International Capital Flows under Asymmetric Information and Costly Monitoring: Implications of Debt and Equity Financing

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October 1999

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ABSTRACT
The composition of international capital flows to developing countries has changed dramatically over the past ten years, with equity flows growing faster than debt flows. This paper examines the impact on a small open economy of increased equity trade in the presence of asymmetric information. A two-period model is developed in which stochastic second-period output depends on first-period investment. Domestic agents may conceal the level of first-period investment from international fund providers. The paper first focuses on international borrowing and shows that firms choose to incur self-monitoring costs to increase capital inflows, leading to higher domestic investment, output, and consumption. The paper then examines the impact of the sale of ownership claims to domestic production. When domestic agents sell equity claims and ownership conveys information, equity trade is preferred to borrowing. Consequently, access to world equity markets raises domestic welfare.

* I would like to thank Martin Boileau, JoAnne Feeney, Jill Holman, and Keith Maskus for their comments on earlier drafts. Any remaining errors are my own.
1. Introduction

Recent changes in capital flows to developing economies highlight the potential impact of international capital flows on economic growth and development. While much of the discussion focuses on the duration and maturity of capital flows and the efficacy of capital controls, relatively less emphasis is placed on the composition of flows. In the ongoing debate on the costs and benefits of financial market development and increased capital flows to developing countries, an important consideration is the relative value of local financing through international debt or international equity. This paper provides an initial examination of the use of international equity as an alternative to international debt. In the model, international capital flows are sensitive to asymmetric information. Domestic agents have more information regarding the use of capital by domestic firms than do international lenders, which reduces the funding available from international markets. As a consequence, firms choose to incur costly monitoring to increase the funds available for domestic investment. By providing less costly monitoring opportunities, international equity financing provides a superior alternative to international borrowing. Equity flows lead to increased domestic investment and raise wealth in developing economies.

The recent Asian financial crisis has focused attention on the role of capital controls in limiting short-term capital movements during crises.¹ Many argue that there are important

¹ See, for example, Stiglitz (1998b), Rodrik (1998), and Rodrik and Velasco (1999) for discussions in favor of capital controls. Mishkin (1999) argues that there is no need for capital controls but that there should be greater bank regulation and supervision to mitigate excessive risk taking by banking institutions as set forth in recent IMF proposals (IMF, 1999a, 1999b). Dooley (1995) provides a comprehensive survey of the literature on capital controls, generally concluding that there is little evidence that capital controls enhance economic welfare. Also see Alesina, Grilli, and Milesi-Ferretti (1994) for evidence that capital controls lead to higher inflation and seigniorage, and lower domestic real interest rates, but no reduction in economic growth.
differences between short-term capital flows and long-term capital flows such as foreign direct investment (FDI).\(^2\) For this reason, consideration of the different components of international capital flows is an important element in understanding the impact of capital controls on capital flows. Figure 1 depicts the composition of official development and private capital flows to developing countries since 1990. Over this period, there has been a dramatic increase in equity flows. FDI and portfolio equity together accounted for 27 percent of total flows in 1990, and had risen to 59 percent of total flows in 1996. Debt flows accounted for a smaller fraction of total flows in each period: 15 percent in 1990 and 29 percent in 1996.

![Figure 1: Net long-term resource flows to developing countries](image)

**Notes:** Developing countries are defined as low- and middle-income countries with 1995 per capita incomes of less than $765 (low) and $9,385 (middle). \(^a\) Preliminary.

**Source:** World Bank (1998)

\(^2\) For example, Montiel and Reinhart (1999) note that FDI is conventionally characterized as more stable than short-term flows. Stiglitz argues that countries should implement policies that discourage “hot money” and facilitate the flow of long-term loans (quoted in Edwards, 1999).
This paper provides one explanation for the substantial increase in the relative importance of international equity in total flows to developing countries. I examine a small open economy that is in need of international capital to fund domestic production. Domestic agents are assumed to have more information regarding their own activities than do foreign investors. In particular, the level of domestic capital formation is not observable to international investors.\(^3\) The model builds on that in Gertler and Rogoff (1990), which considers the inefficiency induced by information asymmetries when agents are allowed to borrow internationally. Here, asymmetric information between domestic agents and international lenders eliminates the equivalence of debt and equity financing.\(^4\) This implies that government restrictions on particular types of international capital flows matter. This paper assesses the impact of removing government restrictions on international equity trades. In particular, I examine how domestic investment, domestic welfare, and international capital flows are affected by the ability to trade ownership claims (including portfolio equity and FDI), instead of exclusively borrowing funds, when the level of domestic investment is not observed by international fund providers.

Other authors concentrate on the interaction between financial markets and growth in a closed-economy setting where financial intermediaries contribute to mitigating asymmetric

\(^3\) The analysis is similar to that in Mishkin (1999) in its concentration on the effect of informational asymmetries, and moral hazard in particular, on capital flows. In contrast to the current paper, Mishkin focuses on moral hazard due to implicit guarantees by domestic governments for foreign investment or by international institutions for domestic government investment.

\(^4\) See Modigliani and Miller (1958) and Stiglitz (1969, 1974) for discussions of the irrelevance of corporate financial policy and the statement of the original Modigliani and Miller Theorem. Asymmetric information can affect the financing decision of a firm because managers may use financial policy decisions to convey information to the market. In this signaling context, see Ross (1977), Leland and Pyle (1977), and Myers and Majluf (1984).
information problems. The research in this area generally finds that domestic financial market development is positively correlated with economic development. A smaller subset of the financial development and growth literature focuses on equity markets and the possibility of both debt and equity financing. Greenwood and Smith (1997) find that bank intermediation is necessarily growth enhancing while equity markets may or may not enhance growth. Boyd and Smith (1995) show that economies tend toward equity financing at higher levels of growth. Levine and Zervos (1998) find that both stock market liquidity and banking development are important determinants of growth. Much of this research, however, focuses on domestic capital markets. Of growing interest is the examination of international capital markets and possible links to economic development.

This paper explores the impact of expanding asset markets from bonds to equity trade in the presence of asymmetric information. The possible effects of capital controls are implicitly examined by determining the extent to which domestic investment is affected by access to international equity flows in the presence of domestic market frictions. Further, the paper considers the impact on domestic investment and international capital flows of firms incurring self-monitoring costs to reduce or eliminate the information asymmetries between domestic agents and foreign investors. The investigation of monitoring activities is consistent with recent entreaties by the International Monetary Fund (IMF) for increased surveillance and regulation to

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5 For example, see King and Levine (1993), Levine (1997), and Levine and Zervos (1998) for empirical evidence that development of domestic financial markets leads to economic growth. See Greenwood and Jovanovic (1990), Bencivenga and Smith (1991, 1992), and Greenwood and Smith (1997) for closed-economy theoretical discussions on financial market liberalization and economic development.

mitigate information asymmetry problems. Among the proposed reforms for strengthening the international financial system are calls for increased reliance on accepted international standards and codes of good practice, improved surveillance by international financial institutions, greater official bank supervision, and encouragement of private-sector monitoring by investors (Fischer, 1999; Camdessus, 1999). These proposals also stipulate increased monitoring by international financial institutions, including monitoring of securities markets. The monitoring modeled in this paper represents increased information flows due to stronger prudential regulation and supervisory policies as well as increased compliance with international standards.  

The severity of the information asymmetry is assumed to depend on the nature of international financing, and is modeled as differences in the cost of monitoring. Since debt flows do not include any ownership element, they are assumed to be subject to a constant monitoring cost. The analysis here shows that even when monitoring is costly, domestic agents choose to incur this cost to obtain greater flows of international capital. Equity financing, on the other hand, incorporates different levels of ownership that may facilitate greater management control, and thus diminish the severity of the information asymmetry.  

As a consequence, equity flows may achieve less costly monitoring than international debt flows. Consider the definition of U.S. direct investment abroad used by the Bureau of Economic Analysis (BEA, 1995, p. 8):

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7 Internationally accepted standards include banking standards (as defined by the Core Principles set out in 1997 by the Basle Committee on Banking Supervision), data dissemination standards (as described in the IMF’s Special Data Dissemination Standard (SDDS)), codes of fiscal, monetary, and financial transparency (as are being prepared by the IMF in cooperation with other institutions), accounting standards, bankruptcy regulations, and standards for the operation of securities markets (Fischer, 1999).

8 See Greenwald, Stiglitz, and Weiss (1984), Jensen (1986), and Stiglitz (1998b) for discussions of adverse selection and moral hazard inherent in domestic equity issues. The emphasis here is on information asymmetries between domestic agents and international investors and ignores many of the issues pertaining to financial intermediaries and their role in mitigating information asymmetries (e.g., see Stiglitz and Weiss, 1981).
“A ‘foreign affiliate’ is a foreign business enterprise in which there is U.S. direct investment, that is, in which a U.S. person owns or controls 10 percent of the voting securities or the equivalent. Foreign affiliates comprise the foreign operations of a U.S. multinational company over which the U.S. parent is presumed to have a degree of managerial influence.”

Ownership implies some level of managerial control and hence the ability to determine, at least partially, the investment undertaken by domestic agents.

The model implicitly considers the difference between portfolio equity and FDI (see Figure 1) in that increased ownership implies more significant control of a firm and thus less costly regulation of the actions of the manager of the firm. Again, this type of assumption is evident in the BEA’s definition of U.S. direct investment abroad (BEA 1995, p. 8):

“A ‘majority-owned nonbank affiliate’ (MOFA) is a foreign affiliate in which the combined direct and indirect ownership interest of all U.S. parents exceeds 50 percent. MOFA’s comprise the foreign operations of a U.S. MNC that are unambiguously controlled by the U.S. parent(s).”

The paper proceeds as follows. Section 2 focuses exclusively on internationally borrowed funds. As a benchmark, Section 2.1 describes Gertler and Rogoff’s (1990) model with and without moral hazard. The ability to monitor domestic activity at a cost is analyzed in Section 2.2. As an alternative to relying exclusively on borrowed funds, Section 3 allows domestic agents to sell equity to international investors. The ability to sell equity is examined both when equity provides costless monitoring (Section 3.2) and when the cost of monitoring is a decreasing function of ownership (Section 3.3). Brief conclusions and some implications of the model are presented in Section 4.
2. Model

2.1 Benchmark

The benchmark environment is identical to Gertler and Rogoff (1990) and is briefly reviewed here to provide baseline levels of investment and domestic welfare against which to compare the monitoring and equity outcomes. There is a small domestic economy inhabited by many identical agents. There are two time periods and each agent in the domestic economy is endowed with $w_1$ and $w_2$ units of the single domestic good in the first and second periods, respectively. Agents are risk neutral and consume only in the second period with utility

$$U(c)=c,$$  

(1)

where $c$ denotes second-period consumption.

Each domestic agent has access to a productive project, which provides risky output for consumption in the second period. Stochastic second-period output is

$$y = \begin{cases} \theta \text{ with probability } \Pi(k) \\ 0 \text{ with probability } 1-\Pi(k) \end{cases}$$  

(2)

where $k$ is the level of first-period investment, $\Pi(k)$ is the probability of a good outcome, $\theta$, and $1-\Pi(k)$ is the probability of a bad outcome in which output is zero. $\Pi(k)$ is a strictly concave function with $\Pi'(k)>0$ and $\Pi''(k)<0$. Accordingly, the probability of a good outcome is increasing with the level of first-period investment chosen by the agent. Also, $\Pi(0)=0$ and $\Pi(\infty)=1$. Output realizations are assumed to be independent across projects. The span of possible realizations (i.e., $\theta$ or 0) does not depend on investment, so the level of investment undertaken is not revealed by the realization of output.

If an agent chooses not to invest in his particular project, his alternative is to save on international markets at the gross world riskless interest rate, $r$. Since agents are ex-ante
identical, the decisions of a representative domestic agent (alternatively called the ‘entrepreneur’) are examined. Agents do not invest in the projects of other domestic agents as all projects are ex-ante identical, and the assumption of risk-neutrality eliminates any risk-sharing motive. Unlike a standard costly state verification (CSV) problem in which output is unobserved and can only be revealed at a cost, here the second-period output of the project is perfectly observed. Therefore, contracts can be written conditional on output. However, they cannot be written conditional on the level of investment, \( k \), since the domestic entrepreneur can conceal \( k \) from the lender.

Consider first the absence of any information asymmetry. The entrepreneur borrows \( b \) from an international investor if he wishes to invest more in his project than his first-period endowment, \( w_1 \). Thus, the entrepreneur’s budget constraint is

\[
w_i + b \geq k.
\]

In return for this amount \( b \), the entrepreneur offers the investor a state-contingent security that pays \( Z^g \) in the event of the good outcome, and \( Z^b \) in the event of the bad outcome. The international investor is assumed to have sufficient funds to lend \( b \) to the domestic agent. The international investor can be thought of as a large financial intermediary that achieves full diversification on international markets. Thus, the international investor is modeled as risk neutral, with the option of investing on world markets at the world interest rate, \( r \). Since \( r \) is

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\(^9\) For ease of exposition, the domestic agent is referred to as ‘he,’ while the foreign investor is denoted ‘she.’

\(^{10}\) Costly state verification stems from an information asymmetry in that only project owners (and not lenders) are able to observe project outcomes costlessly. The specification of asymmetric information here differs from much of the previous literature, which has focused on CSV (following Townsend, 1979; Diamond, 1984; and Bernanke and Gertler, 1989) to examine the effect of financial market development and the integration of capital markets across countries.
exogenous, the security offered by the entrepreneur must provide the lender an expected value equal to the world market rate of return, $r$. That is,

$$\Pi(k)Z^* + [1 - \Pi(k)]Z^b = rb. \quad (4)$$

The entrepreneur’s expected consumption in the second period is equal to his expected return on the project less what he pays to the international investor plus his second-period endowment. Second-period expected consumption can therefore be written as:

$$E(c) = \Pi(k)(\theta - Z^*) - [1 - \Pi(k)]Z^b + w_2. \quad (5)$$

The entrepreneur maximizes expected second-period consumption (5) subject to the budget constraint (3) and the constraint on the security return (4).

The entrepreneur chooses the level of investment, $k^*$, to equate the expected marginal product of capital, $\Pi'(k^*)\theta$, to the cost of capital on world markets, $r$, thus satisfying $\Pi'(k^*)\theta = r$. The amount of funds borrowed on international markets is given by the budget constraint, such that $b^* = k^* - w_i$. The term $k^*$ is the first-best level of investment since there are no information asymmetries in this benchmark specification.

Gertler and Rogoff (1990) show that when the entrepreneur is able to conceal the level of investment from the international investor, the entrepreneur invests too little in the project. In this case, the domestic agent borrows funds from the international investor and then chooses either to invest in his own project or to save these funds on international markets. The information asymmetry is such that the agent can conceal the level of investment and secretly save abroad at the world interest rate, $r$. The international investor observes the agent’s first-period and second-period endowments, the amount borrowed, the production function, and realized output. The investor does not observe the amount, $k$, that the agent invests in his project. The probability of a good outcome, however, depends on this amount. In exchange for
borrowed funds, the entrepreneur must still offer the international investor a security with an expected return of $r$ (equation 4). Yet the project’s ex-post return may be lower in the presence of the information asymmetry because the agent may secretly divert funds abroad. Therefore, the agent must have an incentive to invest in his own project, rather than saving abroad. The agent’s incentive compatibility constraint indicates that the marginal gain from investing in the project must be at least as great as the alternative return to holding assets abroad:

$$\Pi'(k)[\theta - (Z^g - Z^b)] = r. \quad (6)$$

Expected consumption in this case is:

$$E(c) = \Pi(k)(\theta - Z^g) - [1 - \Pi(k)]Z^b + r(w_1 + b - k) + w_2, \quad (7)$$

which includes the agent’s net return on his project (the first two terms), the proceeds from saving funds abroad at the world riskless interest rate, $r$, (the third term), and the second period endowment (the fourth term). The entrepreneur maximizes expected consumption (7) subject to constraints (4) and (6), the budget constraint (3), and a nonnegativity constraint on second period consumption: $w_2 \geq Z^b$.

The equilibrium level of investment when information is asymmetric, $\tilde{k}$, is less than when there is full information, $k^*$. The equilibrium in this case exhibits less international borrowing and less domestic investment than in the absence of the information asymmetry. In equilibrium, the agent does not secretly save funds abroad so that the budget constraint binds, $w_1 + \tilde{b} = \tilde{k}$. For any positive borrowing, $\tilde{b} > 0$, and $\tilde{Z}^g > \tilde{Z}^b = w_2$.

### 2.2 Borrowing with Asymmetric Information and Costly Monitoring

Gertler and Rogoff (1990) do not consider the possibility of monitoring domestic investment levels. Because the domestic agent cannot commit to investing borrowed funds in his
project rather than placing them in a foreign interest-bearing account, the agent suffers lower welfare in the presence of the information asymmetry. Consider the agent’s welfare, as measured by expected consumption, with and without the information asymmetry. The entrepreneur’s expected consumption when there is no information asymmetry (denoted NA) is

$$E(c)_{NA} = \Pi(k^*)\theta - Z^s + w_2$$

(8)

where \(k^*\) is the first-best level of investment. Since there is no asymmetric information, the agent offers the investor a risk-free security with \(Z^s = Z^{h^*} = w_2\) (from the incentive compatibility constraint (6) and satisfying the equilibrium condition for no asymmetry, \(\Pi'(k^*)\theta = r\)). Expected consumption then becomes

$$E(c)_{NA} = \Pi(k^*)\theta.$$  

(9)

In the presence of the information asymmetry (denoted \(A\)), the entrepreneur’s expected consumption is

$$E(c)_A = \Pi(\tilde{k})[\theta - \tilde{Z}^s + w_2],$$

(10)

where \(\tilde{k}\) is the level of investment when the agent is restricted to borrowing. The agent cannot offer the investor a risk-free security because he cannot commit not to save secretly abroad. Therefore, with \(\tilde{Z}^s\) greater than \(w_2\) (which equals \(\tilde{Z}^{h^*}\)) and \(\tilde{k} < k^*\), it is clear that \(E(c)_A < E(c)_{NA}\).

Since \(E(c)_A < E(c)_{NA}\), the domestic agent would like to hire a monitor to report his investment activities to the international investor. The entrepreneur is willing to pay a monitoring cost equal to the difference between the two levels of expected consumption in order to eliminate the information asymmetry:

$$E(c)_{NA} - E(c)_A = [\Pi(k^*) - \Pi(\tilde{k})]\theta + \Pi(\tilde{k})[\tilde{Z}^s - w_2].$$

(11)
The domestic agent’s desire to hire a monitor is consistent with recent discussions by the IMF on strengthening the international financial system. For example, proposals to strengthen the Special Data Dissemination Standard (SDDS) include the development of monitoring procedures for compliance with the standard. Other proposals involve greater contact with private capital markets and refined monitoring of capital flows (IMF, 1999b). While many of the discussions within the IMF focus on monitoring broad financial systems and financial institutions, there appears to be increasing emphasis on monitoring private capital flows and promoting communication with private capital markets (see IMF, 1999a and 1999b, for specific proposals and progress to date). The IMF discussions indicate that the incentives for monitoring international capital flows lie with the international community, including international capital markets, international organizations, financial institutions, and governments. However, in the model at hand, the incentives for monitoring lie with the domestic agent. This stems from the fact that international funds available to the agent are restricted by information problems. Monitoring reduces the agent’s wealth, but has no effect on the international lender because the international investor only invests in the domestic project if her expected return equals the market rate of return. Therefore, the analysis focuses on the entrepreneur’s willingness to pay to be monitored.

Assume that if the domestic agent pays a monitoring cost of \( \alpha \) (in capital units in the first period) then his actions are perfectly revealed to the international investor. The entrepreneur retains the option of saving borrowed funds on international markets but this action can no longer be concealed from the investor. Assume further that the investor can charge the entrepreneur a penalty of \( \Psi \) for all units saved abroad. With this up-front cost of monitoring and the penalty fee, the entrepreneur’s expected consumption becomes
The first two terms are the entrepreneur’s expected net return on the project; the third term is the agent’s return, less any penalty, on all funds saved abroad; the fourth term is the agent’s second-period endowment. The constraint on the security offered by the entrepreneur remains as before such that the international investor’s expected return equals the market return (4).

The entrepreneur’s incentive-compatibility constraint states that the marginal gain from investing in the project must be at least as great as the alternative return to holding assets abroad. With the addition of a penalty for saving abroad rather than investing in the domestic project, this constraint becomes

\[ \Pi'(k)[\theta - (Z^g - Z^b)] = r - \Psi. \]  

(13)

The entrepreneur maximizes expected consumption (12) subject to (4) and (13), a nonnegativity constraint \((w_2 \geq Z^b)\), and the budget constraint \((w_1 + b + a - \alpha \geq k)\), where the budget constraint reflects the up-front monitoring fee. Thus, the previous problem is modified by the addition of the monitoring cost, \(a\), and the penalty fee, \(\Psi\).

**Proposition 1.** There exists \(\overline{k}\) such that \(\Pi'(\overline{k})\theta = r\). Costly monitoring eliminates the information asymmetry so that the agent chooses the first-best level of investment, \(\overline{k} = k^*\). The positive penalty ensures that the agent does not save in assets abroad but invests all borrowed funds and the first period endowment in the domestic project. The entrepreneur chooses the level of borrowing, \(\overline{b}\), to invest \(\overline{k}\) and to pay the monitoring cost \(\overline{\alpha}\), such that \(\overline{b} = \overline{k} + \overline{\alpha} - w_1\). The amount borrowed is greater than the first-best amount, \(\overline{b} > b^*\).

**Proof.** See the Appendix.
Even though the agent invests capital up to the first-best level, $\bar{k} = k^*$, the agent does not achieve the first-best level of expected consumption. Equation (9) indicates expected consumption in the absence of the information asymmetry while expected consumption with the information asymmetry and no monitoring is given by (10). When monitoring is incorporated, expected consumption becomes

$$E(c)_d = \Pi(\bar{k})[\theta - \bar{Z}^g + w_2],$$

(14)

denoted $d$ for debt with monitoring and using $w_2 = Z^b$. Note that the payment from the agent to the investor in the good state, $Z^b$, may be different when monitoring is allowed, i.e., $\bar{Z}^g$ may differ from $\bar{Z}^g$.

**Proposition 2.** $E(c)_A < E(c)_d < E(c)_\infty$. Because $\bar{k} < \bar{k} = k^*$, expected consumption with monitoring is higher than without monitoring. Since the agent must pay the up-front monitoring fee, expected consumption is lower than when there is no information asymmetry.

*Proof.* See the Appendix.

3. **Equity Financing**

3.1 **Information and Ownership**

In the absence of restrictions on international equity trades, the domestic agent may choose to sell ownership claims to the output from his project, rather than borrow on international markets. These ownership claims take the form of either portfolio equity or FDI and potentially transfer managerial control to the international investor. Ownership permits influence over management decisions when, for example, large shareholders sit on the board of directors or take part in day-to-day activities of the firm. Other forms of controls exerted by
shareholders include takeover attempts, proxy fights, and direct monitoring of management decisions (Zhang, 1998). The link between ownership and information is incorporated into the model by assuming that the purchase of a portion, \( e \), of a project (equivalently a firm) allows the international investor to monitor the level of investment undertaken by the entrepreneur. The purchase of \( e \) means the investor either is privy to knowledge about the actions of the manager (the entrepreneur) or has a say in the manager’s decisions.

Precedent for incorporating information as a function of ownership can be found in Razin, Sadka, and Yuen (RSY) (1998). In a theoretical study of efficient tax policy on international capital flows, RSY model foreign direct investment (FDI) as not only a purchase of shares in a company but also as an exercise of control and management. They label FDI a tie-in activity that involves an inflow of both capital and managerial inputs. By contrast, they consider foreign portfolio equity investment (FPEI) and foreign portfolio debt investment (FPDI) as simple flows of capital that do not involve any managerial input. FPEI differs from FDI only in the amount of shares purchased; for example, FDI is defined by the BEA as buying an amount of shares greater than 10% of the equity of a firm. In RSY, both FPEI and FPDI allow only domestic lenders or investors access to information regarding the productivity of domestic firms. FDI, on the other hand, gives foreign investors the same information as domestic agents.

Further support of a link between ownership and control is implicit in papers by La Porta, Lopez-de-Silanes, and Shleifer (1998), Petersen and Rajan (1994), Myers (1998), and Fluck (1998). In a study examining the ownership structure of large corporations in 27 wealthy economies, La Porta, Lopez-de-Silanes, and Shleifer (1998) find that controlling shareholders typically exert more power than their cash-flow rights warrant. These large shareholders are active in corporate governance, exerting control through pyramids (i.e., a chain of companies)
and participation in management. La Porta, et. al. observe that owning 20% of a firm is typically sufficient to achieve effective control.

In a paper focusing primarily on small borrowers, Petersen and Rajan (1994) show that relationships between borrowers and lenders lead to a transfer of information that can help to overcome information asymmetries. They find that close interaction gives the lender information and a voice in the affairs of the firm. This idea applies even more so to equity. Petersen and Rajan argue that if lenders can make their claims to future profits explicit then they may provide greater funds to firms. They conclude that allowing banks to hold equity in firms provides an impetus for increased funding by furnishing banks with a long-term interest in the firms to which they lend. In the present context, this motivates an implicit channel for information and control through equity.

Fluck (1998) examines the use of both debt and equity in the presence of nonverifiable managerial actions. She finds that debt mitigates verification problems through control rights that are contingent on failure to make a fixed payment. Equity holders, on the other hand, avoid verification problems by receiving unconditional control rights that imply equity holders pose a constant threat of dismissal to managers. Fluck states that it is precisely the control rights and maturity design of outside equity that alleviate moral hazard problems of managers diverting cash flows as private benefits. In a similar analysis, Myers (1998) concludes that even when managerial actions and cash flows are nonverifiable, equity plays a role because equity investors can withdraw their assets at any time. Debt, on the other hand, only permits a lender to seize a

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11 This is in contrast to previous work incorporating information asymmetries into models of the financial structure of firms. Much of the early literature specifies models that include CSV or nonverifiability of cash flows but are incompatible with outside equity (e.g., Townsend, 1979; Diamond, 1984). Those
firm’s assets if a promised payment is not made. Both of these papers suggest that buying equity in a firm confers greater control rights than debt. Although these papers focus on the internal capital structure of the firm, rather than the international flow of capital, they provide support for the assumption made here that equity may allow greater control by an international investor.\textsuperscript{12}

The specific information asymmetry modeled in this paper is similar to that in RSY (1998) (also see Gordon and Bovenberg, 1996). Consistent with RSY (1998), different types of equity flows are implicitly considered. Debt, characterized as FPDI, does not reveal information. It is consequently always subject to costly monitoring. Equity, on the other hand, ranges from FPEI to FDI and thus embodies different levels of information. The analysis initially simplifies this so that any amount of equity purchased by the international investor allows costless monitoring of the entrepreneur’s activities. This assumption is then weakened to incorporate FPEI. The amount of shareholder information and control is increasing in the amount of equity owned and thus the monitoring cost is decreasing in ownership.

3.2 Equity and Costless Monitoring

As an initial simplification, I assume that buying any portion of a firm (\(e > 0\)) conveys all information regarding the agent’s actions to the international investor. For convenience, information flows via ownership are modeled as costless monitoring (\(\alpha = 0\)) where the investor can charge the entrepreneur a penalty, \(\Psi\), for all units improperly invested.

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\textsuperscript{12} Additionally, Lipsey (1999) quotes the OECD definition of direct investment to show some element of managerial control in direct investment: “an effective voice in the management, as evidenced by an ownership of at least 10 per cent, implies that the direct investor is able to influence, or participate in the
Normalizing the size of the project to one, the international investor buys $e$ shares in the project while the domestic agent retains $1-e$ shares. The expected value of the shares sold to the investor is then $e\Pi(k)\theta$. Define $V$ as the present value of the shares sold to the investor in the first period. Again, the international investor is able to earn a gross rate of return, $r$, on world markets, implying that this present value is

$$V \equiv \frac{e\Pi(k)\theta}{r}. \quad (15)$$

Consequently, $V$ is the amount of capital that the entrepreneur receives in the first period in return for selling $e$ ownership claims. Note that only the entrepreneur’s decisions are modeled since it is assumed that there is an elastic supply of international investors willing to buy $e$.

Once the domestic agent decides to sell shares in his project, rather than borrow funds, he then chooses whether to invest all of these funds in his domestic project or to save some portion at the world market interest rate, $r$. The agent’s expected consumption upon selling $e$ shares is

$$E(c) = (1-e)\Pi(k)\theta + w_2 + (r-\Psi)[w_1 + \frac{e\Pi(k)\theta}{r} - k], \quad (16)$$

where the first term is the agent’s expected return to his retained portion of the firm. The third term is the agent’s earnings (net of the penalty fee) on any funds saved abroad.

The entrepreneur maximizes expected consumption (16) subject to the budget constraint $(w_1 + \frac{e\Pi(k)\theta}{r} \geq k)$ by choosing the level of investment, $k$, and the portion of the project, $e$, to sell to foreign investors.
Proposition 3. For any positive penalty imposed on funds saved abroad, $\Psi > 0$, there exists $\hat{k} = k^*$ such that $\Pi'(\hat{k}) \theta = r$. All sales of ownership shares are used to finance investment in the domestic project. Therefore, in equilibrium, the agent does not save any funds on international markets.

Proof. See the Appendix.

The choice of $e$ depends on the size of the first-period endowment in relation to the first-best level of investment. Solving the budget constraint for $e$ and using the equilibrium condition gives $\hat{e} = (\hat{k} - w_1)\Pi'(\hat{k})/\Pi(\hat{k})$. The amount of ownership claims sold by the entrepreneur depends on the first-period endowment in the following way:

$$\frac{\partial \hat{e}}{\partial w_1} = -\frac{\Pi'(\hat{k})}{\Pi(\hat{k})} < 0.$$  \hspace{1cm} (17)

Since $\Pi(k)$ and $\Pi'(k)$ are both positive, an increase in $w_1$ leads to a reduction in $\hat{e}$. A wealthier entrepreneur needs less external funding to finance the first-best level of investment and thus sells fewer claims to his second-period output.$^{13}$

Consider the impact of the sale of equity on international capital flows and domestic welfare. The level of investment undertaken by the domestic agent attains the first-best level using debt (with monitoring) or equity financing in the presence of asymmetric information: $\bar{k} = \hat{k} = k^*$. This level is higher than that of the borrowing outcome with no monitoring, $\tilde{k}$.

$^{13}$ This is similar to a more general finding that increases in net worth stimulate investment when information asymmetries exist. Gertler and Rogoff (1990) and Bernanke and Gertler (1989) show this for
When the agent has the opportunity to borrow on international markets and pay a monitoring fee, then a positive penalty imposed by the investor ensures that the agent borrows just enough to invest in the domestic project. Likewise, when the agent sells ownership claims, a positive penalty again ensures that the agent sells just enough ownership shares to finance investment in the project. In both cases, the international investor earns an expected rate of return equal to the market rate on all provided funds and the domestic agent does not save any funds abroad.

The two financing methods differ, however, in the level of expected consumption attained by the entrepreneur. With borrowing, the entrepreneur chooses \( k \) such that \( \Pi'(k)\theta = r \), where \( \bar{b} = k + \alpha - w_i \). Substituting this constraint back into the expression for expected consumption and using the additional constraint (4), expected consumption (denoted with a subscript \( d \) for debt with costly monitoring and rewriting (14) for ease of comparison) is then

\[
E(c)_d = \Pi(\bar{k})\theta - r[\bar{k} + \alpha - w_i] + w_2. \tag{18}
\]

With equity financing, by contrast, the entrepreneur chooses \( \hat{k} \) such that \( \Pi'(\hat{k})\theta = r \). The entrepreneur then chooses how many ownership shares, \( \hat{e} \), to sell so that \( w_i + \frac{\hat{e}\Pi(\hat{k})\theta}{r} = \hat{k} \).

Expected consumption (denoted \( e \) for equity with costless monitoring) is then

\[
E(c)_e = \Pi(\hat{k})\theta - r[\hat{k} - w_i] + w_2. \tag{19}
\]

increases in borrower net worth. Bernanke and Gertler (1989), in particular, show that borrower net worth and agency costs of investment are inversely related.
Given that $\bar{k} = \hat{k}$, it is clear that $E(c)_k > E(c)_d$. The agent’s expected consumption is higher (by the amount $r\overline{\alpha}$) when the agent is allowed to sell equity in his project than when he is constrained exclusively to borrowing funds.

### 3.3 Equity and Endogenous Monitoring Cost

To this point, any positive amount of ownership in the project ($e > 0$) conveys complete information at zero cost. More realistically, the severity of the information asymmetry may diminish with increased ownership in the project. Thus, the cost of monitoring may decline with the amount of a firm that is owned. Similar to the specification of borrowing with costly monitoring, assume that equity conveys information but only at a cost of $\alpha$. Specifically, the cost of monitoring is a decreasing function of the equity owned by the international investor, implying $\alpha(e) > 0$ where $\alpha'(e) < 0$.

Let the maximum monitoring cost be $\overline{\alpha}$, the cost of monitoring when funds are borrowed. Borrowing does not involve any ownership so that $\overline{\alpha}$ is a constant. The cost of monitoring with equity ranges between zero and the cost of monitoring with borrowing:

$$0 \leq \alpha(e) \leq \overline{\alpha} \quad \text{with} \quad \lim_{e \to 0} \alpha(e) = \overline{\alpha} \quad \text{and} \quad \lim_{e \to 1} \alpha(e) = 0.$$  

As shown previously, when monitoring is costless, international equity financing is preferred to international borrowing. For a constant cost of monitoring that is identical under either equity or debt ($\alpha(e) = \overline{\alpha}$), the domestic agent is indifferent to the method of financing project investment. Thus, the focus here is on the effect on investment of a monitoring cost that is positive and less
than $\bar{\alpha}$ and that depends on the level of ownership of the firm. Incorporating the endogenous cost of monitoring changes the agent’s budget constraint as follows:

$$w_1 + \frac{e\Pi(k)\theta}{r} - \alpha(e) \geq k.$$  \hspace{1cm} (21)

Expected consumption with the endogenous cost of monitoring is

$$E(c) = (1 - e)\Pi(k)\theta + w_2 + (r - \Psi)[w_1 + \frac{e\Pi(k)\theta}{r} - \alpha(e) - k].$$  \hspace{1cm} (22)

The penalty, $\Psi$, applies to all funds saved abroad by the domestic agent. The entrepreneur chooses how much of his project to sell, $e$, and how much to invest, $k$, to maximize expected consumption (22) subject to the budget constraint (21). The maximization problem is identical to the previous equity problem, except the cost of monitoring is a function of ownership.

**Proposition 4.** Equilibrium is characterized by the values of $e$ and $k$ that simultaneously solve the budget constraint (21) and the following condition:

$$\Pi'(k)\theta - r + \chi = 0$$  \hspace{1cm} (23)

where

$$\chi = \frac{r\alpha'(e)}{\Pi(k)\theta} \left[ \frac{e\Pi'(k)\theta}{r} - 1 \right].$$

**Proof.** See the Appendix.

There are three possible characterizations of equilibrium, depending on the value of $\chi$. If $\chi$ is zero, then $k=k^*$. By contrast, when $\chi$ is positive (negative), overinvestment, $k>k^*$,

---

14 The cost of monitoring may diminish because the influence on management may increase with ownership. This is consistent with the idea that large shareholders exert more control over management.
(underinvestment, $k < k^*$) in the domestic project occurs. $\chi$ is zero when either $\alpha'(e)$ is zero or the domestic agent sells the entire firm to the international investor, $e=1$. Consider first that $\chi$ is zero due to $\alpha'(e)=0$. With the chosen specific functional forms (see below), this occurs when monitoring is costless, $\alpha(e)=0$. The domestic agent achieves the first-best level of expected consumption because there is no cost to monitoring.

Consider instead that $\chi$ is zero because the agents sells the entire firm, i.e., $e=1$. In this case, the budget constraint is nonbinding and the domestic agent saves any funds above $k^*$ at the international rate, $r$. The international investor has no need to impose a positive penalty as she now owns the entire firm. Thus, $\Psi=0$. This efficient level of investment allows the domestic agent to obtain the efficient level of expected consumption ($E(c) = w_2 + r[w_1 + \frac{\Pi(k)\theta}{r} - k]$).

However, implicit in this characterization of equilibrium is the assumption that information is complete with ownership of the entire firm. While the severity of the information asymmetry is assumed to diminish with increased ownership of the firm, it is unrealistic to assume that foreign investors are able to obtain complete information about the domestic agent’s activities. When the domestic agents sells his entire firm to the international investor, he no longer has any incentive to act in his own best interest. The domestic agent essentially becomes a manager for the international owner. Consequently, the mitigation of moral hazard through the complete sale of equity converts the information asymmetry to a principal-agent problem. Previous studies argue that equity does not appropriately solve principal-agent problems.\(^{15}\) Therefore, in order to

focus on moral hazard problems, I rule out the complete sale of the domestic firm by assuming a binding budget constraint and a positive penalty applied by the international investor.

I focus instead on the equilibrium in which the domestic agent does not sell the entire firm. This equilibrium is characterized by the solution that satisfies the binding budget constraint, (21), and condition (23) with $\chi \neq 0$. The maximization problem has no closed-form solution for $e$ and $k$. Therefore, specific functional forms are chosen to characterize possible solutions when ownership provides information at a cost.

Suppose the probability of successful second-period production is represented by

$$
\Pi(k) = 1 - \exp(-ak),
$$

(24)

where $a$ is given. This function satisfies the necessary properties. The value of $\Pi(k)$ ranges between zero and one for $k$ between zero and infinity. Also, the probability of a positive outcome is increasing in $k$, $\Pi'(k)>0$, but at a decreasing rate, $\Pi''(k)<0$. The expected value of $k$ is

$$
\frac{1}{a}, \text{ with variance } \frac{1}{a^2}.
$$

Let the cost of monitoring be given by

$$
\alpha(e) = \exp(g) - \exp(ge)
$$

(25)

with $g$ given and $0 < e \leq 1$. For $e$ equal to one, $\alpha(e) = 0$. For $e$ equal to zero, $\alpha(e) = \bar{\alpha}$ where $\bar{\alpha}$ is calculated as $\exp(g)-1$. Note that $\alpha'(e)<0$ and $\alpha''(e)<0$, implying that the cost of monitoring decreases slowly at low levels of ownership and more quickly at higher levels of ownership. This is consistent with the idea that FDI mitigates asymmetric information problems better than does FPEI. Two other monitoring-cost functions are considered in the appendix; one is a monitoring cost that decreases at a constant rate and the other is a monitoring cost that decreases quickly at low levels of ownership and more slowly at higher levels of ownership (see table A.1).
Example One. Let \( w_1 = 1, \quad r = 1.04, \quad a = 1, \quad \theta = 10, \quad g = 1 \). The value of \( r \) (stated as the gross rate 1.04) is chosen to be roughly consistent with an average of the three-month money-market deposit rates in the U.S. (approximately 5 percent in 1999) and the Euro area (approximately 3 percent in 1999). The value of the first-period endowment, \( w_1 \), is normalized to one. There is no need to choose a value for the second-period endowment, \( w_2 \), since it is simply an additive term on expected consumption. The variable \( \theta \) is a shift parameter for second-period consumption and is arbitrarily chosen to equal 10. As a benchmark, the parameter for the probability function, \( a \), and the parameter for the monitoring-cost function, \( g \), are both chosen to be one. Other values for \( a \) and \( g \) are considered below.

With a binding budget constraint, \( \hat{k} \) equals 2.366 and \( \hat{e} \) equals 0.312. Substituting in the binding budget constraint and the values for \( \hat{e} \) and \( \hat{k} \), expected consumption is equal to 6.235+\( w_2 \). By contrast, using the same parameter values and functional forms, but with \( \alpha(e) \) set to zero, the first-best solution emerges with \( k^* \) equal to 2.263. The budget constraint is binding in this case, implying \( e^* \) equals 0.147 and first-best expected consumption equals 7.646+\( w_2 \).\(^{16}\)

Note that expected consumption is lower when monitoring is costly, while equilibrium investment is higher. When monitoring depends on the amount of shares sold in the project, the agent invests more than the efficient amount in the first period, \( \hat{k} > k^* \). The domestic agent sells a greater portion of the firm in order to finance this higher level of investment. One implication is that when information problems are more severe or more costly to mitigate, we should expect to see more direct investment than portfolio equity investment.

\(^{16}\) Alternatively, consider \( e=1 \), with \( k^* = 2.263 \). The budget constraint is nonbinding and the agent saves all funds above \( k^* \) at the rate \( r \). Then expected consumption is also 7.646+\( w_2 \).
Using the values in example one, compare the amount of investment with debt versus equity financing. For the equity outcome, the cost of monitoring is \( \alpha(e) = 1.352 \). Recall that the level of investment under debt with monitoring is \( \bar{k} = k^* = 2.263 \). Given \( g=1 \), the relevant cost of monitoring with borrowing is \( \bar{\alpha} = 1.718 \). Expected consumption is then \( 5.859 + w_2 \) (solving equation (18)). Therefore, although the domestic entrepreneur invests more than the efficient amount in his project when using equity financing, he is able to achieve a higher level of expected consumption than using debt under costly monitoring.

### Table 1  Equity versus debt with varying monitoring costs

<table>
<thead>
<tr>
<th>a  = 1</th>
<th>g = 0.5</th>
<th>g = 0.8</th>
<th>g = 1.0</th>
<th>g = 1.2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equity with costly monitoring</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \hat{k} )</td>
<td>2.313</td>
<td>2.344</td>
<td>2.366</td>
<td>2.390</td>
</tr>
<tr>
<td>( \hat{e} )</td>
<td>0.213</td>
<td>0.268</td>
<td>0.312</td>
<td>0.362</td>
</tr>
<tr>
<td>( \alpha(e) )</td>
<td>0.536</td>
<td>0.986</td>
<td>1.352</td>
<td>1.775</td>
</tr>
<tr>
<td>( V )</td>
<td>1.849</td>
<td>2.330</td>
<td>2.718</td>
<td>3.166</td>
</tr>
<tr>
<td>Expected consumption</td>
<td>7.087+w_2</td>
<td>6.617+w_2</td>
<td>6.235+w_2</td>
<td>5.792+w_2</td>
</tr>
<tr>
<td><strong>Debt with costly monitoring</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \bar{k} )</td>
<td>2.263</td>
<td>2.263</td>
<td>2.263</td>
<td>2.263</td>
</tr>
<tr>
<td>( \bar{\alpha} )</td>
<td>0.649</td>
<td>1.226</td>
<td>1.718</td>
<td>2.320</td>
</tr>
<tr>
<td>( \bar{b} )</td>
<td>1.912</td>
<td>2.489</td>
<td>2.982</td>
<td>3.583</td>
</tr>
<tr>
<td>Expected consumption</td>
<td>6.971+w_2</td>
<td>6.372+w_2</td>
<td>5.859+w_2</td>
<td>5.233+w_2</td>
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<tr>
<td><strong>Equity with costless monitoring</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \hat{k} )</td>
<td>2.263</td>
<td>2.263</td>
<td>2.263</td>
<td>2.263</td>
</tr>
<tr>
<td>( \hat{e} )</td>
<td>0.147</td>
<td>0.147</td>
<td>0.147</td>
<td>0.147</td>
</tr>
<tr>
<td>Expected consumption</td>
<td>7.646+w_2</td>
<td>7.646+w_2</td>
<td>7.646+w_2</td>
<td>7.646+w_2</td>
</tr>
</tbody>
</table>

Table 1 presents the impact of varying the parameter \( g \) in the monitoring-cost function. An increase (decrease) in \( g \) implies an increase (decrease) in the cost of monitoring. In each case, equity is preferred to debt. Although the agent invests more than the efficient level, equity
allows the agent to pay a lower monitoring cost since he sells part of the firm to the international investor. Thus, the agent always receives higher expected consumption with equity financing than with debt financing. As the monitoring cost rises (due to an increase in $g$), equity becomes even more preferred; the gap between expected consumption with equity and expected consumption with debt widens. The difference between $\alpha(e)$ and $\overline{\alpha}$ also widens as $g$ increases.

4. Implications and Conclusions

In light of the recent financial crises in Asia and Russia, the IMF has called for increased monitoring of international capital flows. Incorporating increased monitoring into a two-period model of a small open economy, this paper shows that domestic welfare may be increased by monitoring of domestic investment. The alleviation of asymmetric information through monitoring allows a domestic firm to obtain more funds from international markets than when monitoring is not possible. Domestic investment, second-period output, and expected consumption are increased by monitoring of domestic investment activities, even if that monitoring is costly.

Further, when equity transfers information, selling equity in domestic firms increases domestic investment and welfare, and equity trade replaces international borrowing. One implication of this finding is that the imposition of restrictions on international capital movements may inhibit domestic capital formation. Different levels of equity (i.e., portfolio equity versus FDI) may convey different amounts of information to international investors. While there have been recent calls for capital controls that change the composition of capital

\[17\] Table A.2 in the appendix presents the impact of varying the parameter $a$ in the probability function.
flows, this paper shows that it would be detrimental to impose restrictions on capital inflows. In
particular, the numerical results indicate that FDI conveys sufficient information to international
investors, which facilitates increased international funding of domestic projects. While the
numerical results also seem to suggest that restrictions on portfolio equity may be beneficial, this
result depends crucially on the amount of information contained in different levels of equity
flows. The model developed in this paper sets no minimum amount of equity claims that must
be purchased in order to obtain information. Therefore, it would be difficult to endorse any sort
of capital controls that restrict portfolio equity financing.

This paper shows that in the absence of restrictions on equity financing, equity provides a
superior alternative to international debt financing. Thus, the choice of financing options is
important. Based on differences in information, domestic agents choose the financing method
that provides the greatest flow of international capital at the lowest cost. Additionally, agents
choose to incur additional costs in order to receive increased funding. The mitigation of
information asymmetries through costly monitoring indicates that the development of monitoring
procedures may be useful for local financing. Governments or international organizations could
assist in mitigating information asymmetries in securities markets by implementing standard
accounting procedures, strengthening and enforcing legal standards, protecting minority
shareholders against majority shareholders, and protecting all shareholders against fraud
(Stiglitz, 1998a). Therefore, adequate financial regulation that leads to less costly information
flows between international investors and domestic agents may play an important role in the
unrestricted flow of international capital across countries.
Appendix

Proof of Proposition 1. The maximization problem is:

$$\begin{align*}
\text{Max}_{(k,b,Z^s,Z^b)} & \quad \Pi(k)(\theta - Z^s) - [1 - \Pi(k)]Z^b + (r - \Psi)[w_1 + b - \alpha - k] + w_2 \\
\text{subject to} & \quad \Pi(k)Z^s + [1 - \Pi(k)]Z^b = rb \\
& \quad \Pi'(k)[\theta - (Z^s - Z^b)] = r - \Psi \\
& \quad w_2 \geq Z^b \\
& \quad w_1 + b - \alpha - k \geq 0.
\end{align*}$$

Substitute (4) into (12). Denoting the Lagrange multipliers as $\gamma$, $\nu$, and $\lambda$ on constraints (13), (A.1), and (A.2) respectively gives the following first-order conditions:

$$\begin{align*}
\frac{\partial (\bullet)}{\partial k} &= \Pi'(k)\theta - r + \Psi + \gamma \Pi''(k)[\theta - (Z^s - Z^b)] - \lambda = 0 \quad (A.3) \\
\frac{\partial (\bullet)}{\partial b} &= -\Psi + \lambda = 0 \quad (A.4) \\
\frac{\partial (\bullet)}{\partial Z^s} &= -\gamma \Pi'(k) = 0 \quad (A.5) \\
\frac{\partial (\bullet)}{\partial Z^b} &= \gamma \Pi'(k) - \nu = 0. \quad (A.6)
\end{align*}$$

From (A.5) and (A.6), $\gamma=0$ and $\nu=0$. Combining (A.3) through (A.6) then indicates that $\Pi'(k)\theta = r$, which implies $\tilde{k} = k^*$. Additionally, for any positive penalty, $\Psi$, $\lambda$ must be positive (by A.4). Thus, the budget constraint binds, implying the amount borrowed by the agent is $\tilde{b} = \tilde{k} + \tilde{\alpha} - w_1$.

Proof of Proposition 2. $E(c)_A < E(c)_d < E(c)_{NA}$. Since $\tilde{k} < \tilde{k} = k^*$, $\Pi(\tilde{k}) > \Pi(\tilde{k})$. Substituting in the appropriate binding budget constraint, (3) or (A.2), and the constraint on the security return (4), expected consumption in each case can be written as $E(c)_A = \Pi(\tilde{k})\theta - r\tilde{b} + w_2$ and $E(c)_d = \Pi(\tilde{k})\theta - r\tilde{b} + w_2$ where $\tilde{b} = \tilde{k} - w_1$ and $\tilde{b} = \tilde{k} + \tilde{\alpha} - w_1$. As long as $\alpha$ is small enough, the domestic agent is willing to pay this cost in order to receive higher expected consumption. The relationship between $E(c)_A$ and $E(c)_d$ is therefore constrained by the amount of the monitoring cost. If $\alpha$ is too large, then the monitoring cost begins to outweigh the additional expected output from increased domestic investment.
Proof of Proposition 3. The maximization problem is:

$$\max_{\{k,e\}} \quad (1-e)\Pi(k)\theta + w_2 + (r - \Psi)[w_1 + V - k]$$

subject to

$$w_1 + \frac{e\Pi(k)\theta}{r} \geq k \quad \text{(A.7)}$$

where $V \equiv \frac{e\Pi(k)\theta}{r} \quad \text{(15)}$

Substituting in $V$, and denoting the LaGrange multiplier on the constraint as $\lambda$, the first order conditions for this maximization problem are:

$$\frac{\partial(\bullet)}{\partial k} = \Pi'(k)\theta - r - \Psi\left[\frac{e\Pi'(k)\theta}{r} - 1\right] + \lambda\left[\frac{e\Pi'(k)\theta}{r} - 1\right] = 0 \quad \text{(A.8)}$$

$$\frac{\partial(\bullet)}{\partial e} = -\Pi(k)\theta + \Pi(k)\theta - \Psi\frac{\Pi(k)\theta}{r} + \lambda\frac{\Pi(k)\theta}{r} = 0 \quad \text{(A.9)}$$

$$\frac{\partial(\bullet)}{\partial \lambda} = w_1 + \frac{e\Pi(k)\theta}{r} - k \geq 0 \quad \text{(A.10)}$$

(A.9) becomes $\Psi=\lambda$ so that (A.8) becomes $\Pi'(k)\theta=r$. By assumption, the investor charges a positive penalty on all funds saved abroad so that $\Psi>0$ and thus $\lambda>0$. A positive $\lambda$ implies that the constraint binds. Thus,

$$w_1 + \frac{e\Pi(k)\theta}{r} = k \quad \text{(A.11)}$$

The amount of investment, $\hat{k}$, is determined by the condition $\Pi'\hat{k}\theta = r$ where $\theta$ and $r$ are exogenous parameters for this small open economy. The binding budget constraint then determines the amount of shares that the agent sells to the international investor. As the investor charges a positive penalty for any inappropriate investment by the agent, the agent does not want to save any funds abroad. Intuitively, this is due to the impact on the agent’s ownership of his own project. To obtain additional funds in the first period, the agent must sell more of his claims to second-period output. The agent is not inclined to sell more claims than is necessary to finance the first-best level of investment when there is a penalty imposed for doing so.
Proof of Proposition 4. The maximization problem is:

$$\max_{(k,e)} (1 - e) \Pi(k) \theta + w_2 + (r - \Psi)[w_1 + \frac{e \Pi(k) \theta}{r} - \alpha(e) - k]$$

subject to

$$w_1 + \frac{e \Pi(k) \theta}{r} - \alpha(e) - k \geq 0.$$  \hspace{1cm} (21)

Letting $\lambda$ be the Lagrange multiplier on the budget constraint (21), the first-order conditions are:

$$\frac{\partial(\bullet)}{\partial k} = (1 - e) \Pi'(k) \theta + (r - \Psi) \left[\frac{e \Pi'(k) \theta}{r} - 1\right] + \lambda \left[\frac{e \Pi'(k) \theta}{r} - 1\right] = 0 \hspace{1cm} (A.12)$$

$$\frac{\partial(\bullet)}{\partial e} = -\Pi(k) \theta + (r - \Psi) \left[\frac{\Pi(k) \theta}{r} - \alpha'(e)\right] + \lambda \left[\frac{\Pi(k) \theta}{r} - \alpha'(e)\right] = 0 \hspace{1cm} (A.13)$$

$$\frac{\partial(\bullet)}{\partial \lambda} = w_1 + \frac{e \Pi(k) \theta}{r} - \alpha(e) - k \geq 0.$$ \hspace{1cm} (A.14)

Combining (A.12) and (A.13) to eliminate $\Psi$ and $\lambda$ gives the following condition:

$$\Pi'(k) \theta - r + \chi = 0$$ \hspace{1cm} (23)

where $$\chi = \frac{r \alpha'(e)}{\Pi(k) \theta \left[\frac{e \Pi'(k) \theta}{r} - 1\right]}.$$  

Assume that the constraint binds so that (A.14) is an equality. Using specific parameter values, a search for a solution that simultaneously solves (23) and (A.14) is conducted. Any solutions for which either $k$ or $e$ is negative are ignored.
Example Two. Let \( w_i = 1, \ r = 1.04, \ a = 1, \ \theta = 10, \ g = 1. \) Consider two different monitoring-cost functions:

I. \( \alpha(e) = 1 - e \)

II. \( \alpha(e) = \exp(-ge) - \exp(-g) \)

for \( 0 < e \leq 1. \) Function I has \( \alpha'(e) < 0 \) and \( \alpha''(e) = 0, \) implying that the cost of monitoring is decreasing at a constant rate. Function II has \( \alpha'(e) < 0 \) and \( \alpha''(e) > 0, \) implying that the cost of monitoring decreases quickly at lower ownership levels and more slowly at higher ownership levels. Table A.1 compares the solutions using these two monitoring-cost functions to the solution using the monitoring-cost function presented in the paper.

Table A.1 Equity versus debt with different monitoring-cost functions

<table>
<thead>
<tr>
<th>( a = 1, g = 1 )</th>
<th>Benchmark: ( \alpha(e) = \exp(g) - \exp(g e) )</th>
<th>I. ( \alpha(e) = 1 - e )</th>
<th>II. ( \alpha(e) = \exp(-ge) - \exp(-g) )</th>
</tr>
</thead>
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<tr>
<td><strong>Equity with costly monitoring</strong></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>( \hat{k} )</td>
<td>2.366</td>
<td>2.347</td>
<td>2.335</td>
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<tr>
<td>( \hat{e} )</td>
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<td>( \alpha(e) )</td>
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<tr>
<td>( V )</td>
<td>2.718</td>
<td>2.105</td>
<td>1.782</td>
</tr>
<tr>
<td>Expected consumption</td>
<td>6.235+w_2</td>
<td>6.854+w_2</td>
<td>7.179+w_2</td>
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<tr>
<td><strong>Debt with costly monitoring</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \bar{k} )</td>
<td>2.263</td>
<td>2.263</td>
<td>2.263</td>
</tr>
<tr>
<td>( \bar{e} )</td>
<td>1.718</td>
<td>1.000</td>
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<tr>
<td>( \bar{b} )</td>
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<td>2.263</td>
<td>1.896</td>
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<td>6.606+w_2</td>
<td>6.989+w_2</td>
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<tr>
<td>( k^* )</td>
<td>2.263</td>
<td>2.263</td>
<td>2.263</td>
</tr>
<tr>
<td>( e^* )</td>
<td>0.147</td>
<td>0.147</td>
<td>0.147</td>
</tr>
<tr>
<td>Expected consumption</td>
<td>7.646+w_2</td>
<td>7.646+w_2</td>
<td>7.646+w_2</td>
</tr>
</tbody>
</table>

Notice that \( \hat{e} \) is smaller when information asymmetries are mitigated more quickly. Both functions I and II imply that the cost of monitoring decreases more quickly at low levels of \( e \) than it does with the benchmark monitoring-cost function. Thus, both \( \hat{e} \) and \( \alpha(e) \) are lower with functions I and II than with the benchmark. In turn, expected consumption is higher. The difference between expected consumption under debt versus equity financing is greater with the benchmark than with either I or II.
As a robustness check, table A.2 considers changing the parameter $a$ in the probability function for second-period output. An increase in $a$ implies a steeper probability function. Therefore, as $a$ increases, the level of $\hat{k}$ and $\hat{e}$ both fall. Expected consumption is higher when the probability of a good second-period outcome rises more quickly.

**Table A.2 Equity versus debt with varying probability function**

<table>
<thead>
<tr>
<th>g = 1</th>
<th>a = 0.3</th>
<th>a = 0.8</th>
<th>a = 1.0</th>
<th>a = 2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Equity with costly monitoring</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\hat{k}$</td>
<td>3.890</td>
<td>2.679</td>
<td>2.366</td>
<td>1.529</td>
</tr>
<tr>
<td>$\hat{e}$</td>
<td>0.578</td>
<td>0.351</td>
<td>0.312</td>
<td>0.219</td>
</tr>
<tr>
<td>$\alpha(e)$</td>
<td>0.936</td>
<td>1.298</td>
<td>1.352</td>
<td>1.474</td>
</tr>
<tr>
<td>$V$</td>
<td>3.826</td>
<td>2.977</td>
<td>2.718</td>
<td>2.003</td>
</tr>
<tr>
<td>Expected consumption</td>
<td>2.908+w_2</td>
<td>5.731+w_2</td>
<td>6.235+w_2</td>
<td>7.447+w_2</td>
</tr>
<tr>
<td><strong>Debt with costly monitoring</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\bar{k}$</td>
<td>3.531</td>
<td>2.550</td>
<td>2.263</td>
<td>1.478</td>
</tr>
<tr>
<td>$\bar{\alpha}$</td>
<td>1.718</td>
<td>1.718</td>
<td>1.718</td>
<td>1.718</td>
</tr>
<tr>
<td>$\bar{b}$</td>
<td>4.250</td>
<td>3.269</td>
<td>2.982</td>
<td>2.197</td>
</tr>
<tr>
<td>Expected consumption</td>
<td>2.114+w_2</td>
<td>5.301+w_2</td>
<td>5.859+w_2</td>
<td>7.196+w_2</td>
</tr>
<tr>
<td><strong>Costless monitoring</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$k^*$</td>
<td>3.531</td>
<td>2.550</td>
<td>2.263</td>
<td>1.478</td>
</tr>
<tr>
<td>$e^*$</td>
<td>0.403</td>
<td>0.185</td>
<td>0.147</td>
<td>0.053</td>
</tr>
<tr>
<td>Expected consumption</td>
<td>3.901+w_2</td>
<td>7.088+w_2</td>
<td>7.646+w_2</td>
<td>8.983+w_2</td>
</tr>
</tbody>
</table>
References


