^T}\frac{\phi}{1-\phi}\frac{1}{e_2} \tag{A.74}$$

gives us

$$\epsilon((1-\phi)(1-\rho)-1)\frac{\beta(1+i_2)}{c_2^N}=((1-\phi)(1-\rho)-1)\beta\epsilon\frac{1+i_2}{c_2^T}\frac{\phi}{1-\phi}\frac{1}{e_2} \tag{A.75}$$
$$=((1-\phi)(1-\rho)-1)\frac{m_Te_2}{(1-\phi)(1-\rho)}\frac{\phi}{1-\phi}\frac{1}{e_2} \tag{A.76}$$
$$=m_T\frac{(1-\phi)(1-\rho)-1}{(1-\phi)(1-\rho)}\frac{\phi}{1-\phi} \tag{A.77}$$

Which simplifies (A.71) as:

$$\beta(1+i_2) = m_T \left[\frac{\phi}{1-\phi} \frac{(1-\phi)(1-\rho)-1}{(1-\phi)(1-\rho)} \frac{\phi}{1-\phi} \right] \tag{A.78}$$

Yielding the simpler:

$$\beta(1+i_2) = m_T \frac{\phi}{1-\phi} \left[1 + \frac{1+(1-\phi)(\rho+1)}{(1-\phi)(\rho-1)} \right] \tag{A.79}$$

which we will write, for short:

$$\beta(1+i_2) = m_T \Omega_M \tag{A.80}$$

with $\Omega_M > 0$. Using this relation in (A.72) is also simplifying since:

$$m_T e_2 = \epsilon(1-\phi)(1-\rho)\frac{\beta(1+i_2)}{c_2^T} \tag{A.81}$$

$$\implies m_T e_2 = \epsilon(1-\phi)(1-\rho)\frac{m_T \Omega_M}{c_2^T} \tag{A.82}$$

$$\implies c_2^T e_2 = \epsilon(1-\phi)(1-\rho)\Omega_M \tag{A.83}$$

$$\implies \frac{\phi}{1-\phi} c_N = \epsilon(1-\phi)(1-\rho)\Omega_M \tag{A.84}$$

$$\implies c_2^N = \epsilon(1-\phi)(1-\rho) \left[1 + \frac{1+(1-\phi)(\rho+1)}{(1-\phi)(\rho-1)} \right] \tag{A.85}$$

$$\implies c_2^N = \epsilon \left[(1-\phi)(1-\rho) - 1 - (1-\phi)(\rho+1) \right] \tag{A.86}$$

hence the relation:

$$c_2^N = -\epsilon \Omega_\epsilon \tag{A.87}$$

with $\Omega_\epsilon > 0$. We now use these relations to substantially simplify the third optimality condition, equation (A.73):

$$s\kappa \frac{b_1^*}{s-r_0}\beta(1+i_2) - \beta r_1 \kappa \frac{b_1^*}{s-r_0} + m_T \left(c_2^T - \frac{\phi}{1-\phi} s\kappa \frac{b_1^*}{s-r_0} \right) - \epsilon\beta\frac{1+i_2}{e_2} - \epsilon((1-\phi)(1-\rho)-1)s\kappa \frac{b_1^*}{s-r_0}\frac{\beta(1+i_2)}{c_2^N} = 0 \tag{A.88}$$

Start with its last component, which can be rewritten:

$$\epsilon((1-\phi)(1-\rho)-1)s\kappa\frac{b_1^*}{s-r_0}\frac{\beta(1+i_2)}{c_2^N} = -s\kappa\frac{b_1^*}{s-r_0}((1-\phi)(1-\rho)-1)m_T\frac{\Omega_M}{\Omega_\epsilon} \tag{A.89}$$

$$= s\kappa\frac{b_1^*}{s-r_0}((1-\phi)(\rho+1)+1)m_T\frac{\Omega_M}{\Omega_\epsilon} \tag{A.90}$$

And this ratio is simply given by (coming from A.86):

$$\frac{\Omega_M}{\Omega_\epsilon} = \frac{\phi}{1-\phi}\frac{1}{(1-\phi)(\rho-1)} \tag{A.91}$$

The first term of (A.73) can also be written in term of m_T:

$$s\kappa\frac{b_1^*}{s-r_0}\beta(1+i_2) = s\kappa\frac{b_1^*}{s-r_0}\Omega_M m_T \tag{A.92}$$

While the intermediate term is:

$$-m_T\frac{\phi}{1-\phi}s\kappa\frac{b_1^*}{s-r_0} \tag{A.93}$$

Putting these three terms together, we can factor out $s\kappa\frac{b_1^*}{s-r_0}$ with a total coefficient of:

$$\Omega_M - \frac{\phi}{1-\phi} - ((1-\phi)(\rho+1)+1)\frac{\Omega_M}{\Omega_\epsilon} \tag{A.94}$$

$$\Omega_M - \frac{\phi}{1-\phi} - ((1-\phi)(\rho+1)+1)\frac{\phi}{1-\phi}\frac{1}{(1-\phi)(\rho-1)} \tag{A.95}$$

$$= \frac{\phi}{1-\phi}\left[1+\frac{1+(1-\phi)(\rho+1)}{(1-\phi)(\rho-1)} - 1 - ((1-\phi)(\rho+1)+1)\frac{1}{(1-\phi)(\rho-1)}\right] \tag{A.96}$$

$$= 0 \tag{A.97}$$

This implies that (A.73) becomes:

$$m_T c_2^T - \epsilon\beta\frac{1+i_2}{e_2} = \beta r_1 \kappa\frac{b_1^*}{s-r_0} \tag{A.98}$$

Remember that $\beta(1+i_2) = m_T \Omega_M$ so this relation is in fact:

$$(1+i_2)\left(\frac{c_2^T}{\Omega_M} + \frac{c_2^N}{e_2\Omega_\epsilon}\right) = r_1 \kappa \frac{b_1^*}{s-r_0} \tag{A.99}$$

$$(1+i_2)\left(\frac{c_2^T}{\Omega_M} + \frac{c_2^T}{\Omega_\epsilon}\frac{1-\phi}{\phi}\right) = r_1 \kappa \frac{b_1^*}{s-r_0} \tag{A.100}$$

Use then the relation between the Ω_M and Ω_ϵ terms:

$$\frac{\phi}{1-\phi}\Omega_\epsilon = (1-\phi)(\rho-1)\Omega_M \tag{A.101}$$

to simplify further:

$$(1+i_2)\frac{c_2^T}{\Omega_M}\left(1 + \frac{1}{(1-\phi)(\rho-1)}\right) = r_1 \kappa \frac{b_1^*}{s-r_0} \tag{A.102}$$

to finally have (through replacing Ω_M by its value)

$$(1+i_2)c_2^T = \frac{\phi}{1-\phi}\frac{1+2(1-\phi)(\rho-1)}{1+(1-\phi)(\rho-1)} r_1 \kappa \frac{b_1^*}{s-r_0} \tag{A.103}$$

This tells us that an increase in b_1^* must be matched by an increase in $(1+i_2)c_2^T$. Similarly, it also implies that an increase in i_2^* must leave $(1+i_2)c_2^T$ *constant*. Now rewrite this equation in terms of non-tradable consumption, which has an easier intuition:

$$(1+i_2)^2 c_2^N = (1+i_2^*)\frac{1+2(1-\phi)(\rho-1)}{1+(1-\phi)(\rho-1)} r_1 \kappa \frac{b_1^*}{s-r_0} \tag{A.104}$$

Now we simply need to use the aggregate demand condition, (A.54). This relation stipulates that:

$$(1-\phi)(c_2^N)^{\frac{\rho}{\phi(1-\rho)-1}}\left(\frac{\beta(1+i_2^*)}{\phi}\right)^{\frac{\phi(1-\rho)}{\phi(1-\rho)-1}} = \beta(1+i_2) \tag{A.105}$$

Which implies that:

$$(1+i_2)^2 c_2^N = \left(\frac{1-\phi}{\beta}\right)^2 \left(\frac{\beta(1+i_2^*)}{\phi}\right)^{\frac{2\phi(1-\rho)}{\phi(1-\rho)-1}} (c_2^N)^{1+\frac{2\rho}{\phi(1-\rho)-1}} \tag{A.106}$$

The crucial point here is that the exponent on c_2^N is equal to:

$$1 + \frac{2\rho}{\phi(1-\rho)-1} = \frac{\phi(\rho-1)+1-2\rho}{\phi(\rho-1)+1} \tag{A.107}$$

$$= \frac{(1-\rho)+\rho(\phi-1)-\phi}{\phi(\rho-1)+1} \tag{A.108}$$

$$< 0 \tag{A.109}$$

This implies that, all else begin equal, c_2^N is decreasing in b_1 and thus that i_2 is increasing in b_1^*. Finally, we conclude with the comparative statics with respect to i_2^* (the global financial cycle). Relation (A.103) demonstrates that the quantity $(1+i_2)c_2^T$ must stay constant when i_2^* increases. But using the private expenditure switching condition:

$$c_2^N = \frac{1-\phi}{\phi}\frac{(1+i_2^*)}{(1+i_2)}c_2^T \tag{A.110}$$

$$\implies (1+i_2)^2 c_2^N = \frac{1-\phi}{\phi}(1+i_2^*)(1+i_2)c_2^T \tag{A.111}$$

The right-hand side is thus constituted of a term that increases, $1+i_2^*$, and a constant term $(1+i_2)c_2^T$. Hence the left-hand side must also increase: $(1+i_2)^2 c_2^N$ and we just showed that this means that c_2^N decreases and $1+i_2$ increases. □

A.3 Proof of Corollary 1

This can be seen by deriving the closed-form solution for the optimal interest rate. Start from:

$$(1+i_2)^2 c_2^N = (1+i_2^*)\frac{1+2\rho(1-\phi)}{1+(1-\phi)(\rho-1)}r_1\kappa\frac{b_1^*}{s-r_0} \tag{A.112}$$

Then use (A.54) to replace the non-tradable consumption:

$$(1+i_2)^2\left(\frac{\beta(1+i_2)}{1-\phi}\right)^{-\frac{1+\phi(\rho-1)}{\rho}}\left(\frac{\beta(1+i_2^*)}{\phi}\right)^{\frac{\phi(\rho-1)}{\rho}} = (1+i_2^*)\frac{1+2(1-\phi)(\rho-1)}{1+(1-\phi)(\rho-1)}r_1\kappa\frac{b_1^*}{s-r_0} \tag{A.113}$$

Grouping the interest rates together:

$$(1+i_2)^{2-\frac{1+\phi(\rho-1)}{\rho}} = (1+i_2^*)^{1-\frac{\phi(\rho-1)}{\rho}} \left(\frac{\phi}{1-\phi}\right)^{\frac{\phi(\rho-1)}{\rho}} \left(\frac{\beta}{1-\phi}\right)^{\frac{1}{\rho}} \frac{1+2(1-\phi)(\rho-1)}{1+(1-\phi)(\rho-1)} r_1\kappa\frac{b_1^*}{s-r_0} \tag{A.114}$$

$$(1+i_2)^{\rho-1+\rho(1-\phi)+\phi} = (1+i_2^*)^{\rho-\phi(\rho-1)} \left(\frac{\phi}{1-\phi}\right)^{\phi(\rho-1)} \frac{\beta}{1-\phi} \left(\frac{1+2(1-\phi)(\rho-1)}{1+(1-\phi)(\rho-1)} r_1\kappa\frac{b_1^*}{s-r_0}\right)^{\rho} \tag{A.115}$$

Define the following positive constant:

$$\Omega = \left[\left(\frac{\phi}{1-\phi}\right)^{\phi(\rho-1)} \frac{\beta}{1-\phi} \left(\frac{1+2(1-\phi)(\rho-1)}{1+(1-\phi)(\rho-1)}\right)^{\rho}\right]^{\frac{1}{\rho-1+\rho(1-\phi)+\phi}} \tag{A.116}$$

such that we can express the optimal monetary policy as:

$$1+i_2 = \Omega\left(r_1\kappa\frac{b_1^*}{s-r_0}\right)^{\frac{\rho}{\rho-1+\rho(1-\phi)+\phi}} (1+i_2^*)^{\frac{\rho(1-\phi)+\phi}{\rho-1+\rho(1-\phi)+\phi}} \tag{A.117}$$

Now plug in $\rho = 1$ to get a simpler expression:

$$1+i_2^{opt} = \frac{\beta}{1-\phi}\left(r_1\kappa\frac{b_1^*}{s-r_0}\right)(1+i_2^*) \tag{A.118}$$

□

A.4 Proof of Corollary 2

Use the solution from (A.117):

$$1+i_2 = \Omega\left(r_1\kappa\frac{b_1^*}{s-r_0}\right)^{\frac{\rho}{\rho-1+\rho(1-\phi)+\phi}} (1+i_2^*)^{\frac{\rho(1-\phi)+\phi}{\rho-1+\rho(1-\phi)+\phi}} \tag{A.119}$$

Which also directly gives the sensitivity of the interest rate with respect to the world interest rate:

$$\frac{d\ln(1+i_2)}{d\ln(1+i_2^*)} = \frac{\rho(1-\phi)+\phi}{\rho-1+\rho(1-\phi)+\phi} \tag{A.120}$$

Since we have:

$$\frac{\rho(1-\phi)+\phi}{\rho-1+\rho(1-\phi)+\phi}-1=\frac{1-\rho}{\rho-1+\rho(1-\phi)+\phi} \tag{A.121}$$

that directly gives:

$$\frac{di_2}{di_2^*}=\Omega\frac{\rho(1-\phi)+\phi}{\rho-1+\rho(1-\phi)+\phi}\left(r_1\kappa\frac{b_1^*}{s-r_0}\right)^{\frac{\rho}{\rho-1+\rho(1-\phi)+\phi}}(1+i_2^*)^{\frac{1-\rho}{\rho-1+\rho(1-\phi)+\phi}} \tag{A.122}$$

which can be rewritten:

$$\frac{di_2}{di_2^*}\propto(b_1^*)^{\frac{\rho}{\rho-1+\rho(1-\phi)+\phi}}(1+i_2^*)^{\frac{1-\rho}{\rho-1+\rho(1-\phi)+\phi}} \tag{A.123}$$

leading to the expression in the text. □

A.5 Full Employment

In the case where $\rho=1$, the aggregate demand condition is simply:

$$(c_2^N)^{-1}=\frac{\beta(1+i_2)}{1-\phi} \tag{A.124}$$

We can rewrite this condition in the case where we are ar the margin of full employment ($l_2=\bar{l}^-$) while the central bank implements the optimal interest rate:

$$\frac{1}{\bar{l}+\eta_2K_1-s\kappa\frac{\eta_2K_1-b_1-e_2^{opt}b_1^*}{s-r_0}}=\left(\frac{\beta}{1-\phi}\right)^2\left(r_1\kappa\frac{b_1^*}{s-r_0}\right)(1+i_2^*) \tag{A.125}$$

Using again the optimal interest rate, as well as the UIP condition, we also have:

$$e_2^{opt}b_1^*=\frac{1-\phi}{\beta}\frac{r_1\kappa}{s-r_0} \tag{A.126}$$

And putting everything together, this defines the threshold $\tilde{b}_1^*$ for full employment:

$$\tilde{b}_1^*=\left(\frac{\beta}{1-\phi}\right)^2\frac{s-r_0}{r_1\kappa}\frac{1}{1+i_2^*}\frac{1}{\bar{l}+\eta_2K_1-s\kappa\frac{\eta_2K_1-b_1-\frac{1-\phi}{\beta}\frac{r_1\kappa}{s-r_0}}{s-r_0}} \tag{A.127}$$

This expression directly implies that $\tilde{b}_1^*$ is decreasing in b_1, the level of domestic debt (in peso) issued by entrepreneurs at $t = 1$. Since i_2^{opt} is also increasing in b_1^*, this implies that the interest rate necessary to achieve full employment is also decreasing in b_1 (leading to aggregate demand externalities when i_2 is constrained below, see Farhi and Werning 2016 and Korinek and Simsek 2016)).

A.6 Proof of Lemma 1

Net capital flows are defined by:

$$\frac{1}{1+i_2^*}a_{3,j}^* - b_{1,j}^* = c_{2,j}^T - y_{2,j}^T \tag{A.128}$$

With separable preferences, the consumption level of tradables is straightforward, simply using the private first-order condition:

$$\phi(c_2^T)^{-1}\left((c_2^T)^{\phi}(c_2^N)^{1-\phi}\right)^{1-\rho} = \lambda_2 p_2^T = \beta(1+i_2^*) \tag{A.129}$$

which gives:

$$c_{2,j}^T = \frac{1}{\beta(1+i_2^*)} \tag{A.130}$$

Importantly, this relation is independent of the domestic interest rate set by the central bank in the EME. Using the global intermediary condition and the fact that all countries are identical:

$$i_2^* = i_2^\$ + \Gamma\left[\frac{1}{\beta(1+i_2^*)} - y_2^T\right] \tag{A.131}$$

For a small i_2^* this can be approximated as (first-order to make it linear):

$$i_2^* = \frac{i_2^\$ + \Gamma\frac{1-\beta y_2^T}{\beta}}{1+\frac{\Gamma}{\beta}} \tag{A.132}$$

□

A.7 Proof of Proposition 2

Net capital flows are defined by:

$$\frac{1}{1+i_2^*}a_{3,j}^* - b_{1,j}^* = c_{2,j}^T - y_{2,j}^T \tag{A.133}$$

where only $c_{2,j}^T$ is endogenous from the point of view of period $t = 2$. And we also have the expenditure switching relation:

$$c_{2,j}^T = \frac{\phi}{1-\phi}\frac{(1+i_{2,j})}{(1+i_2^*)}c_{2,j}^N \tag{A.134}$$

which in log-form implies:

$$\frac{d\ln c_{2,j}^T}{d\ln(1+i_{2,j})} = 1 + \frac{d\ln c_{2,j}^N}{d\ln(1+i_{2,j})} \tag{A.135}$$

And the last term is coming from the aggregate demand condition (A.54):

$$\frac{d\ln c_{2,j}^T}{d\ln(1+i_{2,j})} = 1 + \frac{\phi(1-\rho)-1}{\rho} \tag{A.136}$$

Hence:

$$\frac{d\ln c_{2,j}^T}{d\ln(1+i_{2,j})} = \frac{(\rho-1)(1-\phi)}{\rho} > 0 \tag{A.137}$$

since $\rho > 1$. This leads to:

$$\frac{d(\frac{a_{3,j}^*}{1+i_2^*} - b_{1,j}^*)}{d\ln(1+i_{2,j})} = c_{2,j}^T\frac{(\rho-1)(1-\phi)}{\rho} \tag{A.138}$$

And finally, from the global intermediary condition:

$$i_2^* = i_2^\$ + \Gamma\int_j(\frac{a_{3,j}^*}{1+i_{2,j}^*} - b_{1,j}^*)dj \tag{A.139}$$

yields the spillover result:

$$\frac{d\ln(1+i_2^*)}{d\ln(1+i_2)} = \Gamma(\rho-1)\frac{c_2^T}{1+i_2^*}\frac{1-\phi}{\rho} \tag{A.140}$$

□

A.8 Proof of Proposition 3

Given the relation between the dollar interest rate and the fed rate, we can also compute the monetary policy response of EMEs after a Fed shock. Start from the log-relation between i_2 and i_2^*, coming from the optimal policy solution (A.117):

$$ln(1+i_2) = \frac{\rho(1-\phi)+\phi}{\rho+(\rho-1)(1-\phi)} ln(1+i_2^*) + Constant \tag{A.141}$$

Then plug-in the equilibrium condition from the global arbitrageurs, which stipulates that (using A.137):

$$d\ln(1+i_2^*) = \frac{1}{1+i_2^*}\left[di_2^{\$} + \Gamma(\rho-1)\frac{1-\phi}{\rho}c_2^T d\ln(1+i_2)\right] \tag{A.142}$$

which gives by differentiating (A.141):

$$d\ln(1+i_2) = \frac{\rho(1-\phi)+\phi}{\rho+(\rho-1)(1-\phi)}\frac{1}{1+i_2^*}\left[di_2^{\$} + \Gamma(\rho-1)\frac{1-\phi}{\rho}c_2^T d\ln(1+i_2)\right] \tag{A.143}$$

and this implies equivalently:

$$\frac{d\ln(1+i_2)}{di_2^{\$}} = \frac{\frac{d\ln(1+i_2)}{di_2^*}}{1-\Gamma(\rho-1)\frac{d\ln(1+i_2)}{di_2^*}\frac{1-\phi}{\rho}c_2^T} \tag{A.144}$$

This expression makes clear that a $\Gamma > 0$ contributes to an amplification of the global financial cycle: every country answers to the Fed more aggressively that without spillovers. It also shows explicitly that both $\rho > 1$ and $\Gamma > 0$ are necessary for the presence of spillovers. Finally, since c_2^T is increasing in b_1^* on the optimal policy equilibrium, spillovers are greater for higher levels of dollar debt. □

A.9 Proof of Proposition 4

The central bank problem, when taking into account how aggregate capital flows impact the interest rate i_2^*, is:

$$\max_{l_2, c_2^T, e_2} \frac{1}{1-\rho}\left[(c_2^T)^{\phi}\left(l_2 + \eta_2 K_1 - s\kappa\frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s - r_0}\right)^{1-\phi}\right]^{1-\rho} + \beta\left(\bar{l} + r_1\kappa\frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s - r_0}\right) + \beta\left(y_3^T + (1+i_2^*)\left(y_2^T - b_1^* - c_2^T\right)\right) \quad \text{(A.145)}$$

with the constraints:

$$l_2 \leq \bar{l} \quad \text{(A.146)}$$

$$e_2 c_2^T = \frac{\phi}{1-\phi}\left(l_2 + \eta_2 K_1 - s\kappa\frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s - r_0} - \frac{b_1}{\bar{w}}\right) \quad \text{(A.147)}$$

$$\beta\frac{1+i_2^*}{e_2} = (1-\phi)\left(l_2 + \eta_2 K_1 - s\kappa\frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s - r_0} - \frac{b_1}{\bar{w}}\right)^{(1-\phi)(1-\rho)-1}(c_2^T)^{\phi(1-\rho)} \quad \text{(A.148)}$$

$$i_2^* = i_2^{\$} + \Gamma(c_2^T - y_2^T) \quad \text{(A.149)}$$

Call ι the Lagrange multiplier on the new constraint. The first-order conditions are then given by (respectively for l_2, c_2^T, e_2, and i_2^*, assuming that we deviate from full-employment as before so $\nu = 0$):

$$\beta(1+i_2) - m_T\frac{\phi}{1-\phi} - \epsilon((1-\phi)(1-\rho)-1)\frac{\beta(1+i_2)}{c_2^N} = 0 \quad \text{(A.150)}$$

$$m_T e_2 - \epsilon(1-\phi)(1-\rho)\frac{\beta(1+i_2)}{c_2^T} - \Gamma\iota = 0 \quad \text{(A.151)}$$

$$s\kappa\frac{b_1^*}{s-r_0}\beta(1+i_2) - \beta r_1\kappa\frac{b_1^*}{s-r_0} + m_T\left(c_2^T - \frac{\phi}{1-\phi}s\kappa\frac{b_1^*}{s-r_0}\right) - \epsilon\beta\frac{1+i_2}{e_2} - \epsilon((1-\phi)(1-\rho)-1)s\kappa\frac{b_1^*}{s-r_0}\frac{\beta(1+i_2)}{c_2^N} = 0 \quad \text{(A.152)}$$

and

$$\beta\left(y_2^T - b_1^* - c_2^T\right) + \epsilon\frac{\beta}{e_2} + \iota = 0 \tag{A.153}$$

As discussed in the text, the part $\beta\left(y_2^T - b_1^* - c_2^T\right)$ comes from terms-of-trade externality *à la* Costinot et al. (2014). To mute this effect, we look at the equilibrium around 0 borrowing ($a_3^* = 0$). This yields:

$$\iota = -\epsilon\frac{\beta}{e_2} \tag{A.154}$$

We can combine (A.152) and (A.150) as in the SOE case to get:

$$m_T c_2^T - \epsilon\beta\frac{1+i_2}{e_2} = \beta r_1 \kappa \frac{b_1^*}{s - r_0} \tag{A.155}$$

while combining (A.150) and (A.151) yields a similar expression as in the SOE case but with an extra term:

$$\beta(1+i_2^*)\frac{1-\phi}{\phi} - \epsilon(2(1-\phi)(1-\rho)-1)\frac{\beta(1+i_2)}{c_2^T} + \Gamma\epsilon\frac{\beta}{e_2} = 0 \tag{A.156}$$

This makes clear that the value of the multiplier ϵ takes a similar form than without coordination, whose effect is through the Γ term:

$$\epsilon\left[(2(1-\phi)(1-\rho)-1)\frac{\beta(1+i_2)}{c_2^T} - \Gamma\frac{\beta}{e_2}\right] = \beta(1+i_2^*)\frac{1-\phi}{\phi} \tag{A.157}$$

To the first-order in Γ, we can thus write the deviation from the previous ϵ as:

$$\epsilon = \frac{e_2 c_2^T}{2(1-\phi)(1-\rho)-1}\frac{1-\phi}{\phi}\left(1 + \frac{\Gamma}{e_2}\frac{c_2^T}{2(1-\phi)(1-\rho)-1}\right) \tag{A.158}$$

Then start again from (A.150):

$$m_T = \frac{1-\phi}{\phi}\beta(1+i_2)\left(1 - \frac{\epsilon}{c_2^N}((1-\phi)(1-\rho)-1)\right) \tag{A.159}$$

Replace m_T with (A.155):

$$c_2^T \frac{1-\phi}{\phi} \beta(1+i_2) \left(1 - \frac{\epsilon}{c_2^N}((1-\phi)(1-\rho)-1)\right) - \epsilon\beta \frac{1+i_2}{e_2} = \beta r_1 \kappa \frac{b_1^*}{s-r_0} \quad \text{(A.160)}$$

Group together the nominal domestic rate:

$$(1+i_2)\left[\frac{1-\phi}{\phi} c_2^T - \frac{\epsilon}{e_2}((1-\phi)(1-\rho))\right] = r_1 \kappa \frac{b_1^*}{s-r_0} \quad \text{(A.161)}$$

where one can see that plugging $\rho = 1$ delivers the solution found in (A.118). Using the expression in (A.158), we get:

$$(1+i_2) c_2^T \frac{1-\phi}{\phi} \frac{1+2(1-\phi)(\rho-1)}{1+(1-\phi)(\rho-1)} + \underbrace{\frac{\Gamma}{e_2} \frac{1-\phi}{\phi} \frac{(c_2^T)^2 (1-\phi)(\rho-1)}{(2(1-\phi)(1-\rho)-1))^2}}_{>0} = r_1 \kappa \frac{b_1^*}{s-r_0} \quad \text{(A.162)}$$

The first and last term are the optimality condition in the SOE case. The middle term comes from internalizing Γ, which immediately indicates that the coordinated central bank implements a lower interest rate as long as $\Gamma > 0$ and $\rho > 1$ (using again the fact the $(1+i_2)c_2^T$ is increasing in i_2). To the first-order, the two solutions are evaluated at the same c_2^T which gives:

$$i_2^C + \frac{\Gamma}{e_2} \frac{c_2^T (1-\phi)^2 (\rho-1)^2}{(2(1-\phi)(\rho-1)+1))^3} = i_2^{Unc} \quad \text{(A.163)}$$

which gives:

$$i_2^{Unc} - i_2^C = \frac{\Gamma}{e_2} \frac{c_2^T (1-\phi)^2 (\rho-1)^2}{(2(1-\phi)(\rho-1)+1))^3} \quad \text{(A.164)}$$

□

A.10 Issuance at $t = 1$: Derivations

Taking as given the interest rates on peso and dollar debt, the optimal amount issued in dollars by entrepreneurs is characterized in the following lemma.

Lemma 2 (Dollar Debt Issuance)**.** *The amount of dollar debt that needs to be paid back at $t = 2$ is given by:*

$$b_1^* = \omega^* \frac{K_1 + e_1\omega^*(1+i_1^*) + \omega(1+i_1)}{\left(\omega\frac{e_2}{e_1} + e_1\omega^*\right)^2} \left(K_1 + \omega\left(1 + i_1 - \frac{e_2}{e_1}(1+i_1^*)\right)\right) \quad \text{(A.165)}$$

This expression is intuitive: entrepreneurs issue up to the point where they pay the same interest rate for both types of debt. Consequently, they issue more in dollars when they expect a stronger currency next period (low e_2). For completeness, the following lemma provides the equilibrium interest rates charged on domestic currency and foreign currency debt.

Lemma 3. *The equilibrium interest rates are given by:*

$$1 + \hat{i}_1 = \frac{K_1 + \omega(1+i_1) + e_1\omega^*(1+i_1^*)}{\omega + e_1\omega^*\frac{e_1}{e_2}} \quad \text{(A.166)}$$

and:

$$1 + \hat{i}_1^* = \frac{K_1 + e_1\omega^*(1+i_1^*) + \omega(1+i_1)}{\omega\frac{e_2}{e_1} + e_1\omega^*} \quad \text{(A.167)}$$

Proofs: Entrepreneurs' optimization program is given by:

$$\min_{b_1, b_1^*} \quad b_1 + e_2 b_1^* \quad \text{(A.168)}$$

$$\text{s.t.} \quad \frac{b_1}{1+\hat{i}_1} + \frac{e_1 b_1^*}{1+\hat{i}_1^*} = K_1 \quad \text{(A.169)}$$

An interior solution exists when a simple UIP condition using the equilibrium interest rates is verified:

$$\frac{e_2}{e_1} = \frac{1+\hat{i}_1}{1+\hat{i}_1^*} \quad \text{(A.170)}$$

Since firms are raising K_1 in total, we can write:

$$K_1 = \frac{b_1}{1+\hat{i}_1} + \frac{e_1 b_1^*}{1+\hat{i}_1^*} \quad \text{(A.171)}$$

$$K_1 = \omega(\hat{i}_1 - i_1) + e_1\omega^*(\hat{i}_1^* - i_1^*) \quad \text{(A.172)}$$

$$K_1 = \omega(1+\hat{i}_1 - 1 - i_1) + e_1\omega^* \left(\frac{e_1}{e_2}(1+\hat{i}_1) - 1 - i_1^*\right) \tag{A.173}$$

$$K_1 = (1+\hat{i}_1)(\omega + e_1\omega^* \frac{e_1}{e_2}) - [\omega(1+i_1) + e_1\omega^*(1+i_1^*)] \tag{A.174}$$

$$\tag{A.175}$$

leading to the equilibrium interest domestic rate of borrowing:

$$1+\hat{i}_1 = \frac{K_1 + \omega(1+i_1) + e_1\omega^*(1+i_1^*)}{\omega + e_1\omega^* \frac{e_1}{e_2}} \tag{A.176}$$

and similarly for the dollar rate (using the UIP condition):

$$1+\hat{i}_1^* = \frac{K_1 + e_1\omega^*(1+i_1^*) + \omega(1+i_1)}{\omega\frac{e_2}{e_1} + e_1\omega^*} \tag{A.177}$$

From this, we get:

$$\hat{i}_1^* - i_1^* = \frac{K_1 + \omega\left(1 + i_1 - \frac{e_2}{e_1}(1+i_1^*)\right)}{\omega\frac{e_2}{e_1} + e_1\omega^*} \tag{A.178}$$

which finally yields:

$$b_1^* = \omega^* \frac{K_1 + e_1\omega^*(1+i_1^*) + \omega(1+i_1)}{\left(\omega\frac{e_2}{e_1} + e_1\omega^*\right)^2} \left(K_1 + \omega\left(1 + i_1 - \frac{e_2}{e_1}(1+i_1^*)\right)\right) \tag{A.179}$$

For the interest rate, using (A.178):

$$\hat{i}_1^* - i_1^* = \frac{K_1 + \omega\left(1 + i_1 - \frac{e_2}{e_1}(1+i_1^*)\right)}{\omega\frac{e_2}{e_1} + e_1\omega^*} \tag{A.180}$$

directly gives the equilibrium interest rate:

$$1+\hat{i}_1^* = \frac{K_1 + e_1\omega^*(1+i_1^*) + \omega(1+i_1)}{\omega\frac{e_2}{e_1} + e_1\omega^*} \tag{A.181}$$

and symmetrically for the interest rate on peso debt.

□

A.11 Proof of Proposition 5

Using (A.117), the optimal exchange rate set by the central bank is given by (for $\Gamma = 0$, hence $i_2^* = i_2^\$$) :

$$e_2^{opt} = \frac{1+i_2^\$}{1+i_2^{opt}} = \Omega^{-1}\left(r_1\kappa\frac{b_1^*}{s-r_0}\right)^{\frac{-\rho}{\rho-1+\rho(1-\phi)+\phi}}(1+i_2^*)^{1-\frac{\rho(1-\phi)+\phi}{\rho-1+\rho(1-\phi)+\phi}} \tag{A.182}$$

We simply need to isolate the b_1^* component to understand the fixed-point problem:

$$e_2^{opt} = A\left(b_1^*\right)^{\frac{-\rho}{\rho+(\rho-1)(1-\phi)}} \tag{A.183}$$

for a positive constant A:

$$A = \Omega^{-1}\left(\frac{r_1\kappa}{s-r_0}\right)^{\frac{-\rho}{\rho+(\rho-1)(1-\phi)}}(1+i_2^*)^{1-\frac{\rho(1-\phi)+\phi}{\rho+(\rho-1)(1-\phi)}} \tag{A.184}$$

where we had:

$$\Omega = \left[\left(\frac{\phi}{1-\phi}\right)^{\phi(\rho-1)}\frac{\beta}{1-\phi}\left(\frac{1+2(1-\phi)(\rho-1)}{1+(1-\phi)(\rho-1)}\right)^{\rho}\right]^{\frac{1}{\rho+(\rho-1)(1-\phi)}} \tag{A.185}$$

The aggregate demand condition is, as before:

$$(c_2^N)^{\frac{-\rho}{(\rho-1)\phi+1}} = Cste \times e_2^{-1} \tag{A.186}$$

and so using optimal policy for the exchange rate:

$$(c_2^N)^{\frac{-\rho}{(\rho-1)\phi+1}} = Cste \times A(b_1^*)^{\frac{\rho}{\rho+(\rho-1)(1-\phi)}} \tag{A.187}$$

which implies, in derivative form:

$$d\ln c_2^N = -\frac{(\rho-1)\phi+1}{\rho+(\rho-1)(1-\phi)}d\ln b_1^* \tag{A.188}$$

Now go back to the budget constraint for non-tradable goods:

$$c_2^N = l_2 + \eta_2 K_1 - s\kappa\frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s-r_0} \tag{A.189}$$

and plug in the optimal exchange rate again:

$$c_2^N = l_2 + \eta_2 K_1 - s\kappa \frac{\eta_2 K_1 - b_1 - A\left(b_1^*\right)^{\frac{(\rho-1)(1-\phi)}{\rho+(\rho-1)(1-\phi)}}}{s - r_0} \tag{A.190}$$

which implies, again in derivative form:

$$dc_2^N = dl_2 + \frac{(\rho-1)(1-\phi)}{\rho+(\rho-1)(1-\phi)} \frac{s\kappa}{s-r_0} e_2^{opt} db_1^* \tag{A.191}$$

Merging the aggregate demand condition with the budget constraint condition:

$$-\frac{(\rho-1)\phi+1}{\rho+(\rho-1)(1-\phi)} \frac{c_2^N}{b_1^*} db_1^* = dl_2 + \frac{(\rho-1)(1-\phi)}{\rho+(\rho-1)(1-\phi)} \frac{s\kappa}{s-r_0} e_2^{opt} db_1^* \tag{A.192}$$

which gives the externality result:

$$\frac{dl_2}{db_1^*} = -\frac{1}{\rho+(\rho-1)(1-\phi)} \left((1+(\rho-1)\phi) \frac{c_2^N}{b_1^*} + (\rho-1)(1-\phi) \frac{s\kappa}{s-r_0} e_2^{opt} \right) < 0 \tag{A.193}$$

□

We can directly express the welfare losses that come from increased in b_1^* in a very concise manner when $\rho = 1$:

Corollary 3. *When $\rho = 1$, an increase in b_1^* yields welfare losses at $t = 2$ equal to:*

$$\frac{d\mathcal{W}}{db_1^*} = -\frac{1-\phi}{b_1^*} \tag{A.194}$$

This comes from two useful features of the problem in that specific case: (i) the path of tradable goods consumption is independent of the nominal interest, and (ii) the optimal policy can be simply expressed as:

$$(1+i_2)c_2^T = \frac{\phi}{1-\phi} r_1 \kappa \frac{b_1^*}{s-r_0} \tag{A.195}$$

But the usual private first-order conditions, when preferences are separable, also give us that:

$$c_2^T = \frac{\phi}{\beta(1+i_2^*)} \tag{A.196}$$

and

$$c_2^N = \frac{1-\phi}{\beta(1+i_2)} \tag{A.197}$$

In terms of optimal policy, this yields the following easy characterization:

$$\frac{\beta}{e_2^{opt}} = \frac{r_1\kappa}{1-\phi}\frac{b_1^*}{s-r_0} \tag{A.198}$$

which means that the product $e_2 b_1^*$ is constant on the optimal policy point. At the same time, welfare can be expressed as follows:

$$\begin{aligned}
\mathcal{W} &= (1-\phi)\ln c_2^N + \beta c_3^N && \text{(A.199)}\\
&= (1-\phi)\ln\left(\frac{1-\phi}{\beta(1+i_2)}\right) + \beta\left(\bar{l} + r_1\kappa\frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s-r_0}\right) && \text{(A.200)}\\
&= (1-\phi)\ln\left(e_2\frac{1-\phi}{\beta(1+i_2^*)}\right) + \beta\left(\bar{l} + r_1\kappa\frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s-r_0}\right) && \text{(A.201)}
\end{aligned}$$

Staying on the optimal policy path, since $e_2 b_1^*$ is constant the derivative with respect to b_1^* is simply:

$$\frac{d\mathcal{W}}{db_1^*} = (1-\phi)\frac{d\ln e_2^{opt}}{db_1^*} \tag{A.202}$$

and using equation (A.198) this yields the result:

$$\frac{d\mathcal{W}}{db_1^*} = -\frac{1-\phi}{b_1^*} \tag{A.203}$$

□

A.12 Issuance with Macroprudential Tax

To see this, express by τ the tax imposed on dollar debt issuance. The maximization program of entrepreneurs is now given by:

$$\min_{b_1, b_1^*} \quad b_1 + e_2 b_1^* \tag{A.204}$$

$$\text{s.t.} \quad \frac{b_1}{1+\hat{i}_1} + \frac{e_1 b_1^*}{1+\hat{i}_1^*}(1-\tau) + T = K_1 \tag{A.205}$$

where T is the tax rebate. The following lemma provides the resulting equilibrium expressions.

Lemma 4 (Issuance with Macroprudential Policy)**.** *The amount of dollar debt that needs to be paid back at $t = 2$ is given by:*

$$b_1^* = \omega^* \frac{K_1 + e_1\omega^*(1+i_1^*) + \omega(1+i_1) - \tau\omega\frac{e_2}{e_1}}{\left(\omega\frac{e_2}{e_1} + e_1\omega^*\right)^2} \left(K_1 + \omega\left(1 + i_1 - \frac{e_2}{e_1}(1 + i_1^* + \tau)\right)\right) \tag{A.206}$$

which is decreasing in τ, while the peso debt to pay back is:

$$b_1 = \omega \frac{K_1 + \omega(1+i_1) + e_1\omega^*(1+i_1^*) + \tau e_1\omega^*\frac{e_1}{e_2}}{\left(\omega + e_1\omega^*\frac{e_1}{e_2}\right)^2} \left(K_1 + e_1\omega^*\left(1 + i_1^* - \frac{e_1}{e_2}(1 + i_1 - \tau)\right)\right) \tag{A.207}$$

which is increasing in τ. Decreasing b_1^* thus increases b_1, according to:

$$\frac{db_1}{db_1^*} = -e_1 \frac{1 + 2\hat{i}_1 - i_1}{1 + 2\hat{i}_1^* - i_1^*} \tag{A.208}$$

Proof: The UIP condition necessary for the interior solution is now :

$$\frac{e_2}{e_1} = \frac{1 + \hat{i}_1}{1 + \hat{i}_1^*}(1 - \tau) \tag{A.209}$$

We follow the same steps as for the proof of Lemma 2.

$$K_1 = \frac{b_1}{1 + \hat{i}_1} + \frac{e_1 b_1^*}{1 + \hat{i}_1^*} \tag{A.210}$$

$$K_1 = \omega(\hat{i}_1 - i_1) + e_1\omega^*(\hat{i}_1^* - i_1^*) \tag{A.211}$$

$$K_1 = \omega(1 + \hat{i}_1 - 1 - i_1) + e_1\omega^*\left(\frac{e_1}{e_2}(1 + \hat{i}_1 - \tau) - 1 - i_1^*\right) \tag{A.212}$$

$$K_1 = (1 + \hat{i}_1)(\omega + e_1\omega^*\frac{e_1}{e_2}) - \tau e_1\omega^*\frac{e_1}{e_2} - [\omega(1 + i_1) + e_1\omega^*(1 + i_1^*)] \tag{A.213}$$

$$\tag{A.214}$$

hence:

$$1+\hat{i}_1 = \frac{K_1 + \omega(1+i_1) + e_1\omega^*(1+i_1^*) + \tau e_1 \omega^* \frac{e_1}{e_2}}{\omega + e_1\omega^* \frac{e_1}{e_2}} \tag{A.215}$$

and similarly for the dollar interest rate charged on entrepreneurs:

$$1+\hat{i}_1^* = \frac{K_1 + e_1\omega^*(1+i_1^*) + \omega(1+i_1) - \tau\omega\frac{e_2}{e_1}}{\omega\frac{e_2}{e_1} + e_1\omega^*} \tag{A.216}$$

From this, we get:

$$\hat{i}_1^* - i_1^* = \frac{K_1 + \omega\left(1+i_1 - \frac{e_2}{e_1}(1+i_1^*)\right) - \tau\omega\frac{e_2}{e_1}}{\omega\frac{e_2}{e_1} + e_1\omega^*} \tag{A.217}$$

which finally yields:

$$b_1^* = \omega^* \frac{K_1 + e_1\omega^*(1+i_1^*) + \omega(1+i_1) - \tau\omega\frac{e_2}{e_1}}{\left(\omega\frac{e_2}{e_1} + e_1\omega^*\right)^2}\left(K_1 + \omega\left(1+i_1 - \frac{e_2}{e_1}(1+i_1^*+\tau)\right)\right) \tag{A.218}$$

The same thing for local currency debt gives us:

$$b_1 = \omega \frac{K_1 + \omega(1+i_1) + e_1\omega^*(1+i_1^*) + \tau e_1\omega^*\frac{e_1}{e_2}}{\left(\omega + e_1\omega^*\frac{e_1}{e_2}\right)^2}\left(K_1 + e_1\omega^*\left(1+i_1^* - \frac{e_1}{e_2}(1+i_1-\tau)\right)\right) \tag{A.219}$$

□

A.13 Proof of Proposition 6

With the framework of optimal debt structure of period $t = 1$, a reduction in b_1^* must be compensated by a corresponding increase in b_1 in order to finance capital expenditures K_1. Specifically, since the following relationship holds:

$$\frac{b_1^*}{1+\hat{i}_1^*} = \omega^*(\hat{i}_1^* - i_1^*) \tag{A.220}$$

we can differentiate with respect to b_1^* to find the corresponding change in the interest rate on dollar debt:

$$db_1^* = w^* d\hat{i}_1^* \left(1 + 2\hat{i}_1^* - i_1^*\right) \tag{A.221}$$

and similarly:

$$db_1 = w d\hat{i}_1 \left(1 + 2\hat{i}_1 - i_1\right) \tag{A.222}$$

But since in equilibrium we need to have that:

$$K_1 = \frac{b_1}{1 + \hat{i}_1} + \frac{e_1 b_1^*}{1 + \hat{i}_1^*} \tag{A.223}$$

Then using (A.220) and differentiating it has to be that:

$$w d\hat{i}_1 = -w^* e_1 d\hat{i}_1^* \tag{A.224}$$

Which implies that:

$$\frac{e_1 db_1}{1 + 2\hat{i}_1 - i_1} = -\frac{db_1^*}{1 + 2\hat{i}_1^* - i_1^*} \tag{A.225}$$

And hence that:

$$\frac{db_1}{db_1^*} = -e_1 \frac{1 + 2\hat{i}_1 - i_1}{1 + 2\hat{i}_1^* - i_1^*} \tag{A.226}$$

Going back to the welfare analysis when $\rho = 1$, we can then find the optimal debt issuance in dollars simply by using:

$$\frac{d\mathcal{W}}{db_1^*} = -\frac{1-\phi}{b_1^*} - \beta \frac{r_1 \kappa}{s - r_0} \frac{db_1}{db_1^*} \tag{A.227}$$

since $e_2 b_1^*$ is constant on the whole optimal policy path. Macroprudential policy is thus optimal when b_1^* is such that:

$$\frac{1-\phi}{b_1^*} = -\beta \frac{r_1 \kappa}{s - r_0} \frac{db_1}{db_1^*} \tag{A.228}$$

A.14 Proof of Proposition 7

Recall that the interest rate faced by the group of EMEs is determined by the intermediary equation:

$$i_2^* = i_2^\$ + \Gamma(c_2^T - y_2^T) \tag{A.229}$$

and this directly implies that any change in the tradable consumption of each SOE at $t = 2$ spills back into the interest rate determination:

$$\frac{d(1+i_2^*)}{db_1^*} = \Gamma \frac{dc_2^T}{db_1^*} \tag{A.230}$$

Going back then to the optimal policy (without coordination) characterization (A.103):

$$(1+i_2)c_2^T = \frac{\phi}{1-\phi} \frac{1+2(1-\phi)(\rho-1)}{1+(1-\phi)(\rho-1)} r_1 \kappa \frac{b_1^*}{s-r_0} \tag{A.231}$$

and using at the same time the closed-form solution for the interest rate (A.117):

$$1+i_2 = \Omega \left(r_1 \kappa \frac{b_1^*}{s-r_0} \right)^{\frac{\rho}{\rho-1+\rho(1-\phi)+\phi}} (1+i_2^*)^{\frac{\rho(1-\phi)+\phi}{\rho-1+\rho(1-\phi)+\phi}} \tag{A.232}$$

we end up with a log-derivative of:

$$\frac{d\ln c_2^T}{d\ln b_1^*} = 1 - \frac{\rho}{\rho-1+\rho(1-\phi)+\phi} \tag{A.233}$$

$$= \frac{(\rho-1)(1-\phi)}{\rho+(\rho-1)(1-\phi)} \tag{A.234}$$

which gives the end result for macroprudential policy spillovers:

$$\frac{d(1+i_2^*)}{db_1^*} = \Gamma(\rho-1) \frac{(1-\phi)}{\rho+(\rho-1)(1-\phi)} \frac{b_1^*}{c_2^T} \tag{A.235}$$

A.15 Micro-foundations for Global Intermediaries

This part offers explicit micro-foundations for the expressions postulated in (17). Since these setups all lead to the same expression, I do not take a stance on which precise foundations are more realistic.

Bianchi and Lorenzoni (2022): The authors postulate that the global arbitrageur has a quadratic cost function for intermediating all capital flows coming from the continuum of EMEs. Denote by $cf_{3,j}$ the net capital flow coming from EME j between period 2 and 3:

$$\Phi\left(\int_j cf_{3,j}dj\right) = \frac{\Gamma}{2}\left(\int_j cf_{3,j}dj\right)^2 \tag{A.236}$$

The net profits are intermediaries are then given by:

$$\int_j a^*_{3,j}dj - (1+i^\$_2)\int_j cf_{3,j}dj - \Phi\left(\int_j cf_{3,j}dj\right) \tag{A.237}$$

Profit maximization for the global arbitrageur thus leads to the same expression as in (17) under quadratic costs, using simply that $cf_{3,j} = c^T_{2,j} - y^T_{2,j}$.

Gabaix and Maggiori (2015): The authors assume that financiers are subject to a financial friction: after taking positions, the financiers can divert a portion of the funds they intermediate (see also Maggiori (2022) for a review). To stay close to the notation, denote by q the position taken by financiers. Financiers maximize the value of the firm:

$$V = (i^*_2 - i^\$_2)q \tag{A.238}$$

If they divert the funds, the household get back only a fraction $1-\Gamma|q|$ of their funds. This implies that the financiers are subject to the financial constraint:

$$V \geq |q|\Gamma|q| = \Gamma q^2 \tag{A.239}$$

The maximization program is thus simply:

$$max_q \quad V \quad \text{such that} \quad V \geq \Gamma q^2 \tag{A.240}$$

Since the financiers would like to borrow or lend as much as possible for any non-zero return ($i^*_2 \neq i_2\$$) the constraint binds:

$$(i^*_2 - i^\$_2)q = \Gamma q^2 \tag{A.241}$$

Substituting q by the equilibrium quantity of flows intermediated, $\int_j c^T_{2,j} - y^T_{2,j} dj$ yields expression (17) in the main text again.

Fanelli and Straub (2021): Global arbitrageurs can borrow directly on US financial markets at the rate set by the Fed, $i^{\$}_2$, but they are subject to a net open position limit $1/\Gamma > 0$, and face heterogeneous participation costs. In particular, intermediary g has costs of g per dollar invested. This implies that the intermediary g solves the following profit-maximization program:

$$\max_{x_g \in [-1/\Gamma, 1/\Gamma]} x_g(i^*_2 - i^{\$}_2) - g|x_g| \tag{A.242}$$

Therefore, the marginal intermediary verifies:

$$\bar{g} = |i^*_2 - i^{\$}_2| \tag{A.243}$$

We denote by $\int_j (c^T_{2,j} - y^T_{2,j}) dj$ the aggregate net capital flow from the continuum of SOEs to the rest of the world. Since each intermediary is against the net position constraint, a total of $\bar{g}$ intermediaries have a position of $1/\Gamma$, which yields the equilibrium relationship between interest rates and aggregate flows:

$$i^*_2 = i^{\$}_2 + \Gamma \cdot \int_j (c^T_{2,j} - y^T_{2,j}) dj \tag{A.244}$$

Coimbra and Rey (2024): In this framework, intermediaries are subject to a VaR constraint. To adapt this to my model without adding risk on the side of individual countries, I assume the following. By investing in a quantity q in EMEs, global intermediaries face random compliance costs $q^2\xi$. They are then required to maintain a position such that the probability that their investment loose money is less than some probability α. This means that intermediaries are required to ensure that:

$$Pr\left(q(i^*_2 - i^{\$}_2) - q^2\xi \leq 0\right) \leq \alpha \tag{A.245}$$

Assuming that ξ follows a uniform distribution on $[0, \Xi]$, where Ξ is understood to be large enough such that a loss is a non-zero probability event, this yields:

$$\Xi - \frac{i_2^* - i_2^\$}{q} = \alpha \tag{A.246}$$

One simply now needs to define $\Gamma = \Xi - \alpha$ to get:

$$i_2^* - i_2^\$ = \Gamma q \tag{A.247}$$

And once again, substituting q by the equilibrium quantity of flows intermediated, $\int_j c_{2,j}^T - y_{2,j}^T dj$ yields expression (17) in the main text.

B Minor Extensions

B.1 General Currency Mismatch

The assumption in the main framework is an extreme form currency mismatch, where entrepreneurs' production at $t = 2$ is in non-tradable goods only. This implies that their net worth is given by:

$$n_2 = \eta_2 K_1 - b_1 - e_2 b_1^* \tag{B.1}$$

Meaning that the exchange rate moves only costs, not the revenues, of entrepreneurs. We can easily extend this framework and work with a general currency mismatch, by assuming that entrepreneurs' capital at $t = 2$ yields a quantity η_2 of non-tradable goods, and a quantity $\iota\eta_2$ of tradable goods, per unit of capital. In this case, their net worth becomes:

$$n_2 = \eta_2 + e_2 \iota K_1 - b_1 - e_2 b_1^* \tag{B.2}$$

and the exchange rate moves income and as well as costs. The net worth multiplier (assume constrained entrepreneurs as before) that govern balance sheet effects is then similar but simply weakened by the presence of tradable goods:

$$\frac{dK_2}{i_2} = (1-\iota)\frac{e_2\kappa b_1^*}{s-\rho_0} \tag{B.3}$$

B.2 Cost of Interest for Firms

Because of the micro-foundation for the financial friction (Tirole 2010), the equivalent of (3) is now:

$$b_2(1+r_2) \leq r_0 k_2 \tag{B.4}$$

We write instead this constraint as:

$$b_2(1+\zeta r_2) \leq r_0 k_2 \tag{B.5}$$

with $\zeta = 1$. This is simply to make sure that when $\zeta = 0$, we are back to the baseline model.

Assuming again that productive firms are constrained, their budget constraint yields:

$$n_2 + b_2 = sk_2 \implies n_2 + \frac{r_0 k_2}{1+\zeta i_2} = sk_2 \tag{B.6}$$

which gives the equilibrium level of re-investment at $t = 2$:

$$k_2 = \frac{n_2}{s - \frac{r_0}{1+\zeta i_2}} \tag{B.7}$$

We linearize this expression for small i_2 in order to preserve tractability:

$$k_2 \approx \frac{n_2}{s-r_0} - \frac{n_2}{(s-r_0)^2}\zeta i_2 \tag{B.8}$$

How does this change the optimal policy problem? The central bank now also has to factor in that a higher interest rate tightens financial frictions, and hence indirectly lowers the amount of non-tradable production (and consumption) at $t = 3$. For simplicity, the optimal policy analysis is done with $\rho = 1$ for this extension. The maximization program of the central bank is:

$$\max_{l_2, i_2, e_2, k_2} (1-\phi)\ln\left(l_2 + \eta_2 K_1 - s\kappa k_2\right) + \beta\left(\bar{l} + r_1\kappa k_2\right) \tag{B.9}$$

with the constraints:

$$l_2 \leq \bar{l} \tag{B.10}$$

$$\beta(1+i_2^*)\left(l_2 + \eta_2 K_1 - s\kappa k_2 - \frac{b_1}{\bar{w}}\right) = (1-\phi)e_2 \tag{B.11}$$

$$k_2 = \frac{\eta_2 - b_1 - e_2 b_1^*}{s - r_0} - \frac{\eta_2 - b_1 - e_2 b_1^*}{(s-r_0)^2}\zeta i_2 \tag{B.12}$$

$$i_2 = 1 + i_2^* - e_2 \tag{B.13}$$

with the respective multipliers: ν, ϵ, λ, μ. The first-order condition are then:

$$\frac{1-\phi}{c_2^N} - \nu - \epsilon\beta(1+i_2^*) = 0 \tag{B.14}$$

$$\lambda\frac{\eta_2 - b_1 - e_2 b_1^*}{(s-r_0)^2}\zeta + \mu = 0 \tag{B.15}$$

$$\epsilon(1-\phi) + \lambda\frac{b_1^*}{s-r_0} - \frac{b_1^*}{(s-r_0)^2}\zeta i_2 + \mu = 0 \tag{B.16}$$

$$-(1-\phi)\frac{s\kappa}{c_2^N} + \beta r_1\kappa + \epsilon\beta(1+i_2^*)s\kappa + \lambda = 0 \tag{B.17}$$

The first condition directly leads to $\epsilon = 1/e_2$, when $\nu = 0$ (the central bank has to allow for under-employment). The last condition simplifies to $\lambda = -\beta r_1 \kappa$ thanks to the first one. The last Lagrange multiplier is then given by the second condition:

$$\mu = \beta r_1 \kappa \frac{n_2}{(s-r_0)^2}\zeta \tag{B.18}$$

Putting everything together yields:

$$\frac{1}{e_2}(1-\phi) = \beta r_1\kappa\frac{b_1^*}{s-r_0} + \frac{b_1^*}{(s-r_0)^2}\zeta i_2 - \beta r_1\kappa\frac{n_2}{(s-r_0)^2}\zeta \tag{B.19}$$

Which can rewritten to isolate the optimal baseline solution when $\zeta = 0$, using once again the UIP condition:

$$1 + i_2 = \frac{\beta r_1 \kappa}{1-\phi}\frac{b_1^*(1+i_2^*)}{s-r_0} - \frac{\zeta}{(s-r_0)^2}\left(\beta r_1 \kappa n_2 - b_1^* i_2\right) \tag{B.20}$$

We are thus left with the previous solution, minus a positive term, highlighting that the central bank implements a lower interest rate than in the baseline case to avoid tightening the financial friction by too much.

B.3 A Version Without Aggregate Demand

This extension presents a version of the model without aggregate demand forces: wages are fully flexible so there is always full employment. All effects instead go through investment. The trade-off of the central bank is the following: by increasing the interest rate, it appreciates the currency which helps financially constrained firms. On the other hand, it raises the cost of investment for unconstrained firms, leading them to investing less. The point of this section is to show that the sames forces are at play: the optimal monetary policy of the central bank depends (positively) on b_1^* and i_2, leading to the same spillovers through intermediaries.[36]

A fraction κ of firms are constrained, subject to the same friction:

$$b_2 \leq r_0 k_2^{\kappa} \tag{B.21}$$

The remaining fraction $1-\kappa$ of firms are unconstrained, but face quadratic costs of adjusting their capital stock. They thus maximize:

$$r_1 k_2^{1-\kappa} - (1+i_2)(k_2^{1-\kappa} - n_2) - \frac{\chi}{2}\left(k_2^{1-\kappa}\right)^2 \tag{B.22}$$

For a given policy rate i_2, each unconstrained firm thus invests:

$$k_2^{1-\kappa} = \frac{r_1 - i_2}{\chi} \tag{B.23}$$

The total capital stock for production in period $t=3$ is then given by:

$$K_2 = \kappa \frac{n_2}{s - r_0} + (1-\kappa)\frac{r_1 - i_2}{\chi} \tag{B.24}$$

Replacing the exchange rate in the net worth:

$$K_2 = \kappa \frac{\eta_2 K_1 - b_1 - \frac{1+i_2^*}{1+i_2} b_1^*}{s - r_0} + (1-\kappa)\frac{r_1 - i_2}{\chi} \tag{B.25}$$

[36] I thank Arvind Krishnamurthy for this suggestion.

Maximizing this capital stock with respect to i_2 delivers the aforementioned trade-off:

$$\kappa \frac{b_1^*}{s - r_0} \frac{1 + i_2^*}{(1 + i_2)^2} = \frac{(1 - \kappa)}{\chi} \tag{B.26}$$

Optimal monetary policy is thus given by the following rule:

$$1 + i_2 = \sqrt{\chi \frac{\kappa}{1 - \kappa} \frac{b_1^*}{s - r_0} (1 + i_2^*)} \tag{B.27}$$

Which has the same forces as Proposition 1 and a very similar form than Equation (15). All other insights follow intuitively.

C FX Interventions

C.1 Setup

For FX interventions to have an effect on the exchange rate, we must add a layer of intermediation (otherwise, FX interventions by just one country are negligible for the global intermediary and thus do not affect the equilibrium exchange rate). We adopt the following notation: i_2^* is the interest rate offered by the global intermediary, while $\tilde{i}_{2,j}$ is the interest offered by country$-j$ specific intermediary. We then have, using the same micro-foundations in Appendix A.15, that:

$$\tilde{i}_{2,j} = i_2^* + \gamma_j \left(c_{2,j}^T - y_{2,j}^T \right) \tag{C.1}$$

and:

$$i_2^* = i_2^{\$} + \Gamma \int_j \left(c_{2,j}^T - y_{2,j}^T \right) dj \tag{C.2}$$

The previous framework of Section 4 is nested by taking $\gamma_j = 0$ for all j. We also allow the central bank to implement FX interventions. To this end, we assume that the central bank has access to a fixed quantity of foreign reserves, denoted by $\bar{f}$. Therefore, the country j can intervene in the FX markets by selling $f_{2,j} \in [0, \bar{f}]$, which changes capital flows according to the following:

$$\frac{1}{1 + i_2^*} a_{3,j}^* - b_1^* = c_{2,j}^T - y_{2,j}^T - f_{2,j} \tag{C.3}$$

By doing this, the central bank effectively reduces capital outflows, which supports the currency. Indeed, by reducing outflows the central bank decreases $\tilde{i}_{2,j}$, and thanks to the UIP condition for households:

$$e_2 = \frac{1 + \tilde{i}_{2,j}}{1 + i_2} \tag{C.4}$$

which simply means that decreasing $\tilde{i}_{2,j}$ appreciates the currency.

C.2 Optimal Use of FX Interventions

The first result in this section confirms that the insight of Itskhoki and Mukhin (2023) also applies to my setup: unconstrained access to FX interventions allows the central bank to achieve full employment.

Proposition 8 (Unconstrained FX Interventions)**.** *When $\bar{f}$ is large enough, the central bank uses FX interventions while choosing an interest rate i_2 that implements full-employment: $l_2 = \bar{l}$.*

This is simply a manifestation of the Tinbergen Principle (Tinbergen 1952). As a result, there are no spillovers between EMEs, as explained in Korinek (2017). The more interesting insights come from the case where $\bar{f}$ is low enough, such that central banks are constrained in their use of reserves. When this is the case, selling reserves is still valuable, because it relaxes the trade-off embedded in choosing the domestic interest rate.

Proposition 9 (Constrained FX Interventions)**.** *When $f_{2,j} = \bar{f}$:*

1. *Country j still allows for under-employment: $l_{2,j} < \bar{l}$;*
2. *The domestic optimal interest $i_{2,j}$ is lower than without FX interventions ;*
3. *The currency is more appreciated than without FX interventions ;*
4. *If implemented by all EMEs, FX interventions have positive spillovers across countries, and i_2^* is lower than without FX interventions.*

Reserves will thus always be used at $t = 2$, and will deliver an appreciated currency (i.e. a lower e_2).[37] From the perspective of period $t = 1$, however, the welfare effects are less obvious.

Proposition 10 (Moral Hazard Consequences of FX Interventions)**.** *Expected FX interventions raise ex-ante dollar debt issuance, b_1^*. Around an approximation point where Γ is large and $\bar{f}/\Gamma$ stays first-order, the possibility of FX interventions reduces welfare absent macroprudential policy when:*

$$\rho \frac{\left(2 + \frac{1+i_1^*}{\hat{i}_1^* - i_1^*}\right) w}{e_1^2 w^* + w e_2^{opt}} > \rho(1-\phi) + \phi \tag{C.5}$$

Proposition 10 highlights an under-appreciated feature of FX interventions. By leaning against depreciations in the future, private debt issuers are incentivized to switch more of their liabilities into dollars. This in turn worsens the stabilization trade-off faced by the central bank. The reason it can go as far as to lowering welfare is more subtle. Moral hazard forces are always present in this model, with or without FX interventions. When it comes to interest rate policy, however, this force is muted by the costs of impairing aggregate demand. In other words, private firms realize that the central bank will appreciate the currency to avoid strong balance sheet effects, but also realize that the central bank will put some weight on its employment mandate, and thus will only appreciate the currency so much. The costs of using the interest rate to manage the currency are thus giving some sort of commitment power to the central bank. This is not the case for FX interventions in my model, which are modeled to be costless. Moral hazard concerns are then greater when considering FX interventions, and can result in lower levels of welfare. As a result, macroprudential policy is even more needed to curb dollar-denominated debt issuance.[38]

[37] The fact that the use of reserves involves positive spillovers across currencies might seem surprising in light of the currency war literature (Eichengreen 2013 ; Jeanne 2021 ; Caballero, Farhi and Gourinchas 2021). This is because all the EMEs considered are on the *same side* of the global intermediary.

[38] Additionally, Das et al. (2024) highlights a novel externality: central banks accumulate reserves ex-ante, which lowers dollar interest rates and thus encourage even more issuance in dollars.

C.3 Proofs

C.3.1 Optimal Policy: Unconstrained Reserves (Proposition 8)

Assume that the central bank has $\bar{f}$ of reserves available. The central bank's problem is now (omitting the subscript j for legibility):

$$\max_{l_2,c_2^T,e_2,f_2} \frac{1}{1-\rho}\left[(c_2^T)^{\phi}\left(l_2+\eta_2 K_1 - s\kappa\frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s-r_0}\right)^{1-\phi}\right]^{1-\rho} \\ +\beta\left(\bar{l}+r_1\kappa\frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s-r_0}\right) \\ +\beta\left(y_3^T+(1+\tilde{i}_2)\left(y_2^T - b_1^* - c_2^T\right)\right) \quad \text{(C.6)}$$

with the constraints:

$$l_2 \leq \bar{l} \quad \text{(C.7)}$$

$$e_2 c_2^T = \frac{\phi}{1-\phi}(l_2+\eta_2 K_1 - s\kappa\frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s-r_0} - \frac{b_1}{\bar{\omega}}) \quad \text{(C.8)}$$

$$\beta\frac{1+\tilde{i}_2}{e_2} = (1-\phi)\left(l_2+\eta_2 K_1 - s\kappa\frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s-r_0} - \frac{b_1}{\bar{\omega}}\right)^{(1-\phi)(1-\rho)-1}(c_2^T)^{\phi(1-\rho)} \quad \text{(C.9)}$$

$$\tilde{i}_2 = i_2^* + \gamma_j(c_2^T - y_2^T - f_2) \quad \text{(C.10)}$$

$$f_2 \leq \bar{f} \quad (\varphi) \quad \text{(C.11)}$$

where φ is the Lagrange multiplier on the FX intervention constraint. This maximization problem is formally equivalent to the coordination one, since the individual central bank now understands that changing the interest rate has an impact on $\tilde{i}$, since there is a layer of country-specific intermediation. The maximization condition are then similar:

$$\nu+\beta(1+i_2) - m_T\frac{\phi}{1-\phi} - \epsilon((1-\phi)(1-\rho)-1)\frac{\beta(1+i_2)}{c_2^N} = 0 \quad \text{(C.12)}$$

$$m_T e_2 - \epsilon(1-\phi)(1-\rho)\frac{\beta(1+i_2)}{c_2^T} - \gamma_j\iota = 0 \quad \text{(C.13)}$$

$$s\kappa\frac{b_1^*}{s-r_0}\beta(1+i_2)-\beta r_1\kappa\frac{b_1^*}{s-r_0}+m_T\left(c_2^T-\frac{\phi}{1-\phi}s\kappa\frac{b_1^*}{s-r_0}\right)$$
$$-\epsilon\beta\frac{1+i_2}{e_2}-\epsilon((1-\phi)(1-\rho)-1)s\kappa\frac{b_1^*}{s-r_0}\frac{\beta(1+i_2)}{c_2^N}=0 \quad \text{(C.14)}$$

and

$$\beta\left(y_2^T-b_1^*-c_2^T\right)+\epsilon\frac{\beta}{e_2}+\iota=0 \quad \text{(C.15)}$$

to which we also add the first-order condition on f_2:

$$\gamma_j\iota=\varphi \quad \text{(C.16)}$$

If the optimal amount of FX intervention is strictly less than $\bar{f}$, the amount of available reserves, then $\varphi=0$. This implies $\iota=0$, which means that:

$$\beta\left(y_2^T-b_1^*-c_2^T\right)+\epsilon\frac{\beta}{e_2}=0 \quad \text{(C.17)}$$

This directly implies that $\nu\neq 0$. Indeed, were ν to be equal to 0, the first three equations would be formally similar to the case in Proposition 1, but this solution is inconsistent with a ϵ value of $e_2\left(y_2^T-b_1^*-c_2^T\right)$. Therefore, the central bank achieves full employment whenever it has access to unconstrained reserves.[39] □

C.3.2 Optimal Policy: Constrained Reserves (Proposition 9)

For $\bar{f}$ small enough, the central bank is then constrained and $\varphi\neq 0$, which means that the central bank fully uses $\bar{f}$ to appreciate the currency. This means that we can simply rewrite the maximization problem as before, taking $\bar{f}$ as fixed, and derive the optimal interest rate given that reserve policy. But we also showed that i_2 was increasing in i_2^*, and since implementing $\bar{f}$ decreases i_2^*, the resulting optimal interest rate is lower with FX interventions.

Individual central bank then do not internalize the effect this has on other countries, through:

$$i_2^*=i_2^\$+\Gamma\int_j(c_{2,j}^T-y_{2,j}^T)dj \quad \text{(C.18)}$$

The use of FX interventions thus lowers i_2^*, resulting in *positive spillovers*, and damp-

[39]This is simply a formal proof of the Tinbergen principle (Tinbergen 1952).

ens the global financial cycle.

C.3.3 Moral Hazard and FX Interventions (Proposition 10)

To generate analytical insights for this part, we assume that γ_j is small enough, while $\bar{f}$ is also large enough to prevent $\bar{f}\gamma_j$ from being second order.[40] This substantially simplifies the analysis, since it is equivalent to having the central bank not internalize the effect of its interest rate policy on $\tilde{i}_2$, while still having an impact on the exchange rate through $\bar{f}$. As a result, for a change in $\bar{f}$ the implied change in the exchange rate comes from:

$$d\ln(1+i_2) = \frac{\rho(1-\phi)+\phi}{\rho-1+\rho(1-\phi)+\phi} d\ln(1+\tilde{i}_2) \tag{C.19}$$

$$\implies de_2 = \frac{\rho-1}{\rho-1+\rho(1-\phi)+\phi} d\ln(1+\tilde{i}_2) \tag{C.20}$$

$$\implies de_2 \approx -\frac{\rho-1}{\rho-1+\rho(1-\phi)+\phi}\gamma_j\bar{f} \tag{C.21}$$

ou Which means that a use of reserves to intervene in the exchange rate market yields, in equilibrium, a lower e_2, i.e. an appreciated currency. Using the equilibrium choice of dollar issuance (Lemma 2, equation A.165), we also have the following:

$$db_1^* = -\left(\frac{2wb_1^*}{e_1^2 w^* + we_2^{opt}} + \frac{1}{e_1}\frac{w^*(1+\hat{i}_1^*)(1+i_1^*)}{e_1 w^* + w\frac{e_2^{opt}}{e_1}}\right)\omega de_2 \tag{C.22}$$

or the simpler:

$$db_1^* = -\left(2b_1^* + w^*(1+\hat{i}_1^*)(1+i_1^*)\right)\frac{\omega de_2}{e_1^2 w^* + we_2^{opt}} \tag{C.23}$$

This expression has two component, simply because a change in the interest rate e_2 has an impact on the quantity issued and the interest rate paid for that issuance (as can be seen from the w^* in the second part). In a first-order approximation, these

[40]This tactic comes from Itskhoki and Mukhin (2023), who use it to derive first-order approximations in a setting with risk.

two effects are additive. At the same time, the UIP condition stipulates that:

$$de_2 = d\tilde{i}_2 - di_2 = -\gamma_j \bar{f} - di_2 \tag{C.24}$$

and the optimal policy at $t = 2$ gives:

$$di_2 = \frac{\rho}{\rho + (\rho - 1)(1 - \phi)} d \ln b_1^* + \frac{\rho(1 - \phi) + \phi}{\rho + (\rho - 1)(1 - \phi)} d\tilde{i}_2 \tag{C.25}$$

Equation (C.23) in logarithm form is:

$$\begin{aligned} d \ln b_1^* &= -\left(2 + \frac{w^*(1 + \hat{i}_1^*)(1 + i_1^*)}{b_1^*}\right) \frac{\omega de_2}{e_1^2 w^* + w e_2^{opt}} && \text{(C.26)} \\ &= -\left(2 + \frac{1 + i_1^*}{\hat{i}_1^* - i_1^*}\right) \frac{\omega de_2}{e_1^2 w^* + w e_2^{opt}} && \text{(C.27)} \end{aligned}$$

which gives, combined with the differential UIP condition:

$$d \ln b_1^* = \frac{\left(2 + \frac{1 + i_1^*}{\hat{i}_1^* - i_1^*}\right) w}{e_1^2 w^* + w e_2^{opt}} \left(\gamma_j \bar{f} + di_2\right) \tag{C.28}$$

And using this inside the optimal policy condition:

$$\begin{aligned} di_2 = \frac{\rho}{\rho + (\rho - 1)(1 - \phi)} \frac{\left(2 + \frac{1 + i_1^*}{\hat{i}_1^* - i_1^*}\right) w}{e_1^2 w^* + w e_2^{opt}} \left(\gamma_j \bar{f} + di_2\right) \\ - \frac{\rho(1 - \phi) + \phi}{\rho + (\rho - 1)(1 - \phi)} \gamma_j \bar{f} \end{aligned} \tag{C.29}$$

Which leads the final expression for the optimal domestic rate at $t = 2$ with FX intervention and moral hazard:

$$di_2 \left(1 - \underbrace{\frac{\rho}{\rho + (\rho - 1)(1 - \phi)} \frac{\left(2 + \frac{1 + i_1^*}{\hat{i}_1^* - i_1^*}\right) w}{e_1^2 w^* + w e_2^{opt}}}_{\text{Feedback effect from moral hazard}}\right)$$

$$= \frac{\gamma_j \bar{f}}{(\rho + (\rho-1)(1-\phi))} \left(\underbrace{\rho \frac{\left(2 + \frac{1+i_1^*}{\hat{i}_1^* - i_1^*}\right) w}{e_1^2 w^* + w e_2^{opt}}}_{\text{Backfire from moral hazard}} - \underbrace{(\rho(1-\phi)+\phi)}_{\text{Relaxation of constraints with FX}} \right) \quad \text{(C.30)}$$

The total effect is then positive when:

$$\rho \frac{\left(2 + \frac{1+i_1^*}{\hat{i}_1^* - i_1^*}\right) w}{e_1^2 w^* + w e_2^{opt}} > \rho(1-\phi) + \phi \quad \text{(C.31)}$$

When this condition is satisfied, the anticipation of FX interventions has such a strong effect on dollar debt issuance, that the resulting equilibrium interest rate in $t = 2$ is even higher than without FX interventions, hurting aggregate demand.

D Intermediary Capacity and the Dollar

To think about the link between the Dollar and global bank leverage in this framework, it is useful to go back to the microfoundations, in particular from Fanelli and Straub (2021) and Coimbra and Rey (2024). In Fanelli and Straub (2021), it is assumed that the intermediaries are subject to a net open position limit $1/\Gamma > 0$ and face heterogeneous participation costs. This yields the equilibrium relationship between interest rates and aggregate flows:

$$i_2^* = i_2^{\$} + \Gamma \cdot \int_j (c_{2,j}^T - y_{2,j}^T) dj \quad \text{(D.1)}$$

In this setup, it seems natural to think of a tightening of financial conditions as a *fall* in $1/\Gamma$: each intermediary is restricted to a smaller net open position when the dollar is relatively more appreciated. In the microfoundations adapted from Coimbra and Rey (2024), Γ is a direct function of the value at risk banks are permitted to have. In a risk-off shock, banks become more strict and thus permit less value at risk, which translates directly into a higher Γ (through a lower α in the details of Appendix A.15).

In terms of comparative statics, recall that the spillover expression from Proposition 2 was:

$$\mathscr{C}(i_2, i_2^*) = \frac{d\ln(1+i_2^*)}{d\ln(1+i_2)} = \Gamma(\rho-1)\frac{c_2^T}{1+i_2^*}\frac{1-\phi}{\rho} \tag{D.2}$$

which makes it clear that spillovers are stronger when Γ is higher, i.e. when financial conditions are tighter. The Global Financial Cycle is then even more exacerbated (see Proposition 3), in the sense that all EMEs react even more to US monetary policy shocks. Similarly (see Proposition 7), the positive spillovers of macroprudential policies are enhanced.

Additionally, equation (D.1) point towards possible asymmetric effects of such dollar shocks. The sign of the wedge between the Fed interest rate, $i_2^\$$, and the interest rate at which EMEs can finance themselves, i_2^*, depends on whether these countries run a current account surplus or deficit. When the continuum of EMEs is a net saver, their i_2^* is *lower* than the US interest rate (the difference being the markup taken by global intermediaries).[41] This reasoning implies that shocks to Γ have asymmetric consequences. When EMEs are net borrowers, they face an interest rate $i_2^* > i_2^\$$. If suddenly Γ increases, the wedge between the two interest rates increases even more, which means that individual countries face a higher i_2^*. This depreciates their currencies, triggering negative balance sheet effects and monetary policy responses:

$$\frac{d\ln(1+i_2)}{d\ln(1+i_2^*)} = \frac{\rho(1-\phi)+\phi}{\rho+(\rho-1)(1-\phi)} \tag{D.3}$$

But the case of EMEs being net savers is going in the opposite direction. They then face an interest rate $i_2^* < i_2^\$$. If suddenly Γ increases, the wedge between the two interest rates increases even more, which means that individual countries face a *lower* i_2^*. This, in turn, appreciates their currency and relaxes the trade-off faced by the central bank. Finally, notice that in this model it is irrelevant whether one particular country is a net saver or borrower. Since the interest rate that it faces, i_2^*, depends on aggregate capital flows, what matters is only the aggregate current account position.

[41] The sign of this wedge has no bearing on the spillover results: even if all EMEs are net savers, they still all tighten to appreciate their currency more, which increases capital inflow and raises i_2^*, depreciating other currencies. This is an important difference from the theory of dynamic term-of-trade manipulation (Costinot et al. 2014).

E Tradable Price Inflation

The main framework of the paper considers that the price of tradables in dollars was fixed at 1. This is the result of the assumption that the continuum of EMEs considered is small relative to the rest of the world. This extension relaxes this assumption.

To do so in a flexible and tractable manner, I assume that the rest of the world has the following linear demand from tradables:

$$D_2^T = D_2 - \delta P_2^T \tag{E.1}$$

where P_2^T is the price in dollars, now an equilibrium object. There is a fixed supply of tradables Y_2^T from the rest of the world at $t = 2$, so that the market clearing condition is:

$$\int_j \left(c_{2,j}^T - y_{2,j}^T \right) + D_2 - \delta P_2^T = Y_2^T \tag{E.2}$$

From the perspective of a single EME, the optimal policy problem is entirely unchanged: an atomistic country does not take into account the effect of its domestic policies on the world price of tradable goods. The only difference from the proof in Appendix A is that we cannot normalize the price to 1 anymore, so the expenditure switching condition is now:

$$c_2^N = \left(\frac{\phi}{1-\phi} \frac{p_2^N}{p_2^T} \right)^{-1} c_2^T = \left(\frac{\phi}{1-\phi} \frac{1}{e_2 P_2^T} \right)^{-1} c_2^T \tag{E.3}$$

and net capital flows are:

$$\frac{1}{1+i_2^*} a_{3,j}^* - b_1^* = P_2^T \left(c_2^T - y_2^T \right) \tag{E.4}$$

E.1 Optimal Policy

The maximization program of the central bank is thus:

$$\max_{l_2, c_2^T, e_2} \frac{1}{1-\rho} \left[(c_2^T)^\phi \left(l_2 + \eta_2 K_1 - s\kappa \frac{\eta_2 K_1 - b_1 - e_2 b_1^*}{s - r_0} \right)^{1-\phi} \right]^{1-\rho}$$

$$+\beta\left(\bar{l}+r_1\kappa\frac{\eta_2 K_1-b_1-e_2 b_1^*}{s-r_0}\right)$$
$$+\beta\left(y_3^T+(1+i_2^*)\left(P_2^T\left(c_2^T-y_2^T\right)-b_1^*\right)\right) \quad \text{(E.5)}$$

with the constraints:

$$l_2 \leq \bar{l} \quad \text{(E.6)}$$

$$e_2 P_2^T c_2^T = \frac{\phi}{1-\phi}\left(l_2+\eta_2 K_1 - s\kappa\frac{\eta_2 K_1-b_1-e_2 b_1^*}{s-r_0}-\frac{b_1}{\bar{w}}\right) \quad \text{(E.7)}$$

$$\beta\frac{1+i_2^*}{e_2 P_2^T} = (1-\phi)\left(l_2+\eta_2 K_1 - s\kappa\frac{\eta_2 K_1-b_1-e_2 b_1^*}{s-r_0}-\frac{b_1}{\bar{w}}\right)^{(1-\phi)(1-\rho)-1}(c_2^T)^{\phi(1-\rho)} \quad \text{(E.8)}$$

Solving this through the exact same algebraic steps of Appendix A.2 yields the optimal policy solution:

$$(1+i_2)P_2^T c_2^T = \frac{\phi}{1-\phi}\frac{1+2(1-\phi)(\rho-1)}{1+(1-\phi)(\rho-1)}r_1\kappa\frac{b_1^*}{s-r_0} \quad \text{(E.9)}$$

E.2 Spillovers

There is now a new source of spillovers across EMEs: the change in the demand for tradable goods impacts the equilibrium price of tradables. To see this, invert the market clearing condition (E.2):

$$P_2^T = \frac{c_2^T - y_2^T + D_2 - Y_2^T}{\delta} \quad \text{(E.10)}$$

so that capital flows, in equilibrium, are:

$$\frac{1}{1+i_2^*}a_{3,j}^* - b_1^* = \frac{c_2^T - y_2^T + D_2 - Y_2^T}{\delta}\left(c_2^T - y_2^T\right) \quad \text{(E.11)}$$

The change in the equilibrium price (in dollars) of the tradable good is:

$$dP_2^T = \frac{1}{\delta}dc_2^T \quad \text{(E.12)}$$

Using the expenditure switching relation, as well as the aggregate demand condition:

$$d \ln c_2^T = \frac{(\rho - 1)(1 - \phi)}{\rho} d \ln(1 + i_2) - \left(1 + \frac{(\rho - 1)\phi}{\rho}\right) d \ln P_2^T \tag{E.13}$$

which gives:

$$d \ln c_2^T = \frac{(\rho - 1)(1 - \phi)}{\rho} d \ln(1 + i_2) - \left(1 + \frac{(\rho - 1)\phi}{\rho}\right) \frac{1}{\delta} d \ln c_2^T \frac{c_2^T}{P_2^T} \tag{E.14}$$

and putting the consumption parts together:

$$d \ln c_2^T \left(1 + \left(1 + \frac{(\rho - 1)\phi}{\rho}\right) \frac{c_2^T}{\delta P_2^T}\right) = \frac{(\rho - 1)(1 - \phi)}{\rho} d \ln(1 + i_2) \tag{E.15}$$

For the interest rate i_2^*, what matters is total spending on tradable goods (capital flows), which we get through:

$$d \ln(P_2^T c_2^T) = d \ln P_2^T + d \ln c_2^T \tag{E.16}$$

$$= \frac{1}{\delta} d c_2^T + d \ln c_2^T \tag{E.17}$$

$$= \frac{1}{\delta} \frac{c_2^T}{P_2^T} d \ln c_2^T + d \ln c_2^T \tag{E.18}$$

$$= \left(1 + \frac{1}{\delta} \frac{c_2^T}{P_2^T}\right) \frac{\frac{(\rho-1)(1-\phi)}{\rho}}{1 + \left(1 + \frac{(\rho-1)\phi}{\rho}\right) \frac{c_2^T}{\delta P_2^T}} d \ln(1 + i_2) \tag{E.19}$$

$$= \frac{1 + \frac{1}{\delta} \frac{c_2^T}{P_2^T}}{1 + \left(1 + \frac{(\rho-1)\phi}{\rho}\right) \frac{c_2^T}{\delta P_2^T}} \frac{(\rho - 1)(1 - \phi)}{\rho} d \ln(1 + i_2) \tag{E.20}$$

Since $\rho \geq 1$, the first fraction is smaller than 1, meaning that total spending on tradable goods is *lower* after a coordinated interest rate shock, than in the case with a fixed tradable good price. This is simply because of the price effect: by raising tradable demand, the tradable price also increases, which makes it less attractive to consume, reversing some of the expenditure switching induced by increasing the domestic interest rate. As a result, spillovers on i_2^* are also reduced, since:

$$di_2^* = \Gamma d(P_2^T c_2^T) \tag{E.21}$$

hence by the same dampening coefficient:

$$\frac{1 + \frac{1}{\delta}\frac{c_2^T}{P_2^T}}{1 + \left(1 + \frac{(\rho-1)\phi}{\rho}\right)\frac{c_2^T}{\delta P_2^T}} \tag{E.22}$$

Notice that when $\delta \to +\infty$, this dampening coefficient goes to 1: this is the case where the price of the tradable good is fixed. The other extreme scenario is when δ approaches 0, which corresponds to a world where the equilibrium price of the tradable good is extremely sensitive to changes in demand from the group of EMEs considered. When that is the case, the dampening coefficient becomes in the limit:

$$\frac{1 + \frac{1}{\delta}\frac{c_2^T}{P_2^T}}{1 + \left(1 + \frac{(\rho-1)\phi}{\rho}\right)\frac{c_2^T}{\delta P_2^T}} \xrightarrow[\delta \to 0]{} \left(1 + \frac{(\rho-1)\phi}{\rho}\right)^{-1} \in \left(\frac{1}{1+\phi}, 1\right) \tag{E.23}$$

The intuition for this dampening is as follows. The source of the spillovers in the main framework is the rebalancing of demand away from non-tradable goods: by raising interest rates, central banks in EMEs are seeking to increase their demand for tradable goods in order to attract capital flows and appreciate their currency. When all central banks in EMEs act in this way, this create pressure on the global market for tradable goods, raising its equilibrium price. This price effect naturally rebalances demand away from tradable goods, lowering the total amount spent. But the total amount spent is exactly what matters for the spillovers through the global intermediary. As a result, tradable price inflation dampens these spillovers by reducing capital flows.[42]

[42] One way to see this result is to recall that the exchange rate is coming from the UIP condition: $e_2 = (1 + i_2^*)/(1 + i_2)$. With tradable price inflation, an increase in i_2 generates less increase in i_2^*, so that central banks can hike relatively less to appreciate their currency.

F Cyclicality and the Short Rate Disconnect

The basic building block of the main framework presented in Section 2 is the presence of dollar debt, which induces monetary policy synchronization in emerging markets. This last fact has been recently questioned by De Leo et al. (2024a), who empirically show that emerging market central banks lower their policy rate in response to a US tightening. This section shows that this result is actually not needed to generate my spillover results: what matters ultimately is that emerging markets implement policy rates that are *higher than what would generate full employment*.

Setup To qualitatively match the findings of De Leo et al. (2024a), I assume that a US tightening is also causing a negative aggregate demand shock in emerging markets. The most parsimonious way to achieve this is to consider a negative shock through a trade channel: the price of tradable goods increases following an increase in $i_2^{\$}$ (Ozhan 2020 ; Camara, Christiano and Dalgic 2024). We can then use the extension in Appendix E, where the price of tradable goods is endogenous, and where the optimal interest rate was shown to verify:

$$(1+i_2)P_2^T c_2^T = \frac{\phi}{1-\phi}\frac{1+2(1-\phi)(\rho-1)}{1+(1-\phi)(\rho-1)} r_1 \kappa \frac{b_1^*}{s-r_0} \tag{F.24}$$

which is similar to the result in Proposition 1 in the main framework, but incorporating P_2^T (the price of tradable goods in dollars). We also showed in Appendix A.2 that $(1+i_2)c_2^T$ is an increasing function of i_2, which directly implies that, all else being equal, the optimal interest rate i_2 (from the point of view of SOE) is strictly *decreasing* in P_2^T. This means that if the shock to P_2^T caused by the increase in $i_2^{\$}$ is large enough, the optimal policy followed by emerging economies is to ease their policy rate, consistent with the results of De Leo et al. (2024a).

Inefficient GFC The identified spillovers of Proposition 4, however, are still present. This is because, even though emerging markets lower their policy rate in response to the Fed, they still implement an interest rate higher than what guarantees full employment because of balance sheet effects: the trade-off between aggregate demand and the exchange rate is still there. As such, the bottleneck externality is the same as in the main framework: engineering a coordinated easing across emerging markets would result in more appreciated currencies, easing the trade-off for individual central banks:

$$\frac{d\ln(1+i_2^*)}{d\ln(1+i_2)} = \Gamma(\rho-1)\frac{c_2^T}{1+i_2^*}\frac{1-\phi}{\rho} > 0 \tag{F.25}$$

Short rate disconnect De Leo et al. (2024a) also document that, while policy rates tend to decrease in response to a US tightening, *market rates* tend to increase. Interestingly, this can also be rationalized in the framework of Appendix D. Conceptually, a US tightening is then accompanied by (i) an increase in P_2^T, and (ii) an increase in Γ reflecting the dollar shock on global intermediaries. While the first effect causes a lower i_2, the second effect causes an increase in i_2^* (which here is the market rate: the interest rate at which the banks in emerging markets can finance themselves) when EMEs are on aggregate net borrowers (see Appendix D for details).