Endogenous financial intermediation and real effects of capital account liberalization

George Alessandria\textsuperscript{a},* , Jun Qian\textsuperscript{b}

\textsuperscript{a}Research Department, Federal Reserve Bank of Philadelphia, 10 Independence Mall, Philadelphia, PA 19106, United States
\textsuperscript{b}Finance Department, Carroll School of Management, Boston College, Chestnut Hill 02467, United States

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Abstract

We consider lending and investment under asymmetric information in a small, developing economy. We allow different forms of financial contracts to arise endogenously. Financial intermediaries mitigate a moral hazard problem in investment choice through costly monitoring. We then examine the impact of opening the capital account on both welfare and the structure of lending contracts. Liberalizing the capital account may improve or worsen the efficiency of financial intermediaries, leading to an improvement or worsening of the aggregate composition of investment projects. We show that efficient financial intermediaries in the closed economy are neither necessary nor sufficient for a capital account liberalization to improve welfare.

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1. Introduction

In the process of economic development, every country faces an important policy decision to open the capital account. At best, allowing free international capital mobility
leads to a capital inflow that stimulates investment and facilitates economic growth.\footnote{Henry (2000) finds that allowing foreign ownership of domestic equities leads to a private investment boom, and Bekaert et al. (2001) find it leads to an extra 1\% annual economic growth in a 5-year period.} At worst, there is capital flight or a destabilizing capital inflow that culminates in an economic or financial crisis.\footnote{Kaminsky and Reinhart (1999) provide empirical evidence that a liberalization of the capital account and financial markets often leads to an excessive (bank) credit expansion, which often precedes financial crises.} The prevailing view, expressed by McKinnon (1991) and Dornbusch (1998), is that success or failure hinges on the efficiency of domestic financial institutions. If financial intermediaries direct capital towards productive projects, the economy benefits. If financial intermediaries direct capital towards unproductive projects, the economy suffers.

With this in mind, Fischer (1998) and Calvo (1998) have promoted reforming the financial sector as a pre-condition to liberalizing the capital account. With efficient financial institutions in place to limit moral hazard and adverse selection in investment by domestic agents, any capital inflow will be directed to its most productive use. This view implicitly assumes that liberalizing the capital account will not alter the efficiency of domestic financial institutions, for better or worse. This appears to be a strong assumption given that this change in policy affects both the supply and price of capital, two important determinants of financial contracts.

In this paper, we develop a general equilibrium model of financial intermediation in which the structure of financial contracts and monitoring efficiency are endogenous. We use this model to examine how both the efficiency of financial intermediaries as well as welfare change following a capital account liberalization. We show that removing restrictions on international capital flows may change the efficiency of financial intermediaries for better or worse with potentially negative welfare consequences.

We base our analysis on a small closed economy that is characterized by two problems common to many emerging markets. First, the economy lacks enough domestic capital to fund all of the positive, net-present-value (NPV) projects available at world interest rates. Second, there is asymmetric information about the type and actions of borrowers that leads to a moral hazard problem in investment. This problem worsens the constraint on capital as bad projects crowd out good projects.

We assume that agents can finance their investments either through direct unmonitored loans or monitored loans from financial intermediaries.\footnote{In many emerging countries stock markets are underdeveloped relative to the banking sector and provide much less funding to firms than banks (e.g., Demirguc-Kunt et al., 2001; Levine, 2002).} As in Diamond (1984) and Williamson (1986),\footnote{Freixas and Rochet (1997) survey the literature on financial intermediaries as delegated monitors.} our financial intermediaries are delegated monitors. They use a combination of monitoring, liquidation, credit rationing and the interest rate to reduce the moral hazard problem in investment. However, these services are costly and may not be provided in a competitive equilibrium. Allowing for unmonitored loans implies that the financial intermediaries must offer favorable contracts to attract borrowers away from the direct lending market. It also permits us to consider how a capital account liberalization alters the structure of financial contracts.
In our model the efficiency of the financial intermediary, measured by the composition of investment projects they finance, is endogenous. Given the moral hazard problem considered, a financial intermediary can lower the interest rate on loans to induce agents with a choice of projects to invest in the socially efficient project (Stiglitz and Weiss, 1981). However, inducing this behavior requires lowering rates to all borrowers. This may be less profitable than charging the maximum rate to attract agents away from the direct lending market and lead the financial intermediary to finance some bad projects.

Liberalizing the capital account allows for a larger scale of investment so that some previously unfunded, positive NPV projects can be funded. However, it increases the risk-free deposit rate which alters the contracts available in the direct lending market. It also eliminates the financial intermediaries’ ability to ration credit as the economy no longer lacks funds to finance all projects. We find that these changes raise the financial intermediaries’ cost of capital and force the financial intermediaries to offer better terms to attract agents away from the direct lending market than in the closed economy. As a result, the opportunity cost of inducing borrowers to invest in the socially efficient project changes so that the financial intermediaries may exit the credit markets following a capital account liberalization. Consequently, liberalizing the capital account may lead to a shift towards unmonitored direct lending and an aggregate risk shift in investment.

A traditional argument for capital controls is based on the idea that banks are inefficient or poorly regulated. Our framework shows that the decision to liberalize the capital account should not be conditioned solely on the efficiency of financial intermediaries in the closed economy as their efficiency may change with this policy. In particular, we show that liberalizing the capital account when financial intermediaries are effective at eliminating moral hazard in the closed economy may lead them to become ineffective in the open economy and generate a welfare loss. This is more likely to occur when a country accesses global capital markets at high interest rates, as high rates raise financial intermediaries’ cost of capital and make it too costly for them to induce agents to invest in good projects. This result provides a new rationale for capital controls. Conversely, liberalizing the capital account when financial intermediaries are ineffective in the closed economy may lead them to become effective in the open economy and this will generate a large increase in welfare. This is more likely to occur at low world interest rates. These cases show that an efficient financial intermediary sector in the closed economy is neither necessary nor sufficient for a capital account liberalization to improve welfare.

We also find that the impact of capital account liberalization on the welfare of the economy is not always consistent with changes in profitability of the financial intermediaries. In particular, we show the financial intermediation sector may collapse in the open economy, but welfare will still increase when world interest rates are low. This occurs when financial intermediaries are relatively ineffective in monitoring projects and the gains from having a viable intermediation sector are dominated by the larger

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investment scale at low (world) costs of capital. In this case delaying entering world capital markets to improve monitoring capabilities unnecessarily postpones valuable welfare gains.

We also use our model to study the decision to allow foreign banks to enter the domestic credit market. Supporters of these financial sector liberalizations, such as Mishkin (2000), argue the additional competition strengthens the banking system. In contrast, Hellmann et al. (2000) argue that foreign entry weakens the franchise value of banks and leads to more risky behavior. We find the entry of foreign intermediaries has mixed results. More competition leads to lower lending rates which discourages moral hazard in investment, and raises welfare. However, if adverse selection is a problem, then lower lending rates attract more agents with bad projects, which lowers welfare.6

A number of recent contributions focus on the fragility of financial systems in emerging markets. Chang and Velasco (2001) and Allen and Gale (2000a) emphasize the relationship between a foreign capital in-flow and the potential for bank runs as the source of fragility, while Allen and Gale (2000b) examine the effect of financial contagion.7 Burnside et al. (2001) argue that losses from the domestic banking sector led to changes in fiscal and monetary policy which triggered the Asian currency crisis. Aghion et al. (2000) show that capital flows interact with collateral constraints to generate additional volatility in business cycle fluctuations. Unlike these papers, we focus on the impact of capital flows on the structure and efficiency of the financial sector and welfare.

The rest of the paper is organized as follows. The next section introduces a small, developing country with a serious moral hazard problem in investment. The direct lending equilibrium is derived and characterized in both closed and open economies. In Section 3, we examine the conditions under which financial intermediaries enter and monitor in the open and closed economies. Section 4 discusses the effects of capital account and financial liberalizations on the efficiency of financial intermediaries and welfare. We present some numerical examples to illustrate the most interesting cases. In Section 5, we discuss the implications of introducing adverse selection into our framework. Section 6 concludes and all proofs are in Appendix A.

2. Direct lending equilibrium

In this section we introduce a model of borrowing and lending under imperfect information. To begin with, we only allow unmonitored debt contracts between borrowers and lenders. This direct lending (DL hereafter) market provides the foundation for our analysis in the next section when monitored borrowing through financial intermediaries (FIs hereafter) is also available. We first solve for the competitive equilibrium in a closed economy which lacks enough funds to finance all positive NPV projects. We then examine

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6 Previous research has shown that with a more competitive banking sector, there may be aggregate risk shifting (e.g., Bhattacharya, 1982; Furlong, 1988). This literature studies banks’ investment and portfolio choices under different competitive structures.

7 Diamond and Rajan (2001a, b) argue that a capital structure that makes banks susceptible to runs is important to commit to providing liquidity.
the competitive equilibrium when international borrowing is possible. We show the model differs from a model with perfect information along two important dimensions. First, a closed economy with an equilibrium interest rate below the world rate may receive a capital inflow upon opening. Second, capital account (CA hereafter) liberalization may lower welfare.

Our small economy is populated by a continuum of agents of measure 1. All agents are risk neutral and do not discount consumption. Each agent is endowed with one unit of a good that can be consumed or invested. Some agents have an indivisible project that requires $K/N$ units of investment. To fund a project, an agent must borrow an additional $K/C_0$ units. If an agent invests in a project, she is the single owner of the project. There are three types of agents that differ in their projects:

1. Type $G$ agents have a good project which returns $K \cdot g$; there is mass $z_G$ of $G$ agents.
2. Type BG agents have both a good and bad project. The bad project returns $K \cdot b$ with probability $\pi$ and 0 otherwise. They can only invest in one project; there is mass $z_{BG}$ of them.
3. Type $L$ agents have no projects and are pure lenders; there is mass $z_L = 1 - z_{BG} - z_G$ of them.

The following assumptions imply that the economy is capital constrained with a potentially serious moral hazard problem. We believe many developing countries have these characteristics.

Assumption 1. $(z_{BG} + z_G) \cdot K > 1; z_{BG} \cdot K < 1; \pi b < 1 < g < b$.

Assumption 2. (a) An agent’s type and action are private information; (b) lenders costlessly liquidate defaulted projects and liquidation destroys all output; (c) there is limited liability.

Assumption 1 implies the economy’s endowment is too small to fund all the good projects but is large enough to fund all the bad projects. The bad project has a negative NPV and the good project has a positive NPV. When successful, the bad project returns more than the good project.

With private information, loan contracts cannot be contingent on an agent’s type or action. This leads to a moral hazard problem in investment for type BG agents as they can invest in the bad project without paying a higher interest rate. The structure of the liquidation technology ensures that all agents that can repay will repay. Borrowing and lending are carried out in the private loan market. The optimal contract at Time 0 is a debt contract that includes: an interest rate on the loan and liquidation upon default. Given the gross interest rate on loans, $r$, and repayment probability, $\gamma$, an agent’s action, $a_i = L, G, BG$, is chosen from the set, $\{B, G, L, C\}$. Let $a_i = B(G)$ represent a type $i$ agent

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8 A less drastic liquidation technology unnecessarily complicates the analysis. Assumption 2b rules out strategic (voluntary) defaults by the borrowers as well as lenders’ mixed strategies on liquidation following default.

9 For a formal argument, see, for example, Diamond (1984) and Gale and Hellwig (1985).
borrowing and investing in a bad (good) project and let \( a_i = L(C) \) represent a type \( i \) agent lending (consuming) his dowment.\(^{10}\) The value functions for the agents are:

\[
V_L(\gamma, r) = \max\{1, \gamma r\},
\]

\[
V_G(\gamma, r) = \max\{Kg - (K - 1)r, \gamma r, 1\},
\]

\[
V_{BG}(\gamma, r) = \max\{\pi[Kb - (K - 1)r], Kg - (K - 1)r, \gamma r, 1\}.
\]

Type \( L \) agents, or pure lenders, face a simple decision: lend or consume. If they consume, they earn 1. If they lend, their endowment they receive \( r \) with probability \( \gamma \) and nothing otherwise.

Type \( G \) agents can choose to act as a pure lender or invest in the good project. To invest in the good project, she borrows \( K \) units at \( r \) and adds her endowment. The project returns \( Kg \) and she repays her loan of \( (K - 1)r \) for an expected return of \( Kg - (K - 1)r \). For a fixed repayment rate, raising the interest rate lowers the value of investing and raises the value of lending. For a fixed interest rate, lowering the repayment rate lowers the expected return to lending.

Type \( BG \) agents face an additional choice beyond those of type \( G \) agents, as they may invest in the bad project. To invest in a bad project she borrows \( K - 1 \) units at \( r \), invests, and is successful with probability \( \pi \). When successful, she repays her loan and earns \( Kb - (K - 1)r \). When unsuccessful, the project returns nothing, the agent defaults on the loan, and earns nothing. Thus, the expected value of investing in a bad project is \( \pi[Kb - (K - 1)r] \). Conditional on investing, the choice of project, good or bad, depends only on the interest rate. As the interest rate increases, the bad project becomes relatively more attractive because limited liability leads agents to repay only when successful. We define

\[
r_{BG} = \frac{K}{K - 1} \frac{g - \pi b}{1 - \pi},
\]

(1)

to be the maximum interest rate on loans that is consistent with a \( BG \) agent investing in a good project. When \( r_{BG} \) is high, type \( BG \) agents have a strong incentive to invest in the good project, which leads to high output and low defaults. When \( r_{BG} \) is low, type \( BG \) agents have a strong incentive to invest in the bad project which leads to low output and high defaults. To provide a role for the FI in alleviating the moral hazard problem, we make the following additional assumption on parameters:

**Assumption 3.** \( g - \pi b < (1 - \pi)\alpha_L \).

Assumption 3 limits the difference in expected return to the two projects. It also implies that the critical interest rate \( r_{BG} \ll 1 \) so that the moral hazard is severe enough that even

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\(^{10}\) We let \( r \) denote the gross interest rate on a loan in the DL market. It is equivalent to the face value of debt. Later, we let \( R \) denote the gross interest rate on loans issued by the FI. Finally, we let \( r_f \) denote the risk-free interest rate.
facing a zero interest rate \((r=1)\) the BG agents will choose to invest in their bad project.\(^{11}\) We focus on this case as it implies that without FIs there is a moral hazard problem in the economy.

2.1. Equilibrium in the closed economy

In this subsection, we define and characterize the competitive DL equilibrium in the closed economy. First, we define social welfare to equal

\[
W = \alpha_G V_G + \alpha_{BG} V_{BG} + \alpha_L V_L. \tag{2}
\]

Risk neutrality implies welfare also equals aggregate output and consumption. The social optimum involves investing in \(\sigma_{FB}^{CLOSE}=1/K\) good projects. This is the First Best solution in the closed economy and yields welfare of \(W_{FB}^{CLOSE}=g\). In a competitive equilibrium, some agents with projects need to be lenders for the private market for direct loans to clear. However, for all positive interest rates type BG agents will invest in the bad project and the competitive equilibrium is not First Best. Prior to discussing the competitive equilibrium, we consider the actions of type \(G\) agents and the DL market.

**Lemma 1.** In an equilibrium with lending, type \(G\) agents must weakly prefer borrowing to lending, i.e., \(V_G(a_G=G) \geq V_L\).

For borrowing and lending to occur, some good projects must be funded. If no good projects are funded, then no lender enters the market as they would be funding negative NPV projects. As type BG agents will invest in their bad projects for all positive interest rates \((r_{BG}<1)\), type \(G\) agents must borrow in order for some good projects to be funded. Because type \(G\) agents have a choice of borrowing and investing in the good project and lending, they will borrow when borrowing and investing weakly dominates lending. Thus, for a DL equilibrium to exist, type \(G\) agents must be willing to borrow.

**Lemma 2.** A DL equilibrium in the closed economy is characterized by the action of BG agents, \(a_{BG}\), the measure of good projects undertaken, \(\sigma\), the loan repayment rate, \(\gamma\), and the interest rate, \(r\):

\[
\begin{align*}
a_{BG} &= B, \quad a_{Bad} = \frac{1 - \alpha_{BG} K}{K}, \\
\gamma_{Bad} &= 1 - (1 - \pi) \alpha_{BG} K; \\
r_{Close} &= \frac{g}{1 - (1 - \pi) \alpha_{BG}}, \quad r_{Bad} = \gamma_{Close} r_{Bad} Close.
\end{align*}
\]

Lemma 2 characterizes the DL equilibrium. The interest rate adjusts so that the supply and demand for loans clear. Type BG agents strictly prefer the bad project to the good project or lending so that we call this a Bad Equilibrium. Type \(G\) agents are indifferent between investing in the good project or lending. Consequently, all of the bad projects are funded and some of the good projects are funded. Some projects fail and default so that the

\(^{11}\) If the good project has a sufficiently high return, then type BG agents will invest in the good project. This leads to an equilibrium with only good projects funded, and leaves no role for FIs.
repayment rate, $\gamma_{\text{Bad\ Close}}$, is relatively low, and the interest rate on loans, $r_{\text{Bad\ Close}}$, is relatively high.

**Proposition 1.** The DL equilibrium in the closed economy is unique.

Given our assumptions on the information structure and parameters, if there is a DL equilibrium, it is unique. If the moral hazard problem is sufficiently severe in that there are many type BG agents in the economy, the DL market breaks down and everyone just consumes their endowment. This collapse of the DL market does not depend on beliefs. In particular, there does not exist a self-fulfilling equilibrium in which no loans are made because lenders believe only type BG agents are seeking loans, and only BG agents seek loans when no loans are made. If a set of parameters could lead to both autarchy and a DL equilibrium, then in autarchy a group of $K-1$ lenders could get together and offer a loan contract that would attract enough type G agents to make a higher return, making the DL market viable.

### 2.2. Equilibrium in the open economy

We now solve for the DL equilibrium in the open economy. We assume that our small open economy can borrow without altering the world risk-free rate, $r^W_f$. We also assume that all domestic agents have direct access to the international credit market to borrow or lend a homogenous good.\(^{12}\)

In the open economy, the social optimum differs from the closed economy as more investment and lending internationally are possible. The social optimum depends on the world interest rate and equals

$$W^\text{FB}_{\text{Open}}(r^W_f) = \max \{ r^W_f, r^W_f + (\alpha_{BG} + \alpha_G)K(g - r^W_f) \}. \quad (3)$$

When the world rate is lower than the return on the good project, the social planner borrows internationally to fund all good projects. If the world rate is higher than the return on the good project, then it is optimal to lend the endowment. In either case, the social optimum in the open economy is higher than the closed economy. We now show this is not always true for the competitive equilibrium.

**Lemma 3.** There exists $r^W_{\text{CAPIN}} > r^W_f$ such that for $r^W_f \leq r^W_{\text{CAPIN}}$ there is a capital inflow in the open economy. Moreover, (a) all agents with projects invest, and type BG agents invest in the bad project; (b) the debt repayment rate is $\gamma_{\text{Open}} = (\alpha_{BG} + \alpha_G)/(\alpha_G + \alpha_{BG}) > \gamma_{\text{Close}}$; and the interest rate is $r^W_{\text{Bad\ Open}} = r^W_f \gamma_{\text{Open}} < r^W_{\text{Bad\ Close}}$; (c) if $r^W_f > r^W_{\text{CAPIN}}$ then all agents lend their endowment at the world rate; (d) the equilibrium is unique.

Lemma 3 describes how the competitive equilibrium depends on the world rate. In the open economy, the expected return on domestic loans must equal the world rate. For low

\(^{12}\) We do not consider the nominal exchange rate but instead focus on the real effects of CA and financial sector liberalization. For reference on the former topic, see Allen and Gale (2000a), and Chang and Velasco (2001).
world rates, there is a capital inflow and more projects are funded than in the closed economy. At high world rates, the domestic lending market breaks down and there is a capital outflow. We define \( r^W_{CAPIN} \) as the highest world risk-free rate consistent with a capital inflow. At this interest rate, type \( G \) agents are just indifferent between investing at home or lending internationally. As the world rate increases, lending becomes relatively more attractive so that at any \( r^W > r^W_{CAPIN} \) the type \( G \) agents choose to lend internationally. Once type \( G \) agents shift to lending, the DL market collapses.\(^\text{13}\)

The DL equilibrium in the open economy is unique. As in the closed economy case, there cannot be a self-fulfilling collapse of the DL market. The DL market is viable unless lending internationally has a higher return than borrowing and investing domestically. In particular, for all \( r^W \in (1, r^W_{CAPIN}] \), all the projects are funded with type BG agents investing in the bad projects.

In contrast to standard neoclassical theory, for a range of world rates above the closed economy rate, our economy receives a capital inflow upon opening. This occurs because type \( G \) agents that were lending in the closed economy are now able to shift to borrowing without affecting the interest rate. This raises the repayment rate and lowers the default premium, which makes borrowing and investing, funded by foreign capital, more attractive. Consequently, a capital inflow leads to an improvement in the composition of projects and the scale of investment. Whether there is a capital inflow or outflow depends on the interest rates and this has important implications for welfare.

**Proposition 2.** Compared to the closed economy, in the open economy:

(a) for all \( r^W \in [1, r^W_{CAPIN}] \), welfare is higher in the open economy; welfare decreases with \( r^W \) for \( r^W < r^W_{CAPIN} \), increases for \( r^W > r^W_{CAPIN} \), and there is a discrete drop at \( r^W_{CAPIN} \).
(b) for all \( r^W \), type \( G \) agents are strictly better off;
(c) for all \( r^W \in [1, r^W_{CAPIN}] \), all agents endowed with projects are better off;
(d) for \( r^W \in (r^W_{Bad}, r^W_{CAPIN}] \), all agents are strictly better off.

Proposition 2 summarizes how welfare varies for the economy and each agent for different world interest rates. At relatively low world interest rates (\( r^W \in [1, r^W_{CAPIN}] \)), the economy borrows and welfare is higher in the open economy because more good projects are funded. As a borrower though, welfare decreases with the interest rate. At moderate to high interest rates (\( r^W > r^W_{CAPIN} \)), the country becomes a lender and welfare is increasing in the world interest rate. At the rate at which the DL market collapses (\( r^W_{CAPIN} \)) the type \( G \) agents are indifferent between lending internationally or participating in the domestic DL market; however, type BG agents strictly prefer borrowing and investing in the bad project to lending. The collapse of the DL market forces the BG agents to become lenders.

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\(^{13}\) All type \( G \) agents switch to lending at the same \( r^W \). If only a fraction of type \( G \) agents became lenders then the default rate would rise, increasing the lending rate and making borrowing even less attractive relative to lending internationally.
In this respect, a small change in the world interest rate leads to a discrete drop in welfare.¹⁴

Entering world capital markets changes the value each agent receives from participating in the DL market. With a capital inflow, the type G agents who were lending in the closed economy shift to borrowing and investing, and they are strictly better off. The lower default premium in the open economy implies that agents can borrow for less than in the closed economy, even when the world rate is higher than the closed economy risk-free rate. As pure lenders also gain from higher world interest rates, in contrast to most models with heterogeneous agents, there is a range of world rates, \( r_f^W \in [r_f^{Bad}, r_{CAPIN}] \), for which the open economy Pareto dominates the closed economy. At very low or high world rates, there are distributional consequences from opening the CA. Pure lenders lose at low rates while agents investing in the bad projects lose at high rates.

Finally, we emphasize that as type G agents are indifferent between borrowing and lending in the closed economy, they always gain from opening the CA. This will force FIs to offer better contracts to attract them in the open economy and will affect the efficiency and profits of FIs.

### 3. Monitored lending

The preceding DL equilibrium is not socially efficient because of the moral hazard problem of type BG agents. In practice, FIs mitigate this problem through costly monitoring and liquidation. In this section, we introduce a monitoring technology and examine the conditions under which FIs enter and provide these services in a competitive equilibrium. We find that the incentive to enter differs depending on whether or not a country is open. We also find openness influences the efficiency of the FI, measured by its ability to reduce this moral hazard problem.

Our baseline case includes a single FI in the closed economy. The FI is a monopolist on both sides of its balance sheet: on the deposit side, by offering competitive rates relative to the DL market, the FI can pool in all the funds in the economy; on the loan side, by offering competitive rates along with monitoring and liquidation, the FI can capture the entire loan market. We begin with a monopolist FI as it is the most straightforward way to introduce the distortions from non-competitive banking sectors that are commonly found in developing countries.¹⁵ We then examine both the monopolist FI and a competitive intermediation sector with many FIs when capital is internationally mobile. We defer discussing how the incentive of the FI to enter and monitor differs across these three economies and the implications for investment and welfare until Section 4.

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¹⁴ The welfare comparison with the closed economy for a range of interest rates above \( r_{CAPIN}^W \) is ambiguous. For instance, at very high rates welfare is higher in the open economy. However, for a moderate range of interest rates above \( r_{CAPIN}^W \), welfare may be lower in the open economy. We show this in the numerical examples of Section 4.

¹⁵ There is empirical support for this approach as Demirgüç-Kunt et al. (2001) find the average three-bank concentration ratio in low income countries is close to 90%, which is much higher than in high income countries.
3.1. Monitoring technology

The monitoring technology gives FIs a role as delegated monitors as in Diamond (1991). The FI ex ante commits $Kc$ units to acquire the ability to monitor one project.\textsuperscript{16} Acquiring the monitoring technology is directly observable by all agents. The monitoring technology is noisy in that it permits the FI to observe the choice of a bad project with probability $p \in (0,1]$, although this observation is not verifiable. A monitored entrepreneur that chooses the bad project is caught with probability $p$ and is not caught otherwise. If an entrepreneur chooses a good project, she is never mistaken for having chosen a bad project. If the FI observes a bad project, the FI liquidates the project and recovers the initial investment of $K$. Fig. 1 summarizes the sequence of events when the FI monitors.

The FI possesses the best monitoring technology available in the country. In a series of papers, La Porta et al. (1997, 1998) show that a country’s legal origin influences the efficiency of its legal system and institutions. Moreover, there is evidence that a country’s legal system and institutions impact the size and efficiency of its financial system (e.g., Demirguc-Kunt et al., 2001; Levine, 1999, 2002). Accordingly, we assume that the cost and effectiveness of the monitoring technology are country-specific and constant.

Given our framework, it is not necessary for depositors to monitor the FI. Since the FI can commit to investing in the monitoring technology at Time 0, it will monitor to separate good projects from bad projects, because doing so increases its expected profits. We assume that the payoffs to bad projects are independent so there is no aggregate uncertainty.\textsuperscript{17} Therefore, the FI can promise depositors a risk-free interest rate, $r_{FI}^{F}$. As long as the FI earns non-negative expected profits, it will acquire the costly monitoring technology at Time 0 and monitor all projects. This in turn ensures that the depositors do not need to monitor the FI (Diamond, 1984).

\textsuperscript{16} We assume the cost of acquiring the monitoring technology is prohibitively expensive so that no individual lender will do so. Intermediaries save from repeated monitoring of the same large project (e.g., Diamond, 1984).

\textsuperscript{17} See Diamond (1984) for an argument regarding how diversification of bank’s assets can eliminate bank runs.
3.2. Monopolistic FI in the closed economy

Before considering the FI’s problem, we describe how the FI is affected by the presence of the DL market.

Lemma 4. In an equilibrium with an FI, all type G agents will borrow from the FI.

Lemma 4 implies the only equilibrium is a pooling equilibrium with all agents either receiving financing from the DL market or through the FI. If the FI only attracts agents investing in bad projects, it will not raise any capital. Similarly, if the FI attracts all the agents investing in good projects, then the DL market will collapse. This implies that as long as type G agents borrow from the FI all other agents including the lenders will borrow and lend through the FI. To attract type G agents the FI must make them as well off as they would have been by borrowing from the DL market. Therefore, the value of a type G agent in the DL market will influence the terms offered by the FI.18

In setting up the FI’s problem, we first observe that introducing the FI worsens the shortage of funds as monitoring uses up some resources. If all agents with projects seek funding from the FI, the FI must design and implement a lottery scheme to ration credit across entrepreneurs. Consider the following lottery when there is oversubscription of loans: to participate, each entrepreneur deposits her endowment with the FI at Time 1; if the entrepreneur wins the lottery she receives the $K$ units to invest in a project; otherwise, she receives nothing and the period ends. The lottery also reduces the amount of capital the FI must raise, which lowers its cost of capital.

The lottery requires each potential borrower to use her endowment as a non-refundable application fee, similar to a non-refundable collateral requirement on a loan contract. With limited liability, agents investing in bad projects prefer a financing scheme with all repayments at the end of the period. Risk neutral type G agents are indifferent in when they repay their loan. Thus, the lottery makes investing relatively more attractive to type G agents, thereby lessens the moral hazard problem.

Conditional on seeking funding from the FI, an agent $i \in \{G,BG\}$ investing in a good project earns

$$V_{i}^{FI}(z_{G} = G; \text{Lottery}) = Pr(\text{Loan})V_{i}^{FI}(G; \text{Loan}) + Pr(\text{No Loan})V(\text{No Loan}). \quad (4)$$

The payoff to a type BG agent from investing in a bad project through the FI is

$$V_{BG}^{FI}(z_{BG} = B; \text{Lottery}) = Pr(\text{Loan})V_{BG}^{FI}(B; \text{Loan}; p) + Pr(\text{No Loan})V(\text{No Loan}). \quad (5)$$

As the FI ex ante cannot distinguish between type G and BG agents, both receive the same contract. To simplify notation, we assume a borrower will owe the FI a total of $K \cdot R$.

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18 We assume that a group of agents (with no monitoring technology) cannot form a coalition to compete with the financial intermediary for loans. See Boyd and Prescott (1986) for conditions under which such coalitions form.
Conditional on receiving a loan, the value of investing in a good project, \( V_G^{FL} \), and investing in a bad project, \( V_{BG}^{FL} \), are:

\[
V_G^{FL}(G; \text{Loan}) = Kg - K R, \quad V_{BG}^{FL}(B; \text{Loan}; p) = (1 - p) \pi K(b - R).
\]

The decision to invest in a good or bad project depends on both the face value of debt, \( Kd \), and the likelihood of not being caught investing in the bad project, \( 1 - p \). We define the critical rate

\[
R_{BG}(p) = \frac{g - (1 - p) \pi b}{1 - (1 - p) \pi}, \tag{6}
\]

at which type BG agents are indifferent between the good and bad project. With uninformative monitoring, \( R_{BG}(0) = (K - 1) \cdot r_{BG}/K \), where \( r_{BG} \) is the unmonitored critical interest rate defined in Eq. (1). With a better monitoring technology, agents investing in bad projects are caught more often and this reduces their incentive to invest in the bad project. This implies that \( R_{BG}(p) \) increases in \( p \).

Following Lemma 4, the FI chooses the combination of deposit rate, \( r_{FI} \), and loan interest rate, \( R \), to attract type G agents as borrowers. These rates depend on the total demand for loans. Given this credit rationing scheme, and the FI’s monitoring and liquidating behavior, let \( \theta_{\text{Close}}^{MON}(r_{FI}^{FL}, R, p) \) represent the probability that a loan applicant receives funding. A special case is if all agents with projects seek funding then the probability an agent receives funding is

\[
\theta_{\text{Close}}^{MON} = \frac{K(1 + c)(a_G + a_{BG})}{1 + K R}.
\]

Finally, let \( Pr(B; r_{FI}^{FL}, R, p) \) represent the probability that an entrepreneur invests in the bad project. As long as agents with projects borrow, the fraction investing in bad project equals

\[
Pr(B; r_{FI}^{FL}, R, p) = \begin{cases} 0 & \text{if } R \leq R_{BG}(p), \\ \frac{a_{BG}}{a_{BG} + a_G} & \text{if } R > R_{BG}(p). \end{cases} \tag{7}
\]

We now define the monopolist FI’s problem: it will set the deposit rate, \( r_{FI} \), lending rate, \( R \), to attract type G agents as borrowers. These rates depend on the total demand for loans. Given this credit rationing scheme, and the FI’s monitoring and liquidating behavior, let \( \theta_{\text{Close}}^{MON}(r_{FI}^{FL}, R, p) \) represent the probability that a loan applicant receives funding. A special case is if all agents with projects seek funding then the probability an agent receives funding is

\[
\theta_{\text{Close}}^{MON} = [K(1 + c)(a_G + a_{BG})]^{-1}.
\]

Finally, let \( Pr(B; r_{FI}^{FL}, R, p) \) represent the probability that an entrepreneur invests in the bad project. As long as agents with projects borrow, the fraction investing in bad project equals

\[
Pr(B; r_{FI}^{FL}, R, p) = \begin{cases} 0 & \text{if } R \leq R_{BG}(p), \\ \frac{a_{BG}}{a_{BG} + a_G} & \text{if } R > R_{BG}(p). \end{cases} \tag{7}
\]

We now define the monopolist FI’s problem: it will set the deposit rate, \( r_{FI}^{FL} \), lending rate, \( R \), design a rationing scheme (if necessary), monitor and liquidate to maximize expected profits per loan:

\[
\prod_{\text{Close}}^{FL} = \max_{r_{FI}^{FL}, R} \Pr(B; r_{FI}^{FL}, R, p) \left[pK + (1 - p) \pi KR\right] + \left[1 - Pr(B; r_{FI}^{FL}, R, p)\right] KR \\
- K \left[1 - \frac{1}{K \theta_{\text{Close}}^{MON}(r_{FI}^{FL}, R, p)}\right] r_{FI}^{FL} - K c, \tag{FI\text{Closed}}
\]

s.t. \( V_G^{FL}(a_G = G; \text{Lottery}) \geq \max \{r_{r_{FI}^{FL}}, r_{r_{FI}^{FL, Bad}}\} \); \( (IC_G) \)

\[
a_{BG} = \arg \max_{\{B, G, L\}} \left\{V_{BG}^{FL}(G; \text{Loan}), V_{BG}^{FL}(B; \text{Loan}, r_{FL}^{FL})\right\}; \tag{IC_{BG}}
\]
Let $\Pi^\text{FI}_{\text{Close}}$ denote the monopolist FI’s expected profits of financing a randomly selected project in the closed economy. The bottom line represents the FI’s costs, namely, the promised return to depositors and the fixed cost of monitoring. (ICG) is the incentive compatibility constraint on type $G$ agents borrowing from the FI rather than borrowing from the DL market, where the payoff is $r_t^\text{FI}$, or becoming depositors and receiving $r_t^\text{FI}$. (ICBG) is the incentive compatibility constraint on type BG agents’ choice of depositing vs. borrowing as well as choice of projects (if borrowing). Finally, (FI-entry) indicates the FI must earn positive profits; otherwise it will not enter.

Prior to describing the FI’s optimal contract, we define a critical loan rate, based on the rationing scheme and Lemma 4 at which type $G$ agents are indifferent to borrowing from the FI or DL markets:19

$$R^\text{Close}_\Theta = g - r_t^\text{Bad}(a_G + a_{BG})(1 + c),$$

This loan rate is negatively affected by rationing and the value of type $G$ agents in the DL equilibrium. More rationing implies type $G$ agents must be compensated for the lower probability of receiving a loan.20 A higher value in the DL equilibrium implies the FI must offer a lower loan rate to attract type $G$ agents. This loan rate is not the profit-maximizing loan rate for all monitoring technologies. In particular, for moderately efficient monitoring technologies, the FI may gain by lowering the loan rate below $R^\text{Close}_\Theta$ to induce type BG agents to invest in good projects.

**Proposition 3.** If there exists an equilibrium with a monopolistic FI in the closed economy, then:

(a) $r_t^\text{FI} = 1$;
(b) there exists $p^\text{MON}_{\text{Close}} \in [0,1]$, such that the FI charges

$$R^\text{MON}_{\text{Close}}(p) = \begin{cases} R^\text{Close}_\Theta, & p < p^\text{MON}_{\text{Close}}, \\ \min\{R_{BG}(p), R^\text{Close}_\Theta\}, & p \in [p^\text{MON}_{\text{Close}}, 1]; \end{cases}$$

(c) given $c$, there is $p^\text{MON}_{\text{Close}} > 0$ such that the monopolist FI enters if $p > p^\text{MON}_{\text{Close}}$.

Part (a) of Proposition 3 follows directly from Lemma 4. Because type $G$ agents prefer borrowing through the FI, the DL market collapses, which leaves lenders with no other investment options other than depositing their funds in the FI at $r_t^\text{FI} = 1$.

Fig. 2 shows how the monopolist FI’s optimal loan contract depends on the monitoring technology. With the exception of one region of $p$, the FI charges $R^\text{Close}_\Theta$ as this is the

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19 $R^\text{Close}_\Theta$ is such that $V_G(a_G = G; \text{Lottery}) = r_t^\text{Bad}$ in (ICG).
20 Alternatively, if the FI has its own capital then the credit rationing among entrepreneurs will be eased. Holmstrom and Tirole (1997) analyze the real effects of capital distribution across firms and intermediation sector in a similar model.
maximum lending rate which will attract type $G$ agents. When the FI’s monitoring is uninformative (low $p$), type BG agents borrow from the FI to invest in the bad project. To induce type BG agents to invest in their good project the FI can lower the loan rate to $R_{BG}(p)$. This is costly as the FI must lower the rate on all loans, which lowers total profits. Therefore, the FI charges the rate $R_{Close}$ and monitors to catch type BG agents investing in bad projects.

As the monitoring technology improves, type BG agents become more willing to invest in the good project at higher interest rates, and it becomes less costly to induce a change in their investment choice. Once the monitoring technology becomes good enough ($p=p_{MON}^{Close}$), it is profitable for the FI to use pricing and monitoring to alter the behavior of type BG agents. At this point, the FI lowers the interest rate on all loans from $R_{Close}$ to $R_{BG}(p)$, leading all type BG agents to switch from bad to good projects. In the resulting equilibrium only positive NPV projects are funded. As the monitoring technology further improves such that $R_{BG}(p)\geq R_{Close}$, the FI does not raise loan rates further, as a higher rate will drive the $G$ agents to borrow from the unmonitored DL market.

Part (c) of Proposition 3 follows from the FI’s entry decision. The FI will invest in the monitoring technology when it is profitable. Because of the fixed cost of monitoring there is a minimum monitoring technology required for the monopolist FI to enter.

When the FI enters, relative to the DL equilibrium, there is a shift towards good projects. The degree to which the mix of projects improves depends on the monitoring technology. For less advanced monitoring technologies, the improvement primarily comes from the FI’s ability to ration credit to attract type $G$ agents. In this respect, the FI improves the mix of projects because the economy is capital constrained. In the open economy, the FI loses this ability and will become less effective in this respect. As the monitoring technology improves, monitoring improves the mix of projects as more bad projects are liquidated early. Once the monitoring technology becomes advanced enough ($p>p_{MON}^{Close}$), there will be an additional improvement in the mix of projects as the FI combines monitoring with the loan contract to induce all agents to invest in good projects.

Fig. 2. FI’s loan contracts in closed economy.
In this respect, a small improvement in the monitoring technology leads to a substantial decrease in the default rate, and a large increase in the effectiveness of the FI and welfare. While no bad projects will be undertaken in this case, the equilibrium will not be First Best because of the monitoring costs.

3.3. Monopolistic FI in the open economy

In this subsection, we allow the monopolist FI and individual agents to borrow and lend in world capital markets. The monopolist FI retains its position as the sole monitoring agent. Gaining access to foreign capital has three effects on the FI. First, from Proposition 2, the value of type \( G \) agents from participating in the DL market increases. This forces the FI to lower its loan rate and tends to lower the FI’s profits. Secondly, domestic lenders have better opportunities abroad, which forces the FI to borrow at the world risk-free rate \( r_W^f \) and increases the FI’s cost of capital. Thirdly, it eliminates the lottery, which both helps and hurts the FI. The FI can lend at higher rates, which increases revenue, but the lost lottery proceeds raise the FI’s costs. These changes affect both the FIs entry decision and efficiency.

In the open economy, the monopolist FI will choose \( R \) to maximize:

\[
\Pi_{\text{FI Open}} = \max_R KR + Pr(B; r_f^W, R, p)K[p + (1 - p)\pi R - R] - (K - 1)r_f^W Kc,
\]

\[
(\text{FI Open})
\]

s.t. \( V^G_{\text{FI}}(a_G = G; \text{Loan}) \geq \max \{ r_f^W, V^{DL}_{\text{G}}(i_{\text{Open}}, r_{\text{Bad Open}}) \} \); \n
\[
(\text{IC}_G)
\]

\[ a_{BG} = \arg \max_{(B, G, L)} \{ V^G_{\text{BG}}(G; \text{Loan}), V^{FI}_{\text{BG}}(B; \text{Loan}), r_f^W \}; \]

\[
(\text{IC}_BG)
\]

\[ \Pi_{\text{FI Open}} \geq 0. \]

The FI must offer a contract to attract type \( G \) agents away from either the open economy DL market, where the payoff is \( V^{DL}_{\text{G}}(i_{\text{Open}}, r_{\text{Bad Open}}) \), or becoming a depositors and receiving \( r_f^W \).

Proposition 4. If there exists an equilibrium with a monopolistic FI in the open economy, then:

(a) \( r_f^{FI} = r_f^W \);
(b) there exists \( p_{\text{Open}}^{MON} \in [0,1] \), such that the FI charges:

\[
R_{\text{Open}}^{MON}(p) = \begin{cases} R_{\Theta}^{Open}, & \text{if } p < p_{\text{Open}}^{MON}; \\ \min\{R_{BG}(p), R_{\Theta}^{Open}\}, & \text{if } p \geq p_{\text{Open}}^{MON}; \end{cases}
\]

\[
(10)
\]

where \( R_{\Theta}^{Open} = (K-1)r_{\text{Bad Open}}^W / K \), and \( r_{\text{Bad Open}}^W \) is defined in Lemma 3.
(c) given \((r_f^W, c)\), there is \(p_{\text{MON}}^{\text{Open}} > 0\) such that the FI enters when \(p \geq p_{\text{MON}}^{\text{Open}}\). Moreover, \(p_{\text{MON}}^{\text{Open}}\) increases when (i) \(c\) increases; (ii) \(r_f^W\) increases.

Proposition 4 defines the FI's optimal pricing strategy in the open economy. Fig. 3 depicts the optimal loan rates of the monopolist FI in the open economy at each monitoring technology. The optimal loan contract is similar to that of the closed FI shown in Fig. 2. There is a critical loan rate, \(R_{\text{Open}}\), at which type \(G\) agents are indifferent between borrowing from the FI or the open economy DL market, a minimum monitoring technology necessary for the FI to enter, \(p_{\text{MON}}^{\text{Open}}\), and a minimum technology, \(p_{\text{MON}}^{\text{Open}}\), at which the FI lowers its loan rate on all loans to shift the type \(BG\) agents into their good projects.

3.4. Competitive financial intermediation sector in the open economy

We now examine an open economy with a large number of competing FIs with access to the same monitoring technology. We assume many foreign FIs join the single domestic FI and interpret this as a financial sector liberalization. Competition between FIs drives each FI’s expected profits to zero.

With a competitive financial intermediation sector, the only difference from the open economy monopolist FI problem is that we impose a zero profit condition. Given \(Pr(B; r_f^W, r_f^p, R, p)\), the profit maximizing loan rate is equal to

\[
R_{\text{COM}}^{\text{Open}}(p) = \arg\max_R \prod_{\text{FI}}^{\text{Open}} (R; p, r_f^W) = 0, \tag{11}
\]

where \(\prod_{\text{FI}}^{\text{Open}}(R; p, r_f^W)\) is defined in \((\text{FI}_{\text{Open}})\).

**Proposition 5.** In an equilibrium with a competitive FI sector in the open economy, each FI’s optimal decision rules are:

(a) \(r_f^C = r_f^W\);
(b) there exists \(p_{\text{COM}}^{\text{Open}} \in [0,1]\), such that each FI charges

\[
R_{\text{COM}}^{\text{Open}}(p) = \begin{cases} 
(\alpha_G + \alpha_{BG}) \left( \frac{K - 1}{K} r_f^W + c \right) - \alpha_{BG} p, & p < \bar{p}_{\text{COM}}^{\text{Open}}, \\
\frac{\alpha_G + \alpha_{BG} p(1 - \pi)}{K - 1}, & p \in \left[ \bar{p}_{\text{COM}}^{\text{Open}}, 1 \right]; \\
K - 1 \frac{r_f^W + c}{K}, & p = \bar{p}_{\text{COM}}^{\text{Open}}; \end{cases} \tag{12}
\]

(c) there exists an entry-level monitoring technology \(\bar{p}_{\text{COM}}^{\text{Open}}, \) where \(\bar{p}_{\text{COM}}^{\text{Open}} = \bar{p}_{\text{COM}}^{\text{Open}}\).

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21 It is debatable whether foreign or domestic FIs are better at monitoring and liquidating domestic investment projects. Allowing differences in monitoring also complicates the deposit side of the market. To avoid this, we make the simplifying assumption. Following the same argument from Section 3.1, the monitoring technology \((p, c)\) is on the technological frontier.

22 We should distinguish between the policy of a single FI and the rest of the industry. If the FI charges a loan rate higher than any other FI in the market it will not attract any borrowers.
The competitive FIs’ loan schedule differs substantially from the monopolist FI loan schedule in the open economy. However, the minimum monitoring technology at which the perfectly competitive FIs enter in the open economy is the same as the monopolist FI requires to enter. This occurs because when the monopolist FI’s monitoring technology is at the level that enables the FI to earn a zero profit in the open economy, each of the competitive FIs with the same level of technology can offer exactly the same contracts as the monopolist FI and earn zero profits.

Fig. 3 plots the competitive FIs’ loan schedule. Part of the loan schedule is downward sloping because as the monitoring technology improves, the competitive FIs catch agents investing in bad projects more frequently and passes the savings to borrowers as lower loan rates. There are two regions in the loan pricing schedule corresponding to different fractions of agents investing in the bad project. There is a discontinuity in $p^\text{COM}_\text{Open}$ as the FIs

![Fig. 3. FI’s loan contracts in open economy.](image)

![Fig. 4. Competitive FI in the open economy.](image)
begin offering contracts to induce the type BG agents to invest in good projects, which leads to a discrete change in the default rate. For all $p < \bar{p}^{\text{COM}}$, each FI would make negative profits by offering a contract that induced type BG agents to invest in a good project as the interest rate which induces this behavior is very low.

In the second region, because the FI’s monitoring technology is advanced, type BG agents strictly prefer good projects. As only good projects are undertaken, the loan rate $R_{\text{COM}}^{\text{Open}} = (K - 1) r_f + c$ satisfies the zero profit condition and does not vary with the monitoring technology.

4. Transition from closed to open economies

In this section, we discuss the implications of opening the CA and liberalizing the financial sector. We define a CA liberalization as a change from the closed to open economy and a financial liberalization as a change from a monopolistic to competitive FI sector in the open economy. We first consider the case of a CA liberalization and then examine the incremental gains from a further financial liberalization.

Our model of endogenous financial intermediation permits us to study the change in welfare, lending contracts and FI efficiency from these policies. We find the decision to undertake these policies should not be solely based on the efficiency of the FI sector in the closed economy, nor should the effectiveness of the policy be judged by the success or failure of the FI sector.

4.1. Capital account liberalization

Liberalizing the CA increases the supply of capital and changes the price of borrowing to the world rate. These two changes alter the problem of the FI. Consequently, the incentive of the FI to enter the credit market and induce good behavior from type BG agents changes.

While theoretical comparisons of FI’s entry decision and efficiency in closed and open economies are possible, welfare implications of a CA liberalization in our model of imperfect information are ambiguous and depend on parameter values. A key finding is that welfare does not necessarily depend on the success or failure of the FI. To facilitate exposition, we first present a series of claims summarizing some important implications of the model, and then illustrate these claims through numerical examples.23

Claim 1. Welfare may decline following a CA liberalization.

Claim 2. The efficiency of the FI in the closed economy does not predict when welfare will decline or increase following a CA liberalization. In particular,

(a) An inefficient FI may become efficient in the open economy leading to an increase in welfare;

23 Proofs on the comparisons of FI’s entry decision and efficiency in closed and open economies, as well as numerical examples illustrating other cases are available from the authors upon request.
(b) An efficient FI may become inefficient in the open economy leading to a decrease in welfare.

**Claim 3.** A collapse of the FI sector and move towards unmonitored lending following the CA liberalization does not imply that welfare declines.

Claim 1 differs from the predictions of a model with perfect information and provides a rationale for capital controls. Claims 2 and 3 imply that the argument for capital controls should not be based solely on the current state of the financial sector. In particular, Claim 2 (Claim 3) implies that an efficient FI in the closed economy (the entry/exit of the FI in the open economy) is neither necessary, nor sufficient for welfare to increase following a CA liberalization.

The preceding claims are based on a benchmark closed economy with a Bad equilibrium. The following parameters, which remain the same in all of our examples, generate such an equilibrium:

\[ \pi = .7, \quad b = 1.4, \quad g = 1.2, \quad K = 10, \quad \alpha_G = .09, \quad \alpha_{BG} = .04. \]

We first study the structure of lending arrangements and mix of projects undertaken for a range of monitoring technologies. Next, we study the welfare implications of the CA liberalization for particular monitoring technologies and a range of world interest rates.

Fig. 5a summarizes the structure of lending arrangements and mix of projects in the closed economy by monitoring technologies \((p, c)\). The thick line separates parameters consistent with FI and DL equilibria. Direct lending is more likely to arise when monitoring catches bad projects infrequently or is costly. Where the FI enters, the thin line separates the choice of project of type BG agents. In general, bad projects are chosen when the likelihood of being caught is small. Finally, conditional on the FI entering, a higher monitoring cost makes the good project mix more likely because the FI gives up less to shift type BG agents into good projects.

Fig. 5b is the open economy version of Fig. 5a for two world interest rates. Solid (dashed) lines divide the parameter space when the world rate is \(r_f = 1(r_f = 1.1)\). As above, thick lines divide DL and FI equilibria, while thin lines separate different mixes of projects. We emphasize two things. First, the minimum technology to induce type BG agents to choose the good project is lower at lower world rates. The FI gives up less by charging the \(R_{BG}(p)\) since it must charge a low rate to attract type \(G\) agents. Second, the FI may be more likely to enter at high world rates because it does not have to offer very low loan rates to attract type \(G\) agents. This implies the mix of projects may be better at higher world rates. It also implies that there is a range of monitoring technologies for which the FI will not enter at low interest rates but will enter at high rates.

Comparing Fig. 5a and b, we see that the FI is more likely to enter in the closed economy. However, given that the FI enters in both the open and closed economy, whether the mix of projects improves or worsens depends on the world interest rate. In particular, for low world rates, the FI shifts type BG agents to good projects for a worse monitoring technology than in the open economy. At higher world rates, the FI requires a better monitoring technology in the open economy to shift type BG agents to good projects. If the mix of projects remains the same or improves after liberalizing the CA, then welfare improves. The figures show
there is a range of inexpensive but ineffective monitoring technologies (low \( p \) and \( c \)) such that in the closed economy the FI does not eliminate bad investments, but in the open economy the FI can do so at low world interest rates. In this case opening the CA leads an ineffective FI to become effective, thus increasing welfare (Claim 2a).

If the mix of projects worsens, we cannot make general welfare statements as the scale of investment increases. We demonstrate that welfare may decrease or increase depending
on the monitoring technology. Fig. 6a and b depicts welfare in the closed and open economies against world interest rates for two specific monitoring technologies. The open economy welfare function is divided into different regions by the direction of the capital flow and entry of the FI.24

Fig. 6. (a) Welfare analysis; case 1. (b) Welfare analysis; case 2.

24 In all the figures $r_{CAPIN}^W = 1.10$ is the world rate consistent with a capital inflow in the DL market. If the FI enters, it may attract type $G$ agents at higher world rates so there is a capital inflow above $r_{CAPIN}^W$. 
Fig. 6a supports our first and third claims. It compares welfare when there is an ineffective \((p=.1)\) but inexpensive \((c=.01)\) monitoring technology. The lines marked “DL OPEN” and “FI CLOSED” depict welfare in the open and closed economies, respectively. In the closed economy the FI enters, rations credit, and monitors. Both types of agents receive loans in proportion to their population, but only type \(G\) agents invest in the good project. In the open economy, the FI does not enter at any world rate and there is a DL equilibrium. Opening the CA changes the structure of financial arrangements and welfare. At low (high) world interest rates there is a capital inflow (capital outflow). At low world interest rates, welfare increases because larger scale of investment dominates the worsened mix of projects. This occurs because the ineffective monitoring technology was only catching a few agents investing in bad projects in the closed economy and was not altering the behavior of BG agents. At high world rates, welfare increases because agents are able to receive a higher return from investing abroad. With moderate rates in a range above \(r^W_{CAPIN}\) the domestic DL market collapses and there is a capital outflow leading to a drop in welfare.

Fig. 6a makes two important points. First, asymmetric information may lead to a decrease in welfare from accessing world capital markets. In this case, the FI exits the market and there is a capital outflow. Second, even if the FI exits welfare may increase. This occurs because, in a sense, the FI is not needed as much in the open economy because it can no longer ration to improve the mix of projects as it was doing in the closed economy.

The second case shows that an efficient FI in the closed economy may become inefficient in the open economy and welfare may decrease (Claim 2b). Fig. 6b depicts a case with a moderately effective \((p=.30)\) and inexpensive \((c=.01)\) monitoring technology. In the closed economy, the FI enters, lends to both types of agents, and type BG agents choose good projects. In the open economy the FI enters at most world rates. The change in welfare depends on the world interest rate and can be divided into three regions: (1) at low world rates the FI induces the same mix of projects as in the closed economy and welfare increases with more investment; (2) at moderate rates, the FI become less efficient and welfare declines in the open economy. For these rates, the FI finds it too costly to shift type BG agents to the good project. Because the larger scale of investment does not offset the worsened mix of projects, welfare is lower than in the closed economy; and (3) for higher world rates, the FI does not enter in the open economy, the domestic DL market collapses and there is a capital outflow. For a range of interest rates consistent with a capital outflow, welfare is lower in the open economy. At higher world rates, welfare is higher in the open economy as agents lend at these high rates.

The second case shows that opening the CA may significantly reduce the efficiency of the FI and decrease welfare at moderately high world interest rates. This occurs at moderate interest rates as the value of being a type \(G\) agent is lowest. Thus the FI can attract them with a relatively high loan contract, which raises the opportunity cost of shifting type BG agents to good projects. This occurs even if the FI was efficient, in terms of inducing a good mix of projects, in the closed economy. Opening the CA in this environment may trigger an investment boom with a worsened composition of projects and substantial defaults, even though the FI was efficient in the closed economy.

In summary, these examples show that the structure of lending arrangements and FI’s monitoring effectiveness are likely to change following a liberalization of the CA.
In particular, FIs may not enter, leading to an unmonitored DL equilibrium. At low interest rates, the larger scale of projects may offset the worsened mix of projects so that welfare will increase. However, for moderate interest rates leading to a capital outflow, welfare may decrease. Finally, the mix of projects undertaken and effectiveness of the FI in the closed economy may be quite different from the open economy. In particular, it is possible for a seemingly effective FI to become much less effective in the open economy. Likewise, it is possible for an ineffective FI in the closed economy to become quite effective in the open economy.

4.2. Financial liberalization

Recent research has focused on the role of financial liberalization on macroeconomic performance. We examine the impact of following a CA liberalization with a financial deregulation. We find that if opening leads to a shift towards unmonitored direct lending; the financial liberalization has no additional impact on the economy. In those cases where the monopolist FI would enter in the open economy, a financial liberalization can increase welfare only if the monitoring technology is ineffective.

Lemma 5. Competitive FIs begin shifting type BG agents into good projects for a less effective monitoring technology than the monopolistic FI \( p_{\text{COM Open}} < p_{\text{MON Open}} \). If \( p_a(p_{\text{COM Open}} < p_{\text{MON Open}}) \), the financial sector liberalization improves the mix of projects and welfare.

If competitive FIs enter in the open economy, these FIs will lend at lower rates than the monopolist FI. As lower rates reduce the opportunity cost of charging \( R_{BG}(p) \), competitive FIs change the behavior of type BG agents with a less advanced monitoring technologies than the monopolist FI. This implies there will be a range of monitoring technologies so that a financial liberalization improves welfare. On the other hand, if there is no change in the mix of projects from a financial liberalization, then the financial liberalization will just transfer wealth from the monopolist FI to agents with projects.

5. Adverse selection

We have concentrated on lending and investment when asymmetric information leads to a moral hazard problem. In practice, adverse selection may be just as big of a concern. Extending our model in this direction is straightforward and does not qualitatively change the results of a CA liberalization. However, introducing adverse selection may undo the gains from a financial liberalization and lead to a welfare loss.

\(^{25}\) See, for example, Demirguc-Kunt and Detragiache (1998), Bekaert et al. (2001) and Chang and Velasco (2001).
Consider introducing a fourth group of domestic agents. These agents, which we call type $B$ agents, only have a bad project. It is socially inefficient for these agents to borrow and invest; however, because of asymmetric information they will borrow whenever the return to investing exceeds the return to lending. In the closed economy, type $B$ agents will crowd out type $G$ agents leading to higher default rates and a lower value of direct lending for type $G$ agents.

With a monopolist FI in the credit market, an improvement in the monitoring technology reduces both the moral hazard problem of type $BG$ agents and the adverse selection problem of type $B$ agents. As the monitoring technology improves, first, the type $BG$ agents shift from bad to good projects, then type $B$ agents drop out of the loan side of the market. The technology at which type $B$ agents stop investing will differ in the closed and open economy because the lending and deposit rates will differ. As before, it is possible for a CA liberalization to improve or worsen the mix of projects.

Consider the impact of a financial market liberalization. With competitive FIs, lending rates are lower. This reduces the moral hazard problem but worsens the adverse selection problem. If adverse selection is more of a problem than moral hazard, or if the monopolistic FI eliminates the moral hazard problem, then a financial liberalization will lead to a lending boom and aggregate shift towards worse projects which decreases welfare. Kaminsky and Reinhart (1999) find evidence of these types of events.

6. Summary and concluding remarks

This paper offers a new framework to evaluate the important policy decisions to liberalize the capital account and domestic financial markets. Our approach is novel in that our analysis is done in a model of endogenous financial intermediation. This allows us to study how these policies alter both the structure and efficiency of lending arrangements as well as welfare.

We find that financial intermediaries are very effective in limiting moral hazard in closed economies. Following a capital account liberalization, they become less effective relative to other forms of finance. This may lead to a substantial shift towards unmonitored debt and an aggregate shift towards negative NPV projects. If the loss from the worsened project mix exceeds the gain from the larger scale of investment, then access to world financial markets may make a country worse off. Alternatively, if financial intermediaries do little to improve the aggregate mix of projects, and monitoring is costly, then a country may gain despite the collapse of the banking sector.

The decision to access world capital markets should be based on the underlying monitoring technology of financial intermediaries rather than just their efficiency in the closed economy. Opening the capital account changes the contracts financial intermediaries will offer, which affects agents’ investment choices. We identify cases where a financial intermediary finances many bad loans in the closed economy but finances very few bad loans in the open economy. In this case, the opportunity cost of
delaying liberalizing the CA is large. We also identify cases where the financial intermediary becomes much less efficient in the open economy. Opening the capital account in this case leads to an investment boom, but it may also trigger substantial defaults and a decrease in welfare, even though the same financial intermediary was profitable and efficient in the closed economy.

The case of liberalizing the financial sector is also uncertain. On the one hand, more competition in the financial sector will lower lending rates and therefore discourage moral hazard in investment. On the other hand, the lower lending rates will attract more agents with bad investment projects. Either way, these policies have important consequences on the efficiency of financial intermediaries.

We conclude with two important limitations of the analysis. First, to make our main points clear, we compared static models in closed and open economies for given monitoring technologies. In this respect, our analysis may provide guidance to the short-term implications of these policies. Over time, it is likely that firms will invest in developing better monitoring technologies and agents may accumulate collateral to reduce the moral hazard problem. Also, by focusing on static models we abstract from uncertainty, particularly over world interest rates. Second, we provide no role for the government to regulate financial intermediaries and no moral hazard problem on the part of the financial intermediaries. Both of these changes would alter the model, but would probably not change our message: the efficiency and structure of financial markets can change for better or worse following a capital account liberalization with positive or negative welfare consequences.

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Appendix A

A. 1 Proof of Lemma 1. In an equilibrium with lending, type $G$ agents weakly prefer borrowing to lending, i.e., $V_G(a=G) \geq V_L$. Suppose a lending equilibrium exists in which type $G$ agents only lend. In this case, type BG agents must invest in good projects;
otherwise, the loans will have a negative NPV. But, if BG agents prefer borrowing and investing in \( G \) to lending, then so will \( G \) agents.

\[ \square \]

**A. 2 Proof of Lemma 2 (equilibria in closed economy with DL).**

A DL equilibrium requires \( V^{BG} > V^G = V^L \). If \( V^{BG} > V^G \) then BG agents must choose a different action than \( G \) agents so that \( a^{BG} = B \). From the value functions, we have

\[ V^{BG} \geq V^G \geq V^L \geq 1. \]  \( \text{(13)} \)

We first demonstrate why a credit rationing equilibrium cannot exist. A Credit Rationing equilibrium requires \( V^{BG} = V^G = V^L \) and \( a^{BG} = G \). If \( V^{BG} = V^G \) then BG agents invest in their good project, and type \( G \) agents will also invest in the good project so that \( BG \) agents must weakly prefer investing in the good project. When the BG agents are indifferent between the two projects, they will choose the good project as this raises the repayment rate and lowers the face value of debt. On the other hand, if \( V^G = V^L \) then \( G \) agents are indifferent between borrowing and lending and the interest rate will rise to clear the loan market. If \( V^G > V^L \) all agents with projects seek loans and credit must be rationed and interest rate will not rise to clear the loan market.

In a Credit Rationing Equilibrium, a small increase in the interest rate lowers the expected return to lending. This occurs when an \( \epsilon \) increase in the face value of debt increases the default rate substantially because the share of bad projects funded rises. The share of bad projects rises if either BG agents switch from good to bad projects, or if more BG agents investing in bad projects are funded. The latter only occurs if the \( \epsilon \) increase leads \( G \) agents to become lenders, but with \( V^G > V^L \) this is not possible. Consequently, \( a^{BG} = G \).

The Credit Rationing Equilibrium is characterized by (1) a lottery so that \( \theta^{CR} = (1/(\pi L + \pi BG)K) \) fraction of BG and \( G \) agents receive loans and invest in the good project; (2) interest rate \( r^{CR} = (g - \pi b)/(\pi L (1 - \pi)) \), repayment rate \( \gamma^{CR} = 1 \) (for details, see Alessandria and Qian, 2003). For the equilibrium to exist, it must be the case that \( r^{CR} > 1 \), which implies that \( \pi L (1 - \pi) \leq g \), but this contradicts Assumption 3.

Ruling out the Credit Rationing Equilibrium means that (13) must hold, and type \( BG \) agents invest in the bad projects. In the Bad Equilibrium the interest rate rises to clear the loan market so that \( V^G = V^L \). If \( G \) agents are indifferent between borrowing and lending then \( r^{Bad} \geq 1 \). However, if \( r^{Bad} \geq 1 > r^{BG} \) then type \( BG \) invest in the bad project. Lenders lend when \( r^{Bad} \geq 1 \). A type \( BG \) agent invests in her bad project if \( r \geq r^{BG} \) but \( r \) is not so high as to discourage investment entirely. In order for this to be an equilibrium, it must be that \( r \geq 1/\gamma^{Close} \). Additionally, the lending rate cannot exceed \((Kg - 1)/(K - 1)\), otherwise \( G \) agents withdraw from the loan side of the DL market, and the market collapses. These two constraints are equivalent so \( g \geq 1 - (1 - \pi) \pi BG K \). Finally, Assumption 3 requires that \( g \leq ((K - 1)/K)(1 - \pi) + \pi b \); thus, an equilibrium is Bad iff

\[ \frac{1 - (1 - \pi) \pi BG}{1 - (1 - \pi) \pi BG K} \leq g \leq \pi L (1 - \pi) + \pi b. \]  \( \text{(14)} \)
A. 3 Proof of Proposition 1 (uniqueness of equilibria with DL).

When the DL market breaks down, the only equilibrium is autarchy. Otherwise, there is borrowing and lending in the economy. We show by contradiction that a set of parameters cannot generate multiple equilibria.

Suppose the Bad and autarchy equilibria coexist. This implies there is a \((r_{\text{Bad}}, \gamma_{\text{Close}})\) that satisfy the conditions on individual agents, and that \(r_{\text{Bad}}/r_{\text{Close}} \geq 1\), and that if no agents are lending then no agents will borrow. Now, if no agents are lending then \(V_0^L = V_0^G = V_0^{BG} = 1\). This implies \(K-1\) lenders can get together and offer a contract at \(r_{\text{Close}}-\epsilon\) and all G and BG agents are willing to borrow at this rate as their return will be \(V_0^{BG} = r_{\text{Close}}/r_{\text{Bad}} = V_0^{BG} \geq \gamma_{\text{Close}}\). This implies that a higher repayment rate of \(\gamma' = (\pi x_{BG} + x_G)/(x_{BG} + x_G)\)\(\gamma_{\text{Close}}\) and a return \(\gamma' (r_{\text{Close}} - \epsilon) > r_{\text{Close}}/r_{\text{Bad}}\) for \(\epsilon\) close enough to zero and that the DL market does not collapse.

\[\square\]

A. 4 Proof of Lemma 3 (equilibrium in open economy with DL).

We show that given the range of world rates, there will be capital inflow. First, define:

\[\gamma_{\text{Open}} = \frac{\pi x_{BG} + x_G}{x_G + x_{BG}}, \quad r_{\text{Open}} = \frac{r_{f}}{\gamma_{\text{Bad}}}, \quad \text{and} \quad r_{\text{CAPIN}} = \frac{Kg / \gamma_{\text{Open}}}{r_{f}} > r_{\text{Bad}}. \tag{15}\]

Consider the case where \(r_{\text{Bad}} = r_{\text{Close}} = K \gamma_{\text{Open}} (K-1) \gamma_{\text{Bad}}\). Suppose a lender charges \(r_{\text{Close}} - \epsilon\). At this rate, all G agents enter the market so that the repayment rate increases to \(\gamma_{\text{Open}}\) and the lender earns \(\gamma_{\text{Open}} / r_{\text{Close}}\). For \(\epsilon \rightarrow 0\), this implies that \(\gamma_{\text{Open}} / r_{\text{Close}} > r_{f}\), so that at \(r_{f} = r_{\text{Bad}}\) in the DL market loans will be made at \(r_{\text{Open}} = (r_{f} / \gamma_{\text{Open}}) > r_{\text{Bad}}\) and G agents strictly prefer borrowing to lending. Moreover, for \(r_{f} > r_{\text{Bad}}\) the value of lending increases while the value of borrowing decreases, implying that there exists \(r_{\text{CAPIN}} > r_{f}\) such that the G agents are indifferent between lending and borrowing. This can be defined as

\[Kg - (K-1) \gamma_{\text{Open}} = r_{\text{CAPIN}}, \quad \text{or} \quad r_{\text{CAPIN}} = \gamma_{\text{Open}} Kg / (r_{f} + (K-1)).\]

The uniqueness proof is similar to the Proofs of Lemma 2 and Proposition 1. There is no Credit Rationing Equilibrium in the open economy.

\[\square\]

A. 5 Proof of Proposition 2 (welfare comparison of DL economies).

Pure lenders gain when \(r_{f} > r_{\text{Bad}}\) and lose when \(r_{f} < r_{\text{Bad}}\). The G agents gain in the open economy for all world interest rates. In the closed economy, G agents are indifferent between borrowing and lending and earn \(r_{\text{Bad}}\). When \(r_{f} > r_{\text{Bad}}\) the G agents can lend and be better off and for \(r_{f} \leq r_{\text{Bad}}\) they can borrow and be better off. Type BG agents are better off in the open economy when there is a capital inflow as they can borrow cheaper in the open economy. It suffices to show that the highest interest rate at which they borrow is \(r_{\text{CAPIN}} / \gamma_{\text{Open}}\) and that
\[ r_W^{\text{CAPIN}} < r_W^{\text{Open}} \implies r_W^{\text{Open}} \frac{\gamma_{\text{Bad}}}{\gamma_{\text{Close}}} < \frac{r_W^{\text{Bad}}}{r_W^{\text{Open}}} \frac{K_g}{(K - 1)} \implies r_W^{\text{Bad}} \frac{g}{I} \frac{K}{(1 - (1 - \pi)x_{BG}} \]

\[ \iff K(1 - \pi)x_{BG} > (1 - \gamma_{\text{Bad}}) = \frac{(1 - \pi)x_{BG}}{x_{BG} + x_G} \iff K(x_{BG} + x_G) > 1, \]

which is true by Assumption 1.

Next we show that open economy welfare, \( W_{\text{Open}}(r_W) \) is decreasing for \( r_W < r_W^{\text{CAPIN}} \) and increasing for \( r_W > r_W^{\text{CAPIN}} \) and there is a discontinuity when \( r_W = r_W^{\text{CAPIN}} \). The first two statements are obvious given the country borrows when \( r_W < r_W^{\text{CAPIN}} \) and lends when \( r_W > r_W^{\text{CAPIN}} \). We show there is a discontinuity at \( r_W = r_W^{\text{CAPIN}} \) as some agents are indifferent between a capital inflow or outflow at \( r_W^{\text{CAPIN}} \) and other agents are strictly worse off. By definition, pure lenders are indifferent to where they lend at \( r_W^{\text{CAPIN}} \). Additionally, by definition of \( r_W^{\text{CAPIN}} \), type \( G \) agents are indifferent between borrowing and lending. However, type BG agents strictly prefer borrowing and investing in the bad project over lending or investing in the good project so that

\[ V_B > V_G = V_L = r_W^{\text{CAPIN}} \]

and thus lose if the DL market collapses at \( r_W = r_W^{\text{CAPIN}} \).

### A. 6 Proof of Proposition (monopolist FI’s loan schedule in the closed economy).

The proof of part (a) is in Section 3.2. To prove part (b), we first derive the loan rate \( R_{\text{Close}} \) which makes \( G \) agents indifferent between borrowing from the FI or from the DL market when the FI uses a lottery to ration credit. With rationing, regardless of the monitoring technology the mass of agents seeking loans will not change so that the probability of a loan will not change and \( R_{\text{Close}} \) will not depend on \( p \) and is defined in Eq. (8). We define the profits from charging \( R_{\text{Close}}^{\text{Close}} = R_{BG}(p) \) and \( R_{BG}(p) \) as:

\[ \prod_{\text{Close}} (R_{\text{Close}}^{\text{Close}}) = K \frac{x_{BG}(p + (1 - p)\pi R_{\text{Close}}^{\text{Close}}) + x_G R_{\text{Close}}^{\text{Close}}}{x_G + x_{BG}} - K(1 + c)(1 - x_G - x_{BG}). \]

(16)

\[ \prod_{\text{Close}} (R_{BG}(p)) = K[R_{BG}(p) - (1 + c)(1 - x_G - x_{BG})]. \]

(17)

If \( R_{BG}(0) < R_{\text{Close}}^{\text{Close}} \) there is a \( p^+ \) such that \( R_{BG}(p^+) = R_{\text{Close}}^{\text{Close}} \). At this point, there is a discontinuity in the profits from charging \( R_{\text{Close}}^{\text{Close}} \) as the BG agents will shift from bad to good projects. This discontinuity implies there exists a range of \( p \in [p, p^+] \) where the FI can earn more by charging \( R_{BG}(p) \) than \( R_{\text{Close}}^{\text{Close}} \). To find \( p_{\text{MON}}^{\text{Close}} \) it suffices to examine the difference in profits from charging \( R_{\text{Close}}^{\text{Close}} \) and \( R_{BG}(p) \)

\[ \Delta \prod_{\text{Close}} = K \left[ R_{BG}(p) - \frac{x_{BG}(p + (1 - p)\pi R_{\text{Close}}^{\text{Close}}) + x_G R_{\text{Close}}^{\text{Close}}}{x_G + x_{BG}} \right]. \]

(18)
Setting this equal to zero and rearranging terms yields an implicit equation that defines
\[ p_{\text{MON}}^{\text{Close}}. \]

\[ \zeta_{BG} \left[ R_{BG}(p) - (p + (1-p)\pi R_{\Theta}^{\text{Close}}) \right] = \zeta_G \left( R_{\Theta}^{\text{Close}} - R_{BG}(p) \right). \]  

(19)

The LHS represents the increased profits from setting a price that changes the behavior of the BG agents, while the RHS represents the lower income from the G agents who borrow at a lower rate.

Setting Eq. (16) to zero allows us to define the entry-level monitoring technology:

\[ p_{\text{Close}}^{\text{MON}} = \frac{1 - (1 + c)(\zeta_G + \zeta_{BG}) + c(\zeta_G + \zeta_{BG}) - (\zeta_G + \zeta_{BG} \pi) R_{\Theta}^{\text{Close}}}{\zeta_{BG} (1 - \pi R_{\Theta}^{\text{Close}})}. \]  

(20)

Substituting \( \gamma_{\text{Open}}^{\text{Bad}}(\pi \zeta_{BG} + \zeta_G)/(\zeta_{BG} + \zeta_G) \) yields

\[ p_{\text{Close}}^{\text{MON}} = \frac{\zeta_{BG} + \zeta_G (1 + c) \zeta_L - \gamma_{\text{Open}}^{\text{Bad}} R_{\Theta}^{\text{Close}}}{\zeta_{BG} \left( 1 - \pi R_{\Theta}^{\text{Close}} \right)}. \]

A. 7 Proof of Proposition 4 (monopolist FI’s loan schedule in the open economy).

The FI’s profit from charging \( R_{BG}(p) \) is

\[ \prod_{\text{Open}} (R_{BG}(p)) = KR_{BG}(p) - (K - 1) r_{f}^{W} - Kc, \]

and the profit from charging \( R_{\Theta}^{\text{Open}} \) is

\[ \prod_{\text{Open}} (R_{\Theta}^{\text{Open}}) = K \frac{\zeta_{BG} \left[ p + (1-p)\pi R_{\Theta}^{\text{Open}} \right] + \zeta_G R_{\Theta}^{\text{Open}}}{\zeta_G + \zeta_{BG}} - (K - 1) r_{f}^{W} - Kc. \]

(22)

If \( r_{f}^{W} > r_{\text{CAPIN}}^{W} \) and type G agents lend internationally in the DL market then \( R_{\Theta}^{\text{Open}} = g - r_{f}^{W} / K. \) Setting Eqs. (21) and (22) equal and rearranging terms yields

\[ \zeta_{BG} \left[ R_{BG}(p) - (p + (1-p)\pi R_{\Theta}^{\text{Open}}) \right] = \zeta_G \left( R_{\Theta}^{\text{Open}} - R_{BG}(p) \right), \]  

(23)

which implicitly defines the shifting technology of \( p_{\text{MON}}^{\text{Open}}. \) To find the minimum technology at which the FI enters Eq. (22) is set to zero and solved for

\[ p_{\text{Open}}^{\text{MON}} = \frac{(\zeta_G + \zeta_{BG}) (\frac{K-1}{K}) r_{f}^{W} + c - R_{\Theta}^{\text{Open}} (\pi \zeta_{BG} + \zeta_G)}{\zeta_{BG} (1 - \pi R_{\Theta}^{\text{Open}})}. \]  

(24)

Substituting \( R_{\Theta}^{\text{Open}}, \gamma_{\text{Open}}^{\text{Bad}} = ((K-1)/K)r_{f}^{W} \) allows us to simplify (24):

\[ p_{\text{Open}}^{\text{MON}} = \frac{\zeta_{BG} + \zeta_G}{\zeta_{BG}} \frac{c}{1 - \pi R_{\Theta}^{\text{Open}}}. \]

Obviously, \( p_{\text{MON}}^{\text{Open}} \) is increasing in \( c \) and \( R_{\Theta}^{\text{Open}}. \) Since \( R_{\Theta}^{\text{Open}} \) is increasing in \( r_{f}^{W}, \) so is \( p_{\text{MON}}^{\text{Open}}. \)
A. 8 Proof of Proposition 5 (competitive FIs’ loan schedule in open economy).

We assume a perfectly competitive market for loans. We use the zero profit condition to define $R_{\text{COM}}^{\text{open}}(p)$ in (11). Alternatively, we can define the loan contract as a function of the $p$ and $\Pr(B; r^{W}_{f}, p) = \Pr(B; r^{W}_{f}, R(p), p)$ and solve the zero profit condition for

$$R(p, \Pr(B; r^{W}_{f}, p)) = \frac{(K-1) r^{W}_{f} + c - \Pr(B; r^{W}_{f}, p)p}{1 - \Pr(B; r^{W}_{f}, p)[1 - p(1 - \pi)]}.$$  

In general, there are discrete investment choices for each type of agent, so we can define two regions corresponding to $(a_{G}, a_{BG}) = \{(G, B), (G, G)\}$. We can use the schedule of $\Pr(B; r^{W}_{f}, p)$ to find the loan rate with different $p$. When all agents invest in $G$ projects, the zero profit condition requires that:

$$R_{\text{COM}}^{2} = \frac{K-1}{K} r^{W}_{f} + c.$$  

At $p^{\text{COM}}_{\text{open}}$, BG agents are indifferent between their good and bad project so that $V^{B} = V^{G}$ so that $p^{\text{COM}}_{\text{open}}$ solves this implicit equation

$$(1 - p) \pi K [b - R(p, \Pr(B; r^{W}_{f}, p) = 0)] = K [g - R(p, \Pr(B; r^{W}_{f}, p) = 0)],$$

$$\Rightarrow p^{\text{COM}}_{\text{open}} = 1 - \frac{g - R_{\text{COM}}^{2}}{\pi (b - R_{\text{COM}}^{2})}.$$  

Finally, in the first region, BG agents invest in $B$ while $G$ agents invest in $G$ projects, and

$$R_{\text{COM}}^{1} (p) = \frac{(\alpha_{G} + \alpha_{BG}) \frac{(K-1)}{K} r^{W}_{f} + c - \alpha_{BG} p}{\alpha_{G} + \alpha_{BG} (1 - \pi)}.$$  

References


