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Trade and Financial Liberalization with Asymmetric Information in Bank Financing

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We investigate trade and financial openness in a small developing country where entrepreneurs need bank financing to operate in an import-competing sector but banks do not observe their ability. This informational asymmetry causes adverse selection of low-ability individuals into entrepreneurship and also prevents poor but able individuals from being entrepreneurs. We find that trade opening improves national welfare, but a tax is needed on foreign financial capital. Trade opening reduces an income gap between the rich and the poor, while financial opening affects this income gap ambiguously.

Key words: Trade Liberalization; Financial Liberalization; Asymmetric Information; Welfare; Income Distribution

JEL Codes: F13, F21, O16

1 INTRODUCTION

The last two decades have seen an increase in trade and financial openness in many developing countries. Such a trend has its support in an economic theory: for a small open economy with perfectly competitive markets, trade and financial openness improves resource allocation and national welfare. While this theory provides a useful benchmark, more complicated issues are involved in the selection of trade and financial policies in developing countries, where market failure is the norm and the governments may be more concerned with income distribution and political economy implications than resource allocation and national welfare.

In this article we model a small developing country where capital is allocated by imperfect financial markets. In the country, banks receive deposits from domestic and foreign capital owners, and lend the money to domestic entrepreneurs for undertaking risky investment projects in an import-competing sector. Banks do not observe the success probability of any individual borrower, so the loan rate is set according to the average success probability of the borrower pool.[1] Such a loan contract implies high-ability borrowers subsidizing low-ability borrowers, allowing the latter to adversely select into entrepreneurship. To minimize adverse

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[1]Our asymmetric-information specification follows Bernanke and Gertler (1990), whose model examines the role of macro-economic policies in dealing with the problem of financial fragility.

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selection, banks require borrowers to commit their own capital assets in project undertaking. More-wealthy borrowers thus receive lower loan rates since there is less an incentive for adverse selection among more-wealthy borrowers. Expecting to pay higher loan rates, less-wealthy potential entrepreneurs lose the incentive to pursue entrepreneurship.

The model shows that imperfect financial markets imply too low an ability threshold for entrepreneurship and too high an asset threshold for entrepreneurship. Some projects with excessive risks are adversely selected to be financed, while individuals with capital assets below a threshold do not obtain loans even if they have socially desirable projects. The type of financial market imperfections described in our model is quite relevant to developing countries. Empirical evidence shows that credit constraints and adverse selection are common in the financial intermediation of many developing countries.[2]

Our model provides a framework for examining trade and financial liberalization policies in developing countries. We start by asking the question of what the policies should be. In a second-best world with imperfect financial markets, trade and financial liberalization may increase or decrease national welfare, depending on the nature of the market imperfections. In our model, we find that trade liberalization improves national welfare. The optimal trade policy is however not free trade but an import subsidy with which the adverse section problem is minimized. We find a non-monotonic relationship between financial openness and welfare. On the one hand, financial openness lowers banks' cost of funds, causing more socially inefficient projects to be financed and thus reducing welfare. On the other hand, it lowers the asset barrier to entrepreneurship, enabling more socially efficient projects to be undertaken and thus enhancing welfare. We show that the optimal policy is partial financial opening.

The choice of trade and financial policies in developing countries may depend more on political economy considerations than on national welfare. One important basis for political economy evaluation is income distribution. In our model income is unevenly distributed because individuals differ in entrepreneurial ability and capital assets. We focus on the income gap between a group of poor individuals who all become workers despite their potential as entrepreneurs, and a group of rich individuals among whom the high-ability ones become entrepreneurs and the low-ability ones become workers and save capital in banks. We find that trade liberalization decreases the income of successful entrepreneurs relative to workers and hence narrows the income gap between the rich and the poor. Financial opening increases the income of successful entrepreneurs but decreases the interest income of rich individuals, and hence has an ambiguous effect on the income gap between the rich and the poor.

It is worth noting that our results are associated with a specific type of asymmetric information in financial markets. The policy implications from our analysis may change with respect to different types of market imperfections. In the international trade and investment literature, there are several useful policy analyses based on asymmetric-information models. For example, Dixit (1987, 1989a,b) studies the optimal choice of trade policies when information is asymmetric in domestic risk-sharing markets, Grossman and Horn (1988) and Bagwell and Staiger (1989) examine the role of trade protection when information is asymmetric in commodity markets. Flam and Staiger (1991) and Bond (1993) investigate infant industry policies in the presence of information-induced capital market imperfections.[3] Kletzer and Bardhan (1987) show asymmetric information in financial markets as a

[2] See Ray (1998, chapter 14) for a discussion of credit allocation in developing countries.

[3] Bond (1993) uses the model of Bernanke and Gertler (1990) to study the infant-industry policy. His study focuses on the welfare effect of an infant-industry tariff and does not address the issues of financial openness and income distribution examined in this paper.

determinant of trade patterns, while Grossman (1999) investigates comparative advantage derived from informational asymmetries in labor markets. Gertler and Rogolf (1990) present an analysis of the role of asymmetric information in international investment.

The remainder of the article is organized as follows. In section 2 we describe a small open developing economy. In section 3 we discuss entrepreneurial choice decisions under asymmetric information. In section 4 we examine the resource allocation, national welfare, and income distribution effects of trade and financial liberalization. In section 5 we conclude. The Appendix contains mathematical proofs of the lemmas and propositions.

2 THE ECONOMY

In this section we describe the economic structure of a small open developing country.

2.1 Production

There are two production sectors. A traditional sector produces good Y with labor as the sole input. The unit cost of good Y equals aw, where w is the wage rate and a is the unit labor requirement. A modern sector produces good X with entrepreneurs and capital as inputs; each entrepreneur is endowed with certain amount of entrepreneurial ability.[4] To produce good X, an entrepreneur must undertake an investment project of one unit of capital; her entrepreneurial ability determines the project's success probability. Specifically, a project yields $x > 0$ units of X with probability q and zero with probability $(1 - q)$, where q is an index of entrepreneurial ability with value between zero and one. For simplicity we assume that project risks are idiosyncratic; hence the aggregate output of X is deterministic when a large number of projects are undertaken.

2.2 Population

The country is populated with a continuum of individuals of unit mass. Each individual is endowed with one unit of labor and k units of capital asset. Capital asset k is distributed unevenly in the population. For simplicity, we assume that there are two asset groups: a fraction λ of the population belongs to a rich group, each of whom is endowed with $0 < \kappa < 1$ units of capital; the remaining individuals belong to a poor group with zero capital. Thus, total capital endowment equals $K = \lambda\kappa$. In the population a fraction μ are potential entrepreneurs who are endowed with entrepreneurial ability; the remaining $(1 - \mu)$ fraction are non-entrepreneurs. Entrepreneurial ability is distributed among potential entrepreneurs according to a distribution function $F(q)$ over the interval [0, 1]. A potential entrepreneur must take two steps to become a producer of good X. First, she must spend $e > 0$ units of effort to evaluate a project to learn her chance of success; without doing so she would have zero probability of success. Second, she must invest one unit of capital to implement the project. We assume that ability is independent of asset. Thus, there are $\mu\lambda$ rich potential entrepreneurs and $\mu(1 - \lambda)$ poor (less wealthy) potential entrepreneurs.

2.3 Consumption

All individuals are risk neutral. We specify the utility function as $U(C_x, C_y) - ie$, where C_x and C_y are consumptions of the two goods, $i = 1$ if the individual evaluates a project, and $i = 0$

[4] See Bond (1986) who modifies the Heckscher–Ohlin model with entrepreneurial ability as an additional production factor.

otherwise. The function $U(\cdot)$ is identical among individuals and homothetic in consumption. We choose good Y as the numeraire and denote p as the price of good X. The indirect utility function can be shown to be $v(p)I - ie$, where I denotes income, and $v'(p) < 0$.

2.4 Policy

The country is small in both the world commodity market and capital market, thus facing a fixed $\bar{p}$, the world price of good X, and a fixed $\bar{r}$, the world riskless rate of return to capital. The country is capital-scarce such that it imports good X when open to international trade and attracts foreign capital when open to international capital movement.[5] Denoting τ as the tariff on good X and t as the tax on the return to foreign capital, the domestic price of good X equals $p = (1 + \tau)\bar{p}$ and the domestic riskless rate of return to capital equals $r = (1 + t)\bar{r}$. In the remainder of our analysis, we define trade liberalization as a decrease in τ and financial liberalization as a decrease in t.

2.5 Financial Intermediation

An investment project requires one unit of capital, but no individual has a capital endowment greater than one unit. Thus, to produce good X, an entrepreneur must borrow from financial markets. We assume that capital is intermediated by competitive, risk-neutral banks. There is asymmetric information in financial intermediation; banks do not observe each borrower's q. A financial contract is signed before an individual evaluates her project, and banks observe a borrower's capital asset and require it to be fully committed in her project. These assumptions simplify the model by abstracting from any signaling behavior from the borrower. Under these assumptions, the optimal financial contract is a loan contract with a discriminatory loan repayment rate (denoted by R_k) contingent on the borrower's capital asset.[6] Specifically, an individual can borrow $(1 - k)$ units of capital from a bank, where $k = \kappa$ for a rich person and $k = 0$ for a poor person. If her project succeeds, she repays $(1 - k)R_k$; if her project fails, she defaults on the loan.

3 ENTREPRENEURIAL CHOICE

A potential entrepreneur faces two decisions: (1) whether to evaluate a project, and (2) whether to undertake the project after evaluating it. Figure 1 illustrates these two decisions.

3.1 Project Undertaking

Consider the project-undertaking decision first. If an entrepreneur chooses to undertake a project, she self-finances her capital asset k and borrows $(1 - k)$ from a bank, obtaining an expected income $q(px - (1 - k)R_k)$. If she chooses not to undertake her project, she can work in the Y sector as a worker and deposit her capital asset in banks, obtaining an income w +

[5] We can show that for two countries that differ only in capital stock, the capital-scarce country has a higher output ratio Y/X under autarky and hence a higher autarky relative price p given homothetic preferences. As a result, it imports X and exports Y. We can also show that, at fixed p, the capital-scarce country has a higher autarky r and hence attracts foreign capital. The derivations of the trade and investment patterns are available from the author upon request.

[6] The derivation of the optimal contract is similar to that of Bernanke and Gertler (1990) and is omitted here.

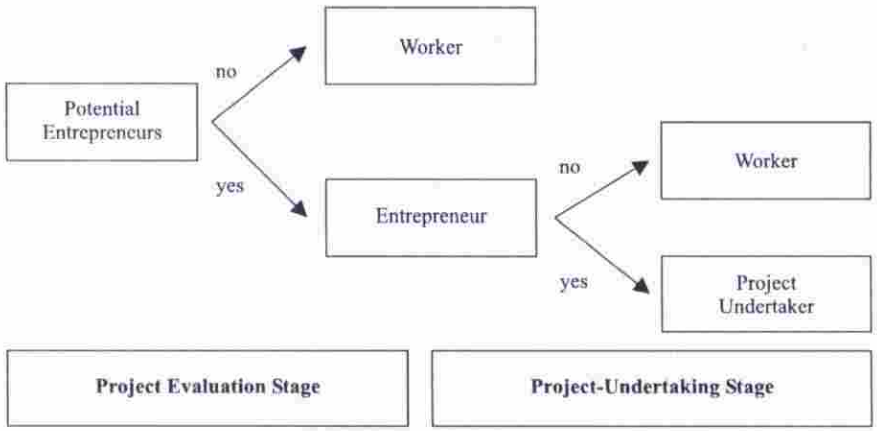

FIGURE 1 Entrepreneurial choice.

rk. Let $\hat{q}_k$ be the ability of an entrepreneur with capital asset k who is indifferent between the two choices. We have:

$$\hat{q}_k(px - (1 - k)R_k) = w + rk \tag{1}$$

Because banks do not observe q, the optimal contract specifies the same loan rate R_k for all borrowers with asset k. From the perspective of an entrepreneur, her expected income rises with her ability; hence entrepreneurs with $q \geq \hat{q}_k$ choose to borrow and undertake projects. Thus $\hat{q}_k$ is an ability threshold for entrepreneurship. In Figure 2 we draw an "Occupational Choice" curve based on Equation (1). A higher loan rate implies a higher capital cost for undertaking an entrepreneurial project and therefore corresponds to a higher ability threshold.

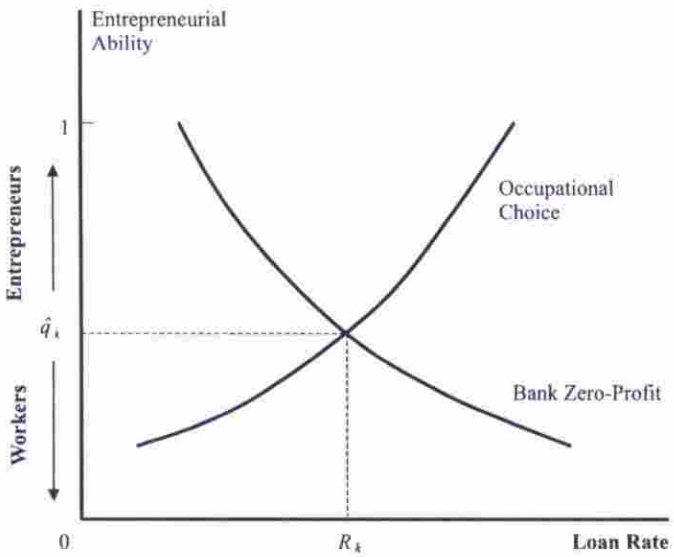

FIGURE 2 Ability threshold for entrepreneurship.

Banks make loans based on the average success probability of the borrower pool, which equals.

$$\bar{q}_k = \left[\int_{\hat{q}_k}^{1} q dF(q)\right]/(1 - F(\hat{q}_k))^7$$

Competition among banks implies zero expected profit from loans:

$$\bar{q}_k R_k - r = 0. \tag{2}$$

In Figure 2 we draw a "Bank Zero-Profit" curve based on Equation (2). A higher ability threshold for entrepreneurship implies a higher success probability of the borrower pool and hence a lower loan rate offered by banks.

If banks observed a borrower's entrepreneurial ability, the loan rate would depend on the entrepreneurial ability; it would not matter whether the borrower is rich or poor. When banks do not observe a borrower's entrepreneurial ability, however, the loan rate will depend on the borrower's self-finance capacity, *i.e.*, the capital asset she owns. Lemma 1 describes how equilibrium loan rates depend on capital assets.

> Lemma 1: With asymmetric information in financial markets, the more capital asset an individual has, the lower the loan rate (R_k) and the higher the ability threshold ($\hat{q}_k$) for her to become an entrepreneur.

A proof of Lemma 1 is in the Appendix. Intuitively, because of asymmetric information, the marginal entrepreneur receives the loan rate set for the average borrower, so she enjoys a low cost of external capital. The more capital asset the marginal entrepreneur owns, the less external capital she gets. Because of a higher ratio of internal capital to external capital, a richer individual's total capital cost is higher at any given loan rate, so she chooses to be an entrepreneur only if the success probability is higher. Graphically an increase in k shifts up the "Entrepreneurial Choice" curve in Figure 2, leading to the results in Lemma 1.

3.2 Project Evaluation

The decision of project evaluation is made prior to the decision of project undertaking (see Figure 1). Project evaluation requires a fixed cost of e units of effort. An individual evaluates a project if and only if the expected utility-gain from doing so is no less than the disutility e. In the Appendix we show that the expected income from evaluating a project exceeds the income of being a worker by the amount of $\pi_k = (1 - F(\hat{q}_k))(\bar{q}_k px - w - r)$, which implies an expected utility gain of $v(p)\pi_k$. A potential entrepreneur compares the expected benefit $v(p)\pi_k$ and the cost e to decide whether to evaluate a project. In Figure 3, the horizontal line indicates the level of the fixed cost of entering entrepreneurship, and the upward-sloped curve depicts the expected utility gain from entering the project evaluation stage of entrepreneurship. The expected benefit from entering entrepreneurship increases with capital asset because richer entrepreneurs will enjoy lower loan rates (Lemma 1) and hence higher expected entrepreneurial income in the project-undertaking stage. We state this result in:

> Lemma 2: With asymmetric information in financial markets, the higher the capital asset a potential entrepreneur has, the higher the expected return from project evaluation (π_k).

The intersection of the two curves defines an asset threshold for individuals to enter the project-evaluation stage of entrepreneurship. The asset threshold $\hat{k}$ satisfies $v(p)\pi(\hat{k}) = e$. For our purpose, we consider the case in which $0 < \hat{k} < \kappa$. In this case, only rich potential

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[7] It can be shown that $d\bar{q}_k/d\hat{q}_k = \left[\int_{\hat{q}_k}^{1} F'(\hat{q}_k)(1 - F(q))dq\right]/[1 - F(\hat{q}_k)]^2 > 0$.

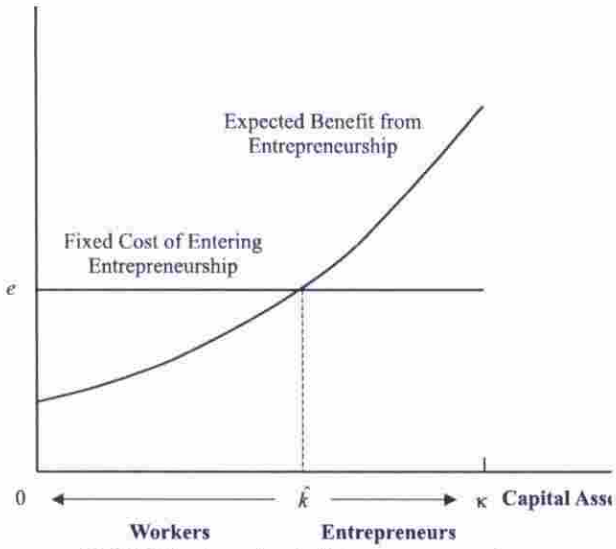

FIGURE 3 Asset threshold for entrepreneurship.

entrepreneurs ($k = \kappa$) evaluate projects. Poor individuals ($k = 0$) do not enter the project-evaluation stage of entrepreneurship.

3.3 Market Inefficiency

Comparing the asymmetric-information equilibrium to the full-information equilibrium, we find:

Proposition 1: Asymmetric information results in:

(i) an ability threshold for entrepreneurship lower than the socially efficient level, which allows low-ability rich individuals to be entrepreneurs;

(ii) an asset threshold for entrepreneurship higher than the socially efficient level, which prevents high-ability poor individuals from being entrepreneurs.

Proposition 1 is proved in the Appendix. Intuitively, because banks cannot distinguish between high-ability and low-ability borrowers, they set loan rate according to the average borrower. This induces low-ability individuals to undertake projects. If banks identified them, they would face higher loan rates and would not choose to undertake projects. Thus the ability threshold for entrepreneurship is lower than the socially efficient level.

While asymmetric information reduces the ability threshold for entrepreneurial selection, it raises the asset threshold for project evaluation. In the full-information equilibrium, all potential entrepreneurs enter the stage of project evaluation; the entry is independent of capital asset. In the asymmetric-information equilibrium, however, the expected return from project evaluation increases with capital asset (Lemma 2). With a sufficiently high cost of project evaluation, less-wealthy potential entrepreneurs will decide not to enter the project-evaluation stage of entrepreneurship. In this case, capital asset becomes an entry barrier for poor potential entrepreneurs to enter sector X.

4 TRADE AND FINANCIAL LIBERALIZATION

We model trade liberalization as a decrease in τ, the tariff on imports of X, and financial

liberalization as a decrease in t, the tax on the rate of return to foreign capital. In the following three subsections, we discuss the effects of trade and financial liberalization on resource allocation, national welfare, and income distribution, respectively.

4.1 Effects on Resource Allocation

We first examine how trade and financial liberalization affects the ability and asset thresholds for entrepreneurship and hence the resource allocation. Consider a decrease in the tariff on imported good X. As the tariff decreases, good X becomes cheaper domestically. This reduces the expected entrepreneurial income, and hence only relatively able individuals choose to be entrepreneurs. In Figure 2, a tariff reduction shifts up the "Occupational Choice" curve, implying an increase in the ability threshold.

Trade liberalization makes more potential entrepreneurs evaluate their projects. The reason is that a lower tariff drives out low-ability entrepreneurs in the project-undertaking stage, and hence raises the expected utility gain of entering entrepreneurship. This increase in the expected entry benefit makes less-wealthy potential entrepreneurs able to overcome the fixed cost of entering entrepreneurship and therefore willing to enter the project evaluation stage (Figure 3). Thus a tariff reduction lowers the asset threshold for entrepreneurship.

Turning to the policy of financial opening, a decrease in the tax on foreign capital inflow affects both the occupational choice condition and the bank zero-profit condition. Financial opening reduces the deposit rate, making it more attractive to invest capital asset in entrepreneurship. In Figure 2 this shifts down the "Occupational Choice" curve. A lower deposit rate means lower cost of funds received by banks, and competition makes banks lower the loan rate. In Figure 2 this shifts the "Bank Zero-Profit" curve to the left. As entrepreneurial career becomes more attractive and loan rates get lower, low-ability individuals now undertake projects. Thus, financial opening lowers the ability threshold for entrepreneurship.

Like trade liberalization, financial opening also makes more potential entrepreneurs enter entrepreneurship. Because financial opening lowers the cost of capital, the expected income from being an entrepreneur exceeds the income of being a worker, and therefore the expected benefit of project evaluation rises. With the cost of project evaluation fixed, an increase in the expected benefit of entering entrepreneurship makes less-wealthy potential entrepreneurs willing to enter the project evaluation stage of entrepreneurship (Figure 3). Thus financial opening lowers the asset threshold for entrepreneurship.

We summarize the above results in:

Proposition 2: In a capital-scarce small open economy with asymmetric information in financial markets, (i) trade liberalization lowers the asset threshold but raises the ability threshold for entrepreneurship; (ii) financial liberalization lowers both the asset threshold and the ability threshold for entrepreneurship.

4.2 Effects on National Welfare

In this subsection we examine the effects of trade and financial liberalization on national welfare. Recall that asymmetric information has resulted in an ability threshold for entrepreneurship lower than the socially efficient level and an asset threshold higher than the socially efficient level (Proposition 1). As we show in the previous subsection, both trade and financial liberalization lowers the asset threshold, which improves resource allocation and hence national welfare. Trade liberalization raises the ability threshold, which improves welfare because it reduces the adverse selection problem in financial intermediation. By contrast, financial opening lowers the ability threshold, which intensifies the adverse selection problem and hence reduces national welfare.

In the Appendix we derive the optimal levels of trade and financial openness. We summarize the results in:

> Proposition 3: In a capital-scarce small open economy with asymmetric information in financial markets, (i) trade liberalization increases national welfare, the optimal policy being a negative tariff on imports; (ii) financial liberalization increases national welfare when the existing barrier to foreign capital is sufficiently high but decreases national welfare when it is sufficiently low, the optimal policy being a tax on foreign capital.

Proposition 3 reflects the nature of the asymmetric information. With adverse selection in financial markets, welfare improvement requires policies that raise the ability threshold. A reduction in the tariff lowers the price of X and discourages the entry of low-ability entrepreneurs; the adverse selection problem is minimized when there is a negative tariff (*i.e.*, an import subsidy) on imports of X. In contrast, a decrease in the tax on foreign capital lowers the cost of capital and encourages the entry of low-ability entrepreneurs; the adverse selection problem is minimized when there is a positive tax on foreign capital.

4.3 Effects on Income Distribution

Income is distributed unevenly in the population because individuals differ in asset and ability. In our model all individuals in the poor group become workers and receive the wage w. For individuals in the rich group, those with ability below $\hat{q}$ become workers and receive wage income w and asset income $r\kappa$, and those with ability above $\hat{q}$ become entrepreneurs. Because banks do not observe ability, all entrepreneurs face the same loan rate and receive the same entrepreneurial income when successful.

Figure 4 illustrates the effect of trade liberalization on income distribution. In this case of two asset groups, entrepreneurs come only from the wealthy group. A successful entrepreneur receives an income equal to $[px - (1 - \kappa)R]$. This income is the same for all successful entrepreneurs regardless of their ability; higher ability increases the probability of success but not the realized income. As a result of trade liberalization, both price p and loan rate R decrease. To find out how entrepreneurial income responds to trade liberalization, we

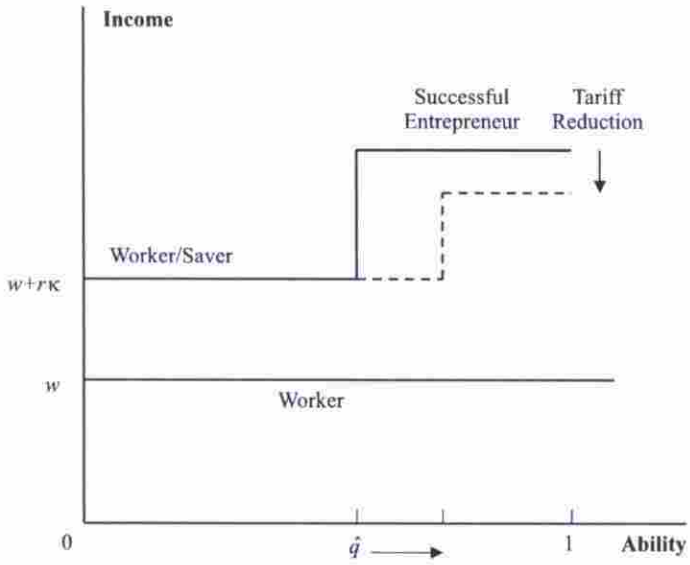

FIGURE 4 Trade liberalization and income distribution.

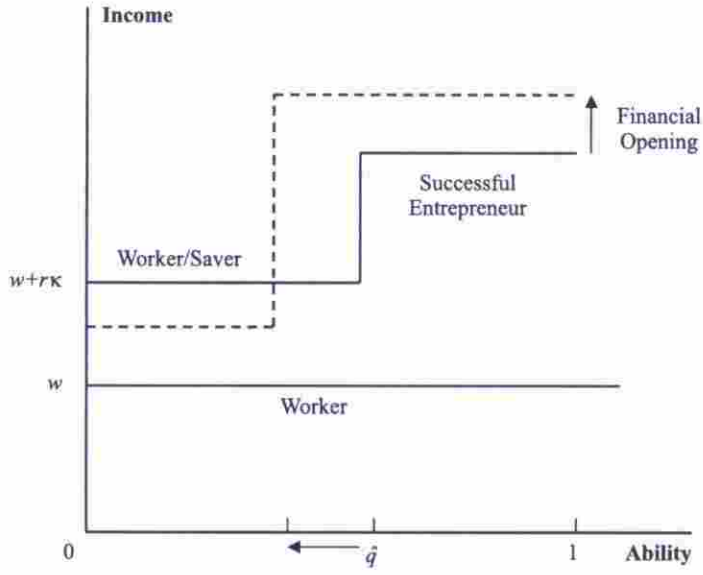

FIGURE 5 Financial opening and income distribution.

examine the occupational choice equation, $\hat{q}[px - (1 - \kappa)R] = w + r\kappa$. As stated in Proposition 2, trade liberalization raises the ability threshold for entrepreneurship, $\hat{q}$. From the occupational choice equation we learn that a higher $\hat{q}$ necessarily implies a lower income for successful entrepreneurs, $[px - (1 - \kappa)R]$. Although the tariff reduction, by alleviating adverse selection, gives rise to a lower loan rate, the decrease in the loan rate is not large enough to offset the decrease in the price of good X so that income falls for successful entrepreneurs. As Figure 4 shows, this decrease in entrepreneurial income reduces the income inequality between the rich and the poor. It is worth noting that the fall in income inequality is accompanied by rising real income for poor individuals (who are workers) since the price of good X has fallen following the trade liberalization.

Figure 5 illustrates the effect of financial opening on income distribution. Financial opening lowers the loan cost directly by reducing t but raises the loan cost indirectly by worsening adverse selection. However, the direct effect always dominates the indirect effect. To see this, we examine the occupational choice equation, $\hat{q}[px - (1 - \kappa)R] = w + r\kappa$. As stated in Proposition 2, financial opening lowers the ability threshold for entrepreneurship. For the occupational choice equation to hold at a lower $\hat{q}$, the income for a successful entrepreneur must rise relative to the income for a worker/saver. This increase in income inequality within the rich group may or may not imply an increase in income inequality between the rich and the poor. On the one hand, the interest income for workers in the wealthy group falls after financial opening, which narrows the income gap between the rich and the poor. On the other hand, the income for successful entrepreneurs rises after financial opening, which widens the income gap between the rich and the poor.

We summarize the above results in:

Proposition 4: In a capital-scarce small open economy with asymmetric information in financial markets,

(i) trade liberalization decreases the income gap between the rich and the poor. It increases the real income of workers and has an ambiguous effect on the real income of entrepreneurs;
(ii) financial opening has an ambiguous effect on the income gap between the rich and the poor. It increases the income of entrepreneurs, decreases the income of workers who own capital asset, and has no effect on the income of workers with zero capital asset.

5 CONCLUSION

In this paper we investigate trade and financial openness in a small developing country where entrepreneurs need bank financing to operate in an import-competing sector but banks do not observe their ability. We show that this informational asymmetry results in an ability threshold for entrepreneurship lower than the socially efficient level, which allows low-ability rich individuals to be entrepreneurs, and an asset threshold for entrepreneurship higher than the socially efficient level, which prevents high-ability poor individuals from being entrepreneurs.

The main results of the paper are two. First, we show that trade and financial liberalization may affect national welfare in different directions in the presence of asymmetric information. In our model, trade opening improves national welfare but financial opening would decrease national welfare in a country where the degree of financial openness is already high; in this country the welfare gain from further financial openness does not offset the welfare loss from an intensified adverse selection problem. This contrasts with the full-information case in which both trade and financial liberalization improves national welfare.

Second, we examine the income distribution effects of trade and financial liberalization in the presence of asymmetric information. We find that trade opening increases the real income of workers and may increase or decrease the real income of entrepreneurs. The income gap between the rich and the poor decreases following trade liberalization. We find that financial opening has an ambiguous effect on the income gap between the rich and the poor. Following financial liberalization the income of entrepreneurs increases, the income of workers stay unchanged, and the interest income of rich individuals decreases.

Admittedly we take a quite simplistic view regarding trade and financial liberalization as well as financial market imperfections. Our welfare results are derived from a specific informational asymmetry and may be sensitive to other types of informational asymmetries. For simplicity we assumed that ability and asset are independently distributed in the population; it would be useful to consider the interaction between ability and asset distributions in the determination of income inequality. We leave these issues to future research.

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APPENDIX

Proof of Lemma 1

From Equation (1) we obtain $\partial\hat{q}_k/\partial k = (r - \hat{q}_k R_k)/(px - (1-k)R_k)$ at any given R_k. Since $r = \bar{q}_k R_k$ and $\bar{q}_k > \hat{q}_k$, we have $r > \hat{q}_k R_k$. Therefore $\partial\hat{q}_k/\partial k > 0$, at any given R_k. An increase in k thus shifts up the "Occupational Choice" curve in Figure 2 and results in a higher $\hat{q}_k$ and a lower R_k.

Proof of Lemma 2

The expected income from evaluating a project exceeds the income of being a worker by $\pi_k = (1 - F(\hat{q}_k))(\bar{q}_k px - w - r)$. To derive this expression, note that if an individual evaluates a project, she has a probability $(1 - F(\hat{q}_k))$ to be an entrepreneur, receiving an expected income equal to $\bar{q}_k px - (1-k)r$. By the same token, she has a probability $F(\hat{q}_k)$ to find that her q is below $\hat{q}_k$; in this case, she chooses to be a worker, receiving an income $(w + rk)$. If the individual does not evaluate a project, her income is $(w + rk)$. Thus, $\pi_k = (1 - F(\hat{q}_k))(\bar{q}_k px - (1-k)r) + F(\hat{q}_k)(w + rk) - (w + rk) = (1 - F)(\hat{q}_k))(\bar{q}_k px - w - r)$. Using the definition of $\bar{q}_k$, we rewrite $\pi_k = \int_{\hat{q}_k}^{1} qpx dF(q) - (1 - F(\hat{q}_k))(w + r)$. Differentiating π_k with respect to $\hat{q}_k$, we obtain $d\pi_k/d\hat{q}_k = (w + r - \hat{q}_k px)F'(\hat{q}_k)$. From Equations (1) and (2), we have $w + r - \hat{q}_k px = (1 - \hat{q}_k/\bar{q}_k)(1-k)r > 0$. Therefore, $d\pi_k/d\hat{q}_k > 0$. Combining this result with Lemma 1, we obtain $d\pi_k/dk > 0$.

Proof of Proposition 1

Under full information, resource allocation is socially efficient: the marginal return from sector X equals the opportunity resource cost, $q^* px = w + r$, where q^* is the ability threshold in the full-information case. Under asymmetric information, the ability threshold of entrepreneurial selection is given by $\hat{q}px = w + r - (1 - \hat{q}/\bar{q})(1 - \kappa)r$. Subtraction yields $q^* - \hat{q})px = (1 - \hat{q}/\bar{q})(1 - \kappa)r > 0$. Thus, the ability threshold for entrepreneurship is lower in the asymmetric-information equilibrium than in the full-information equilibrium.

Proof of Proposition 2

In the presence of τ and t, the occupational choice equation becomes $\hat{q}((1 + \tau)x - (1-k)R = w + (1 + t)\bar{r}k$ and the bank zero-profit condition becomes $\bar{q}(\hat{q})R = (1 + t)\bar{r}$. Totally differentiating the two equations we obtain $d\hat{q}/d\tau < 0$ and $d\hat{q}/dt > 0$. In the presence of τ and t, the value of $\hat{k}$ can be solved from $v(\tau(1 - F(\hat{q}(\hat{k})))[(1 + \tau)\bar{q}(\hat{k})x - w - (1 + t)\bar{r}] = e$. Let Φ be the left-hand side of the equation, $\Phi = \Phi(\hat{k}, \tau, t)$. Using the definition of π, we have $\Phi = v(\tau)\pi(\hat{k})$; hence $\partial\Phi/\partial\hat{k} = v\partial\pi/\partial\hat{k} > 0$ (Lemma 2). Applying Roy's identity we have

$\partial\Phi/\partial\tau = -v(C_x - X) < 0$, where C_x is the consumption of good X. Thus, $d\hat{k}/d\tau = -(\partial\Phi/\partial\tau)/(\partial\Phi/\partial\hat{k}) > 0$. Similarly we can show $d\hat{k}/dt > 0$.

Proof of Proposition 3

Define national welfare as the sum of utilities over the population, $W = v(p)I - \mu\lambda e$, where I denotes national income, $I = \mu\lambda(1 - F(\hat{q}))\bar{q}((1 + \tau)x - (1 - \kappa)r/\bar{q}) + (\mu\lambda F(\hat{q}) + (1 - \mu)\lambda)(w + r\kappa) + (1 - \lambda)w + \tau[C_x - \mu\lambda(1 - F(\hat{q}))\bar{q}x]$. The four terms in the right-hand side of the equation are total entrepreneurial income, total income received by low-ability rich workers, total income received by poor workers, and the tariff revenue. By combining terms, we simplify the equation as $I = \mu\lambda(1 - F(\hat{q}))(\bar{q}x - w - r) + w + r\lambda\kappa + \tau C_x$. To see the welfare effect of the tariff, we differentiate W with respect to τ, which yields:

$$\frac{dW}{d\tau} = \frac{\partial v}{\partial \tau} I + cC_x - v\mu\lambda(\hat{q}x - w - r)F'(\hat{q})\frac{d\hat{q}}{d\tau}.$$

Using Roy's identity,

$$C_x = -\frac{\partial W}{\partial \tau} / \frac{\partial W}{\partial I} = -\frac{\partial v}{\partial \tau}\frac{I}{v};$$

hence the first two terms in the above equation cancel out. Since $\hat{q}x - w - r < 0$ when $\tau = 0$ and $d\hat{q}/d\tau < 0$ (Proposition 2), we have

$$\frac{dW}{d\tau} < 0 \text{ at } \tau = 0,$$

which implies that W would increase if τ were pushed below zero. Thus, national welfare is maximized when there is a negative tariff (*i.e.*, an import subsidy) on X. Next we examine financial opening. In the presence of the tax on the rate of return to foreign capital, the domestic cost of funds equals $(1 + t)\bar{r}$. National income is then given by $I = \mu\lambda(1 - F(\hat{q}))\bar{q}(px - (1 - \kappa)(1 + \tau)\bar{r}/\bar{q} + (\mu\lambda F(\hat{q}) + (1 - \mu)\lambda)(w + (1 + t)\bar{r}\kappa) + (1 - \lambda)w + t\bar{r}[\mu\lambda(1 - F(\hat{q})) - \lambda\kappa]$.

The fourth term in the right-hand side of the equation is the tax revenue. By combining terms, we simplify the equation as $I = \mu\lambda(1 - F(\hat{q}))(\bar{q}px - w - \bar{r}) + w + \bar{r}\lambda\kappa$. To see the welfare effect of the tax, we differentiate W with respect to t, which yields:

$$\frac{dW}{dt} = -v\mu\lambda(\hat{q}px - w - \bar{r})F'(\hat{q})\frac{d\hat{q}}{dt}$$

Evaluating at $t = 0$, we have $\hat{q}px - w - \bar{r} < 0$. From Proposition 2 we have $d\hat{q}/dt > 0$. It follows that

$$\frac{dW}{dt} > 0 \text{ at } t = 0,$$

which implies that national welfare is maximized when there is a positive tax on foreign capital.