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COSTLY MONITORING IN FINANCIAL MARKETS AND CAPITAL OUTFLOW RESTRICTIONS

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This paper examines welfare implications of removing capital outflow restrictions in a country whose financial markets are relatively inefficient in monitoring borrowers. A simple general equilibrium model is developed in which credit is rationed in one of the two production sectors due to costly information in financial markets. Opening to international capital markets is shown to cause an outflow of domestic wealth but no inflow of foreign credit, leading to more severe credit rationing. If the domestic investment opportunities that are unexploited due to credit rationing are sufficiently profitable, welfare of the country declines after it removes capital outflow restrictions. [O16]

1. INTRODUCTION

Advocates of free capital movements believe that removing capital flow restrictions will "promote better alignment of domestic interest rates with international rates, increase the availability of funds from abroad."[1] Many developing countries, however, are reluctant to open their financial markets. In particular, outward capital flows are strictly restricted by many LDCs in an attempt to direct more domestic funds to domestic investments. We show in this paper that capital outflow restrictions imposed by many LDCs may be justified on welfare grounds.

Our starting point is that financial markets are imperfect in both DCs and LDCs, but the imperfections are much more severe in LDCs. The analysis of this paper is based on a two-country two-good general equilibrium model. The two countries are assumed to have the same economic structure except that one of them (the LDC) has a less efficient financial system than the other (the DC). In the model, entrepreneurs must borrow from banks to undertake projects in one of the two production sectors, but banks do not observe the project outcome of a borrower unless they incur a monitoring cost. It is a familiar result in the literature that the optimal contract in the presence of costly state verification is a debt contract and monitoring occurs only in the state of default.[2] It has been further shown by Williamson (1987) that equilibrium

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[1]World Bank (1990: 113).

[2]See Townsend (1979), Gale and Hellwig (1985), and Williamson (1987). Debt contracts being optimal depends on the assumption that state verification proceeds nonstochastically. If

credit rationing in the sense of Stiglitz and Weiss (1981) can emerge in this setting. Our specification of financial markets follows Williamson (1987). We use the monitoring cost (per bankruptcy case) as an indicator of the efficiency of a country' financial markets.[3]

The paper shows that when international capital flows are prohibited, credit is more severely rationed in the LDC, and consequently welfare of the LDC is lower than that of the DC.[4] This raises the question of whether the LDC should open to international capital markets for foreign funds. Our model shows, however, that if capital can move freely across borders, the LDC capital owners will make deposits in the DC banks (which offer higher deposit interest rate),[5] but the DC banks will not be interested in making loans to LDC entrepreneurs (which are associated with higher monitoring cost) provided that credit is rationed in the DC. Thus, opening to international capital markets would not help the LDC raise funds for domestic entrepreneurs; on the contrary, it would deteriorate the credit rationing situation in the LDC.

The paper shows further that the removal of capital outflow restrictions can make the LDC worse off in terms of welfare. In the general equilibrium framework, opening to international capital markets has two opposite effects on the LDC's welfare. On the one hand, it reduces welfare by intensifying credit rationing in the production sector relying on external finance (the X sector) and leaving profitable investment opportunities unexploited. On the other hand, it improves welfare by shifting capital out of the production sector (the Y sector) where the marginal return to capital is below the world interest rate. The welfare loss dominates the welfare gain, however, when the domestic investment opportunities that are unexploited due to credit rationing are sufficiently profitable.

Our results suggest that developing countries should be very cautious in making the decision of removing capital outflow restrictions when their domestic financial markets are much more inefficient than that of developed countries. The issue of international capital controls has been studied extensively by a large number of articles.[6] Relatively little research has been done, however, to address this issue using

stochastic monitoring is feasible, then debt contracts are not optimal. Boyd and Smith (1994) show, however, that debt contracts are "almost optimal" when stochastic monitoring can be implemented.

[3]The magnitude of the monitoring cost indicates the efficiency of a country's financial system in proceeding bankruptcy and recovering defaulted loans. This interpretation originates in Boyd and Smith (1992), whose model is developed from Williamson (1986, 1987).

[4]This requires the assumption that the improvement of monitoring efficiency is associated with lower total monitoring cost. See section 4.

[5]The direction of international capital flow would remain the same if we allow the possibility of the LDC banks raising the deposit interest rate to the level of the DC banks. It will be shown in section 5 that the LDC banks can do so if and only if they make loans exclusively to DC entrepreneurs.

[6]See the recent survey by Dooley (1995).

models in which domestic capital markets are formally specified. There is now a large literature on asymmetric information and financial market imperfections in which many such models are developed.[7] This paper shows that the incorporation of rigorous models of financial markets in open-economy general equilibrium framework can sharpen our understanding of some important issues.

The remainder of the paper is organized as follows. Section 2 presents a two-good general equilibrium model which incorporates the financial market specification of Williamson (1987). Section 3 considers a world with two countries that differ only in the efficiency of their financial markets in monitoring borrowers, and shows that capital will flow from the country with the lower efficiency to the country with the higher efficiency. Section 4 investigates the case in which international capital flows are prohibited. Section 5 derives the welfare implications of removing capital flow restrictions in the country with less efficient financial markets. Section 6 examines the welfare results in several extensions of the model. Section 7 concludes.

2. THE MODEL

This section develops a two-good general equilibrium model. Consider a country that produces goods X and Y. The production function for good Y is given by

$$Y = Y(K_y, T) \tag{1}$$

where K_y is the amount of capital employed in the Y sector, T is a specific factor (land, for example) to the Y sector whose supply is inelastic. Assume that $Y(\cdot)$ has all the properties of a neoclassical production function.

The production of good X, however, requires indivisible investments. Assume that the size of investment project in the X sector is one unit of capital. Furthermore, assume that there exists idiosyncratic risk in the undertaking of any project. Specifically, an investment project yields an outcome of $\tilde{x}$ units of good X, and the $\tilde{x}$'s are independent and identically distributed across project undertakers according to the distribution function $F(\cdot)$ and the density function $f(\cdot)$. The function $f(\cdot)$ is continuously differentiable on the interval $[0, x_{\max}]$.

The economy is populated by a continuum of risk-neutral individuals of unit mass. A fraction α of the population are "potential entrepreneurs," who know how to produce X. The remaining individuals are "nonentrepreneurs," who do not have the ability to produce X. For simplicity, assume all capital and land are owned by nonentrepreneurs. By choosing units so that the average amount of capital owned by a nonentrepreneur is one, we have total supply of capital equal to

[7] See the survey by Gertler (1988).

$$K = 1 - \alpha. \tag{2}$$

Potential entrepreneurs need to borrow from nonentrepreneurs in order to produce X. Following Williamson (1987), we assume that any nonentrepreneur can form a "bank," which takes deposits, makes loans, and monitors borrowers.[8] A potential entrepreneur may obtain external funds by signing a contract with a bank. Information is asymmetric, however, between borrowers and banks. Specifically, the realization of project outcome (denoted by x) is costlessly observable only to the project undertaker. Banks know the distribution of x, but can observe the x of a particular project only by incurring a cost of γ units of good X. Thus, there is costly state verification in financial intermediation.

The informational asymmetry about project outcome leads to a potential moral hazard problem: a borrower who obtains high x has an incentive to claim that her x is low. If banks monitored all projects, the moral hazard problem would be solved but it would be too costly. An optimal solution should be one that eliminates the moral hazard incentive with minimum total monitoring cost. As Williamson (1987) and others show, the optimal contract in the presence of costly state verification is a debt contract and monitoring occurs only in the state of default. According to this contract, a borrower repays her debt at a fixed interest rate (denote R as one plus the interest rate) if her project return x exceeds R, and repays x if her x is below R. When a borrower reports that her project return is below R, the bank spends γ to verify the reported outcome and confiscates the entire project return. Under the contract, a borrower declares bankruptcy (i.e., $x < R$) only when her project return x is in fact below R.

Loan interest rate R is chosen by the bank to maximize its expected return per unit of loan. A loan is repaid with probability $(1 - F(R))$ and is defaulted on with probability $F(R)$. Monitoring occurs when a borrower defaults. Thus, the expected return per unit of loan for the bank is

$$E\pi = R(1 - F(R)) + \int_0^R x dF(x) - \gamma F(R). \tag{3}$$

Notice that $E\pi$ would be monotonically increasing in R if there were no costly state verification problem ($\gamma = 0$). When state verification requires a cost of $\gamma > 0$, the expected profits of the bank is no longer a monotonically increasing function of R. As R rises, *total* monitoring cost rises because the amount of defaulting loans increases

[8]Williamson (1986) shows that financial intermediation through banks dominates direct lending in this setting.

with R, which drives down $E\pi$. By assuming that the second-order condition of maximizing $E\pi$ holds, i.e.,

$$f(R) + \gamma f'(R) > 0 \tag{4}$$

the expected profits of the bank becomes concave in R, and there exists a unique loan interest rate at which $E\pi$ is maximized (see figure 1). This loan interest rate can be solved from the first-order condition of maximizing $E\pi$ with respect to R,

$$1 - (R) - \gamma f(R) = 0. \tag{5}$$

Competition among banks ensures that the expected profits per unit of loan equals the deposit interest rate plus one (denoted by r),

$$r = E\pi. \tag{6}$$

The determination of R and r is illustrated in figure 1.

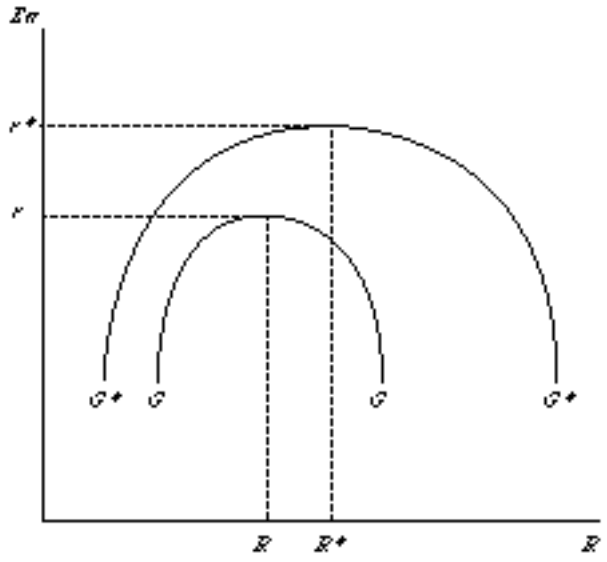

Figure 1

The supply of credit comes from the deposits of nonentrepreneurs. A nonentrepreneur can either deposit her capital endowment in a bank, or invest directly in the *Y* sector. In equilibrium, the marginal return to capital invested in the *Y* sector must equal *r*,

$$pY'(K_y, T) = r, \tag{7}$$

where *p* is the price of *Y* relative to that of *X*. Equation (7) implies

$$K_y = K_y(r), \qquad K_y' < 0. \tag{8}$$

Thus, the supply of credit is given by

$$K_x = K - K_y(r) = K_x(r), \qquad K_x' > 0. \tag{9}$$

On the other hand, the demand for credit comes from potential entrepreneurs. Given the contract, the expected income for a potential entrepreneur equals

$$EI = \int_R^{x_{max}} x\,dF(x) - (R - (R)). \tag{10}$$

Note that $dEI/dR = -(1 - F(R)) < 0$. That is, the higher the contracted loan interest rate, the lower the expected income for an entrepreneur. Throughout the paper, we assume that $EI > 0$. Recall that *R* is determined by $1 - F(R) - \gamma f(R) = 0$ (equation (5)). Thus, a sufficiently high x_{max} guarantees that $EI > 0$. Since potential entrepreneurs are identical *ex ante*, given that $EI > 0$, all of them want to borrow from banks. The demand for credit is then given by

$$K_x^d = \alpha. \tag{11}$$

From equations (9) and (11), it is clear that *r* must be sufficiently high for credit demand to be met.[9] If there were no costly state verification problem, the expected profits of the bank would be monotonically increasing in *R* so that the bank would be

able to set sufficiently high loan interest rate R, which would allow it to offer sufficiently high deposit interest rate r such that $K_x^d = K_x$. In the presence of costly state verification, however, banks choose R to maximize the expected profits net of the expected total monitoring cost. Since the expected total monitoring cost rises with the amount of bankruptcy cases, which rises with R, banks have to balance the expected benefits from higher R against the expected increase in total monitoring cost due to higher R. As a result, the expected profit function for banks is nonmonotonic in R. From figure 1 it is clear that the maximum deposit interest rate that a bank can offer is $r = E\pi$. If this r is too low to attract sufficient deposits for all potential entrepreneurs, i.e.,

$$K_x(r) < \alpha, \tag{12}$$

then credit will have to be rationed in equilibrium.

The possibility of equilibrium credit rationing in the presence of costly monitoring was first shown by Williamson (1987). As in Stiglitz and Weiss (1981), the emergence of equilibrium credit rationing relies on banks' expected profit function being nonmonotonic in loan interest rate. The information asymmetries that cause banks' expected profit function to be nonmonotonic, however, are different in the Williamson model and in that of Stiglitz and Weiss. The adverse selection and moral hazard problems in Stiglitz and Weiss are due to *ex ante* asymmetric information, and the *ex post* project returns are assumed to be costlessly observable by both lenders and borrowers. By contrast, the moral hazard problem in the Williamson model is due to asymmetric information about *ex post* project returns.

In the following analysis, we focus on the case in which equilibrium credit rationing emerges. Potential entrepreneurs draw a lottery to determine who obtain credit. Let μ be the fraction of potential entrepreneurs who receive loans in equilibrium, $\mu < 1$. In equilibrium, total amount of loans obtained by entrepreneurs must equal total amount of loanable funds supplied by nonentrepreneurs,

$$\alpha\mu = K_x(r). \tag{13}$$

Equation (13) provides a link between the deposit interest rate and the degree of credit rationing measured by μ. The lower the equilibrium deposit interest rate, the more severe the credit rationing situation. This is clear from

[9]There is a parameter restriction on α. For credit demand to be met, we must have $1 - \alpha - K_y(r) \geq \alpha$, or equivalently $\alpha \leq (1 - K_y(r)) / 2$.

$$\frac{d\mu}{dr} = \frac{1}{\alpha} K_x'(r) > 0. \tag{14}$$

Given that $\alpha\mu$ entrepreneurs produce X in the credit-rationing equilibrium, and that the risk of producing X is idiosyncratic and the number of producers is large, the aggregate output of X is nonstochastic and equals

$$X = \alpha\mu\bar{x}, \tag{15}$$

where

$$\bar{x} = \int_0^{x_{max}} x dF(x). \tag{16}$$

By substituting (8) into (1) and (13) into (15), we have

$$Y = Y(K_y(r), T), \tag{17}$$

$$X = K_x(r)\bar{x}. \tag{18}$$

It is now clear that resource allocation in this economy depends on r, which is determined in financial markets.

3. INTERNATIONAL CAPITAL FLOWS

Now consider a world with a less developed country (LDC) and a developed country (DC). Assume that both countries have the economic structure described in the previous section and have credit rationing in equilibrium.[10] For our purpose, assume that the two countries differ only in the efficiency of their domestic financial systems in monitoring borrowers, the DC's system being more efficient. Free trade in goods are assumed so that the two countries face the same p. Denote variables of the DC with an asterisk. Then our assumption is $\gamma^* < \gamma$.

[10]To obtain the welfare results of the paper, it is not necessary to assume credit rationing in the DC if there are more than two developing countries, as we will show in section 6.

The implications of $\gamma^* < \gamma$ can be derived from the comparative statics of the model. One of them is

$$\frac{dr}{d\gamma} = \frac{dE\pi}{d\gamma} = -f(R) < 0. \tag{19}$$

Thus, $\gamma^* < \gamma$ implies $r^* > r$. As a result of this gap between DC and LDC deposit interest rates, capital owners in the LDC have an incentive to deposit their capital endowments in DC banks. Equation (19) also implies that $E\pi^* > E\pi$, i.e., the expected return from lending to entrepreneurs in the DC is higher than that to entrepreneurs in the LDC; as a result, banks do not have any incentive to lend capital to the LDC entrepreneurs. The following proposition indicates the direction of international capital flow in this hypothetical two-country world.

Proposition 1. *In a world with two countries that differ only in the efficiency of their financial markets in monitoring borrowers, there is an incentive for capital to flow from the country with the lower efficiency to the country with the higher efficiency, but no incentive for capital to flow from the country with the higher efficiency to the country with the lower efficiency.*

The intuition for $r^* > r$ is as follows. The LDC banks, facing a higher monitoring cost per bankruptcy case, have to set loan interest rate at a lower level to reduce the number of bankruptcy cases so as to minimize total monitoring cost.[11] A lower loan interest rate implies lower expected return per unit of loan, which in turn implies lower equilibrium deposit interest rate. In figure 1, the *GG* curve is the one for the LDC (higher γ) while the G^*G^* curve is the one for the DC.

4. THE CASE IN WHICH CAPITAL OUTFLOW IS PROHIBITED

The previous section showed that if international capital movement is not restricted, then capital will flow from the LDC to the DC. In this section we consider the case in which the LDC prohibits capital outflow, and in the next section we will examine the welfare effects of removing capital outflow restrictions in the LDC.[12]

We measure a country's welfare by its aggregate consumption. This measure of welfare assumes that *ex post* compensations between individuals can take place; it is

[11] This can be verified by differentiating the first-order condition of a bank's maximization problem (equation (5)).

[12] We focus on capital outflow restrictions since there is no reason for capital inflow restrictions in this model.

also consistent with our assumption that individuals are risk neutral.[13] Aggregate consumption equals the value of the output of the two goods *net of* the total monitoring cost spent in financial intermediation. Thus, total welfare of the LDC is given by

$$V = pY + X - K_x(r)\gamma F(R). \tag{20}$$

By substituting (17) and (18) into (20), we have

$$V = pY(K_y(r), T) + K_x(r)\bar{x} - K_x(r)\gamma F(R). \tag{21}$$

For simplicity we assume that the LDC is a small country which takes p as given. Totally differentiating V with respect to γ, we obtain

$$\frac{dV}{d\gamma} = pY' K_y'(r)\frac{dr}{d\gamma} + (\bar{x} - \gamma F(R))K_x'(r)\frac{dr}{d\gamma} - K_x(r)F(R)(1+\varepsilon), \tag{22}$$

where

$$\varepsilon = \frac{\gamma}{F(R)}\frac{dF(R)}{d\gamma} < 0. \tag{23}$$

ε is the elasticity of the amount of defaulting loans with respect to the monitoring cost γ. The higher the monitoring cost, the lower the loan interest rate, and the smaller the amount of defaulting loans.

[13] In the presence of costly state verification, if agents are risk averse, one needs to assume that the monitoring cost is a positive function of the size of loans monitored in order to have the verification region defined on an interval in the optimal contract. This is shown in Townsend (1979). If the monitoring cost is fixed, as assumed in this paper, lenders need to be risk neutral for the verification region defined on an interval. We assume that both lenders and borrowers are risk neutral mainly for expositional convenience. Note that in this model risks are idiosyncratic and there is no aggregate risk. Since the paper focuses on *ex post* welfare, the welfare results we obtain would not be affected if borrowers are risk averse.

To determine the sign of $dV/d\gamma$, we first use equations (3) and (10) to obtain

$$\bar{x} - \gamma F(R) = EI + \quad (24)$$

Equation (24) says that the expected *net* output of X from a project is split between the entrepreneur (who obtains EI) and the lender (who obtains r). In addition, we have $pY' = r$ from (7) and $K_y'(r) = -K_x'(r)$ from (9). By substituting them into (22), we obtain

$$\frac{dV}{d\gamma} = (EI)K_x'(r)\frac{dr}{d\gamma} - K_x(r)F(R)(1 - |\varepsilon|) \quad (25)$$

This establishes the following proposition.

Proposition 2. *In a world with two countries that differ only in the efficiency of their financial systems in monitoring borrowers, if international capital flows are prohibited, welfare will be lower in the country with the lower efficiency, as long as* $|\varepsilon| \leq 1$, *or* x_{max} *is sufficiently large.*

It is straightforward that $|\varepsilon| \leq 1$ guarantees $dV/d\gamma < 0$. Since $dr/d\gamma < 0$, the first term in (25) is negative; higher monitoring cost forces the deposit interest rate to be set at a lower level, leading to more severe credit rationing and lower welfare. If $|\varepsilon| \leq 1$, the second term in (25) is also negative; higher monitoring cost per bankruptcy case is accompanied by higher *total* monitoring cost, leading to further welfare reduction.

When $|\varepsilon| > 1$, the second term in (25) is positive; an increase in γ results in smaller total monitoring cost, saving money for consumption. In this case, the first term in (25) must dominate the second term in order to have $dV/d\gamma < 0$; this is guaranteed by a sufficiently large x_{max}. To see this, recall that $EI = \int_R^{x_{max}} xdF(x) - R(1 - F(R))$, where R is the solution to $1 - F(R) - \gamma f(R) = 0$. Therefore, higher x_{max} implies higher EI and consequently larger welfare loss from increasing credit rationing.

5. THE REMOVAL OF CAPITAL FLOW RESTRICTIONS

The previous section showed that when international capital flows are prohibited, welfare is lower in the LDC where monitoring is less efficient. Since the reason for lower welfare in the LDC is that many potential entrepreneurs do not get funds to proceed with their potentially profitable projects, one may wonder whether opening to international credit markets helps. In this section we investigate the welfare effects of removing capital outflow restrictions in the LDC.

When the LDC opens to international capital markets, capital owners in the LDC are attracted by the higher deposit interest rate offered by the DC banks. To compete for deposits, the LDC banks must set a deposit interest rate as high as that of the DC banks. As is clear from figure 1, if the LDC banks want to offer r^*, its expected profits from lending must equal $E\pi^*$, which is only possible when they make loans exclusively to the DC entrepreneurs. Unable to obtain loans from the LDC banks, the LDC potential entrepreneurs turn to the DC banks. But they cannot get loans from the DC banks either because of the same reason that they are turned down by the LDC banks. To lend to the LDC entrepreneurs, banks would have to incur a higher monitoring cost since bankruptcy cases would be proceeded by the relatively inefficient LDC financial institutions when the LDC borrowers default. Note that potential entrepreneurs in the LDC can offer to pay a higher loan interest rate, but no bank will accept it because the expected return per unit of loan will not be increased by setting a higher loan interest rate. As we have shown in previous sections, a higher loan interest rate increases the probability of default, leading to a lower expected return per unit of loan. Thus, when credit is rationed in the DC, banks will lend only to the DC entrepreneurs, and potential entrepreneurs in the LDC will not get the funds they need to proceed with their investment projects.

To summarize, the removal of capital outflow restrictions in the LDC has the following consequences. First, the LDC potential entrepreneurs cannot get external funds and consequently the X sector disappears in the LDC. This is a phenomenon referred to by Mankiw (1986) as "financial collapse."[14] Second, the LDC capital which was used to finance LDC projects is now obtained by DC entrepreneurs. Third, there is a general equilibrium effect on the Y sector. Since LDC capital owners can receive r^* from lending to DC borrowers, and the marginal return from investing in the Y sector was $pY' = r$, they will withdraw capital from the Y sector until $pY' = r^*$. As a result, the Y sector shrinks.

To see the welfare implications of the removal of capital outflow restrictions, we compare total welfare of the LDC before and after the removal of capital outflow restrictions. Total welfare of the LDC before the removal of capital outflow restrictions is given by

$$V = pY(K_y(r), T) + K_x(r)\bar{x} - K_x(r)\gamma F(R). \tag{26}$$

[14]Mankiw (1986) shows that small changes in the risk-free interest rate can cause large changes in the allocation of credit (which he refers to as financial collapse). It is worth noting that the complete disappearance of the X sector is not what drives the results of this paper. If potential entrepreneurs are assumed to have different ability, the LDC would still produce X after the removal of capital outflow restrictions but the welfare results derived from the benchmark model would maintain. This will be shown in section 6.

while total welfare of the LDC after it removes capital outflow restrictions is given by

$$V' = pY(K_y(r^*), T) + K_x(r^*)r^* . \tag{27}$$

By subtracting (26) from (27), using $EI + r = \bar{x} - \gamma F(R)$, we have

$$\begin{aligned}\Delta V = & -K_x(r)(EI + r) + K_x(r^*) - K_x(r)]r \\ & - [pY(K_y(r), T) - pY(K_y(r^*), T)].\end{aligned} \tag{28}$$

Figure 2 is helpful to the understanding of equation (28). Before the removal of capital outflow restrictions, the LDC produces both *X* and *Y*. In figure 2, the area between the negatively-sloped curve (the marginal return to capital in the *Y* sector) and the horizontal axis from the origin to $K_y(r)$ is the output value of good *Y*, while the area between the $(EI + r)$ line and the horizontal axis from $K_y(r)$ to *K* is the net output value of good *X*; the sum of the two areas is *V*. After the removal of capital outflow restrictions, the LDC produces only *Y* and lends capital to the DC. In figure 2, the area between the negatively-sloped curve and the horizontal axis from the origin to $K_y(r^*)$ is the output value of good *Y*, while the area between the r^* line and the horizontal axis from $K_y(r^*)$ to *K* is the return from loans to the DC; the sum of the two areas is *V'*. It follows that ΔV equals the difference between the area denoted by **G** (gain) and the area denoted by **L** (loss). We can verify that **L** equals the absolute value of the first term in (28), and **G** equals the second and the third terms in (28).

To determine the welfare effects on the LDC, note first that for the LDC to lose from opening to international capital markets, it is necessary that $EI + r > r^*$. If the expected net output value of undertaking a project in the LDC is lower than the DC deposit interest rate, i.e., $\bar{x} - \gamma F(R) = EI + r < r^*$, then the *X* sector is simply unprofitable for the LDC to establish. In that case, there is no doubt that the LDC should abandon capital outflow restrictions. The more interesting case is the one in which $EI + r > r^*$, i.e., from the viewpoint of the LDC, investing in the *X* sector is more profitable than lending capital to the DC. This is the case we focus on. In this case, the disappearance of the *X* sector due to the lack of credit causes a welfare loss equal to **L**.

The shrinkage of the *Y* sector, however, results in a welfare gain equal to **G**. Since the world interest rate is r^*, and the marginal return to capital invested in the *Y* sector

before the removal of capital outflow restrictions was $pY' = r < r^*$, more income is generated when capital moves out of the Y sector.

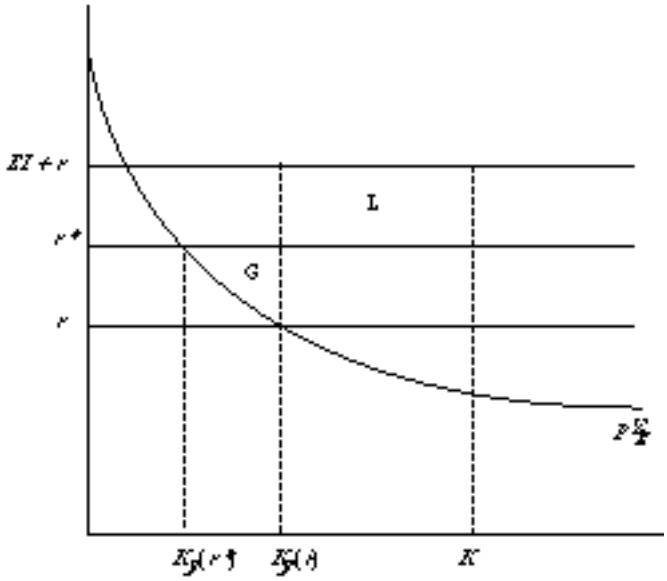

Figure 2

What is the condition under which **L** > **G**? From (28) we know that $\Delta V < 0$ if

$$K_x(r)(EI + r - r) > [K_x(r') - K_x(r)]r - [pY(K_y(r), T) - pY(K_y(r'), T)], \qquad (29)$$

or equivalently,

$$EI > \frac{K_x(r')r - p(Y - Y')}{K_x(r)} - r \qquad (30)$$

Recall that $EI = \int_R^{x_{max}} xdF(x) - (1 - F(R))R$ and R is the solution to $1 - F(R) - \gamma f(R)$

$= 0$. Thus, a sufficiently large x_{max} guarantees that (30) holds. In figure 2, an increase in x_{max} shifts up the line of $(EI + r)$ but leaves other curves unchanged, leading to a larger **L**. This establishes the following proposition.

Proposition 3. *For the country with the less efficient financial system in monitoring borrowers, its welfare declines after it removes capital outflow restrictions as long as x_{max} is sufficiently large so that* (*30*) *holds.*

It is important to note that even if a high x_{max} may be obtained from investment projects in the LDC, there will be no loan contracts for the LDC entrepreneurs. In this model, the rent generated by a high x_{max} would go entirely to the entrepreneur; the expected profits of competitive banks are determined not by how potentially productive an industry is, but on the monitoring cost they have to incur for each bankruptcy case, which is higher in the LDC.

For the DC where the financial system is more efficient in monitoring borrowers, the removal of capital flow restrictions in the LDC generates more credit for its potential entrepreneurs. As a result of the alleviation of credit rationing, welfare of the DC is improved. We have the following proposition.

Proposition 4. *The country with the more efficient financial system in monitoring borrowers always benefits from international capital flows.*

6. EXTENSIONS

The analyses in the previous sections were based on a highly stylized model which has some rather extreme implications. For example, X is not produced in the LDC after the removal of capital outflow restrictions. In this section, we show that by slightly modifying the model, some extreme features of the benchmark model disappear, but the welfare results derived from it remain valid.

First we modify the model by assuming that entrepreneurs have different ability. Suppose a fraction λ of potential entrepreneurs have high ability g, and the remaining potential entrepreneurs have low ability b. Let $\tilde{x}$ be the outcome of a project undertaken by an entrepreneur with ability j, $j = g, b$. Assume that projects undertaken by both types of entrepreneurs have an expected return higher than zero, i.e., $EI_g > 0$, $EI_b > 0$. Furthermore, assume that banks can observe g and b hence they can issue separate debt contracts to each ability group (the case in which g and b are not observed is discussed below). Let R_j be one plus the loan interest rate for borrowers with ability j. Banks' expected profits per unit of loan from lending to entrepreneurs with ability j are given by

$$E\pi_j = R_j(1 - F(R_j / j)) + \int_0^{R_j / j} jx\, dF(x) - \gamma F(R_j / j). \tag{31}$$

The profit-maximizing loan interest rate is implied by the first-order condition

$$j(1 - F(R_j / j)) - (1 - \theta) R_j f(R_j / j) - \gamma f(R_j / j) = 0. \quad (32)$$

We assume that the second-order condition for profit maximization holds. It is easy to verify that

$$R_g > R_b \quad E\pi_g > E\pi_b. \quad (33)$$

Let r be one plus the equilibrium deposit interest rate. Assume that loanable funds channeled at this rate are sufficient for high-ability entrepreneurs, but not enough for all entrepreneurs. That is,

$$\lambda\alpha < K_x(r) < \lambda\alpha + (1 - \lambda)\alpha. \quad (34)$$

As a result, there is equilibrium credit rationing. Since $E\pi_g > E\pi_b$, banks will lend first to high-ability entrepreneurs. In equilibrium, all high-ability entrepreneurs obtain loans, but only a fraction μ of low-ability entrepreneurs are able to obtain loans. μ is such that

$$\mu(1 - \lambda)\alpha = K_x(r) - \lambda\alpha. \quad (35)$$

Competition among banks ensures that the zero profit condition is met,

$$\lambda\alpha (E\pi_g - r) + \mu(1 - \lambda)\alpha (E\pi_b - r) = 0. \quad (36)$$

Substituting (35) into (36),

$$\lambda\alpha (E\pi_g - r) + (K_x(r) - \lambda\alpha)(E\pi_b - r) = 0, \quad (37)$$

which solves the equilibrium deposit interest rate.

Now consider a world with two countries, the DC and the LDC, which differ only in γ. The LDC is assumed to have a higher monitoring cost than the DC. Both $E\pi_g$ and $E\pi_b$ are lower in the LDC than in the DC, since

$$\frac{dE\pi_j}{d\gamma} = F'(R_j / j) < 0. \tag{38}$$

Totally differentiating (37), and noting that $dE\pi_g / d\gamma < dE\pi_b / d\gamma$, we obtain

$$\frac{dr}{d\gamma} = \frac{\lambda\alpha (dE\pi_g / d\gamma - dE\pi_b / d\gamma) + K_x(r)(dE\pi_b / d\gamma)}{K_x(r) - K_x'(r)(E\pi_b - r)} < 0. \tag{39}$$

The denominator of (39) is positive since $K_x(r) > 0$ and $E\pi_b < r$. (39) implies that higher monitoring cost brings about lower deposit interest rate. Thus, there is an incentive for capital to flow from the LDC to the DC.

If the LDC removes capital outflow restrictions, wealth owners in the LDC will be attracted by the higher deposit interest rate offered by the DC banks. To compete for deposits, banks in the LDC raise r to match r^*. Unlike in the benchmark model, the LDC entrepreneurs will still receive loans as long as $E\pi_g > r^*$. In this modified model, the consequence of the removal of capital outflow restrictions is that credit becomes more severely rationed for low-ability entrepreneurs in the LDC. This can be seen from banks' zero-profit condition,

$$\lambda\alpha (E\pi_g - r) + \tilde{\mu} (1 - \lambda)\alpha (E\pi_b - r) = 0, \tag{40}$$

where $\tilde{\mu}$ is the fraction of low-ability LDC entrepreneurs who obtain loans. As the expected profits from lending to high-ability entrepreneurs go down due to higher deposit interest rate, the LDC banks can only afford to lend to fewer low-ability entrepreneurs.[15]

Thus, in this slightly modified model, when capital outflow restrictions are removed in the LDC, all high-ability and some low-ability local entrepreneurs still

[15] $\frac{d\tilde{\mu}}{dr^*} = \frac{\lambda\alpha + \tilde{\mu}(1 - \lambda)\alpha}{(1 - \lambda)\alpha(E\pi_b - r^*)} < 0.$

obtain funds to proceed with their projects, and consequently the LDC still produces X. The welfare implication on the LDC in the modified model, however, is the same as that of the simple benchmark model. The removal of capital outflow restrictions intensifies credit rationing and reduces welfare (provided that x_{max} is sufficiently large) in the LDC, while welfare in the DC is increased because the inflow of LDC capital alleviates credit rationing there.

Next we relax the assumption that credit rationing exists in all countries. Consider a three-country model in which the DC has the most efficient financial system and credit is *not* rationed there. The two other countries, LDC1 and LDC2, differ in the efficiency of monitoring borrowers, and credit is rationed in both countries. Suppose the monitoring cost is higher in LDC1 than in LDC2. With free international capital movements, wealth owners in both LDC1 and LDC2 will deposit their wealth in DC banks. Since there is no credit rationing in the DC and there are profitable investment opportunities in the LDCs, the DC banks will make loans to the LDC entrepreneurs. However, since the LDC2's financial system is more efficient than the LDC1's, banks in the DC will lend first to entrepreneurs in LDC2. As long as credit remains rationed in LDC2, entrepreneurs in LDC1 will not obtain loans. Thus, the welfare result regarding the LDC in the two-country model applies to LDC1 in this three-country model.

Further extension of the benchmark model is possible but may require significant modification of the model structure. For example, in the case in which banks cannot identify high-ability entrepreneurs from low-ability entrepreneurs and the verification of project outcome is costly, there are both moral hazard and adverse selection problems. The standard debt contract may not be optimal, and the conditions under which the pooling (separating) equilibrium exists need to be derived.[16] We do not pursue this case here but we conjecture that the welfare results derived from the benchmark model would survive. Suppose a pooling equilibrium exists and the debt contract remains optimal. Then banks set one loan interest rate for all borrowers so that

$$E\pi = \lambda E\pi_g(R) + (1 - \lambda)E\pi_b(R). \tag{41}$$

From the first-order condition we get R and consequently the equilibrium deposit interest rate $r = E\pi(R)$. It is easy to show that r is lower in the LDC, the country with higher monitoring cost. When capital restrictions are removed, capital moves from the LDC to the DC and the LDC entrepreneurs cannot obtain loans to produce X. We then have a situation similar to that in the benchmark model, and the same welfare results can be obtained.

[16]Innes (1991) presents a model in which the standard debt contract is optimal in the presence of both moral hazard and adverse selection problems.

7. CONCLUSIONS

This paper has examined the welfare implications of removing capital outflow restrictions in a developing country where financial markets are relatively inefficient in monitoring borrowers. A simple general equilibrium model is developed in which credit is rationed in one of the two production sectors due to costly information in financial markets. Opening to international capital markets is shown to cause an outflow of domestic wealth but no inflow of foreign credit, leading to more severe credit rationing in the production sector relying on external funds and a reduction of production output in the other sector. The expansion of credit rationing implies a welfare loss, while the alignment of the marginal return to capital to the world interest rate implies a welfare gain. The paper shows that the welfare loss dominates the welfare gain when the domestic investment opportunities that are unexploited due to credit rationing are sufficiently profitable.

While the model developed in this paper served its purpose, its limitations are also obvious. First, we used the magnitude of monitoring cost as an indicator of the efficiency of a country's financial system, which is clearly an oversimplified abstraction. Second, the model is static; the efficiency of financial markets is assumed to be exogenously given. As a result, we were not able to address dynamic welfare implications of the removal of capital flow restrictions. We conjecture, however, that the static welfare effects shown in this paper will not disappear in dynamic models.

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