A Model of Fickle Capital Flows and Retrenchment

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Abstract

We develop a global equilibrium model of capital flows that addresses the tension between their fickleness during foreign crises and retrenchment during local crises. In a symmetric world with domestic fire sales risk, gross flows mitigate local crises since the fickle flows exit the country at weak prices (or exchange rates) whereas retrenched flows are brought back at relatively high valuations. While gross flows create global liquidity, they are undervalued by local policymakers due to their public good nature. If the system is heterogeneous, the model features reach-for-safety and reach-for-yield flows that can destabilize developed and emerging market economies, respectively. Similarly, a rise in the correlation of local liquidity crisis (a global cycle) hampers the global liquidity creation mechanism and depresses gross capital flows and safe interest rates.

JEL Codes: **E3, E4, F3, F4, F6, G1**

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1. Introduction

Capital inflows are large, often exceeding 20 percent of GDP per year for advanced economies and half of that for emerging market economies (see, e.g., Lane and Milesi-Feretti 2007, Lane 2012). But they are also *fickle*; that is, foreign investors have a tendency to exit when the country is in distress. The combination of their large size and fickleness has made capital flows a perennial source of headaches for policymakers around the world. This concern has spawned an academic and policy literature that attempts to identify the fire-sale externalities of fickleness and the need to regulate them (see e.g. IMF (2012) for a recent survey).

Less noticed than fickleness, but as prevalent, is *retrenchment.* That is, local investors tend to liquidate past foreign investments and bring the liquidity back home during local crises (see, e.g., Forbes and Warnock (2012) and Broner et al. (2013a,b)). In the presence of retrenchment, it is no longer a foregone conclusion that gross flows reduce financial stability even in the presence of financially destabilizing fickleness. Our main goal in this paper is to address this tension and its implications. To this end, we develop a model of capital flows that takes as given an extreme form of fickleness and asks whether capital flows can still be a useful source of liquidity in a global economy exposed to domestic fire sales.

Specifically, we consider a world conformed by countries that experience occasional domestic financial crises—that is, liquidity shocks that lower the asset prices below their fundamental valuations. We focus on investors that are specialists in their local markets and can provide liquidity during a local crisis—we interpret these investors as sophisticated financial institutions. Critically, we also make these investors extremely fickle in foreign markets: that is, we assume they liquidate their positions in a country that experiences a crisis regardless of the (asset) price level. This assumption can capture a variety of factors that could handicap foreigners during local distress: Knightian uncertainty, asymmetric information, deterioration of property rights, and so on. We remain agnostic about the source of fickleness, since our objective is not to understand why (some) foreign investors are jittery. Rather, we ask the question of whether gross capital flows driven by (extremely) jittery investors still can be beneficial for financial stability, and if so, in which environments that's the case. Briefly, our answer is that *away from extreme reach-for-safety and reach-for-yield environments, gross flows generate stabilizing global liquidity services, and that these benefits rise when local economies are more exposed to local fire sales and global correlations are low.*

The intuition for the net financial stability benefit of gross flows is that fickle foreigners sell local assets at fire-sale prices, but the local investors sell and retrench their diversified foreign assets at relatively high valuations. In a symmetric environment, every inflow is matched by an outflow that has equal size (that is, there are no net imbalances). Since the outflows are liquidated at a higher return than inflows, symmetric capital flows provide liquidity and increase the fire-sale prices during domestic liquidity crises. The return differential between the outflows and inflows (during a crisis) is the amount of liquidity insurance the country obtains from

international capital markets. That is, once we focus on certain types of flows that could be subject to fire sales, such as, equity, long-term debt, or short-term debt denominated in local currency, our model suggests that they *create global liquidity despite their fickleness.* However it is important to note that there is a public good aspect in the global liquidity generated via fickle gross flows. Intuitively, every capital inflow into a country is an outflow from the perspective of some other countries. The local regulators take into account the fickleness cost of inflows, but they do not take into account the retrenchment benefit of inflows for those other countries.

For global liquidity creation to be significant, crises need to be sufficiently uncorrelated. If this is the case, a worsening in the scarcity of safe (i.e. fire-sale immune) domestic store of values increases gross capital flows, a correlation reminiscent of the pre- global financial crisis period. The liquidity service from flows is naturally reduced when the local liquidity shocks become more correlated. Thus, an increase in the importance of global shocks—which can be thought of as capturing the aftermath of the crisis—reduces the magnitude of gross flows and increases the demand for safe assets. In terms of prices, the risk premium on flows increases, the safe interest rate declines, and domestic fire sales become more severe. All these features have been observed during the post-crisis period (see, e.g., Mirando-Agripino and Rey 2015).

We envision the symmetric case of our model as roughly capturing the gross flows among developed countries. The above liquidity-creation based conclusions must be qualified when there are substantial asymmetries in liquidity or investment returns across the different regions of the world. We identify two potentially destabilizing mechanisms—reach for safety and reach for yield—that apply when developed markets with substantial liquidity but relatively low returns trade capital flows with emerging markets with smaller liquidity but relatively high returns.

The reach-for-safety mechanism is driven by cross-country differences in liquidity (captured by the availability of local safe assets in our model). The greater liquidity in a developed country makes its assets relatively attractive for the investors in emerging markets. Other things equal, this induces the developed country to experience greater inflows relative to its outflows (or run current account deficits). The model further reveals that, when there are global liquidity shocks, the inflows into the developed country are relatively safe whereas the outflows are relatively risky. Intuitively, the investors in the developed country sell liquidity insurance (at a premium) to the emerging markets. These types of reach-for-safety flows are a mixed bag for financial stability, as they exacerbate the financial crises in the developed country while mitigating the crises in emerging markets. (See Gourinchas and Rey 2007 and Gourinchas et al 2010, 2012 for extensive evidence on the venture capitalist and insurer role played by the U.S. in the global system).

The reach-for-yield mechanism is driven by cross-country differences in investment returns. If the return in developed markets is lower than in emerging markets, then investors in developed markets hold foreign assets not only to mitigate local crises, but also to chase after the higher returns in emerging markets. We show that the flows that are purely driven by the pursuit of higher returns are destabilizing, since they exacerbate crises in emerging markets without providing financial stability benefits elsewhere.

Related literature. At the core of our mechanism is international diversification. There is an extensive neoclassical benchmark literature that attempts to understand capital flows using standard frictionless models of international risk sharing (see e.g., Grubel (1968); Cole and Obstfeld (1991); Obstfeld (2009); Van Wincoop (1994, 1999); Lewis (2000); Coeurdacier and Rey (2013); Lewis and Liu (2012)), with a correspondingly large empirical literature that has tried to quantify the potential benefits from international risk sharing and has found mixed results (e.g., Coeurdacier et al. (2015) argue they are small and Colacito and Croce (2010) take the opposite view). The main reason for diversification in our model is different from the ones highlighted in this literature, as in our model international liquidity is used to fund the comparative advantage of domestic arbitrageurs during fire sales. In fact, we view our model as capturing the international positions held by sophisticated institutional investors that can arbitrage fire sales (as opposed to unsophisticated households that make passive portfolio investments). This focus on specialists is consistent with the evidence in Bruno and Shin (2014) documenting that the bulk of the surge in capital flows is accounted for by institutional investors.

There is a literature on capital flows that focuses on liquidity/capital allocation in an environment with financial frictions as the central driving force behind gross flows. As in our paper, this literature focuses on gross positions held by sophisticated financial intermediaries, and emphasizes the role of these flows in allocating liquidity where it is most needed (see, for instance, Brunnermeier et al. (2012); Bruno and Shin (2013); Miranda-Agrippino and Rey (2015); Gabaix and Maggiori (2015); Fostel et al. (2015)). The emphasis in this literature is that the fickleness of inflows suggest that capital flows can exacerbate domestic fire-sale externalities.[1] In view of these and other concerns, the literature has recently emphasized that fickle capital flows, while potentially useful for capital allocation purposes, can *increase* crisis risks and should be subject to macroprudential regulation (see, for instance, Caballero and Krishnamurthy (2004, 2005, 2006); Korinek (2010); Jeanne and Korinek (2010); Ostry et al. (2010); Ostry (2012); Caballero and Lorenzoni (2014); Stiglitz and Gurkaynak (2015); Brunnermeier and Sannikov (2015); Calvo (2016); Korinek and Sandri (2016)). Our contribution from the perspective of this literature is to explore the global equilibrium implications of fickleness. Through our fickleness assumption we take as given the core conclusions of this literature, and study whether the risk-sharing mechanisms dimension can offset the negative volatility implications once we consider the feedbacks of the global equilibrium. In this methodological sense we also relate to Scott and Uhlig (1999), who take as given the fickleness of financial investors and study the impact of this feature on economic growth.

Our fickleness assumption is also reminiscent of the international finance literature that attempts to understand the portfolio home bias in equities using models in which locals are more informed about their home market than foreign markets (see, for instance, Gehrig (1993); Bren-

[1] This criticism was a central theme of the post World War II meetings at Bretton Woods (e.g., Forbes (2016)), and it has reemerged in earnest in the post subprime crisis era, mostly in response to the spillovers of developed markets' expansionary monetary policies onto emerging market economies (see, e.g., IMF (2012)) but also onto other developed market economies (see, e.g., Klein (2012)).

nan and Cao (1997); Van Nieuwerburgh and Veldkamp (2009)). Fickleness can be interpreted as saying that the information disadvantage in a foreign market becomes particularly acute when the market is distressed. However, in our framework fickleness is also a source of opportunities for sophisticated local arbitrageurs as long as they have enough liquidity, which they obtain by investing abroad and hence it is also a force against home bias (which could explain some of the decline in home bias observed in recent decade; for example, Coeurdacier and Rey 2013 document that the world average home bias in equity market declined from 90 percent in 1988 to 60 percent by 2008).[2]

By highlighting the public good nature of the liquidity created by gross capital flows, we also touch on an extensive normative literature associated to capital flows. Much of the theoretical support for building policy barriers to capital flows in this literature relies on some externality, principally within the domestic financial system, which leads to an excessive credit boom, followed by destructive busts. This analysis is typically conducted from the perspective of an individual country. However, an increasing body of empirical literature documents that capital account restrictions divert capital flows to other countries (see, for instance, Forbes et al. (2016); Giordani et al. (2014); Ghosh et al. (2014)). There is a small but important theoretical literature that incorporates these diversions into a multilateral analysis of capital flow taxation (e.g. Ostry et al. (2012); Blanchard and Ostry (2012); Jeanne (2014); Korinek (2012)).[3] Ostry et al. (2012); Jeanne (2014); Blanchard and Ostry (2012) emphasize the importance of a multilateral analysis of capital control measures and the value of coordination in preserving the power of a domestic policy. Our analysis shares some of the mechanisms and logic behind their work but we focus on the potential global liquidity costs of these controls rather than on their benefits.

From a methodological angle, our two central ingredients are endogenous liquidity creation and fire sales. As such, our paper relates to Allen and Gale (1994, 2005) who endogenize market size and volatility in a closed economy context with entry costs. In our model liquidity is created in a manner akin to Holmström and Tirole (1998, 2001), though our context and mechanism are different.

The core (non-reach-for-yield) reason for capital flows in our environment is the scarcity of locally safe assets to store value for domestic fire-sales stabilization. In this sense, our work is closely related to the burgeoning literature on limited availability of global assets and its macroeconomic consequences (e.g. Caballero (2006); Caballero et al. (2008, 2016); Bernanke et al. (2011); Gorton et al. (2012); Krishnamurthy and Vissing-Jorgensen (2012); Gorton (2016)).

Our model also shares elements of the limits-to-arbitrage and fire sales literature. In particular, the (limited) liquidity pricing of local assets is similar to, e.g., Allen and Gale (1994); Shleifer and Vishny (1997); Gabaix et al. (2007); Lorenzoni (2008); Krishnamurthy (2010); Gromb and Vayanos (2016); Holmström and Tirole (2001). In addition to these mechanisms we highlight the

[2] See also the recent contributions that analyze the positive implications of certain types of information asymmetry for the dynamics of flows (e.g., Albuquerque et al. (2009); Tille and Van Wincoop (2010)).

[3] IMF (2012) refers to this multilateral approach as the Keynes-White notion of operating "at both ends of the transaction."

benefit of gross outflows as a channel to partially insulate local arbitrageurs from local fire sales. Finally, the all or none attitude of fickle foreign investors behind the fire sales is reduced form in our model, but is intended to capture the attitude of Knightian agents facing an unfamiliar (foreign) situation, and as such it relates to Dow and da Costa Werlang (1992); Caballero and Krishnamurthy (2008); Caballero and Simsek (2013); Haldane (2013).

The rest of the paper is organized as follows. Section 2 presents the model and defines the equilibrium. Section 3 characterizes the equilibrium and illustrates how symmetric capital flows help to create liquidity and mitigate crises in our environment. This section also discusses the public good aspect of liquidity, and illustrates how local policymakers that are concerned with financial stability can choose to restrict capital flows despite their financial stability benefits. Section 4 provides further characterization for a special case of the model ("the beta model"), and uses it to analyze the determinants of gross capital flows in our setting, as well as to obtain a global liquidity cycle in capital flows and asset prices. Section 5 considers a variant of the model in which an (infinitesimal) country has different return and liquidity parameters than the remaining countries, and uses it to analyze asymmetric flows driven by reach for safety and yield, as well as their interaction with the global liquidity cycle. Section 6 concludes and is followed by several appendices containing extensions and the proofs of the propositions that are not developed in the body of the paper.

2. The Model

The model features three periods, $t \in \{0, 1, 2\}$, and a single consumption good in each period. There is a continuum of mass one of locations denoted by superscript $j \in J$. In period 1, an aggregate state $s \in S = \{1, ...|S|\}$ is drawn with probability $\gamma_s > 0$, where $\sum_{s \in S} \gamma_s = 1$. The aggregate state determines the probability of a liquidity shock in a location, denoted by $\pi_s \in [0, 1]$. Specifically, a random variable ω^j is drawn for each j and i.i.d. across j, with $\pi_s = \Pr\left(\omega^j = b\right)$ and $1 - \pi_s = \Pr\left(\omega^j = g\right)$. We say that a location with $\omega^j = b$ experiences a liquidity shock. We assume $\sum_S \gamma_s \pi_s \in (0, 1)$ so the probability of a liquidity shock is positive but less than one. We also assume π_s is strictly increasing in s so that aggregate states with greater s are associated with greater likelihood of liquidity shocks.

There are three types of assets. First, in each location, there is a linear technology in period 0: investing one unit of the consumption good produces one unit of a location-specific risky asset. If $\omega^j = g$, then each unit of the asset pays R units in period 1 and 0 units in period 2. If instead $\omega^j = b$, so that the location experiences a liquidity shock, then each unit of the asset pays 0 units in period 1 and R units in period 2. In this case, the asset is traded in period 1 at an endogenous price p_s^j.[4] We concentrate our attention on symmetric equilibria in which the

[4] To economize on notation, we assume the asset is not tradeable in period 1 when $\omega^j = g$. This is without loss of generality since in this case the asset pays zero units in period 2, so its ex-dividend price in period 1 would be zero.

price when $\omega^j = b$ is the same for all locations, that is, $p_s^j \equiv p_s$ for each j.

Second, there is also a risk-free asset that pays 1 unit of the consumption good in period 1 (and 0 units in period 2). The risk-free asset is in fixed supply denoted by η. In period 0, the risk-free asset is traded at an endogenous price q_f.

Third, there are also Arrow-Debreu financial securities that facilitate the sharing of aggregate risk. Specifically, for each aggregate state $s \in S$, there is an Arrow-Debreu security that pays 1 unit of the consumption good in period 1 if state s is realized (and 0 units in all other states or in period 2). In period 0, the Arrow-Debreu security for state s is traded at an endogenous price q_s. The Arrow-Debreu securities are in zero net supply.[5]

There are two types of agents. First, in each location, there is a mass of entrepreneurs with preferences given by $E[\tilde{c}_2]$. These agents have access to a linear technology that converts 1 unit of the consumption good in period 1 into λ units of the consumption good in period 2. They are endowed with e units of the risky asset of their own location. We focus attention on the limit as $\lambda \to \infty$, which leads to a simple behavior for entrepreneurs.If $\omega^j = g$ is realized in their location in period 1, then they receive Re units of the consumption good from their endowment. They invest this in the linear technology and consume λRe units in period 2. If instead $\omega^j = b$ is realized in period 1, then they sell their endowment at the market price $p_s e$. They invest in the linear technology and consume $\lambda p_s e$ in period 2. The main role of these entrepreneurs is to capture asset sales driven by liquidity needs.

Second, in each location, there is also a mass of investors. These are the main agents in our model and their preferences are

$$E[u(c_0) + c_{1,s} + c_{2,s}] \tag{1}$$

where the utility function, $u(\cdot)$, satisfies $u'(c) > 0, u''(c) < 0$ for each $c > 0$ as well as the Inada-type conditions, $u'(0) = \infty$ and $u'(1) < R$. Investors are endowed with one unit of the consumption good in period 1, as well as η units (all of the fixed supply) of the risk-free asset.

In period 0, investors in location j choose an investment strategy, $x^{j',j}$, in risky assets across locations, j'. We impose that $x^{j,j}$ is point mass, and $x^{j',j}$ for $j' \neq j$ is a density with respect to the Lebesgue measure. Investors also choose how many consumption units to invest the risk-free asset, y, or in Arrow-Debreu securities, $(z_s)_s$. Investors' budget constraint in period 0 is,

$$c_0 + x^{j,j} + x^{out,j} + yq_f + \sum_s z_s q_s = 1 + \eta q_f, \text{ where } x^{out,j} = \int_{j' \neq j} x^{j',j} dj'. \tag{2}$$

Here, $x^{out,j}$ denotes the outflows: the aggregate amount of investment made by investors in location j in other locations. Investors are not allowed to short-sell risky assets, $x^{j',j} \geq 0$ for

[5] Note that the financial markets are incomplete in the sense that investors cannot trade financial contracts whose payoffs are contingent on the realizations of the local liquidity shocks, $\{\omega^j\}_j$. In Appendix A.1, we develop a version of the model with complete markets and show that (under stronger assumptions) our main results continue to apply in this setting.

each j',[6] but they are allowed to take unrestricted positions on the risk-free asset or Arrow-Debreu securities subject to obtaining nonnegative consumption in all periods and states.

In period 1, if $\omega^{j'} = g$ and $j' \neq j$, then investors receive R units of the consumption good from their risky asset investments in location j'. By a law of large numbers, these locations generate $x^{out,j}(1-\pi_s)R$ units of the consumption good. If instead $\omega^{j'} = b$ and $j' \neq j$, then investors are required to sell their risky asset holdings in this location, which captures our fickleness assumption (see below for a discussion). By a law of large numbers, these sales generate $x^{out,j}\pi_s p_s$ units of the consumption good. Hence, the amount of resources investors receive from investments in other locations is given by $x^{out,j}\overline{R}_s$, where

$$\overline{R}_s = (1-\pi_s)R + \pi_s p_s, \tag{3}$$

denotes the expected one-period payoff from unit foreign investment conditional on the aggregate state s. In addition, investors receive $y+z_s$ units of the consumption good from their investments in the risk-free asset or the Arrow-Debreu securities.

Investors' total resources in period 1, as well as what they do with those resources, also depends on the shock in their own location. If $\omega^j = g$, then investors' risky asset investment in own location pays $Rx^{j,j}$ units in period 1. Moreover, investors do not have a remaining investment opportunity so they consume all of their available resources in period 1. Then, investors' budget constraints in state $\omega^j = g$ can be written as,

$$\begin{aligned} c_{1,s}\left(\omega^j = g\right) &= x^{j,j}R + x^{out,j}\overline{R}_s + y + z_s \\ \text{and } c_{2,s}\left(\omega^j = g\right) &= 0. \end{aligned} \tag{4}$$

If instead $\omega^j = b$, then investors' risky asset investment in own location pays zero units in period 1. However, investors are not required to sell their holdings in their own location. We let $\chi_s^{j,j} \geq 0$ denote investors' position in the local risky assets in period 1 when $\omega^j = b$ and the aggregate state is s. Then, investors' budget constraints in state $\omega^j = b$ can be written as,

$$\begin{aligned} c_{1,s}\left(\omega^j = b\right) + \chi_s^{j,j}p_s &= x^{j,j}p_s + x^{out,j}\overline{R}_s + y + z_s, \\ c_{2,s}\left(\omega^j = g\right) &= \chi_s^{j,j}R. \end{aligned} \tag{5}$$

Putting everything together, investors in each location j make an investment plan, $\left[x^{j',j} \geq 0\right]_{j'}, y^j, \left(z_s^j, \chi_s^j \geq 0\right)_s$, to maximize their expected utility in (1), where c_0^j is determined by Eq. (2); $c_{1,s}^j\left(\omega^j = g\right)$ and $c_{2,s}^j\left(\omega^j = g\right)$ are determined by Eq. (4), and $c_{1,s}^j\left(\omega^j = b\right)$ and $c_{2,s}^j\left(\omega^j = b\right)$ are determined by Eq. (5); and consumption in all periods and states are nonneg-

[6] The binding constraint here will be the short-selling of the local asset, $j' = j$ (we could relax it for foreign assets, $j' \neq j$). In our model, the price of the local asset is correlated with local liquidity shocks, and thus, short selling the local asset could provide some insurance with respect to liquidity shocks. As we noted earlier, for analytical tractability, we focus our efforts on the case in which markets are incomplete, which also requires restricting short selling [see Footnote 5].

ative, $c_0^j \geq 0, c_{1,s}^j \geq 0, c_{2,s}^j \geq 0$.

The equilibrium with symmetric prices is a collection of these optimal allocations, together with prices, $(p_s)_s, q_f, (q_s)_s$, that ensure market clearing. The market clearing condition for the risky asset in a country j with $\omega^j = b$ in period 1 can be written as,

$$e + x^{in,j} + x^{j,j} = \chi_s^j \text{ where } x^{in,j} = \int_{j' \neq j} x^{j,j'} dj'. \tag{6}$$

Here, $x^{in,j}$ denotes the inflows: the aggregate amount of investment in a location made by investors in other locations. The left side captures the supply of risky assets, which comes from the entrepreneurs, the ex-ante inflows, and the ex-ante local investments. The right side captures the demand, which comes only from local investors, since entrepreneurs as well as foreigners sell all of their asset holdings when $\omega^j = b$. The market clearing condition for the risk-free asset in period 0 can be written as,

$$\int_j y^j dj = \eta. \tag{7}$$

Finally, the market clearing condition for the Arrow-Debreu security for state s can be written as,

$$\int_j z_s^j dj = 0. \tag{8}$$

3. Gross Flows and Global Liquidity Creation

In this section, we characterize the equilibrium and illustrate that there exists gross flows despite the fickleness element. We also illustrate how these flows contribute to global liquidity creation and mitigate fire sales. Throughout, we focus on the following parametric condition.

Assumption 1. $\eta < eR$.

Under this condition, we conjecture that (in every aggregate state) the equilibrium price of the risky asset in locations with state $\omega^j = b$ is below its expected payoff, $p_s < R$ for each s. We will refer to this situation as a *fire sale* of risky assets. Since investors have linear utility between periods 1 and 2, the presence of fire sales implies that investors in locations with state $\omega^j = b$ invest all of their resources in period 1 in the risky asset, that is, $c_{1,s}^j \left(\omega^j = b\right) = 0$ and their position, $\chi_s^{j,j}$, is determined by Eq. (5).

We also conjecture a symmetric equilibrium allocation in which each location invests the same amount in the risky assets of each other location, $x^{j',j} = x^{out,j}$ for each $j' \neq j$; and all locations choose identical allocations. We denote these symmetric allocations by dropping the superscript j, that is,

$$x^{out,j} \equiv x^{out}, y^j \equiv y, z_s^j \equiv z_s \text{ for each } j.$$

Note that these assumptions also imply that the inflows into a location are equal to the outflows, $x^{in,j} \equiv x^{in} = x^{out}$ [cf. (2) and (6)]. When it is clear from the context, we also drop the superscript

"in" or "out" and denote these symmetric gross flows with simply x.

With symmetry, the market clearing conditions (7) and (8) imply $y = \eta$ and $z_s = 0$. Combining this with the budget constraints $(2), (4), (5)$, we obtain,

$$\begin{aligned} c_0 + x^{j,j} + x^{out} &= 1, \\ c_{1,s}\left(\omega^j = g\right) &= x^{j,j}R + x^{out}\overline{R}_s + \eta \\ c_{2,s}\left(\omega^j = b\right) &= \left(x^{j,j}p_s + x^{out,j}\overline{R}_s + \eta\right)\frac{R}{p_s}. \end{aligned}$$

Here, the last line substitutes for $\chi_s^{j,j}$ using our earlier conjecture that $c_{1,s}^j\left(\omega^j = b\right) = 0$.

Substituting these expressions into the objective function in (1), and rearranging terms, the representative investors' problem can be written as,

$$\max_{x^{j,j}, x^{out}} u\left(1 - x^{j,j} - x^{out}\right) + x^{j,j}R + \sum_s \gamma_s \left(x^{out}\overline{R}_s + \eta\right) M_s, \tag{9}$$

$$\text{where } M_s \equiv 1 - \pi_s + \pi_s \frac{R}{p_s}. \tag{10}$$

Here, M_s denotes the expected period-1 marginal utility conditional on the aggregate state s. When $\omega^j = g$, local investors do not have an investment opportunity in period 1 and consume their available resources. When $\omega^j = b$, local investors take advantage of local fire sales in period 1 to invest their available resources so as to obtain greater marginal utility, $R/p_s > 1$. The expression for expected marginal utility, M_s, combines these two cases.

To solve problem (9), first note that the ex-ante marginal utility from investing in the local risky asset is simply equal to its payoff, R. In contrast, the ex-ante marginal utility from investing in foreign risky assets is given by, $\sum_s \gamma_s \mu_s(p_s)$, where

$$\mu_s(p_s) \equiv \overline{R}_s M_s = \left(\left(1 - \pi_s\right)R + \pi_s p_s\right)\left(1 - \pi_s + \pi_s \frac{R}{p_s}\right).$$

Here, the function, $\mu_s(p_s)$, captures the ex-ante marginal utility conditional on the aggregate state s and given the price level p_s. One-period payoff from foreign investment is relatively low, $\overline{R}_s < R$, because local investors are fickle and sell their risky assets when there is liquidity shock in the foreign location. On the other hand, expected period-1 marginal utility is relatively high, $M_s > 1$, because foreign assets are retrenched back into the country to arbitrage local fire sales when there is a local liquidity shock. The ex-ante marginal utility, $\mu_s(p_s) = \overline{R}_s M_s$, combines the costs and benefits of foreign investment. Our next result characterizes this expression and shows that it always exceeds the ex-ante marginal utility from local investment.

Lemma 1. *For each aggregate state s with $\pi_s \in (0,1)$, the ex-ante marginal utility from foreign investment, $\mu_s(p_s)$, is strictly decreasing in p_s over the range $p_s \in (0, R]$, and it satisfies $\mu_s(R) = R$. In particular, when $p_s \in (0, R)$, we have $\mu_s(p_s) > R$ and investing in foreign risky assets*

dominates investing in local risky assets, that is, $x^{j,j} = 0$.

Intuitively, the scarcity of local liquidity, as captured by the presence of local fire sales, induces investors to obtain liquidity insurance by investing in foreign risky assets. Consistent with this intuition, a decline in the fire-sale price, p_s, increases the marginal benefit from foreign investment, $\mu_s(p_s)$.

Combining Lemma 1 with problem (9), we also characterize the equilibrium level of foreign investment as the solution to,

$$u'\left(1 - x^{out}\right) = E\left[\overline{R}_s M_s\right] = \sum_s \gamma_s \mu_s(p_s). \tag{11}$$

Investors invest in foreign risky assets up to the point at which the ex-ante marginal utility from investment is equal to their current marginal utility from consumption. Note also that a reduction in the fire-sale price p_s (in any aggregate state with $\pi_s > 0$) increases x^{out}. Intuitively, a lower price level increases the value of liquidity insurance, which increases foreign investment that provides this insurance.

Next consider the determination of the fire-sale asset prices for risky assets, p_s. Recall that $c^j_{1,s}\left(\omega^j = b\right) = 0$ and χ^j_s is determined by Eq. (5). Using this expression, as well as our earlier observations, the market clearing condition (6) can be rewritten as,

$$p_s = \frac{\eta + x^{out}\overline{R}_s}{e + x^{in}}. \tag{12}$$

The denominator of this term captures the total amount of sales, which come from liquidity-driven sales (e) and the past inflows all of which are liquidated in a crisis in view of the fickleness assumption. The numerator captures the total amount of cash in the market, which comes from the local investors' cash and foreign asset positions that are determined by the past outflows. Eq. (12) says that (when there are fire sales) the asset price is determined by the cash-per-asset in the market. This expression illustrates the key tension captured by our model: while inflows tend to reduce the fire-sale price, outflows are retrenched back into the country and help to stabilize the fire-sale prices.

Recall also that, in a symmetric equilibrium, inflows are equal to outflows, $x^{in} = x^{out} = x$. After substituting this into Eq. (12) and rearranging terms, the fire-sale asset prices can also be written as,

$$p_s = P^{mc}_s(x) \equiv \frac{\eta + x(1 - \pi_s)R}{e + x(1 - \pi_s)}. \tag{13}$$

Here, the last equality defines the market clearing relation, $p_s = P^{mc}_s(x)$, which describes the price level in state s as a function of the gross flows. The following lemma resolves the tension between inflows and outflows for a symmetric equilibrium, and shows that retrenchment dominates fickleness.

Lemma 2. *Under Assumption 1, for each aggregate state s with $\pi_s < 1$, the market clearing price level, $P_s^{mc}(x)$, is strictly increasing in symmetric gross flows, x.*

The intuition for why retrenchment dominates fickleness can be understood by inspecting Eq. (12). Note that inflows (x in the denominator) are liquidated at the fire-sale return, p_s. However, the outflows (x in the numerator) are retrenched back into the country at the return from foreign investment, $\overline{R}_s$. When $p_s < R$ and $\pi_s < 1$, the fire-sale return is lower than the return from foreign investment, $p_s < \overline{R}_s = (1-\pi_s)R + \pi_s p$. It follows that the symmetric flows on net increase liquidity and fire-sale prices. Intuitively, the fickle flows exit at weak local prices, as they are driven by local liquidity shocks, while retrenchment flows take place at favorable average prices as they are driven by shocks back at home rather than globally. Hence, despite their fickleness, gross flows help to bring the excess liquidity in foreign financial markets that do not experience liquidity shocks into the local market that has a liquidity shock.

The equilibrium level of gross flows and prices, $x, (p_s)_s$, are characterized by solving Eq. (11) together with Eq. (13) for each aggregate state s. The following result establishes the existence of an unique symmetric equilibrium that features $x \in (0,1)$, and $p_s < R$ (verifying our conjecture).

Proposition 1 (Equilibrium Capital Flows and Global Liquidity Creation)**.** *Consider the above model (with Assumption 1). There exists a unique symmetric equilibrium allocation, $x^{j,j}, \left(x^{out} = x^{in} = x\right), y, (z_s, \chi_s)_s$, with symmetric prices, $(p_s)_s, q_f, (q_s)_s$. The equilibrium allocation satisfies $x^{j,j} = 0, y = \eta, z_s = 0$. The tuple $(x, (p_s)_s)$ is characterized by Eqs.* (11) *and* (13)*, and satisfies $x \in (0,1)$ and $p_s < R$ for each s.*

We postpone the characterization of financial asset prices, $q_f, (q_s)_s$, to the end of this section. Next, we specialize to the case with a single aggregate state to illustrate Proposition 1 as well as how gross flows help to create liquidity.

3.1. Global liquidity creation

Suppose S is a singleton so there is a single aggregate state. Let $\pi \equiv \pi_s \in (0,1)$ denote the probability of a liquidity shock, $p \equiv p_s$ denote the fire-sale asset price, and $\mu(p)$ and $P^{mc}(x)$ denote the functions characterized in Lemmas 1 and 2. Figure 1 visualizes the resulting equilibrium, characterized in Proposition 1. The declining curve corresponds to the optimality condition, $u'(1-x) = \mu(p)$. The increasing curve corresponds to the increasing market clearing relation, $p = P^{mc}(x)$. The equilibrium corresponds to the intersection.

The figure also illustrates the autarky equilibrium that would obtain if all foreign investment was banned. In this case, investors solve the same portfolio problem as before with the additional restriction that $x^{j,j'} = 0$ for any $j' \neq j$. It is then easy to check that investors hold some local risky assets, $x^{jj} > 0$, characterized by solving the equation, $u'\left(1 - x^{j,j}\right) = R$. However, as illustrated by Eq. (5), these local investments do not generate any additional liquidity when

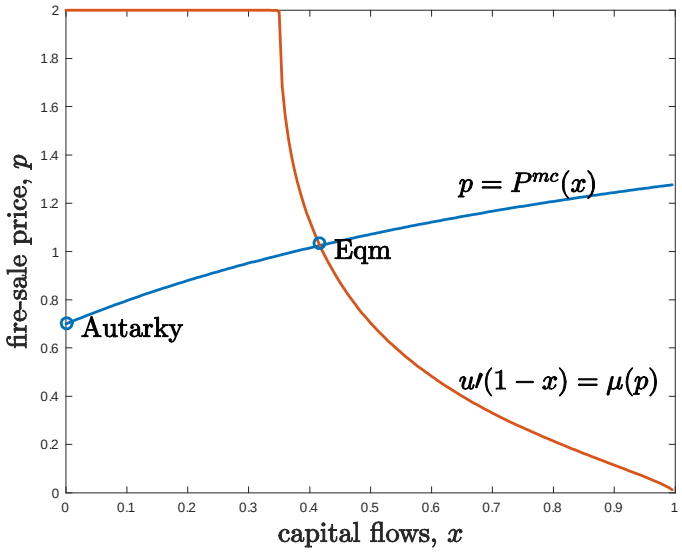


Figure 1: Equilibrium when there is a single aggregate state.

there is a local liquidity shock in period 1. Therefore, the fire-sale price is still characterized by Eq. (13) after substituting zero capital flows, $x = x^{out} = x^{in} = 0$. In particular, the fire-sale price in autarky is lower than the fire-sale price in an equilibrium with global flows.

3.2. Public good aspects of global liquidity creation

[To be included. See Section 4 of our NBER working paper version for an analysis in an earlier draft.]

3.3. Asset prices and returns

Let us go back to the general case with possibly multiple aggregate states, S, and complete the characterization of equilibrium. Recall our convention that π_s is strictly increasing in s so that states with greater s are associated with greater likelihood of liquidity shocks. Combining this with Eq. (13) illustrates that p_s is strictly decreasing in s: that is, states with a greater likelihood of liquidity shock are associated with strictly lower equilibrium prices. Intuitively, these states feature less global liquidity since more locations are simultaneously hit by the liquidity shock. This also implies that the payoff from foreign investment, $\overline{R}_s = (1-\pi_s)R + \pi_s p_s$, is strictly decreasing in s; whereas the marginal utility in period 1, $M_s = 1 - \pi_s + \pi_s \frac{R}{p_s}$ is increasing in s.

Next consider the asset prices in period 0, $q_f, (q_s)_s$. Recall that the equilibrium features $y = \eta$ and $z_s = 0$ for each s. Suppose investors in a location consider changing these allocations, y^j, z_s^j. Following similar steps as above (and using $x^{j,j} = 0$) the optimal allocations solve the

following problem

$$\max_{x^{out},y^j,\left(z_s^j\right)_s} u\left(c_0\right)+\sum_s \gamma_s\left(x^{out}\overline{R}_s+y^j+z_s^j\right)M_s, \tag{14}$$
$$\text{where } c_0=1-x^{out}-q_f\left(\eta^j-y^j\right)-\sum_s q_s z_s^j.$$

Using the optimality condition with respect to z_s^j, we obtain an expression for Arrow-Debreu prices,

$$\frac{q_s}{\gamma_s}=\frac{M_s}{u'\left(1-x\right)}. \tag{15}$$

As usual, the state price q_s/γ_s (or the stochastic discount factor) is determined by the expected marginal utility in the corresponding state divided by the marginal utility in period 0. Note also that q_s/γ_s is strictly increasing in s (like M_s), because π_s is strictly increasing (Assumption 1) and p_s is strictly decreasing in s. As expected, states with greater probability of liquidity shocks feature more expensive state prices. For future reference, note also substituting Eq. (15) into (11) implies $1=\sum_s q_s\overline{R}_s$: as expected, the price of foreign diversified investment is equal to the value of a replicating portfolio.

Using the optimality condition for η^j, we also obtain an expression for the risk-free asset price,

$$q_f=\frac{E\left[M_s\right]}{u'\left(1-x\right)}. \tag{16}$$

We define the risk-free return as the inverse of this price, $R_f=1/q_f$. Using Eq. (11) to substitute for $u'\left(1-x\right)$ in the previous expression, we further obtain,

$$R_f=\frac{E\left[\overline{R}_s M_s\right]}{E\left[M_s\right]}=E\left[\overline{R}_s\right]+\frac{cov\left(\overline{R}_s,M_s\right)}{E\left[M_s\right]}. \tag{17}$$

All else equal, the risk-free rate is higher when the expected return from risky assets is lower and when these risky returns covary positively with marginal utility.

In our setting, the covariance is negative since M_s is strictly increasing in s, whereas the expected payoff from foreign investment, $\overline{R}_s$, is strictly decreasing in s. Combining this observation with Eq. (17), we also find that the risk premium on foreign assets is positive,

$$E\left[\overline{R}_s\right]-R_f=-\frac{cov\left(M_s,\overline{R}_s\right)}{E\left[M_s\right]}\geq 0, \tag{18}$$

with strict inequality as long as there are multiple states. Intuitively, the value of the foreign investment is reduced by the fact that they pay relatively less when aggregate liquidity is relatively scarce. The following result summarizes the characterization of asset prices.

Proposition 2 (Equilibrium Asset Prices and Risk Premia)**.** *Consider the symmetric equilibrium characterized in Proposition 1. The fire-sale price, p_s, is strictly decreasing in s (which*

captures the likelihood of the liquidity shock). The state price, q_s/γ_s, is characterized by Eq. (15) *and is strictly decreasing in s. The price and the return of the risk-free asset are characterized by Eqs.* $(16-17)$. *The risk premium on foreign investment is characterized by Eq.* (18)*, and is strictly positive as long as there are multiple aggregate states.*

4. Determinants of Gross Flows

So far, we have illustrated how gross capital flows contribute to global liquidity, and how there is a public good aspect to global liquidity creation. In this section, we analyze the determinants of gross flows in our setting. We also illustrate how our model can naturally generate a global cycle in capital flows and asset prices driven by the (perceived) likelihood of global liquidity shocks.

We show these results using a special case of the model ("the beta model") that leads to closed form solutions. In this model, liquidity shocks are either completely uncorrelated or fully correlated across regions. Specifically, suppose there are three aggregate states, $s \in \{1,2,3\}$, that feature,

$$\pi_1 = 0, \qquad \pi_2 = \pi, \qquad \pi_3 = 1, \tag{19}$$

for some $\pi \in (0,1)$. In particular, state $s=2$ corresponds to the state in which the liquidity shocks are i.i.d. across the regions. States $\{1,3\}$ together can be thought of as a "correlated shock" state in which the liquidity shocks are perfectly correlated across the countries. Specifically, either all countries are hit (state 3) or no country is hit (state 1). We also assume the state probabilities are given by,

$$\gamma_1 = \beta(1-\pi), \qquad \gamma_2 = 1-\beta, \qquad \gamma_3 = \beta\pi. \tag{20}$$

Here, the parameter $\beta \in (0,1)$ captures the extent to which the shocks are correlated. The limit, $\beta \to 0$, corresponds to the single-state model that we analyzed in Section 3.1, in which liquidity shocks are completely uncorrelated, whereas the other limit, $\beta \to 1$, corresponds to perfectly correlated shocks.

To characterize the equilibrium, first note that the expected returns are given by,

$$\overline{R}_1 = R, \qquad \overline{R}_2 = (1-\pi)\,R + \pi p_2, \qquad \overline{R}_3 = p_3, \tag{21}$$

whereas the marginal utilities are given by,

$$M_1 = 1, \qquad M_2 = 1 - \pi + \pi R/p_2, \qquad M_3 = R/p_3. \tag{22}$$

Next note that $\mu_1(p) = \overline{R}_1 M_1 = R$ and $\mu_3(p) = \overline{R}_3 M_3 = R$. Thus, Eq. (11) becomes,

$$u'(1-x) = E\left[\overline{R}_s M_s\right] = \beta R + (1-\beta)\,\mu_2(p_2), \tag{23}$$

where $\mu_2(p_2) = \overline{R}_2 M_2$. The market clearing conditions (13) imply,

$$p_2 = P_2^{mc}(x) = \frac{\eta + x(1-\pi)R}{e + x(1-\pi)}. \tag{24}$$

The last two equations determine the pair, (x, p_2). Figure 2 below, which is a generalized version of Figure 1 from the previous section, provides a pictorial illustration of the equilibrium pair, (x, p_2).

Using the market clearing condition (13), we also calculate the price in state 3 (with $\pi_3 = 1$) as,[7]

$$p_3 = \frac{\eta}{e}. \tag{25}$$

This is also the average fire-sale price conditional on a liquidity shock in the correlated shock state, $\{1, 3\}$ (since $\pi_1 = 0$ and $\pi_3 = 1$). Note that we have, $p_3 < p_2$: that is, the aggregate shock state features deeper fire sales than the i.i.d. state. Intuitively, the aggregate shock state has as much aggregate liquidity on average but this liquidity is not distributed appropriately across the states (state 3 has too little and state 1 has too much of it).

Next consider the prices and returns for financial assets. Using Eq. (21), the expected return on foreign assets is given by,

$$E\left[\overline{R}_s\right] = (1-\pi)R + \pi\left(\beta p_3 + (1-\beta)p_2\right). \tag{26}$$

In particular, asset returns depend on the weighted average fire-sale prices across the correlated and uncorrelated states. State prices are given by $q_s/\gamma_s = M_s/u'(1-x)$ where M_s are characterized in (22).

Finally, using Eqs. (21) and (22), together with Eq. (17), the risk-free rate is given by,

$$\begin{aligned} R_f &= \frac{E\left[\overline{R}_s M_s\right]/M_2}{E\left[M_s\right]/M_2}, \\ \text{where } \frac{E\left[\overline{R}_s M_s\right]}{M_2} &= \beta\frac{1}{(1-\pi)/R + \pi/p_2} + (1-\beta)\left((1-\pi)R + \pi p_2\right) \\ \text{and } \frac{E\left[M_s\right]}{M_2} &= \beta\frac{1-\pi+\pi R/p_3}{1-\pi+\pi R/p_2} + 1 - \beta. \end{aligned} \tag{27}$$

As we will see, the normalization with M_2 is useful since it will enable us to sign the changes in both the numerator and the denominator in the comparative statics exercises that we will consider. In particular, the numerator is the weighted average of the geometric and arithmetic average of R and p_2, with the weight on the geometric average is given by β. This expression is between p_2 and R and it is decreasing in β since geometric average is smaller than the arithmetic average. The denominator is the weighted average of the relative marginal utility in

[7] We could similarly calculate the fire-sale price in state 1 as $p_1 = \frac{\eta + xR}{e+x}$. This price does not play any role in the analysis since $\pi_1 = 0$, that is, the liquidity shock happens with zero probability in state 1.

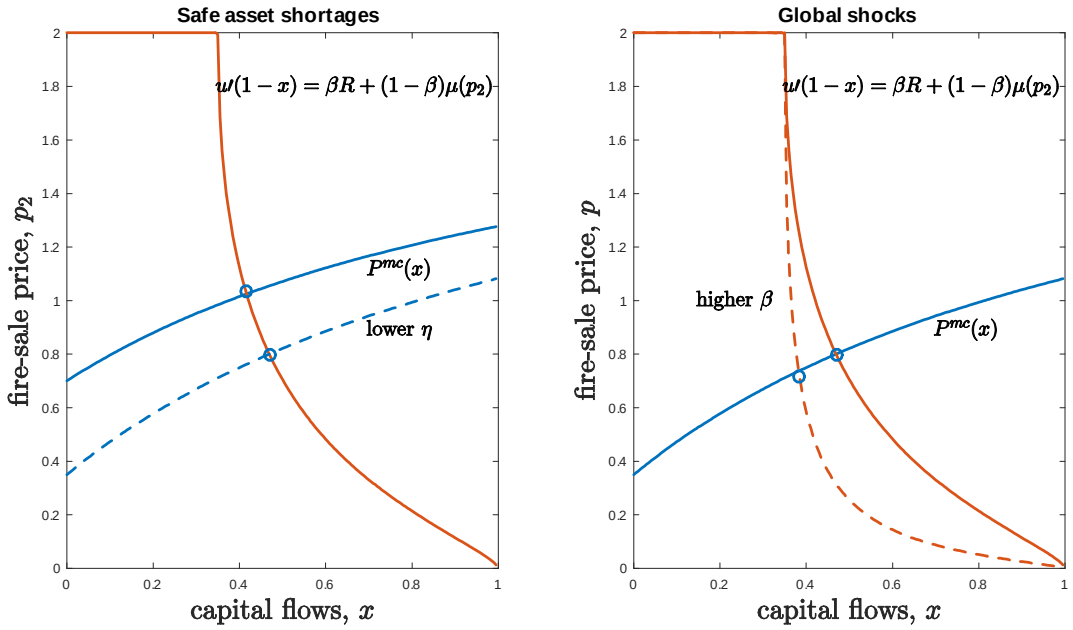


Figure 2: Comparative statics of equilibrium with respect to changes in the supply of safe assets (left panel) and the probability of correlated liquidity shocks (right panel).

the correlated state $\{1, 3\}$ (relative to the uncorrelated state) and one, with the weight on the relative marginal utility given by β. This expression is greater than one and it is increasing in β since the marginal utility is higher in the correlated state.

The risk premium can also be obtained from Eqs. (26) and (27). Thus, Eqs. $(21-27)$ provide a closed-form characterization of the equilibrium in the beta model. We next use this model to establish a number of comparative statics results.

4.1. Safe-asset shortages

Consider a shortage of liquidity as captured by a reduction in the supply of safe assets, η. Recall that the equilibrium pair, (x, p_2), is characterized by the optimality condition (23) and the market clearing relation (24). The left panel of Figure 2 illustrates that a decline in η shifts the market clearing equation downwards, without affecting the optimality condition. This increases the capital flows, x, while also reducing the fire-sale price in the uncorrelated state, p_2. Intuitively, the fire-sale price declines because investors have less liquidity to arbitrage asset fire sales (cf. (13)). The anticipation of these more severe fire sales induce greater ex-ante investment in foreign risky so as to obtain liquidity insurance (cf. (11)). When there is greater liquidity shortage, there is greater need for global liquidity creation, and gross capital flows increase so as to satisfy this need.

Next note that, by Eq. (25), the shortage of liquidity also reduces the fire-sale price in the correlated shock state, p_3. In fact, the price declines more in this state than in the uncorrelated

state because gross flows do not provide liquidity when there is a correlated shock. Technically, we show in the appendix that a reduction in η reduces p_3/p_2.

Next consider the impact on asset prices in period 0. By Eq. (26), the expected return on risky foreign assets also declines due to lower fire-sale prices. What happens to the risk-free rate depends on Eq. (27). In the appendix, we show that a reduction in η lowers the term in the numerator (since it lowers p_2) and raises the term in the denominator (since it lowers p_3/p_2). Thus, the risk-free return also declines. Intuitively, the shortage of liquidity reduces asset returns broadly while also increasing the insurance value of safe assets, which translates into a reduction in the risk-free rate.

Finally, consider the risk premium on foreign financial assets, $E\left[\overline{R}_s\right]-R_f$. Since the expected return on foreign asset and the risk-free asset both decline, the effect on the risk premium is in general ambiguous. However, it is easy to check that the risk premium becomes zero as $\eta \to eR$ (as this limit features $p_s \to R$ and $M_s \to 1$ for each s) whereas it becomes strictly positive for any $\eta < eR$ (see Assumption 1 and Eq. (18)). Thus, the risk premium also increases in the neighborhood of abundant safe assets, $\eta = eR$. The following result summarizes this discussion.

Proposition 3. *Consider the beta model described in this section. A reduction in η (that exacerbates safe asset shortages) increases gross flows, x, reduces fire-sale prices in both states, p_2, p_3, as well as the relative fire-sale price in the correlated state, p_3/p_2. It reduces expected risky asset returns, $E\left[\overline{R}_s\right]$, as well as the risk-free return, R_f. In the (lower) neighborhood of $\eta = eR$, it also increases the risk premium on foreign assets, $E\left[\overline{R}_s\right] - R_f$.*

This result provides one explanation for the worldwide increase in gross capital flows in the run-up to the Global Financial Crisis (see Bluedorn et al. (2013)). From the lens of our model, the gross flows increased at least in part as a response to the global asset shortages that developed in early 2000s (see e.g., Caballero (2006)).

4.2. Global shocks and the global financial cycle

Next consider an increase in the (perceived or real) probability of the correlated shock state, β. The right panel of Figure 2 illustrates that this shifts the optimality curve downwards without affecting the market clearing equation. Hence, it lowers the gross flows, x, as well as the fire-sale price in the uncorrelated state, p_2. Intuitively, correlated shocks reduce the value of liquidity insurance which translates into lower ex-ante investment, x, and lower ex-post liquidity. The latter lowers the price even in the uncorrelated state. Hence, the presence of correlated shocks affects asset prices even if those shocks are ultimately realized.

Next consider the impact on asset prices in period 0. By Eq. (26), the expected return on risky foreign assets $E\left[\overline{R}_s\right]$ declines due to lower fire-sale prices. By Eq. (27), the risk-free return R_f also declines (since the numerator declines and the denominator increases). Intuitively, as the liquidity shocks become more correlated, the risk-free asset becomes more valuable as it provides liquidity when there is a global liquidity shock.

Finally, consider the risk premium on foreign financial assets, $E\left[\overline{R}_s\right] - R_f$. As in the case of safe asset shortages, the effect is in general ambiguous. However, it is easy to check that the risk premium is zero in the limit as $\beta \to 0$ (as this limit is equal to a single aggregate state, in which case there is no aggregate risk) whereas it becomes strictly positive for any $\beta > 0$ (see Eq. (18)). Thus, the risk premium is increasing in the neighborhood of no global shocks, $\beta = 0$. The following result summarizes this discussion.

Proposition 4. *Consider the beta model described in this section. An increase in β (that makes the liquidity shocks more correlated) reduces the capital flows, x, and reduces fire-sale asset price in the uncorrelated state, p_2. It reduces the expected return on foreign financial assets, $E\left[\overline{R}_s\right]$, as well as the risk-free interest rate, R_f. In the neighborhood of $\beta = 0$, it also increases the risk premium on foreign assets, $E\left[\overline{R}_s\right] - R_f$.*

An increase in β in this model can be thought of as capturing a "risk-off" environment in which the investors retrench into their home markets (even at date 0, before crises are realized). This reduces the capital flows and liquidity creation, while also reducing the risk-free rate and increasing the risk premia. This result is consistent with the large decline in gross capital flows in the aftermath of the Global Financial Crisis (see Bluedorn et al. (2013) and Lane and Milesi-Ferretti (2012); Milesi-Ferretti and Tille (2011)). From the lens of our model, the global crisis increased the (real or perceived) correlations of financial crises, which in turn reduced the usefulness and the magnitude of gross capital flows.

5. Reach for Safety and Yield

In our baseline model, gross capital flows are entirely driven by the liquidity insurance motive, and they create global liquidity and improve fire-sale prices. In this section, we consider a slight variant of the baseline model to illustrate two additional mechanisms that might drive capital flows, and investigate how they affect fire sales.

Specifically, consider a version of the model in which all but one of the countries are "regular" and have the parameters as described in the previous section. The remaining country is "special" and has potentially different parameters, (η^*, R^*): its supply of safe assets is given by η^*, and the return on its risky assets is given by R^*. As before, investors in the special country are endowed with all of the safe assets in this country as well as one unit of the consumption good in period 0. The rest of the model is unchanged.

Since the special country has Lebesgue measure zero, the equilibrium allocations and prices in the regular countries are the same as the symmetric equilibrium characterized in the previous sections, denoted by $x, (p_s)_s, q_f, (q_s)_s$. Our goal in this section is to characterize the equilibrium allocations and prices in the special country, which we denote by $x^{*,*}, x^{in,*}, x^{out,*}, y^*, (z_s^*, p_s^*)_s$.[8] Throughout, we assume the parameters satisfy the following.

[8] As before, we focus on symmetric equilibria for regular countries so that $x^{in,*}$ (resp. $x^{out,*}$) denotes the risky investment inflows into (resp. outflows from) the special country from (resp. into) each regular country.

Assumption 2. $R^* - R \in \left[0, \frac{\eta}{e}\frac{\sum_s q_s \pi_s}{\sum_s q_s(1-\pi_s)}\right]$ and $\eta^* - \eta \geq -\frac{\sum_s q_s p_s x}{q_f}$.

In particular, we assume the parameters in the special country are not too far from their counterparts in the regular countries, which helps to obtain an interior solution, and we focus attention on the case in which the special country has weakly higher return, $R^* \geq R$.

First consider the investments made by regular countries' investors in the special country, $x^{in,*}$. In view of Assumption 2, we conjecture an equilibrium with strictly positive inflows, $x^{in,*} > 0$. We assume this equilibrium satisfies the no-arbitrage condition,

$$\sum_s \overline{R}_s^* q_s = 1 = \sum_s \overline{R}_s q_s, \text{ where } \overline{R}_s^* = (1-\pi_s) R^* + \pi_s p_s^*. \tag{28}$$

This condition says that (when there is positive investment into the special country) the cost of investment (one unit) must be equal to the value of a replicating portfolio of Arrow-Debreu securities.[9] The second equality (which we established in Section 3.3) says that the same condition also holds for investment into regular countries. Hence, Eq. (28) can also be viewed as saying that the investors are at the margin indifferent between investing in the special country and regular countries.

Next consider the investments made by the special country's investors, $x^{out,*}, y^*, (z_s^*)_s$. These are not uniquely determined, because there are multiple equivalent ways of obtaining the same payoff vector. We therefore define the country's liquidity purchase (or sale) in each state as,

$$l_s^{out,*} = x^{out,*}\overline{R}_s + y^* + z_s^* - \eta^*.$$

Note that l_s^* captures the additions to (or subtractions from) the country's liquidity starting with its endowment, η^*. We conjecture that the equilibrium features fire sales also in the special country, $p_s^* < R$ for each s. Then, investors in the special country solve the following analogue of problem (9),

$$\max_{x^{*,*} \geq 0, (l_s^* \geq -\eta^*)_s} u(c_0^*) + x^{*,*} R^* + \sum_s \gamma_s l_s^* M_s^*, \tag{29}$$

$$\text{where } c_0^* + x^{*,*} + \sum_s q_s l_s^* = 1 + q_f \eta^*. \tag{30}$$

In the appendix, we show that $x^{*,*} = 0$, that is, investing in the local risky asset is dominated also for the risky country. Consider the remaining optimality conditions. For each state s with $\pi_s > 0$, we conjecture that there is an interior solution, $l_s > -\eta^*$, with the corresponding optimality conditions,

[9] We technically state this as an assumption because the regular investors in our model are actually indifferent to take any nonnegative position in the special country, as this country has measure zero. In a version of the model in which the special countries have strictly positive but small mass $\Delta > 0$, condition (28) would always hold in equilibrium. Hence, the equilibrium we analyze can be viewed as the limit of these equilibria as $\Delta \to 0$.

$$\frac{M_s^*}{u'(c_0^*)} = \frac{q_s}{\gamma_s} = \frac{M_s}{u'(c_0)}, \text{ where } M_s^* = 1 - \pi_s + \pi_s \frac{R^*}{p_s^*}. \tag{31}$$

Hence, as long as investors in the special country consume a strictly positive amount in a state, the SDF is equal to their relative marginal utility. As we established in Section 3.3, the SDF is also always equal to the relative marginal utility of investors in regular countries.

If $\pi_1 > 0$, then Eqs. (31) describe all of the optimality conditions. If $\pi_1 = 0$, we allow for a corner solution for state 1. In this case, $M_1^* = M_1 = 1$ and the optimality condition can be written as,

$$c_0^* < c_0, l_1 = -\eta^*; \text{ or } c_0^* = c_0, l_1 > -\eta^* \text{ and } p_1^* = p_1. \tag{32}$$

Here, the first case captures a corner solution in state 1. The second case captures an interior solution. In this case, p_1^* is not uniquely determined.[10] But this indeterminacy is innocuous since $\pi_1 = 0$ and liquidity shocks happen with zero probability in this state. We resolve this indeterminacy by assuming, $p_1^* = p_1$.

Finally, consider the equilibrium value of fire-sale prices in the special country, $(p_s^*)_s$. Using similar steps as before, these prices are determined by the following analogue of Eq. (13),

$$p_s^* = \frac{\eta^* + l_s^*}{e + x^{in,*}}. \tag{33}$$

The following result establishes the existence of equilibrium.

Proposition 5. *Consider the model with regular countries that satisfy Assumption 1 and a special country that satisfies Assumption 2. There exists an equilibrium in which the allocations and prices for regular countries are characterized by Propositions 1-2. In the special country, there is no local investment,* $x^{*,*} = 0$. *The remaining allocations,* $x^{in,*}, c_0, (l_s^*)_s, (p_s^*)_s$, *are characterized as the unique solution to the system of equations* $(28), (30), (31-32)$, *and* (33).

We next use this model to illustrate the reach for safety and yield mechanisms and their implications for capital flows. Unlike regular countries, the special country trades safe and contingent assets in equilibrium so its inflows and outflows are not necessarily determined by investments in risky assets. We adopt the convention that its total inflows are equal to the

[10] The reason for this indeterminacy is that investors in the special country can transfer liquidity from state 1 to other states (therefore lowering p_1^*), and investors in regular countries can send greater inflows into the special country to neutralize the price impact of these liquidity transfers (therefore leaving p_s^* and M_s^* with $\pi_s > 0$ unchanged).

inflows into its risky assets, $X^{in,*} = x^{in,*}$; whereas its total outflows are given by,[11]

$$\begin{aligned} X^{out,*} &= x^{out,*} + q_f\left(y^* - \eta^*\right) + \sum_s q_s z_s^* \\ &= \sum_s q_s l_s^* = 1 - c_0. \end{aligned} \tag{34}$$

Here, the first equality in the second line follows from the definition of l_s^* (together with $\sum_s \overline{R}_s q_s = 1$) and the second equality follows from the budget constraint (30). Hence, outflows are equal to the value of investors' liquidity purchases in period 0. Since there is no local investment in period 0, this is also equal to the investors' endowment in period 0 (one) net of their consumption.

5.1. Reach for safety and global imbalances

We first abstract away from return differences, $R^* = R$, and focus on the effect of asymmetries in the liquidity supply, η^*. A developed country with deep financial markets and a large supply of safe assets—such as the U.S.—can be thought of as featuring $\eta^* > \eta$. When the liquidity is sufficiently high, $\eta^* > eR$, the country would completely avoid fire sales in autarky.[12] In particular, it would experience less severe fire sales than other countries, $p_s^* = R > p_s$ for each s. Conversely, an emerging market country is captured by $\eta^* < \eta$. In autarky, this country would experience more severe fire sales than other countries, $p_s^* = \frac{\eta^*}{e} < p_s$ for each s.

We next analyze the equilibrium with free capital flows. Using Proposition 5, it is easy verify that the equilibrium in the special country obtains when, $c_0^* = c_0$ and,

$$\begin{aligned} p_s^* &= p_s < R \\ x^{in,*} &= x + (e+x)(\Lambda - 1), \\ X^{out,*} &= x, \\ l_s^* &= \left(x\overline{R}_s + \eta\right)\Lambda - \eta^* \text{ for each } s, \end{aligned} \tag{35}$$

where we refer to Λ as *the leverage ratio of outflows*, and define it as,

$$\Lambda = \frac{x + q_f \eta^*}{x + q_f \eta}. \tag{36}$$

[11] With trade in safe and contingent assets, there is in general an indeterminacy in the definition of gross flows since the special country can always sell a financial asset to regular countries and purchase exactly the same asset from those countries. This would increase inflows as well outflows without any additional effects. Our definition excludes these types of spurious flows and focuses on the lowest level of gross flows that could emerge in our setting.

[12] In autarky, the country invests in only local risky assets, $x^{jj,*} > 0$, characterized by solving the equation, $u'\left(1 - x^{j,j,*}\right) = R$. It is then easy to check that the country's asset price in period 1 (conditional on a liquidity shock) is characterized by $p_s^* = \min\left(R, \frac{\eta^*}{e}\right)$ for each s.

The first line in (35) says that the asset prices in the special country are the same as those in regular countries. In particular, even though a developed country with $\eta^* > eR$ would avoid fire sales in autarky, it cannot escape fire sales in equilibrium with free capital flows. Conversely, an emerging market country with $\eta^* < \eta$ obtains higher fire-sale prices with free capital flows than what it would obtain in autarky.

To understand these results, consider the case of a developed country with $\eta^* < \eta$ (the case with $\eta^* < \eta$ is symmetric). All else equal, greater liquidity in this country would increase the fire-sale prices, which would increase the expected return, $\sum_s \overline{R}^*_s q_s$, above the level obtained in regular countries, $\sum_s \overline{R}_s q_s$. This temporarily violates the indifference condition (28) and makes the country's assets attractive to foreign investors. This translates into greater inflows, $x^{\text{in},*}$, which in turn worsens fire-sale prices as illustrated by Eq. (33). This process stops only when the special country also experiences severe fire sales that equate its expected return with those in regular countries. In fact, the second and the third lines of Eq. (35) illustrate that the developed country receives more inflows than outflows (it has a current account deficit). These net inflows neutralize the country's initial liquidity advantage and induce fire sales in equilibrium.

While this intuition explains why the developed country experiences fire sales as severe as in the regular countries *on average*, it does not explain why the asset prices are equated *state-by-state*. In fact, from the earlier market clearing condition (13), one could expect a developed country to have relatively high prices in states with high π_s in which the global liquidity is low—because its greater domestic liquidity supply could provide some cushion. This does not happen in our model because investors in the developed country do not necessarily retain their initial endowments of liquidity. Rather, as captured by Eq. (31), they trade financial assets so as to move their liquidity across aggregate states.

The last line in (35) characterizes the equilibrium outcome from these trades. Investors in the developed country can be thought of as selling some of their safe asset endowments, $\eta^* - \eta\Lambda$ (which is positive when $\eta^* > \eta$), to make a leveraged investment in foreign diversified portfolio. We refer to Λ as the leverage ratio of outflows, because it captures the value of (effective) foreign risky asset investments divided by the value of outflows, $\sum_s q_s x \overline{R}_s \Lambda / x$. For a developed country, the leverage ratio is greater than one, $\Lambda > 1$, meaning that the country's outflows are riskier than in other countries. Intuitively, investors in the developed country are selling some of their excess liquidity to take advantage of the positive risk premium on foreign assets [cf. Eq. (18)]. In our model, this effect is strong and ensures that the country has the same (fire-sale) asset price as regular countries in every state.

Conversely, an emerging market country with $\eta^* < \eta$ has more outflows relative to its inflows ($X^{out,*} = x > x^{in,*}$), and its outflows are also safer than those in regular countries, $\Lambda < 1$. Intuitively, the scarcity of liquidity in this country reduces the inflows, while also inducing the country to purchase safe assets from abroad to obtain additional liquidity (by paying the risk premium). These forces improve the fire-sale prices relative to what the country would obtain in autarky. The following result summarizes this discussion.

Proposition 6. *Consider the setup in Proposition 5 with $R^* = R$ and $\eta^* \neq \eta$. With free financial flows, the equilibrium allocations in the special country are given by* (35)*. Regardless of its liquidity supply, the country experiences fire sales with prices that are equal to those in the representative country, $p_s^j = p_s < R$ for each s. When $\eta^* > \eta$, the country receives more inflows than its outflows, $x^{in,*} > X^{out,*} = x$, and has riskier (more leveraged) outflows than regular countries, $\Lambda > 1$. When $\eta^* < \eta$, the country has more outflows than its inflows, $X^{out,*} = x > x^{in,*}$, and safer (less leveraged) outflows than regular countries, $\Lambda < 1$.*

These results suggest that the *reach-for-safety* flows have potentially destabilizing effects for developed markets with $\eta^* > \eta$ but stabilizing effects for emerging markets with $\eta^* < \eta$. Hence, the effect of reach-for-safety flows on worldwide financial stability is ambiguous.

The results are also consistent with the empirical work by Gourinchas and Rey (2007); Gourinchas et al. (2010), who document that the outflows of the U.S. are riskier than its inflows. They also show that the U.S. earns a risk premium on capital flows in normal times, but it transferred resources and provided insurance to the rest of the world during the Global Financial Crisis. Our model suggests that these transfers are likely to have exacerbated the severity of the GFC in the U.S., while mitigating its impact in the countries that held the (relatively) safe U.S. assets.

We conclude this section with an analysis of how the global liquidity cycle we described earlier affects flows driven by reach for safety. To this end, consider the special case ("the beta model") we analyzed in Section 4. Suppose β increases so that the shocks become more correlated. As captured by Proposition 4, this decreases the symmetric flows, x, as well as the risk-free rate, R_f. In the appendix, we show that it also *increases* the absolute value of the country's imbalances (as a fraction of outflows), $\left|x^{\text{in},*} - x\right| / x$, as well the absolute value of its relative leverage ratio, $|\Lambda - 1|$. In particular, a developed country with $\eta^* > \eta$ increases its (proportional) current account deficit as well as the riskiness of its outflows. Conversely, an emerging market with $\eta^* < \eta$ increases its (proportional) current account surplus and the safety of its outflows. Intuitively, the "risk-off" induced by the increase in β strengthens the flows driven by reach for safety. The following result summarizes this discussion.

Corollary 1. *Consider the setup in Proposition 6 for the special case of the "beta model" described in Section 4. An increase in β (that makes the liquidity shocks more correlated) increases $\left|x^{in,*} - x\right| / x$ and $|\Lambda - 1|$.*

5.2. Reach for yield

We next abstract away from differences in liquidity supply, $\eta^* = \eta$, and investigate the effect of asymmetries in return, R^*. We focus on the more interesting case with $R^* > R$, so that the special country can be thought of as a rapidly growing or high yielding emerging market such as Russia or Turkey. These types of countries appear to have relatively attractive fundamental

returns, especially in recent years in which the asset returns in developed markets have been unusually low.

To simplify the exposition, we restrict attention to the special case ("the beta model") we analyzed in Section 4. Using Proposition 5, and Eqs. (19) and (20), the foreigners' optimality (or indifference) condition (28) can be rewritten as,

$$q_1 R^* + q_2 \left((1-\pi) R^* + \pi p_2^* \right) + q_3 p_3^* = q_1 R + q_2 \left((1-\pi) R + \pi p_2 \right) + q_3 p_3. \tag{37}$$

Likewise, local investors' optimality conditions (31) for states 2 and 3 can be rearranged as,

$$\frac{1-\pi+\pi\frac{R^*}{p_2^*}}{1-\pi+\pi\frac{R}{p_2}} = \frac{\frac{R^*}{p_3^*}}{\frac{R}{p_3}} = \frac{u'\left(c_0^*\right)}{u'\left(c_0\right)}. \tag{38}$$

These two equations uniquely determine (p_2^*, p_3^*), as well as c_0^*. In the appendix, we show that the solution also satisfies $\frac{u'(c_0^*)}{u'(c_0)} > 1$. By (32), this also implies $l_1^* = -\eta^*$ (there is a corner solution for state 1). The remaining allocations, $x^{in,*}, l_2^*, l_3^*$, are characterized by solving the market clearing conditions (33) for states 2 and 3 together with the budget constraint (30).

Using $R^* > R$, Eq. (37) implies that the country experiences more severe fire sales than the regular countries on average. Further analysis shows that the country experiences more severe fire sales in both distress states, $p_2^* < p_2$ and $p_3^* < p_3$ (see Lemma 3 in the appendix).

For intuition, suppose the country had the same fire-sale prices as regular countries, $p_2^* = p_2$ and $p_3^* = p_3$. This would violate the indifference condition (37), because foreign investors would strictly prefer to invest in the special country. This would increase the inflows into the special country $x^{in,*}$, and lower fire-sale prices according to (33). This process stops only when the special country's fire-sale prices are lower and the indifference condition is reestablished.

We further show that $p_2^*/p_2 < p_3^*/p_3$: that is, the relative depth of fire sales in the special country is greater in the idiosyncratic shock state than in the aggregate shock state (see Lemma 3 in the appendix). Intuitively, since the crises are more frequent in state 3, local investors in the special country purchase more liquidity for this state than in state 2. This helps to mitigate somewhat the fire sales caused by the reach-for-yield inflows in state 3 (the global crisis), at the expense of deepening the fire sales in state 2 (local crises).

An interesting aspect of this equilibrium is that investors in the special country take precaution against fire sales driven by reach for yield. Specifically, since $\frac{u'(c_0^*)}{u'(c_0)} > 1$, the special country has greater outflows than the regular countries, $X^{out,*} > x$ [cf. Eq. (34)]. Moreover, as we noted earlier, the special country borrows against its liquidity in the benign aggregate state 1 (that does not feature crises) so as to purchase more liquidity for states $s \in \{2,3\}$. In contrast, regular countries' foreign assets pay relatively more in state 1 since $\overline{R}_1 = R > \overline{R}_s$ for each $s \in \{2,3\}$. Thus, the special country not only holds more foreign assets than the regular countries, but it also holds safer assets that pay relatively more in distress states. Nonetheless, with free capital flows, these attempts at obtaining greater insurance backfire since they make

the country attractive to foreigners and ultimately translate into greater inflows. Formally, we show that $x^{in,*} > X^{out,*} > x$: the reach for yield increases the country's inflows more than its outflows. The following result summarizes this discussion.

Proposition 7. *Consider the setup in Proposition 5 with $\eta^* = \eta$ and $R^* > R$, for the special case of the "beta model" described in Section 4. In equilibrium with free financial flows, the special country experiences deeper fire sales than the regular countries in both distress states, but less so in the more distressed state; that is, $p_2^*/p_2 < p_3^*/p_3 < 1$. The special country has more inflows than outflows, $x^{in,*} > X^{out,*}$, as well as greater and safer outflows than regular countries, $X^{out,*} > x$ and $l_1^* = -\eta^*$.*

We next investigate how the global risk and return conditions affect the reach for yield. To this end, we substitute $q_s = \gamma_s \frac{M_s}{u'(c_0)}$ [cf. Eq. (31)] into Eq. (37) and rearrange terms to obtain,

$$(R^* - R)(1-\pi)(M_1\beta + M_2(1-\beta)) = (\overline{p} - \overline{p}^*)\pi(M_2(1-\beta) + M_3\beta), \tag{39}$$
$$\text{where } \overline{p} = \frac{p_2 M_2(1-\beta) + p_3 M_3 \beta}{M_2(1-\beta) + M_3\beta} \text{ and } \overline{p}^* = \frac{p_2^* M_2(1-\beta) + p_3^* M_3 \beta}{M_2(1-\beta) + M_3\beta}.$$

Here, the second line defines the probability and price weighted average fire-sale prices. Eq. (39) captures the trade-off from investing in the special country relative to other countries. Investors collect net positive returns if there is no crisis (captured by the left side), but they make net negative returns if there is a crisis (captured by the right side). Net gains are multiplied by the probability of no crisis $(1-\pi)$ and the average marginal utility conditional on no crisis. Net losses are calculated in similar fashion. The indifference condition obtains when the weighted net gains and the net losses are equated.

Eq. (39) shows that, all else equal, a decline in investment returns in other countries, R, makes investing in the special country more attractive. In equilibrium, this decreases the relative fire-sale price in the special country—so as to counter the greater net gains with greater net losses conditional on a crisis.

Eq. (39) also shows that, all else equal, a decline in the correlation parameter, β, makes investing in the special country relatively more attractive: it decreases the weighting term on the right (loss) side while increasing the weighting term on the left (gain) side since $M_1 < M_2 < M_3$. In equilibrium, this reduces the relative fire-sale price in the special country. The intuition is that investing in high-yielders makes losses during local crises, and these losses are less costly when the local crises are less correlated with aggregate distress states.

It follows that a decline in R (low global returns) as well as a decline in β (risk-on) strengthens the reach-for-yield mechanism. The following proposition formalizes these results.

Corollary 2. *Consider the setup in Proposition 7. A decrease in R as well as a decrease in β reduces the special country's relative weighted average fire-sale price, $\overline{p}^* - \overline{p}$ [defined in (39)].*

$$\max_{x^{out,*},y^*,(z_s^*)_s} u\left(c_0^*\right) + \sum_s \gamma_s \left(x^{out,*}\overline{R}_s + y^* + z_s^*\right) M_s^*,$$

where $c_0 = 1 - q_f\left(\eta^* - y^*\right) - \sum_s q_s z_s^*$

and $M_s^* \equiv 1 - \pi_s + \pi_s \dfrac{R^*}{p_s^*}$.

6. Final Remarks

We developed a global equilibrium model of capital flows that addresses the tension between their fickleness during foreign crises and retrenchment during local crises. In a nutshell, our main finding is that gross capital flows create liquidity and stabilize domestic fire sales. Moreover, the destabilizing forces in the reach-for-safety and reach-for-yield scenarios we considered, stem not from the associated gross flows but from their imbalance which translate into net flows.

In the model the distinction is stark: symmetric flows are stabilizing while imbalances are not for the net recipient country. However, the practical message is broader as ultimately what matters for stabilization is not whether a country has a current account deficit or not, but whether its fickle inflows exposed to domestic fire sales are comparable in magnitude to retrenchable outflows. When viewed in this light, it is apparent that in terms of inflows (non-fickle) FDI flows are stabilizing while short term debt denominated in foreign currency is not (it is fickle but not exposed to domestic fire sales). For outflows, the reliability of the retrenchment in case of a domestic event is also crucial, as there are plenty of episodes in emerging markets when the extent of retrenchment has been very limited (see e.g. Jeanne et al 2017). From this perspective, international reserves play a special role precisely because their retrenchment is fully reliable.

Going back to the model, we assumed that investors have rational and thus common beliefs at the ex-ante investment stage (although we motivated the ex-post fickleness of foreigners with an unmodeled belief friction). Introducing belief disagreements would generate a tension between speculation and risk sharing, similar to Simsek (2013), that would qualify some of our conclusions. In particular, an investor who is relatively optimistic about a foreign market can invest there even though she does not need liquidity and is not an expert in the foreign market. These speculative flows would be destabilizing for the foreign market without providing insurance benefits elsewhere—just like the reach-for-yield flows in our environment. In fact, the speculative flows can also be categorized as reaching for yield as they are driven by high perceived returns in the minds of the investors. We thus conjecture that heterogeneous beliefs would strengthen the reach-for-yield channel.

There are two other extensions that we leave for future work. The first one is to add an investment margin at date 0 to entrepreneurs. In this case capital inflows at date 0 may increase

the size of the illiquid assets and the potential fire sales, but also allow for a larger domestic investment. In fact, the single-country literature typically focuses on this particular trade-off, which serves to highlight that our mechanisms and externalities are distinct from those in the standard capital flow taxation literature. Second, in our model foreign investment is (ultimately) undertaken by unleveraged investors. In practice, leveraged intermediaries play a central role in facilitating foreign investment, and some of the most significant global crises stem from shocks to intermediary capital, as considered by the stringent macro-stress tests applied to most large banks around the world in the aftermath of the subprime crisis (see, e.g., Bruno and Shin (2015)).

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Appendix A: Extensions

A.1. Insurance for Local Liquidity Shocks

[To be included. See Section A.1 of our NBER working paper version.]

Appendix B: Proofs

Proof of Lemma 1. We have,

$$\begin{aligned}\mu_s'(p_s) &= \pi_s\left(1-\pi_s+\frac{R}{p_s}\pi_s\right)-\pi_s\frac{R}{p_s^2}\left(\left(1-\pi_s\right)R+\pi_s p_s\right)\\ &= \pi_s\left(1-\pi_s\right)\left(1-\frac{R^2}{p_s^2}\right).\end{aligned}$$

Hence, $\mu_s(p_s)$ is strictly decreasing over the range $p_s \in (0,R)$. Using $\mu_s(R) = R$, we also obtain $\mu_s(p_s) > R$, which in turn implies $x^{j,j} = 0$. □

Proof of Lemma 2. Taking the derivative of Eq. (13), we obtain,

$$\frac{d}{dx}\left(\frac{\eta+x\left(1-\pi_s\right)R}{e+x\left(1-\pi_s\right)}\right)=\frac{\left(1-\pi_s\right)}{e+x\left(1-\pi_s\right)}\left(R-P_s^{mc}(x)\right)>0.$$

Here, the inequality follows since $\eta < eR$ implies $P_s^{mc}(x) = \frac{\eta+x(1-\pi_s)R}{e+x(1-\pi_s)} < R$, which completes the proof. □

Proof of Proposition 1. Most of the proof is provided in the main text. It remains to check that there exists a unique solution to Eqs. (11) and (13). To this end, define the function,

$$F(x) = u'(1-x) - \sum_s \gamma_s \mu_s(p_s), \text{ where } p_s = \frac{\eta+x\left(1-\pi_s\right)R}{e+x\left(1-\pi_s\right)} \text{ for each } s.$$

By Lemma 2, F is strictly increasing in x. Note also that,

$$\begin{aligned}F(0) &= u'(1) - \sum_s \gamma_s \mu_s\left(\frac{\eta}{e}\right)\\ &< R - \sum_s \gamma_s \mu_s\left(\frac{\eta}{e}\right) < 0,\end{aligned}$$

where the first inequality follows since we assume $u'(1) < R$ and the second one follows since $\mu_s\left(\frac{\eta}{e}\right) > R$ by Lemma 1. Finally, note that $F(1) = \infty$ since we assume $u'(0) = \infty$. By continuity, there exists a unique solution to the equation, $F(x) = 0$, over the range, $x \in (0,1)$. This proves the existence and the characterization of equilibrium. Since $\eta < eR$ implies $P_s^{mc}(x) = \frac{\eta+x(1-\pi_s)R}{e+x(1-\pi_s)} < R$, the equilibrium also satisfies $p_s < R$ for each s. □

Proof of Proposition 2. Provided in the main text. □

Proof of Proposition 3. The analysis in the main text shows that $dx/d\eta < 0$ and $dp_2/d\eta > 0$: that is, reducing η increases x and reduces p_2 (see Figure 2). Using (25), p_3 also declines. To show that p_3/p_2

declines, note that

$$\begin{aligned}\frac{d\left(p_3/p_2\right)/d\eta}{p_3/p_2} &= \frac{dp_3/d\eta}{p_3} - \frac{dp_2/d\eta}{p_2} \\ &= \frac{dp_3/d\eta}{p_3} - \frac{\partial P_2\left(x;\eta\right)/\partial\eta + \left(\partial P_2\left(x;\eta\right)/\partial x\right)\left(dx/d\eta\right)}{p_2} \\ &> \frac{dp_3/d\eta}{p_3} - \frac{\partial P_2\left(x;\eta\right)/\partial\eta}{p_2} \\ &= \frac{1}{\eta} - \frac{1}{\eta + x\left(1-\pi\right)} > 0.\end{aligned}$$

Here, the third line follows since $dx/d\eta < 0$ and $\partial P_2\left(x;\eta\right)/\partial x > 0$ (by Lemma 2) and the last line follows by evaluating the derivatives from Eqs. (24) and (25) and using $x \in (0,1)$. Hence, reducing η also reduces p_3/p_2.

Combining these results with Eq. (26), $E\left[\overline{R}_s\right]$ also declines. To show the effect on R_f, consider separately the numerator and the denominator of Eq. (27). The numerator is given by

$$\frac{E\left[\overline{R}_s M_s\right]}{M_2} = \beta\frac{1}{\left(1-\pi\right)/R + \pi/p_2} + \left(1-\beta\right)\left(\left(1-\pi\right)R + \pi p_2\right).$$

This is an average of the arithmetic and the geometric averages of R and p_2. Thus, the effect has the same sign as the effect on p_2, that is, $\frac{d\left(E\left[\overline{R}_s M_s\right]/M_2\right)}{d\eta} > 0$ (since $\frac{dp_2}{d\eta} > 0$). The denominator is given by,

$$\frac{E\left[M_s\right]}{M_2} = \beta\frac{1-\pi+\pi R/p_3}{1-\pi+\pi R/p_2} + 1 - \beta.$$

Taking the derivative of this and rearranging terms, we obtain,

$$\frac{dE\left[M_s\right]/M_2}{d\eta} = \frac{\beta\pi\left(1-\pi+\pi R/p_3\right)}{1-\pi+\pi R/p_2}\left(-\frac{dp_3/d\eta}{p_3}\frac{1}{\left(1-\pi\right)p_3+\pi R} + \frac{dp_2/d\eta}{p_2}\frac{1}{\left(1-\pi\right)p_2+\pi R}\right).$$

This is strictly negative since $\frac{dp_3/d\eta}{p_3} > \frac{dp_2/d\eta}{p_2}$ and $\frac{1}{(1-\pi)p_3+\pi R} > \frac{1}{(1-\pi)p_2+\pi R}$. Combining the effect on the numerator and the denominator, we obtain $\frac{dR_f}{d\eta} > 0$. In particular, decreasing η decreases R_f.

Finally, to show that reducing η increases the risk premium in a neighborhood of $\eta = eR$, we let $x\left(\eta\right), \left[p_s\left(\eta\right)\right]_s$ denote the equilibrium as a function of η. The analysis in the proof of Proposition 1 implies that $x\left(\cdot\right), \left[p_s\left(\cdot\right)\right]_s$ are continuous functions for $\eta < eR$. Taking the limit of Eq. (13), we obtain, $\lim_{\eta\to eR} p_s = R$. Using Eqs. (3) and (10), we further obtain $\lim_{\eta\to eR}\overline{R}_s = R$ and $\lim_{\eta\to eR} M_s = 1$ for each s. Using Eq. (17), we obtain $\lim_{\eta\to eR} R_f = R$. Thus, the risk premium in the limit is zero, $\lim_{\eta\to eR} E\left[\overline{R}_s\right] - R_f = 0$. However, by Eq. (18), $E\left[\overline{R}_s\right] - R_f > 0$ for each $\eta < eR$. It follows that reducing η increases the risk premium in a neighborhood of $\eta = eR$, completing the proof. □

Proof of Proposition 4. The analysis in the main text shows that $dx/d\beta < 0$ and $dp_2/d\beta < 0$: that is, increasing β reduces x and p_2 (see Figure 2). Combining these results with Eq. (26), $E\left[\overline{R}_s\right]$ also declines. To show the effect on R_f, consider separately the numerator and the denominator of Eq. (27). Increasing β reduces the numerator since it increases the weight on the geometric average of p_2 and R relative to the arithmetic average (and the former is strictly smaller). It also increases the numerator since $\frac{1-\pi+\pi R/p_3}{1-\pi+\pi R/p_2} > 1$ (since $p_3 < p_2$). It follows that $\frac{dR_f}{d\beta} < 0$, that is, increasing β reduces the risk-free rate. Finally, following similar steps as in the proof of Proposition 3, we have $\lim_{\beta\to 0} E\left[\overline{R}_s\right] - R_f = 0$,

and $E\left[\overline{R}_s\right] - R_f > 0$ for any $\beta > 0$. This shows that increasing β also increases the risk premium, $E\left[\overline{R}_s\right] - R_f$, in a neighborhood of $\beta = 0$, completing the proof. □

The following lemma will be used in the proofs of Propositions 5 and 7. The lemma concerns the following system of equations,

$$\sum_{s\in S} q_s\left(\left(1-\pi_s\right)R^* + \pi_s p_s^*\right) = \sum_{s\in S} q_s\left(\left(1-\pi_s\right)R + \pi_s p_s\right), \tag{B.40}$$

$$\frac{1-\pi_s+\pi_s\frac{R^*}{p_s^*}}{1-\pi_s+\pi_s\frac{R}{p_s}} = \frac{u'\left(c_0^*\right)}{u'\left(c_0\right)} \text{ for each } s\in S'. \tag{B.41}$$

Here, $S' \subset S$ denotes the set of states with $\pi_s > 0$, and $\left(c_0, \left(p_s\right)_{s\in S}\right)$ correspond to the equilibrium variables in regular countries characterized in Proposition 1.

Lemma 3. *Under Assumption 2, there exists a unique solution to the system of equations* $(B.40 - B.41)$*, denoted by* $\left(c_0^*, \left(p_s^*\right)_{s\in S'}\right)$*. When* $R^* = R$*, the solution satisfies* $c_0^* = c_0$ *and* $p_s^* = p_s$ *for each* $s \in S'$*. When* $R^* > R$*, the solution satisfies* $\frac{u'(c_0^*)}{u'(c_0)} > \frac{R^*}{R} > 1$ *and* $p_s^* < p_s$ *for each* $s \in S'$*. In addition,* p_s^*/p_s *is increasing in* s *(where recall that* π_s *is increasing in* s*).*

Proof. We first show that there exists a unique solution. Note that, for each $s \in S'$ and $\tilde{c}_0 \in (0, c_0]$, Eq. $(B.41)$ has a unique solution, p_s^*. We denote the solution with the function, $P_s^*\left(\tilde{c}_0\right)$ defined over the range $\tilde{c}_0 \in (0, c_0]$). Note also that $P_s^*\left(\tilde{c}_0\right)$ is strictly increasing in $\tilde{c}_0$ and it satisfies $\lim_{\tilde{c}_0\to 0} P_s^*\left(\tilde{c}_0\right) = 0$ and $P_s^*\left(c_0\right) = \frac{R^*}{R} p_s \geq p_s$.

We next substitute $P_s^*\left(c_0^*\right)$ into Eq. $(B.40)$ to observe that the equilibrium consumption is determined by, $F\left(c_0^*\right) \equiv 0$, where we define $F\left(\cdot\right)$ as the function,

$$F\left(\tilde{c}_0\right) = \sum_s q_s\left(\left(1-\pi_s\right)R^* + \pi_s P_s^*\left(\tilde{c}_0\right)\right) - \sum_s q_s\left(\left(1-\pi_s\right)R + \pi_s p_s\right).$$

Note that $F\left(\tilde{c}_0\right)$ is strictly increasing in $\tilde{c}_0$ over $(0, c_0]$, and it satisfies $F\left(c_0\right) \geq 0$ since $R^* \geq R$ and $P_s^*\left(c_0\right) \geq p_s$. We also have

$$\begin{aligned}
\lim_{\tilde{c}_0\to 0} F\left(\tilde{c}_0\right) &= \sum_s q_s\left(1-\pi_s\right)R^* - \sum_s q_s\left(\left(1-\pi_s\right)R + \pi_s p_s\right) \\
&\leq \sum_s q_s\left(1-\pi_s\right)\left(R^* - R\right) - \sum_s q_s \pi_s \eta/e \\
&< 0.
\end{aligned}$$

Here, the first line uses $\lim_{\tilde{c}_0\to 0} P_s^*\left(\tilde{c}_0\right) = 0$, the second line follows from $p_s \geq \frac{\eta}{e}$ (cf. Eq. (13)), and the last line follows from Assumption 2. It follows that there exists a unique level of consumption, $c_0^* \in (0, c_0]$, that satisfies $F\left(c_0^*\right) = 0$. This in turn implies that the induced level of asset prices, $\left(P_s^*\left(c_0^*\right)\right)_{s\in S'}$, solve the system $(B.40 - B.41)$.

Next suppose $R^* = R$. In this case, it is easy to check (by guess and verify) that the solution features $c_0^* = c_0$ and $p_s^* = p_s$ for each $s \in S'$.

Next suppose $R^* > R$. In this case, we first show that $\frac{u'(c_0^*)}{u'(c_0)} > \frac{R^*}{R}$. To prove this, let $\bar{c}_0$ denote the level of consumption that satisfies $\frac{u'(\bar{c}_0)}{u'(c_0)} = \frac{R^*}{R}$. From our earlier analysis, it suffices to show that

$F(\overline{c}_0) > 0$. To this end, we substitute $\frac{u'(\overline{c}_0)}{u'(c_0)} = \frac{R^*}{R}$ into Eq. $(B.41)$ to observe that $P_s(\overline{c}_0)$ satisfies,

$$(1-\pi_s)\left(\frac{1}{R^*} - \frac{1}{R}\right) + \pi_s\left(\frac{1}{P_s(\overline{c}_0)} - \frac{1}{p_s}\right) = 0. \tag{B.42}$$

Since $R^* > R$, this equation implies $P_s(\overline{c}_0) \leq p_s$, with strict equality if $\pi_s < 1$. Note also that we have $p_s < R < R^*$ (see Proposition 1). Using these expressions, we obtain,

$$\begin{aligned}
(1-\pi_s)(R^*-R) + \pi_s(P_s(\overline{c}_0) - p_s) &= (1-\pi_s)\frac{(R^*-R)}{R^*R} + \pi_s\frac{(P_s(\overline{c}_0)-p_s)}{R^*R} \\
&\geq (1-\pi_s)\frac{(R^*-R)}{R^*R} + \pi_s\frac{(P_s(\overline{c}_0)-p_s)}{P_s(\overline{c}_0)\,p_s} \\
&= 0,
\end{aligned}$$

with strict inequality if $\pi_s < 1$. Here, the inequality follows because $P_s(\overline{c}_0) - p_s \leq 0$ and $P_s(\overline{c}_0)\,p_s < R^*R$, and the last line follows from Eq. $(B.42)$. After multiplying the previously displayed inequality with q_s and summing over s (and observing that $\pi_s < 1$ for at least one state), we obtain $F(\overline{c}_0) > 0$. This proves that $c_0^* < \overline{c}_0$ and thus $\frac{u'(c_0^*)}{u'(c_0)} > \frac{R^*}{R}$.

This analysis also implies that $p_s^* < p_s$ for each $s \in S'$. since

$$p_s^* = P_s(c_0^*) < P_s(\overline{c}_0) \leq p_s.$$

Here, the first inequality follows since the function $P_s(\cdot)$ is strictly increasing and the second inequality follows from Eq. $(B.42)$.

To establish the last claim in the lemma, consider $\tilde{s}, s$ with $\tilde{s} < s$ (and $\pi_{\tilde{s}} < \pi_s$). To reach a contradiction, suppose $\frac{p_{\tilde{s}}^*}{p_{\tilde{s}}} > \frac{p_s^*}{p_s}$, which also implies $\frac{R^*}{p_{\tilde{s}^*}} / \frac{R}{p_{\tilde{s}}} < \frac{R^*}{p_{s^*}} / \frac{R}{p_s}$. Then note that,

$$\begin{aligned}
\frac{1-\pi_{\tilde{s}} + \pi_{\tilde{s}}\frac{R^*}{p_{\tilde{s}^*}}}{1-\pi_{\tilde{s}} + \pi_{\tilde{s}}\frac{R}{p_{\tilde{s}}}} &< \frac{1-\pi_s + \pi_s\frac{R^*}{p_{\tilde{s}^*}}}{1-\pi_s + \pi_s\frac{R}{p_{\tilde{s}}}} \\
&< \frac{1-\pi_s + \pi_s\frac{R^*}{p_{s^*}}}{1-\pi_s + \pi_s\frac{R}{p_s}} \\
&= \frac{u'(c_0^*)}{u'(c_0)}.
\end{aligned}$$

Here, the first line follows since $1 < \frac{R^*}{p_{\tilde{s}^*}} / \frac{R}{p_{\tilde{s}}}$ and $\pi_{\tilde{s}} < \pi_s$, the second line follows since $\frac{R^*}{p_{\tilde{s}^*}} / \frac{R}{p_{\tilde{s}}} < \frac{R^*}{p_{s^*}} / \frac{R}{p_s}$, and the last line follows from Eq. $(B.41)$ applied for s. However, the resulting inequality provides a contradiction to Eq. $(B.41)$ applied for $\tilde{s}$ and proves that $\frac{p_{\tilde{s}}^*}{p_{\tilde{s}}} > \frac{p_s^*}{p_s}$. This completes the proof of the lemma. □

Proof of Proposition 5. Following similar steps as in Section 3, investors in the special country solve

the following problem,

$$\max_{x^{*,*},x^{out,*},y^*,(z_s^*)_s} u\left(c_0^*\right) + x^{*,*}R^* + \sum_s \gamma_s \left(x^{out,*}\overline{R}_s + y^* + z_s^*\right) M_s^*,$$
$$\text{where } c_0^* + x^{*,*} + x^{out,*} + q_f y^* + \sum_s q_s z_s^* = 1 + q_f \eta^*$$
$$\text{and } M_s^* \equiv 1 - \pi_s + \pi_s \frac{R^*}{p_s^*}.$$

Substituting $l_s^* = x^{out,*}\overline{R}_s + y^* + z_s^* - \eta^*$ and using the pricing relations $\sum_s q_s \overline{R}_s = 1$ and $\sum_s q_s = q_f$, the problem reduces to problem (29) in the main text, which we also replicate here,

$$\max_{x^{*,*}\geq 0,(l_s^*\geq -\eta^*)_s} u\left(c_0^*\right) + x^{*,*}R^* + \sum_s \gamma_s l_s^* M_s^*,$$
$$\text{where } c_0^* + x^{*,*} + \sum_s q_s l_s^* = 1.$$

Here, the constraint, $l_s^* \geq -\eta^*$, follows since investors are required to have nonnegative consumption.

We next show that $x^{*,*} = 0$, that is, investors in the special country also strictly prefer foreign risky assets (in period 0) to local risky assets. By Eq. (28), we have $E\left[\overline{R}_s^* \frac{q_s}{\gamma_s}\right] = 1$. This implies that one of the two must hold: (i) there exists an aggregate state $\tilde{s}$ such that $\overline{R}_{\tilde{s}}^* \frac{q_{\tilde{s}}}{\gamma_{\tilde{s}}} < 1$, or (ii) $\overline{R}_s^* \frac{q_s}{\gamma_s} = 1$ for each s.

First suppose (i) holds so that there exists an aggregate state $\tilde{s}$ such that $\overline{R}_{\tilde{s}}^* \frac{q_{\tilde{s}}}{\gamma_{\tilde{s}}} < 1$. From problem (29), the marginal return from investing in state $\tilde{s}$ is given by $\frac{\gamma_{\tilde{s}}}{q_{\tilde{s}}} M_{\tilde{s}}^*$. Combining this with the inequality, $\overline{R}_{\tilde{s}}^* \frac{q_{\tilde{s}}}{\gamma_{\tilde{s}}} < 1$, we obtain,

$$\frac{\gamma_{\tilde{s}}}{q_{\tilde{s}}} M_{\tilde{s}}^* > M_{\tilde{s}}^* \overline{R}_{\tilde{s}}^* \geq R^*.$$

Here, the second inequality follows since Lemma 1 shows $M_{\tilde{s}}^* \overline{R}_{\tilde{s}}^* > R^*$ if $\pi_{\tilde{s}} \in (0,1)$, and it can be checked that $M_{\tilde{s}}^* \overline{R}_{\tilde{s}}^* = R^*$ if $\pi_{\tilde{s}} = 0$ or $\pi_{\tilde{s}} = M$.Thus, in this case, investing in the aggregate state $\tilde{s}$ strictly dominates investing in the local risky asset.

Now suppose (ii) holds so that $\overline{R}_s^* \frac{q_s}{\gamma_s} = 1$ for each s. Let $\overline{s}$ be a state with $\pi_{\overline{s}} \in (0,1)$. Then, the marginal return from investing in state $\overline{s}$ is given by,

$$\frac{\gamma_{\overline{s}}}{q_{\overline{s}}} M_{\overline{s}}^* = M_{\overline{s}}^* \overline{R}_{\overline{s}}^* > R^*,$$

where the second inequality follows from Lemma 1. Thus, in this case, investing in the aggregate state $\overline{s}$ strictly dominates investing in the local risky asset.

Combining the two cases, we conclude that $x^{*,*} = 0$. The remaining optimality conditions for problem (29) imply Eq. (31) in the main text. Following similar steps as in Section 3, we also obtain Eq. (6).

It remains to show that (under Assumption 2) there exists a unique solution, $x^{in,*}, c_0, \left(l_s^*\right)_s, \left(p_s^*\right)_s$, to Eqs. $(28), (30), (31-32)$, and (33).

Note that Eqs. (28) and (31) correspond to Eqs. $(B.40)$ and $(B.41)$ we analyzed in Lemma 3. Using the lemma, there exists a unique solution to these equations that satisfy $c_0^* \leq c_0$ and $p_s^* \leq p_s$ for each s with $\pi_s > 0$.

This characterizes all prices except possible the price for state 1 when $\pi_1 = 0$. For this state, the price is characterized by Lemma 3 and Eq. (32). When $R^* = R$, we have an interior solution with $c_0^* = c_0$ and $p_1 = p_1^*$. When $R^* > R$, we have a corner solution with $c_0^* < c_0, l_1^* = -\eta^*$, which also implies $p_1 = 0$

in view of Eq. (33).

It follows that the equilibrium consumption level and prices, $\left(c_0^*, (p_s^*)_{s\in S}\right)$, are uniquely characterized and they satisfy $c_0^* \leq c_0$ and $p_s^* \leq p_s$ for each s. To characterize the remaining allocations, we multiply the market clearing conditions (33) with q_s and aggregate over all states to obtain,

$$\sum q_s \left(e + x^{in,*}\right) p_s^* = \sum_s q_s \left(\eta^* + l_s^*\right) = 1 + q_f \eta^* - c_0^*. \tag{B.43}$$

Here, the second equality follows from the budget constraint (30). Hence, the inflows solve the equation, $G\left(x^{in,*}\right) = 0$, where we define the function,

$$G\left(\tilde{x}^{in}\right) = \sum_s q_s \left(e + \tilde{x}^{in}\right) p_s^* + c_0^* - \left(1 + q_f \eta^*\right). \tag{B.44}$$

Note that $G\left(\tilde{x}^{in}\right)$ is increasing in $\tilde{x}^{in}$ with $\lim_{\tilde{x}^{in}\to\infty} G\left(\tilde{x}^{in}\right) = \infty$. Note also that

$$\begin{aligned} G(0) &\leq \sum q_s e p_s + c_0 - \left(1 + q_f \eta^*\right) \\ &= 1 + q_f \eta - \sum_s q_s p_s x - \left(1 + q_f \eta^*\right) \\ &= q_f \left(\eta - \eta^*\right) - \sum_s q_s p_s x < 0. \end{aligned}$$

Here, the first line follows since $p_s^* \leq p_s$ and $c_0^* \leq c_0$, the second line follows since the analogue of Eq. $(B.43)$ also holds for regular countries, and the last line follows from Assumption 2. It follows there exists a unique solution, $x^{in,*} > 0$, to the equation, $G\left(x^{in,*}\right) = 0$, which determines the equilibrium level of inflows.

Finally, using Eq. (13), we also obtain the equilibrium liquidity holdings,

$$l_s^* = p_s^* \left(e + x^{in,*}\right) - \eta^* \text{ for each } s.$$

This characterizes the equilibrium and completes the proof of Proposition 5. □

Proof of Proposition 6. It can be checked that Eqs. (35) solve the equation system $(28), (30), (31-32)$, and (33). By Proposition 5, this solution correspond to the equilibrium in the special country. The remaining statements in the proposition follow by inspecting the closed-form solution. □

Proof of Corollary 1. Next consider the special case with correlated shocks described in Section 4. Consider an increase in β. As described by Proposition 4, this reduces x and R_f. Next note that Eqs. (35) implies

$$\begin{aligned} \frac{\left|x^{\text{in},*} - x\right|}{x} &= \left(\frac{e}{x} + 1\right) |\Lambda - 1| \\ \text{and } |\Lambda - 1| &= \frac{|\eta^* - \eta|}{x R_f + \eta}. \end{aligned}$$

Since x and R_f declines, these expressions imply that $|\Lambda - 1|$ and $\frac{\left|x^{\text{in},*} - x\right|}{x}$ also decline. □

Proof of Proposition 7. By Lemma 3, the equilibrium features $c_0 > c_0^*, p_2 < p_2^*$, and $p_3 < p_3^*$. Since

$c_0 > c_0^*$, by Eq. (32), we also have $l_1^* = -\eta^*$. Finally, Lemma 3 also shows that $p_2/p_2^* < p_3/p_3^*$.

Note also that $c_0^* < c_0$ implies $X^{out,*} = 1 - c_0^* > x = 1 - c_0$. It remains to show that $x^{in,*} > X^{out,*} = 1 - c_0^*$. To this end, consider the function $G(\cdot)$ defined by Eq. $(B.44)$ in the proof of Proposition 5. Recall that the inflows are defined as the solution to $G\left(x^{in,*}\right) = 0$. Next note that,

$$\begin{aligned} G\left(X^{out,*}\right) &= \sum_s q_s \left(e + X^{out,*}\right) p_s^* + c_0^* - (1 + q_f \eta^*) \\ &< \sum_s q_s \left(e + X^{out,*}\right) p_s + c_0^* - (1 + q_f \eta) \\ &= c_0^* - c_0 + \left(X^{out,*} - x\right) \sum_s q_s p_s \\ &= (c_0^* - c_0) \left(1 - \sum_s q_s p_s\right). \end{aligned}$$

Here, the second line uses $p_s^* \leq p_s$ and $\eta^* = \eta$, the third line follows since the analogue of Eq. $(B.43)$ also holds for the regular countries, and the last line substitutes $X^{out,*} = 1 - c_0^*$ and $x = 1 - c_0$. Next note that $\sum_s q_s \overline{R}_s = 1$ [cf. Eq. (28)]. Since $p_s \leq \overline{R}_s$ with strict inequality for states with $\pi_s > 0$, this implies $\sum_s q_s p_s < 1$. Combining this with $c_0^* < c_0$, we have $G\left(X^{out,*}\right) < 0$. Since $G(\cdot)$ is an increasing function, it follows that the solution to $G\left(x^{in,*}\right) = 0$ satisfies $x^{in,*} > X^{out,*}$, completing the proof. □

Proof of Corollary 2. First consider a decrease in R. Let $\tilde{p}_2 = p_2/R$ denote the price-to-return ratio in state 2. Then, equations (23) and (24) (that characterize the equilibrium in regular countries) can be written in terms of $(\tilde{p}_2, x)$ as,

$$\begin{aligned} u'(1 - x) &= R \left(\beta + (1 - \beta)(1 - \pi + \pi \tilde{p}_2) \left(1 - \pi + \pi \frac{1}{\tilde{p}_2}\right)\right), \\ \text{and } \tilde{p}_2 &= \min\left(1, \frac{\eta/R + x(1 - \pi)}{e + x(1 - \pi)}\right). \end{aligned}$$

As before, the first equation describes $\tilde{p}_2$ as a decreasing function of x, the second equation describes $\tilde{p}_2$ as an increasing function of x, and the equilibrium corresponds to the intersection. Moreover, decreasing R strictly decreases the first curve for each x, and (under Assumption 1) strictly increases the second curve for each x. It follows that decreasing R decreases the equilibrium level of foreign investment, x. Thus, decreasing R also decreases the price level, $p_2 = \min\left(R, \frac{\eta + Rx(1-\pi)}{e + x(1-\pi)}\right)$, while leaving $p_3 = \min\left(R, \frac{\eta}{e}\right)$ unchanged.

Next note that Eq. (39) implies,

$$\frac{\overline{p} - \overline{p}^*}{R^* - R} = \frac{1 - \pi}{\pi} \frac{M_1 \beta + M_2 (1 - \beta)}{M_2 (1 - \beta) + M_3 \beta}. \tag{B.45}$$

This implies that $\frac{\overline{p} - \overline{p}^*}{R^* - R} < \frac{1-\pi}{\pi}$ since $M_1 < M_2 < M_3$.After substituting for $M_s = 1 - \pi_s + \pi_s \frac{R}{p_s}$, the equation can also be written as,

$$\frac{\overline{p} - \overline{p}^*}{R^* - R} \frac{\pi}{1 - \pi} = \frac{\beta \frac{1}{R} + (1 - \beta)\xi(R)}{(1 - \beta)\zeta(R) + \beta \frac{1}{p_3}}, \text{ where } \xi(R) = (1 - \pi)\frac{1}{R} + \pi \frac{1}{p_2}.$$

It can be checked that increasing $\xi(R)$ increases the right hand side (since it is less than one). Thus, de-

creasing R increases $\frac{\overline{p}-\overline{p}^*}{R^*-R}$, both directly via the $1/R$ term in the numerator, and indirectly by increasing $\xi(R) = (1-\pi)\frac{1}{R} + \pi\frac{1}{p_2}$. It follows that decreasing R decreases $\overline{p}^* - \overline{p}$.

Next consider a decrease in β. By Proposition 4, this increases x, which in turn increases p_2 and leaves p_3 unchanged. Thus, it also decreases M_2 and leaves M_1 and M_3 unchanged.

Inspecting Eq. $(B.45)$ illustrates that decreasing β tends to increase $\frac{\overline{p}-\overline{p}^*}{R^*-R}$ by decreasing the weight on the smaller marginal utility (M_1) in the numerator as well as the weight on the larger marginal utility (M_3) in the denominator. However, decreasing β also generates an indirect effect since it also decreases M_2. As it turns out, the indirect effect tends to decrease $\frac{\overline{p}-\overline{p}^*}{R^*-R}$, counteracting the direct effect. We conjecture that the indirect effect does not overturn the direct effect, that is, $\frac{d}{d\beta}\left(\frac{\overline{p}-\overline{p}^*}{R^*-R}\right) < 0$, which in turn implies that decreasing β decreases $\overline{p} - \overline{p}^*$ (equivalently, increases $\overline{p}^* - \overline{p}$).

To prove this conjecture, we differentiate Eq. $(B.45)$ with respect to β, which implies that $\frac{d}{d\beta}\left(\frac{\overline{p}-\overline{p}^*}{R^*-R}\right) < 0$ if and only if,

$$\frac{M_1\beta + M_2(1-\beta)}{M_2(1-\beta) + M_3\beta} > \frac{M_1 + \frac{d}{d\beta}(M_2(1-\beta))}{M_3 + \frac{d}{d\beta}(M_2(1-\beta))}$$

We make a second conjecture that $\frac{d}{d\beta}(M_2(1-\beta)) < 0$. Under this conjecture, the above inequality holds because,

$$\frac{M_1\beta + M_2(1-\beta)}{M_2(1-\beta) + M_3\beta} > \frac{M_1}{M_3} > \frac{M_1 + \frac{d}{d\beta}(M_2(1-\beta))}{M_3 + \frac{d}{d\beta}(M_2(1-\beta))}.$$

Here, the first equality follows from $M_1 < M_2 < M_3$, and the second inequality uses $M_1 < M_3$ together with $\frac{d}{d\beta}(M_2(1-\beta)) < 0$.

Hence, it remains to prove the second conjecture, $\frac{d}{d\beta}(M_2(1-\beta)) < 0$. To this end, note that Eq. (23) in Section 4 implies,

$$u'(1-x) = R\beta + ((1-\pi)R + \pi p_2)(1-\beta)M_2.$$

Taking the derivative with respect to β, and using $\frac{du'(1-x)}{d\beta} < 0$ (since increasing β decreases x), we obtain,

$$R + \pi\frac{dp_2}{d\beta}(1-\beta)M_2 + ((1-\pi)R + \pi p_2)\frac{d}{d\beta}(M_2(1-\beta)) < 0.$$

From here, note that $R + \pi\frac{dp_2}{d\beta}(1-\beta)M_2 > 0$ implies that $\frac{d}{d\beta}(M_2(1-\beta)) < 0$. That is, our second conjecture follows from a third conjecture,

$$(1-\beta)\pi\left(\frac{-dp_2}{d\beta}\right)M_2 < R. \tag{B.46}$$

To prove the third conjecture, note that Eq. (23) can also be written as,

$$\frac{u'(1-x)}{R} = \beta + (1-\beta)\left(1-\pi+\pi\frac{p_2}{R}\right)\left(1-\pi+\pi\frac{R}{p_2}\right).$$

Taking the derivative with respect to β, and using $\frac{du'(1-x)/R}{d\beta} < 0$, we obtain,

$$(1-\beta)\,\pi\left(\frac{-dp_2}{d\beta}\right)\frac{M_2}{R} < \frac{\left(1-\pi+\pi\frac{p_2}{R}\right)\left(1-\pi+\pi\frac{R}{p_2}\right)-1}{\frac{1-\pi+\pi\frac{p_2}{R}}{(1-\pi)\frac{1}{R}+\pi\frac{1}{p_2}}\frac{R}{p_2^2}-1} < 1$$

Hence, the last inequality follows since it is equivalent to, $\left(1-\pi+\pi\frac{R}{p_2}\right)\left((1-\pi)\frac{1}{R}+\pi\frac{1}{p_2}\right) < \frac{R}{p_2^2}$, which in turn holds since $1-\pi+\pi\frac{R}{p_2} < \frac{R}{p_2}$ and $(1-\pi)\frac{1}{R}+\pi\frac{1}{p_2} < \frac{1}{p_2}$. This establishes the third conjecture in $(B.46)$, which in turn implies $\frac{d}{d\beta}\left(\frac{\bar{p}-\bar{p}^*}{R^*-R}\right) < 0$. This completes the proof. □