Global Financial Cycle and Liquidity Management*

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Abstract

Emerging market (EM) economies deploy policies to manage capital flows even though they experience less volatile gross capital inflows than advanced economies. We present a model that accounts for this aspect by showing that in countries with higher financial development, gross capital inflows are more volatile, but they are smoothed to a large extent by offsetting private capital outflows. Therefore, there is less need for government involvement for example through foreign exchange intervention. The model also predicts that higher financial development leads to lower interest rate spreads between foreign liabilities and assets, a prediction consistent with the data. Finally, the model provides novel normative implications for capital flow management. Private agents under-invest in liquidity because they do not internalize the impact on domestic interest rates. Contrary to conventional wisdom, a social planner would thus increase the size and volatility of gross capital flows.

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1 Introduction

Emerging market (EM) economies are subject to fluctuations in their access to foreign funds as a result of the global financial cycle. To smooth the domestic impact of these shocks, they rely on several capital flow management policies, such as countercyclical capital controls or foreign exchange interventions.[1]

One paradox is that advanced economies do not use such policies (or to a much lesser extent) even though they are subject to *more* capital flow volatility than EMs. This is illustrated by Figure 1. The upper-left panel shows that the standard deviation of gross capital inflows in terms of GDP is significantly higher for advanced economies than for EMs.[2] However, EMs use capital flow management policies to a much greater extent, as shown by the two lower panels using capital controls data from Fernández et al. (2016). Despite greater reliance on policy intervention, EMs experience a larger volatility in the current account (upper-right panel). As a matter of accounting, this must be because gross capital inflows are more correlated with gross capital outflows in advanced economies than in EMs.

This paper proposes a model that accounts for these facts, provides additional predictions consistent with empirical evidence, and lead to novel normative implications for capital flow management.

We present a simple three-period model of an EM economy with a large number of private agents who borrow from foreign investors in the first period to finance an illiquid domestic investment and to accumulate liquid foreign assets. There is a risk of an external financial tightening in the second period. External tightening means that foreign investors wish to withdraw their funds because they highly value liquidity, leading to a fire sale of EM debt. When external financial conditions tighten EM agents as well as foreign arbitrageurs use their liquidity to buy home debt. External financial tightening thus leads to a "retrenchment" (as defined by Forbes and Warnock (2012)) in which EM agents repatriated foreign funds at the same time as foreigners sell EM assets. In a decentralized equilibrium, EM agents hold a level of liquidity such that the expected benefit from buying back domestic debt at the fire-sale price is exactly offset by the opportunity cost of carrying the liquidity.[3]

[1]Rey (2015), the IMF (2012), Ostry et al. (2011) and Jeanne, Subramanian and Williamson (2012) have advocated the use of such policies.

[2]The country groups are listed in Appendix B.

[3]The opportunity cost of reserves is measured as the spread between the interest rate

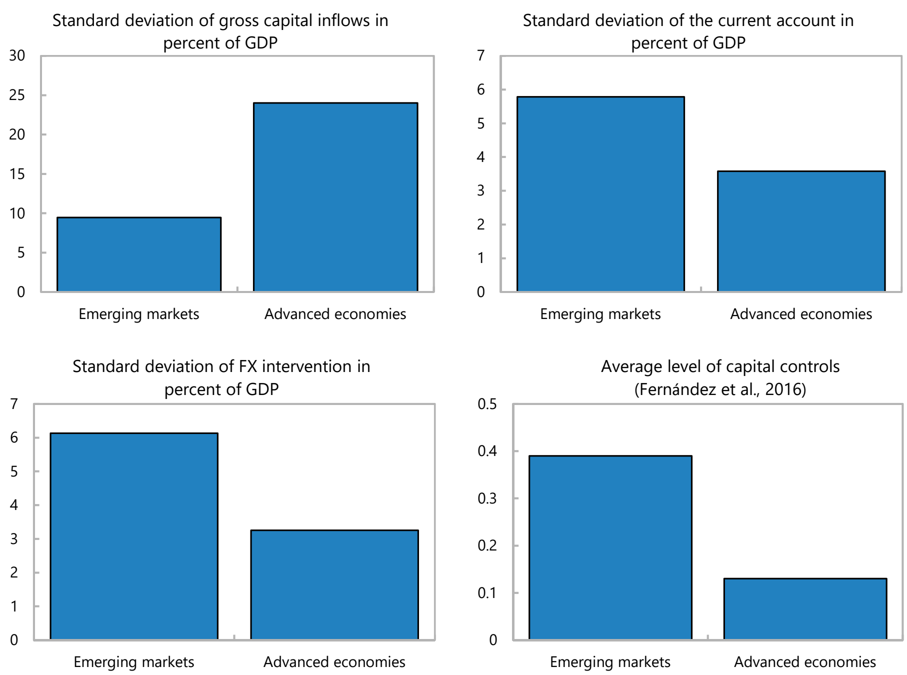


Figure 1: Capital flows and capital flow management in emerging markets and advanced economies

The model highlights the importance of domestic financial development, defined as a country's ability to produce financial assets and sell them to foreign investors. More financially developed countries channel a larger share of gross capital inflows into external liquidity rather than towards domestic physical investment. This might look like a diversion of capital flows away from their most productive use but the country's large external balance sheet in fact helps it to finance more investment at home. External liquidity reduces the country's cost of external borrowing and stimulates domestic productive investment. In countries with a low level of financial development, the government can partially substitute itself to the private accumulation of reserves using foreign exchange intervention. As financial development increases, the government increasingly lets the private sector insure itself. This explains why the government is more involved in capital flow management in EMs than in advanced economies even though EMs have less volatile gross capital inflows.

We then use the model to derive normative implications about optimal capital flow management. The scope for public intervention comes from a pecuniary externality: private agents do not internalize the impact of their decisions on the price of domestic debt. Increasing liquidity raises the price of EM debt, both ex ante and in a fire sale. This reduces the carry cost of liquidity but also the associated benefits. We show that on balance, the level of liquidity is always too low under laissez-faire. A constrained social planner finds it optimal to increase foreign borrowing so as to accumulate more foreign liquidity. Paradoxically, although welfare of an EM economy is reduced by the uncertainty in external financial conditions, welfare is maximized by maximizing the size of the country's external balance sheet, and the volatility of gross capital flows. This is contrary to conventional wisdom which generally prescribes to restrict capital flows to buttress resilience to global financial shocks. The social planner also reduces physical investment below the laissez-faire level so as to exploit the country's monopsonist power in issuing its own debt. We show that the social planner allocation can be implemented by using two policy instruments: a tax on gross capital inflows and a (larger) subsidy on foreign liquidity.

We then take a closer look at the data in light of the model. We define a country's international borrowing spread as the difference between the return

on external debt and the return on liquid reserves, as in Rodrik (2006). See Adler and Mano (2016) for a recent review of how to measure the opportunity cost of reserves.

that it pays on its external liabilities and the return that it earns on its external assets (the opposite of the "exorbitant privilege" studied by Gourinchas and Rey). The model makes three empirical predictions: 1) gross capital inflows are positively correlated with gross capital outflows and with the borrowing spread over time; 2) the borrowing spread is negatively correlated with the size of external liabilities across countries; and 3) the use of foreign exchange interventions is negatively correlated with the size of foreign liabilities across countries. We find the three predictions to be consistent with the data in a sample of EM countries.

Relationship to the literature. As noted in the introduction, most of the theoretical literature on capital flow management has focused on controls on capital inflows—see for example Ostry et al. (2012), Korinek (2011). The rationale for policy intervention generally arises from pecuniary externalities associated with collateral constraints, as analyzed for example in Jeanne and Korinek (2010), Bianchi (2011), Benigno et al. (2016), Schmitt-Grohé and Uribe (2017), and Korinek (2018)In these models there is no meaningful separate role for the management of inflows and outflows (in particular reserves). What matters in a crisis is the net worth of indebted agents and it is irrelevant if net worth is increased by lowering external debt or increasing external assets. These papers have shown that controls on capital inflows should be used to reduce external over-borrowing. By contrast we show here that under certain conditions, capital flow management should increase gross capital flows. The pecuniary externalities at work in our model are distributive externalities in the sense of **?**.

In a more closely related contribution, Caballero and Simsek (2016) present a model of gross capital flows in which capital flow surges and retrenchments are generated by fickle global investors. Our analysis share several features with theirs, in particular the association of capital flow retrenchments with fire sales. There are also several differences that turn out to be significant for the results: in our model capital flows involve short-term and long-term debt rather than real assets, and there is one representative agent per economy. This leads to normative implications that are sometimes the opposite of those in Caballero and Simsek (2016). Other differences are that we focus on the case where capital flows between emerging markets and advanced economy investors (rather than between similar countries) and analyze the role for reserves interventions by the government. Another paper analyzing the optimal management of gross capital flows is Aizenman (2011). In their model reserves are used to prevent contagion in the liquidation of domestic projects. The optimal policy involves both a tax on external borrowing and a subsidy on the accumulation of private reserves.

The paper is also related to a theoretical literature on the optimal level of reserves for an economy with fluctuating access to foreign financial flows. Jeanne and Rancière (2011) present a model of the optimal level of reserves to deal with the risk of rollover risk in external debt. Reserves are modeled as an insurance contract that pays off conditional on the realization of a sudden stop, like in Caballero and Panageas (2008). Bianchi, Hatchondo and Martinez (2013) analyze a similar problem when reserves take the form of a noncontingent asset and can be financed by sovereign defaultable debt. Gourinchas, Rey and Govillot (2017) present a model in which EMs holds low-yielding US assets because these assets yield a higher return in bad times. In these models there is no meaningful difference between reserves held by the government or by the private sector. Similar to our paper, Céspedes, Chang and Velasco (2017) and Céspedes and Chang (2019) analyze models in which official reserves are needed because the private sector does not internalize the beneficial effects of liquidity in periods of financial distress.

On the empirical side, our paper is related to the literature that studies the behavior of gross capital flows in the global financial cycle. Forbes and Warnock (2012) and Broner et al. (2013) have documented how gross capital inflows and outflows tend to move together. Broner et al. (2013) document that gross capital flows are very large and volatile, especially relative to net capital flows. During crises, total gross flows collapse and there is a retrenchment in both inflows by foreigners and outflows by domestic agents. Davis and van Wincoop (2017) document that the correlation between capital inflows and outflows has increased substantially over time in advanced and developing countries. IMF (2013) shows that buffering foreign capital flows with offsetting resident flows has been a key contributor to EM economies being more resilient to fluctuations in foreign capital inflows after the global financial crisis.

A line of empirical literature has pointed to the stabilizing benefits of reserves. Bussière et al. (2015) show that countries with high reserves relative to short-term debt suffered less from the global financial crisis, particularly when associated with a less open capital account. Ghosh, Ostry and Qureshi (2016) find that countries with higher stocks of foreign exchange reserves are significantly less likely to experience a crisis following surges in capital inflows. Aizenman, Cheung and Ito (2015) find that emerging market economies with lower reserve holdings in 2012 tended to experience exchange rate depreciation against the U.S. dollar when many emerging markets were adjusting to the news of tapering quantitative easing in 2013. Blanchard, Adler and de Carvalho Filho (2015) show that countercyclical reserve interventions have stemmed exchange rate pressures from global capital flow shocks in emerging market economies.

The paper is structured as follows. The next section presents the model assumptions and section 3 characterizes the laissez-faire equilibrium. Section 4 looks at the impact of domestic financial development on capital flows and the conditions under which foreign exchange intervention is warranted. Section 5 analyzes the problem of a social planner. Section 6 presents our empirical results and section 7 concludes.

2 Model

We consider a small open (emerging market or EM) economy over three periods $t = 0, 1, 2$. The economy is populated by identical agents who borrow from foreign investors in period 0 to finance domestic investment projects as well as foreign liquid assets (reserves). The domestic projects are illiquid in the sense that they pay off in period 2 and cannot be sold in period 1. There is no domestic financial intermediation and no domestic government for now.

We assume that EM debt is purchased by foreign investors who can also invest in cash. We capture the global financial cycle by assuming that foreign investors' valuation of liquidity varies over time. The price of EM debt falls when foreign investors value liquidity highly in period 1. The EM debt can be then purchased by the EM agents and by foreign arbitrageurs. Figure 2 reports the timeline and the main assumptions, which we describe in more details below.

EM borrowers. The EM country is populated by a continuum of mass one of identical borrowers. In period 0 the borrowers issue long-term debt (to be repaid in period 2) to finance an investment in capital. The budget constraints of the representative EM borrower are,

$$
\begin{aligned}
a_0 + k &= p_0 b_0 + e, && (1)\\
a_1 + p_1 b_1 &= a_0 + p_1 b_0 && (2)\\
b_1 + c_2^{EM} &= f(k) + a_1. && (3)
\end{aligned}
$$

In period 0 the representative EM agent finances an illiquid domestic investment k as well as liquid foreign assets a_0 with domestic equity e and by issuing long-term bonds b_0. The payoff of the investment is an increasing and concave function of k and occurs in period 2, when the EM agent consumes. External debt has the same maturity as the illiquid investment (it is repaid in period 2).

The foreign assets are invested in global liquidity (or "cash"), which is modeled as a zero-return storage technology. One may think of a as the reserves of the private sector (the case of public reserves will be considered in section 4). The representative EM borrower adjusts his balance sheet to external financial conditions by buying back a quantity of bonds $b_0 - b_1$ at price p_1 in period 1, after which he is left with a quantity of reserves a_1. Debt is default-free but its price responds to shocks in foreign investors' valuation of liquidity. Assets and liabilities are assumed to be non-negative ($b_t, a_t \geq 0$ for $t = 0, 1$).

The welfare of the EM residents is equal to their expected period-2 consumption,

$$U_0^{EM} = E_0 \left(c_2^{EM} \right). \tag{4}$$

Foreign investors. The EM agents borrow from foreign investors in period 0. The foreign investors are endowed with a certain amount of wealth that they can invest in EM debt or in cash. We assume that their endowment is large enough that they invest part of it in cash in period 0.

The preferences of foreign investors are given by

$$U_0^{FI} = E_0 \left[\beta_1 \left(c_1^{FI} + \beta_2 c_2^{FI} \right) \right], \tag{5}$$

where β_1 and β_2 are stochastic viewed from period 0 and both are revealed in period 1.[4]

The discount factors β_1 and β_2 reflect the foreign investors' valuation of liquidity. External financial conditions are tighter in period 1 if foreign investors value liquidity more in period 1 and less in period 2, i.e., when β_1 is higher and β_2 is lower. These stochastic preferences are a simple way of obtaining a risk premium on EM debt in our model and can be interpreted literally in terms of investors' patience, like in the Diamond-Dybvig model.

[4]The fact that β_2 is revealed in period 1 is without restriction of generality. If there is residual uncertainty in period 1 the baseline analysis applies subject to replacing β_2 by $E_1 \beta_2$.

Alternatively, the preference shocks can be viewed as a reduced-form representation of a model where foreign investors are affected by financial frictions. As shown in appendix A, the baseline model is isomorphous to a model where foreign investors have the same preferences as EM borrowers but have access to an alternative investment between periods 1 and 2. Tighter financial conditions, in that model, are states in which the return on the alternative investment is higher than on cash.[5] We assume stochastic preferences in the baseline model as this simplifies the presentation and clarifies the nature of the essential financial friction is in our framework, which is market incompleteness.

The other class of foreign investors is the period-1 arbitrageurs. There is a unitary mass of identical foreign arbitrageurs endowed with a limited amount of funds ϕ in period 1, which they can use to buy EM debt or invest in cash. The arbitrageurs are inactive in period 0. The arbitrageurs have the same utility as the EM agents,

$$U_0^{FA} = E_0\left(c_2^{FA}\right), \tag{6}$$

where

$$c_2^{FA} = \phi \max\left(1, \frac{1}{p_1}\right) \tag{7}$$

is the arbitrageurs' period-2 consumption. The arbitrageurs invest their endowment in EM debt if $p_1 < 1$ and in cash if $p_1 > 1$. For the sake of brevity we will call the period-0 lenders and period-1 arbitrageurs simply "investors" and "arbitrageurs" in the following.

Risk structure. In order to derive closed-form solutions, we assume that the economy can be in two states in period 1, as described in Table 1. The external financial conditions are either normal or tight. If they are normal, $\beta_1 = \beta_2 = 1$ so that foreign investors are willing to hold EM debt at price $p_1 = 1$. If external financial conditions are tight, foreign investors value period-1 liquidity more, and period-2 liquidity less, than in normal times. The ex-ante probability of the tight state is denoted by π.

Table 1. Risk structure.

External financial conditions	β_1	β_2
Normal (prob. $1-\pi$)	1	1
Tight (prob. π)	$\beta_H > 1$	$\beta_L < 1$

[5] Another assumption is that some foreign investors exit the investment industry in period 1. The details can be found in the appendix.

First best. We characterize the first best as a benchmark for the rest of the analysis. In the first best there are complete markets allowing EM residents to make payment contingent on the state of external financial conditions. Let us denote by b_N and b_T the period-2 repayments conditional on the external financial conditions being normal (state N) or tight (state T). Given their preferences, the foreign investors are ready to buy those claims at prices $p_N = 1 - \pi$ and $p_T = \pi\beta_L$ respectively. Leaving aside their investment in reserves, the representative EM resident solves the problem

$$\max_{k,b_N,b_T} f\left(k\right) - \left(1-\pi\right) b_N - \pi b_T,$$

subject to the budget constraint $k = e + \left(1-\pi\right) b_N + \pi\beta_L b_T$ and the non-negativity constraints $b_N \geq 0$, $b_T \geq 0$. The solution is that EM residents do not repay when external financial conditions are tight ($b_T = 0$), and the first-best level of investment satisfies

$$f'\left(k^{FB}\right) = 1.$$

With complete contracts EM borrowers can insure themselves against fluctuations in external financial conditions.

3 Laissez-faire

We now solve for the laissez-faire equilibrium in which: (i) the EM borrowers set the levels of k, a_t, b_t ($t = 0, 1$) so as to maximize their utility (4) subject to the budget constraints (1)-(3) and taking the prices p_0 and p_1 as given; and (ii) the prices p_0 and p_1 clear the market for EM debt in periods 0 and 1. The equilibrium is contingent on the state of external financial conditions (normal or tight) from period 1 onwards. We derive the laissez-faire equilibrium by proceeding backwards, starting with period 1.

Period-1 equilibrium. We solve for the period-1 price of debt, p_1, taking the balance sheet of EM borrowers, a_0 and b_0, as given. Let us denote by q the "fire-sale" price of EM debt, i.e., the equilibrium price when the foreign investors sell all their debt holdings b_0 to the arbitrageurs and the EM agents. There are two possible cases. If $q < 1$, EM agents and arbitrageurs spend all their liquid wealth $a_0 + \phi$ to buy back the debt so that its price is equal to $\left(a_0 + \phi\right)/b_0$. If $a_0 + \phi \geq b_0$, there is enough liquidity in the market

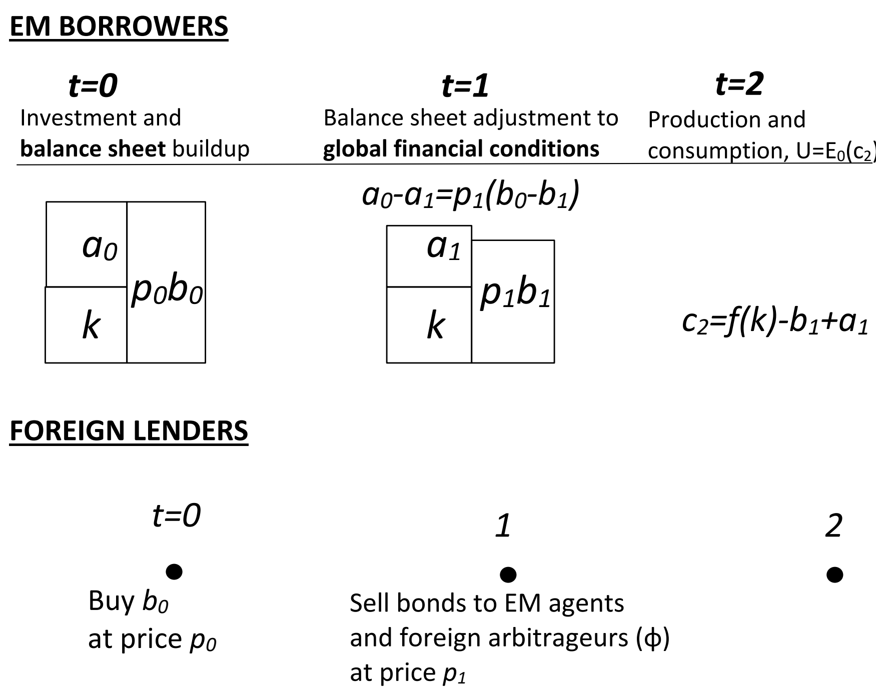


Figure 2: Model timeline

to set the debt price equal to 1. Putting the two cases together, the fire-sale price of EM debt is given by,

$$q = \min\left(1, \frac{a_0 + \phi}{b_0}\right). \tag{8}$$

The equilibrium period-1 price of debt, p_1, depends on how the fire-sale price, q, compares with foreign investors' intrinsic valuation of debt, β_2. If $q > \beta_2$ the foreign investors sell all their EM debt holdings in period 1 and the price of debt is at the fire-sale level, $p_1 = q$. If $\beta_2 > q$ the foreign investors keep some EM debt in their portfolios so that its price must be equal to β_2. It follows that the period-1 price of debt is equal to either the foreign investors' valuation or the fire-sale price, whichever price is higher

$$p_1 = \max(q, \beta_2). \tag{9}$$

Equations (8) and (9) and $\beta_L \leq 1$ imply that the period-1 price of debt cannot be larger than 1, and that it is equal to 1 if external financial conditions are normal, $p_1^N = 1$. From now on we assume that β_L is lower than the equilibrium level of q so that $p_1^T = q$. A condition ensuring that this is true will be derived later.

Period-0 demand for EM debt. In period 0 the foreign investors can invest in cash, which yields expected utility $E_0\beta_1$ per dollar invested, or in long-term bonds, which yields $E_0(\beta_1 p_0)/p_0$. The period-0 equilibrium price of debt, thus, is given by

$$p_0 = \frac{E_0(\beta_1 p_1)}{E_0(\beta_1)}. \tag{10}$$

In period 0 foreign investors value period-1 payments with the stochastic discount factor $\beta_1/E_0(\beta_1)$. There is a pure risk premium in the period-0 price of EM debt if p_1 is negatively correlated with β_1, that is if the price of EM debt falls when external financial conditions are tight.

With the two-state specification given in Table 1, using $p_1^N = 1$ and $p_1^T = q$, the period-0 price of debt is given by

$$p_0 = \frac{1 - \pi + \pi\beta_H q}{1 - \pi + \pi\beta_H}. \tag{11}$$

Solving for b_0 in equations (1), (8) and (11) it is possible to express the period-0 price of EM debt in terms of physical investment k and the investment in reserves a_0. The following lemma describes how p_0 varies with k and a_0.

Lemma 1 *Denote by $p(k, a_0)$ the period-0 price at which foreign investors are ready to buy EM debt if the representative EM agent invests k in physical capital and a_0 in reserves. Then,*

(i) if $k \leq e + \phi$, $p(k, a_0) = 1$;

(ii) if $k > e + \phi$, $p(k, a_0) < 1$, and the price of EM debt is decreasing in physical investment and increasing in reserves,

$$\frac{\partial p}{\partial k} < 0, \ \frac{\partial p}{\partial a_0} > 0.$$

Proof. Using equation (8) and (11) to substitute out q and p_0 from the budget constraint (1) gives

$$(k + a_0 - e)(1 - \pi + \pi\beta_H) = (1 - \pi) b_0 + \pi\beta_H \min(b_0, a_0 + \phi).$$

If $b_0 \leq a_0 + \phi$ one has $p_0 = q = 1$ and this equation reduces to $k + a_0 = b_0 + e$. If $b_0 \geq a_0 + \phi$ simple manipulations of this equation give

$$b_0 = a_0 + \phi + \left(1 + \beta_H \frac{\pi}{1 - \pi}\right)(k - e - \phi).$$

Using this expression to substitute out b_0 from (8) gives

$$q = \left[1 + \left(1 + \beta_H \frac{\pi}{1 - \pi}\right) \frac{(k - e - \phi)}{a_0 + \phi}\right]^{-1}. \tag{12}$$

The condition $q \leq 1$ then is satisfied only if $k - e - \phi \geq 0$. Hence there are two cases. Either $k - e - \phi \leq 0$ and $q = 1$ or $k - e - \phi \geq 0$ and q is given by the equation above. These two cases are summarized by

$$q = \left[1 + \left(1 + \beta_H \frac{\pi}{1 - \pi}\right) \frac{(k - e - \phi)^+}{a_0 + \phi}\right]^{-1}, \tag{13}$$

using the conventional notation $x^+ = \max(x, 0)$. The function $p(k, a_0)$ is then obtained by plugging this expression for q into (11). The other properties immediately follow from that. ■

The important point in Lemma 1 is that the price that foreign investors are ready to pay for EM debt depends on the extent to which the debt finances illiquid physical investment or liquid reserves: p_0 decreases with b_0 if the debt finances illiquid physical investment but increases with b_0 if the debt finances reserves. Thus the foreign investors' demand for EM debt cannot be written as a function of its price only.

Point (i) of Lemma 1 comes from the fact that if $k \leq e + \phi$, the EM agent can finance k by issuing a quantity of debt that is lower than ϕ. This debt can then be bought at price $q = 1$ by the arbitrageurs in period 1. Thus, there is no risk in the price of debt, and its period-0 price is $p_0 = 1$. EM reserve accumulation, in this case, is indeterminate and does not have any impact on debt prices or welfare.

If $k > e + \phi$, the resources of the arbitrageurs are not sufficient to prevent a fall in the EM debt price if financial conditions are tight. In this case, the fire-sale price of debt decreases with k and increases with a_0. On one hand, higher investment k is financed by issuing more debt b_0, which depresses the fire-sale price of debt. On the other hand, issuing debt in order to accumulate reserves raises the fire-sale price of debt. To understand this result one can substitute out a_0 from (8) using (1), which gives

$$q = p_0 - \frac{k - e - \phi}{b_0}.$$

This expression shows that the fire-sale price of debt increases with the size of the external debt through a direct channel and an indirect channel. The fire-sale price of EM debt, q, is lower than p_0. Hence, selling debt at price p_0 in period 0 and accumulating the proceeds as reserves to buy back the debt in period 1 raises the fire-sale price of debt (direct channel). By raising the fire-sale price, reserves accumulation also increases the ex-ante price p_0 (indirect channel).

Period-0 reserves. Next, consider the problem of EM agents in period 0. The EM agents' welfare can be computed by assuming that they spend all their reserves to buy back EM debt in period 1.[6] Using $a_1 = 0$ and the budget constraints (1)-(3) to substitute out k and c_2^{EM} in (4), the representative

[6] If $p_1 < 1$ this is indeed what they do in equilibrium. If $p_1 = 1$ their purchase of EM debt is indeterminate but their welfare is the same as if they spent all their reserves on EM debt.

borrower's welfare can be written,

$$U_0^{EM} = f(k) - b_0 + a_0 E_0\left(\frac{1}{p_1}\right), \tag{14}$$

$$= f(k) - \frac{k-e}{p_0} + a_0\left[E_0\left(\frac{1}{p_1}\right) - \frac{1}{p_0}\right]. \tag{15}$$

The representative EM agent maximizes his welfare taking the prices p_0 and p_1 as given. The first-order condition for k equates the marginal cost of issuing bonds and the marginal return on capital,

$$f'(k) = \frac{1}{p_0}. \tag{16}$$

Note that because of Lemma 1, if $k^{FB} \leq e + \phi$ capital is at its first-best level under laissez-faire and the period-1 price of debt is not impacted by external financial conditions. We rule out this trivial case by assuming $k^{FB} > \phi + e$ or

$$f'(\phi + e) > 1. \tag{17}$$

The second term on the right-hand side of (15) is the benefit of holding reserves a_0 for the EM borrowers. This is the net benefit of issuing bonds at price p_0 in period 0 and investing the proceeds in cash to buy back EM debt at price p_1 in period 1. In an equilibrium where EM borrowers hold reserves (i.e., in which the constraint $a_0 \geq 0$ is not binding) the marginal net benefit of accumulating reserves must be equal to zero

$$E_0\left(\frac{1}{p_1}\right) - \frac{1}{p_0} = 0. \tag{18}$$

For the two-state specification given in Table 1, the marginal benefit of accumulating reserves is a function of the expected fire-sale price q. Using this fact it is possible to show the following result.

Lemma 2 *The fire-sale price of EM debt q is equal to or larger than $1/\beta_H$. The representative EM agent holds a strictly positive level of reserves if and only if $q = 1/\beta_H$.*

Proof. Using $p_1^N = 1$, $p_1^T = q$ and equation (11) the net benefit of accumulating reserves (the l.h.s. of (18)) can be written

$$1 - \pi + \frac{\pi}{q} - \frac{1 - \pi + \pi\beta_H}{1 - \pi + \pi\beta_H q} = \pi(1-\pi)\frac{1-q}{q}\frac{1-\beta_H q}{1-\pi+\pi\beta_H}. \tag{19}$$

If $q < 1/\beta_H$ the marginal benefit of borrowing to accumulate reserves is strictly positive. This is not possible in equilibrium since EM agents would borrow without limit. If $q > 1/\beta_H$ and $q < 1$ the marginal benefit of borrowing to accumulate reserves is strictly negative so that the constraint $a_0 \geq 0$ is binding. Hence $a_0 > 0$ is possible only if $q = 1/\beta_H$ or $q = 1$. The second case is ruled out by assumption (17). ■

Reserve accumulation establishes a floor of $1/\beta_H$ on the fire-sale price of EM debt. The intuition for this result is as follows. In the tight state foreign investors and EM agents receive period-1 payoffs of respectively β_H and $1/q$ per unit of reserves. Foreign investors price EM debt in such a way that they are indifferent between holding debt or cash. For EM agents to be indifferent about their level of reserves, they must receive the same payoff as foreign investors, $1/q = \beta_H$. If $1/q > \beta_H$, EM residents have incentives to accumulate an infinite amount of reserves and if $1/q < \beta_H$, EM agents hold zero reserves.

Period-0 equilibrium. Putting things together, the equilibrium level of capital and price of debt are determined as in Figure 3. The upward sloping curve corresponds to the EM demand for funds, equation (16). The downward sloping curve represents the foreign investors's supply of funds, $p_0 = p(k, a_0)$ taking into account the endogeneity of a_0 to the fire-sale price. For $k \leq e + \phi$, $p_0 = 1$ as stated in Lemma 2. When k exceeds $e + \phi$, the fire-sale price q falls below 1 but as long as it is larger than $1/\beta_H$, EM residents do not invest in reserves (by lemma 2) so that p_0 is equal to $p(k, 0)$. When the fire-sale price reaches $1/\beta_H$, EM residents start to accumulate reserves so that the fire-sale price remains equal to $1/\beta_H$, and p_0 is equal to $1/(1 - \pi + \pi\beta_H)$. In order to alleviate notations we introduce a new notation for the expected value of β_1

$$\beta^e \equiv 1 - \pi + \pi\beta_H.$$

Figure 3 shows an equilibrium (point A) where EM agents accumulate a positive level of reserves. The following Proposition characterizes such equilibria in general.

Proposition 3 *(Laissez-Faire) The EM agents hold a strictly positive level of reserves in the laissez-faire equilibrium if and only if $\beta_H\beta_L < 1$ and*

$$f'\left(e + \frac{\beta_H}{\beta^e}\phi\right) > \beta^e. \tag{20}$$

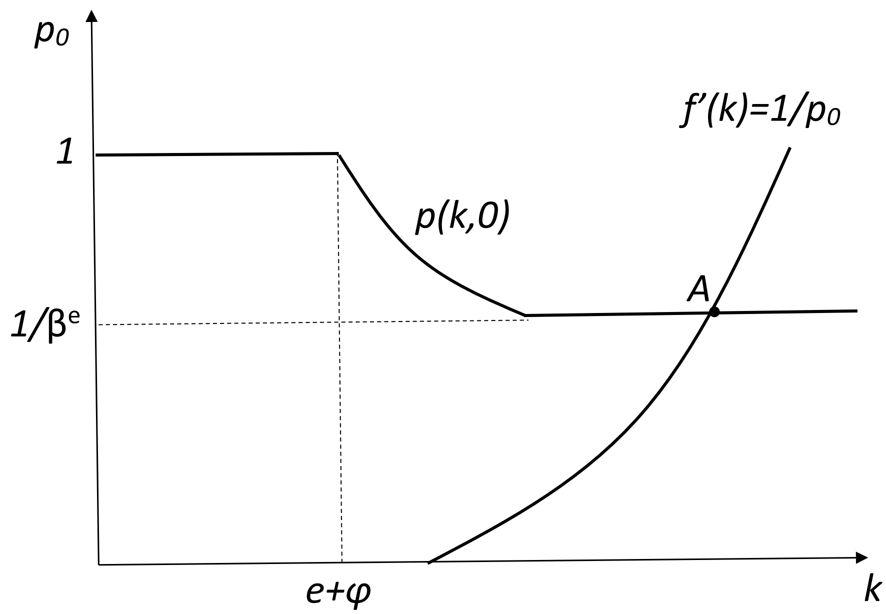


Figure 3: Equilibrium k and q

In this equilibrium the price of EM debt is equal to $p_0 = 1/\beta^e$ *in period* 0 *and falls to* $q = 1/\beta_H$ *in period* 1 *if financial conditions are tight. The period*-0 *level of physical investment is given by*

$$f'\left(k^{LF}\right) = \beta^e. \tag{21}$$

and the EM country's external balance sheet is given by

$$b_0^{LF} = \frac{\beta_H \beta^e \left(k^{LF} - e - \phi\right)}{(1-\pi)\left(\beta_H - 1\right)}, \tag{22}$$

$$a_0^{LF} = \frac{\beta^e \left(k^{LF} - e\right) - \beta_H \phi}{(1-\pi)\left(\beta_H - 1\right)}. \tag{23}$$

Proof. Assume that the constraint $a_0 \geq 0$ is not binding so that (18) applies. Then by Lemma 2 q is equal to $1/\beta_H$. The condition $\beta_H \beta_L < 1$ is necessary for $q > \beta_L$. By Lemma 2 there cannot be an equilibrium with $q = \beta_L$ and the condition $a_0 \geq 0$ is not binding. Then (9) and (10) imply the expression for p_0 given in the proposition. The expression for k^{LF} results from (16). The expressions in (22) and (23) result from the budget constraint $k^{LF} + a_0 = p_0^{LF} b_0 + e$ and $1/\beta_H = (a_0 + \phi)/b_0$ from equation (8). Condition (20) is necessary to ensure that the expression for a_0 given in (23) is consistent with the non-negativity constraint $a_0 \geq 0$. ■

The condition given in the proposition, equation (20), is stronger than (17) because it also ensures that the non-negativity constraint on reserves is not binding. If (17) is satisfied but (20) is not, the price of debt falls in period 1, but not by enough to induce the EM agents to accumulate reserves.

An implication of Proposition 3 is that the level of physical investment k^{LF} and the debt prices p_0 and p_1 do not depend on the endowments of the EM agents and arbitrageurs, e and ϕ. Thus, changes in e or ϕ lead to changes in the EM balance sheet such that the price of EM debt remains the same. For example, a lower level of equity e or arbitrageur resources ϕ induce EM residents to issue more debt and accumulate more reserves so as to keep the price of debt the same.

4 Financial development and capital flows

We assumed in the previous section that EM agents were unconstrained in the amount of debt that they can issue. We now relax this assumption and assume that domestic agents can issue a limited amount of debt because of a *domestic* financial friction. The question is how domestic financial development affects capital flows, reserves accumulation and the risk premium in the EM economy.

Domestic financial friction. We now assume that EM borrowers are subject to to the credit constraint,

$$p_0 b_0 \leq d, \tag{24}$$

where d is an exogenous parameter that reflects the country's level of financial development. There are several possible microfoundations for this friction. For example, assume the collateral constraint

$$p_0 b_0 \leq \gamma \left(a_0 + k\right), \tag{25}$$

where γ is a coefficient lower than one. This could be justified, for example, by the fact that creditors can recover only a fraction γ of the borrower's assets following a default. If this constraint were violated the borrower could make a take-or-leave offer to reduce her debt to $\gamma(a+k)$ in period 0, which creditors would accept. This implies that creditors do not lend more than $\gamma(a+k)$. The credit constraint (25) can then be rewritten as (24) with $d = \gamma e/(1-\gamma)$.

In this context, financial development is a change in the financial environment that allows EM borrowers to issue more debt, for example by increasing the share of assets that can be collateralized or otherwise strengthening creditor rights.

Impact of financial development on capital flows. We study how the country's external balance sheet, a_0 and b_0, investment k, and debt prices, p_0 and q, depend on the level of financial development. There are three stages of financial development to consider.

1. Low financial development. If d is low enough, the price of debt does not fall by enough when external financial conditions are tight to induce EM agents to accumulate reserves. The country issues too little debt to be much affected by external financial conditions. In this regime, the additional capital inflows allowed by financial development finance physical investment only ($k = e + d$).

   This is true if $d \leq \phi$, since in this case EM agents issue debt at price $p_0 = 1$ and reserves yield a zero return. When d exceeds ϕ, EM agents do not invest in reserves iff the marginal return on capital is larger than the marginal return on reserves, that is

   $$f'(e+d) \geq 1 - \pi + \frac{\pi}{q(e+d,0)}, \tag{26}$$

   where $q(k, a_0)$ is the fire-sale price of debt as a function of physical capital and reserves. The l.h.s. and r.h.s. of this equation are respectively decreasing and increasing in d. Hence the low financial development regime arises if $d \leq \widehat{d}$, where $\widehat{d}$ the level of financial development for which condition (26) is an equality.

2. Intermediate financial development. For $d \in [\widehat{d}, d^{LF}]$, the country invests a share of capital inflows in liquid foreign assets. Financial development in this case leads to the accumulation of both capital and foreign assets. The comparative statics with respect to financial development are stated in the following proposition.

Proposition 4 *EM borrowers hold a positive level of reserves and their external borrowing is constrained if and only if the level of domestic financial development is intermediate,* $d \in \left[\widehat{d}, d^{LF}\right]$*. In this case domestic financial development (an increase in d) raises real investment* k *and reserves* a_0 *as well as the price of EM debt,*

$$\frac{\partial k}{\partial d} > 0, \; \frac{\partial a_0}{\partial d} > 0 \; \textit{and} \; \frac{\partial p_0}{\partial d} > 0.$$

Proof. In equilibrium k and a_0 satisfy

$$k + a_0 = e + d$$

$$f'(k) = 1 - \pi + \frac{\pi}{q(k, a_0)}.$$

The first equation is the budget constraint (1) using the fact that (24) is binding. The second equation equates the marginal product of capital and the marginal benefit of reserves. These equations imply that k, a_0 and q are increasing in d. ■

Financial development leads to gross capital inflows that finance increments in both physical capital and foreign assets. Both capital and reserves increase at the margin because domestic agents equate the returns on both types of assets. The returns on reserves falls because the fire-sale price of EM debt increases, which reduces the ex-ante risk premium in EM debt.

3. High financial development. For $d > d^{LF}$, the constraint (24) is no longer binding so that further financial development does not affect capital flows.

Proposition 4 sheds some light on the facts reported in Figure 1. The fact that advanced economies have larger and more volatile capital flows than EMs could be explained, through the lens of the model, by their higher level of financial development. This financial volatility is not associated with real economic volatility if capital inflows and outflows are very correlated with each other. The fact that advanced economies have a less volatile current account balance than EMs is consistent with this interpretation.

The capital flow management policies used by EM governments could be interpreted as a substitute to the insurance that advanced economies obtain from private gross capital flows. We discuss below the case of foreign exchange interventions (capital controls are discussed in section 5).

Government reserves. To analyze the scope for foreign exchange intervention, we now introduce an EM government that can borrow and accumulate reserves. The government has no expenditure. The budget constraints of the government are

$$
\begin{aligned}
a_0^g &= p_0 b_0^g, && (27)\\
a_0^g + p_1 b_1^g &= p_1 b_0^g + a_1^g, && (28)\\
z_2 &= a_1^g - b_1^g, && (29)
\end{aligned}
$$

where z_2 is a lump-sum transfer to the private sector. We assume that the government sells all its reserves to buy back the country's debt if external financial conditions are tight in period 1. That is, $a_1^g = a_0^g$ and $z_2 < 0$ if external financial conditions are normal (the government imposes a tax $-z_2$ to pay for the carry cost of reserves) and $a_1^g = 0$ and $z_2 > 0$ if external financial conditions are tight (the government rebates the profit from its interventions). Not that when it intervenes the government buys back more debt that it has issued in period 0 ($b_1^g < 0$), that is the government buys back some debt issued by the private sector. The budget constraints (1)-(3) still apply to the households, with the transfer z_2 added.

We interpret these government balance sheet operations as a sterilized foreign exchange interventions by the central bank. When a central bank buys reserves and sells the same quantity of domestic government debt, it increases the total supply of debt by the consolidated government sector (treasury plus central bank) to the private sector and accumulates an equivalent quantity of reserves. This corresponds to an increase in b_0^g and a_0^g in our model.

We assume that the government has its own borrowing constraint in period 0,

$$p_0 b_0^g \leq d^g.$$

We assume separate borrowing constraints for the government and the private sector because these constraints are determined by different factors. The borrowing constraint of private borrowers is determined by private creditor rights and their enforcement. The borrowing constraint of the government is determined by its ability to raise taxes and by the cost of a government default. Thus the government might be able to expand the country's total borrowing limit.

Note that we have imposed constraints on what the government can do with its balance sheet. Most importantly, the government cannot make transfers to the private sector in period 0. If it could, the government might use its borrowing capacity to finance more investment in physical capital in period 0. It is easy to see (by consolidating the budget constraint of the government with that of the private sector) that the government could achieve the same allocations as in the laissez-faire equilibrium in which the private sector borrowing capacity is increased from d to $d + d^g$. That is, the effect of government balance sheet interventions would be equivalent to that of financial development. We do not allow the government to make transfers in period 0 because we focus on reserves interventions.

We then have the following result.

Proposition 5 *Government reserves interventions are welfare-increasing if and only if the level of domestic financial development is in an interval, $d \in [\widetilde{d}, d^{LF}]$, where $\widetilde{d} < \widehat{d}$. If the private sector holds reserves, a government accumulation of reserves partially crowds out private reserves, crowds in physical investment and raises the price of government debt,*

$$-1 < \frac{\partial a_0}{\partial a_0^g} < 0,\ \frac{\partial k}{\partial a_0^g} > 0,\ \frac{\partial p_0}{\partial a_0^g} > 0.$$

Proof. We look at the impact on EM welfare of a small government reserves intervention $\delta a_0^g > 0$. First, assume that the private sector does not accumulate reserves because $d < \widehat{d}$. Then $k = d$ and the welfare impact of the reserves interventions is the government's expected profit $\delta a_0^g \left(E_0 \left(1/p_1\right) - 1/p_0 \right)$. By Lemma 2 it is positive if and only if $q\left(d, 0\right) < 1/\beta_H$. Using equation (13) this means

$$d > \widetilde{d} \equiv \phi \left(1 + \frac{\left(1 - \pi\right) \beta_H}{\beta^e} \right).$$

Second, assume that the private sector is constrained but accumulates reserves ($\widehat{d} < d < d^{LF}$). Then a government reserves intervention is equivalent to a marginal increase in financial development, which increase total reserves, physical capital and the price of EM debt. Finally, if the private sector is unconstrained ($d > d^{LF}$) Ricardian equivalence applies. ■

The impact of government reserves interventions depends on the level of financial development. If financial development is low the country does not issue enough debt to be much affected by external financial conditions and there is no strict benefit from government interventions. If financial development is high, the economy is in a Ricardian regime where government reserves interventions have no impact.

The range of financial development levels for which government reserves interventions are appropriate is broader than the range for which the private sector holds reserves ($\widetilde{d} < \widehat{d}$). This is because the government cannot invest in physical capital. There are equilibria in which the the return on reserves is dominated by the return on capital but it is worthwhile for the government to invest in reserves.

Proposition 5 may explain why, as shown in Figure 1 government reserves interventions are more prevalent in EMs than in AEs even though they have less volatile gross capital flows than AEs.

5 Social planner

We now consider a social planner who sets a_0 and b_0 in period 0 subject to the same constraints as EM agents. The social planner is benevolent and maximizes the welfare of EM borrowers. The difference between the social planner allocation and the laissez-faire allocation is that the social planner takes into account that the price of EM debt is endogenous to country's aggregate liquid foreign assets. Whether the social planner wants to accumulate more or less reserves than private agents is not obvious a priori. Accumulating more reserves lowers the interest rate at which EM agents can borrow in period 0, but also increases the fire-sale price of debt and so reduces the gain from holding reserves.

Social planner allocations. Consider the period-0 welfare of EM borrowers and foreign arbitrageurs,

$$U_0^{EM} = f(k) - b_0 + a_0\left(1 - \pi + \frac{\pi}{q}\right), \tag{30}$$

$$U_0^{FA} = \phi\left(1 - \pi + \frac{\pi}{q}\right). \tag{31}$$

These expressions come from equations (6), (7), (14) and using the fact that p_1 is equal to 1 with probability $1 - \pi$ and to q with probability π.

Using (8) we have

$$U_0^{EM} + U_0^{FA} = f(k) - \beta^e (k - e - \phi).$$

The sum of the welfare of EM agents and foreign arbitrageurs is equal to the investment payoff minus the expected payoff that must be paid to foreign investors for providing the net funding gap $k - e - \phi$. Importantly, $U_0^{EM} + U_0^{FA}$ is constant given k, implying that for a given level of physical investment, changes in the EM balance sheet redistribute welfare between EM agents and foreign arbitrageurs.

Equation (31) shows that since the welfare of arbitrageurs decreases with the fire-sale price q, the EM social planner maximizes welfare by maximizing q given k. This implies that the social planner makes the constraint (24) binding. If $d < d^{LF}$ the country's external balance sheet is larger with the social planner than under laissez-faire.

The constrained efficient allocation is characterized in the following proposition.

Proposition 6 *(Social planner allocation) A constrained-efficient social planner maximizes foreign borrowing b_0 and sets a lower level of physical capital k, and a higher level of reserves a_0, than under laissez-faire*

$$\begin{aligned} p_0^{SP} b_0^{SP} &= d \geq p_0^{LF} b_0^{LF} \\ a_0^{SP} &> a_0^{LF} \\ k^{SP} &< k^{LF} \end{aligned}$$

Proof. The social planner solves

$$\max_{k,a_0} U_0^{EM} = f(k) - \beta^e (k - e - \phi) - \phi \left(1 - \pi + \frac{\pi}{q(k, a_0)}\right) + \lambda (d - k - a_0).$$

The first-order conditions are

$$\begin{aligned} f'(k) &= \beta^e + \lambda - \frac{\phi \pi}{q^2} \frac{\partial q}{\partial k}, \\ \lambda &= \frac{\phi \pi}{q^2} \frac{\partial q}{\partial a_0}. \end{aligned}$$

The second equation implies $\lambda > 0$. The first equation implies $f'(k) > \beta^e = f'\left(k^{LF}\right)$. ■

The social planner borrows at least as much as under laissez-faire and strictly more if $d > d^{LF}$. This result runs directly counter the idea that the problem with the global financial cycle is that it generates excessively large and volatile gross capital flows. The problem is the opposite: gross flows are not sufficiently large and volatile under laissez-faire. Gross flows plays a stabilizing role in our model because they stabilize the price of domestic liabilities and thus reduce the risk premium that the country has to pay.

The reason for public intervention in this model is not the kind of pecuniary externality at work in Jeanne and Korinek (2010), Bianchi (2011), Benigno et al. (2013) and others. The EM social planner exercises monopoly power to dilute and appropriate the rent that foreign arbitrageurs extract from the fire sale of EM debt. The EM social planner transfers this rent to her residents to the maximum extent allowed by domestic financial development.

Capital controls. For financially developed countries, policy instruments other than sterilized interventions are needed because Ricardian equivalence applies. One policy instrument could be liquidity regulation, such as a rule constraining the EM borrowers to hold a minimum fraction of their external debt in reserves. In practice, this type of regulation can be implemented if the borrowers are part of the regulated financial sector. The government could also use taxes or subsidies on capital flows.

We denote by τ_a and τ_b the tax rates on, respectively, foreign asset and foreign debt. The period-0 budget constraint of EM agents becomes

$$k + (1 + \tau_a)\, a_0 = (1 - \tau_b)\, p_0 b_0 + z, \tag{32}$$

where z is the lump-sum rebate of the taxes. We look for the tax rates that implement the social planner allocation.

Proposition 7 *(Optimal capital controls) The social planner allocation can be implemented with a subsidy on reserves accumulation combined with a tax on capital inflows (the tax rate on inflows being smaller than the subsidy rate on outflows),*

$$\tau^b > 0,\ \tau^a < -\tau^b.$$

Proof. The first-order conditions for the decentralized equilibrium with the taxes are

$$
\begin{aligned}
f'(k)\left(1-\tau^{b}\right)p_{0} &= 1, \\
\frac{1+\tau_{a}}{1-\tau_{b}}\frac{1}{p_{0}} &= E_{0}\left(\frac{1}{p_{1}}\right).
\end{aligned}
$$

The first equation, $k^{SP} < k^{LF}$ and $p_0^{SP} > p_0^{LF}$ imply $\tau^b > 0$. The second equation and $1/p_0^{SP} > E_0\left(1/p_1^{SP}\right)$ imply $\tau^a < -\tau^b$. $\blacksquare$

The subsidy on outflows and tax on inflows make private borrowers internalize that the price of debt p_0 increases with a_0 but decreases with b_0. The tax τ^b reduces investment and the net capital inflow. There is a net subsidy $-(\tau_a + \tau_b)$ on financing reserves with debt, which increases the size of the country's balance sheet. The social planner subsidizes the financing of reserves by debt but taxes the accumulation of physical capital by debt.

6 Data

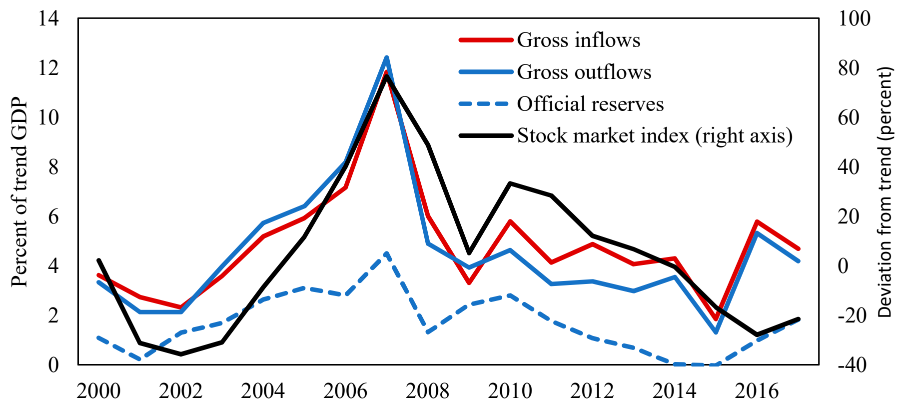
Figure 4 shows a few facts that are consistent with the model. EMs face very volatile gross capital inflows, especially at the time of the global financial crisis, with inflows increasing more than three folds in the years prior 2007 and then collapsing in 2008 and 2009. The volatility of gross inflows has been largely absorbed through offsetting capital outflows which capture the purchase of foreign assets by residents in EMs. In other words, when foreign investors increase their holdings of EMs' assets, EM residents accumulate foreign assets and viceversa. The public sector actively contributes to this stabilizing mechanism by increasing official reserves when gross inflows increase.

The chart also shows the evolution of the stock market total-return index in EMs.[7] We see that in the years prior to the global financial crisis, stock prices in EMs rose rapidly above trend exactly when foreign investors increased their holdings of EM assets while EM residents brought their money abroad. The opposite dynamic took place post 2007, when EM stock prices plunged while gross capital flows declined sharply. This suggests that EM residents seize a trading advantage by buffering the volatility of gross capital inflows with gross outflows: they sell EM assets when prices are high and

[7] This is computed in deviation from a log-linear trend, as reported on the right axis.

save the proceeds abroad; and then use foreign funds to buy back EM assets when prices decline.

Figure 4: Gross capital flows and stock market index, average across EMs



As we show in this section, these stylized facts were not observed only in the global financial crisis, they hold more generally in the global financial cycle. The purpose of this section is to provide suggestive evidence supporting the model (rather than testing the model against possible alternatives). We first describe the country sample and the data.

Data. Our baseline empirical analysis uses annual data and focuses on a core sample of EMs that belong to the MSCI Emerging Market Index and have at least 10 years of data. We use data from the IMF International Investment Position (IIP) and Balance of Payments (BOP) statistics from 1990 to 2017. IIP statistics include data on the stock of foreign assets and liabilities, while BOP data provide information on gross capital flows and the investment income from gross liabilities and assets.

We assess the robustness of our empirical findings along several dimensions. First, we consider a larger sample of EMs which includes all countries at an intermediate level of development.[8] Second, we replicate the analysis by considering only countries with complete data from 2005 onward. This ensures that our findings are not driven by the unbalanced nature of the dataset before 2005, since the time-series coverage varies significantly across

[8]This larger sample includes all countries with population above 2 million, except those considered as "Advanced Economies" by the IMF World Economic Outlook or as "Low Income" by the World Bank.

countries. Third, we check whether the results are robust to using quarterly data, including countries with at least 5 years of data. Quarterly data are generally available for a shorter time span, but for several countries they provide more data points given the higher frequency of observation.

The model makes predictions about the returns on foreign assets and liabilities. Using BOP and IIP data, we compute for each country and period t the rate of return on foreign assets r_t^A and liabilities r_t^L as follows:

$$\begin{aligned} r_t^A &= \left(A_t - O_t + Y_t^A\right)/A_{t-1} - 1 \\ r_t^L &= \left(L_t - I_t + Y_t^L\right)/L_{t-1} - 1 \end{aligned}$$

where A_t and L_t denote assets and liabilities, O_t and I_t are gross outflows and inflows, and Y_t^A and Y_t^L are the income payments on assets and liabilities. We define a country's international borrowing spread as the difference between the return paid on liabilities and the return earned on assets, $r_t^L - r_t^A$.

We compare three predictions of the model with the data.

Prediction 1: gross capital inflows are positively correlated with gross capital outflows and with the borrowing spread over time. In the model, capital inflows are correlated with capital outflows in both periods 1 and 2 for the countries that accumulate (private or public) reserves. Period 0 looks like a capital flow boom (with large and positive inflows and outflows) whereas period 1 features a retrenchment (with negative inflows and outflows) if external financial conditions tighten. Furthermore, the price of the domestic asset falls if there is a retrenchment, leading to a low return for foreign investors and a high return for the EM agents, i.e., a low realized borrowing spread. More generally, gross inflows and outflows tend to expand when EM asset prices are increasing and viceversa, which should generate a positive correlation between gross flows and the borrowing spread.

Table 1 reports the relevant correlations in our sample. For each country, we compute the time-series correlation between inflows and outflows and report the cross-country average in the first row of the table. The average correlation is positive and statistically significant across all EM samples and data frequencies. This is consistent with a number of findings reported in the literature, e.g. Forbes and Warnock (2012), Broner et al. (2013), IMF (2013), and Davis and van Wincoop (2017).

The more novel prediction of the model is the positive correlation between gross flows and the borrowing spread. The second and third rows of Table

Table 1: Correlation of capital flows and international borrowing spreads

	(1)	(2)	(3)	(4)	(5)	(6)
	Annual data			Quarterly data		
	Core EM sample	Large EM sample		Core EM sample	Large EM sample	
		all years	post 2005		all years	post 2005
Correlation:						
Inflows/outflows	0.69***	0.44***	0.53***	0.77***	0.61***	0.69***
Inflows/spreads	0.12**	0.09**	0.10*	0.16***	0.04	0.12*
Outflows/spreads	0.26***	0.22***	0.25***	0.23***	0.17***	0.18**

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

1 confirm that gross flows are positively correlated with borrowing spreads, i.e. with the excess return on EM assets relative to foreign assets. In other words, when EM asset prices are booming, thus generating a higher realized borrowing spread, foreigners tend to buy EM assets while residents invest abroad. The opposite dynamic takes place when EM asset prices decline. This suggests that EM residents enjoy a trading advantage by selling domestic assets to foreigners when prices are high and buying them back at a discount when prices are low.

Prediction 2: the borrowing spread is negatively correlated with the size of external liabilities across countries. This is perhaps the most counterintuitive implication of the model. Conventional wisdom suggests that countries with larger foreign liabilities are more exposed to changes in the global financial cycle. This could imply greater instability and higher international borrowing spreads, as foreign investors demand higher risk premia. As shown in section 4, however, the model predicts that domestic financial development leads to both a larger stock of foreign liabilities and a lower cost of borrowing abroad. By selling more assets internationally, EMs can reinvest the proceeds abroad and use them to stabilize the ebb and flow of the global financial cycle

The model prediction is in line with the evidence presented in Table 2. The table shows that countries with larger gross liabilities in percent of GDP tend to enjoy lower international borrowing spreads. This is true across all country samples and data frequency. Looking at the results based on annual data, an increase in gross liabilities of 10 percent of GDP tends to reduce borrowing spreads by about 50 basis points.

Table 2: International borrowing spreads over size of foreign liabilities

	(1)	(2)	(3)	(4)	(5)	(6)
	Annual data			Quarterly data		
	Core EM sample	Large EM sample		Core EM sample	Large EM sample	
		all years	post 2005		all years	post 2005
Liabilities	-0.04**	-0.06***	-0.05***	-0.11**	-0.04*	-0.23***
	(0.02)	(0.02)	(0.02)	(0.04)	(0.02)	(0.04)
Constant	7.62***	9.88***	9.18***	13.99***	7.61***	24.78***
	(1.77)	(1.71)	(1.55)	(4.01)	(2.46)	(4.47)
Countries	22	61	47	16	40	14
R-squared	0.18	0.16	0.21	0.38	0.09	0.767

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

A possible concern with the interpretation of our results is that spreads may decline in countries that have larger foreign liabilities because they are intrinsically safer and less susceptible to fleeing foreign investors. Columns (1) to (3) in Table 3 shows that this is not the case, since capital inflows are more volatile in countries with larger liabilities. As shown in columns (4) to (6), the decline in borrowing spreads seems instead to be driven by the higher covariance between gross inflows and outflows in countries with larger liabilities, consistent with our observation about the stabilizing effects of gross outflows vis-à-vis changes in global financial conditions.

Table 3: Variance and covariance of capital flows over foreign liabilities

	(1)	(2)	(3)	(4)	(5)	(6)
	Variance of capital inflows			Covariance inflows/outflows		
	Core EM sample	Larger EM sample		Core EM sample	Larger EM sample	
		all years	post 2005		all years	post 2005
Liabilities	0.09***	0.07***	0.08***	1.73***	0.89***	1.53***
	(0.01)	(0.01)	(0.01)	(0.26)	(0.15)	(0.24)
Constant	-2.44**	-0.47	-1.38	-103.81***	-53.79***	-104.03***
	(0.93)	(0.72)	(0.91)	(23.50)	(14.43)	(24.78)
Countries	22	61	47	22	61	47
R-squared	0.80	0.56	0.62	0.69	0.37	0.47

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

Prediction 3: the use of foreign exchange interventions is negatively correlated with the size of foreign liabilities across countries. As we showed in section 4, financial development allows the private sector to accumulate its own reserves, reducing the need for the government to stabilize domestic asset prices with foreign exchange interventions.

Indeed, columns (1) to (3) in Table 4 show that countries with larger liabilities tend to have a lower share of reserves in foreign assets. Furthermore, these countries not only have relatively less reserves, but they also use them less actively in offsetting inflows. Columns (4) to (6) show indeed a reduction in the covariance between reserves and gross inflows relative to the covariance between outflows and inflows. Therefore, in countries with larger liabilities, the private sector seems to play a more preponderant role in offsetting movements in capital inflows.

Table 4: Size and use of official reserves over foreign liabilities

	(1)	(2)	(3)	(4)	(5)	(6)
	Share of reserves in foreign assets			cov(reserves,infl.) / cov(outflows,infl.)		
	Core EM sample	Larger EM sample		Core EM sample	Larger EM sample	
		all years	post 2005		all years	post 2005
Liabilities	-0.22***	-0.12**	-0.16***	-0.35**	-0.36**	-0.30***
	(0.08)	(0.05)	(0.05)	(0.16)	(0.15)	(0.10)
Constant	59.11***	54.57***	58.29***	77.14***	91.84***	82.57***
	(6.82)	(5.00)	(5.47)	(14.98)	(14.61)	(10.89)
Countries	22	61	47	21	44	38
R-squared	0.29	0.09	0.17	0.20	0.12	0.20

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

7 Conclusions

The global financial cycle exposes emerging markets to large fluctuations in capital inflows. A common policy prescription is to increase resilience by restricting capital flows, for example through the use of capital controls. In this paper, we offered a different perspective by pointing out that countries can buffer the volatility of capital inflows with offsetting capital outflows. We formalized this argument using a tractable model which shows that emerging markets can use their balance sheets to extract rents from the ebb and flow of the global financial cycle. This requires accumulating reserves when capital inflows are high, and using them to buy back domestic assets at low prices when foreigner investors disinvest.

To fully benefit from this buffering mechanism, countries need to be sufficiently financially developed, i.e. the need to have large enough international balance sheets. When financial constraints limit the issuance of international debt by private agents, the government can use foreign exchange intervention to enhance buffering. Foreign exchange intervention becomes instead ineffective in countries with high financial development since private agents undo government intervention because of Ricardian equivalence effects. The model implications are in line with empirical stylized facts showing that more financially developed countries tend to have greater covariance between inflows and outflows, benefit from lower borrowing spreads, and rely less on official reserves.

Contrary to conventional policy prescriptions, the model thus calls for dealing with the global financial cycle by expanding the balance sheets of emerging markets by using foreign exchange intervention and fostering financial development. Furthermore, the model provides a rationale to increase a country's balance sheets beyond the laissez-faire equilibrium level. This is because the social planner internalizes the effects on bond prices arising from the management of balance sheets. Regarding implementation, the planner's solution cannot be attained with foreign exchange intervention because of Ricardian effects. It instead requires using taxes and subsidies to induce agents to hold larger balance sheets.

In the paper, we used a stylized three-period model to clarify the key mechanisms behind financial buffering. The analysis can be extended in several directions. First, the model can be extended to incorporate non-tradable goods and study how financial buffering can also help to stabilize the real exchange rate. Second , the model can be nested into a conventional DSGE framework to analyze its quantitative implications.

A Model with global financial frictions

We show that a model in which foreign investors are affected by financial frictions is equivalent to the baseline model with preference shocks. The assumptions of the model remain the same except those related to the foreign investors.

We assume that the foreign investors have the same utility as arbitrageurs and EM agents,

$$U_0^{FI} = E_0\left(c_2^{FI}\right),$$

which replaces (5).

A randomly selected fraction θ of foreign investors must exit the investment industry in period 1. The exiting investors sell their holding of EM debt and invest the proceeds in cash.

The foreign investors who do not exit have access to an alternative investment with gross return $R \geq 1$ between period 1 and period 2. The alternative return R is stochastic viewed from period 0 and revealed in period 1. The non-exiting investors cannot raise new funds in period 1: they must re-invest their assets at interest rate R.

In general, the fraction of exiting investors, θ, could be stochastic or not viewed from period 0, and it could be correlated or not with the alternative return R. A large realization of θ could be interpreted as a "sudden stop."

The investors' intrinsic period-1 valuation of EM debt is $1/R$. Going through the same steps as in section 3 to prove (9), one can show that the period-1 price of debt is equal to foreign investor's valuation or the fire-sale price, whichever is higher,

$$p_1 = \max\left(q, \frac{1}{R}\right). \tag{33}$$

Denoting by w the period-0 endowment of the investors, their budget constraint is $w = m + p_0 b_0$ where m is their investment in cash. The period-2 consumption of foreign investors is equal to $m + p_1 b_0$ if they have to exit and liquidate their portfolio in period 1, and to $R\,(m + p_1 b_0)$ if they can reinvest in period 1 (this uses the fact that $p_1 \geq 1/R$ in equilibrium). Thus, the ex-ante welfare of foreign investors is

$$U_0^{FI} = E_0\left\{\left[(1-\theta)\,R + \theta\right](m + p_1 b_0)\right\}. \tag{34}$$

In the baseline model, the investors' welfare is instead given by

$$U_0^{FI} = E_0 \left[\beta_1 \left(m + p_1 b_0 \right) \right]. \tag{35}$$

Comparing (9) and (33), and (34) and (35), it appears that the model with financial frictions is equivalent to the baseline model if

$$\begin{aligned} \beta_1 &= (1-\theta) R + \theta, \\ \beta_2 &= 1/R. \end{aligned}$$

Tighter external financial conditions correspond to an increase in the alternative return R that both raises the value of liquidity and lowers the price of EM debt in period 1. In the two-state specification, normal conditions correspond to $R = 1$ and external financial tightening to $R > 1$. Denoting by $R_H > 1$ the higher return, the mapping between the two models is given by $\beta_L = 1/R_H$ and $\beta_H = (1-\theta) R_H + \theta$. One needs a positive rate of exit $\theta > 0$ in order to satisfy the condition $\beta_H \beta_L < 1$.

B Data

Table 5: Country sample

Advanced economies	**Emerging markets**
Australia	Armenia
Austria	Azerbaijan
Belgium	Belarus
Canada	Bolivia
Czech Republic	Brazil
Denmark	Bulgaria
Finland	Chile
France	China
Germany	Colombia
Greece	Costa Rica
Hong Kong	Croatia
Ireland	Dominican Republic
Israel	El Salvador
Italy	FYR Macedonia
Japan	Georgia
Korea	Guatemala
Lithuania	Honduras
Netherlands	Hungary
New Zealand	India
Norway	Jamaica
Portugal	Jordan
Slovak Republic	Kazakhstan
Slovenia	Kyrgyz Republic
Spain	Mexico
Sweden	Moldova
Switzerland	Mongolia
United Kingdom	Nicaragua
United States	Panama
	Paraguay
	Peru
	Philippines
	Poland
	Romania
	Russia
	Saudi Arabia
	Serbia
	Thailand
	Turkey
	Ukraine
	Uruguay

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