Foreign Lenders in Emerging Economies

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Abstract

In recent decades, after liberalizing their credit markets emerging economies have frequently experienced sustained output growth but also large volatility of output and asset (e.g., real estate) prices. This paper studies an economy where firms face credit constraints tied to the pledgeable returns - output and collateralizable assets - of their investments and domestic and foreign lenders have different comparative advantages in obtaining investment returns. Building on evidence from emerging economies, we postulate that foreign lenders are more efficient than domestic ones in monitoring the output of specialized assets but have less information in the local market where assets are traded. The analysis reveals that opening the economy to foreign lenders can raise average productivity and output but also the volatility of output and of the price of collateral assets over the business cycle. These effects appear more pronounced the lower is the degree of contract enforceability in the economy.

JEL Codes: E44, F34.

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1 Introduction

The macroeconomic behavior of emerging economies has recently been the object of an intense debate. In the last three decades or so, several of these economies, such as Mexico, Argentina, Brazil, the South East Asian countries, have experienced sustained output growth but also large volatility of output and asset (e.g., real estate) prices (for a detailed account, see Neumeyer and Perri, 2005). A regularity that stands out in these boom-and-bust cycles is that they have often followed episodes of internationalization of the domestic credit markets. For example, foreign banks acquired a significant presence in South East Asia during the eighties and in Mexico and Argentina during the nineties. Tornell, Westermann, and Martinez (2003) have recently obtained empirical evidence that confirms this observation: analyzing a large set of middle-income countries, they have found that financial liberalization leads to more rapid growth but also to larger volatility and incidence of crises.

Drawing on this evidence, in this paper we put forth an explanation for the recent macroeconomic behavior of emerging economies based on the comparative advantages of foreign and domestic investors. Our explanation builds on one single premise: in emerging economies foreign and domestic lenders have allegedly different advantages in obtaining returns from the investments

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they finance. On the one hand, it is claimed that foreign lenders have a more efficient technology than local lenders for monitoring the output of sophisticated, specialized investments (see, e.g., Giannetti and Ongena, 2005; Dages, Goldberg, and Kinney, 2000). For example, internationally active U.S. banks can count on more efficient loan officers, more advanced information technologies, and sounder assessment practices than local banks of developing economies. This allows them to better monitor the specialized investments made by high growth companies or exporters, for example. On the other hand, it is acknowledged that domestic lenders have longer experience than foreign ones in the local asset markets (Dell'Ariccia, Friedman and Marquez, 1999). Given the lack of market transparency in emerging economies, this implies that, when financing investments, domestic lenders can have private information in the local market for collateral assets which is unavailable to foreign lenders (Boot and Kanatas, 1995). Thus, while more efficient at monitoring the specialized output of sophisticated businesses, foreign lenders may for instance be less efficient at disposing of their collateralized land or buildings - an activity fairly unsophisticated per se but that benefits from inside information in the local real estate market. We embed this asymmetry between foreign and domestic lenders in a general equilibrium model-economy where credit contracts are imperfectly enforceable and firms face credit constraints tied to the pledgeable returns - output and collateralizable assets - of their investments. We demonstrate that this single asymmetry can help explain why a liberalized emerging economy can experience higher average output but also larger volatility of asset prices and output than an emerging economy closed to foreign lenders. In particular, opening the economy to foreign lenders can raise the average productivity of investment but, through the linkage between asset prices and credit constraints, can increase the volatility in the volume and productivity of investment over the business cycle.

The intuition of the model can be summed up as follows. We let the firms that populate our economy invest in productive assets with various degree of specialization. Specialized assets are tailored to their businesses and, hence, yield more output in the event of success. However, in the event of default, they are specific to their businesses and, hence, illiquid. Firms can borrow from foreign or from domestic lenders to finance investments. Domestic lenders are reluctant to finance investment in specialized assets because these assets are illiquid. Thanks to their better ability to monitor specialized assets, foreign lenders can instead compensate for their illiquidity by obtaining higher repayment in the event of success. Liberalizing the credit market thus allows to exploit the comparative advantage of foreign lenders and finance more specialized investments, raising average productivity and output. However, liberalizing the credit market also exposes the economy to the comparative disadvantage of foreign lenders. Domestic lenders have private information in the local market for (collateral) assets and liquidate assets in this market in a timely manner. In contrast, because they know this market less and can only rely on public signals such as the asset price, foreign lenders make "mistakes" in the local asset market. In particular, they hoard assets during booms, when the asset price is peaking and projects should be liquidated; or they liquidate assets during recessions, when the asset price is plunging and assets should be hoarded. Their countercyclical asset supply renders the asset price more procyclical and, through the linkage between the asset price and credit constraints, it exacerbates output volatility.

The comparative advantages of foreign and domestic lenders interact in a rich manner over the business cycle. Consider the following example. Suppose that a positive shock to the productivity of assets raises their price. The increase of the asset (collateral) price renders generic/liquid assets relatively more attractive, discouraging domestic lenders from financing specialized/illiquid ones. This induces more firms to borrow from foreign lenders to finance investments in specialized assets. In turn, foreign lenders make mistakes in the local market for collateral assets: they hoard assets during the boom and resell them during the recession. Hence, the change in lenders' composition renders the asset price more procyclical. This can destabilize output. In fact, as the asset price becomes more procyclical, credit constraints loosen during the boom and tighten during the recession. This raises the volume of investment financed during the boom and lowers it during the recession, exacerbating output volatility. Moreover, unlike domestic lenders, foreign ones finance specialized investments even when the asset (collateral) price rises during the boom.

Therefore, the rise (drop) in the volume of investment during the boom (recession) is accompanied by a rise (drop) in its average productivity. This "investment productivity" effect reinforces the "investment volume" effect and further exacerbates output volatility.

The plan of the paper is as follows. In Section 2, we relate the paper to the prior literature. Section 3 lays out the setup. In Section 4, we solve the model. Section 5 characterizes the equilibrium. In Section 6, we discuss our results. In Section 7, we perform robustness and sensitivity analyses. Section 8 concludes. Details on the solution algorithm are relegated to the Appendices.

2 Prior Literature

This paper speaks to three strands of literature. The first strand investigates the role of financial markets in the instability of emerging open economies. Aghion, Bacchetta and Banerjee (2004) develop a model where financial inflows tend to increase firms' profits by promoting investment but also tend to reduce profits by increasing the price of a non-tradeable input. Furthermore, in their economy firms' investment is tied to their profits through credit constraints (à la Bernanke and Gertler, 1989). Aghion, Bacchetta and Banerjee (2004) show that, as a result of these mechanisms, liberalizing the capital account of a middle-income economy can increase the volatility of its business cycle. Other studies in this strand of literature explain the instability of emerging open economies by focusing on the build-up of a currency or maturity mismatch between banks' assets and liabilities. In Diamond and Rajan (2001), domestic banks intermediate the short-term funds of foreign dispersed investors. The short-term maturity of their liabilities commits domestic banks to fund illiquid investments, but also generates a maturity mismatch between assets and liabilities. In turn, this mismatch exposes the economy to financial crises.[1] In this strand of literature, our paper also shares features with Caballero and Krishnamurty (2001), who develop a model of financial crises based on the interaction between a foreign credit constraint - faced by the whole economy in the international financial market - and a domestic credit constraint - faced by domestic firms vis à vis domestic banks. Despite our different objective and mechanism, we share with Caballero and Krishnamurty (2001) the distinction between project returns easily pledgeable to foreign investors (output or international collateral) and project returns easily pledgeable to domestic investors (local collateral).

This paper also relates to the growing literature on the role of financial imperfections in generating endogenous business cycles. The seminal paper of Kiyotaki and Moore (1997) shows that, through their effect on credit constraints, changes in asset prices can amplify productivity shocks. As stressed by Matsuyama (2006), in Kiyotaki and Moore (1997) financial imperfections propagate and amplify shocks but do not generate endogenous business cycles. This is a critical issue. While it is argued that in emerging economies the booms endogenously created the conditions for the subsequent recessions, most of the literature on financial imperfections restricts attention to the amplification of shocks and cannot explain a boom-and-bust cycle.[2] Our analysis contributes instead to a small stream of papers in which financial imperfections generate instability and fluctuations besides amplification and propagation. In Matsuyama (2006), for example, during booms credit flows to "bad" projects, meant as projects more exposed to credit constraints and that generate less pecuniary externalities. This change in the composition of projects progressively erodes borrowers' net worth until the economy peaks and enters a recession. In Matsuyama (2006), financiers are homogenous and business fluctuations stem from changes in the composition of projects. In our economy, endogenous business fluctuations stem from changes in the composition of lenders.[3]

[1] Neumeyer and Perri (2005) explain the instability of emerging open economies with the interaction between the real interest rate and firms' wage bill.

[2] The self-reinforcing nature of booms or busts is also at the core of models of liquidity in the financial sector. Focussing on the banking sector, Allen and Gale (2004) study an economy where declines in asset prices force some banks into liquidation, which in turn further depresses asset prices, in a self-reinforcing manner. In a different vein, Guerrieri and Lorenzoni (2008) and Perez (2008) investigate how the expectation of credit constraints affects investors' choice between liquid and illiquid assets and how, in turn, this choice can amplify aggregate shocks.

[3] Several scholars argue that during the booms of emerging economies there was no progressive deterioration of

Finally, this paper relates to the literature on asset pricing in environments with informed and uninformed traders. In Grossman and Stiglitz (1980) some traders extrapolate information on the future return of a risky asset from its current price. However, the asset price can convey imperfect information on future returns. In fact, uninformed traders can be unable to discern whether the asset price is high because the future asset return will be high or because the current asset supply is low. In our economy, the behavior of domestic (foreign) lenders in the local asset market resembles that of informed and uninformed traders in Grossman and Stiglitz (1980). In particular, if the asset price was a fully revealing public signal, there would be no difference in the behavior of domestic and foreign lenders in the asset market and endogenous cycles would not occur. Therefore, this paper may also be broadly viewed as an application of Grossman and Stiglitz (1980) to the analysis of business cycles in economies with credit imperfections.[4]

3 Model Setup

Agents and Goods. The economy lasts two periods ($t = 1, 2$) and each period has a "production stage" and a "liquidation stage". The population comprises a unit continuum of entrepreneurs and two continua of lenders (l), domestic ($l = d$) and foreign ($l = f$), each of measure larger than one. There are two storable goods, a final good and productive assets. In both periods, every lender starts out with an amount I of final good. Entrepreneurs expect utility $U_t = E_t(c_t)$ from their consumption of final good while lenders expect utility $U_t^l = E_t(c_t^l + c_{t+1}^l)$.

Real Sector.

Production. Each entrepreneur can operate one project during the production stage. At the beginning of the project, she can transform an amount I of final good into an amount A of assets. The entrepreneur also chooses the degree of specialization $n_t \in [0, 1]$ of her assets, sustaining an effort cost $n_t^2/2$. At the end of the project, the assets produce with probability π (after which they depreciate); otherwise, production fails but the assets can be liquidated. The expected return is

$$\pi y(1 + n_t) + (1 - \pi)Av_t(1 - n_t). \tag{1}$$

In (1), $y(1 + n_t)$ is the output of final good in the event of success, where $y \in [y_{\min}, y_{\max}]$ is distributed across entrepreneurs according to the probability density function $f(.)$; Av_t is the amount of final good expected in the event of asset liquidation, gross of liquidation costs. As (1) illustrates, by specializing her assets an entrepreneur can obtain an additional output yn_t but she renders the assets more specific to her business and, hence, illiquid. $Av_t n_t$ is the final good lost in liquidation costs upon resale.[5]

Liquidation. During the liquidation stage, each entrepreneur can employ one unit of liquidated assets in a second use. The assets produce an amount $x\theta_t$ of final good (after which they depreciate). $x \in [0, 1]$ reflects an entrepreneur's idiosyncratic productivity as a second hand user and is uniformly distributed across entrepreneurs. θ_t reflects entrepreneurs' aggregate productivity as second hand users and satisfies

$$\theta_1 = \theta + \varepsilon \tag{2}$$

$$\theta_2 = \theta, \tag{3}$$

where $\varepsilon \in [\varepsilon_{\min}, \varepsilon_{\max}]$ and $\varepsilon \sim h(.)$, while θ can take on the value θ^H ("boom") or $\theta^L < \theta^H$ ("recession"). We denote by $Pr(\theta_2{=}\theta^H \,|\, \theta_1 - \varepsilon{=}\theta^L)$ ($Pr(\theta_2{=}\theta^L \,|\, \theta_1 - \varepsilon{=}\theta^H)$) the probabil-

the quality of projects and that the most evident regularity consisted instead of firms' tendency to borrow from foreign investors in the wake of liberalization (see, e.g., Radelet and Sachs, 1998).

[4] There is a literature that uses the intuition of Grossman and Stiglitz (1980) to explain asset market crises and contagion. For example, Yuan (2005) constructs a model in which informed traders are credit rationed. She shows that the informativeness of the asset price decreases when the price falls, generating crises and contagion.

[5] For the costs of asset repossession, liquidation and redeployment see, e.g., Ramey and Shapiro (2001).

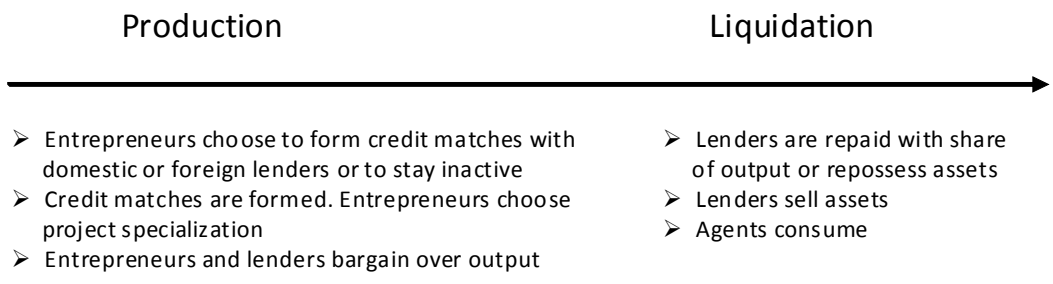

Figure 1: Time line in a period.

ity that the economy transits from a boom to recession (respectively, from a recession to a boom) from the first to the second period.

Credit Sector. At the beginning of the production stage, each entrepreneur can form a credit match with a lender to finance her project. Credit matches feature limited contractibility (as in Rajan, 1992, for example). An entrepreneur can pledge to operate a generic (G) project ($n_t = 0$) or a specialized (S) one ($n_t > 0$) but, conditioning on specializing ($n_t > 0$), she cannot commit to a particular degree of specialization n_t. Moreover, as explained below, an entrepreneur can only pledge part of the output of her project to her lender. During a project, entrepreneur and lender engage in a Nash bargaining over the allocation of the project returns. As in standard credit contracts, the lender retains the right to repossess and liquidate the assets if the project fails.

Lenders. We aim at describing an emerging economy where in the credit sector local lenders operate alongside foreign lenders from an advanced economy. We capture this by assuming that foreign and domestic lenders have different comparative advantages in obtaining project returns. On the one hand, foreign lenders have a more sophisticated technology than domestic ones for monitoring the output of specialized assets.[6] Specifically, in the event of project success the maximum output a lender $l = d, f$ can monitor and obtain as repayment equals $(1 - \alpha)y + \min\{\omega^l, yn_t\}$, where $0 < \alpha < 1$ and $0 < \omega^d < \omega^f$. On the other hand, foreign lenders have less experience and information in the local asset market. Specifically, while the asset price p_t is publicly observable, at the beginning of the production stage only entrepreneurs and domestic lenders observe the realization of θ_t and (in the first period) ε.

Remark. In the real world, at any time some projects are financed and others are liquidated. Hence, a market is always open where collateral assets are traded. In our economy, project financing occurs during the production stage while project liquidation occurs during the liquidation stage. To guarantee that entrepreneurs and lenders observe the asset price when they make financing decisions, we can think that at the beginning of the morning an asset market is open where entrepreneurs post their asset demand for the liquidation stage and lenders post their supply, contingent on the failure of funded projects. An auctioneer then computes the total demand and supply at each price level and announces the price that clears the market.

3.1 Discussion of the Setup

Agents and Real Sector. The assumption that entrepreneurs discount the future more than lenders is standard in the literature on credit imperfections (see, e.g., Kiyotaki and Moore, 1997). This guarantees that in the first period entrepreneurs do not save enough to self-finance their

[6] The different efficiency of financial institutions across countries is widely acknowledged in the literature (see, e.g., Mendoza, Quadrini, and Ríos-Rull, 2007).

projects in the second period. The restriction that entrepreneurs (lenders) are fully impatient (patient) is for simplicity. In the real sector, the salient feature is that specialized assets yield more output than generic ones in the event of success but they are less liquid in the event of default. This characterizes specialized assets as highly productive but specific and illiquid.

Credit Sector. In the credit sector, the assumption of limited contractibility renders the choice between domestic and foreign lenders non-trivial. As it will become evident shortly, if output or the degree of specialization were perfectly contractible no entrepreneur would need to borrow from a foreign lender. The way we specify limited contractibility follows the literature. In Rajan (1992), for example, entrepreneurs have limited ability to pledge to repay all their output or to implement actions during projects (such as the specialization effort in our setup).

Lenders. The assumption that domestic and foreign lenders have different comparative advantages in obtaining project returns constitutes the distinctive feature of our economy. Financial institutions of advanced economies have a more sophisticated technology for monitoring borrowers' behavior and output than local institutions of developing economies. In fact, internationally active financial institutions (e.g., multinational banks) employ more efficient inputs to monitor projects, such as better trained loan officers, a more advanced information technology, and sounder assessment practices. This advantage kicks in when projects are fairly sophisticated, for instance consisting of the ventures of exporters trying to market specialized products in the international market. However, domestic lenders have longer experience and more inside information than foreign ones in the local asset market. This is especially true in an emerging economy, where local markets often lack transparency, and even more true if the economy has recently undergone financial liberalization and faces the entry of foreign lenders unfamiliar with the local asset market.

Note that a closely related interpretation of the asymmetry between domestic and foreign lenders could be as follows. Firms that borrow from foreign banks are generally large businesses engaged in exporting their products (Giannetti and Ongena, 2007). Thus, an important share of their output consists of export revenues, which foreign lenders are well accustomed to monitoring and seizing in the international goods market. In contrast, firms' collateral typically consists of fixed, non-tradable assets that are difficult to abscond, such as real estate (Kiyotaki and Moore, 1997). A typical feature of real estate markets is their idiosyncrasy: the organization of these markets, their liquidity and the type of institutions differ across countries. Therefore, when foreign lenders liquidate real estate in the local market, the experience built in their home market could be of little use. In this interpretation, the asymmetric skills of foreign and domestic lenders stem from the higher international tradeability of output relative to collateral.

4 Model Solution

In solving the model, we focus first on agents' decisions taking as given the asset prices p_1 and p_2. We start with agents' decisions in the credit market, assuming that in a credit match a lender has full bargaining power vis-à-vis an entrepreneur. We proceed backward. We first solve for the degree of specialization n_t chosen by an entrepreneur. We then solve for a lender's decision whether to finance a generic project ($n_t = 0$), to finance a specialized project ($n_t > 0$), or to store her endowment. Finally, we solve for the decision of an entrepreneur whether to form a credit match with a domestic lender, to form a credit match with a foreign lender, or to remain inactive. We then turn to lenders' decision in the asset market. In the first period, in the event of project failure and asset repossession, a lender can resell the assets or store them with the objective of reselling them in the second period. Thus, we solve for this asset sale decision. After solving for agents' decisions, we derive the asset demand and supply in each period and solve for the asset prices p_1 and p_2.

4.1 Agents' Decisions

Credit Market. We first solve for the degree of specialization n_t chosen by an entrepreneur. An entrepreneur takes into account that, as a result of the bargaining process, the repayment extracted by her lender in the event of success will equal $(1-\alpha)y + \min\left\{\omega^l, yn_t\right\}$ and that, if she specializes ($n_t > 0$), she will bear an effort cost $n_t^2/2$. Therefore, in period t her expected return is

$$W_t^G = \pi\alpha y \tag{4}$$

if she operates a generic project,

$$W_t^{Sl} = \pi[\alpha y + \max(0, yn_t - \omega^l)] - \frac{n_t^2}{2} \tag{5}$$

if she operates a specialized project and has borrowed from a lender of type $l = d, f$, and zero if she has not obtained financing. Simple maximization of W_t^{Sl} implies that $n_t \in \{0, \pi y, 1\}$ if the entrepreneur operates a specialized project.

We now turn to the decision of a lender whether to finance a generic project, to finance a specialized project, or to store her endowment. Let ℓ^l be an indicator variable taking on the value one if in the event of project failure a lender of type $l = d, f$ resells assets in the first period, and zero otherwise. It is straightforward that in the first period a lender's expected return from financing a generic project equals

$$V_1^{Gl} = \pi(1-\alpha)y + (1-\pi)A\left[\ell^l p_1 + (1-\ell^l)E^l(p_2)\right], \tag{6}$$

her expected return from financing a specialized project equals

$$V_1^{Sl} = \pi[(1-\alpha)y + \min\left\{\omega^l, yn_t\right\}] + (1-\pi)A\left[\ell^l p_1 + (1-\ell^l)E^l(p_2)\right](1-n_t), \tag{7}$$

while her return from storing her endowment equals I. In the second period, analogous expressions apply, with the difference that assets are necessarily resold and, hence, p_2 replaces $\ell^l p_1 + (1-\ell^l)E^l(p_2)$ in (6) and (7). The trade-off the lender faces can be understood by inspecting (6) and (7). The lender will finance a specialized project if and only if the higher repayment she may obtain from this project relative to a generic project exceeds her expected loss due to the lower asset liquidity, i.e.

$$V_1^{Sl} > V_1^{Gl}, \tag{8}$$

and her expected return from the specialized project exceeds her opportunity cost of funds I, i.e.

$$V_1^{Sl} > I. \tag{9}$$

Symmetric conditions and reasoning (omitted for brevity) hold for the financing of a generic project and for storage of the endowment. Clearly, because $\omega^f > \omega^d$ a foreign lender is more willing to finance a specialized project than a domestic lender. This is where the comparative advantage of foreign lenders kicks in.

Finally, we need to solve for the decision of an entrepreneur whether to form a credit match with a domestic lender, to form a credit match with a foreign lender, or to remain inactive. This decision is straightforward: an entrepreneur will form a credit match only if her expected return from the match exceeds her zero return from inaction. Moreover, if both the match with a domestic lender and that with a foreign lender dominate inaction, the entrepreneur will form the credit match with the highest expected return.

Asset Market. Having solved for agents' decisions in the credit market, we can now turn to lenders' decision in the asset market. Consider the first period decision of a lender when to resell

assets in the event of project failure. The lender compares her proceeds in the first period with her expected proceeds in the second. Breaking ties in favor of early resale,

$$\ell^l = \begin{cases} 1 & if \quad p_1 \geq E^l[p_2 \left| \Im_1^l \right.] \\ 0 & if \quad p_1 < E^l[p_2 \left| \Im_1^l \right.] \end{cases} , \tag{10}$$

where $E^l[p_2 \left| \Im_1^l \right.]$ is the first period expectation of the second period asset price p_2 conditional on the information set $\Im_1^l$. Remember that, when the resale decision is made, the information set of a domestic lender includes the realizations of θ_1 and ε, while that of a foreign lender only includes the current asset price.[7] This is where the comparative advantage of domestic lenders kicks in.

4.2 Asset Price

Having studied agents' decisions, we now turn to the determination of the asset price in the local asset market. In each period, in equilibrium, the asset demand M_t^d equals the asset supply M_t^s. Consider first the asset demand. Each entrepreneur with $x\theta_t \geq p_t$ demands one unit of assets for second use. Given the uniform distribution of x,

$$M_t^d = 1 - \frac{p_t}{\theta_t}. \tag{11}$$

Consider next the asset supply. In the first period, only the assets of the projects failed in the first period and not stored by lenders are resold. Therefore,

$$M_1^s = M_1^{sd} + M_1^{sf} \tag{12}$$

where M_1^{sd} (M_1^{sf}) is the supply of assets by domestic (foreign) lenders. In the second period, the assets of the projects failed in the first period and stored by lenders are resold together with the assets of the projects failed in the second period. Therefore,

$$M_2^s = M_2^{sfd} + \widehat{M}_1^{sd} + \widehat{M}_1^{sf} \tag{13}$$

where M_2^{sfd} is the supply of assets that come from projects failed in the second period, while $\widehat{M}_1^{sd}$ ($\widehat{M}_1^{sf}$) is the supply of assets that come from projects failed in the first period and that have been stored by domestic (foreign) lenders. Observe that in both periods the asset supply depends upon lenders' resale decisions ℓ^d and ℓ^f.

5 Equilibrium

We are now in a position to define an equilibrium of our economy.

Definition. *For given support* $[\varepsilon_{\min}, \varepsilon_{\max}]$ *and probability density function h(.) of* ε; *support* $[y_{\min}, y_{\max}]$ *and probability density function f(.) of* y; *stochastic process of* θ, *i.e. Prob.(*$\theta_1 - \varepsilon = \theta^H$*) and Prob.(*$\theta_2 = \theta^H \left| \theta_1 - \varepsilon = \theta^H \right.$*); realizations* $\theta_1, \varepsilon, \theta_2$; *structural parameters* A,I,π,α,ω^d,ω^f; *a rational expectations equilibrium (REE) is defined by a vector of prices and quantities*

$$\mathrm{V} = [p_1, p_2, E^d(p_2), E^f(p_2), M_1^d, M_2^d, M_1^s, M_2^s, \ell^d, \ell^f] \tag{14}$$

[7] As it will become clear later in the analysis, two different combinations of θ and ε can lead to the same equilibrium asset price p_1. Hence, foreign lenders can be unable to exactly infer the realization of θ in the first period. Note that the group of agents who borrow from foreign lenders may differ in two different equilibria with the same asset price. Thus, in principle, by observing the productivity of their borrowers, some foreign lenders could realize that their borrowers would indeed resort to them only in one of the two equilibria. We reason as if lenders choose their asset supply before observing the productivity of their borrowers. Allowing borrowers' productivity to convey extra information to foreign lenders would not add to the message of the paper and would render the analysis more cumbersome.

such that entrepreneurs and lenders maximize their utility and the credit and asset markets clear in both periods.

Before turning to characterize the equilibrium, we introduce simplifying assumptions about the probability density functions and the parameters. These assumptions entail no loss of generality and render the intuition clearer. First of all, we assume that the probability density functions $f(.)$ of y and $h(.)$ of ε are triangular. This distribution guarantees that the returns of both successful and liquidated assets are bounded and yields intuitive insights. Second, we let $Pr(\theta_2{=}\theta^H \left| \theta_1 - \varepsilon{=}\theta^L \right.){=}Pr(\theta_2{=}\theta^L \left| \theta_1 - \varepsilon{=}\theta^H \right.){=}1$, that is the economy can experience a boom followed by a recession or a recession followed by a boom. This assumption is purely for expositional purposes. Finally, we introduce two technical parameter restrictions to avoid corner solutions in entrepreneurs' choice of the degree of specialization (i.e. to guarantee that an entrepreneur chooses $n_t \in (0,1)$ if her lender finances a specialized project):[8]

$$\pi y_{\max} < 1, \tag{15}$$

$$0 < \omega^d < \pi y_{\min}^2. \tag{16}$$

We can now characterize the equilibrium. Because this paper explores a possibility result, our objective is not to characterize all equilibria but to show that in some equilibria the model can replicate the behavior of liberalized emerging economies. We explain the properties of such equilibria in two steps. First, we characterize the distribution of entrepreneurs according to whether they are financed or not and to the type of lender - domestic or foreign - they borrow from. This also allows us to pin down the asset supply. Second, we study the pattern of output and asset prices. This stepwise presentation of the equilibrium is for expositional purposes because all endogenous variables are determined jointly. Specifically, we need to solve a general equilibrium system with a problem of signal extraction by foreign lenders. In fact, in our economy the equilibrium asset price has both a "substitution effect" and an "information effect" (Admati, 1985): not only it clears the asset market, but in the first period it also affects the information set of foreign lenders by conveying information about the underlying θ and, hence, about θ_2 (which in turn determines the asset demand in the second period, as in (11)). If the equilibrium price p_1 does not reveal θ, foreign lenders will potentially make different asset sale decisions from domestic ones.[9]

It is well known that even simple noisy rational expectations models with diversely informed agents rarely admit closed form solutions (Admati, 1985). We have kept our economy simple to have a clear intuition of the mechanisms at work. Yet, since the equilibrium system is still too complex to be solved in closed form we resort to simulations. Let us start with entrepreneurs' distribution. We are interested in equilibria in which i) credit constraints bind for a positive measure of entrepreneurs so that some entrepreneurs are not financed and ii) both domestic and foreign lenders finance a positive measure of entrepreneurs so that foreign lenders are not redundant. We focus on a region of the parameter space such that in equilibrium entrepreneurs' distribution satisfies the following properties (refer to Figure 2 for an illustration).

I. Entrepreneurs' Distribution. *There is a region of the parameter space such that:*

i. Financing. *In each period t, there exists a threshold value $\underline{y}_t$ ($y_{\min} < \underline{y}_t < y_{\max}$) such that a) the entrepreneurs with $y \in [\underline{y}_t, y_{\max}]$ obtain credit and operate specialized projects; whereas b) the entrepreneurs with $y \in [y_{\min}, \underline{y}_t]$ remain inactive.*

[8] Restriction (15) guarantees that the optimal degree of specialization $n_t = \pi y$ never hits its upper bound (one). Restriction (16) guarantees that, when an entrepreneur borrows from a domestic lender, the optimal degree of specialization $n_t = \pi y$ never hits its lower bound (zero).

[9] The limited informativeness of p_1 stems from the randomness of the asset demand which, in turn, is due to the randomness of the aggregate productivity θ_1 (as induced by the noise ε). This feature of our environment parallels Grossman and Stiglitz (1980), where the randomness of the supply of a risky asset dilutes the informativeness of its equilibrium price.

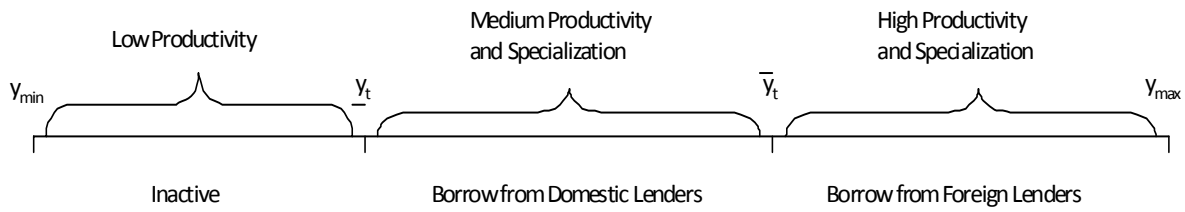

Figure 2: Entrepreneurs' distribution across productivity levels.

ii. Lender Type. *In each period t, there exists a threshold value $\overline{y}_t$ ($\underline{y}_t < \overline{y}_t < y_{\max}$) such that a) the entrepreneurs with $y \in [\underline{y}_t, \overline{y}_t]$ borrow from domestic lenders; whereas b) the entrepreneurs with $y \in (\overline{y}_t, y_{\max}]$ borrow from foreign lenders.*

The distribution in Figure 2 appears to match the borrowing pattern of emerging economies. In fact, in these economies highly productive and specialized businesses (e.g., exporters, high growth companies, sophisticated innovators) often borrow from foreign lenders, while less productive and specialized ones borrow from local lenders. The intuition behind this distribution is easy to grasp. Entrepreneurs with low productivity ($y \in [y_{\min}, \underline{y}_t]$) cannot pledge enough returns to lenders and cover their opportunity cost of funds I. These entrepreneurs do not obtain credit and remain inactive. Medium productive entrepreneurs ($y \in [\underline{y}_t, \overline{y}_t]$) can instead borrow from domestic lenders to finance projects. Moreover, since domestic lenders extract less output than foreign ones ($\omega^d < \omega^f$) in the event of success, these entrepreneurs have no incentive to borrow from foreign lenders. Finally, highly productive entrepreneurs ($y \in [\overline{y}_t, y_{\max}]$) need to resort to foreign lenders to finance projects. In fact, the specialization of these entrepreneurs is high and the liquidity of their assets low. This implies that domestic lenders are unwilling to finance them. In contrast, foreign lenders finance them because they can compensate for the illiquidity of their collateral assets by obtaining a higher repayment in the event of success.

When entrepreneurs' distribution satisfies the properties in (I) we can rewrite the asset supply as a function of the sale decisions of domestic and foreign lenders in the first period (respectively, ℓ^d and ℓ^f) and the productivity thresholds $\underline{y}_t$ and $\overline{y}_t$ that partition the distribution. Specifically, in the first period

$$M_1^s = \underbrace{(1-\pi)A\ell^d\left[F(\overline{y}_1) - F(\underline{y}_1)\right]}_{M_1^{sd}} + \underbrace{(1-\pi)A\ell^f\left[(1-F(\overline{y}_1)\right]}_{M_1^{sf}} \tag{17}$$

where M_1^{sd} (M_1^{sf}) is the supply of assets by domestic (foreign) lenders. In the second period,

$$M_2^s = \underbrace{(1-\pi)A[1-F(\underline{y}_2)]}_{M_2^{sfd}} + \underbrace{(1-\pi)A(1-\ell^d)\left[F(\overline{y}_1) - F(\underline{y}_1)\right]}_{\widehat{M}_1^{sd}} + \underbrace{(1-\pi)A(1-\ell^f)\left[1-F(\overline{y}_1)\right]}_{\widehat{M}_1^{sf}}. \tag{18}$$

where M_2^{sfd} is the supply of assets that come from projects failed in the second period, while $\widehat{M}_1^{sd}$ ($\widehat{M}_1^{sf}$) is the supply of assets that come from projects failed in the first period and that have been stored by domestic (foreign) lenders.

We can now turn to the core of our analysis, that is the equilibrium patterns of output and asset prices. We compare these patterns with those that would occur in a benchmark economy (denoted by superscript B) closed to foreign lenders, for example because of entry regulation. We focus on the boom-recession scenario (the results for the recession-boom scenario are symmetric).

II. Output and Asset Price. *Consider a benchmark economy where no entrepreneur is allowed to borrow from a foreign lender. Assume that a boom occurs in the first period followed by a recession in the second period, that is* $\theta_1 - \varepsilon = \theta^H$ *and* $\theta_2 = \theta^L$*. There exists a region of the parameter space such that entrepreneurs' distribution satisfies the properties in (I) in both our economy and the benchmark economy (with the caveat that in the latter* $\overline{y}_1^B = \overline{y}_2^B = y_{\max}$*, i.e. all active entrepreneurs borrow from domestic lenders) and in addition the following results apply:*

i. (Asset Price Volatility) *In the first-period boom the asset price is higher than in the benchmark economy. In the second-period recession the asset price is instead lower than in the benchmark economy. The percentage asset price drop from the boom to the recession is larger than in the benchmark economy, i.e.*

$$\frac{p_2}{p_1} - \frac{p_2^B}{p_1^B} > 0; \tag{19}$$

ii. (Output Average) *The average output across the two periods is larger than in the benchmark economy. Formally, defining output in our (the benchmark) economy in the two periods as* $\mathcal{Y}_1$ *and* $\mathcal{Y}_2$ *(*$\mathcal{Y}_1^B$ *and* $\mathcal{Y}_2^B$*),*

$$g = \frac{\mathcal{Y}_1 + \mathcal{Y}_2}{\mathcal{Y}_1^B + \mathcal{Y}_2^B} > 1; \tag{20}$$

iii. (Output Volatility) *In the first-period boom, output is larger than in the benchmark economy; in the second-period recession, output is lower than in the benchmark economy. The percentage output drop from the boom to the recession is larger than in the benchmark economy, i.e.*

$$v = \frac{\mathcal{Y}_2}{\mathcal{Y}_1} - \frac{\mathcal{Y}_2^B}{\mathcal{Y}_1^B} > 0. \tag{21}$$

As we shall see shortly, our result holds for a broad region of the parameter space. But let us first consider a baseline parameterization. We need to choose the support of the idiosyncratic project return (y); the realizations of θ^H, θ^L and ε, which determine the aggregate productivity of liquidated assets, as well as the probability $\Pr(\theta^H)$ of θ^H and the support of ε; the three technological parameters π (probability of project success), A (amount of collateralizable assets of a project) and I (investment in the project); and the two enforceability parameters, ω^d (amount of specialized output pledgeable to domestic lenders) and $1 - \alpha$ (share of non-specialized output pledgeable to domestic or foreign lenders).[10]

Baseline Parameterization. In our baseline parameterization, we let the aggregate productivity of second-hand users satisfy the following values: in the first period, $\theta_1 = \theta^H + \varepsilon = 0.55$, where $\theta^H = 0.75$ and $\varepsilon = -0.2$; in the second period, $\theta_2 = \theta^L = 0.5$. The remaining parameters are as follows: the distribution of y is a symmetric triangular over the interval $[0.5, 1]$; the distribution of ε is a symmetric triangular over the interval $[-0.5, 0.5]$; moreover, $\Pr(\theta^H) = 0.85$, $A = 0.5$, and $I = 0.5$. Collectively, these parameters imply that the minimum (average) return of a successful non-specialized project equals the investment in the project 0.5 (respectively, 0.75), while the maximum return a lender obtains from liquidating assets in the first (second) period equals 0.275 (0.25), that is roughly half the investment in the project. We set the probability of project success π at 60%. Finally, we let the enforceability parameters satisfy $\alpha = 0.2$ and $\omega^d = 0.1$, meaning that 20% of the output of a non-specialized project can be absconded by an entrepreneur. Plugging in these values, we find that: i) in our economy, the asset price drops by about 8.8 percent, from 0.5176 to 0.4721. In the benchmark economy, it drops by about 8.5 percent, from 0.5167 to 0.4729. ii) The average output in the two periods equals 0.2437 while in the benchmark economy it equals 0.2425. Thus, $g = 0.5$ percent. iii) In the first period, output is 0.257 in our economy, 0.2546 in

[10] We do not need to specify ω^f (amount of specialized output pledgeable to foreign lenders) as this does not enter the equilibrium system. In the Appendix, we set appropriate restrictions on the value of ω^f.

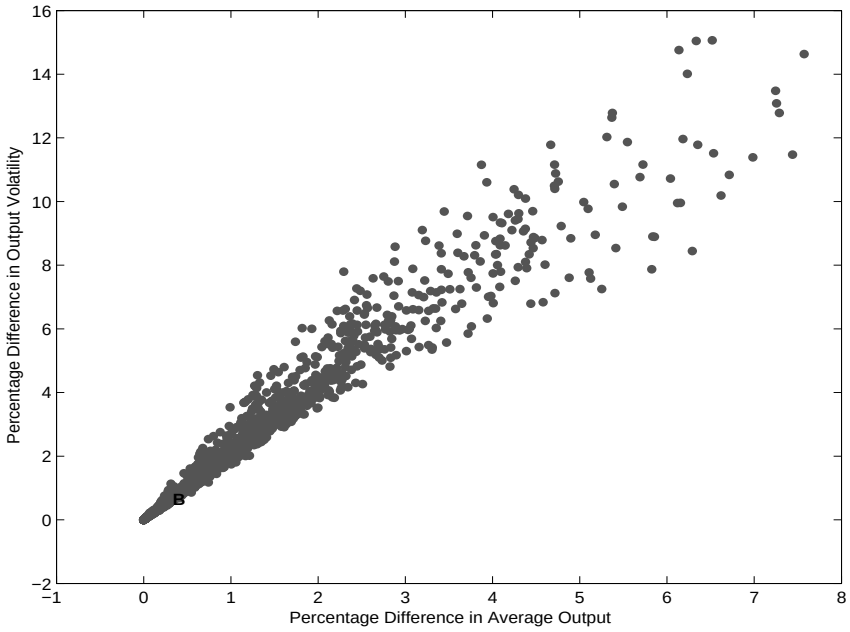

Figure 3: Output gap and volatility gap between liberalized and closed economy.

the benchmark economy. In the second period, output is 0.2304 in our economy, 0.2305 in the benchmark. Thus, $v = 0.88$ percent.

Figure 3 plots the percentage differences in the average output g and in the output volatility v between our economy and the benchmark closed economy in a large sample of parameter combinations such that an equilibrium with the properties in (I)-(II) occurs. We generate this graph by fixing the distributions of y and ε and the values of $\theta^H, \varepsilon, \theta^L, \Pr(\theta^H)$, and I as in the baseline parameterization and varying the parameters α, ω^d, π and A around their baseline values. We then retain all the parameter combinations such that an equilibrium exists with the properties in (I)-(II). In the graph the baseline parameterization is indicated with a "**B**".[11]

6 Interpretation of the Results

The central result of this paper is that the entry of foreign lenders into the economy may raise the average output but also exacerbate the volatilities of the asset price and output. Indeed, Figure 1 displays a positive relationship between these two effects. To illustrate the intuition behind our result, we proceed in two steps. We first analyze the interaction between the asset price and lenders' composition. We then investigate how this interaction affects output.

6.1 Asset Price

When a boom raises the asset (collateral) price in the first period, domestic lenders become unwilling to finance very specialized projects (projects with large n_t). This occurs because the higher the asset price, the higher the expected value of collateral assets that a lender will forgo if she funds

[11] The range of parameter values is chosen as follows: $\alpha \in [0.05, 0.30]$, $A \in [0.4, 0.8]$, $\pi \in [0.5, 0.8]$ and $\omega^d \in [0.05, 0.15]$. For each parameter, the interval is discretized in order to contain 15 points, thus generating a total of $15^4 = 50,625$ permutations of parameters. We retain the permutations such that an equilibrium with the properties in (I)-(II) is realized.

a specialized project rather than a generic one. As a result, some highly specialized entrepreneurs turn to foreign lenders to finance projects ($\overline{y}_1$ falls). In turn, this change in lenders' composition affects the intertemporal distribution of the asset supply. Because of their poor information in the local asset market, foreign lenders make "mistakes" in timing their asset sale. When a boom occurs in the first period, followed by a recession in the second, lenders should sell assets in the first period, when their price is high, without waiting for the second period. Domestic lenders observe θ_1 and ε, which are sufficient statistics for θ_2, and, hence, correctly anticipate the decline of the asset price that will occur in the second period. In contrast, foreign lenders do not observe the realizations of θ_1 and ε, but only the price p_1, which may not be a sufficient statistic for θ_2. Therefore, foreign lenders may misunderstand a boom-recession scenario (θ_2=θ^L) for a recession-boom scenario (θ_2=θ^H). If this occurs, they will expect that the asset demand will rise further and will defer their asset sale to the second period.

The "mistake" of foreign lenders renders their asset supply countercyclical, depressing the overall asset supply in the first period and raising it in the second. This renders the asset price more procyclical and, hence, more volatile. Clearly, the mechanism is self-reinforcing: the additional increase in the asset price that occurs in the first period feeds back on lenders' composition, further raising the share of foreign lenders in the first period and so forth, in a cumulative manner.

6.2 Output

The analysis yields two insights about output. First, the presence of foreign lenders raises the average output across periods. Intuitively, in both periods, thanks to their higher ability to monitor specialized assets, foreign lenders are willing to finance specialized projects that otherwise would be left idle by domestic lenders. The second insight is that the presence of foreign lenders may increase output volatility. We now review the channels through which output volatility rises.

Investment volume effect. The higher the asset price, the higher the expected return that an entrepreneur can pledge to a lender. Thus, in each period the measure of entrepreneurs who obtain financing and invest in projects is an increasing function of the asset price p_t. This implies that, when the presence of foreign lenders exacerbates the asset price cycle in the way explained in the previous section, it also increases the volume of investment in the boom and decreases it in the recession. This exacerbates the output cycle as well.

Investment productivity effect. The higher the asset price, the larger the relative importance of collateral assets in projects' expected return. Therefore, the opportunity cost associated with the illiquidity of specialized assets increases with the asset price. This implies that domestic lenders become less willing to finance specialized projects when the asset price rises during a boom. In an economy closed to foreign lenders, this effect dampens the increase (drop) of output during the boom (recession). In contrast, in our economy this effect is mute because entrepreneurs can replace domestic lenders with foreign ones in the financing of specialized projects. Therefore, the rise (drop) in the volume of investment during the boom (recession) occurs without a significant drop (increase) in average productivity. Like the "investment volume" effect, the "investment productivity" effect thus exacerbates the volatility gap between the two economies.

Liquidation effect. When foreign lenders defer their asset resale to the second period, they shift the "liquidation output" of these assets from the boom to the recession. This tends to depress output during the boom and foster it during the recession, reducing the volatility gap. The results of our simulations reveal that the liquidation effect is generally weaker than the other two effects combined. Therefore, our economy features a larger output volatility than the benchmark. Indeed, we find that the liquidation effect tends to be weaker than the "investment volume" effect taken in isolation. To establish this, we considered a second benchmark economy closed to foreign lenders where entrepreneurs always operate specialized projects.[12] This can be thought as an economy where a planner subsidizes specialized projects or, alternatively, as a closed economy with no problems of limited contractibility. In this second benchmark economy, the "investment

[12] Details on this experiment are available from the authors.

productivity" effect is mute (projects are always specialized) and the only two effects at work are the "investment volume" effect and the "liquidation" effect. We found that in a large set of simulations output drops more in our economy than in the benchmark one. This suggests that by itself the "investment volume" effect tends to dominate the "liquidation" effect.

7 Robustness and Sensitivity

Our primary objective is to establish a possibility result. Yet, it is important to understand in which scenarios - that is, in which regions of the parameter space - the mechanism we describe is more likely to be operational. It is also important to investigate how in the class of equilibria satisfying the properties in (I)-(II) the volatility gap v and the output gap g depend on the parameters of the model. We now turn to these issues.

7.1 Robustness Analysis

In our model-economy, there are two main reasons for which an equilibrium with the properties in (I)-(II) can fail to occur. First, the equilibrium asset price can be fully informative, in which case in the first period foreign lenders make the same asset sale decisions as domestic ones. Second, the entrepreneurs' distribution can fail to satisfy the properties in (I). In particular, it could be that no entrepreneur is excluded from the credit market or that no entrepreneur borrows from a domestic lender or that no entrepreneur borrows from a foreign lender. We perform a battery of experiments to characterize conditions under which these alternative scenarios materialize. In each experiment, we let a pair of parameters vary and fix the other parameters as in the baseline parameterization. To conserve space, we describe here two experiments obtained varying the parameters ω^d and α that measure enforceability (Figure 4) and the technological parameters π and A (Figure 5). The results of other experiments are gathered in a supplement available upon request. In both figures, dots denote the combinations of parameters that generate an equilibrium of the type in (I)-(II), with "**B**" indicating our baseline parameterization.

Letting α and ω^d vary. In Figure 4, we only let the parameters α and ω^d that measure enforceability vary. In particular, α ranges from 0.05 to 0.3 (the baseline value is 0.2) and ω^d ranges from 0.05 to 0.15 (the baseline value is 0.1).[13] The results are fairly intuitive. In the upper section of the figure (parameter combinations denoted by circles), the economy tends to be without foreign lenders. This occurs because the ability of domestic lenders to monitor specialized assets, as measured by ω^d, is high. In turn, this implies that domestic lenders are willing to finance specialized projects and, hence, entrepreneurs do not need to resort to foreign lenders. The opposite occurs in the lower section of the figure (parameter combinations denoted by diamonds). Here ω^d is so low that domestic lenders never finance specialized projects and, hence, no entrepreneur resorts to them. In these two regions of the parameter space, therefore, entrepreneurs' distribution has not the properties in (I). Interestingly, observe that, adjacent to the region without domestic lenders, there is also a region where the equilibrium is fully informative (parameter combinations denoted by squares). The rationale is that when few domestic lenders finance projects, the price in the first period tends to reveal the underlying shocks. Remember, in fact, that during the first period boom domestic lenders sell assets and this tends to keep the asset supply large and the price low. In turn, this "confuses" foreign lenders who, observing a low price, believe that a negative shock has occurred. If, however, there are few domestic lenders this general equilibrium effect is mute and the price in the first period is high and fully revealing.

Letting A and π vary. In Figure 5, we only let the two technological parameters π and A vary. In particular, π ranges from 0.5 to 0.8 (the baseline value is 0.6) and A ranges from 0.4 to 0.8 (the baseline value is 0.5).[14] In the upper section of the figure (large π) foreign lenders are inactive

[13] For both parameters we create a grid of 40 equally spaced points in the chosen interval.
[14] For both parameters we create a grid of 40 equally spaced points in the chosen interval.

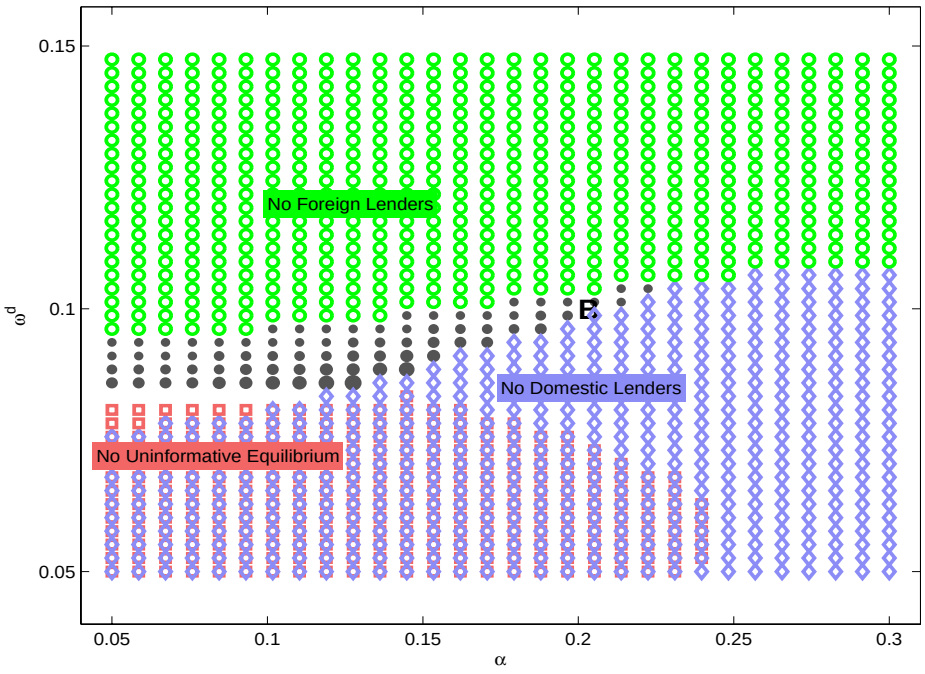

Figure 4: Letting α and ω^d vary.

(parameter combinations denoted by circles). Remember that foreign lenders help overcome the asset illiquidity that plagues specialized projects. If the probability of project success π is high, the cost of asset illiquidity is low because projects rarely fail. Thus, domestic lenders are willing to finance specialized projects and foreign lenders become redundant. This also occurs when A is low, which explains why the band of equilibria satisfying the properties in (I)-(II) is upward sloping. In the lower section of the graph, the opposite occurs: the value of π is so low that foreign lenders are essential and no domestic lender is active. Finally, as in the previous experiment, there is a region of the parameter space where domestic lenders are active but in such a small number that the equilibrium is fully informative (parameter combinations denoted by squares).

7.2 Sensitivity Analysis

Besides helping understand when our mechanism is operational, Figures 4 and 5 also convey information on the strength of the mechanism. In the figures, the size of the circles is proportional to the average output gap between our economy and the benchmark closed economy. Since output gap and volatility gap go hand in hand (see again Figure 3), this also implies that the size of the circles is roughly proportional to the volatility gap. The impact of α probably yields the most interesting insight (observe Figure 4). A higher value of α means lower output verifiability for all lenders, due for example to a less efficient legal enforcement of contracts. Figure 4 reveals that, keeping all the other parameters fixed, a higher α entails a higher output gap and a higher volatility gap. Thus, our model suggests that liberalizing an economy with a low degree of contract enforceability can lead to a substantial gain in output but also significantly increase output volatility. The intuition is straightforward: when α is high, pledgeable output accounts for a low share of the expected return of projects while collateral assets account for a large share. In our model, the mechanism that generates output volatility hinges on fluctuations of the asset price. A higher α thus tends to increase the relevance of collateral values, magnifying the impact on output of asset price fluctuations.

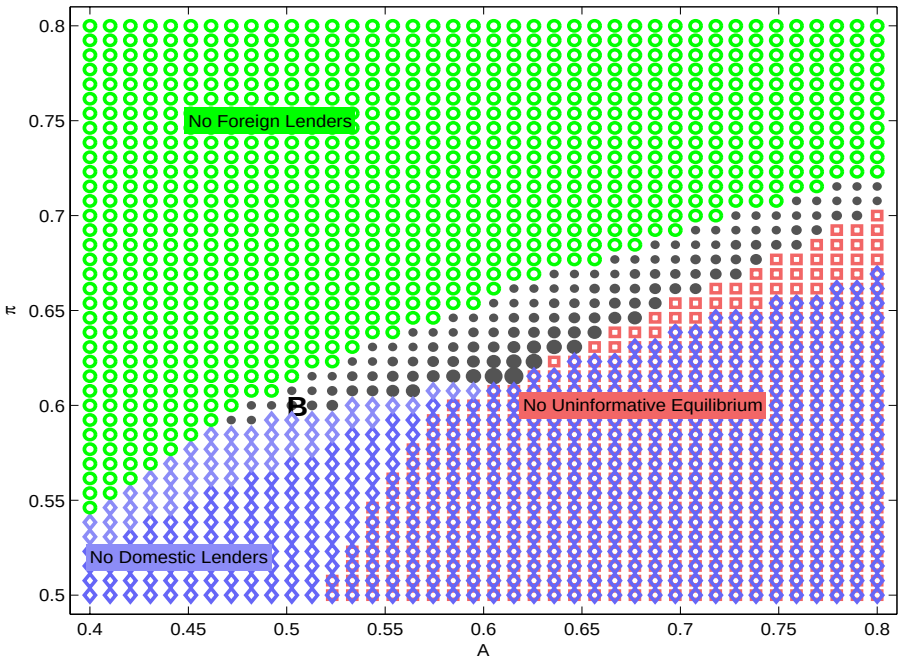

Figure 5: Letting A and π vary.

8 Conclusion

In this paper, we have put forth an explanation for the recent macroeconomic behavior of emerging economies based on the comparative advantages of domestic and foreign lenders. We have postulated that foreign lenders have a more efficient technology for monitoring the output of specialized assets than domestic ones while domestic lenders have more information than foreign ones in the local market where assets are traded. The paper shows that, when firms face credit constraints tied to the pledgeable returns of projects, this asymmetry can explain why after liberalization episodes emerging economies tend to experience higher average output but also larger asset price and output volatility. The analysis also suggests that these effects of the entry of foreign lenders are more pronounced the lower is the degree of contract enforceability in the economy. Thus, following credit market liberalization, economies with a poor contractual environment could be the most likely to benefit in terms of output growth but also the most vulnerable to increased instability.

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9 Appendix A. General Equilibrium System and Solution Algorithm

DERIVATION OF THE SYSTEM.

We here derive the system of equations that determine the values of the endogenous variables in an equilibrium in which entrepreneurs' distribution has the properties in (I). We also establish necessary parameter restrictions for such an equilibrium to exist. We proceed in two steps.

Step 1. We first determine the value $\underline{y}_t$ $(t = 1, 2)$ such that the entrepreneurs with $y \in [y_{\min}, \underline{y}_t]$ are inactive.

a) *No domestic lender finances an entrepreneur with* $y \in [y_{\min}, \underline{y}_t]$. In period $t = 1, 2$, the value $\underline{y}_t$ below which a domestic lender prefers storing her endowment than financing a specialized project satisfies $V_t^{Sd} = I$. Using the formula for V_1^{Sd} in (7) (and its analogous for V_2^{Sd}), we obtain

$$\underline{y}_1 = \frac{1}{\pi} \frac{I - \left(\pi\omega^d + (1-\pi) A \max(p_1, p_2)\right)}{1 - \alpha - (1-\pi) A \max(p_1, p_2)}, \tag{22}$$

$$\underline{y}_2 = \frac{1}{\pi} \frac{1 - \left(\pi\omega^d + (1-\pi) A p_2\right)}{1 - \alpha - (1-\pi) A p_2}. \tag{23}$$

Since for $y \in [y_{\min}, \underline{y}_t]$ for a domestic lender a generic project has a lower expected return than a specialized one (see point (c) below), a domestic lender is also unwilling to finance a generic project.

b) *No foreign lender finances an entrepreneur with* $y \in [y_{\min}, \underline{y}_t]$. Let the value of ω^f satisfy $\omega^f = \frac{1}{2} \max\{(\pi \underline{y}_1)^2, (\pi \underline{y}_2)^2\}$. Under this condition, for an entrepreneur with $y \in [y_{\min}, \underline{y}_t]$ the expected return W_t^{Sf} from a specialized project equals $\pi\alpha y$ at most. In fact, ω^f is such that a foreign lender extracts the full surplus of specialization net of the effort cost for specializing. Therefore, such an entrepreneur would choose $n_t = 0$ during the project. Expecting this, a foreign lender will not finance her (see also point (a) above).

Step 2. We now determine the value $\underline{y}_t$ $(t = 1, 2)$ such that the entrepreneurs with $y \in [\underline{y}_t, y_{\max}]$ operate specialized projects and, among them, those with $y \in [\underline{y}_t, \overline{y}_t]$ borrow from domestic lenders whereas those with $y \in (\overline{y}_t, y_{\max}]$ borrow from foreign lenders.

c) *For an entrepreneur with* $y \in (\underline{y}_t, \overline{y}_t]$ *a domestic lender prefers financing a specialized project, while for an entrepreneur with* $y \in (\overline{y}_t, y_{\max}]$ *she prefers financing a generic project.* From point (a) above we know that for $y \in (\underline{y}_t, \overline{y}_t]$ a domestic lender always prefer financing a specialized project than storing her endowment. In period $t = 1, 2$, the value $\overline{y}_t$ above which a domestic lender prefers financing a generic project than a specialized project satisfies $V_t^{Gd} = V_t^{Sd}$. Using the expressions for V_t^{Gd} and V_t^{Sd}, we obtain

$$\overline{y}_1 = \frac{\omega^d}{(1-\pi) A \max(p_1, p_2)}, \tag{24}$$

$$\overline{y}_2 = \frac{\omega^d}{(1-\pi) A p_2}. \tag{25}$$

Observe also that, given (16), when she borrows from a domestic lender, an entrepreneur always prefers a specialized project than a generic one.

d) *For an entrepreneur with* $y \in (\overline{y}_t, y_{\max}]$ *a foreign lender prefers financing a specialized project.* Let

$$\omega^f > y_{\max} (1-\pi) A \max\left\{\max\{p_1, E^f(p_2)\}, p_2\right\}. \tag{26}$$

Then, a foreign lender will be willing to finance the specialized project of an entrepreneur with $y \in [\overline{y}_t, y_{\max}]$. In fact, under (26), even for $y = y_{\max}$, $V_t^{Sf}|_{y=y_{\max}} > V_t^{Gf}|_{y=y_{\max}} > I$, for $t = 1, 2$.

(e) *An entrepreneur with* $y \in (y_{\min}, \overline{y}_t]$ *prefers borrowing from a domestic lender than from a foreign lender; an entrepreneur with* $y \in (\overline{y}_t, y_{\max}]$ *prefers borrowing from a foreign lender than from a domestic lender.* That an entrepreneur with $y \in (y_{\min}, \overline{y}_t]$ prefers a domestic lender stems immediately from the fact that a domestic lender extracts less output than a foreign lender. Next, observe that, as long as $\omega^f < \frac{1}{2} \min\{(\pi \overline{y}_1)^2, (\pi \overline{y}_2)^2\}$, an entrepreneur with $y \in (\overline{y}_t, y_{\max}]$ prefers borrowing from a foreign lender and operating a specialized project than borrowing from a domestic lender and operating a generic project. In fact, her expected return from specialization net of the output extracted by a foreign lender exceeds zero.

SUMMARY OF THE SYSTEM.

We choose the parameters and the probability density functions so that they satisfy the assumptions in the main text (i.e., the probability density functions of y and ε are triangular,

$Pr(\theta_2{=}\theta^H \left|\theta_1-\varepsilon{=}\theta^L\right.){=}Pr(\theta_2{=}\theta^L \left|\theta_1-\varepsilon{=}\theta^H\right.){=}1$, and (15)-(16) hold) as well as the restrictions on ω^f derived above. For given values of $E^d[p_2\left|\Im_1^d\right.]$ and $E^f[p_2\left|\Im_1^f\right.]$, an equilibrium vector of the residual endogenous variables $[p_1,p_2,\underline{y}_1,\underline{y}_2,\overline{y}_1,\overline{y}_2,\ell^d,\ell^f]$ solves the system defined by (22), (23), (24), (25), (11), (12), (13), and (10), i.e., combining (11) with (13) and (10),

$$\underline{y}_1 = \frac{1}{\pi}\frac{I-\left[\pi\omega^d+(1-\pi)\,A\max(p_1,p_2)\right]}{1-\alpha-(1-\pi)A\max(p_1,p_2)} \tag{27}$$

$$\underline{y}_2 = \frac{1}{\pi}\frac{I-\left[\pi\omega^d+(1-\pi)\,Ap_2\right]}{1-\alpha-(1-\pi)Ap_2} \tag{28}$$

$$\overline{y}_1 = \frac{\omega^d}{(1-\pi)\,A\max(p_1,p_2)} \tag{29}$$

$$\overline{y}_2 = \frac{\omega^d}{(1-\pi)\,Ap_2} \tag{30}$$

$$p_1 = \theta_1\left[1-(1-\pi)A\left\{\ell^d\left[F(\overline{y}_1)-F(\underline{y}_1)\right]+\ell^f\left[1-F(\overline{y}_1)\right]\right\}\right] \tag{31}$$

$$p_2 = \theta_2\left[1-(1-\pi)A\{1-F(\underline{y}_2)+(1-\ell^d)\left[F(\overline{y}_1)-F(\underline{y}_1)\right]+(1-\ell^f)\left[1-F(\overline{y}_1)\right]\}\right] \tag{32}$$

$$\ell^l = \begin{cases} 1 & if \quad p_1 \geq E^l[p_2\left|\Im_1^l\right.] \\ 0 & if \quad p_1 < E^l[p_2\left|\Im_1^l\right.] \end{cases} \qquad l=d,f. \tag{33}$$

where the variables must satisfy $y_{\min}{<}\underline{y}_1{<}\overline{y}_1{<}y_{\max}$, $y_{\min}{<}\underline{y}_2{<}\overline{y}_2{<}y_{\max}$, $p_1{>}0$, $p_2{>}0$. Now, consider the values of $E^d[p_2\left|\Im_1^d\right.]$ and $E^f[p_2\left|\Im_1^f\right.]$. Starting with $E^d[p_2\left|\Im_1^d\right.]$, given the stochastic process specified for θ, once θ_1 and ε are known θ_2 is also known. Furthermore, there is no aggregate uncertainty in the second period. Hence, $E^d[p_2\left|\Im_1^d\right.]{=}p_2$. Consider next $E^f[p_2\left|\Im_1^f\right.]$. Given the process of θ, $\Pr\left(\theta_2=\theta^L|p_1\right)=\Pr\left(\theta_1-\varepsilon=\theta^H|p_1\right)$. Therefore, using the Bayes rule,

$$\Pr\left(\theta_2{=}\theta^L|p_1\right)=\frac{Pr(\theta_1-\varepsilon{=}\theta^H)\Pr(p_1\left|\theta_1-\varepsilon{=}\theta^H\right.)}{\Pr(\theta_1-\varepsilon{=}\theta^L)\Pr(p_1\left|\theta_1-\varepsilon{=}\theta^L\right.)+\Pr(\theta_1-\varepsilon{=}\theta^H)\Pr(p_1\left|\theta_1-\varepsilon{=}\theta^H\right.)}. \tag{34}$$

Denote $p_2^H=p_{2|\theta_2=\theta^H}$ and $p_2^L=p_{2|\theta_2=\theta^L}$. We have

$$E^f[p_2\left|\Im_1^f\right.]=\left[1-\Pr\left(\theta_2{=}\theta^L|p_1\right)\right]p_2^H+\Pr\left(\theta_2{=}\theta^L|p_1\right)p_2^L. \tag{35}$$

SOLUTION ALGORITHM.

The algorithm to solve the system (27)-(35) follows these steps:

1. Set $\theta_1-\varepsilon=\theta^H$ and choose a value for ε. Guess a value for ℓ^f (say $\ell^f=0$).

2. Solve the system made by equations (27) to (33). Obtain values for $p_1,p_2,\underline{y}_1,\underline{y}_2,\overline{y}_1,\overline{y}_2$,and ℓ^d conditional on the guess $\ell^f=0$ and verify that $y_{\min}{<}\underline{y}_1{<}\overline{y}_1{<}y_{\max}$, $y_{\min}{<}\underline{y}_2{<}\overline{y}_2{<}y_{\max}$, $p_1{>}0$, $p_2{>}0$. Call p_{2H} the value found for p_2.

3. Calculate the numerator of (34) from the probability density function of ε, which gives us $\Pr(p_1\left|\theta_1-\varepsilon{=}\theta^H\right.)$.

4. Plug the value of p_1 into the system made by (27) to (33) where you now switch the values of $\theta_1-\varepsilon$ and θ_2.

5. Solve the resulting system for new values of $p_2,\underline{y}_1,\underline{y}_2,\overline{y}_1,\overline{y}_2,\ell^d$ and for ε (which is now treated as an endogenous variable), verifying that $y_{\min}{<}\underline{y}_1{<}\overline{y}_1{<}y_{\max}$, $y_{\min}{<}\underline{y}_2{<}\overline{y}_2{<}y_{\max}$, $p_1{>}0$, $p_2{>}0$. Call p_{2L} the value found for p_2.

6. The probability density of ε found in (5) gives $\Pr(p_1 \left| \theta_1 - \varepsilon = \theta^L \right.)$.

7. Using (34), calculate $\Pr\left(\theta_2 = \theta^L | p_1\right)$.

8. Using (35), calculate $E^f[p_2 \left| \Im_1^f \right.]$.

9. Verify that the guess was correct, i.e. indeed $E^f[p_2 \left| \Im_1^f \right.] > p_1$ and, hence, $\ell^f = 0$.

Note on benchmark economy. The system for the benchmark economy (omitted for brevity but available from the authors upon request) is analogous to that for our economy, with the exception that $\overline{y}_t = y_{\max}$ $(t = 1, 2)$. The resulting system can then be solved as a standard system in the endogenous $[p_1, p_2, \underline{y}_1, \underline{y}_2, \overline{y}_1, \overline{y}_2, \ell^d]$.

10 Appendix B. Formulae for Output

OUR ECONOMY.

Output in period 1. The output in the first period equals

$$\mathcal{Y}_1 = \pi \mathcal{A}_1 + (1 - \pi)(\mathcal{B}_1 - \mathcal{C}_1). \tag{36}$$

In (36), $\mathcal{A}_1$ is the output of successful projects, i.e.

$$\mathcal{A}_1 = \int_{\underline{y}_1}^{y_{\max}} (y + \pi y^2) f(y) dy, \tag{37}$$

while $\mathcal{B}_1$ is the output obtained from liquidated assets, i.e.

$$\mathcal{B}_1 = \frac{A(\theta_1 + p_1)}{2} \left\{ \ell^d \left[F(\overline{y}_1) - F(\underline{y}_1) \right] + \ell^f \left[1 - F(\overline{y}_1) \right] \right\}. \tag{38}$$

In (38) $(\theta_1 + p_1)/2$ is the average productivity of a liquidated asset in the first period, while the term in the square parenthesis times A is the measure of assets that are liquidated. Finally, $\mathcal{C}_1$ measures the transaction costs sustained in asset liquidation, i.e.

$$\mathcal{C}_1 = p_1 A \left[\ell^d \int_{\underline{y}_1}^{\overline{y}_1} \pi y g(y) dy + \ell^f \int_{\overline{y}_1}^{y_{\max}} \pi y g(y) dy \right]. \tag{39}$$

Output in period 2.

$$\mathcal{Y}_2 = \pi \mathcal{A}_2 + (1 - \pi)(\mathcal{B}_2 - \mathcal{C}_2), \tag{40}$$

where

$$\mathcal{A}_2 = \int_{\underline{y}_2}^{y_{\max}} (y + \pi y^2) f(y) dy, \tag{41}$$

$$\mathcal{B}_2 = \frac{A(\theta_2 + p_2)}{2} \left\{ 1 - F(\underline{y}_2) + (1 - \ell^d) \left[F(\overline{y}_1) - F(\underline{y}_1) \right] + (1 - \ell^f) \left[1 - F(\overline{y}_1) \right] \right\}, \tag{42}$$

$$\mathcal{C}_2 = p_2 A \left[\int_{\underline{y}_2}^{y_{\max}} \pi y f(y) dy + (1 - \ell^d) \int_{\underline{y}_1}^{\overline{y}_1} \pi y f(y) dy + (1 - \ell^f) \int_{\overline{y}_1}^{y_{\max}} \pi y f(y) dy \right]. \tag{43}$$

BENCHMARK ECONOMY.

Output in period 1.

$$\mathcal{Y}_1=\pi\mathcal{A}_1+(1-\pi)(\mathcal{B}_1-\mathcal{C}_1), \tag{44}$$

where

$$\mathcal{A}_1 = \int_{\underline{y}_1}^{\overline{y}_1}(y+\pi y^2)f(y)dy+\int_{\overline{y}_1}^{y_{\max}} yf(y)dy, \tag{45}$$

$$\mathcal{B}_1 = \frac{A(\theta_1+p_1)}{2}\left\{\ell^d\left[1-F(\underline{y}_1)\right]\right\}, \tag{46}$$

$$\mathcal{C}_1 = A\ell^d p_1\int_{\underline{y}_1}^{\overline{y}_1}\pi yf(y)dy. \tag{47}$$

Output in period 2.

$$\mathcal{Y}_2=\pi\mathcal{A}_2+(1-\pi)(\mathcal{B}_2-\mathcal{C}_2), \tag{48}$$

where

$$\mathcal{A}_2 = \int_{\underline{y}_2}^{\overline{y}_2}(y+\pi y^2)(y)dy+\int_{\overline{y}_2}^{y_{\max}} yf(y)dy, \tag{49}$$

$$\mathcal{B}_2 = \frac{A(\theta_2+p_2)}{2}\left\{1-F(\underline{y}_2)+(1-\ell^d)\left[1-F(\underline{y}_1)\right]\right\}, \tag{50}$$

$$\mathcal{C}_2 = p_2A\left[\int_{\underline{y}_2}^{\overline{y}_2}\pi yf(y)dy+(1-\ell^d)\int_{\underline{y}_1}^{\overline{y}_1}\pi yf(y)dy\right]. \tag{51}$$