Foreign Lenders in Emerging Economies*

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Abstract

We study an emerging economy with credit frictions where domestic and foreign lenders have asymmetric skills in obtaining returns from funded projects. Foreign lenders have a more efficient technology for monitoring output than domestic ones; domestic lenders have more information than foreign ones in the local asset (collateral) market. Building on this single asymmetry, we find that an emerging economy open to foreign lenders can experience higher average output but also larger volatility of asset prices and output than a closed economy. Thus, the model can replicate the recent macroeconomic pattern of emerging economies in the aftermath of financial liberalization episodes.

JEL Codes: E44.

Keywords: Domestic and Foreign Lenders, Emerging Economies, Boom and Bust Cycles.

1 Introduction

The macroeconomic pattern of emerging economies has recently generated a great deal of interest in academic and policy circles. In the last three decades or so, several emerging 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 liberalization and 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 hard evidence that confirms this apparent regularity: analyzing a set of 35 middle-income countries, they have found empirically that financial liberalization leads to more rapid growth, but also to larger volatility and incidence of crises.

Inspired by this evidence, in this paper we propose a novel explanation for the recent macroeconomic pattern of emerging economies based on the asymmetric skills of foreign and

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domestic lenders. Our explanation builds on one single observation: in emerging economies foreign and domestic lenders have different comparative advantages in obtaining returns (output and asset value) from funded projects. On the one hand, foreign lenders operating in an emerging economy have allegedly a more efficient technology for monitoring entrepreneurs' output than local lenders (see, e.g., Giannetti and Ongena, 2005; Dages, Goldberg, and Kinney, 2000). For example, internationally active U.S. banks can typically count on more efficient loan officers, more advanced information technologies, and sounder assessment practices than local banks of developing economies. On the other hand, domestic lenders have longer experience than foreign lenders in the local asset (collateral) market. This implies that they can have local private information in this market whereas foreign lenders can only rely on public information. We embed this asymmetry between foreign and domestic lenders in an economy where credit contracts feature limited commitment and entrepreneurs face credit constraints tied to the pledgeable returns (output and asset value) of their projects. We find that this single asymmetry can 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, we find that this asymmetry can raise the average productivity of projects but, through the link between asset prices and credit constraints, can also increase the volatility in the volume and productivity of projects over the cycle.

The intuition of the model can be summed up as follows. In our economy, entrepreneurs can invest in generic projects or in specialized ones. Specialized projects are tailored to entrepreneurs' skills and, hence, yield more output in the event of success. However, in the event of default, the assets (collateral) of these projects are entrepreneur-specific and, hence, illiquid. Entrepreneurs can borrow from foreign lenders or from domestic ones to finance projects. Domestic lenders are reluctant to finance specialized projects because these projects have illiquid collateral. Thanks to their better ability to monitor output, foreign lenders can instead compensate for their illiquidity by obtaining higher repayment in the event of success. All in all, the asymmetry between the skills of foreign and domestic lenders allows to finance more specialized/illiquid projects than in a closed economy, raising average productivity and output.

While the asymmetry between foreign and domestic lenders raises average output, it also exacerbates its volatility. Domestic lenders have private, soft information in the local asset (collateral) market and liquidate projects in this market in a timely manner. By contrary, 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 already plunging and assets should be hoarded. Their countercyclical asset supply renders the asset price more procyclical and, through the link between the asset price and credit constraints, it exacerbates output volatility.

To better grasp how the skills of foreign and domestic lenders interact over the business cycle consider the following scenario. Suppose that a positive shock to the productivity of assets raises their price. The increase of the asset (collateral) price renders generic/liquid projects relatively more attractive, discouraging domestic lenders from financing specialized/illiquid projects. This

induces more entrepreneurs to borrow from foreign lenders to finance specialized projects. In turn, foreign lenders make mistakes in the local asset market: 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 effect raises the volume of projects financed during the boom and lowers the volume of projects financed during the recession, exacerbating output volatility. Moreover, unlike domestic lenders, foreign lenders finance specialized projects even when the asset (collateral) price rises during the boom. Therefore, the rise (drop) in the volume of projects during the boom (recession) occurs without a significant drop (rise) in their average productivity. This "project composition" effect reinforces the "project volume" effect and exacerbates output volatility.

The remainder of this paper unfolds as follows. In section 2, we relate the paper to the extant literature. In section 3, we lay out and discuss the setup. In section 4, we solve the model. Section 5 characterizes the equilibrium and shows the existence of boom and bust cycles. In section 6, we discuss our result. In section 7, we perform a sensitivity analysis of the equilibrium. Section 8 concludes. Proofs and details on the solution algorithm are relegated to the Appendices.

2 Related Literature

This paper relates 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 the above 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 firms' (or banks') assets and liabilities. Shneider and Tornell (2004) show that during a boom the interaction between credit constraints and currency mismatch generates financial fragility, meant as a scenario in which a small negative shock can trigger a severe crisis. Diamond and Rajan (2001) build instead a model in which 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 mismatch between the maturity of their 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

[1] In a related vein, Neumeyer and Perri (2005) explain the instability of emerging open economies with the interaction between the real interest rate and firms' wage bill. In particular, they show that, in the presence of a working capital constraint, an increase of the interest rate increases firms' effective labor cost and, hence,

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 entrepreneurs 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 (domestic or 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 (2004a), in Kiyotaki and Moore (1997) financial imperfections propagate and amplify shocks but do not generate endogenous business cycles. This issue is of fundamental importance. While it is argued that in emerging economies the booms endogenously created the conditions for the following recessions, most of the literature on financial imperfections focuses only on the amplification of shocks and cannot explain a boom-and-bust cycle.[2] Our analysis contributes instead to a small set of papers in which financial imperfections generate instability and fluctuations besides amplification and propagation. Matsuyama (2004a and 2004b) are the closest to our analysis. In Matsuyama (2004a), 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 (2004a and 2004b), 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]

Finally, this paper relates to the literature on asset pricing in environments with informed and uninformed traders. Grossman and Stiglitz (1980) develop a model in which noise traders extrapolate information on the future return of a risky asset from its current price. However, the asset price contains imperfect information on future returns. In fact, traders cannot 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 (collateral) market parallels that of informed and uninformed traders in Grossman and Stiglitz (1980). In particular, if the asset price were a fully informative public signal, there would be no difference in the behavior of domestic and foreign lenders in the local asset

reduces labor demand. In turn, this reduce employment and output.

[2] The self-reinforcing nature of booms or busts is also at the center of a few models of liquidity in the financial sector. Focussing on the banking sector, for example, Allen and Gale (2004) study an economy where declines in asset prices force some banks in liquidation, which in turn further depresses asset prices, in a self-reinforcing fashion.

[3] Our explanation of endogenous business cycles and Matsuyama's may be seen as complementary. Some scholars (e.g., Corsetti, Pesenti and Roubini, 1999) argue that emerging economies suffered from a deterioration of the quality of projects during the booms. By contrary, other scholars (e.g. Radelet and Sachs, 1998) argue that, in the wake of financial liberalization, during the booms the most evident pattern was firms' tendency to borrow from foreign investors.

market and endogenous cycles would not occur. Therefore, this paper may also be thought as an application of the idea of Grossman and Stiglitz (1980) to the analysis of business cycles in emerging economies.

3 Model Setup

Time, Agents, and Goods. The economy lasts two periods ($t = 1, 2$) and each period has a "morning" and an "afternoon". 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, as well as projects-ideas. In both periods, every lender starts out with an amount I of final good while every entrepreneur starts out with one project. Entrepreneurs' utility function is $U_t = E_t(c_t) - n_t^2/2$ while lenders' utility function is $U_t^l = E_t(c_t^l + c_{t+1}^l)$, where in period t $E(c_t)$ $(E(c_t^l))$ is an entrepreneur's (lender's) expected consumption of final good, $n_t \in [0, 1]$ is the degree of specialization chosen by the entrepreneur for her project, and $n_t^2/2$ is the effort cost that the entrepreneur sustains to specialize.

The Real Sector.

Morning. Each entrepreneur can implement her project during the morning. At the beginning of the morning, she can transform an amount I of final good into an amount A of assets. At the end of the morning, the assets produce with probability π; with probability $1 - \pi$, production fails but the assets can be liquidated. The expected return of the project 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 during the project an entrepreneur can obtain an additional output yn_t but she also renders the assets more specific to herself and, hence, illiquid. $Av_t n_t$ is the final good lost in liquidation costs upon resale.[4]

Afternoon. In the afternoon, each entrepreneur can employ one unit of liquidated assets in a second use, obtaining an amount $x\theta_t$ of final good. $x \in [0, 1]$ reflects entrepreneurs' idiosyncratic productivity as second hand users and is uniformly distributed across them. θ_t reflects entrepreneurs' aggregate productivity as second hand users and satisfies

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

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

[4] Ramey and Shapiro (2001, p. 961) stress the importance of search costs in asset redeployment and argue: "Thin markets and costly search complicate the process of finding buyers whose needs best match the capital's characteristics. The cost of search includes not only monetary costs, but also the time it takes to find good matches within the industry".

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"). Conditioning on its realization in the first period, θ is governed by a two-state Markov chain.

The Credit Sector. At the beginning of the morning, each entrepreneur can form a credit match with a lender to finance her project. Credit matches feature limited contractual commitment (as in Rajan, 1992, for example). First, when an entrepreneur and a lender write a credit contract after forming a match, the entrepreneur can contractually commit to implement a generic (G) project ($n_t = 0$) or a specialized (S) project ($n_t \geq 0$) but, conditioning on specializing ($n_t \geq 0$), she cannot commit to a degree of specialization n_t. Therefore, the credit contract between the entrepreneur and the lender specifies only (i) whether the project implemented is generic or specialized and (ii) the amount of output that the entrepreneur must repay to the lender in the event of success (as well as the right of the lender to repossess the assets in the event of failure, as in a standard credit contract). Second, after the entrepreneur chooses her degree of specialization n_t during the project, the lender can always threaten to recall her financing and cause the immediate termination of the project and liquidation of the assets. This way, the lender can force a renegotiation of the initial credit contract and obtain a higher repayment in the event of success of the project.

Domestic and Foreign Lenders. We want to capture 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 skills in obtaining project returns. On the one hand, foreign lenders have a more efficient technology for monitoring output than domestic lenders: the maximum output a lender $l = d, f$ can monitor and obtain as repayment in the event of success equals

$$R^l = (1 - \alpha)y + \min\left\{\omega^l, yn_t\right\} \tag{4}$$

where $\omega^f > \omega^d > 0$ and $0 < \alpha < 1$. On the other hand, foreign lenders have less experience and information in the market for the local asset (collateral). In particular, at the beginning of the morning, besides the publicly observable asset price p_t, entrepreneurs and domestic lenders observe the realization of θ_t and (in the first period) ε, while foreign lenders only observe the asset price.

Remark. In the real world, at any point in time some projects are financed and others are liquidated. Hence, an asset (collateral) market is always open where agents observe the asset price. In our economy, project financing occurs in the morning while project liquidation occurs in the afternoon. To guarantee that entrepreneurs and lenders observe the asset price when they make borrowing and 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 afternoon while lenders post their asset supply (contingent on the failure of funded projects). A market maker (auctioneer) then computes the total asset demand and supply at each price level and sets the price that clears the asset market.

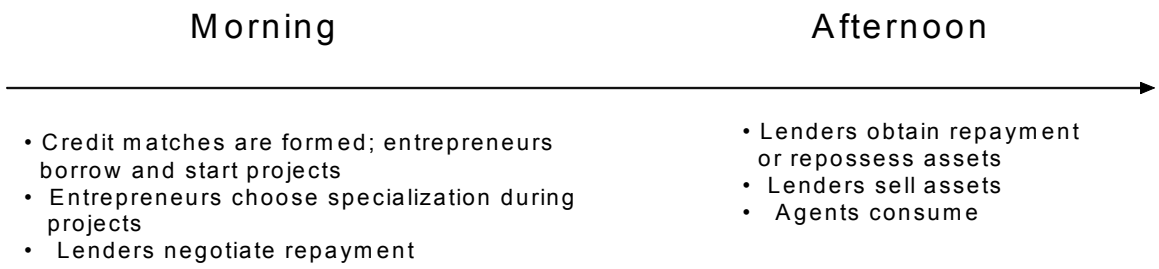

Figure 1: Within Period Time Line.

3.1 Discussion of the Setup

Agents and the Real Sector. The assumption that entrepreneurs discount the future more heavily than lenders is standard in the literature on credit imperfections (see, e.g., Kiyotaki and Moore, 1997). This assumption guarantees that in the first period entrepreneurs do not save enough to self-finance their projects in the second period. The restriction that entrepreneurs (lenders) are fully impatient (patient) is only for simplicity. In the real sector, the important feature is that a specialized project yields more output than a generic one in the event of success but its assets are less liquid in the event of default. This characterizes specialized projects as potentially highly productive but highly specific and illiquid.

The Credit Sector. In the credit sector, the assumption of limited commitment renders the choice between domestic and foreign lenders meaningful. 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 commitment in the credit sector closely follows the literature. In Rajan (1992), for example, on the one hand entrepreneurs have limited ability to commit to repay all their output or to implement actions during their projects and therefore can be denied credit. On the other hand, lenders are also unable to commit their financing. This allows lenders to extract additional output during projects' lifetime by threatening to recall their financing and liquidate projects prematurely.

Domestic and Foreign Lenders. The assumption that domestic and foreign lenders have asymmetric skills in obtaining project returns constitutes the salient feature of our economy. Financial institutions of advanced economies typically have a more efficient technology for monitoring borrowers' behavior and output than local institutions of developing economies. In fact, foreign lenders employ more sophisticated inputs to monitor projects (e.g., better trained loan officers, a more advanced information technology, sounder assessment practices). Moreover, foreign lenders have stronger incentives to monitor borrowers' output and avoid its expropriation, and the asymmetry we specify could be thought as a reduced form for these different incentives. In fact, in emerging economies borrowers' political protections often prevent local lenders from monitoring output in an active manner, especially when local lenders are publicly owned banks subject to political control (Giannetti and Ongena, 2005); foreign lenders are instead mostly independent from this control. However, domestic lenders have naturally

longer experience than foreign lenders in the local asset (collateral) market. This is especially true in an economy that until recently has been closed to foreign lenders and that, after an episode of financial liberalization, faces the entry of foreign lenders with scarce familiarity with the local asset market. In our model, we capture this feature by assuming that in the local asset market domestic lenders have private, soft information (they observe θ_t and ε besides the asset price p_t) while foreign lenders can only rely on public information (the asset price).

Note that a complementary interpretation of the asymmetry between the skills of 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, 2005). 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. By contrary, 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 sharply 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 (i.e., the *specialization, financing,* and *borrowing* decisions*)*, assuming that inside a credit match a lender has full bargaining power vis-à-vis the entrepreneur. We proceed backward. We first solve for the degree of specialization n_t chosen by an entrepreneur during her project. We then solve for a lender's contractual decision after a match is formed whether to finance a generic project ($n_t = 0$), to finance a specialized project ($n_t \geq 0$), or not to fund the entrepreneur and 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 (i.e., the *asset sale* decision). In the first period, in the event of project failure and asset repossession, a lender can resell the assets in the afternoon or store the assets with the objective of reselling them in the afternoon of the second period. Thus, we solve for the first period decision of a lender when to resell assets if the funded project fails. 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 during her project. The entrepreneur takes into account that the repayment extracted by her lender in the event of success equals R^l in (4) and that, if she specializes ($n_t > 0$), she will bear

a non-pecuniary effort cost $n_t^2/2$. Therefore, in period t her expected return is

$$W_t^G = \pi\alpha y \tag{5}$$

if she implements a generic project,

$$W_t^{Sl} = \pi\left(\alpha y + \max\{0, yn_t - \omega^l\}\right) - \frac{n_t^2}{2} \tag{6}$$

if she implements 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^S implies that $n_t \in \{0, \pi y, 1\}$ if the entrepreneur implements a specialized project.

We now turn to the contractual 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. In the first period, a lender's expected return from financing a generic project equals

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

her expected return from financing a specialized project equals

$$V_1^{Sl} = \pi[(1-\alpha)y + \min\left\{\omega^l, yn_t\right\}] + (1-\pi)A\left[\ell^l p_1 + (1-\ell^l)E^l(p_2)\right](1-n_t), \tag{8}$$

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 the terms in the square parentheses of (7) and (8). Breaking ties in favor of a generic project, in the first period a lender of type l will finance a specialized project if and only if $V_1^{Sl} > \max\{V_1^{Gl}, I\}$. The trade-off the lender faces can be grasped by observing (7) and (8). The lender will finance a specialized project if and only if: i) the higher repayment she may obtain from this project relative to a generic project exceeds her expected loss due to the lower asset (collateral) liquidity (hence, $V_1^{Sl} > V_1^{Gl}$); and ii) her expected return from the specialized project exceeds her opportunity cost of funds I (i.e., $V_1^{Sl} > I$). Analogous conditions and reasoning -which we omit for brevity- hold for the financing of a generic project and for storage of the endowment.

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 return from inaction (zero). 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

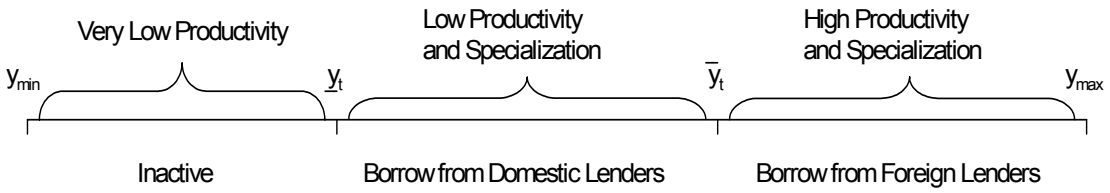

Figure 2: Entrepreneurs' Distribution across Productivity Levels.

with her expected proceeds in the second. Breaking ties in favor of early resale,

$$\ell^l = \begin{cases} 1 & if \quad p_1 \geq E^l[p_2 \,|\Im_1^l] \\ 0 & if \quad p_1 < E^l[p_2 \,|\Im_1^l] \end{cases}, \tag{9}$$

where $E^l[p_2 \,|\Im_1^l]$ is the first period expectation of the asset price p_2 in the second period conditional on the information $\Im_1^l$ of a lender of type l. Note that, when the resale decision is made, the information set of a domestic lender includes the realizations of θ_1 and ε besides the current asset price p_1, while that of a foreign lender includes only the current asset price.[5]

We are now in a position to write the following lemma about entrepreneurs' distribution (refer also to figure 2).

Lemma 1. *There is a region of the parameter space such that:*

i) 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 implement specialized projects; whereas b) the entrepreneurs with $y \in [y_{\min}, \underline{y}_t]$ remain inactive.

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

PROOF: In Appendix A.

Henceforth, we focus on the distribution illustrated in Lemma 1 (see section 7 for a discussion and for alternative distributions). The intuition behind this distribution is easy to grasp. Entrepreneurs with very 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. Low productive entrepreneurs ($y \in [\underline{y}_t, \overline{y}_t]$) can instead borrow from domestic lenders to finance their specialized projects. Moreover, since domestic lenders extract

[5] As it will later become clear later in the analysis, two different combinations of θ and ε can lead to the same asset price p_1 in equilibrium. 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.

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 specialized projects. In fact, the degree of specialization of these entrepreneurs is high and the liquidity of their collateral low. This implies that domestic lenders are unwilling to finance their specialized projects. By contrary, foreign lenders are ready to finance them because they can compensate for the illiquidity of their collateral by obtaining higher repayment in the event of success.

4.2 Asset Price

Having solved for agents' decisions, we now determine 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. Taking into account the uniform distribution of x,

$$M_t^d = 1 - \frac{p_t}{\theta_t}. \tag{10}$$

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,

$$M_1^s = \underbrace{(1-\pi)A\ell^d\left[F(\overline{y}_1) - F(\underline{y}_1)\right]}_{M_1^{sd}} + \underbrace{(1-\pi)A\ell^f\left[(1-F(\overline{y}_1)\right]}_{M_1^{sf}} \tag{11}$$

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,

$$M_2^s = \underbrace{(1-\pi)A[1-F(\underline{y}_2)]}_{M_2^{sfd}} + \underbrace{(1-\pi)A(1-\ell^d)\left[F(\overline{y}_1) - F(\underline{y}_1)\right]}_{\widehat{M}_1^{sd}} + \underbrace{(1-\pi)A(1-\ell^f)\left[1-F(\overline{y}_1)\right]}_{\widehat{M}_1^{sf}} \tag{12}$$

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 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 in the first period, which in turn hinge on their information $\Im_1^d$ and $\Im_1^f$.

5 Equilibrium

We can now define the equilibrium.

Definition 1. *For given i) supports ($[\varepsilon_{\min}, \varepsilon_{\max}]$ and $[y_{\min}, y_{\max}]$) and probability density functions (f(.) and h(.)) of y and ε; ii) given stochastic process of θ, i.e. Prob.($\theta_1 - \varepsilon = \theta^H$) and Prob.($\theta_2 = \theta^H \left| \theta_1 - \varepsilon = \theta^H \right.$); iii) given choice of the structural parameters I, A, π,*

ω^d, ω^f, α; *and iv) given realizations* $\theta_1, \varepsilon, \theta_2$, *the equilibrium is defined by a set of prices and quantities*

$$\mathrm{V} = [p_1, p_2, E^d(p_2), E^f(p_2), \underline{y}_1, \underline{y}_2, \overline{y}_1, \overline{y}_2, \ell^d, \ell^f] \tag{13}$$

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

In what follows, we assume that the probability density functions $f(.)$ of y and $h(.)$ of ε are triangular. Moreover, we let $Pr(\theta_2 = \theta^L \left| \theta_1 - \varepsilon = \theta^H \right.) = 1$, i.e. the economy can experience a boom followed by a recession or a recession followed by a boom. In Proposition 1, we compare the patterns of output and the asset price with those that would occur in a benchmark economy (denoted by superscript B) closed to foreign lenders ($\overline{y}_t^B = y_{\max}$, for $t = 1, 2$). We focus on the boom-recession scenario (the results for the recession-boom scenario are symmetric).

Proposition 1. *Consider a benchmark economy where no entrepreneur can borrow from a foreign lender* ($\overline{y}_t^B = y_{\max}$, for $t = 1, 2$). *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:*

*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.*

$$\frac{p_2}{p_1} - \frac{p_2^B}{p_1^B} > 0; \tag{14}$$

*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* $\mathcal{Y}_2^B$),

$$g = \frac{\mathcal{Y}_1 + \mathcal{Y}_2}{\mathcal{Y}_1^B + \mathcal{Y}_2^B} > 1; \tag{15}$$

*ii) (**Output Volatility**) In the first-period boom, output is larger than in the benchmark economy. In the second-period recession, output is instead 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.*

$$v = \frac{\mathcal{Y}_2}{\mathcal{Y}_1} - \frac{\mathcal{Y}_2^B}{\mathcal{Y}_1^B} > 0. \tag{16}$$

PROOF: See Appendix A for the solution algorithm and Appendix B for the output formulae.

Example. Let the aggregate productivity of second-hand users satisfy the following values: in the first period, $\theta_1 = \theta^H + \varepsilon_1 = 0.55$, where $\theta^H = 0.75$, $\varepsilon_1 = -0.2$; in the second period, $\theta_2 = \theta^L = 0.5$. We fix the other parameters 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, $\Pr(\theta^H) = 0.85$, $A = 0.5$, $I = 0.5$, $\alpha = 0.2$, $\omega = 0.1$ and $\pi = 0.6$. Plugging in these values, we find that:

i) The asset price drops in our economy 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) Average output in the two periods is 0.2437. In the benchmark economy, it is 0.2425, that is, 0.5 percent smaller.

iii) In the first period, output is 0.257 in our economy, 0.2546 in the benchmark economy. In the second period, output is 0.2304 in our economy, 0.2305 in the benchmark.

Figure 3 plots the extra average output g (output gap henceforth) and the extra output volatility v (volatility gap henceforth) of our economy relative to the benchmark closed economy. This graph is constructed using a sample of $1,000$ combinations of parameters for which an interesting equilibrium exists; for illustrative purposes, for some parameter values, we report the combination of parameters that generates the point in the graph. To generate this sample, we fix $\Pr(\theta^H)$ and π at the values of the example above (0.85 and 0.6 respectively), and let α, A, I, and ω vary. Starting from the initial values, we perform a grid search over the parameter space. Denoting with x_0 the initial vector of parameters, we generate a proposed new vector x_1' based on x_0 plus a normally distributed random vector.[6] We keep generating values for x_1' until the combination of parameters is such that: (1) the conditions for Lemma 1 are satisfied; and (2) a boom-bust episode occurs both in our economy and in the benchmark economy (i.e. in both economies the output drops from the first to the second period). When this occurs, we set $x_1 = x_1'$, compute the equilibrium, and generate a proposed new vector x_2' based on x_1, and so forth. The range of values for the parameters is as follows: $\alpha \in (0, 0.58)$, $\omega \in (0.06, 0.15)$, $A \in (0.32, 0.84)$, $I \in (0.32, 0.65)$, and each of the parameters appears to be roughly uniformly distributed over its range.

6 Discussion of the Result

Proposition 1 conveys the key result of the paper: the presence of foreign lenders may foster the average output but may also exacerbate the volatility of the asset price and output. Figure 1 also reveals a systematic relationship between these two effects: the output gap goes hand in hand with the volatility gap. To illustrate the rationale 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] In order to explore a large region of the parameter space, one would like to set the standard deviation of the random vector equal to a large number. In order to study accurately the sensitivity of the results to the parameters, one would like to set the standard deviation of the random vector to a small number. We balance these considerations and choose a value of 0.02 for the standard deviation.

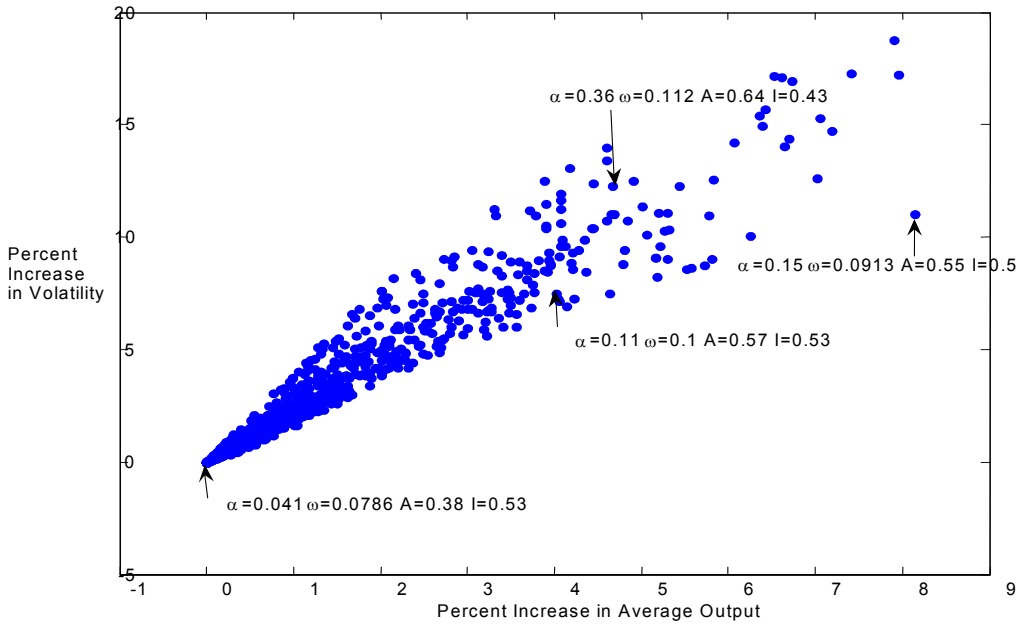

Figure 3: Extra Average Output and Output Volatility in the Liberalized Economy.

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 happens because the higher the asset price, the higher the expected value of collateral that a lender will forgo if she funds a specialized project rather than a generic one. As a result, some highly productive entrepreneurs turn to foreign lenders to finance specialized projects ($\overline{y}_1$ falls). In turn, this change in lenders' composition affects the intertemporal distribution of the asset supply and the dynamic pattern of the asset price as follows.

Because of their scarce 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. Instead, foreign lenders do not observe the realizations of θ_1 and ε, but only the price p_1, which is not a sufficient statistic for θ_2 (see also section 7.2 for the informativeness of the asset price). Therefore, foreign lenders may misunderstand a boom-recession scenario ($\theta_2 = \theta^L$) for a recession-boom scenario ($\theta_2 = \theta^H$). 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 fostering it in the second. This renders the asset price more procyclical, 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

Proposition 1 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 output and enforce repayments, foreign lenders are willing to finance specialized projects that otherwise would not be financed by domestic lenders. In particular, foreign lenders can compensate for the illiquidity of these projects by obtaining higher repayment in the event of success. The second insight is that the presence of foreign lenders may increase the output volatility. We now review the three effects that determine the volatility gap between our economy and the benchmark.

The "project 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 implement 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, it increases the volume of projects in the boom and decreases its volume in the recession. This exacerbates the output cycle (as in Kiyotaki and Moore, 1997, for example).

The "project composition" effect. The higher the asset price, the larger the relative importance of collateral in projects' expected return. Therefore, the loss associated with the illiquidity of specialized projects 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 tends to dampen the increase (drop) of output during the boom (recession). By contrary, in our economy this effect is absent because entrepreneurs can replace domestic lenders with foreign ones in the financing of specialized projects. This implies that, unlike in the benchmark economy, the rise (drop) in the volume of projects during the boom (recession) occurs without a significant drop (increase) in their average productivity. Therefore, like the "project volume" effect, the "project composition" effect exacerbates the volatility gap.

The "project 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 "project liquidation" effect 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 project liquidation effect is generally weaker than the other two effects combined. Therefore, consistent with the observation that the entry of foreign lenders in emerging economies generally raises output volatility, our economy features a larger output volatility than the benchmark. We also find that the project liquidation effect tends to be weaker than each of the other two effects taken in isolation. To establish this, we

consider a second benchmark economy closed to foreign lenders where entrepreneurs always implement specialized projects (details on this economy are available from the authors upon request). This can be thought as an economy where a social planner subsidizes the implementation of specialized projects or, alternatively, as a closed economy with no problems of limited contractual commitment. In this second benchmark economy, the "project composition" effect is absent (projects are always specialized) and the only two effects at work are the "project volume" effect and the "project liquidation" effect. It turns out that in a large set of simulations output drops more in our economy than in the benchmark one, while in the latter output drops less than in our preferred benchmark economy. This indicates that the "project volume" effect tends to dominate the "project liquidation" effect.

7 Sensitivity Analysis and Further Issues

In this section, we perform a sensitivity analysis of the equilibrium, relating the dynamics of the asset price and output to the parameters of the model. We then discuss the informational role of the asset price and firms' distribution more in detail.

7.1 Sensitivity Analysis

We investigate how the volatility gap v (i.e. the extra drop in output in our economy relative to the benchmark) and the output gap g (i.e. the difference between average output in our economy and in the benchmark) depend on the parameters of the model. To understand the sensitivity of the results, we consider again the $1,000$ combinations obtained in section 5 and perform a linear regression of v and g on the vector of parameters. Our estimated regression[7] for v yields

$$v = -0.37 + 0.52\alpha - 5.48\omega + 0.7083A + 0.977I, \ R^2 = 0.54 \tag{17}$$

while the regression for g yields

$$g = -0.227 + 0.2267\alpha - 2.42\omega + 0.293A + 0.46I, \ R^2 = 0.49. \tag{18}$$

Comparing the results of the two regressions, we find that, for all parameters, the volatility gap and the output gap go hand in hand. Put differently, the "gain" from an increase in average output goes hand in hand with the higher volatility coming from larger fluctuations.[8] Because the coefficients in the regression for v have the same sign as those in the regression for g, in Figure 3 the points in the north-east section of the graph tend to feature (on average) higher values of α, A and I, and lower values of ω.

The most striking insight probably stems from the effects of α and ω. A higher value of α and a lower value of ω mean lower output verifiability, due for example to less efficient legal

[7] Clearly, these regressions are only meant to be illustrative, because they refer to a truncated sample of observations in which the output drop in our model is larger than in the benchmark model. We ran analogous regressions including the points where the drop in output in our economy is smaller than in the benchmark economy. The results were qualitatively similar to those reported here.

[8] Similar results emerge as far as price volatility is concerned: in our model economy, larger output fluctuations are associated with large swings in asset prices.

enforcement. For given shock to fundamentals, a higher α (or a lower ω) entails a higher output gap but also a higher volatility gap. In numbers, an increase in α of 0.01 increases the output gap by a quarter percentage point and the volatility gap by about half a percentage point. The economic implication is relevant. Liberalizing an economy with a weak enforcement system can yield a substantial gain in output but can also dramatically increase the volatility of output and asset prices. The intuition for this finding is straightforward: when α is higher, pledgeable output constitutes a lower share of the expected return of projects and correspondingly the collateral value constitutes a larger share. The mechanism that generates endogenous cycles hinges on fluctuations of the asset price. A higher α tends to increase the relevance of collateral values and hence to foster the importance of fluctuations of the asset price.

7.2 The Informativeness of the Asset Price

As argued previously, in our economy the equilibrium asset price p_1 has a dual effect. Not only it clears the local asset market, as in any standard Walrasian setting, but in the first period it also affects the information set of foreign lenders by revealing information about the underlying θ and, hence, about θ_2. In other words, foreign lenders infer θ_2 from the equilibrium price p_1. The occurrence of endogenous cycles hinges on the limited informativeness of the equilibrium price p_1: if the asset price were fully informative, domestic lenders would not differ from foreign ones in the local asset (collateral) market (i.e., the asset sale decisions ℓ^d and ℓ^f would coincide). 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.[9]

7.3 Firm Distribution

The entrepreneurs' distribution in Lemma 1 is not the unique possible. For example, there is a region of the parameter space such that the marginal entrepreneurs who implement projects (those with y close to $\underline{y}_t$) borrow from foreign lenders while entrepreneurs with medium productivity resort to domestic lenders. We focus on the distribution in Lemma 1 for three important reasons. First, this distribution is highly tractable and yet it yields general implications. In fact, we experimented with more complicated distributions and found that the mechanism we describe carries through and the qualitative results of the analysis do not differ. Second, our objective is not to characterize exhaustively every possible scenario but rather to show that our model can reproduce the typical macroeconomic pattern of liberalized emerging economies. Third, the distribution in the lemma appears to capture critical stylized facts of the borrowing pattern in emerging economies. In fact, it is generally observed that large, highly productive businesses tend to borrow from foreign lenders, while smaller, less productive businesses borrow from local lenders. In the real world, this also happens because forming a credit match

[9] 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.

with a foreign bank may entail extra fixed costs that an unsophisticated, unproductive firm is unwilling to sustain. The extra output that can be extracted by a foreign lender ($\omega^f - \omega^d$) could easily be reinterpreted as such a fixed borrowing cost.

8 Conclusion

In this paper, we have put forward an explanation for the recent macroeconomic pattern of emerging economies based on the asymmetric skills of domestic and foreign lenders. We have shown that, when firms face credit constraints tied to the pledgeable returns of their projects, this asymmetry can explain why after liberalization episodes emerging economies experience higher average output but also higher asset price and output volatility than before liberalization.

We believe that the paper delivers an interesting policy implication. Recently, scholars and policy-makers have stressed the role that governments have in injecting liquidity in the asset market during recessions. There is however an equally important role played by governments during recent busts that is largely neglected. Besides injecting liquidity, in emerging economies governments have often created institutions, the "Asset Management Companies", whose main purpose has been to collect information on the asset market and thereby coordinate the trade of assets. The Asset Management Companies have played a critical role in identifying the best moments for the liquidation of the assets of distressed firms, as well as best users of these assets. This paper provides a macroeconomic rationale for the informational role of Asset Management Companies. Especially in an emerging economy that has experienced an episode of financial liberalization, foreign lenders are unlikely to have accurate knowledge of the local market for firms' assets. This paper suggests that in such an economy institutions specialized in disseminating information in the local asset market can stabilize the economy while preserving the growth benefits that the presence of foreign lenders entails.

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9 Appendix A. Proofs and Solution Algorithm

PROOF OF LEMMA 1.

We preliminarily set two restrictions on the parameters to avoid corner solutions for an entrepreneur's degree of specialization $n_t = \pi y$. Precisely, we assume

$$\pi y_{\max} < 1, \tag{19}$$

$$0 < \omega^d < \pi y_{\min}^2. \tag{20}$$

The first restriction guarantees that the optimal degree of specialization $n_t = \pi y$ never hits its upper bound (one). The second restriction 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); put differently, when she borrows from a domestic lender, an entrepreneur always prefers a specialized project than a generic one. Given this observation, we can characterize the region of the parameter space where the lemma holds in two steps.

Step 1. Points (a) and (b) imply together 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 (8) (and its analogous for V_2^{Sd}), we obtain

$$\underline{y}_1 = \frac{1}{\pi} \frac{I - \left(\pi\omega^d + (1-\pi) A \max(p_1, p_2)\right)}{1 - \alpha - (1-\pi) A \max(p_1, p_2)}, \tag{21}$$

$$\underline{y}_2 = \frac{1}{\pi} \frac{1 - \left(\pi\omega^d + (1-\pi) A p_2\right)}{1 - \alpha - (1-\pi) A p_2}. \tag{22}$$

Since for any $y \in [y_{\min}, \underline{y}_t]$ for a domestic lender a generic project has a lower expected return than a specialized project (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. Points (c), (d), and (e) imply together that the entrepreneurs with $y \in [\underline{y}_t, y_{\max}]$ implement specialized projects and that the active entrepreneurs with $y \in [\underline{y}_t, \overline{y}_t]$ borrow from domestic lenders while the active entrepreneurs with $y \in (\overline{y}_t, y_{\max}]$ borrow from foreign lenders.

c) *For an entrepreneur with* $y \in (y_{\min}, \overline{y}_t]$ *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 $y \in (y_{\min}, \overline{y}_t]$ 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

$$\overline{y}_1 = \frac{\omega^d}{(1-\pi)\, A \max(p_1, p_2)}, \tag{23}$$

$$\overline{y}_2 = \frac{\omega^d}{(1-\pi)\, A p_2}. \tag{24}$$

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

$$\omega^f > y_{\max}(1-\pi)\, A \max\left\{\max\{p_1, E^f(p_2)\}, p_2\right\}. \tag{25}$$

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, (25) implies that, 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.* The result that an entrepreneur with $y \in (y_{\min}, \overline{y}_t]$ prefers borrowing from a domestic lender stems immediately from the fact that a domestic lender extracts less output than a foreign lender. Next, observe also 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 implementing a specialized project than borrowing from a domestic lender and implementing 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 AND SOLUTION ALGORITHM.

Summary. For given values of $E^d[p_2 \,|\Im_1^d]$ and $E^f[p_2 \,|\Im_1^f]$, 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 (21), (22), (23), (24), (10), (11), (12), and (9), i.e., combining (10) with (12) and (9),

$$\underline{y}_1 = \frac{1}{\pi}\frac{I - \left[\pi\omega^d + (1-\pi)\, A \max(p_1, p_2)\right]}{1 - \alpha - (1-\pi) A \max(p_1, p_2)} \tag{26}$$

$$\underline{y}_2 = \frac{1}{\pi}\frac{I - \left[\pi\omega^d + (1-\pi)\, A p_2\right]}{1 - \alpha - (1-\pi) A p_2} \tag{27}$$

$$\overline{y}_1 = \frac{\omega^d}{(1-\pi)\, A \max(p_1, p_2)} \tag{28}$$

$$\overline{y}_2 = \frac{\omega^d}{(1-\pi)\, A p_2} \tag{29}$$

$$p_1 = \theta_1\left[1 - (1-\pi)A\left\{\ell^d\left[F(\overline{y}_1) - F(\underline{y}_1)\right] + \ell^f\left[1 - F(\overline{y}_1)\right]\right\}\right] \tag{30}$$

$$p_2 = \theta_2\left[1 - (1-\pi)A\{1 - F(\underline{y}_2) + (1-\ell^d)\left[F(\overline{y}_1) - F(\underline{y}_1)\right] + (1-\ell^f)\left[1 - F(\overline{y}_1)\right]\}\right] \tag{31}$$

$$\ell^l = \begin{cases} 1 & if \quad p_1 \geq E^l[p_2 \,|\Im_1^l] \\ 0 & if \quad p_1 < E^l[p_2 \,|\Im_1^l] \end{cases} \qquad l = d, f. \tag{32}$$

Now, consider the values of $E^d[p_2 \,|\Im_1^d]$ and $E^f[p_2 \,|\Im_1^f]$. Starting with $E^d[p_2 \,|\Im_1^d]$, 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, $E^d[p_2 \,|\Im_1^d] = p_2$. 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,

$$\Pr\left(\theta_2 = \theta^L | p_1\right) = \frac{Pr(\theta_1 - \varepsilon = \theta^H) \Pr(p_1 \left| \theta_1 - \varepsilon = \theta^H \right.)}{\Pr(\theta_1 - \varepsilon = \theta^L) \Pr(p_1 \left| \theta_1 - \varepsilon = \theta^L \right.) + \Pr(\theta_1 - \varepsilon = \theta^H) \Pr(p_1 \left| \theta_1 - \varepsilon = \theta^H \right.)}. \tag{33}$$

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

$$E^f[p_2 \left| \Im_1^f \right.] = \left[1 - \Pr\left(\theta_2 = \theta^L | p_1\right)\right] p_2^H + \Pr\left(\theta_2 = \theta^L | p_1\right) p_2^L. \tag{34}$$

Algorithm. The algorithm to solve the system (26)-(34) 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 (26) to (32). 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 $\ell^f = 0$. Call p_{2H} the value found for p_2.

3. Calculate the numerator of (33) 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 (26) to (32) 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). 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 (33), calculate $\Pr\left(\theta_2 = \theta^L | p_1\right)$.

8. Using (34), 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 $\overline{y}_t = y_{\max}$. 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

$$\mathcal{Y}_1 = \pi \mathcal{A}_1 + (1 - \pi)(\mathcal{B}_1 - \mathcal{C}_1). \tag{35}$$

In (35), $\mathcal{A}_1$ is the output of successful projects, i.e.

$$\mathcal{A}_1 = \int_{\underline{y}_1}^{y_{\max}} (y + \pi y^2) f(y) dy, \tag{36}$$

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

$$\mathcal{B}_1 = \frac{A(\theta_1 + p_1)}{2} \left\{ \ell^d \left[F(\overline{y}_1) - F(\underline{y}_1) \right] + \ell^f \left[1 - F(\overline{y}_1) \right] \right\}. \tag{37}$$

In (37) $(\theta_1+p_1)/2$ 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.

$$\mathcal{C}_1 = p_1 A \left[\ell^d \int_{\underline{y}_1}^{\overline{y}_1} \pi y g(y) dy + \ell^f \int_{\overline{y}_1}^{y_{\max}} \pi y g(y) dy \right]. \tag{38}$$

Output in period 2.

$$\mathcal{Y}_2 = \pi \mathcal{A}_2 + (1-\pi)(\mathcal{B}_2 - \mathcal{C}_2), \tag{39}$$

where

$$\mathcal{A}_2 = \int_{\underline{y}_2}^{y_{\max}} (y + \pi y^2) f(y) dy, \tag{40}$$

$$\mathcal{B}_2 = \frac{A(\theta_2+p_2)}{2} \left\{ 1 - F(\underline{y}_2) + (1-\ell^d) \left[F(\overline{y}_1) - F(\underline{y}_1) \right] + (1-\ell^f) \left[1 - F(\overline{y}_1) \right] \right\}, \tag{41}$$

$$\mathcal{C}_2 = p_2 A \left[\int_{\underline{y}_2}^{y_{\max}} \pi y f(y) dy + (1-\ell^d) \int_{\underline{y}_1}^{\overline{y}_1} \pi y f(y) dy + (1-\ell^f) \int_{\overline{y}_1}^{y_{\max}} \pi y f(y) dy \right]. \tag{42}$$

BENCHMARK ECONOMY.

Output in period 1.

$$\mathcal{Y}_1 = \pi \mathcal{A}_1 + (1-\pi)(\mathcal{B}_1 - \mathcal{C}_1), \tag{43}$$

where

$$\mathcal{A}_1 = \int_{\underline{y}_1}^{\overline{y}_1} (y + \pi y^2) f(y) dy + \int_{\overline{y}_1}^{y_{\max}} y f(y) dy, \tag{44}$$

$$\mathcal{B}_1 = \frac{A(\theta_1+p_1)}{2} \left\{ \ell^d \left[1 - F(\underline{y}_1) \right] \right\}, \tag{45}$$

$$\mathcal{C}_1 = A \ell^d p_1 \int_{\underline{y}_1}^{\overline{y}_1} \pi y f(y) dy. \tag{46}$$

Output in period 2.

$$\mathcal{Y}_2 = \pi \mathcal{A}_2 + (1-\pi)(\mathcal{B}_2 - \mathcal{C}_2), \tag{47}$$

where

$$\mathcal{A}_2 = \int_{\underline{y}_2}^{\overline{y}_2} (y + \pi y^2)(y) dy + \int_{\overline{y}_2}^{y_{\max}} y f(y) dy, \tag{48}$$

$$\mathcal{B}_2 = \frac{A(\theta_2+p_2)}{2} \left\{ 1 - F(\underline{y}_2) + (1-\ell^d) \left[1 - F(\underline{y}_1) \right] \right\}, \tag{49}$$

$$\mathcal{C}_2 = p_2 A \left[\int_{\underline{y}_2}^{\overline{y}_2} \pi y f(y) dy + (1-\ell^d) \int_{\underline{y}_1}^{\overline{y}_1} \pi y f(y) dy \right]. \tag{50}$$