Costly Information, Foreign Entry, and Credit Access

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Keywords: Foreign Entry, Asymmetric Information, Economic Development
JEL Classification: D82, F3, G2, O16, O19.

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By allowing financial institutions in developed countries to lend directly to firms in less developed countries (LDCs), open capital markets are generally thought to alleviate domestic liquidity constraints, to improve the allocation of credit, and hence, to increase aggregate output. As a result of these potential benefits, many LDCs opened their capital markets in the 1980s and 1990s. These openings fostered foreign lenders' entry into their economies and changed the local competitive structure of their financial sectors. But the assumption that opening capital markets is beneficial has recently come under serious doubt, as empirical studies have repeatedly failed to find a consistent relation between foreign lenders' entry, credit access, and aggregate output in LDCs.[1] This lack of empirical evidence leads to this paper's central question: why might open capital markets and the resulting entry of foreign lenders *not* increase credit access and aggregate output in LDCs?

In this paper, I show that information asymmetries and the effect of foreign entry on competitive dynamics in the local credit market provide an answer. This paper presents a theoretical framework that explains how foreign entry affects firms' access to credit when foreign lenders enjoy a different cost of capital and ability to acquire information about firms than domestic lenders. Empirical evidence suggests that this framework is particularly relevant in the context of LDCs with significant foreign lender entry (Mian, 2006). Within this framework, it is possible to identify situations where foreign entry induces a segmented credit market that adversely affects credit access for many domestic firms. This potential decline in credit access provides new insights for understanding why foreign entry may not always increase aggregate output. At the same time, the model provides predictions on when foreign lenders' entry will improve both credit access and aggregate output. In particular, the model illustrates how the impact of foreign entry will depend on the distribution of firms, the relative costs of lenders, and the cost of information.

[1] For example, Rodrik (1998) and Edison, Levine, Ricci and Sløk (2003) find no effect of open capital markets and financial integration. See Eichengreen (2001) for a more detailed review of this literature. More recent research focusing on the specific impact of foreign participation in domestic equity markets and foreign bank entry also reaches differing conclusions. For example, Bekaert, Harvey, and Lundblad (2005) and Henry (2000) find positive correlations between equity market liberalization and economic performance, while Detragiache, Tressel and Gupta (2008) and Gormley (2006) find foreign bank entry to be negatively related to overall domestic credit.

The model focuses on the important role information plays in shaping competition when lenders differ in both their access to information and their cost of capital. Recent work by Dell'Ariccia and Marquez (2004) and Sengupta (2006) demonstrate that these differences among lenders can have important implications for the overall distribution of credit. In both models, one lender, generally understood to be the 'foreign' lender, enjoys a cost advantage in extending finance, but at the same time has no information about firms' quality. The 'domestic' (informed) lender, however, has perfect knowledge about some firms' types but has a higher cost of funds. Under these assumptions, they show that foreign lenders' entry will induce a segmented credit market, which has broad empirical support (Berger, Klapper, and Udell, 2001; Clarke, Cull, and Peria, 2001; Gormley, 2006; Mian, 2006), but that foreign entry will still improve credit access for all firms.

However, recent empirical studies find that foreign entry is sometimes associated with a decline in credit access for domestic firms (Detragiache, Gupta, and Tressel, 2008; Gormley, 2006). Additionally, empirical evidence finds that domestic lenders do not enjoy costless access to information about firms' quality in LDCs (Aleem, 1990), and despite the weak accounting standards and poor institutions found in LDCs, it is also likely that foreign lenders possess some ability to acquire information about domestic firms through costly screening technologies. Therefore, I use a similar theoretical framework as the aforementioned works, but I instead make the following assumptions: one, both types of lenders have access to information about firms, and two, acquiring this information is costly for both lenders, but may be more costly for foreign lenders. In the model, lenders will acquire this information by paying a fixed screening cost per firm.[2] By incorporating these arguably realistic observations, I am able to derive a number of novel predictions.

First, segmentation of the credit market following foreign entry has the potential to reduce credit access for many firms. The intuition is straightforward. When screening costs are sufficiently

[2] For simplicity, the fixed screening cost is assumed to be uniform across all types of firms. This assumption greatly reduces the analysis, but is not essential. All subsequent findings will hold in a more general setting where screening costs are allowed to vary with the scale of expected lending to a firm so long as the screening cost does not increase 1-1 with the amount of expected lending.

high, a competitive equilibrium may occur, where domestic lenders pool all firms together with a uniform financial contract rather than invest in the costly screening technology. Relative to the first-best allocation without information asymmetries, a pooling equilibrium over-funds low-return firms and under-funds high-return firms. This type of lending pattern is a standard problem in emerging economies (Banerjee, Cole, and Duflo, 2003). But the entrance of foreign lenders may break this pooling equilibrium. When foreign lenders have a lower cost of funds, it can be worthwhile for them to target and finance the subset of high-return firms capable of profitably investing large amounts of capital—a practice commonly called 'cream-skimming'. Since screening costs are fixed, foreign lenders' lower marginal cost of funds allows them to offer a more competitive lending rate than domestic lenders to these high-return firms, even when foreign lenders' have a higher cost of screening. This 'cream-skimming', however, reduces the average quality of firms being pooled by domestic lenders and may eliminate the feasibility of a pooling equilibrium for firms in which domestic lenders maintain a competitive advantage and strengthen the incentives of domestic lenders to begin screening their remaining borrowers. But, if distinguishing the high-return firms not targeted by foreign lenders from the low-return firms is too costly, domestic lenders will instead exit the market entirely reducing credit access for firms not targeted by foreign lenders.

This potential decline in credit leads to the model's second implication: foreign lenders' entry has the potential to either increase or reduce net output. 'Cream-skimming' by foreign lenders increases net output by eliminating the under-financing of high-return firms capable of profitably investing large amounts of capital, and if domestic lenders invest in the screening technology in response to foreign entry, this investment will reduce the number of negative net present value (NPV) projects financed by domestic lenders and also increase net output. However, if screening is too costly, such that foreign lenders are limited to 'cream-skimming' and domestic lenders respond to this 'cream-skimming' by exiting some sectors of the economy entirely, many positive NPV projects will lose funding. These projects will remain unfunded as neither domestic nor foreign lenders will find it cost-effective to screen firms in these sectors of the economy, and as a result, net output may fall.

The model thus provides a relatively simple explanation as to why foreign lenders' entry may not necessarily increase overall output. In emerging economies with significant costs to screening projects, the initial domestic allocation of credit may fail to achieve the first-best allocation because domestic lenders optimally choose to pool risks and cross-subsidize losses on low-return projects with gains on high-return firms rather than invest in costly screening technologies. If true, foreign entry may take the form of 'cream-skimming', which can both redirect credit towards the most profitable firms and reduce the credit access of firms that continue to rely on domestic lenders.

At the same time, the model sheds light on when 'cream-skimming' is more likely to occur, and when this segmentation of the market will reduce credit access and net output. The relative costs of the two lenders, particularly foreign lenders' screening costs, will determine whether segmentation occurs. This suggests that both the manner in which foreign lenders enter the country—portfolio inflows, de novo branches, or acquisitions—and the quality of the country's local institutions may be important. Capital market openings that reduce foreign lenders' relative disadvantage in screening firms should exhibit less 'cream-skimming'. If segmentation occurs, however, the distribution of firms and domestic lenders screening costs will be important in determining whether segmentation adversely affects the net output of the economy. In particular, a fall in net output is more likely to occur when domestic lenders face many low-return firms or are ineffective at screening firms. Since domestic screening costs may measure bank-, borrower-, and country-specific factors regarding asymmetric information, this suggests the impact of foreign entry may vary across countries and industries. For example, higher screening costs might occur at the country level because of undeveloped credit rating agencies or inadequate enforcement of accounting standards that make screening very costly for lenders.[3] The model also indicates that a decline in output will be less likely to occur if foreign entry lowers the cost of capital for domestic lenders.

[3] This latter argument provides a potential explanation as to why empirical studies fail to find a strong positive correlation between open capital markets and aggregate output, particularly in LDCs where domestic institutions are generally very weak (Edwards, 2001; Arteta, Eichengreen, and Wyplosz, 2001).

A final implication of the model is that an adverse impact of foreign entry can either be short-lived or become exacerbated with time. If foreign lenders' relative disadvantage in screening firms decreases with time spent in the country, the potential of foreign entry to create adverse effects will lessen with time. Therefore, it is possible for net output to fall initially following foreign entry but than gradually increase over time as the economy moves toward the first best allocation. However, if foreign entry limits the ability of firms to obtain credit in the early stages of a product's life-cycle, then foreign entry may have long-run adverse affects on net output. In such a situation, the 'cream-skimming' by foreign lenders of the larger, successful firms in mature product markets may reduce the ability of domestic lenders to finance the projects of younger, smaller firms in new product markets. This may inhibit innovation and the development of new product markets and subsequently reduce the net output of the economy in the long-run. These theoretical predictions, along with those on how the impact of foreign entry may vary by industry and country, suggest a number of interesting avenues for future empirical research.

Overall, the analysis provides new insights about certain unexplained consequences of foreign entry into emerging capital markets, and is related to three distinct literatures. First, the paper is related to a growing theoretical literature concerning the unanticipated effect that greater competition may have on the lending relationships that small and medium-sized firms rely on (Boot and Thakor, 2000; Petersen and Rajan, 1995). In particular, the potential for credit-rationing and the non-existence of equilibrium following an increase in competition is similar to that discussed by Rothschild and Stiglitz (1976) and Stiglitz and Weiss (1981). The finding of 'cream-skimming' and its potential adverse implications is also similar to that of Detragiache, Gupta, and Tressel (2008). In their model, segmentation can occur when foreign lenders have comparative advantage in acquiring specific types of information relative to domestic lenders, and as a result of this, firms without this type of information are never better off following foreign entry. This paper differs in that it assumes foreign lenders are always at an information disadvantage relative to domestic lenders and finds that foreign entry has the potential to lower the cost of all firms with positive NPV projects. Additionally, this paper explores how the immediate and long-run impact of foreign entry will depend on the distribution of firms, the relative costs of lenders, and the characteristic of product markets.

Second, the paper is related to the recent literature that explores the important role information plays in shaping competition when lenders differ in both their access to information and their cost of capital. As noted earlier, recent work by Dell'Ariccia and Marquez (2004) and Sengupta (2006) demonstrate that these differences among lenders can induce segmented credit markets but will still improve overall credit access. However, in Dell'Arriccia and Marquez (2004), foreign entry does increase domestic banks' loan portfolio risk, which in a more complete model with costly bank capital could cause a reduced lending capacity for domestic banks. While this has the potential to generate adverse affects on credit and output similar to this paper, their paper does not explore this possibility. Moreover, by assuming domestic lenders have perfect information about borrower types while foreign lenders have no information, their framework is unable to shed light on when segmented markets will induce declines in credit access, which firms or industries are most likely to be adversely affected, and whether these changes are welfare-enhancing.

Finally, the paper is related to a literature that attempts to explain the adverse consequences of open capital markets by connecting capital inflows with reduced financial stability (Stiglitz, 2000; Agénor, 2003; Kaminsky and Schmukler, 2003; Eichengreen and Leblang, 2003; Dell'Ariccia and Marquez, 2006). While not the focus of this paper, the model developed below suggests that foreign entry may instead increase financial stability. Such an outcome will occur if the 'cream-skimming' of foreign lenders induces domestic lenders to increase their investments in screening technologies so as to reduce the number of negative NPV projects being funded.

The remainder of the paper proceeds as follows. Section 1 provides the basic setup and assumptions of the model. Section 2 discusses the possible equilibria prior to foreign lenders' entry, and Section 3 describes the possible equilibria following foreign entry. Section 4 then analyzes the factors that determine the impact of foreign entry. Section 5 demonstrates the robustness of the models' findings and discusses possible extensions, and Section 6 generalizes the model to a repeated game framework without full commitment by lenders. Finally, Section 7 concludes.

1 The Basic Model

1.1 Agents and Technology

There are two types of agents: firms and lenders. All agents are risk-neutral, and because of limited liability, no firm can end up with a negative amount of cash.

The real sector consists of three types of firms, $i \in \{A, B, C\}$, and a continuum θ_i of each type, where $\theta_A + \theta_B + \theta_C$ is normalized to equal 1. Each type of firm has the ability to implement one project of size $I \in \{1, \lambda\}$, where $\lambda > 1$. If successfully implemented, the project yields a verifiable return $RI > r^* I$, where r^* is the exogenous international cost of capital. For simplicity, all firms have zero wealth and must borrow the entire amount I from lenders in order to implement the project.

Among the three types of firms, there will be one type that lenders always want to finance, C (the 'cream'), another type they never want to finance, B (the 'bad'), and a third type that they only want to finance for small projects, A (the 'average'). This is formally established by having the three types differ in their ability to implement projects successfully. If financed, the 'cream' firms always succeed with probability 1, regardless of project size, while 'bad' firms only succeed with probability p. Projects that only succeed with probability p have a negative net expected return given the international cost of funds, r^*, such that $pR < r^*$. 'Average' firms, however, implement the smaller project of size 1 with certain success, while larger projects only succeed with probability p. Given this setup, the economy's expected net output is maximized when 'cream' firms are financed for projects of size λ, 'average' firms for projects of size 1, and 'bad' firms are not financed. This is the first-best allocation of credit.

The concept of 'cream' firms should be interpreted broadly. Their ability to successfully implement the project of size $\lambda > 1$ serves to represent high-return firms capable of profitably investing large amounts of capital. This would include firms with large projects, multiple projects, or the potential for many future projects, and hence, 'cream' firms are not necessarily currently large in size. Additionally, allowing firms to vary based on the return, *R*, to their projects rather than the amount of capital they can successfully invest does not qualitatively change the findings. This possibility is discussed in more detail in Section 5.

For simplicity, it is assumed there are relatively more 'average' firms than 'cream' in the economy, such that $\theta_A > \theta_C$.[4] Moreover, to demonstrate the potential for foreign entry to adversely affect output, the following assumption about the distribution of firms is made:

$$\frac{\theta_B}{\theta_A} > \frac{(\mathrm{R} - r^*)}{r^* - p\mathrm{R}} \tag{1}$$

Assumption (1) ensures that the number of 'bad' firms is sufficiently high relative to 'average' firms to exclude equilibria where lenders can profitably pool 'bad' and 'average' firms together. This assumption will ensure the existence of equilibrium where foreign entry can adversely affect credit access for some firms. This will be discussed in more detail in Section 3, and in Section 4, I will explore the implications of relaxing this assumption.

The financial sector consists of many perfectly competitive domestic and foreign lenders willing to extend capital in the amount of $I \in \{1, \lambda\}$. Without the costly screening of firms, lenders are unable to identify a firm's type, thus providing the source of information asymmetry in the model. Lenders, however, may invest in a screening technology that perfectly identifies a firm's type. The cost of this screening technology will capture the severity of the asymmetric information problem.

Domestic lenders will initially differ from foreign lenders in two key ways. First, the domestic lenders have access to an unlimited supply of domestic funds at opportunity cost, r, while foreign

[4] All subsequent findings are robust to dropping this assumption so long assumption (1) is modified to also include $\theta_B > \theta_C(R - r)/(r - pR)$ such that it is never profitable for lenders to pool 'bad' and 'cream' firms.

lenders' have access to an unlimited supply of international funds at opportunity cost, r^*, where $r^* < r$. There are a couple potential justifications for this assumption. First, the higher domestic cost of capital could reflect the poor access to international markets and the weak deposit collection technologies of many domestic lenders in emerging economies.[5] Second, in a more general model with risk-averse investors, foreign lenders' lower cost of capital could be generated through risk sharing and their better ability to diversify their investments.

The second initial difference between foreign and domestic lenders is that foreign lenders find it more costly to overcome information asymmetries because of distance, cultural, or institutional barriers. Specifically, domestic lenders can screen at cost $C > 0$ per firm while foreign lenders must pay $C^* > C$. The assumption that domestic lenders incur a positive screening cost implies that these are clients of domestic lenders where their type is not fully known or easily discovered. In reality, this will be true for new firms or existing clients where future projects are not known with certainty. Moreover, the positive screening cost for domestic lenders captures the weak accounting standards and poor institutions that make acquiring information about firms particularly costly to do in LDCs (Aleem, 1990). Lastly, the assumption that screening costs are larger for foreign lenders is supported by a large literature that finds foreign lenders are informationally-disadvantaged relative to domestic lenders. For example, Mian (2006) finds distance barriers are an important informational cost for foreign banks in Pakistan, while Stein (2002) demonstrates that the greater hierarchical structure of foreign banks relative to domestic banks also likely makes it more costly for foreign banks to use the 'soft-information' necessary to screen firms effectively.

In later analysis, I will relax these cost assumptions to examine how the impact of foreign entry varies based on the relative cost structures of each lender. While there are number of potential

[5] One concern about this assumption is that governments in emerging economies often provide subsidized funds to domestic lenders such that their direct cost of funds is less than the cost of capital on international capital markets. However, privileged access to funds does not necessarily imply a lower cost of funds. Domestic lenders typically have much higher non-interest costs than international lenders. For example, the average wage bill of domestic banks is twice as large as the average wage bill of foreign banks in India. By sidestepping local unions, foreign banks in India employ one-seventh the number employers per unit of assets (Hanson 2003).

reasons to believe these initial assumptions about domestic and foreign lenders may hold in reality, as described above, it is possible to imagine scenarios where they will be violated. For instance, it may be possible for foreign lenders to lower their cost of screening below that of domestic lenders by acquiring domestic lenders (and their knowledge of the local economy). Moreover, domestic lenders may be able to borrow directly from international markets, thus reducing their cost of capital to the international level. Both of these possibilities, and others, will be explored further in Section 4.

As currently specified, however, the relative cost structures of foreign and domestic lenders will induce a segmented market. The fixed nature of screening costs and foreign lenders' lower marginal cost of funds ensures that foreign lenders will be able to offer more competitive lending rates than domestic lenders for firms that invest sufficiently large amounts of capital. Hence, this cost structure will induce what might be perceived as 'cream-skimming' behavior by foreign lenders. To generate this, I will assume that projects of size λ are sufficiently large to provide foreign lenders the competitive advantage in financing these projects, whereas the smaller projects are not given the initial assumption about lenders costs. Specifically, the following assumptions are made:

$$r^* + \frac{C^*}{\lambda} < r + \frac{C}{\lambda} < R \tag{2}$$

$$R < r^* + C^* \tag{3}$$

Assumptions (2) and (3) are what distinguish foreign lenders from domestic lenders. The first inequality in equation (2) ensures it is always feasible to screen larger projects in the economy and that the international cost of capital is sufficiently low to offset foreign lenders' disadvantage in screening larger projects relative to domestic lenders. The international cost of funds will not, however, be low enough to provide the foreign lenders an advantage in financing smaller projects, where the per-unit cost of screening is higher. In fact, equation (3) states that foreign lenders' per-unit cost of screening smaller projects is too high to profitably screen and finance these projects.

For simplicity, the fixed screening cost is assumed to be uniform across all types of firms.

This assumption greatly reduces the analysis, but is not essential. All subsequent findings will hold in a more general setting where screening costs are allowed to vary with the scale of expected lending to a firm so long as the screening cost does not increase 1-1 with the amount of expected lending. The model is also be robust to assuming the foreign banks incur the same cost of screening, but receive a lower precision signal of a of firm's type than domestic banks.

1.2 Timing of Events

There is no discounting between periods, and the timing of events is as follows:

$t = 0$: firms discover their type, i

$t = 1$: lenders choose their menu of financial contracts F; firms apply for financing

$t = 2$: lenders screen applicants and provide capital, I, to successful applicants

$t = 3$: project outcomes are realized; financial contracts are settled

The basic idea of this timeline is the following: Lenders initially choose what menu of financial contracts they wish to offer firms. In doing this, will they choose both what type of financial contracts to offer and to which firms will they offer these contracts. Firms then approach lenders and apply for their preferred financial contract from the menu of available contracts. If the contract is designated for firms of a specific type, the lenders screen applicant firms to verify their type and financing is provided to successful applicants. Finally, project outcomes are realized in the final period and all financial contracts are settled.

1.3 Financial Contracts and Strategies

Let F_j represent the menu of contracts offered by lender j, where $F_j^{I,k}$ denotes a financial contract from lender j in amount I designated for firms of type $k \in \{0, A, B, C\}$. When $k = 0$, the contract is unscreened and available to all firms, regardless of type, but for $k \neq 0$, the contract is only available to a firms where screening by the lender reveals $i = k$. Each contract is a mapping of the observable output from the project, Y, into a payment for the firm. Specifically,

$$F:\{0, RI\} \to \mathbb{R}_+ .$$

Each type of contract maps into a non-negative payment since firms have no initial wealth and cannot receive a negative payment. Moreover, it is important to note that this mapping spans the universe of potential contracts, and hence, the concept of a 'lender' used here is very general and encompasses banks, stockholders, etc. However, it will be shown later that equilibrium contracts can always be replicated by a pure-debt contract. For this reason, all future references to financial contracts will be made with respect to pure-debt contracts.[6]

Let $f(i)$ designate the contract choice of a firm of type i, where $f(i) = \varnothing$ is allowed. A firm's strategy consists only of its contract choice, and a strategy configuration in this economy consists of the set of contracts F_j for each lender $j \in L$, and $f(i)$ for each firm $i \in E$. Firms' actions are limited in that $f(i) \in \mathbb{F}$, where $\mathbb{F}$ is the set of all F_j's. The equilibrium concept used is Subgame Perfect, and a strategy configuration will be an equilibrium if each lender $j \in L$ is maximizing expected profits and each firm i is maximizing its expected utility given the strategies of all other agents in the economy.

The expected utility of a firm i with financial contract, F, can be expressed as:

$$u(F \mid i) = p(i \mid I)F(RI) + (1 - p(i \mid I))F(0) \ , \tag{4}$$

where $p(i \mid I)$ is the probability of success for a firm of type i with a project of size I, which is determined by the amount of financing associated with the finance contract, F.

Likewise, the expected profits of lender j lending to firm i with contract F is,

$$\pi_j(i \mid F) = \left[p(i \mid I)\mathrm{R} - r(j) \right] I - u(F) - C(j)S \ , \tag{5}$$

where $r(j)$ and $C(j)$ represent the cost funds and screening for lender j, I represents the amount of financing associated with contract, F, and $S = 0$ for unscreened contracts and equals 1 otherwise.

Finally, let $\chi(F, \mathbb{F})$ be the set of firm types that accept the contract offer F when the set of

[6] See Appendix A for more details.

available financial contracts is $\mathbb{F}$. In other words, $i \in \chi(F, \mathbb{F})$ if and only if $f(i) = F$. And for clarity, $f(i) = \varnothing$ is assumed the default choice of firms when no available financial contract provides a positive expected return, and it will be assumed that all firms choose with equal probability among contracts that give the same utility when such contracts provide the highest expected return to the firm. Given this, the economy's equilibrium is formally defined as:

Definition of Equilibrium: A strategy configuration, $f(i)$ for each firm $i \in E$ and $\mathbb{F}$ implied by F_j for each lender $j \in L$, constitutes an equilibrium if and only if,

1. Given $\mathbb{F}$, each firm $i \in E$ chooses $f(i) \in \mathbb{F}$ to maximize $u(f)$.
2. Each lender $j \in L$ chooses F_j to maximize $\int_{i \in \chi(F_j, \mathbb{F})} \pi_j(i \mid F_j) di$ where $i \in \chi(F_j, \mathbb{F})$ is

given by condition 1, and $\int_{i \in \chi(F_j, \mathbb{F})} \pi_j(i \mid F_j) di = 0$.

Before solving the equilibrium in both the closed and open economies, it is first worth noting two implicit assumptions being made in the basic model described above. These assumptions greatly simplify the initial analysis, but are not crucial to results.

First, I am implicitly assuming that lenders can fully commit to their financial contracts in two key ways. One, lenders will always screen financial contracts of type $k \neq 0$. This eliminates lenders from deterring 'bad' borrowers by declaring all contracts will be screened, but not actually screening them. And two, lenders can fully commit to the initial terms of any contract, F, and their initial menu of contracts, F_j. In other words, there is no possibility of renegotiation between lenders and firms after screening reveals a firms' type, and hence, firms will have no incentive to misrepresent their type when applying for a screened financial contract. With a few extensions on the basic model, however, it can be shown that full commitment by lenders is an equilibrium strategy in a repeated game. This is shown in Section 6, where a more general version of the above model is solved.

Second, I am assuming that all firms implement the project if they receive financing from a lender. In the absence of this assumption, lenders will have an incentive to offer a financial contract that actually pays firms to *not* implement the project. This contract could be used to induce 'bad' firms to reveal themselves without having to invest in the costly screening technology. However, this contract would likely never exist in reality since it will never be feasible for lenders to make a positive payoff to firms that identify themselves as 'bad' as this would induce all firms and individuals without projects to seek the same payoff. This can be easily captured in the above model by introducing a fourth type of firm that has no project. So long as the mass of these zero project firms is sufficiently large, a financial contract that pays a positive amount to 'bad' firms that abandon their low-return projects will not be feasible.[7] Again, adding this extension and relaxing the full commitment assumptions in a more general framework will be formally done in Section 6.

2 Analysis of Domestic Lenders

In the economy prior to foreign entry, the set of lenders, L, consists of only domestic lenders. It can be shown that either a pooling or separating equilibrium will exist depending on whether the domestic cost of screening, C, exceeds some threshold, $\underline{C}$, defined by equation (6).

$$\underline{C} \equiv \lambda(R - r) - \left(R - \frac{r}{1-(1-p)\theta_B} \right) \tag{6}$$

When the cost of screening does not exceed this value, a separating equilibrium occurs in which 'cream' firms will be financed for large projects, 'average' firms for small projects if $r + C \leq R$, and 'bad' firms are never financed. However, when screening is costly, all firms will be pooled on the smaller project using a financial contract that does not screen applicants. The 'cream' firms will be unwilling to obtain financing for the larger project and the 'bad' firms will be financed. Hence, the first-best allocation is achieved only when the information asymmetry (captured by $C > 0$) is sufficiently small. The existence of these two allocations is stated formally in Proposition 1.

[7] Acemoglu (1998) uses a similar method to eliminate these unrealistic types of contracts.

Proposition 1.

1. If $C > \underline{C}$ and $r/\left(1-(1-p)\theta_B\right) \leq \mathrm{R}$, there exists an equilibrium in which domestic lenders only offer an unscreened financial contract of size I=1 to firms with the payoffs

$$F(Y) = \begin{cases} \mathrm{R} - r^{pool} & \text{if } Y = \mathrm{R} \\ 0 & \textit{otherwise} \end{cases}$$

where $r^{pool} \equiv r/\left(1-(1-p)\theta_B\right)$, and all firms receive this financial contract.

2. If $C \leq \underline{C}$, there exists an equilibrium in which domestic lenders offer a screened financial contract of size $I = \lambda$ to firms of type $k = C$ with the following payoffs:

$$F(Y) = \begin{cases} \lambda(\mathrm{R} - r^{C}) & \text{if } Y = \mathrm{R}\lambda \\ 0 & \textit{otherwise} \end{cases}$$

where $r^{C} \equiv r + C/\lambda$, and all firms of type $i = C$ receive this financial contract. And if $r + C \leq \mathrm{R}$, domestic lenders also offer a financial contract of size I=1 to firms of type $k = A$ with payoffs

$$F(Y) = \begin{cases} \mathrm{R} - r^{A} & \text{if } Y = \mathrm{R} \\ 0 & \textit{otherwise} \end{cases}$$

where $r^{A} \equiv r + C$, and all firms of type $i = A$ receive this financial contract. If $r + C > \mathrm{R}$, however, $f(A) = \varnothing$, and $f(B) = \varnothing$ always.

The allocations described here are the only equilibrium allocations.

A proof of Proposition 1 is found in the appendix, but the intuition is straightforward. When information asymmetries are sufficiently large, as captured by a large cost of screening, C, a lender will find it optimal to forego screening and instead offer an unscreened contract that pools all borrowers on the small project. In this case, all firms, including bad firms, will choose to accept a cheap (but small) unscreened contract making a pooling equilibrium possible. The pooling equilibrium, however, will only exist if domestic lenders can profitably pool all borrowers, which is true when $r/\left(1-(1-p)\theta_B\right) \leq R$, and there does not exist any other contract capable of enticing 'cream' firms away from the unscreened contract. This is true for $C > \underline{C}$. This pooling contract and allocation of credit is the unique equilibrium when $C > \underline{C}$.

When $C \leq \underline{C}$, however, perfectly competitive domestic lenders can always offer 'cream' firms a screened contract that induces them to take the larger project rather that be pooled with all other firms. When the 'cream' select this larger contract, the pooled contract becomes unprofitable since it is never feasible to pool just 'average' and 'bad' firms by assumption (1). Thus, the 'average' will only be financed in a separating equilibrium if the cost of screening is sufficiently low such that domestics lenders can profitably screen and finance them. This will only occur for $r + C \leq R$. This allocation of credit to 'average' and 'cream' firms is the unique equilibrium allocation when $C \leq \underline{C}$.[8]

The pooling equilibrium, where $C > \underline{C}$, provides an intriguing starting point from which to analyze the effect of opening capital markets. In the separating equilibrium, there is no room for improving the allocation of credit if 'average' firms are being financed, while the pooling equilibrium always fails to achieve the first-best. Funds diverted away from 'bad' firms towards larger projects for 'cream' firms would increase net output. This 'over-financing' of 'bad' firms and 'under-financing' of 'good' firms is a standard criticism of emerging economies. Moreover, the pooling equilibrium is most likely to occur when the information asymmetries are large and the cost of screening is high, which is also a common characteristic of emerging economies (Aleem, 1990). Empirical evidence also suggests this is a reasonable starting point due to the lack of screening done by domestic lenders in many emerging markets.[9] Given this, I will now analyze the impact of allowing foreign lenders to enter an economy that exhibits a pooling equilibrium.

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[8] However, it is not the unique equilibrium contract. For example, a financial contract that pays $F(Y=0) > 0$ but is otherwise identical is also an equilibrium contract. Since $Y = 0$ occurs with probability zero, the payment in failure is not pinned down in equilibrium. See Appendix B for more details.

[9] For an example involving banks in India, see Banerjee, Duflo and Cole (2003). Gormley, Johnson and Rhee (2007) also provide suggestive evidence that Korean bond holders did not screen their investments in 1998.

3 Analysis of Foreign Entry

Following foreign entry, the set of lenders, L, consists of both domestic lenders and foreign lenders. I will express financial contracts from foreign lender *j* as $F_{j,*}$.

Similar to before, the equilibrium depends on the cost of screening borrowers, though it now depends on both the foreign and domestic cost of screening. Foreign entry has no effect on the equilibrium allocation of credit if foreign lenders' cost of screening domestic firms is prohibitively expensive, such that $C^* > \overline{C}$ where

$$\overline{C} \equiv \lambda(\mathrm{R} - r^*) - \left(\mathrm{R} - \frac{r^*}{1-(1-p)\theta_B}\right). \tag{7}$$

But when the foreign cost of screening is sufficiently low, such that $C^* \leq \overline{C}$, foreign lenders' will enter by 'cream-skimming' firms capable of profitably investing large amounts of capital. This can break a pooling equilibrium and induce an output increasing reallocation of credit from 'bad' to 'cream' firms. This 'cream-skimming' by foreign lenders, however, may reduce the ability of 'average' firms to obtain financing for their positive NPV projects as stated in Proposition 2.

Proposition 2. *If $C^* \leq \overline{C}$, there exists an equilibrium where foreign lenders only offer financial contracts of size $I = \lambda$ designated for firms of type $k = C$ with the following payoffs:*

$$F_*(Y) = \begin{cases} \lambda(\mathrm{R} - r^{*,C}) & \text{if } Y = \mathrm{R}\lambda \\ 0 & \textit{otherwise} \end{cases}$$

where $r^{*,C} \equiv r^* + C^* / \lambda$ and all firms of type $i = C$ receive financing from a foreign lender. And, if $r + C \leq \mathrm{R}$, domestic lenders only offer a screened financial contract of size $I = 1$ designated for firms of type $k = A$ with the following payoffs:

$$F(Y) = \begin{cases} \mathrm{R} - r^A & \text{if } Y = \mathrm{R} \\ 0 & \textit{otherwise} \end{cases}$$

where $r^A \equiv r + C$ and all firms of type $i = A$ receive financing from a domestic lender. If $r + C > \mathrm{R}$,

$f(A) = \varnothing$, and $f(B) = \varnothing$ always. This is the only equilibrium allocation when $C^* \leq \overline{C}$.

A formal proof of Proposition 2 can be found in the appendix, but the effect of foreign entry is straightforward. When foreign lenders' cost of capital is sufficiently low, foreign lenders induce 'cream' firms in a domestic pooling equilibrium to undertake larger projects by offering them more competitive contracts for larger projects. They can accomplish this despite their higher cost of screening because of their lower marginal cost of funds and the fixed nature of screening costs. Specifically, the cutoff value of screening will be more relaxed than before foreign entry, such that $\underline{C} < \overline{C}$ if $\lambda > 1/[1-(1-p)\theta_B]$. Therefore, when $\underline{C} < C^* < \overline{C}$, the economy switches from a pooling equilibrium to a separating equilibrium.

The switch away from the pooling equilibrium, however, will not necessarily benefit 'average' firms that only implement projects of size 1 with certain success. The high per-unit cost of screening 'average' firms prevents foreign lenders from profitably financing these firms, and 'average' firms will continue to rely on domestic lenders. But, the fraction of firms approaching domestic lenders with positive NPV projects is now lower because of foreign lenders' cream-skimming, and by assumption (1), the remaining fraction of 'bad' firms is sufficiently high that pooling the 'average' and 'bad' firms is not feasible. So, in order for domestic lenders to finance the 'average' firms in this equilibrium, C must be sufficiently low that the domestic lender can profitably screen 'average' firms given their cost of funds, r. This will only be possible when $R \geq r + C$ holds.

So long as both the domestic and foreign costs of screening is sufficiently low, the economy will reflect the first-best equilibrium in terms of the projects being financed – 'cream' firms are financed for the largest project by foreign lenders, 'average' firms are financed for the smaller project by domestic lenders, and 'bad' firms are not financed. This is true despite foreign lenders' higher cost of screening, $C^* > C$. However, if information asymmetries are large and the domestic cost of screening is high, such that $R < r + C$, foreign lenders' targeting of 'cream' firms may induce domestic lenders to exit the market entirely. In this case, the entrance of foreign lenders increases the size of 'cream' projects being implemented at the cost of some 'average' firms being shut out along with the 'bad' firms. While 'average' firms do have positive NPV projects, they will not be financed if both domestic and foreign lenders' find it too costly to screen them.

If 'average' firms no longer receive financing, the overall impact of opening capital markets on net output is unclear. This is stated formally in Proposition 3:

> Proposition 3: *In an economy that switches from the pooling equilibrium with domestic lenders to the separating equilibrium with foreign lenders, net output always increases if* $\mathrm{R} \geq r + C$. *Otherwise, net output will decline when* $(\mathrm{R}-r)\theta_A > \left([\lambda(\mathrm{R}-r^*)-C^*]-(\mathrm{R}-r)\right)\theta_C + (r-p\mathrm{R})\theta_B$.

A formal proof of Proposition 3 is in the appendix, but the intuition is straightforward. When $R \geq r + C$, net output increases since the reallocation of finance away from 'bad' firms to larger 'cream' projects always increases net output. However, when $R < r + C$, the opening of capital markets also decreases net output from 'average' firms. If this loss, $(R-r)\theta_A$, is sufficiently large, overall net output will be lower following foreign entry.

4 Comparative Analysis and Implications

The model thus provides a relatively simple explanation as to why foreign lenders' entry may not necessarily increase overall output in the opening economy. In emerging economies with significant costs to screening projects, the initial domestic allocation of credit may fail to achieve the first-best allocation because domestic lenders choose to pool risks and cross-subsidize losses on low-return projects with gains on high-return firms rather than invest in costly screening technologies. While foreign lenders may be even less effective at screening domestic firms because of institutional, cultural, or distance barriers, their access to low cost international funds may allow them to offer a more competitive lending rate to firms capable of investing large amounts of capital. Therefore, their entry can increase output by providing the 'cream' firms an alternative contract that will induce them to take on larger projects that domestic lenders failed to finance. At the same time, investment may be declining for other borrowers with positive NPV projects if domestic lenders lack the ability to screen the remaining pool of borrowers that are not targeted by the foreign lenders. The overall effect on net output is unclear. The reallocation from 'bad' to 'cream' firms increases net output, but if 'average' firms are no longer financed, this can reduce overall output.

The empirical predictions of the model are substantiated by a growing literature that analyzes the impact of foreign entry. The targeted lending by foreign lenders is well documented by a number of empirical studies (Berger, Klapper, and Udell, 2001; Clarke, Cull, and Peria, 2001; Gormley, 2006; Mian, 2006). Additionally, Detragiache, Gupta, and Tressel (2008) find that foreign entry is associated with an overall decline in financial deepness while Gormley (2006) finds a reduction in overall domestic loans following foreign entry into India. This decline in credit access is not easily understood in the context of existing models that study how foreign lenders' comparative disadvantage in screening borrower types may affect the allocation of credit. These models find that the segmentation should improve credit access for all firms (Dell'Ariccia and Marquez, 2004; Sengupta, 2006). Lastly, this decline in credit access for firms that rely on domestic lenders also provides a potential explanation as to why empirical studies fail to find a strong positive correlation between open capital markets and aggregate output, particularly in LDCs where domestic lenders are generally very inefficient (Edwards, 2001; Arteta, Eichengreen, and Wyplosz, 2001).

At the same time, the model suggests that the inconclusive evidence pertaining to the opening of capital markets may also be the consequence of differences in the underlying fundamentals for each country that in turn generate different equilibrium outcomes. In order to illustrate the potential for a fall a net output, the basic model discussed above made a number of assumptions regarding the relative costs of lenders and the distribution of firms. However, relaxing some of these assumptions will eliminate the potential for a fall in net output. In doing this, the model is able to provide a taxonomy of when foreign lenders' entry will occur via cream-skimming and when this segmentation of the market will adversely affect net output. Additionally, by exploring the underlying factors that may affect lenders' cost of funds and screening abilities, it is possible to derive predictions as to how the quality of domestic institutions and type of foreign entry may also play an important role in determining equilibrium outcomes. Both of these issues are now discussed in greater detail.

4.1 Domestic Lenders and the Distribution of Firms

The finding that foreign entry may adversely affect credit access and net output relies on two key factors. First, foreign lender entry must occur via 'cream-skimming' that reduces the quality of borrowers being pooled by domestic lenders. Whether this 'cream-skimming' actually occurs in equilibrium will depend on the relative cost structures of each lender and is discussed in more detail in Section 4.2. And second, this reduction in the quality of borrowers being pooled by domestic lenders is sufficient to induce domestic lenders to exit from that market entirely.

The exit of domestic lenders, however, depends on the distribution of firms faced by domestic lenders and their ability to screen firms. For an exit to occur, there must be sufficient number of 'bad' firms seeking credit that it is unprofitable for domestic lenders to continue pooling the 'bad' and 'average' firms and not bother screening their loans. In the above setup, this was ensured via assumption (1). Additionally, the domestic cost of screening, *C*, must be sufficiently high that domestic lenders do not find it profitable to screen the 'average' firms. This occurs when $C > \mathrm{R} - r$. In the absence either assumption, foreign entry will unambiguously increase net output.

This suggests that the impact of foreign entry may vary significantly across industries and countries based on the distribution of firms and the ability of domestic lenders to screen their investments. For example, if Assumption (1) failed to hold such that there was not a large fraction of 'bad' entrepreneurs seeking credit, than domestic lenders could always continue offering the same financial contract after foreign entry since it would still be feasible to pool the risks of 'bad' and 'average' firms. In this scenario, foreign entry would unambiguously increase net output as 'cream' firms take on larger projects, and all other firms continue being financed as before. However, the economy would still fail to achieve the first best allocation in that the 'bad' firms, and their negative NPV projects, would continue to be financed by domestic lenders. Only if the domestic cost of screening was sufficiently low would this pooling of the 'average' and 'bad' firms be broken by other domestic lenders attempting to increase profits by investing in the screening technology.

Given this, in markets where 'bad' entrepreneurs represent a larger fraction of entrepreneurs, foreign entry is more likely to lower net output. This might include industries that represent new product markets, where there is often a high degree of entry by young, unproven firms. Moreover, Proposition 3 implies that the overall effect of domestic lenders exit on net output, should an exit occur, will depend on the relative number of 'cream' firms to 'average' firms. Specifically, net output is more likely to fall in sectors of the economy where the number of 'cream' firms, θ_C, is relatively small compared to the number of 'average' firms, θ_A that will be credit-rationed for high values of *C*.

Since domestic screening costs may measure bank-, borrower-, and country-specific factors regarding asymmetric information, this also suggests the impact of foreign entry may vary across countries and industries. For example, higher screening costs might occur at the country level because of undeveloped credit rating agencies or inadequate enforcement of accounting standards that make screening very costly for lenders. Alternatively, some industries may be naturally more difficult for lenders to assess borrowers' potential. This might include relatively young industries, industries that rely heavily on intangible assets, and industries with uncertain growth prospects.

The model also indicates a potential role for the quality of domestic lenders and the transfer of technology between foreign and domestic lenders. If domestic lenders are inherently poor at screening borrowers, this will make an adverse affect of foreign entry more likely. This low ability to screen borrowers may be more likely to occur in countries where government regulations have historically limited competition and innovation in the financial sector, or where the banking system's primary role was to support government programs rather than identify good investments. On the other hand, Levine (1996) argues that domestic banks may actually improve by adopting the technologies of foreign banks. If such transfers of technology occur and C falls, the model indicates foreign entry could increase the likelihood of achieving the first-best equilibrium.

Additionally, if foreign lenders' entry affects the cost of funds for domestic lenders, this could also have implications for the equilibrium outcome. For example, if domestic lenders adopt technologies used by foreign lenders to increase efficiency and lower their cost of funds, this would decrease the likelihood that cream-skimming would adversely affect 'average' firms by reducing the likelihood that $r + C > R$. Moreover, if domestic lenders are able to borrow directly from international capital markets at cost, r^*, this would have the same effect. The possibility of domestic lenders borrowing directly from international capital markets is discussed in Section 5.

4.2 The Comparative Advantage of Foreign Lenders

While the distribution of firms and the ability of domestic lenders to screen firms are important in determining when 'cream-skimming' by foreign lenders will be welfare enhancing, whether foreign lenders choose to enter the market via 'cream-skimming' depends on the comparative advantage of foreign lenders. As seen above, when foreign lenders exhibit a lower cost of funds but higher cost of screening firms, they will have an advantage in lending to firms capable of investing large amounts of capital, thus inducing them to enter via 'cream-skimming'.

In the absence of this comparative advantage, however, a number of other outcomes could occur. First, if domestic lenders have an absolute advantage, such that $C^* > C$ and $r^* > r$, opening markets would have no effect as foreign lenders would never be competitive and would not enter the country. On the other hand, if foreign lenders have an absolute advantage over domestic lenders, such that $C^* < C$ and $r^* < r$, they would enter the market and completely replace domestic lenders. The economy would resemble the closed economy described in Proposition 1, and could exhibit either a pooling or separating equilibrium depending on foreign lenders' cost of screening. Finally, if foreign lenders exhibit a comparative advantage in screening, such that $r^* \geq r$ and $C^* < C$, the role of domestic and foreign lenders in the open economy would be reversed. Foreign entry could break the pooling equilibrium and achieve the first best equilibrium if $r^* + C^* \leq R$. However, in this case, foreign lenders would break the pooling equilibrium by screening and offering the 'average' firms a more competitive financial contract, and domestic lenders would instead finance only 'cream' firms.

Analysis on foreign lenders' cost of screening also yields a number of interesting predictions regarding how foreign entry occurs may matter for domestic firms' access to credit. In the base model where foreign lenders exhibit a comparative advantage in the cost of funds, foreign lenders' cost of screening determines whether foreign lenders will enter and to which degree their entry will occur via cream-skimming. If $C^* > \overline{C}$, there will be no firms for which the foreign lender can offer a more competitive financial contract to since no firm would be able to successfully invest large enough amounts of capital to overcome the foreign lenders cost of identifying that firm's type. But, as C^* falls, there will be an increasing number of firms for which the foreign lender will have a competitive advantage and engage in 'cream-skimming. However, if C^* is sufficiently low, such that $r^* + C^* \leq R$, the foreign lender would not enter via cream-skimming. Instead, the foreign lender would be able to profitably screen and finance both 'average' and 'cream' firms leading to the first best allocation.

This comparative analysis with respect to the foreign lenders cost of screening suggests that whether foreign entry occurs via cream-skimming would also vary based on the country and industry. Similar to with domestic lenders, we can think of the foreign lenders cost of screening, C^*, as being determined by a number of country-, bank-, and firm-specific factors. For example, in industries or among firms where it is relatively costly to screen a borrower's potential, foreign lenders entry would be more likely to occur via cream-skimming. The same would hold true for countries with poor accounting standards or credit rating agencies that might increase the average cost of screening.

It is also possible that differences in the foreign lenders cost of screening across countries could vary based on how a country opens up to foreign entry. One type of capital account opening used is to restrict foreign entry to portfolio inflows and de novo branching. In other words, foreign institutions are allowed to purchase bonds and stocks of domestic firms and establish foreign bank branches, but not allowed to acquire domestic lenders. This approach is preferred by countries, such as India and China, as a means to increase the available pool of capital without divesting the government's ability to implement social policy through government controlled domestic banks. Alternatively, countries may allow unrestricted entry where foreign lenders are allowed to also acquire domestic banks. This type of liberalization was widely used in Eastern Europe and Latin America in the 1990s, and resulted in large fractions of each countries lenders becoming foreign-owned.

These different capital market openings could in turn affect the equilibrium screening cost of foreign lenders, C^*. This might occur if screening costs for foreign lenders are an increasing function of distance, both physical and institutional, between the foreign lenders' home country and the country in which the foreign lender is entering. Restrictions on foreign lenders ability to establish de novo branches or acquire domestic lenders could increase the foreign lenders cost of screening if such barriers increase the physical distance over which foreign lenders must operate. Alternatively, allowing foreign lenders to acquire domestic lenders might reduce their cost of screening, if such acquisitions provide some transfer of local knowledge about firms to the foreign lender or reduces the institutional barriers the lender might otherwise need to overcome. These differences in openings could potentially provide an explanation as to why studies of foreign lenders' entry in Eastern Europe tend to find more positive effects on aggregate output (Giannetti and Ongena, 2007), whereas studies of countries that restrict acquisitions, such as India, have found signs of 'cream-skimming' and drops in credit access for many firms (Gormley, 2006).

However, allowing foreign lenders to acquire domestic financial assets could also be very costly if foreign lenders' cost of screening is higher than domestic lenders even after acquisition. In this case, the foreign lender might still find it too costly to screen average borrowers, whereas the domestic lender may not. If this were to occur, then transferring domestic assets to the foreign lender can actually increase the likelihood of 'average' firms being rationed out of the market by reducing the amount of assets held by the domestic lenders willing to undertake such lending.

Moreover, studying how foreign lenders' cost of screening may vary over time suggests that any adverse impact of foreign entry may be very short-lived. If foreign lenders' relative disadvantage in screening firms decreases with time spent in the country because of a slow accumulation of knowledge about the local economy, then foreign lenders' cream-skimming will decline with time as well. Thus, foreign entry may initially be accompanied by a rise in credit allocated to the largest, most profitable firms while all other firms find themselves suddenly rationed by domestic lenders inadequate at screening the remaining pool of projects. As time of exposure increases, however, foreign lenders may be more able and likely to target the 'average' borrowers and the first-best allocation of credit will be achieved thus increasing net output. However, if foreign entry limits the ability of firms to obtain credit in the early stages of a product's life-cycle, then the initial adverse effects of foreign entry may become worse over time. This possibility is discussed in Section 5.3.

Overall, these findings suggest a number of testable predictions. Capital market openings that reduce foreign lenders' relative disadvantage in screening firms should exhibit less 'cream-skimming' and be more likely to improve overall credit access and net output. Similarly, in economies where screening is less costly for domestic banks to undertake, foreign entry is more likely to improve overall credit access and net output. To the author's knowledge, the importance of how foreign lenders impact may vary by country or industry is relatively unexplored by the existing literature

5 Robustness and Extensions

This section will discuss the robustness of the model's main implications. First, I will demonstrate that allowing domestic lenders to borrow from foreign lenders will not affect the main findings so long as the degree of asymmetric information between lenders is sufficiently large.

Second, I will show that the findings are robust to more general assumptions regarding the distribution of firm types (in regard to size and profitability of projects). And last, I will demonstrate some additional dynamic implications of the model pertaining to product-life cycles and innovation.

5.1 Domestic Banks, but Foreign Capital

The model suggests two potential policy tools the domestic government could use to induce the first-best allocation of credit. The first is to reduce the cost of domestic screening such that $C \leq R - r$. This would ensure that all projects are screened; 'cream' firms choose larger projects, and 'bad' firms are not financed. The second is that the government could reduce the cost of funds for domestic lenders. One potential way to do this would be allow the domestic lenders to borrow directly from international capital markets. In essence, foreign lenders will provide the capital at cost $r^* < r$, and domestic lenders will do the screening at cost $C < C^*$. By combining the advantages of each type of lender, this arrangement maximizes the likelihood of achieving equilibria where 'cream' firms implement larger projects, and 'average' firms are not credit-rationed.

There are many potential reasons, however, why allowing domestic lenders to borrow directly from foreign lenders may not necessarily induce the first best allocation. First, this arrangement only achieves the first-best allocation so long as $r^* + C \leq R$, such that offering a loan to 'average' firms is feasible for domestic lenders. Otherwise, 'average' firms will still be credit rationed in any separating equilibrium. Second, any corruption among domestic lenders, which is not accounted for in the model here, might make bypassing the domestic lenders optimal.

Such borrowing arrangements will also suffer from information asymmetries. Because screening is costly, domestic lenders will always have an incentive to shirk on their obligation to screen after foreign lenders provide capital for projects if screening is not perfectly observable. This moral hazard problem would be very similar to that of Holmstrom and Tirole (1997). In the simple model above, the moral hazard would be irrelevant since any project failure is a costless signal that screening was not done and foreign lenders could refuse to compensate domestic lenders when projects fail. However, if screening is imperfect, such that even 'average' firms fail with some small probability, foreign lenders would either need to incur a cost to detect screening or provide compensation to domestic banks in excess of the true cost of screening, C, to ensure the domestic lenders' incentives are properly aligned. Either way, the added costs can render this arrangement between domestic and foreign lenders unprofitable even when $r^* + C < R$.

5.2 The Distribution of Firms and Lenders

The basic mechanisms of the model would also be robust to allowing for a richer distribution of firms with varying project sizes, λ, and returns, R. The screening cost thresholds, $\underline{C}$ and $\overline{C}$, would simply become firm-specific in such a model. For instance, a 'cream' firm i with a project of size $\lambda(i)$ and return $R(i)$ that implies a cost threshold, $\underline{C}(i) \geq C$, would be screened and financed fully in the economy without foreign lenders. And, all 'cream' firms with smaller projects or returns, such that, $\underline{C}(i) < C$, will be pooled with 'average' and 'bad' firms. Again, foreign entry has the potential to unravel the pooling equilibrium as foreign lenders' lower cost of funds ensures they will target a larger set of 'cream' firms and reduce the number of firms pooled by domestic lenders.

It is also worth reemphasizing that the model's findings are not driven by the types of lenders in the economy or the nature of the screening technology. Lenders in the economy are very general in that they are allowed to offer any mixture of debt and equity contracts. Therefore, the model is able to encapsulate both banks and capital markets, and the results do not rely on forcing all lenders to act as 'banks' via debt contracts or by eliminating the use equity financing via capital markets. Moreover, the model's findings do not depend on how the screening technology is specified. Assuming foreign lenders incur the same cost of screening as domestic lenders, but receive a lower precision signal of a of firm's type will not qualitatively change the findings.

5.3 Long-run Innovation and Product Life-Cycles

By extending the model to an overlapping generation framework where firms exhibit various stages of life, it is also possible to generate some long-run implications for innovation in the economy and overall net output. For example, suppose that firms live for two periods, where in the first stage of life, they are 'young' and in the second stage they are 'old'. When 'young', firms are either 'average' or 'bad'—this can be viewed as the early stage of a product's life-cycle. When they become old, all bad firms remain 'bad', while there is some stochastic process transforming average firms into 'bad' or 'cream'. This can be viewed as the product maturing where only a few firms emerge as the primary producers. A new set of young firms is born each period, and all firms 'die' at the end of the second period or whenever they are unable to obtain credit—whichever is earliest.

If some screening cost is necessary to reassess an 'average' firm's quality in period 2, than foreign entry can also lead to a decline in future 'cream' project and net output. The intuition is straightforward. When screening is very costly, domestic lenders may choose to pool all young firms along with all old firms that successfully implemented their first project when young. Young firms that failed are clearly 'bad', and hence, never refinanced in old age. Again, foreign lenders will have a competitive advantage in lending to older, 'cream' firms and will steal these projects away from domestic lenders by offering a more competitive lending rate to these firms. If domestic lenders find it too costly to screen firms in their 'young' stage of life, they may exit the market entirely. In this case, future 'cream' firms will never develop and instead die 'young'.

This suggests that negative impact of foreign entry on net output may actually increase over time. This will occur if foreign entry limits the ability of firms to obtain credit in the early stages of a product's life-cycle. New product markets typically exhibit a high degree of entry by young, small firms, but then eventually undergo a 'shakeout' where only a small subset of the initial entrants will grow and survive as the market matures (Gort and Klepper, 1982; Jovanovic and MacDonald, 1994; Klepper, 1996). In such a situation, the 'cream-skimming' by foreign lenders of the larger, successful firms in mature product markets will reduce the ability of domestic lenders to finance the projects of younger, smaller firms in new product markets. This will inhibit innovation and the development of new product markets and subsequently reduce future net output of the economy. These theoretical predictions suggest an interesting avenue for future empirical research.

6 General Model without Full Commitment

In the basic model, I implicitly make the assumption that each lender, j, can perfectly commit to screen projects and fully commit the initial terms of any contract, F, and initial menu of contracts, F_j. This full commitment assumption was important in two key ways. First, it eliminated the possibility that lenders would renege on their commitment to screen. In a more general model, lenders will have an incentive to do this since firms never misrepresent their type in equilibrium. Second, after lenders invest in the screening technology, their optimization problem changes since the cost of screening is sunk, and the firms' type is now known. Because of this, a lenders' initial contract may no longer be optimal in a more general model, and the threat to refuse financing a firm caught misrepresenting its type may not be credible. For example, financing the 'average' firm caught misrepresenting its type might allow a foreign lender to recoup some of its initial loss, and renegotiation of the initial contract could benefit both the lender and firm ex-post. If this were true, 'average' firms should know foreign lenders' ex-ante threat to provide zero financing is not credible.

To address these concerns, I now generalize the model and extend it to a repeated game framework where I do not make any assumptions regarding lenders' ability to commit. It will then be shown that a full commitment strategy by lenders can be derived as an optimal equilibrium strategy without affecting any of the main findings of the more basic model. This is accomplished by assuming firms can observe whether lenders have either renegotiated their financial contracts in the past or shirked on their commitment to screen contracts. With this assumption, it can be costly for lenders that renegotiate their contracts in that it may attract applicants in the future that are ex-ante unprofitable for the lender to do business with. Since these unwanted applicants will increase lenders' future costs, it will be optimal for lenders to preserve their 'reputation' by never renegotiating or altering their financial contracts even after information about firms' types is revealed. The same type of argument holds for lenders that may wish to save money today by not screening their contracts. The future costs of having to screen unwanted applicants that apply on the hope the lender will again fail to screen all their contracts will exceed the benefits of shirking on their commitment to screen today. Therefore, the repeated game equilibrium without full commitment will resemble a non-repeated equilibrium where full commitment is assumed.

I will also generalize the model to allow firms that receive financing to choose whether they wish to implement the project or not. This is formally done by allowing firms that receive financing from a lender to choose action $q \in \{0,1\}$, where $q = 1$ indicates the project is undertaken and $q = 0$ indicates the project is not undertaken. The action q is observable to lenders. As noted earlier, this will introduce an additional wrinkle into the problem in that lenders will have an incentive to offer a financial contract that actually pays firms to *not* implement the project as a way to induce 'bad' firms to reveal themselves without having to invest in the costly screening technology.

In reality, however, lenders will not have an incentive to offer contracts that pay 'bad' borrowers to not implement the project since this will induce all firms without projects to seek the same payoff. This will be formally captured in the model by introducing a fourth type of firm, $i = Z$, that has no project to implement and $q = 0$ is their only possible action. Additionally, there will be a continuum θ_Z of these firms, where

$$\theta_Z > \frac{\theta_B(r^* - p\mathrm{R})}{p(\mathrm{R} - r^*)} \tag{8}$$

Assumption (8) ensures that the mass of firms without projects, θ_Z, is sufficiently large to rule out financial contracts that pay a positive amount to 'bad' firms that abandon their low-return projects.

The remaining assumptions regarding agents remain the same as before. The timing of the model is also similar, except that the game is now repeated and allows for renegotiation of contracts after firms' types becomes known through screening. Within in each time-period t, there is now a stage game broken in six sub-periods, s, where at:

$s = 0$: firms discover their type, i

$s = 1$: lenders choose their menu of financial contracts F; firms apply for contracts

$s = 2$: lenders screen the applicants using screening technology, S

$s = 3$: lenders choose whether to renegotiate new contract, $\hat{F}$, or provide financing, I

$s = 4$: firms receiving capital make investment decision, q

$s = 5$: project outcomes are realized, financial contracts are settled

There is no discounting between sub-periods, but there is discounting between time-periods. Lenders will be long-lived in that they expect to play the game for an infinite amount of periods in the future, while firms are short-lived and only play for one period. At the start of each period, t, a new continuum $1+\theta_Z$ of firms is born. The discount rate between time periods for each lender j is simply the inverse of their opportunity cost of funds, $1/r(j)$.

Because firms now choose whether to implement the project after receiving financing, the financial contract is now expressed as the following mapping:

$$F:\{0,1\}\times\{0,RI\}\rightarrow\mathbb{R}_+.$$

The first argument, q, indicates whether the project is undertaken by the firm, and the second argument, Y, is again the observed output on the project.

Lender j is allowed to renege on its commitment to screen contracts at $s = 2$ and allowed to renegotiate screening contracts at $s = 3$ after firms' types become known.[10] Lenders are allowed to offer any renegotiated contract to the firm, but it is only accepted if the new contract represents a pareto improvement for both the lender and firm. Given this, firms' decisions regarding the financial

[10] There is never any incentive to renegotiate unscreened contracts since no actions are made and no new information is learned between $s = 1$ and $s = 3$ for lenders of firms accepting this type of contract.

contract at $s=1$ will need to incorporate a lender $j's$ optimal decision on screening investment at $s=2$ and incentives to renegotiate a screening contract at $s=3$.

Let $F_t(j)$ be the set of contracts initially offered by lender j during the stage game at time t. As before, $F_{j,t}^{I,k}$ will designate a financial contract of size $I \in \{0,1\}$ and type $k \in \{0,Z,A,B,C\}$ offered by lender j during the stage game at time t. Then, I will define $\hat{F}_{j,t}^{I,k}$ as the renegotiated contract offered at $s=3$. Again, a contract is a mapping of observables into a payment for the firm, and the screening technology remains the same as before.

Let $f_t(i)$ designate the initial contract choice of firm of type i, during the stage game at time t where $f_t(i)=\varnothing$ is allowed, and let $\hat{f}_t(i)$ represent the contract agreed upon after renegotiation. If no renegotiation occurs, $f_t(i)=\hat{f}_t(i)$. Firm $i's$ investment decision during the stage game at time t is given by $q_t(i)$. A strategy configuration in this economy consists of the set of contracts F_j for each lender $j \in L$, and $\{f(i), q(i \mid f(i))\}$ for each firm $i \in E$.

Lender $j's$ screening decision during the stage game at time t is given by $S_t(j)$, and a lenders' strategy consists of the initial set of contracts it offers, its screening decision, and renegotiated set of contracts. As before, all actions in the stage game will be perfectly observable to all agents. Therefore, each agent will condition its optimal decision based on actions taken by other agents in previous sub-periods of the stage game.

Moreover, each agent in the stage game at time t will have perfect knowledge of the history of actions taken by all lenders prior to period t. I will define $a_{j,t}$ as the actions of lender j during the stage game at time t where $a_{j,t}=\{F_t(j), S_t(j), \hat{F}_t(j)\}$, and $a_t=\bigcup_{j\in L} a_{j,t}$. Therefore, the history known by all agents is given by $h_t=\{a_0,a_1,...,a_{t-1}\}$. Lastly, define H_t as the set of all possible histories, h_t, and assume that $h_0=\varnothing$. Since agents have knowledge of lenders' past actions, they will also condition their decisions in the stage game at time t based on the lenders' history.

In particular, I will assume that when firms observe a lender that has either failed to screen a contract in the past or renegotiated a contract in the past, the firms assign a probability $\varepsilon > 0$ that the lender will do so again in the future. This will be important in that if no contract is available for firms of type *i* that provide a positive, expected return, a firm's default choice is not $f(i) = \varnothing$ as before. Instead, a firm's next course of action will be apply for contracts from lenders that have failed to screen their contracts or have renegotiated their contracts in the past on the small hope this will occur again. These applications, which are ex ante unprofitable for lenders, will serve to provide a future cost to lenders that renegotiate contracts or fail to screen their loans.

A strategy configuration in this economy consists of $\left\{f(i \mid h_t), q\left(i \mid \hat{f}(i), h_t\right)\right\}$ for each $i \in E$, $h_t \in H_t \ \forall t$ and $\left\{F_t(j \mid h_t), S_t\left(j \mid \chi_t(F_t, \mathbb{F}_t), h_t\right), \hat{F}_t\left(j \mid \chi_t(F_t, \mathbb{F}_t), i, h_t\right)\right\}_{t=0}^{\infty}$ for each $j \in L$ and $h_t \in H_t$. As before, $\chi_t(F_t, \mathbb{F}_t)$ is the set of firm types in period t that accept the contract offer F_t when the set of available financial contracts is $\mathbb{F}_t$. Firms actions are limited in that $f_t(i) \in \mathbb{F}_t$, where $\mathbb{F}_t$ is the set of all $F_t(j)$'s, and $q \in \{0,1\}$. Lenders actions are limited in that $S(j) \in \{0,1\}$. Since all agents actions at time t are a function of history, h_t, I will suppress this notation in subsequent text.

The expected utility of firms at time t can be written as:

$$u_t : \mathbb{F}_t \times \{0,1\} \rightarrow \mathbb{R}_+$$

where the first argument denotes the financial contract. The second argument is the choice to implement, q. Given the above setup, the expected utility of a contract is

$$\begin{aligned} &u_t(F_t^{I,k}, q = 0 \mid i) = F_t^{I,k}(0,.) \\ &u_t(F_t^{I,k}, q = 1 \mid i) = p(i \mid I) F_t^{I,k}(1, RI) + \left(1 - p(i \mid I)\right) F_t^{I,k}(1,0) \end{aligned} \tag{9}$$

where $p(i \mid I)$ is the probability of success for a firm of type i with a project of size I.

The expected future returns for lender j,

$$\pi:\{0,1\}\times\{Z,A,B,C\}\times\{0,1\}\rightarrow\left[-r(j)\lambda-C(j),\left(R-r(j)\right)\lambda\right],$$

is a function the lender's screening decision, $S(j)$, and a firm's type, i, and decision, q. The losses are limited below by the largest amount of capital a lender would ever extend, λ, at opportunity cost $r(j)$ for lender of type j. It is then easily shown, that:

$$\begin{aligned}
&\pi_{j,t}\left(S(j),i,q=0\mid F_{j,t}^{I,k},s\leq 2\right)=-F_{j,t}^{I,k}(0,.)-S(j)C(j)\\
&\pi_{j,t}\left(S(j),i,q=1\mid F_{j,t}^{I,k},s\leq 2\right)=[p(i\mid I)R-r(j)]I-u(F_{j,t}^{I,k},q=1\mid i)-S(j)C(j)\\
&\pi_{j,t}\left(S(j),i,q=0\mid F_{j,t}^{I,k},s>2\right)=-F_{j,t}^{I,k}(0,.)\\
&\pi_{j,t}\left(S(j),i,q=1\mid F_{j,t}^{I,k},s>2\right)=[p(i\mid I)R-r(j)]I-u(F_{j,t}^{I,k},q=1\mid i)
\end{aligned}\tag{10}$$

Compared to the basic model discussed earlier, the lenders' future expected returns from a given financial contract is now a function of the screening decision, $S(j)$. Moreover, it is important to note that the expected profits of the lender for going forward with a screening contract change after screening is conducted at $s=2$. The lender no longer considers the sunk cost of screening when solving its optimization problem. This was also true in the more basic model but irrelevant since full commitment ensured lenders only optimized their contracts at $s=1$. Given this, the economy's Subgame Perfect equilibrium in the repeated game is defined as:

Definition of Equilibrium: A strategy configuration, $\{F_t(j),S_t(j),\hat{F}_t(j)\}_{t=0}^{\infty}$ for each $j\in L$ and $h_t\in H_t$, and $\{f_t(i),q_t(i)\}$ for each $i\in E$, $h_t\in H_t$ $\forall t$ constitutes an equilibrium if and only if for every period t it is true that:

1. For every $\hat{f}_t(i)$ and h_t, each $i\in E$ chooses $q_t(i)\in\{0,1\}$ to maximize $u_{i,t}(\hat{f},q)$.
2. For every $f_t(i)$ and h_t, each $j\in L$ chooses $\hat{F}_t(j)$ to maximize

   $\pi_{j,t}\left(S(j),i,q_t(i)\mid\hat{F}_t(j),s>2\right)+V_t(j)$ where $q_t(i)$ is given by condition 1.
3. For every $f_t(i)$ and h_t, each $j\in L$ chooses $S_t(j)$ to maximize

$\pi_{j,t}\left(S_t(j), i, q_t(i) \mid \hat{F}_t(j), s \le 2\right) + V_t(j)$ where $q_t(i)$ is given by condition 1, and $\hat{F}_t(j)$ by condition 2.

4. For every set of contracts offered, $\mathbb{F}_t$, and h_t, each $i \in E$ chooses $f_t(i) \in \mathbb{F}_t$ to maximize $u_{i,t}\left(\hat{f}_t(i), q_t(i) \mid S_t(j)\right)$ where $q_t(i)$ is given by condition 1, $\hat{f}_t(i)$ by condition 2, and $S_t(j)$ by condition 3.

5. For every h_t, each $j \in L$ chooses $F_t(j)$ to maximize

$\int_{i \in \chi(F_{j,t}, \mathbb{F}_t)} \pi_{j,t}\left(S_t(j), i, q_t(i) \mid \hat{F}_t(j), s \le 2\right) + V_t(j)$ where $q_t(i)$ is given by condition 1, $\hat{F}_t(j)$ by condition 2, $S_t(j)$ by condition 3, and $i \in \chi_t(F_{j,t}, \mathbb{F}_t)$ by condition 4, and

$\int_{i \in \chi(F_j, \mathbb{F})} \pi_{j,t}\left(S_t(j), i, q_t(i) \mid \hat{F}_t(j), s \le 2\right) di = 0$.

6. $V_t(j) = \sum_{m=t+1}^{\infty} \frac{1}{r^{m-t}} \left[\int_{i \in \chi(F_{j,m}, \mathbb{F}_m)} \pi_{j,m}\left(S_m(j), i, q_m(i) \mid \hat{F}_m(j), s \le 2\right) \right]$ where $q_m(i)$ is given by condition 1, $\hat{F}_m(j)$ by condition 2, $S_m(j)$ by condition 3, $i \in \chi_m(F_{j,m}, \mathbb{F}_m)$ by condition 4, and $F_m(j)$ by condition 5 for all $m \ge t+1$.

Given this definition, it can be shown that there exists an equilibrium allocation similar to that of the basic model presented in Section 1. Specifically, lenders will adopt strategies to always honor their initial financial contracts, such that $\hat{F}_t(j) = F_t(j)$ and $S(j) = 1$ for $k \neq 0$. Therefore, the full commitment assumptions of the more basic model can be generated as an optimal strategy. Since the dynamics of the economy with or without foreign lenders are the same, I will just state the equilibrium that exhibits a separating equilibrium similar to that of Section 3.

Proposition 4. *If $C^* \le \overline{C}$, there exists an equilibrium where all foreign lenders offer a financial contract of size λ to 'cream' firms with the following payoffs:*

$$\tilde{F}_{*,t}(q,Y) = \begin{cases} \lambda(\mathrm{R} - r^{*,C}) & \text{if } q = 1, Y = \mathrm{R}\lambda \\ 0 & \textit{otherwise} \end{cases} \forall t$$

where $r^{*,C} \equiv r^* + C^* / \lambda$ *and all firms of type* $i = C$ *accept finance from a foreign lender and choose* $q(C \mid \tilde{F}_*^{\lambda,C}, h_t) = 1$. *Foreign lenders never renegotiate contracts and choose* $S_t(j) = 1 \ \forall t$. *And if* $r + C \le \mathrm{R}$, *all domestic lenders offer a contract of size 1 to 'average' firms with payoffs*

$$\tilde{F}_t\ (q,Y) = \begin{cases} \mathrm{R} - r^A & \text{if } q = 1, Y = \mathrm{R} \\ 0 & \textit{otherwise} \end{cases} \forall t$$

where $r^A \equiv r + C$ *and all firms of type* $i = A$ *accept finance from a domestic lender and choose* $q(i \mid \tilde{F}^{1,A}, h_t) = 1$. *Domestic lenders never renegotiate contracts and choose* $S_t(j) = 1 \ \forall t$. *If* $r + C > \mathrm{R}$, $f(A \mid h_t) = \varnothing$, *and* $f(B \mid h_t) = \varnothing$ *always. This is the only equilibrium allocation when* $C^* \le \overline{C}$.

The proof of Proposition 4 can be found in the appendix, but the intuition as to why full commitment by lenders is an optimal strategy is straightforward. If a lender attempts to skimp on its screening in any period, it gains today but loses in the future because it destroys its reputation as a lender that always screens. With its 'reputation' gone, all 'bad' firms will apply for the screened financial contract in the future driving up the lender's costs. The gains from not screening will be offset by these future losses. Likewise, foreign lenders will refuse to renegotiate with 'average' borrowers that take the 'cream' project because this also ruins the lenders' 'reputation'. Since all 'average' firms of the future can observe this renegotiation and approach foreign lenders' known for renegotiation, the gains from renegotiation today are outweighed by future expected losses.[11]

Therefore, in a repeated game where firms approach lenders that occasionally do not screen projects or have shown a past willingness to renegotiate, it will always be optimal for lenders to commit to screening their projects and never renegotiate. A failure to screen or showing a willingness to renegotiate contracts will be costly for lenders in that it may attract applicants in the

[11] Interestingly, the reputational concerns of lenders provide another rational for bank specialization that is complementary but different from that of Stein (2002).

future that are ex-ante unprofitable for the lender to do business with. Since these unwanted applicants will increase the lenders future costs, it will be optimal for lenders to preserve their 'reputation' by never renegotiating or altering their financial contracts.

7 Concluding Remarks

Emerging economies are often criticized for having financial sectors that seem to 'over-finance' low-return projects and 'under-finance' high-return projects. For this reason, and many others, it is typically argued that opening capital markets would improve credit access and overall output in these economies. However, the theory developed in this paper suggests this type of domestic credit allocation may occur when information asymmetries are large and domestic lenders choose to pool risks rather than invest in costly screening technologies.

If true, foreign entry may take the form of 'cream-skimming' and adversely affect overall credit access. Foreign lenders' use their lower cost of funds to offer more competitive financial contracts but only finance firms capable of profitably investing large amounts of capital because of their higher cost of acquiring information about domestic firms. This type of entry may both redirect credit towards the largest, most profitable firms in the economy and reduce the credit access of informationally opaque firms with positive NPV projects that rely solely on domestic lenders. As a result, the overall net output may decrease after foreign entry when information asymmetries are sufficiently costly to overcome. The potential decline in output provides new insights to the inconclusive relation between foreign entry and aggregate output.

The theory is also able to generate predictions of when foreign lenders' entry will occur via 'cream-skimming' and when this segmentation of the market will adversely affect credit access and net output. The impact of foreign lender entry will depend on the distribution of firms, the relative costs of foreign and domestic lenders, and the severity of information asymmetries. This yields a number of interesting hypotheses on how foreign lenders impact may vary by industry and country.

It also provides an explanation for why most empirical studies of foreign lender entry, which assume a uniform impact across countries and industries, fail to find consistent evidence. At the same time, the model provides guidance for future empirical research on foreign lender entry.

The implications of the model are robust to lenders ability to commit to financial contracts or engage in syndicated lending type arrangements. The findings also hold for a very general set of firm distributions and yield themselves to interesting dynamic implications. Future credit access may unambiguously increase as foreign lenders acquire local information and provide low cost funds to a wider distribution of firms, but future net output could still fall if the initial 'cream-skimming' upon entry by foreign lenders reduces innovation and the development of new product-markets.

8 Appendix

A – Justification for Using Pure Debt Contracts

For all financial contracts where projects are implemented, it is sufficient to consider only contracts with $F(Y = RI) \geq 0$ and $F(Y = 0) = 0$ as long as there are many lenders offering identical contracts in equilibrium. This is proven in Lemma 1 using the general setup and model described in Section 6. Given this, when projects are implemented (such that $q = 1$) these contracts can be interpreted as pure debt contracts of size I and lending rate $R - F(q = 1, Y = RI)/I$.

Lemma 1: *For all financial contracts of size* $I \in \{1, \lambda\}$ *and type* $k \in \{0, Z, A, B, C\}$ *it is sufficient to consider only equilibrium contracts with* $F^{I,k}(q = 1, Y = RI) \geq 0$ *and* $F^{I,k}(q = 1, Y = 0) = 0$ *when there are* $n \geq 2$ *lenders offering the same contracts in equilibrium.*

For each financial contract, lenders must provide a non-negative payment in each state of the world when projects are implemented. This implies some payment $F(q = 1, Y = R) \geq 0$ for successful projects and $F(q = 1, Y = 0) \geq 0$ for failures.

For financial contracts where $k \neq 0$, this yields an expected return of

$u(F^{I,k}, q = 1 \mid i = k) = p(k \mid I) F^{I,k}(q = 1, Y = RI) + [1 - p(k \mid I)] F^{I,k}(q = 1, Y = 0) \equiv \overline{u}$

and expected profit $\pi_j(k, q = 1 \mid F_j^{I,k}) = p(k \mid I)[R - r(j)]I - u(F^{I,k}, q = 1 \mid k) - C(j)$.

Since all firms accepting this contract will be of type k, the expected returns can always be replicated for each agent involved by using a contract where $F^{I,k}(q = 1, Y = 0) = 0$ and $F^{I,k}(q = 1, Y = RI) = \overline{u} / p(k \mid I)$.

For financial contracts where $k = 0$ and all borrowers accepting it in equilibrium have the same probability of success, $\tilde{p}(i \mid I)$, a similar reasoning holds. A payment of $F(q = 1, Y = RI) = \overline{u} / \tilde{p}(i \mid I)$ in success and zero otherwise can always replicate the expected payment of contracts that pay a non-zero amount in failure.

For financial contracts where $k=0$ and all borrowers accepting the contract in equilibrium do not have the same probability of success, $\tilde{p}(i \mid I)$, the expected payment for all agents cannot be replicated using a contract with $F^{I,k}(q=1,Y=0)=0$. However, it can be shown that a contract with $F^{I,k}(q=1,Y=0)>0$ cannot exist in equilibrium when $k=0$ and not all borrowers accepting the contract have the same probability of success. Consider the case where $n \geq 2$ lenders offer a contract with $F^{I,0}(q=1,Y=RI)=G \geq 0$ and $F^{I,0}(q=1,Y=0)=H>0$. If a continuum 1 of entrepreneurs accept the contract where a fraction α only succeed with probability p, the expected return for each lender is given by $\left[[1-\alpha(1-p)](RI-G)-\alpha(1-p)H\right]/n$ and this must equal zero in equilibrium. A lender that offered a contract where $F^{I,0}(q=1,Y=RI)=G+\varepsilon$ and $F^{I,0}(q=1,Y=0)=0$ for some $\varepsilon>0$, however, would make profits of $(1-\alpha)(RI-G-\varepsilon)$ because only firms with prob-ability of success 1 will take this new contract. And, for $(1-\alpha)(RI-G-\varepsilon)>0$ this contract will be more profitable. But, since $[1-\alpha(1-p)](RI-G)-\alpha(1-p)H=0$ in any equilibrium, it must be true that $RI>G$ when $H>0$. Therefore, there exists some ε such that $(1-\alpha)(RI-G-\varepsilon)>0$. Therefore, contracts with $k=0$ and $H>0$ can never be an equilibrium. QED

B – Proof of Proposition 1

To avoid having to redo the proof later when I move to the more general model described in Section 6, I prove this proposition and the propositions that follow using the more general setup of the model described in Section 6. In particular, I allow firms to not implement projects, and I include the fourth type of firm, $i=Z$, that has no project to implement and $q=0$ is their only possible action. There will be a continuum θ_Z of these firms, where $\theta_Z > \theta_B(r^* - pR)/p(R-r^*)$. Please see

Section 6 of the paper for more details about this more general setup.

Given the general setup described in Section 6, there are 10 different types of financial contracts that lenders could offer: $F^{1,k}, F^{\lambda,k}\ \forall k \in \{0, Z, A, B, C\}$. The proof that the equilibrium of Proposition 1 exists and is the unique allocation will be done in six parts. In part 1, I will prove that it is sufficient to only consider contracts of the form $F(1, RI) > 0$, $F(1,0) = 0$ and $F(0,.) = 0$ when the number of lenders offering identical contracts is $n \geq 2$. In parts 2-4, I will show that 7 of the 10 financial contracts cannot be equilibrium contracts. In part 5, I will then derive the conditions under which the three remaining financial contracts can co-exist in equilibrium. This will be sufficient to prove the allocations of Proposition 1 are unique. Finally, in part 6, I will prove that none of the non-equilibrium contracts can be used to break the equilibrium in Proposition 1.

Part 1 – When there are $n \geq 2$ lenders offering the same contracts in equilibrium, a contract with $F(0,.) = G > 0$ cannot be an equilibrium if any type of firm actually accepts the contract and chooses $q = 0$ in equilibrium. Any individual lender could increase profits by offering the same contract with $F(0,.) = G - \varepsilon > 0$, for some $\varepsilon > 0$. Firms choosing the original contract with $q = 0$ would no longer take the new contract from that particular lender, while those that choose $q = 1$ would still do so. Since $\pi(q = 0, i \mid F) < 0$ for $F(0,.) > 0$, the lender's profits would increase from this change. Therefore, it is sufficient to only consider equilibrium contracts with $F(0,.) = 0$. And, from Lemma 1, we know it is also sufficient to consider only equilibrium contracts with $F(1, RI) \geq 0$ and $F(1,0) = 0$. If $F(1, RI) = 0$, however, no firm would actually accept the contract in equilibrium (since by default they choose $f = \varnothing$ if no contract provides a positive return.) Thus, it must be possible to represent any equilibrium contract as $F(1, RI) > 0$, $F(1,0) = 0$ and $F(0,.) = 0$

Part 2 -- When there are $n \geq 2$ lenders offering the same contracts in equilibrium, any financial contract $F^{I,k}$ yielding negative expected profits for the lender at $t = 1$ cannot be an equilibrium contract as any individual lender could increase profits by dropping the contract. This allows me to exclude financial contracts that are ex-ante unprofitable for the lender if any firm were to accept the contract. Those contracts are: $F^{\lambda,A}, F^{1,B}, F^{\lambda,B}, F^{1,Z}$ and $F^{\lambda,Z}$.

Given $pR < r$, the $F^{\lambda,A}, F^{1,B}$ and $F^{\lambda,B}$ contracts always yield a negative return for the lender if $q = 1$ when the contract takes the form $F(1,RI) > 0$ and $F(1,0) = 0$, and $C > 0$ ensures that $F^{1,Z}$ and $F^{\lambda,Z}$ each yield a negative return for the lender if accepted by firms of type Z.

Part 3 -- Suppose that $F^{\lambda,0}$ was an equilibrium contract. By assumption (1), $\theta_A > \theta_C$, $pR < r$, and Part 1, this contract can only be profitable if 'cream' firms accept it, and will never be profitable if both 'cream' and 'bad' firms accept it. When $F(1,RI) > 0$, $F(1,0) = 0$ and $F(0,.) = 0$ in equilibrium, however, it is easy to see that if 'cream' firms prefer this contract in equilibrium, then it must be that $F^{\lambda,0}(1,R\lambda) > F^{1,0}(1,R)$. But, $F^{\lambda,0}(1,R\lambda) > F^{1,0}(1,R)$ implies that 'bad' firms must also prefer this contract since Part 2 proves that $F^{1,0}$ and $F^{\lambda,0}$ are the only possible contracts available to bad firms in any equilibrium. Therefore, $F^{\lambda,0}$ can never be an equilibrium contract.

Part 4 -- Suppose $F^{1,C}$ was an equilibrium contract. Then, it must make zero profits, and by Part 1, we know the contract can be implemented as a pure debt contract. Together, this implies that $F^{1,C}$ would charge an interest rate of $r + C$ in equilibrium. But, another lender could always increase profits by offering the larger contract $F^{\lambda,C}$ at exactly the same interest rate, and 'cream' firms would always prefer the larger contract. Therefore, $F^{1,C}$ cannot be an equilibrium contract.

Part 5 – From Parts 1-4, we know there are only three possible types of contracts that could be offered in equilibrium: $F^{1,0}, F^{1,A}$ and $F^{\lambda,C}$. Therefore, lenders either offer an unscreened contract for small projects, a screened contract for 'average' firms, or a large screened contract for 'cream' borrowers. Moreover, by Part 1, it is sufficient to consider only contracts with $F(1,RI) > 0$, $F(1,0) = 0$ and $F(0,.) = 0$.

If $F^{1,0}$ is an equilibrium contract, then it must be the case that 'bad' borrowers choose it since there is no other contract available to 'bad' firms. Therefore, by assumption (1) and $\theta_A > \theta_C$ this contract can only be profitable if both 'average' and 'cream' borrowers also select it, and it is feasible for the lender. Therefore, by the zero profit condition, $F^{1,0}$ must offer a lending rate $r^{pool} = r/\left(1-(1-p)\theta_B\right)$, and will only be feasible for the lender if $r^{pool} \leq R$. The contract will also only exist if neither of the other two contracts is preferred by either 'average' or 'cream' firms. The zero profit condition ensures that $F^{1,A}$ must offer an equilibrium lending rate of $r^A = r + C$ and $F^{\lambda,C}$ must offer a lending rate of $r^C = r + C/\lambda$. By assumption (2), $F^{\lambda,C}$ is always feasible, but $F^{1,A}$ will exist only if $r + C \leq R$. Because $F^{\lambda,C}$ in equilibrium offers a higher return to 'cream' firms than $F^{1,A}$ offers to 'average' firms, we need only check when 'cream' firms will prefer $F^{\lambda,C}$ to $F^{1,0}$. This will occur when $\lambda(R - r^C) \geq R - r^{pool}$, and this is true for $C \leq \underline{C}$. Thus, we now know that for $C \leq \underline{C}$, $F^{1,A}$ and $F^{\lambda,C}$ that pay lending rates $r^A = r + C$ and $r^C = r + C/\lambda$ respectively are the only possible equilibrium contracts, and for $C > \underline{C}$, $F^{1,0}$ that pays a lending rate $r^{pool} \leq R$ is the only potential equilibrium contract. Thus the allocation in Proposition 1 is unique when there are $n \geq 2$ lenders offering the same set of contracts.

Part 6 – To prove these are in fact equilibrium financial contracts, it must now be shown that none of the other non-equilibrium contracts can offer a potential profitable deviation for agents.

Consider the case where $C > \max\{\underline{C}, r - pR\}$, and all firms are pooled on the small project. While enticing either 'average' or 'cream' firms to take a contract where $F(0,.) > 0$ and then choose $q = 0$ can never be a profitable deviation, it is possible that taking such a loss on 'bad' firms would be profitable since lenders already take a loss on these firms. However, by assumption (8), the losses on such a contract would always be greater for any contract where $k = 0$ since all firms of type Z would take the contract and choose $q = 0$. However, for $F^{I,B}$ contracts, the lender could entice only 'bad' firms to take the contract and choose $q = 0$ if $F^{I,B}(0,.) > p(R - r^{pool})$. If each 'bad' firm were to switch contracts, the lender takes a minimum loss of $p(\mathrm{R}-r^{pool})+C$ on the new contract per 'bad' firm, whereas the loss before was $p(\mathrm{R}-r^{pool})+r-p\mathrm{R}$. But, if $C>r-p\mathrm{R}$, this deviation can never be profitable. Therefore, no contract where firms choose $q=0$ can break this equilibrium.

Given $F^{I,B}(0,.)>0$ can never be a profitable deviation, lenders could never increase profits by offering $F^{I,B}$ contracts (i.e. 'bad' firms would still implement their project at a loss, but the lender would now take a larger loss because it screens the 'bad' firm). And clearly, it is never profitable to offer $F^{I,Z}$, $F^{\lambda,A}$, $F^{1,A}$ or $F^{1,C}$. The $F^{\lambda,0}$ contract will also by unprofitable by assumption (1), $\theta_A>\theta_C$, and the fact that bad will always prefer the contract if 'cream' borrowers do.

This leaves only $F^{\lambda,C}$. However, $C>\underline{C}$ implies that lenders can never profitably induce 'cream' firms to take a larger contract with screening. Therefore, $F^{1,0}$ is an equilibrium contract for $C>\max\{\underline{C},r-p\mathrm{R}\}$, $r^{pool}=r/\left(1-(1-p)\theta_B\right)$ and $r^{pool}\leq\mathrm{R}$.

Now consider the case where $C\leq\underline{C}$. Clearly, no $F^{I,B},F^{I,Z}$ contract can be a profitable deviation, and no $F^{I,0}$ contract can be a profitable deviation since 'bad' firms would accept it and a pooling equilibrium with all firm types is never profitable for lenders when $C\leq\underline{C}$. This only leaves $F^{\lambda,A}$ and $F^{1,C}$. But, $F^{\lambda,A}$ can never be profitable for a lender to offer, and $F^{1,C}$ can never be both profitable for the lender and better for the 'cream' firm given $F^{\lambda,C}$. Therefore, for $C\leq\underline{C}$, $F^{1,A}$ and $F^{\lambda,C}$ are the unique equilibrium contracts, which can be expressed as pure debt contracts that pay lending rates $r^A=r+C$ and $r^C=r+C/\lambda$ respectively. And, $F^{1,A}$ is an equilibrium contract if and only if $r^A\leq\mathrm{R}$. QED

C – Proof of Proposition 2

Using the same logic as in parts 1-4 of the proof of Proposition 1, there are only two potential foreign lender contracts that can be equilibrium contracts $F_*^{1,0}$ and $F_*^{\lambda,C}$, and it is sufficient to consider contracts of the form $F_*(1,RI)>0$, $F_*(1,0)=0$ and $F_*(0,.)=0$. [Unlike domestic lenders, $F_*^{1,A}$ cannot be an equilibrium contract for foreign lenders because of assumption (3).] And similar to parts 5-6 of Proposition 1, it can be shown that $F_*^{1,0}$ only exists as a pure debt contract with interest rate $r^{*,pool}=r^*/\left(1-(1-p)\theta_B\right)$ for $C^*>\max\{\overline{C},r^*-p\mathrm{R}\}$, $r^{*,pool}\le \mathrm{R}$ and $F_*^{\lambda,C}$ only exists for $C^*\le\overline{C}$, and charges a lending rate $r^{*,C}=r^*+C^*/\lambda$. Moreover, it can be shown that these two contracts always exclude their domestic equivalents from being equilibrium contracts. Thus, the only other possible equilibrium contract is $F^{1,A}$ where $F^{1,A}$ exists only if $r^A\le\mathrm{R}$, $C^*\le\overline{C}$ just as in the economy without foreign lenders. Then, using the same approach as in part 6 of the proof for Proposition 1, it is easy to see that no other available contracts break this equilibrium. QED

D – Proof of Proposition 3

For an economy to switch from a pooling equilibrium with domestic lenders to the separating equilibrium with foreign lenders, it must be that $C^*\le\overline{C}$ and $r^{pool}\le\mathrm{R}$. Moreover, in the pooling equilibrium, net output is $(\theta_A+\theta_C)(\mathrm{R}-r)-\theta_B(r-p\mathrm{R})$, while in the separating equilibrium where $r+C\le\mathrm{R}$, net output is $\left(\lambda(\mathrm{R}-r^*)-C^*\right)\theta_C+(\mathrm{R}-r)\theta_A$. Therefore, net output will increase when:

$$\left(\lambda(\mathrm{R}-r^*)-C^*\right)\theta_C+(\mathrm{R}-r)\theta_A>(\theta_A+\theta_C)(\mathrm{R}-r)-\theta_B(r-p\mathrm{R})$$
$$C^*<\lambda(\mathrm{R}-r^*)+\theta_B(r-p\mathrm{R})/\theta_C-(\mathrm{R}-r)$$

Given assumption (1) and $\theta_A>\theta_C$, this condition is always true when $C^*\le\overline{C}$ and $r^{pool}\le\mathrm{R}$.

In the separating equilibrium where $r+\mathrm{R}>C$, the equivalent condition for in increase in net output is easily shown to be: $(\mathrm{R}-r)\theta_A>\left([\lambda(\mathrm{R}-r^*)-C^*]-(\mathrm{R}-r)\right)\theta_C+(r-p\mathrm{R})\theta_B$ QED

E – Proof of Proposition 4

This proof will proceed in five parts. First, I will show that all firms are choosing the optimal investment decision q [condition 1 of the equilibrium]. Second, I will prove no lender has an incentive to renegotiate given the equilibrium contracts and investment decisions [condition 2 of the equilibrium]. Third, I will prove that screening after firms have accepted a contract is optimal for lenders [condition 3 of the equilibrium]. Fourth, I will prove firms always choose the optimal contract given those available, lenders' optimal screening decision, and lenders' optimal renegotiation strategy [condition 4 of the equilibrium]. Fifth, I will prove that given optimal investment decisions, renegotiation decisions, screening decisions, and contract choices of firms, that the contracts offered are an equilibrium and provide zero profits [condition 5]

Part 1 – For all t and h_t, all firms clearly choose the optimal action $q=1$ given the contract offered. For cream firms with $\tilde{F}_{*,j,t}^{\lambda,C}$, $q(C\,|\,\tilde{F}_{*,j,t}^{\lambda,C},h_t)=1$ maximizes utility, and for average firms with $\tilde{F}_{j,t}^{1,A}$, $q(A\,|\,\tilde{F}_{j,t}^{1,A},h_t)=1$ clearly maximizes utility.

Part 2 – For all t, h_t, and $f_t(i)$, no lender has an incentive to renegotiate the contract at $s=3$. It is easy to see that there does not exist any other contract that can increase both the lender and firms expected payment, so no renegotiation is possible.

Part 3 – Both foreign lenders and domestic lenders (when $r+C\le R$) choose to screen their contracts for all t and h_t. To see this, consider a foreign lender that chooses to not screen the contract it offers in period t because it knows that only 'cream' firms will select the contract in equilibrium. By parts 1 and 2, we know it will never want to renegotiate the contract, and the 'cream' firms will always implement the project. Therefore, $S=0$ yields the firm a return of $\pi_{j,t}\left(S_t(j)=0,i,q_t(i)\,|\,\tilde{F}_{j,s},s\le 2\right)=\theta_C C^*/n$ in period t, where *n* is the number of other lenders offering the same contract in equilibrium.. (It avoids paying the cost C^* for the θ_C/n firms that accept its contract in equilibrium.). Because it failed to screen, however, all 'bad' firms in all future periods will choose to accept this lenders' contract. This implies $V_t=-\theta_B C^*/(r^*-1)$. Therefore, for $S=0$, $\pi_{j,t}+V_t=\theta_C C^*/n-\theta_B C^*/(r^*-1)$, while for $S=1$, $\pi_{j,t}+V_t=0$. Therefore, the lender will not choose $S = 0$ when

$$0 > \frac{\theta_C C^*}{n} - \frac{\theta_B C^*}{r^* - 1}$$
$$n > \frac{\theta_C (r^* - 1)}{\theta_B}$$

The intuition for this result is straightforward. If the foreign lender attempts to skimp on its screening in any period, it gains today but loses in the future because it destroys its reputation as a lender that always screens. With its 'reputation' gone, all 'bad' firms will apply for the screened financial contract in the future driving up the lenders costs. The gains from not screening will be lower than the future losses when n is high because this implies the lender finances a smaller share of the 'cream' firms and hence, benefits less from not screening. Since, there are an infinite number of foreign lenders in the economy competing for borrowers, i.e. $n = \infty$, this condition always holds and it will never be an equilibrium strategy for lenders to not screen a contract where $k \neq 0$. A similar argument can be used to prove that domestic lenders also never have an incentive to choose $S = 0$.

Part 4 – For every set of contracts offered, $\mathbb{F}_t$, and h_t, each $i \in E$ chooses $f_t(i) \in \mathbb{F}_t$ to maximize $u_{i,t}\left(\hat{f}_t(i), q_t(i) \mid S_t(j)\right)$. This statement is clearly true for 'cream' firms who always get the highest possible return by selecting $\tilde{F}^{\lambda,C}_{*,j,t}$. Likewise, when $r + C \leq \mathrm{R}$ and $\tilde{F}^{1,A}_{j,t}$ is offered, the 'average' firms maximize their utility by selecting $\tilde{F}^{1,A}_{j,t}$. However, if $r + C > \mathrm{R}$, then 'average' may want to choose $\tilde{F}^{\lambda,C}_{*,j,t}$ if they think the contract may be renegotiated once their type becomes known at $s = 3$. This is possible since at $s = 3$, after the screening cost is already sunk, the foreign lender could extract $\mathrm{R} - r - \tilde{\varepsilon} > 0$ if it renegotiated and went ahead with a contract of

$$\tilde{F}^{1,A}_{*,t}(q, Y) = \begin{Bmatrix} \tilde{\varepsilon} & \text{if } q = 1, Y = \mathrm{R} \\ 0 & \textit{otherwise} \end{Bmatrix}$$

where $\tilde{\varepsilon} > 0$. The 'average' firm would obviously prefer this new contract over receiving no contract at all which is initial agreement. Therefore, the maximum return for the lender of renegotiation at

$s=3$ is $\pi_{j,t}\left(S_t(j),i,q_t(i)\,|\,\tilde{F}_{j,t},s>2\right)=\theta_A(\mathrm{R}-r^*)/n$. But, by renegotiating in period t, all 'average' firms in the future will choose to accept this contract because the lenders' reputation for not renegotiating is destroyed. This implies $V_t=-\theta_A\left((r^*+C^*)-\mathrm{R}\right)/(r^*-1)$. Thus, renegotiation implies, $\pi_t+V_t=\theta_A(\mathrm{R}-r^*)/n-\theta_A\left((r^*+C^*)-\mathrm{R}\right)/(r^*-1)$. A foreign lender that chooses to not renegotiate simply makes $\pi_{j,t}+V_t=0$ because it does not provide them with a contract. Therefore, renegotiation will not be optimal when,

$$0>\frac{\theta_A(\mathrm{R}-r^*)}{n}-\frac{\theta_A\left((r^*+C^*)-\mathrm{R}\right)}{r^*-1}$$
$$n>\frac{(\mathrm{R}-r^*)(r^*-1)}{(r^*+C^*)-\mathrm{R}}$$

Again, the intuition is straightforward. If the foreign lender renegotiates the contract today, it gains back some of its initial loss in screening the 'average' firms that approached it, but by renegotiating when no other foreign lender does, it will receive all the 'average' firms again in the next period and thereafter. 'Average' firms will know the lender has a reputation for renegotiation and approach it forever thereafter. But, from the perspective of today, this yields a cost to the foreign lender because it always takes a loss on average firms when $r^*+C^*>R$. Again, since there are many lenders and $n=\infty$, this condition will always hold in the model and it will never be profitable for foreign lenders to renegotiate the contract. Similarly, it can be shown that domestic lenders will also never have an incentive to renegotiate their screened contracts.

Part 5 – Given the lenders never find it optimal to renegotiate or not invest in the screening technology, the lenders are in essence 'fully committed' to their financial contracts. Thus, using a similar approach as in the proofs of Proposition 1 and 2, it is then possible to show that these two contracts are equilibrium contracts in the economy following foreign entry and yield zero profits. Additionally, using the same approach as in Proposition 2, it is possible to show this is the unique equilibrium allocation of credit.

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