Entrepreneurship, Financial Market Imperfections, and Trade *

Hitoshi Sato †

Hitotsubashi University

This Draft: November 2006

Abstract

It is widely recognized that financial intermediaries play an important role in supporting entrepreneurs who start innovative activities such as new businesses and R&D. This paper studies the formation of the entrepreneurial class in a simple trade model in which asymmetric information between entrepreneurs and financial intermediaries limits the extent to which the entrepreneurial class prospers. In a world economy with two countries identical except for the efficiency of financial intermediaries, the country with more efficient financial intermediaries exports the entrepreneur intensive good. This country not only expands the entrepreneurial class but also enjoys reduced agency problems resulting from improved terms of trade. However, if free trade in the financial intermediary sector is also permitted, the country with more efficient financial intermediaries loses comparative advantage in the entrepreneur intensive good and does not enlarge the entrepreneurial class relative to autarky. In particular, without international capital mobility, this country's entrepreneurial class would be smaller than the other country's. Also, the agency problem in the entrepreneur intensive good would be worse than the other country.

*I am grateful to Bob Staiger for guiding the direction of study and valuable comments. I would like to thank Charles Engel, Rodolfo Manuelli, Bruce Hansen and other seminar participants at University of Wisconsin and Hitotsubashi University for helpful suggestions. I also appreciate valuable comments from Taiji Furusawa, Maria Muniagurria and Menzie Chinne. All errors are mine.

†e-mail: satohit@econ.hit-u.ac.jp

1 Introduction

Financial markets pool small savings and reallocate them to the highest return use, mitigating inefficiencies that stem from agency problems or transaction costs. In particular, it is widely believed that when financial intermediaries finance entrepreneurs who are starting innovative activities, they facilitate the introduction of new products to markets.[1] Although it is not completely free from skeptical views, a large body of macroeconomics literature finds that the development of financial systems and productivity growth are positively correlated (for example, see Levine et al. (2000)).[2] If financial market imperfections have an impact on the real sector as suggested by the literature, it is natural to conjecture that such a impact would vary depending on industries and serve as a catalyst for gains from trade between countries. Motivated by this observation, this paper studies how trade in goods would impact the formation of the entrepreneurial class when financial markets are impaired by agency problems. Moreover, trade in services has attracted a great deal of interest of policymakers and businesses as exemplified by the inclusion of service trade into the GATT/WTO rules in the Uruguay round of trade negotiations. Upon this upsurge of interest, this paper also examines the impact of trade in financial intermediary services.

Several preceding studies highlight the role of financial markets in international trade. In a seminal study, Kletzer and Bardhan (1987) develop a two-sector model in which a country with a lower enforcement cost in credit contracts has comparative advantage in the sector relying on external finance. Beck (2002) explores evidence for Kletzer and Bardhan (1987) using a 30-year panel of 65 countries. Assuming that the manufacturing sector is more credit intensive than other sectors, he finds that financial development has a causal impact on exports and the trade balance of that sector.[3] Matsuyama (2004) shows that a wealthier country has a comparative advantage in the sectors in which borrowing constraints are relatively severe in a Ricardian framework. Although these studies provide useful insights on how financial market imperfections may cause international trade, none of them answer the questions raised above.[4]

In order to address the questions raised above, I begin in section 2 with developing a

[1] This idea dates back to Schumpeter (1911).

[2] King and Levine (1993a) and King and Levine (1993b) are early papers that test if the degree of financial development is positively related to economic growth, using data on 80 countries over the 1960-89 periods. Skeptics have criticized this type of cross-country study for failing to deal with causality appropriately. Responding to such a criticism, Rajan and Zingales (1998) test a more microeconomic hypothesis: countries with better financial institutions tend to observe relatively rapid growth in industries that are more dependent on external financing.

[3] Assuming that the manufacturing sector has an increasing returns to scale production technology and the other sector a constant returns to scale production technology, he shows that the manufacturing sector relies more heavily on external finance than the other sector. Then, he tests a correlation between private credit and the export/import share of the manufacturing sector.

[4] Grossman (1984) is an early study that examines the formation of entrepreneurs in a small open economy. Unlike the current model, without any agency problems or contracting problems, he considers an environment where risk averse agents either take profit risk as an entrepreneur or earn a risk-free wage as a worker. He shows that the supply of entrepreneurs is small in equilibrium relative to a first-best allocation.

simple general equilibrium framework in which heterogeneously skilled agents choose one of the following three occupations in the presence of credit market imperfections: starting an investment project that output is stochastic (risky project); starting an investment project that output is non-stochastic (safe project); and, instead of starting a project, depositing endowed capital asset in a financial intermediary (subsistence). I assume that one final good sector uses the fruits from the risky project while the other final good sector uses those from the safe project. This characterization reflects cross-industry differences in technological maturity, based on the premise that investment projects tend to fail more frequently in industries where technologies rapidly progress than in industries with matured technologies.

Each agent who chooses to start a project has to apply for a loan in order to finance project costs. The credit market imperfections are modeled as a standard costly state verification (CSV) problem: i.e., financial intermediaries cannot observe the realization of the risky project without using a costly auditing technology. In section 3, the model shows the formation of clusters of agents in a closed economy setting. The most skilled agents start the risky project and form the class of entrepreneurs. While the moderately skilled choose the safe project, a group of the least-skilled agents become lenders.

In section 4, I put the model in a two-country open economy setting and examine how international trade affects the formation of the entrepreneurial class and the income distribution over the different occupational classes. If a country had the more efficient financial intermediaries than the rest of the world, it would be the exporter of the entrepreneur intensive good (the risky-project intensive good) and expand the entrepreneurial class. One interesting finding is that such a country could benefit not only from the standard gains from trade (gains from exchange and specialization) but also from the mitigation of the agency problem in the risky project. The reverse would take place in the rest of the world would. If the rest of the world imperfectly specialized under free trade, its gains from trade would be partially offset by an exacerbation of the agency problem in the risky project. As a result of free trade in goods, most agents in the exporting sector would be better off and all agents in the importing sector worse off. Lenders' welfare change depends on which good a country would export. I also discuss an alternative source of comparative advantage. Even if there is no cross-country difference in the efficiency of the financial intermediary services, the two countries that have different distributions of capital asset endowments could gain from trade.

In section 5, I investigate how international trade in financial services would impact on the formation of entrepreneurial class and trade structure. To this purpose, I elaborate the financial service sector by introducing (i) a fixed overhead cost for auditing the risky project and (ii) an upper limit of the number of projects that a financial intermediary can audit. This seemingly minor departure form the standard CSV setting generates more subtle results than the base model. A basic insight that we obtain from this extension is that if free trade in financial intermediary services is permitted, a country with the better financial service

sector than the rest of the world loses comparative advantage in the entrepreneur intensive good and does not enlarge the entrepreneurial class more than in autarky. In particular, without international capital mobility, the entrepreneurial class in such a country might shrink. As a result, it would be an importer of the entrepreneur intensive good.

Prior to proceeding, I briefly show some empirical examples about cross-country differences in financial intermediaries and trade patterns in four major developed economies. It is widely recognized that the United States has more developed financial markets than other OECD countries, as is typically shown in the difference in the development of venture capital investment. For example, the OECD (2003) reports that among OECD countries, the United States had the largest venture capital investment over 1998-2001 as a share of GDP, about 0.5 per cent. In contrast, Japanese venture capital investment over the same period was almost negligible. The United Kingdom and Germany recorded about 0.21 per cent and 0.15 per cent.[5]

Additional indirect evidence is cross-country differences in accounting standards. Accounting standards reflect the degree of information disclosure. Higher accounting standards facilitate financial contracting by securing the interpretability and comparability of information across firms. Levine et al. (2000) report the index of accounting standards for 44 countries that was originally constructed by the Center for International Financial Analysis and Research.[6] This index noticeably varies even across developed countries. While the average score over 44 countries is 61 and the standard deviation is 13.5 (the possible maximum and minimum are 90 and 0, respectively), the Unites States and the United Kingdom have scores of more than 70. In contrast, Germany and Japan have 62 and 65, respectively.[7]

Now let us turn to trade patterns. Table 1 based on the OECD (2003) shows ratios of exports by industries with the highest R&D intensity to exports by industries with the next-highest R&D intensity. The group with the highest R&D intensity includes industries such as pharmaceuticals, computer and telecommunication equipments, and medical instruments. This group contains industries that heavily rely on venture capital investment in the Unites States.[8] The group with the next-highest R&D intensity includes industries such as electrical machinery, motor vehicles, and chemicals.[9] The United States and the

[5]Other statistics on venture capital investment indicate a similar tendency; the U.S. and U.K. have relatively high investment while Germany's is smaller relative to these two countries. Japanese venture capital investment tends to be of little importance. See for example, see Baygan and Freudenberg (2000).

[6]La Porta et al. (1998) and Rajan and Zingales (1998) use the same index.

[7]La Porta et al. (1998) conclude that the degree of protecting investors (and creditors) differs depending on legal origin. They discover that countries in the common-law tradition tend to protect investors more than countries in the French-civil-law tradition. German-civil-law countries take an intermediate stance toward investor protections. These differences in the legal framework may also have an impact on the performance of financial intermediaries.

[8]See Ueda and Hirukawa (2003) for this point. Such industries include office and computing machines, communication and electronics, and professional and scientific instruments.

[9]These are ratios of $\frac{\text{Exports in "high-technology" industries}}{\text{Exports in "medium-high-technology" industries}}$. "High-technology" represents a group of industries with the average R&D intensity in 1991-1999 more than 7.7 per cent. It includes Aircraft and space craft (ISIC 353), Pharmaceuticals (2423), Office, accounting and computing machinery (30), Radio, TV and communication equipment (32), medical, precision and optical instruments (33). "Medium-high-

Table 1: **Ratios of Exports in 2001 and 1992**

	2001	1992
United States	1.02	0.83
United Kingdom	1.21	0.67
Japan	0.59	0.58
Germany	0.40	0.28
Total OECD	0.65	0.48

Notes: Based on OECD, STI Scoreboard 2003, Table D.9.2. (p. 193).

United Kingdom tend to have higher export weights in industries with the highest R&D intensity relative to Japan and Germany (this tendency seems persistent as seen in both 2001 and 1992). Hence, this table supports a casual observation that the Unites States has comparative advantage in industries in which technologies rapidly progress while Japan and Germany have comparative advantage in industries with relatively matured technology, such as automobiles and consumer electronics.[10]

Related Literature In addition to the existing studies already mentioned, this paper is related to two recent studies that examine the role of financial market imperfection in dynamic settings. Considering a model in which wealth is stochastically accumulated over generations through bequests, Ranjan (2001) shows that a country with a strong system of legal enforcement has a comparative advantage in human capital intensive goods. Using a similar wealth accumulation model, Wynne (2005) stresses that wealth accumulation may change a country's comparative advantage to industries that tend to be exposed more sever

technology" is a group of industries with the next highest R&D intensity that range is between 3.9 and 2.1 per cent. This group contains Electrical machinery (31), Motor Vehicles, trailers and semi-trailers (34), Chemicals excluding pharmaceuticals (24 excluding 2423), Railroad equipment and transport equipment (352+359), machinery and equipment (29). Total OECD excludes Korea, Luxembourg, Czech Republic and Slovak Republic. R&D intensity is defined as the ratio of R&D to production in 12 OECD countries. For more detail, see OECD (2003).

[10]Characterizing industries in terms of individual-effort intensity and teamwork-effort intensity, Grossman and Maggi (2000) and Grossman (2004) argue that the Unites States has comparative advantage in software and financial services (individual-effort intensive), Japan and Germany have comparative advantage in automobiles and consumer electronics (team-work intensive), and Italy has comparative advantage in fashion designs (individual-effort intensive). They suggest that the financial sector is an industry in which a talented individual's performance is more important than team work. Of course, there might be many other elements that have formed the current international differences in the financial sector. Among them, institutional changes can have great impacts on the performance of the financial sector since it has been more strictly regulated by government than the manufacturing sector. Full-scale deregulation in the financial sector started in the early 1980's in the United Kingdom and United Sates. Other developed countries followed this trend. However, deregulation has differently evolved across countries. As another example, it is thought that a rapid development of venture capital in the Unites States is partly attributed to institutional changes, such as the introduction of the Bayh-Dole Act.

financial market imperfections.[11] These studies emphasize the role of factor accumulation to alleviate financial market imperfections in small country settings. This paper constructs a model in a general equilibrium setting and stresses general equilibrium ramifications of international trade in goods and services. This paper is also related to the work of Horn et al. (1995) that study the impact of international trade on managerial incentives in a moral hazard setting. However, in their study, international trade may improve managerial incentives by increasing the degree of competition in a Cournot model. Hence, the role of international trade is different from this paper.

The remainder of the paper proceeds as follows. Section 2 presents the model settings while Section 3 describes equilibrium in a closed economy. Section 4 examines the model in an open economy setting. Section 5 extends the model and discusses trade in goods and financial services. Section 6 concludes. The proofs and other technical comments are found in the Appendix.

2 Setup of the Model

This section develops a simple model in which each heterogeneously-skilled agent chooses one of the following occupations in the presence of financial market imperfections: (i) operating a risky investment project (entrepreneur); (ii) operating a safe investment project; and (iii) depositing her endowed asset at a financial intermediary (lender). I also briefly describe the model's equilibrium without financial market imperfections for reference.

2.1 Agents and Timing of Events

Consider a closed economy that comprises two sectors, Y and Z. Sector Y produces the hi-tech or "novel" good while sector Z produces the technologically matured or "conventional" good. The economy is populated with a continuum of risk-neutral agents of total mass 1. Each agent is endowed with a fixed amount of capital $k > 0$ at birth and lives for two periods, $t = 0, 1$. Agents consume the two final goods only in the second period. Their homothetic preferences over the final goods are represented by an indirect utility function $V(p_Y, p_Z)I$ where I is the income in the second period and p_Y and p_Z are the prices of goods Y and Z, respectively.

Given this preferences, agents attempt to increase their income as much as they can in the first period. At the beginning of $t = 0$, each agent draws from a costless lottery that provides her with an entrepreneurial skill. The entrepreneurial skill dictates the level of capital input required to start an investment project. Having observed her entrepreneurial skill, each agent settles down to one of the following occupations. First, agents can simply

[11] In their models, capital (or wealth) is stochastically accumulated over generations through bequests. Since they focus on linear Markov process, the steady-state distribution of capital is independent from the initial distribution. Without other parametrical differences, all countries eventually reach the same capital distribution. Therefore, the ultimate source of comparative advantage has to be sought somewhere outside capital endowment.

deposit their capital k at risk-neutral financial intermediaries and receive the safe return rk at $t = 1$ where r is the gross interest rate. Those who choose this option will be referred to as "lenders."

Second, agents may start an indivisible investment project. The necessary capital input level for the investment project is greater than agent's own capital k. Hence, in order to start an investment project, each agent has to apply for a loan from a financial intermediary. There are two types of investment projects. Each type of project yields a specialized intermediate good for final goods Y and Z. Abusing notations a little, the project for good Y will be referred to "project Y." The term of "project Z" will be used in the same manner. It is assumed that while project Z is a safe investment, project Y may fail and result in no output. Due to this specification, agents who choose project Y will be referred to "entrepreneurs." At $t = 1$, the agent knows her project realization. After selling her output in the perfectly competitive intermediate good markets, the agent repays the financial intermediary her debts and allocates the remaining revenue for the second-period consumption.

2.2 Production Technology

At $t = 0$, the investment projects come in discrete, indivisible units, and each agent can operate only one project. The amount of capital input required for startup is common between projects Y and Z. However, this amount varies according to agents' skills. A skilled agent can start either project with a low startup cost. More specifically, each agent draws her startup cost $x \in [\underline{x}, \bar{x}]$ from a density function $g(x)$ with cumulative distribution function $G(x)$. I assume that all agents have to borrow to start a project: $\underline{x} > k$.

Project Y succeeds, yielding q_1 units of intermediate product for good Y, with a probability $1 - \nu > 0$, and fails, yielding 0, with probability ν. In contrast, project Z is non-stochastic and always yields q units of intermediate product for good Z. In order to emphasize that the difference in these two types of projects is merely the risk of default, I assume that there is no productivity difference between the two projects on average: $\nu q_1 = q$. The intermediate goods can be converted to final goods in a one-to-one manner without any additional costs.

2.3 Financial Contracts

The financial market is perfectly competitive in the sense that the interest rate r is given for all agents and financial intermediaries. However, the financial market is imperfect due to asymmetric information between financial intermediaries and borrowers. Specifically, I apply a standard costly state verification (CSV) problem to project Y. Namely, the agent who has chosen project Y will have private information about the project realization. The financial intermediary can observe it only if he employs a costly auditing technology that precisely reveals the true state. It is also assumed that the agent's repayment to the financial intermediary cannot exceed her end of period wealth. Given this assumption of "limited

liability" along with the CSV problem, the agent is tempted to hide her revenue and renege the repayment.

Although there are several alternative ways to incorporate such a financial market imperfection into the model, the standard CSV problem is chosen here for two reasons. First, it readily links the riskiness of investment projects with credit market imperfections. As the probability of project failure increases, an agent is more tempted to hide her project success from the financial intermediary. This leads to a more frequent auditing and a higher lending rate. Second, it is well known that the financial intermediary chooses a simple debt contract for the standard CSV problem.[12] This solution clarity is a considerable advantage when we handle the agency problem in a general equilibrium setting.

By the revelation principle, the class of contract is restricted to direct-revelation mechanisms in which the agent reveals her private information. Since the financial market is perfectly competitive except for the CSV problem, the agent can offer a financial contract on a take-it-or-leave-it basis to a financial intermediary. Such a contract is composed of the amount of finance, the agent's net gains contingent on her reports on the project realization, and the probabilities that the financial intermediary verifies the project realization.

As is typical in models of this type, the agent in the state of "failure" truthfully reports the project realization in equilibrium. Thus, the financial intermediary never performs a costly state verification when the entrepreneur reports her "success." With this observation, the financial contract for the type-x agent must satisfy the incentive compatibility constraint for the agent: the agent's truth-telling gain $\pi(x)$ is no less than the gain from renege, namely,

$$\pi(x) \geq [1 - \eta(x)]pq_1, \tag{1}$$

where $\eta(x)$ represents the probability of auditing the type-x agent.

As for the financial intermediary's participation constraint, it is necessary that the expected repayment from the agent must be greater than or equal to the payment to lenders:

$$(1 - \nu)[pq_1 - \pi(x)] - \nu\eta(x)pc \geq r(x - k), \tag{2}$$

where c denotes a cost for auditing and it is measured in units of project output.

The contracting problem follows that (i) the incentive-compatibility constraint for the agent in (1) is binding; (ii) the financial intermediary's participation constraint in (2) is also binding. These two conditions give a set of $\eta(x)$ and $\pi(x)$ as follows:

$$\eta(x) = \frac{r(x - k)}{p(q - \nu c)} \tag{3}$$

and

$$\pi(x) = pq_1 - \left[\frac{q_1}{q - \nu c}\right] r(x - k), \tag{4}$$

where I impose $q - \nu c > 0$ in order for the (conditional) auditing probability $\eta(x)$ to be positive.

[12] See for example, Townsend (1979), Gale and Hellwig (1985), and Williamson (1986).

This solution set maximizes the agent's expected gain. In order to see this, it is convenient to rewrite the participation constraint for the financial intermediary as follows:

$$\eta(x)p[q - \nu c] = r(x - k). \tag{5}$$

The left-hand side of equation (5), the expected return to the financial intermediary, is linearly increasing in the auditing probability $\eta(x)$. Therefore, the binding participation constraint for the financial intermediary insures the profit maximization for the agent.[13]

Equations (4) implies that the unit price of external credit is inflated by $\lambda \equiv q/(q - \nu c)$ in order to cover the expected auditing cost. As would be expected, this mark-up rate is increasing in the probability of project failure ν and the auditing cost c. If either ν or c is zero, the mark-up rate λ becomes one and the financial market imperfection disappears.

Note that the conditional probability $\eta(x)$ is decreasing in the relative price p and increasing in the debt size $x - k$. Financial intermediaries punish the agent who attempted to hide the true state by confiscating all revenues pq_1. Thus, a higher relative price can discourage agents from deceiving financial intermediaries through raising agents' stakes for hiding their revenues. As a result, financial intermediaries can reduce the probability of auditing. In the same logic, the agents with higher debts are more likely to misbehave than those with lower debts. Thus, financial intermediaries have to audit high debtors more frequently than low debtors.

The incentive-feasible financial contract is summarized as follows:

- If the agent reports a "success," there is no auditing. Her returns after the repayment is given in equation (4). The agent's returns are always zero in "failure."[14]
- The financial intermediary commits himself to auditing the project state with the probability given in equation (3) if the agent reports a "failure."[15]

With this financial contract, the average output of project Y operated by the type-x agent is given by

$$y = q - \nu\eta(x)c, \tag{6}$$

which implies that the average project output y decreases when a less-skilled agent operates due to the agency problem. This skill-dependent (average) output of project Y contrasts with project Z that yields the same output regardless agents' skills.

[13] Also, note that the binding participation constraint for the financial intermediary minimizes the auditing cost.

[14] For the case that revenue realizations have a continuous support such that $q \in [0, \bar{q}]$, see the Appendix.

[15] This is a flaw of the standard CSV setting. It is *ex post* inefficient for the financial intermediary to perform a costly verification since the agent always faithfully reports the project state in equilibrium. In other words, the contract is not renegotiation-proof. I here assume that a commitment device, such as legalized disclosure rules, is available to financial intermediaries. An alternative assumption is to interpret the auditing cost as unavoidable costs for liquidating an unsuccessful project. Regardless the flaw of the *ex-post* inefficiency, main implications of the standard CSV setting seem still appealing: debt contracts are prevailing in the real world; the lending rate is inflated due to the necessary auditing cost.

2.4 Perfect Information

Prior to examining the model with asymmetric information, a brief review of the case of perfect information (i.e. $\lambda = 1$) is helpful to see how the model basically works. Note that all agents and financial intermediaries are risk-neutral, which implies that projects Y and Z are indifferent for them.

Let $v(z)$ be the expected return of an agent of type x. Choosing good Z as the numeraire, $v(x)$ satisfies

$$v(x) = \max\{pq - r(x-k),\ q - r(x-k), rk\},$$

where p denotes the relative price of good Y. Both goods must be produced in equilibrium. This implies that all agents are indifferent between the two projects with $p = 1$.

The total capital $\bar{k}$ is equal to the total project costs such that

$$\bar{k} = \int_{x \in E} x dG(x), \tag{7}$$

where E is the set of agent types who start the projects. Since the project return is monotonically decreasing in x, this equilibrium condition in the credit market solely determines the marginal agent of type $\hat{x}$ whose project return is equal to rk. This, in turn, pins down the equilibrium interest rate to $r = q/\hat{x}$. I assume that the equilibrium interest rate cannot be below 1.

Figure 1 illustrates the determination of lenders and borrowers. The expected returns from a project are expressed as a downward-sloping straight line with slope $-r$. All agents who belong to the interval $[0, \hat{x}]$ become borrowers. The sum of the total outputs of the two final goods is given by $Y + Z = qG(\hat{x})$ so that the production possibility frontier (PPF) is simply a straight line with slope -1. The allocation between the two sectors is determined by the demand side.

It is noteworthy that there would be no international trade with perfect information, provided that all countries have the same preferences and the investment technologies: all countries would have the common autarky price.

3 Equilibrium in a Closed Economy

This section solves the model in a closed economy setting. I will first show that agents are clustered according to their skill levels: only the most skilled agents start project Y and the least skilled agents become lenders while moderately skilled agents start project Z.

3.1 Project Choice

Similarly to the case of perfect information, an agent of type x gains

$$v(x) = \max\{pq - \lambda r(x-k),\ q - r(x-k), rk\}.$$

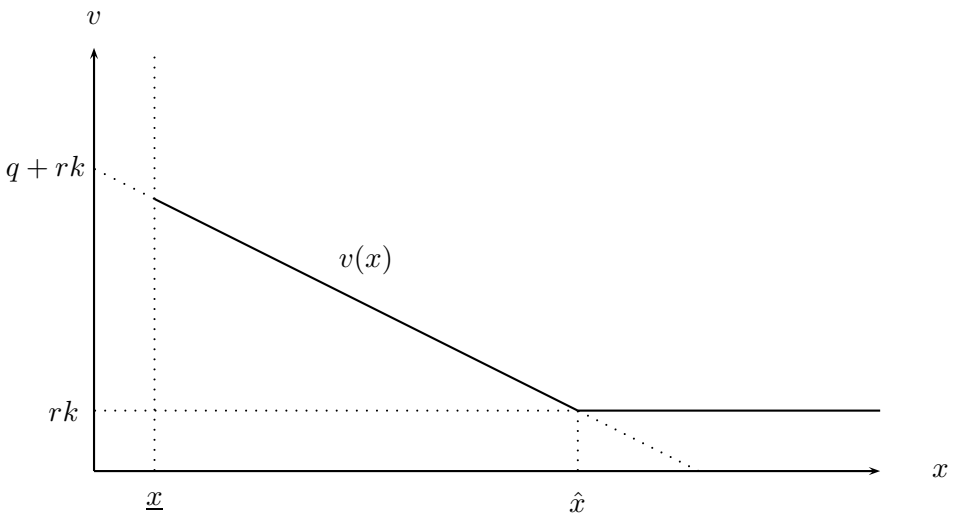

Figure 1: **Determination of Borrowers and Lenders.**

More-skilled agents (low x) could gain more than less-skilled agents (high x) in both projects Y and Z. Notice, however, that the production risk in project Y raises not only the lending rate but also the expected marginal return of agents' own capital as seen in $\partial(1-\nu)\pi(x)/\partial k = \lambda r > r$. Hence, more-skilled agents who do not have to rely on external finance so much as less-skilled agents tend to prefer project Y to project Z. In other words, more-skilled agents are less exposed to the agency problem than less-skilled agents. Based on this observation, we establish the following results about agents' occupational choice.

Lemma 1. *Given that both projects Y and Z are active in an economy, there exist two thresholds of agent types x_1 and x_2 such that*

1. *all agents with $x \in [\underline{x}, x_1]$ start the risky project (project Y).*
2. *all agents with $x \in [x_1, x_2]$ start the safe project (project Z).*
3. *all agents with $x \in [x_2, \infty)$ become lenders.*

Proof. See the Appendix. □

Figure 2 illustrates the essence of Lemma 1. As is in Figure 1, agents' expected returns from the investment projects are two downward-sloping straight lines. Due to the agency problem, the slope of project Y, $-\lambda r$, is steeper than one in project Z. When both projects to be active in the economy, the agents in the interval $[\underline{x}, x_1)$ strictly prefer project Y to project Z. The determination of x_2 is exactly the same as in the perfect information case. Accordingly, the model exhibits a "positive sorting" of agents heterogenous in entrepreneurial skills. The most-skilled agents apply for loans from financial intermediaries and launch the risky project: they become "entrepreneurs." The moderately-skilled agents choose the

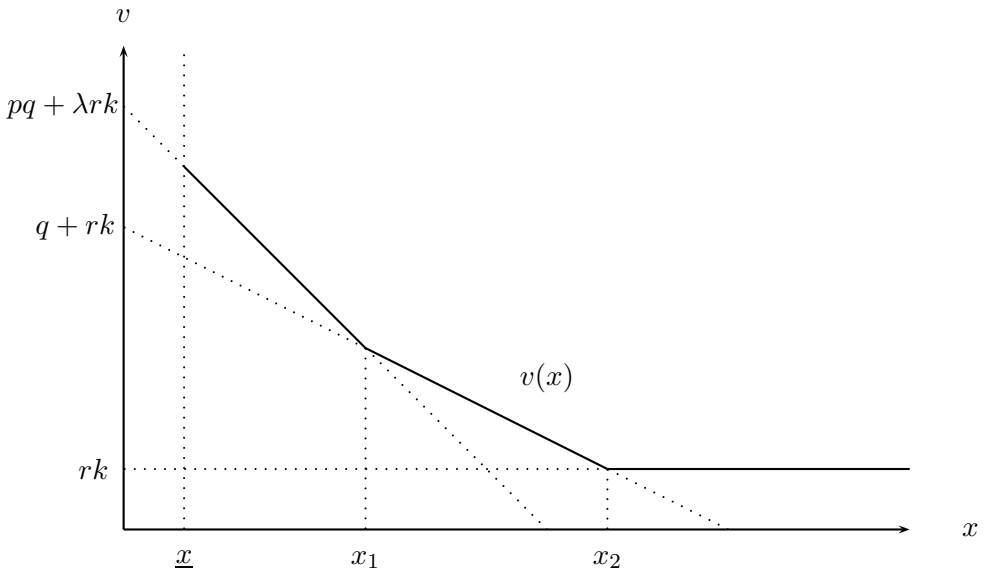

Figure 2: **Determination of Entrepreneurs.**

safe project. In return for the safe and uniform revenues, the least-skilled agents provide their capital assets for borrowers through the financial intermediaries.

There is no agent who is refused a loan in spite that she is willing to start an investment project. In this sense, credit-rationing dose not occur in the model. Different lending rates in the two projects determine different borrowing limits for projects Y and Z. As a result, all agents optimally choose their occupations.[16]

The threshold types are characterized as follows. The agents of type x_1 observe

$$x_1 - k = \frac{(p-1)q}{(\lambda - 1)r}, \tag{8}$$

which implies that a higher relative price p enables more agents to choose project Y.

Similarly, the agents of type x_2 observe

$$x_2 = \frac{q}{r}. \tag{9}$$

As in the perfect information case, the marginal borrowers' type x_2 is determined by the credit market clearing in equation (7). Hence, the equilibrium interest rate is simply $r = q/x_2(k)$.[17]

[16]The CSV literature often claims that CSV problems could cause credit-rationing. Hence, some readers might wonder why any credit-rationing would not occur as the current model is a variant of the standard CSV model. This is because the identities of lenders and borrowers are endogenously determined in the model. In fact, most existing CSV models assume an exogenous fixed ratio at which agents can access investment projects.

[17]Since project Z is risk-free in the current setting, the equilibrium interest rate is the same as the one in the case of perfect information. If the risk-free project is not available in the economy, the interest rate would divert from that under perfect information. When the minimum risk project has the index $\underline{\lambda} > 1$, the interest rate becomes $\tilde{r} = q/[\underline{\lambda}(x_2(k) - k) + k]$. It is straightforward to see that $\tilde{r} < r$ due to the inefficiency of auditing.

3.2 Equilibrium Analysis

We can now describe the general equilibrium of the closed economy. I assume that there is no output uncertainty in good Y at the aggregate level. By Lemma 1, the output of sector Y can be derived by aggregating equation (6) as follows:

$$Y(p) = qG(x_1(p)) - \nu c \int_{\underline{x}}^{x_1(p)} \eta(x,p)g(x)dx. \tag{10}$$

The agents between x_1 and x_2 are engaged in project Z: i.e.,

$$Z(p) = q[G(x_2) - G(x_1(p))]. \tag{11}$$

It is straightforward to see that $Y(p)$ is increasing in p. Furthermore, notice that such an output increase is composed of two parts. The derivative of equation (10) with respect to p is given by

$$\frac{dY(p)}{dp} = [q - \nu\eta(x_1,p)c]g(x_1)x_1'(p) + \frac{\nu c}{p}\int_0^{x_1(p)} \eta(x,p)g(x)dx. \tag{12}$$

The first term is the increase by an inflow of agents from project Z. The second term is due to the mitigation of the financial market imperfection. As discussed in the previous section, a higher p reduces the frequency of auditing since it raises the value of project Y, thus encouraging agents, the residual claimant of the project, to report the project realization truthfully.

With equations (10) and (11), we can construct a relative supply schedule $y_s(p) \equiv Y(p)/Z(p)$ that is monotonically increasing in p. Therefore, along with the standard relative demand schedule, a unique equilibrium is determined at the intersection. This result is summarized in the following proposition along with comparative statics analysis:

Proposition 1. *There exists a unique equilibrium in which all agents are sorted as described in Lemma 1. The equilibrium relative price of good Y increases as (i) the agency problem becomes severe (an increase in λ); (ii) the aggregate capital endowment decreases.*

Proof. See the Appendix. □

The results of comparative statics are intuitive. A higher λ (i.e. a high c and/or high ν) increases the output loss in good Y through exacerbating the agency problem. Likewise, when the aggregate capital asset decreases, all entrepreneurs have to borrow more, which implies that financial intermediaries have to audit agents in project Y more frequently. This also leads to an increase in the output loss in good Y.

It is useful to characterize the production possibility frontier (PPF) for the analysis that I carry out in the next section. Recall that the PPF under perfect information is a linear line. The heterogeneity in entrepreneurial skills does not play any role there. However, once financial market imperfections are introduced, the skill heterogeneity generates the "positive-sorting" of agents. This leads to a bowed-out PPF. This is recorded in the following corollary of Proposition 1.

Corollary 1. *With credit market imperfections, the production set of the economy is strictly convex. As the degree of credit market imperfections becomes severe, the production possibility frontier (PPF) shifts inward, holding the maximum potential output of sector Z constant.*

Proof. See the Appendix. □

The logic of the corollary is simple. The set of outputs (Y, Z) varies as threshold x_1 shifts over the interval $[\underline{x}, x_2]$. As a result of the positive sorting, the project output by the threshold type x_1, $q - \nu\eta(x_1)c$, falls as the output of good Y increases (the production of good Y is decreasing returns to scale in agents). In project Z, any agent yields q (the output of good Z is constant returns to scale in agents). A bowed-out PPF follows immediately from this. This also implies that the "positive-sorting" is socially efficient, minimizing the production inefficiency stemming from the financial market imperfection.

4 Open Economy Analysis

In this section, putting the basic framework discussed above in a two country open economy, I will explore gains from international trade. Two potential sources of comparative advantage will be considered. First, it is assumed that the countries are different in the quality of financial intermediary services. I call this type of difference "institutional difference." The model becomes a variant of Ricardian model and presents a clear-cut picture of international trade. After showing trade patterns, welfare consequences of trade will be discussed.

The second potential source is differences in the distribution of the capital endowment. Since we know that a higher capital endowment k has a similar effect on the equilibrium relative price p to a lower auditing cost c, it is more interesting to compare different distributions with the same mean.[18] This type of difference will be referred to as "distributional difference." Unfortunately, unlike "institutional difference," this difference demands additional parameter restrictions in order to obtain a decisive prediction about patterns of trade.

4.1 Institutional Difference

Consider now a world economy with two otherwise identical countries that have different verification technologies. I refer to these two countries as "home" and "foreign" and will use an asterisk (*) to denote foreign variables. Suppose that the home country has a lower auditing cost than the foreign country, that is, $c < c^*$.

Since (i) the two countries' capital endowments are the same and (ii) a risk-free project is available, the two countries have the same equilibrium interest rates in autarky. Hence,

[18] This line of comparative advantage is similar to Grossman and Maggi (2000) and Grossman (2004). However, the embedded mechanism in this paper is completely different from theirs.

there is no room for international capital flows. In addition, as long as both countries are imperfectly specialized under free trade, the interest rates under open economy are still the same. I focus on this case.

From the analysis of the closed economy, it is straightforward to see patterns of trade between these two countries. The home country has the greater number of agents who can start the risky project than the foreign country since the financial intermediaries in the home country offer the lower lending rate for the risky project than those in the foreign country. It leads to a lower autarky relative price of good Y in the home country. Patterns of trade are summarized in the following proposition.

Proposition 2. *Suppose that the home country has a better auditing technology than the foreign country ($c < c^*$). Then, the home country exports good Y (output of the risky project) and imports good Z (output of the safe project) in a free-trade equilibrium.*

Proof. See the Appendix. □

Figure 3 illustrates the PPFs for the home and foreign countries. The absence of distortions in sector Z reflects the same vertical intercept. As is shown in the proof of Proposition 2, when the two PPFs have the same slope, the relative supply of good Y is greater in the home country than in the foreign country. Point A represents the home country's autarky. If the same autarky price p^a is applied to the foreign county, the foreign production occurs at point B, the tangency between the foreign PPF and the price line with slope p^a. By the assumption that the two countries have the identical homothetic preferences, it is immediately established that $p^a < p^{a*}$.

Let point C be the home production point under free trade. Since the relative price of good Y rises at this point, the home country can enjoy a gain stemming from the alleviation of financial market imperfections at point C. This can be seen by drawing a hypothetical PPF on which the probability of auditing is evaluated at the autarky price p^a. A dashed curve in the figure depicts such a hypothetical PPF (the upper part is omitted for the simplicity in the presentation). Point D that has the same allocation of agents as point C (free trade) shows the production efficiency loss by fixing the auditing frequency at the autarky level.

4.2 Effects of Trade

We now turn to the distribution of gains from trade. Consider first the home country. Figure 4 depicts the change in the allocation of agents caused by free trade as an upward shift in the expected return schedule in project Y. The interest rate does not change in the case of imperfect specialization. While the total number of lenders does not change, the agents who run project Y increases from $[\underline{x}, x_1]$ to $[\underline{x}, x_1']$. The foreign country experiences the opposite allocation change.

Consider next which class of agents benefit from trade. The agents who run project Z ($x \in [x_1', x_2]$) and the lenders ($x \in [x_2, 1]$) earn the same incomes as before free trade. Hence,

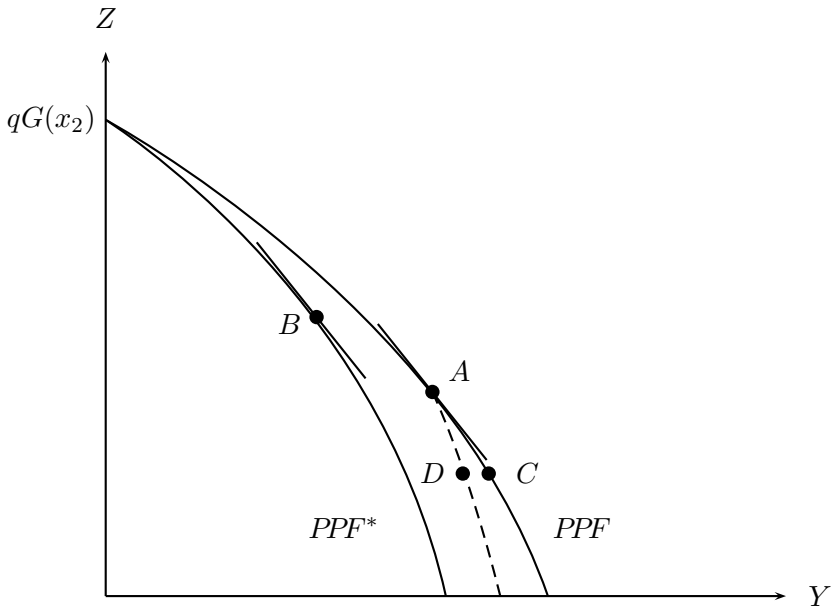

Figure 3: **Comparative Advantage and Gains from Trade.**

they are worse off since their purchasing power unambiguously falls in terms of good Y. In contrast, the agents who choose project Y in autarky gain since their purchasing power rises in terms of either good. Notice that the expected repayment $\lambda r(x-k)$ is invariant to the relative price of good Y. Thus, among agents who run project Y in autarky, those who are less-skilled tend to gain more from free trade.

The agents who switch from project Z to project Y after opening up trade may gain or not. Letting Δp be the increase in the relative price due to free trade, their income increment $\Delta v(x)$ takes some value between $[0, \Delta pq]$ according to their types $x \in [x_1, x_1']$. The agents who are close to x_1 tend to gain while those who are close to x_1' tend to lose. The type of agents who are neutral depends on the consumption share of good Y, for example. As the consumption share of good Y becomes smaller, the number of agents who can gain from trade increases.

In the foreign country, the opposite welfare changes take place. The agents who chose project Z in autarky and the lenders gain from trade. The agents who choose project Y in autarky are unambiguously worse off. The agents who switch from project Y to project Z under free trade may gain or lose.

It is noteworthy that the home lenders lose while the foreign lenders gain from trade even though they simply offer their assets through the save deposits: free trade works adversely (favorably) for the lenders who reside in the country with superior (inferior) financial institutions. This counterintuitive result may emerge since all agents are sorted to the different occupations according to their skills and the home country continues to produce the good without comparative advantage due to imperfect specialization. Even

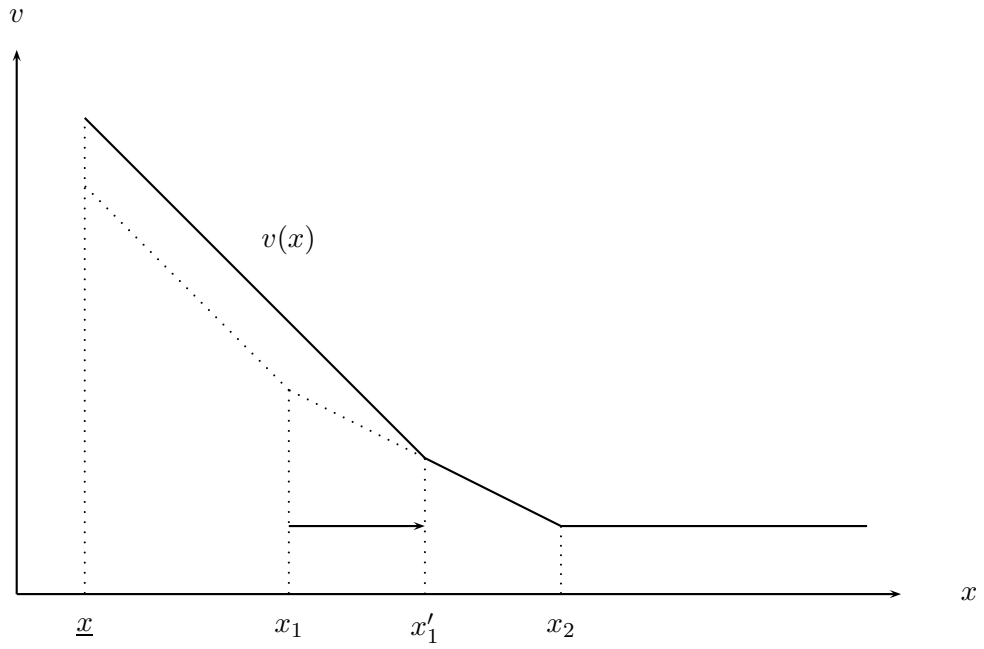

Figure 4: **Effects of Trade on Occupational Choice (Imperfect Specialization).**

though lenders' capital finances the exporting sector (Y), the interest rate is determined such that the threshold lenders (x_2) are indifferent to project Z (importing sector).

These findings are summarized in the following proposition.

Proposition 3. *If a country imperfectly specializes and exports good Y, there exists a threshold project start-up cost $\tilde{x} \in (x_1, x_1')$ such that all agents who have $x < \tilde{x}$ gain and those who have $x > \tilde{x}$ lose from free trade: i.e.,*

1. *The agents who could run project Y in autarky ($x \in [\underline{x}, x_1]$) gain.*
2. *The agents who would choose project Z in autarky but switch to project Y under free trade ($x \in [x_1, x_1']$) may gain or lose.*
3. *All agents who would choose project Z under free trade ($x \in [x_1', x_2]$) and lenders ($x \in [x_2, \infty)$) lose.*

In contrast, if a country exports good Z, there exists threshold type agents among those who switch from project Y to Z after opening up trade. All agents who have lower project start-up costs than this threshold type lose and those who have higher project costs gain from free trade.

From Proposition 3, the following observation is immediate:

Corollary 2. *Compared to autarky, if a country has comparative advantage in good Y, the income inequality across agents increases under free trade in the Lorentz dominance sense. If a country has comparative advantage in good Z, the income inequality across agents decreases under free trade.*

4.3 Distributional Difference

This section will explore another potential source of comparative advantage. Could two countries that have different distributions of capital endowments gain from trade in the presence of financial market imperfections? This question is motivated by the analysis of "institutional difference" that concludes that the home country has a wider income distribution than the foreign country under free trade. For example, consider two countries that have started trade based on their auditing technology difference. Then, suppose that such a difference disappears because one country catches up to the other in terms of the quality of financial intermediaries. Would trade also disappear? In order to examine this question in full scale, an appropriate dynamic model is needed.[19] This task is beyond the scope of this paper. However, as a preliminary step, it may be useful to examine whether differences in the distribution of capital endowments can solely be a source of comparative advantage in a static model.

In order to focus on differences in capital distributions, I will fix the project cost at x.[20] At the beginning of the first period, each agent draws her asset $k \in [\underline{k}, \bar{k}]$ from a density function $f(k)$ with cumulative distribution function $F(k)$. I set $\bar{k} < x$ in order to maintain the assumption that no agent can self-finance her project. Furthermore, for analytical simplicity, I will focus on a particular class of distributions such that (i) distributions have the single-crossing property, (ii) a distribution is obtained from another by a *symmetric* mean-preserving spread, and (iii) density functions are symmetric.

By Proposition 1, we already know that two countries that are identical except for the aggregate supply of capital would trade. In order to eliminate this motivation of trade, I assume that the mean capital endowments is the same across countries. Without loss of generality, suppose that the home country has a more dispersed distribution of capital than the foreign country. These assumptions are summarized as follows.

Assumption 1. The home capital distribution $F(k)$ and the foreign capital distribution $F^*(k^*)$ satisfy

(a) $\hat{k} \equiv \int_{\underline{k}}^{\bar{k}} k dF(k) = \int_{\underline{k}^*}^{\bar{k}^*} k dF^*(k)$,

(b) $F(k) > F^*(k)$ for $\min\{\underline{k}, \underline{k}^*\} < k < \hat{k}$ and $F(k) < F^*(k)$ for $\hat{k} < k < \max\{\bar{k}, \bar{k}^*\}$.

[19] Wynne (2005) presents a dynamic model of international trade in which the enforcement of financial contracts is imperfect. In his model, the initial income distribution is irrelevant to the steady-state distribution. Thus, differences in the income distributions between two economies by themselves cannot be an ultimate motivation of trade. However, this conclusion depends on the assumption of linear Markov process. It is known that once this assumption is relaxed, multiple invariant distributions are possible in the steady state. For example, see Banerjee and Newman (1993).

[20] In this model, differences in agents' skills are translated to differences in the start-up costs of the investment projects. Thus, changing the capital distribution under a constant x is equivalent to changing the skill distribution under a constant k as long as financial market imperfections exist. However, I explicitly modify the model for expositional clarity. When financial market imperfections do not exist, differences in capital endowments are no longer equivalent to those in agents' skills. With the heterogeneity of capital endowments, all agents are indifferent between running a project and depositing their capitals.

(c) $F(\hat{k}) = F^*(\hat{k}) = 1/2$.

Recalling that the total mass of agents is 1, the credit market clearing condition is given by

$$[1 - F(k_2)]x = \hat{k}, \tag{13}$$

where k_2 represents the capital endowments owned by the marginal agents who are indifferent between project Z and depositing. The equilibrium interest rate is simply $r = q/x$. Using this interest rate, the agents who are indifferent between projects Y and Z have capital k_1 such that

$$k_1 = \frac{(\lambda - p)x}{\lambda - 1}. \tag{14}$$

The setting of financial contracting is the same as before except that the two countries have the same auditing costs. Thus, the conditional probability of auditing is given by $\eta(k) = r(x - k)/p(q - \nu c)$.

The aggregate output of good Y is obtained by subtracting the output loss due to auditing from the gross output. This is expressed by

$$Y(p) = q[1 - F(k_1(p))] - \frac{\gamma}{p}\int_{k_1(p)}^{\bar{k}} (x - k)f(k)dk, \tag{15}$$

where

$$\gamma \equiv \frac{\nu c r}{q - \nu c}.$$

The aggregate output of good Z is given by

$$Z(p) = q[F(k_1(p)) - F(k_2)]. \tag{16}$$

The aggregate outputs of goods Y and Z in the foreign country are analogous to the home country's outputs.

Now we are prepared to ask whether or not these two countries could gain from trade. The answer is partially "yes." For the same reason as that in the case of skill heterogeneity, agents are clustered according to their capital endowments: the richest agents opt for project Y; the middle-class agents choose project Z; the poorest agents become lenders. Therefore, intuitively, it seems that the home country's wider capital distribution is more efficient in the production of good Y than the foreign country's unless the mass of lenders is small. For example, suppose that the threshold capital k_1 is the average capital ($\hat{k} = \hat{k}^*$).[21] Although both countries have the same number of project Y (=1/2), the home country produces more good Y than the foreign country. This is because the aggregate output loss due to the costly auditing is smaller in the home country than the foreign country. However, of course, if the threshold capital k_1 declines further, the foreign country's output of good Y increases rapidly and equals the home country's output of good Y at some $k_1 \in (\underline{k}^*, \hat{k})$ since

[21] Namely, $p = p* = \lambda(1 - \hat{k}/x) + \hat{k}/x$ is chosen.

the foreign country has the thicker distribution of the middle-class agents than the home country. The total measure of projects $1-F(k_2)$ depends on the ratio of capital endowments to the project cost, $\hat{k}/x$. Therefore, we can summarize the possibility of international trade solely based on the distributional difference in capital endowments as follows.

Proposition 4. *Suppose that relative to the capital endowment, the project cost is sufficiently high so that the mass of projects is no more than 1/2. Then, the home country unambiguously has the comparative advantage in good Y. Otherwise, which country has comparative advantage in good Y is not necessarily clear.*

Proof. See the Appendix. □

When does the threshold capital k_1 decrease? From equation (14), it is straightforward to see the following two cases: (i) the relative price of good Y is high (i.e. preferences are skewed toward good Y); (ii) the external credit dependence is low (i.e. a high $\hat{k}/x$). Notice that in each case, the agency problem is mitigated. Thus, when the agency problem is not significant, it becomes difficult to identify gains from trade.

In contrast to the institutional difference, the distributional difference examined here suggests gains from trade in the limited cases. It is not easy to assess to what extent such limitations could be justified. However, it is known that industries vary in terms of the degree of external finance dependence and that younger firms tend to rely on external credit markets more than older firms in most industries. Rajan and Zingales (1998), for example, report that industries such as drugs, radio, office and computing, and professional goods show high external financial dependence relative to other industries. Thus, we may conjecture that trade based on the distributional difference might be important in such industries.

4.4 Trade in Financial Services (Preliminaries)

So far the possibility that the home financial intermediaries offer financial services to the foreign agents has been abstracted from the model. This section allows financial intermediaries to provide financial services freely across the borders. We return to the assumption that the home country has the better auditing technology such that $c < c^*$. Except for this difference, as the previous section, the two countries are identical.

The result of free trade in financial services is simple: the home country offers financial intermediary services to all agents in project Y. Since the home financial intermediaries can offer the lower lending rate for project Y, all foreign financial intermediaries cease financing project Y. This implies that the foreign country becomes a replica of the home country. Trade in goods, hence, becomes redundant.

Both countries realize the resource allocation equivalent to that in the home autarky. Free trade in services is completely substitutable with free trade in goods. All gains from trade in financial services belong to the foreign country.

These observations are summarized in the following proposition.

Proposition 5. *Suppose that the home country has a better auditing technology than the foreign country. In the model economy, free trade in financial services completely substitutes trade in goods. Both countries realize the same resource allocation as that in the home autarky. The foreign country can enjoy all gains from trade in financial services.*

With respect to the welfare changes by service trade, the following results are immediate.

Corollary 3. *Free trade in financial services yields a higher world welfare than free trade in goods and service autarky. The foreign country is better off and the home country is worse off, compared to trade in goods.*

Although these results are instructive, they contain extremes: free trade in financial services not only completely substitute trade in goods but also enables the foreign county to enjoy all gains from trade. Obviously, these extremes are partially attributed to the model structure. financial intermediaries do not have any resource constraints for auditing. In order to examine the issue of trade in financial services further, it is necessary to provide more detailed structure for the financial intermediaries in the model. I pursue this in the following section.

5 Trade in Financial Services

In this section, I incorporate the financial service sector into the model in a more explicit manner: (i) financial intermediaries have to incur a fixed cost for auditing project Y; (ii) the auditing technology has a capacity constraint. These minor modifications enable us to examine in a richer framework the role of the financial service sector in trade.

5.1 Set-up

The credit market is imperfect due to the CSV problem in sector Y as in the basic model. I add the following assumptions:

- Each financial intermediary needs to incur a fixed overhead cost $k_f > 0$ (measured in units of capital) to provide financial services for entrepreneurs in project Y.
- Each financial intermediary can audit up to $\bar{m}$ entrepreneurs in project Y.

These two assumptions are motivated by the premise that financial intermediary services for venturous projects require expertise. The fixed cost k_f can be interpreted as a cost for maintaining a specialized auditing technology for a certain industry.

A financial intermediary accepts an incentive-feasible contract similar to the one in the basic model. The only difference from the original contract is that each financial intermediary must collect additionally k_f units of capital from lenders. If we assume that each

financial intermediary evenly spreads the fixed cost k_f over $\bar{m}$ projects, the incentive-feasible contract is obtained by solving the following two equations simultaneously:

$$\pi(x) = [1 - \eta(x)]pq_1, \tag{17}$$

and

$$(1 - \nu)[pq_1 - \pi(x)] - \nu\eta(x)pc = r(x - k + k_f/\bar{m}). \tag{18}$$

The results are as follows:

$$\eta(x) = \frac{r(x - k + k_f/\bar{m})}{p(q - \nu c)}, \tag{19}$$

and

$$\pi(x) = pq_1 - \left[\frac{q_1}{q - \nu c}\right] r\left(x - k + k_f/\bar{m}\right). \tag{20}$$

Note that if $\bar{m}$ goes to infinity, the above contract becomes identical to that in the basic model. Thus, the base model is a special case in which financial intermediaries virtually have no resource constraint. Another note is that the introduction of the auditing capacity and the fixed cost is equivalent to that each agent would have to increase borrowing by $k_f/\bar{m}$ compared to the basic model (compare equation (20) to equation (4)). Since it is a measurement issue, the auditing upper limit $\bar{m}$ will be normalized to one, hereafter.

5.2 Equilibrium

As in the basic model, each agent chooses the occupation that yields the highest return. The threshold agents of type x_1 who are indifferent between projects Y and Z satisfy $pq - \lambda r(x_1 - k + k_f) = q - r(x_1 - k)$ where $\lambda = q/(q - \nu c)$, namely,

$$r(\lambda - 1) = \frac{q(p - 1) - \lambda r f_k}{x_1 - k}. \tag{21}$$

Intuitively, the threshold type x_1 is determined such that the net increase in project return per unit of borrowing (the right-hand side) equals the net increase in the per unit borrowing cost.

The threshold agents of type x_2 between project Z and lending are the same as those in the basic model, satisfying $q - r(x_2 - k) = rk$. This is expressed by

$$x_2 = \frac{q}{r}. \tag{22}$$

The credit market clearing condition is modified as follows:

$$\bar{k} = \int_{\underline{x}}^{x_2} x dG(x) + k_f G(x_1), \tag{23}$$

where $k_f G(x_1)$ is the total capital used by the financial intermediaries financing project Y. This credit market clearing condition implies that the total number of projects in the

economy must decrease as the number of project Y increases (a lower x_2). Equations (21), (22), and (23) determine the interest rate r that clears the credit market for a given p. It is straightforward to see that as p rises, the interest rate r also rises. This is because a higher p induces more agents to choose project Y that increases the capital demand by financial intermediaries. Thus, denoting the interest rate that clears the credit market by $r = r(p)$, we can express the aggregate outputs of goods Y and Z as functions of p only. The remaining endogenous variables p, Y,and Z are solved for using the two aggregate outputs and the relative demand.

The aggregate outputs take the same forms as in the basic model: i.e.,

$$Y(p) = qG(x_1(p)) - \nu c \int_{\underline{x}}^{x_1(p)} \eta(x,p) g(x) dx, \tag{24}$$

and

$$Z(p) = q[G(x_2(r(p))) - G(x_1(p))], \tag{25}$$

where $\eta(x,p) = r(p)[x - k + k_f]/[p(q - \nu c)]$.

The partial derivative of $Y(p)$ with respect to p is given by

$$\frac{\partial Y(p)}{\partial p} = [q - \nu \eta(x_1, p)c] g(x_1) x_1'(p) - \frac{\nu c(\epsilon_r - 1)}{p} \int_0^{x_1(p)} \eta(x,p) g(x) dx, \tag{26}$$

where ϵ_r is the elasticity of the interest rate with respect to the relative price such that $\epsilon = r'(p)p/r$. It can be shown that $\epsilon_r < 1$ (see the Appendix). This also implies that the r's increase induced by a rise in p does not completely offset the effect of the initial p's increase on x_1 in equation (21) (i.e. $x_1'(p) > 0$). Thus, we conclude that $Y(p)$ is increasing in p. The current setting yields the same result about output change as the basic model. A higher p increases Y through inflows of entrepreneurs from the safe project as well as a decrease in the output loss caused by auditing.

It is immediate that $\partial Z(p)/\partial p < 0$ from $x_2'(r) \cdot r'(p) < 0$ and $x_1'(p) > 0$. In sum, it is established that the relative supply $y_S(p) = Y(p)/Z(p)$ is monotonically increasing in p. As in the basic model, along with the standard relative supply curve, we can identify a unique equilibrium at the intersection.

I next examine comparative statics with respect to the overhead fixed cost k_f. A lower k_f (or equivalently a higher $\bar{m}$) improves the efficiency of financial intermediary services. From the credit market clearing condition in equation (23), the effect of a lower k_f is essentially the same as the one of a higher k. Therefore, we can obtain similar results to those in the comparative statics described in Proposition 1.

Proposition 6. *As the overhead fixed cost for financial intermediaries decreases (or equivalently, each financial intermediary becomes able to audit more risky projects), the relative price of good Y declines. The interest rate also declines.*

Proof. See the Appendix. □

These results are easy to understand. By an improvement in the efficiency in the financial service sector, more capital resources become available to project investments. The agency problem in sector Y is mitigated since each entrepreneur can reduce its reliance on the credit market.

5.3 International Trade

I measure the efficiency of financial intermediary services by the fixed overhead cost k_f. This cost may include some regulation costs by financial authorities. Considers two countries that are identical except for k_f. Suppose that $k_f < k_f^*$, namely, the home country has the more efficient financial service sector than the foreign country. From Proposition 6, the home autarky price p^a is lower than the foreign autarky price p^{*a}. Also, the home autarky interest rate r^a is lower than the foreign autarky interest rate r^{*a}. From equation (22), this implies that the total number of projects undertaken in the home country is greater than that in the foreign county ($x_2 > x_2^*$). In other words, even though the foreign country has a larger mass of lenders than the home country, the foreign country's production is lower in both goods Y and Z than the home country's.

The following patterns of trade liberalization will be examined.

[INT] *Free trade in goods and services with international capital mobility (Integration).* The two countries are integrated with the exception that agents' immigration is prohibited.

[SA] *Service autarky.* There is free trade only in final goods Y and Z. International capital mobility is not allowed.

[SAC] *Service autarky with international capital mobility.* There is free trade only in final goods Y and Z. However, capital is mobile across the countries.

[ST] *Service trade.* Free trade in goods and financial services. International capital mobility is not allowed.

5.3.1 Free trade in goods and services with capital mobility (INT)

I start with this extreme case as a benchmark. This case is similar to free trade in services in the basic model. Since capital is footloose across the countries, the home and foreign countries become virtually a single economy.

All foreign financial intermediaries are replaced with home financial intermediaries since the home financial intermediaries can always offer a better financial contract than the foreign intermediaries. Financial intermediaries' (gross) revenue from financing an agent of type x is expressed by $r(x - k + k_f)$ (see the right-hand side of equation (18) with $\bar{m} = 1$). Since the home and foreign financial intermediaries face the same interest rate, it is straightforward that the foreign financial intermediaries cannot compete with the home financial intermediaries.

Let $\tilde{p}$ and $\tilde{r}$ be the equilibrium relative price of good Y and the interest rate. The credit market clearing condition is given by

$$2\bar{k} = \int_{\underline{x}}^{x_2} x dG(x) + \int_{\underline{x}}^{x_2^*} x dG^*(x) + k_f \left[G(x_1) + G^*(x_1^*) \right]. \tag{27}$$

Because of the agents' heterogeneity, it is optimal that the home country and the foreign country have the exactly same size of agents engaged in both projects Y and Z. Namely, $x_1 = x_1^*$ and $x_2 = x_2^*$. Along with the above credit market clearing condition, we, therefore, conclude that the foreign country becomes a replica of the home country in autarky: i.e., $\tilde{p} = p^a$ and $\tilde{r} = r^a$.

Half of the home country's financial intermediaries audit foreign agents in project Y. The home country exports financial services to the foreign country and obtains $rk_f G^*(x_1)$. In exchange, the foreign country exports capital to the home country. This exported capital exactly makes up the home capital used by the home financial intermediaries who export their services.

The combination of free trade in services and the liberalization of international capital mobility completely substitutes trade in goods. The home's superior financial intermediaries with the lower overhead cost become available across the two countries. In addition, the symmetric production patterns realize in the two countries, which maximizes the production efficiency. Therefore, this benchmark maximizes world welfare measured by the world outputs of $p^a(Y + Y^*) + Z + Z^*$. However, all gains from free trade goods and services belong to the foreign country.

Proposition 7. *If free trade goods and financial services are allowed along with international capital mobility, trade in goods does not take place. Instead, the home country exports financial services and the foreign country exports capital. The foreign country enjoys all gains from trade in goods and services.*

5.3.2 Service autarky (SA)

The analysis for this case is similar to that for free trade only in goods in the basic model. Proposition 6 indicates that the home country becomes the exporter of good Y and the foreign country becomes the exporter of good Z. The expansion of the home production of good Y raises the home interest rate r, which implies that the number of agents engaged in project Z decline and the number of lenders increases in the home country.

Because $\epsilon_r < 1$, the analysis of winners and losers is also similar to that in the basic model. The agents in project Y in autarky gain while those in project Z in autarky lose in the home country. Although lenders' income rk increases, they are also losers since r/p declines. In the foreign country, the opposite changes take place.

Under free trade, the interest rates in the two countries are not necessarily equalized. In order to see this, it is necessary to examine the credit market clearing condition. The

interest rate that clears the credit market for a given p, that is, $r = r(p)$, is implicitly determined by equations (21), (22), and (23) as follows:

$$\bar{k} = \int_{\underline{x}}^{q/r(p)} x dg(x) + k_f G\left[\frac{q[p-1] - \lambda r(p) k_f}{r(p)[\lambda - 1]} + k\right]. \tag{28}$$

As p falls, the interest rate $r(p)$ declines because the output of good Y decreases. When p reaches the minimum at which the economy can supply good Y (denoting by $\underline{p}$), the interest rate simply becomes $\underline{r}$ that satisfies $\bar{k} = \int_{\underline{x}}^{q/\underline{r}} x dG(x)$. We have $k_f < k_f^*$, which implies that the foreign country's minimum price for producing good Y (denoting by $\underline{p}^*$) is higher than the home country's.[22]

Next, totally differentiating equation (28) and setting $dr = 0$, we obtain

$$\left[k_f g(x_1)\left(\frac{\lambda}{\lambda - 1}\right) - G(x_1)\right] dk_f = \frac{q k_f g(x_1)}{r[\lambda - 1]} dp. \tag{29}$$

In order to see the sign of the inside of the square brackets in the left-hand side, we need additional specifications on parameters and the distribution function g. Since G is monotonically increasing in x_1, I consider the two possibilities: (i) the sign is positive for all x_1 and (ii) the sign is nonnegative for some low range of $x_1 \in [\underline{x}, \acute{x}]$ and then turns to be negative for the next range $x_1 \in (\acute{x}, \bar{x}]$.

The first case (always positive sign) tends to occur when λ is close to one and/or k_f is very large. In this case, we have $dp/dk_f > 0$ for all x_1: if k_f rises, we need an increase in p in order to clear the credit market. The economic intuition is as follows. When λ is close to one, the agency problem in project Y is not severe (or even ignorable). This implies that projects Y and Z are not very different in terms of profitability. Thus, the agents in project Y are very sensitive to changes in k_f. As a result, even a small increase in k_f may lead to a large shift of agents from project Y to project Z. Thus, an increase in k_f generates an *excess supply* of capital in the credit market. When x_1 is large, the demand increase caused by an increase in k_f is also large. However, the agents in project Y are so sensitive to changes in k_f that an increase in k_f always generates an excess supply of capital. Therefore, an increase in p, which lures agents to project Y, is always required to balance the credit market.

The second case is much more natural than the first case. When the agency problem is relatively severe, the agents in project Y are less sensitive to an increase in k_f. However, when x_1 is small, p is relatively low, which implies that the net returns to project Y ($pq - \lambda r(x - k + k_f)$) is small. Thus, an increase in k_f still causes a large agent shift from sector Y to sector Z. This demand decline overweighs the demand increase caused by the increase in k_f since the size of sector Y is small. Therefore, as in the first case, an increase in p is necessary to balance the credit market: i.e., $dp/dk_f > 0$. However, when the Y

[22] This is because the project startup cost including the overhead cost ($x + k_f$) is lower in the home country than in the foreign country.

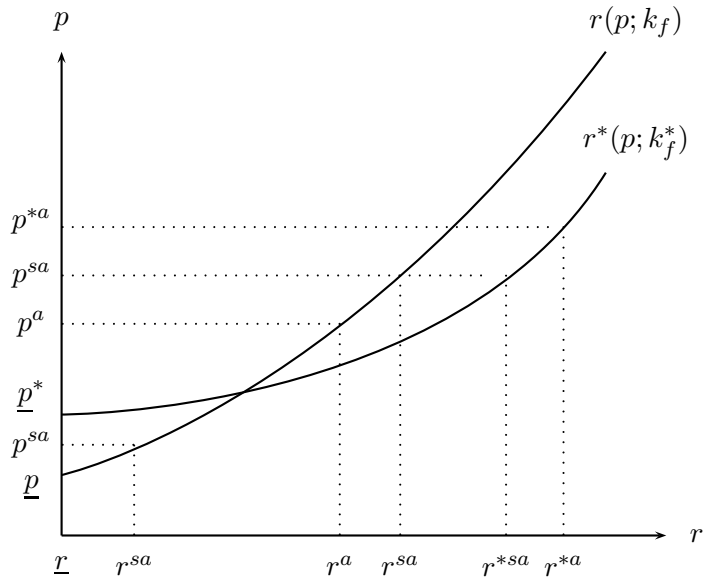

Figure 5: **The Credit Market Clearing Conditions.**

sector is large (high x_1), p (and the net returns) is also high. The wide profit margins make infra-marginal agents in project Y further insensitive to changes in k_f. Now an increase in k_f generates a large capital demand since the Y sector is large so that there exists an *excess demand* for capital. In order to clear the credit market, a decrease in p, which shifts agents in project Y to project Z, is necessary: i.e., $dp/dk_f < 0$. Hereafter, I will focus on this second case since the agency problem in the credit market is the sole difference to distinguish project Y from project Z.

Based on the above discussions on $r(p)$, Figure 5 illustrates two interest rate schedules that are consistent with the second case considered above. Reflecting $r'(p) > 0$, both curves are upward-sloping. Along the northeast direction, Y sector expands (x_1 rises). Since the foreign minimum price $\underline{p}^*$ is greater than the home minimum price $\underline{p}$, $r^*(p)$ starts at a higher vertical intercept. However, $k_f < k_f^*$ implies that the foreign credit market tends to be tighter than the home credit market. Thus, as sector Y expands, the foreign interest rate rises more rapidly than the home interest rate. The intersection of $r(p)$ and $r^*(p)$ corresponds to $\acute{x}$ at which $dp/dk_f = 0$ is the case. For $x_1 \in [\underline{x}, \acute{x})$, $dp/dk_f > 0$ is the case. This is reflected in that $r^*(p)$ is located above $r(p)$. Likewise, $dp/dk_f < 0$ for $x_1 \in (\acute{x}, \bar{x}]$ is reflected in that $r^*(p)$ is located below $r(p)$ after the intersection.

Three observations are immediately in order. First, free trade in goods does not equalize the interest rates in the two countries. The interest rates might be equalized only when the equilibrium price p^{sa} happens to coincide with the intersection of $r(p)$ and $r^*(p)$. However, of course, there is no guarantee for such a situation in equilibrium.

Second, if the equilibrium price p^{sa} falls somewhere in the range between $\underline{p}$ and $\underline{p}^*$, the foreign country perfectly specializes in good Z while the home country is diversified. In this case, the agency problem disappears in the foreign country and r^* becomes the interest rate

under perfect information $\underline{r}$. In such an equilibrium, the home interest rate is higher than the foreign interest rate (see $\underline{r}$ and r^{sa} next to $\underline{r}$ in the figure). If k_f^* is very large relative to k_f, the range of $[\underline{p}, \underline{p}^*]$ expands so that the likelihood of this type of equilibrium increases.

Third, if the two countries are imperfectly specialize, $r < r^*$ holds even under free trade. This is also depicted in the figure. As suggested in Proposition 6, $p^a < p^{*a}$ and $r^a < r^{*a}$ in autarky. Suppose that the equilibrium price p^{sa} between p^a and p^{*a} realized. Then, while the home interest rises to r^{sa}, the foreign interest rate falls to r^{*sa} without convergence.

I summarize these findings in the following:

Proposition 8. *Suppose that the home country has a lower fixed cost in the financial service sector than the foreign country ($k_f < k_f^*$). Then, (i) the home country exports good Y and imports good Z; (ii) the home interest rate rises and the foreign interest rate falls. However, the home interest rate is still lower than the foreign interest rate if the two countries incompletely specialize (imperfect equalization); and (iii) the patterns of winners and losers by trade are the same as those in the basic model (see Proposition 3).*

5.3.3 Service autarky with international capital mobility (SAC)

Under service autarky without international capital mobility (SA), the two countries' interest rates are not equalized. Thus, it is meaningful to consider international capital mobility in service autarky (SAC).

I will concentrate on the case in which $r < r^*$ in SA (i.e., k_f and k_f^* are close to each other and both countries imperfectly specialize in the two goods). By allowing international capital investment, the home capital continues to move to the foreign country until both countries' interest rates are equalized. Let $\hat{r}$ be such an equilibrium interest rate. This leads to an expansion of sector Y in the foreign country. The opposite takes place in the home country.

Without the agency problem in sector Z, the threshold agents who are indifferent between project Z and lending are identical across the countries in equilibrium: $x_2 = x_2^* = q/\hat{r}$. Since a part of home capital is used in the foreign country, the home output of good Y declines, compared to service autarky (x_1 falls). However, $x_1 > x_1^*$ still holds even with international capital mobility. This can be seen by showing the credit markets never realize the international capital shift that allows $x_1 = x_1^*$.

From equation (23), the capital market clearing conditions in the home country and the foreign country are given by

$$\bar{k} - R = \int_{\underline{x}}^{q/\hat{r}} x dG(x) + k_f G(x_1), \tag{30}$$

and

$$\bar{k}^* + R = \int_{\underline{x}}^{q/\hat{r}} x dG^*(x) + k_f^* G^*(x_1^*), \tag{31}$$

where R denotes the amount of home capital in the foreign country. From these two credit market clearing conditions, we obtain the equilibrium level of R as follows:

$$R = \frac{k_f^* G(x_1^*) - k_f G(x_1)}{2}. \tag{32}$$

It is obvious that when R is high, $G(x_1^*)$ tends to be large while $G(x_1)$ small. The home threshold type for project Y in equilibrium is derived by replacing k with $k - R$ in equation (21): i.e., $x_1 = q(\hat{p} - 1)/[\hat{r}(\lambda - 1)] - \lambda k_f/(\lambda - 1) + k - R$ where $\hat{p}$ denotes the equilibrium relative price of good Y. Likewise, for the foreign country, the threshold type is given by $x_1^* = q(\hat{p} - 1)/[\hat{r}(\lambda - 1)] - \lambda k_f^*/(\lambda - 1) + k^* + R$. Thus, denoting the amount of R that realizes $x_1 = x_1^*$ by $\hat{R}$, it is given by

$$\hat{R} = \frac{\lambda}{2(\lambda - 1)}[k_f^* - k_f]. \tag{33}$$

Suppose that $x_1 = x_1^*$ holds in equilibrium as a result of international capital mobility. Then, $G(x_1) = G^*(x_1^*)$ and equation (32) becomes

$$R = \frac{G(x_1)[k_f^* - k_f]}{2}. \tag{34}$$

However, since $\lambda/(\lambda - 1) > 1$ in equation (33), R in equation (34) is lower than $\hat{R}$. This indicates that in order for the credit market to generate $\hat{R}$, it is necessary that $x_1^* > x_1$. Therefore, the credit markets are not able to generate R that realizes $x_1 = x_1^*$.

Intuitively, since the foreign financial sector incurs the higher fixed cost, the profitability of the foreign agents is always lower than the same type of the home agents (the repayment by an agent of type x is given by $\lambda r(x - k + k_f)$). With international capital mobility, the profitability of the threshold type x_1 must be equalized across the countries. Therefore, $x_1 > x_1^*$ holds in equilibrium.

We can conclude that the home output of good Z is smaller than the foreign's ($q[G(x_2) - G(x_1)] < q[G^*(x_2^*) - G^*(x_1^*)]$). Therefore, the home country continues to export good Y although the export of Y declines, relative to service autarky without capital mobility. Also, since the home country receives the interest revenue $\hat{r}R$ from the foreign country, the home country runs a deficit in trade in goods.

Proposition 9. *Suppose that the home country and the foreign country imperfectly specialize in goods Y and Z in service autarky without international capital mobility (SA). If international capital mobility is permitted, the home country becomes the exporter of capital. Although the volume of trade in goods declines, the home country continues to export good Y.*

5.3.4 Service trade (ST)

In this case, financial intermediaries can provide their services across the borders. However, I return to the assumption that capital is immobile between the countries. In this model,

exports of financial services mean that a country's financial sector can supply the financial intermediary service for project Y to the agents in the other country. I assume that financial intermediaries have to use their own country's capital for the fixed overhead cost. For example, a home financial intermediary that serves a foreign agent raises k_f units of capital in his country, raising $x - k^*$ units of capital for the project in the foreign country.

Permitting free trade in financial services dramatically changes the equilibrium from the one in service autarky. Recall that $r < r^*$ in service autarky. Along with $k_f < k_f^*$, these cost advantages over the foreign financial sector give the incentive the home financial intermediaries to export their services. With trade in financial services, the home financial intermediaries would offer the expected payoff of $pq - \lambda r^*(x-k) - \lambda r k_f$ to the foreign agents of type x in project Y while the foreign financial intermediaries would offer $pq - \lambda r^*(x-k) - \lambda r^* k_f^*$ to the same agents. Thus, as long as $rk_f \leq r^* k_f^*$ holds, the home financial intermediaries can export. However, if the inequality is strict (i.e. $rk_f < r^* k_f^*$), the home financial intermediaries can earn positive profits, offering a more profitable contract to the foreign agents than the foreign financial intermediaries. For example, by offering the expected payoff $pq - \lambda r^*(x-k) - \lambda r(k_f + \delta)$ where $\delta > 0$ satisfies $r(k_f + \delta) < r^* k_f^*$, the home financial intermediaries can gain more from the foreign market than from the home market. However, by the assumption of perfect competition, any profitable opportunities will be eliminated by the entry and exist of financial intermediaries. Thus, the two countries' interest rates in equilibrium must satisfy $r = r^* k_f^*/k_f$ where the home financial intermediaries are indifferent between the domestic market and the foreign market while all financial intermediaries (including the foreign financial intermediaries) are break-even. For notational ease, I rewrite this relationship as $r = \mu r^*$ where $\mu \equiv k_f^*/k_f > 1$ can be interpreted as the relative efficiency of the home financial intermediaries.

From these observations, the credit market clearing conditions in the two countries are expressed by

$$\bar{k} = \int_{\underline{x}}^{q/(\mu r^*)} x dG(x) + k_f G(x_1) + \zeta k_f G(x_1^*) \tag{35}$$

and

$$\bar{k}^* = \int_{\underline{x}}^{q/r^*} x dG^*(x) + (1-\zeta) k_f^* G^*(x_1^*), \tag{36}$$

where ζ is the share of the home financial intermediaries in the foreign credit market. The threshold types of x_1 and x_1^* are written by

$$x_1(p, r^*) = \frac{q(p-1) - \lambda \mu r^* k_f}{\mu r^*(\lambda - 1)} - k, \tag{37}$$

and

$$x_1^*(p, r^*) = \frac{q(p-1) - \lambda \mu r^* k_f}{r^*(\lambda - 1)} - k^*. \tag{38}$$

Therefore, eliminating ζ from equations (35) and (36), we can define the foreign interest rate function $r^*(p)$ that clears the credit markets for a given p. The $r^*(p)$ is qualitatively

very similar to the $r(p)$ function discussed in the case of service autarky (i.e. $\partial r^*(p)/\partial p > 0$ and $\epsilon_{r^*} < 1$). The equilibrium is determined by the good market clearing condition along with these credit market clearing conditions. The good market clearing condition can be described in a similar manner to the case in service autarky.

From equations (37) and (38), we can immediately conclude that $x_1 < x_1^*$ always holds in equilibrium.[23] In other words, the home country has a *smaller* size of the class of entrepreneurs than the foreign country. This is a rather surprising result, taking account the fact that the home financial intermediaries and the foreign financial intermediaries compete with each other in the foreign market while the home financial intermediaries continue to serve the home entrepreneurs' needs. Intuitively, this situation may emerge because the ultimate source of comparative advantage in the home country is the fixed overhead cost of the financial sector. When only trade in goods is allowed, this comparative advantage realizes in the productivity of good Y. Once trade in goods and financial services is permitted, the expansion of the home financial sector crowds out the good sectors including the Y sector by raising the home interest rate.[24]

Another surprising result from trade in financial services is that the agency problem in the home country may be *worse* than the foreign country even though the home financial intermediaries serve the domestic market. This can be seen in the frequency of auditing that is give by $\eta(x) = r(x - k + k_f)/p(q - \nu c)$. Noting that $r = \mu r^*$ and $k_f^* = \mu k_f$, the home agents of type x in project Y will be audited with the probability of

$$\eta(x) = \frac{\mu r^*(x - k) + \mu r^* k_f}{p(q - \nu c)}. \tag{39}$$

Likewise, the foreign agents in project Y will be audited with the probability of

$$\eta^*(x) = \frac{r^*(x - k) + \mu r^* k_f}{p(q - \nu c)}. \tag{40}$$

Again, the high home interest rate increases the value of borrowing that increases the agents' incentive to cheat. This higher frequency of auditing implies that for each type of the agents in project Y, the home outputs of good Y is lower than the foreign outputs of good Y.

The home country produces good Y fewer than the foreign country for these two reasons: the decline of the agents engaged in project Y and the deterioration of the agency problem. Hence, permitting free trade in financial services may let the home country be the importer of good Y. Since along with the two goods, the financial service (the third good) is tradable, it is in general unclear the direction of trade in goods Y and Z in this model except for that the home country is the net importer of both or one of these goods. The following proposition summarizes the findings described above.

[23] Recall that by assumption, each agent has the same amount of capital in the two countries: $k = k^*$.

[24] It can be easily checked the total mass of agents in either project Y or project Z is lower in the home country than the foreign country. This is simply verified by comparing $x_2 = q/(\mu r^*)$ to $x_2^* = q/r^*$.

Proposition 10. *If trade in financial services is permitted along with trade in goods (ST), the home country exports the financial service in exchange for importing goods. Furthermore, (i) the home country's interest rate rises above the foreign country's interest rate; (ii) the home country's entrepreneurial class becomes smaller than the foreign country's; (iii) the agency problem in project Y becomes worse in the home country than in the foreign country.*

It is clear that free trade in goods and services without international capital mobility (ST) cannot realize the same level of world welfare as free trade in goods and services with international capital mobility (INT). This is because (i) the inefficient foreign financial intermediaries are still viable in the domestic market and (ii) the production patters in the two countries are not symmetric.

Although it is not clear if service trade (ST) is better than service autarky (SA), both countries can gain from trade. However, the distributions of gains from trade are quite different. In the case of the home country, service autarky yields essentially the same distribution as in the basic model. The agents in good Y (the entrepreneurial class) are the beneficiaries of trade in service autarky. In contrast, the lenders would be the chief beneficiaries of trade in goods and services. The entrepreneurial class hurts.

The patterns of trade in this extended model are much more subtle than those in the basic model. In particular, unlike in the basic model, free trade in financial services does not completely eliminate trade in goods. Rather, if international capital mobility is prohibited, trade in goods and financial services yields the very different patterns of trade. Due to the lack of international credit market, the two countries cannot directly exchange the financial services and capital. As a result, the home country's entrepreneurial class becomes smaller than the foreign country's even though the home financial intermediaries are more efficient than the foreign financial intermediaries.

6 Conclusions

It is widely recognized that the entrepreneurial class is an important element of the economy. This paper studies the formation of the entrepreneurial class in a simple international trade model in which asymmetric information between entrepreneurs and financial intermediaries limits the extent to which the entrepreneurial class prospers.

The model shows that only agents with sufficient net worth can profitably run the risky project. This is because while the risky project yields a high return for agents' own capital assets, it also raises the price of external financing. All agents optimally choose their occupation according to the size of their net worth.

The financial intermediaries in the country with a lower auditing cost can offer a lower lending rate toward entrepreneurs who are willing to start the risky project. Thus, the home country has a greater number of entrepreneurs in the risky project than does the foreign country. It leads to a lower relative autarky price of the risky project in the home country.

Opening up trade brings about an additional gain (or loss) in addition to the standard gains from trade. If a country has a comparative advantage in the risky project, an increase in the relative price of exports mitigates the production loss in the risky project due to credit market imperfections. In contrast, for a country that has comparative advantage in the safer project, this price change exacerbates the production loss in the risky project as long as this country imperfectly specializes under free trade.

In autarky, the income distribution in the country with comparative advantage in the risky project is more dispersed than in the country with comparative advantage in the safer project. Agents who choose the project in which a country has a comparative advantage in autarky can gain from trade. Whether or not lenders can gain from trade depends on their country's comparative advantage. While the lenders in a country that has comparative advantage in the risky project lose, those in a country that has comparative advantage in the safer project gain. Accordingly, trade widens the income distribution in the country that exports the risky project. In contrast, it brings about a more concentrated income distribution in the country that exports the safer project.

In addition to trade in goods, if free trade in financial intermediary services is allowed, trade in goods disappears. Both countries realize the same resource allocation as that which the country with the better auditing technology realizes in autarky. The country with the inferior auditing technology can enjoy all gains from trade in financial services. Since free trade in financial services enables the country with the inferior auditing technology to access the better one, it yields higher world welfare than free trade in goods and service autarky in the sense that the value of the world outputs of the final goods is increased.

The model stresses that the efficiency of financial intermediary services plays an important role in the formation of entrepreneurial class and trade structure. In order to examine the role of the financial intermediaries in an open economy more deeply, I introduced a fixed overhead cost into the financial intermediaries that finance the risky project. This assumption is motivated by the well-known fact that financial intermediary services require specialized skills, depending on borrowers' business fields. However, the main economic sense of this modification is allowing the financial sector to compete resources with the other manufacturing sectors. This seemingly minor modification yields more subtle predictions about the trade structure and the formation of the entrepreneurial class.

Two findings should be stressed. First, if trade in financial services is permitted along with trade in goods, but without international capital mobility, the home country with the more efficient financial sector exports the financial service and imports the entrepreneur intensive good. This is a rather surprising result since the home financial intermediaries continue to serve for the home entrepreneurs under free trade.

Second, we observe that (i) the home country's interest rate rises above the foreign country's interest rate; (ii) the home country's entrepreneurial class becomes smaller than the foreign country's; (iii) the agency problem in project Y becomes worse in the home country than in the foreign country. All these changes suggest that the distribution of gains

from trade would be reversed. The chief beneficiaries of free trade in goods and services would be lenders while the entrepreneurs in project Y would be worse off. Thus, adding free trade in financial services to free trade in goods may overturn the economic consequences obtained by the basic model.

The economic intuition of these results can be easily seen in the fact that the home country's source of comparative advantage is the cost superiority in the financial sector and that the allocation of capital endowment is switched from the good sectors to the financial service sector after opening up free trade in financial services.

Consequently, it is not surprising that once international capital mobility is added, the two countries' production patterns becomes symmetric. The home country still exports the financial intermediary service. However, the foreign country can now pay this financial service with capital migration to the home country. As in the free trade in goods and financial services in the basic model, trade in goods completely substituted by trade in financial services. Even in this case, the home country cannot enlarge its entrepreneurial class. All gains from trade belongs to the foreign country.

A Proofs of the Results in the Main Text

A.1 Proof of Lemma 1

For the agent type, we have

$$\frac{\partial v(x)}{\partial x} = -\lambda r \quad \text{(project Y) or} \quad \frac{\partial v(x)}{\partial x} = -r \quad \text{(project Z)}. \tag{A.1}$$

Thus, if the highest type ($\underline{x}$) chooses project Z, there is no agent who profitably choose project Y. Hence, if both projects are active in the economy, the highest type necessarily chooses project Y.

When project Y is active, the highest type earns from project Y no less than project Z, or equivalently,

Condition 1. $p \geq 1 + (\lambda - 1)r(\underline{x} - k)/q$

Given Condition 1, (A.1) implies that there exists a unique x_1 who are indifferent between projects Y and Z. Hence, all agents who belong to the interval $[\underline{x}, x_1]$ choose project Y. Since the derivation of x_2 is the same as in the case of perfect information, it is omitted.

A.2 Proof of Proposition 1

As shown in the main text, the derivative of the aggregate output Y with respect to p is given by

$$\frac{dY(p)}{dp} = [q - \nu\eta(x_1, p)c]g(x_1)x_1'(p) + \frac{\nu c}{p}\int_0^{x_1(p)} \eta(x, p)g(x)dx. \tag{A.2}$$

By assumption, $q - \nu\eta(x_1, p)c > 0$. It follows that $dY(p)/dp > 0$. Likewise, the derivative of the aggregate output of Z is given by

$$\frac{dZ(p)}{dp} = -qg'(x_1)x_1'(p) < 0. \tag{A.3}$$

These two derivatives establish that the relative supply schedule $Y(p)/Z(p)$ is monotonically increasing in p. Define the price at which Condition 1 marginally holds as $\underline{p} = 1 + (\lambda - 1)r(\underline{x} - k)/q$. The relative supply $y_S(p) \equiv Y(p)/Z(p)$ is zero until the relative price p reaches $\underline{p}$ and starts to increase as p increases further.

The relative demand schedule is standard. Therefore, an equilibrium is unique and the equilibrium price is greater than $\underline{p}$. Thus, Condition 1 always holds in equilibrium and so does Lemma 1.

It is straightforward to see the y_s schedule shifts upward due to an increasing c. The relative supply function is expressed by

$$y_s(p) = \frac{qG(x_1(p)) - \nu c\int_{\underline{x}}^{x_1(p)} \eta(x, p)g(x)dx}{q[G(x_2) - G(x_1(p))]}. \tag{A.4}$$

Hence, $\partial y_s/\partial c < 0$ for all p is immediate. $\underline{p}$ increases as c rises. These implies that a higher c shifts the $y_s(p)$ schedule upward.

With respect to the proof of comparative statics in $\bar{k}$, I will use Corollary 1. Thus, it is relegated to the end of the proof of Corollary 1.

A.3 Proof of Corollary 1

The marginal agents who choose project running (x_2) is fixed by k. The set of outputs (Y, Z) varies through shifts of threshold x_1 over the interval $[\underline{x}, x_2]$. Thus, we can define the marginal product of agent in sector Y (MPL_Y) by the output of type x_1. This is given by

$$MPL_Y = q - \nu c \eta(x_1, p).$$

The marginal product of agent in sector Z (MPL_Z) is simply q. Thus, for example, by shifting threshold agents x_1 marginally from sector Z to sector Y, we obtain $dY = MPL_Y \cdot dx_1$ and $dZ = -MPL_Z \cdot dx_1$ where dx_1 is the marginal amounts of type x_1. It follows that the slope of the *PPF* takes the standard form of the marginal rate of transformation (*MRT*): $MRT(= -dZ/dY) = MPL_Z/MPL_Y$.

Since the model does not use the standard marginal pricing rules, it is necessary to check if *MRT* satisfies $MRT = p$. Threshold agents x_1 hold $pq - \lambda r(x_1 - k) = q - r(x_1 - k)$. This equation can be arranged such that

$$\begin{aligned} q &= pq - (\lambda - 1) r(x_1 - k) \\ &= pq - \frac{\nu c}{q - \nu c} r(x_1 - k) \\ &= p[q - \nu c \eta(x_1, p)] \\ &= p \cdot MPL_Y. \end{aligned} \tag{A.5}$$

Since $q = MPL_Z$, equation (A.5) indicates that $MPL_Z/MPL_Y = p$.

Next, I show that *MRT* is monotonically increasing in x_1, namely, the slope of *PPF* becomes steeper as the production of Y increases. Since MPL_Z is constant, it is sufficient to verify that MPL_Y is decreasing in x_1. It is equivalent to check that $\eta(x_1, p)$ is increasing in x_1.

When *MRT* increases with x_1, the relative price p rises. Since a higher p mitigates the output loss due to the CSV problem, it is necessary to check this positive effect on MPL_Y does not dominate the negative effect from increasing x_1. (In this model, the production technology depends on p due to the agency problem.)

By totally differentiating $pq - \lambda r(x_1 - k) = q - r(x_1 - k)$, we obtain

$$\frac{dp}{dx_1} = \frac{(\lambda - 1) r}{q}. \tag{A.6}$$

We now compute $d\eta/dx_1$. It is given by

$$\frac{d\eta}{dx_1} = \frac{r\left[p - (x_1 - k)\frac{dp}{dx_1}\right]}{p^2(q - \nu c)}. \tag{A.7}$$

Using dp/dx_1 in equation (A.6), the inside of the square brackets becomes $p - r(\lambda - 1)(x_1 - k)/q$, which is obviously positive. Thus, we can conclude $dMPL_Y/dx_1 < 0$.

It is straightforward to see $\partial MRT/\partial c > 0$ and $\partial MRT/\partial \nu > 0$ for any p. Accordingly, the degree of credit market imperfections increases (λ goes up), the slope of the *PPF* becomes steeper for all x_1. This implies that a higher λ sifts the *PPF* inward, holding the maximum potential output of good Z at $qG(x_2)$.

A.4 Proof of Comparative Statics in $\bar{k}$

I will first show MPL_Y is increasing in k for all p (i.e. for all x_1). A change in $\bar{k}$ works through $r(k)$ in addition to directly changing MPL_Y. MPL_Y is expressed by

$$MPL_Y = q - \frac{\nu c r[x_1 - k]}{p(q - \nu c)}. \tag{A.8}$$

Since r is decreasing in k, $\partial MPL_Y/\partial k > 0$ is immediate. It follows that $\partial MRT/\partial k < 0$. Also, a rise in k expands the production set as a whole. Therefore, the *PPF* expands outward and its slope becomes flatter. Fixing p at a certain level, $MRT|_k > MRT|_{k+\Delta k}$. This holds for all p, which means that a rise in k shifts the relative supply schedule shifts downward.

A.5 Proof of Proposition 2

I prove Proposition 2 in a more general setting than one in the main text: project Z also has uncertainty. In order to keep that project Y is riskier than Z in the sense that all entrepreneurs have a higher probability of default in project Y than project Z, the probability of failure in project Z is smaller than in project Y such that $\nu_Y > \nu_Z$. (I will use subscripts Y and Z for projects Y and Z, respectively.) This is the only difference in these two projects. The output of project Z in "failure" is also normalized to 0. Hence, projects Y and Z have the expected output q.

It is sufficient to compare the threshold entrepreneur x_1 in the home and foreign countries, given a certain price level p. By profit maximization, $MRT = MRT^*$. The MRT is given by

$$MRT = \frac{q - \nu_Z c \frac{\tilde{r}[x_1 - k]}{q - \nu_Z c}}{q - \nu_Y c \frac{\tilde{r}[x_1 - k]}{p[q - \nu_Y c]}}. \tag{A.9}$$

It follows that

$$MPL_Y = MPL_Y^* \quad \text{and} \quad MPL_Z = MPL_Z^*. \tag{A.10}$$

Here I will check only $MPL_Z = MPL_Z^*$, which is expressed as follows:

$$\frac{c\tilde{r}[x_1 - k]}{q - \nu_Z c} = \frac{c^* \tilde{r}^*[x_1^* - k]}{q - \nu_Z c^*}. \tag{A.11}$$

The equilibrium interest rate $\tilde{r}$ is given by

$$\tilde{r} = \frac{q}{\lambda_Z[x_2 - k] + k} \tag{A.12}$$

where $\lambda_Z = q/(q - \nu_Z c)$. Substitute equation (A.12) and its analogy for the foreign country for equation (A.11). After straightforward but tedious computation, equation (A.11) becomes

$$\frac{x_1 - k}{q[x_2 - k] + k[q - \nu_Z c]} = \frac{x_1^* - k}{q[x_2 - k] + k[q - \nu_Z c^*]}, \tag{A.13}$$

where $k = k^*$ and $x_2 = x_2^*$ are used. Notice that the denominator of the left-hand-side (LHS) is greater than that in the right-hand-side (RHS). Thus, $x_1 > x_1^*$ is immediate. For any given price p, the home country allocates more agents in project Y than the foreign country. Thus, $p < p^*$ in autarky.

A.6 Proof of Proposition 4

Rearrange the aggregate output of good Y as follows:

$$\begin{aligned} Y &= q[1 - F(k_1)] - \gamma \int_{k_1}^{\bar{k}} (x - k) f(k) dk \\ &= [1 - G(k_1)](q - \gamma x) + \gamma \int_{k_1}^{\bar{k}} k f(k) dk \\ &= [1 - F(k_1)](q - \gamma x) + \gamma \left[\hat{k} - \int_{\underline{k}}^{k_1} k f(k) dk \right] \\ &= [1 - F(k_1)](q - \gamma x) + \gamma \left[\hat{k} - k_1 F(k_1) + \int_{\underline{k}}^{k_1} F(k) dk \right], \end{aligned} \tag{A.14}$$

where integration by parts is applied for the last line.

The foreign aggregate output takes the same form:

$$Y^* = [1 - F^*(k_1^*)](q - \gamma x) + \gamma \left[\hat{k}^* - k_1^* F^*(k_1^*) + \int_{\underline{k}^*}^{k_1^*} F^*(k) dk \right]. \tag{A.15}$$

By assumption, $\hat{k} = \hat{k}^*$. Also, from equation (14), $k_1 = k_1^*$ for a given p.

Calculating $\Delta Y(p) \equiv Y(p) - Y^*(p)$, we obtain

$$\Delta Y(p) = (q - \gamma x + \gamma k_1)[F^*(k_1) - F(k_1)] + \gamma \int_{\underline{k}}^{k_1} [F(k) - F^*(k)] \, dk. \tag{A.16}$$

A direct consequence of Assumption 1 is

$$\int_{\underline{k}}^{k} [F(k) - F^*(k)] dk \geq 0 \quad \text{for} \quad \underline{k} \leq k \leq \bar{k}. \tag{A.17}$$

Therefore, the second term of ΔY is nonnegative. (In particular, for $k_1 < \bar{k}$, it is strictly positive.) However, the first term may be positive or negative. More specifically,

$$\begin{aligned} F^*(k_1) - F(k_1) &< 0 \quad \text{if} \quad k_1 < k \\ F^*(k_1) - F(k_1) &\geq 0 \quad \text{o.w.}, \end{aligned} \tag{A.18}$$

and the equality is obtained if $F(k_1) = 1/2$.

Consequently, $\Delta Y > 0$ for $k_1 \geq \hat{k}$, and there exists a $k'' < \hat{k}$ such that $\Delta Y(k'') = 0$.

The aggregate outputs of good Z is expressed as

$$Z = q\left[F(k_1) - F(k_2)\right]. \tag{A.19}$$

The analogy for the foreign country is given by

$$Z^* = q\left[F^*(k_1) - f^*(k_2^*)\right]. \tag{A.20}$$

The threshold levels of asset are uniquely determined by

$$F(k_2) = F^*(k_2^*) = 1 - \frac{W}{x}. \tag{A.21}$$

As before, define $\Delta Z \equiv Z - Z^*$ as follows:

$$\Delta Z = q[F(k_1) - F^*(k_1)]. \tag{A.22}$$

Therefore,

$$\begin{aligned} \Delta Z &> 0 \quad \text{if} \quad k_1 < \hat{k} \\ \Delta Z &\leq 0 \quad \text{o.w.}, \end{aligned} \tag{A.23}$$

and the equality is obtained if $k_1 = \hat{k}$.

These observations establish the following:

$$\frac{Y|_{k_1=\hat{k}}}{Z|_{k_1=\hat{k}}} > \frac{Y^*|_{k_1=\hat{k}}}{Z^*|_{k_1=\hat{k}}} \quad \text{and} \quad \frac{Y|_{k_1=k"}}{Z|_{k_1=k"}} < \frac{Y^*|_{k_1=k"}}{Z^*|_{k_1=k"}}. \tag{A.24}$$

Recall that $Y|_{k_1=k"} = Y^*|_{k_1=k"}$. Therefore, given $k'' > k_2^*$, there exist a $k' \in (k'', \hat{k})$ at which $\frac{Y|_{k_1=k'}}{Z|_{k_1=k'}} = \frac{Y^*|_{k_1=k'}}{Z^*|_{k_1=k'}}$.

In sum, if $x \geq 2\hat{k}$, $F(k_l^*) \geq 1/2$, which implies all entrepreneurs have their assets $k \geq \hat{k}$. In this case, the home country unambiguously has a comparative advantage in good Y. However, if parameter k/x satisfies $1/2 > F(k') > F(k_l^*) = 1 - (k/x)$ (i.e. the average asset level $\hat{k}$ is close to the project cost.), which country has comparative advantage in which good becomes ambiguous. If the preference is extremely skewed toward good Y , it is likely that the foreign country becomes an exporter of good Y. (More specifically, if the equilibrium price is settled at the level with which $k' > k_1$ holds, the foreign country exports good Y.)

A.7 Elasticity ϵ_r

By differentiating equation (21) with respect to p, we obtain

$$\frac{\partial x_1}{\partial p} = \frac{qr(\lambda-1) - q(p-1)\lambda r'(p)}{[r(\lambda-1)]^2}. \tag{A.25}$$

Next, by totally differentiating the credit market clearing condition in (23), we obtain

$$\frac{dr}{dx_1} = \frac{r^3 k_f g(x_1)}{q^2 g(x_2)}. \tag{A.26}$$

Therefore, combining equations (A.25) and (A.26), we obtain $r'(p)$ as follows:

$$r'(p) = \frac{r^2(\lambda-1)k_f g(x_1)}{g(x_2)(\lambda-1)^2 q + (p-1)\lambda r k_f g(x_1)}, \tag{A.27}$$

and

$$\epsilon_r = \frac{rp(\lambda-1)k_f g(x_1)}{g(x_2)(\lambda-1)^2 q + (p-1)\lambda r k_f g(x_1)} > 0. \tag{A.28}$$

First, we can check that x_1 is increasing in p, that is, $\partial x_1/\partial p > 0$. From equation (A.25), this is equivalent to

$$r'(p) < \frac{r(\lambda-1)}{\lambda(p-1)}. \tag{A.29}$$

Notice that if we set $g(x_2)(\lambda - 1^2)q = 0$ in equation (A.27), $r'(p)$ becomes $r(\lambda-1)/[\lambda(p-1)]$. However, $g(x_2)(\lambda - 1^2)q > 0$. Thus, we conclude that (A.29) holds.

Next, we take the inverse of ϵ_r.

$$\frac{1}{\epsilon_r} = \frac{g(x_2)(\lambda-1)^2 q}{rp(\lambda-1)k_f g(x_1)} + \frac{\lambda(p-1)}{p(\lambda-1)}. \tag{A.30}$$

By defining $\theta \equiv p(\lambda-1)/[\lambda(p-1)]$ and $\alpha \equiv \frac{g(x_2)(\lambda-1)^2 q}{rp(\lambda-1)k_f g(x_1)}$, ϵ_r can be expressed by

$$\epsilon_r = \frac{\theta}{\alpha\theta + 1}. \tag{A.31}$$

Using inequality in (A.29), we obtain

$$r'(p)\frac{p}{r} < \frac{p(\lambda-1)}{\lambda(p-1)} = \theta. \tag{A.32}$$

Therefore, we conclude that

$$\epsilon_r = \frac{\theta}{\alpha\theta + 1} < \theta \Leftrightarrow \epsilon_r < 1. \tag{A.33}$$

A.8 Proof of Proposition 6

The proof is essentially the same as that for comparative statics in $\bar{k}$ in proposition 1. First, MPL_Y is decreasing in k_f for all p (i.e. for all x_1). A change in k_f works through $r(k)$ in addition to directly changing MPL_Y. MPL_Y is expressed by

$$MPL_Y = q - \frac{\nu c r[x_1 - k + k_f]}{p(q - \nu c)}. \tag{A.34}$$

Since r is increasing in k_f, $\partial MPL_Y/\partial k_f < 0$ is immediate. It follows that $\partial MRT/\partial k_f > 0$. Thus, a decline in k_f expands the production set as a whole except for the vertical intercept on the Z axis. The *PPF* expands outward and its slope becomes flatter. Fixing p at a certain level, $MRT|_{k_f} > MRT|_{k_f - \Delta k_f}$. This holds for all p, which means that a decline in k_f shifts the relative supply schedule shifts downward. The decrease in the interest rate follows from $r'(p) > 0$ for any $k_f > 0$.

B General Settings of the CSV Problem

This appendix provides a brief exposition on the CVS problem in a case of continuous output realization. Suppose the output of project Y is distributed over $[0, \bar{q}]$ with the cumulative distribution function $F(q)$ and the density function $f(q)$.

A sub-optimal contract is a standard debt contract that characteristics are as follows:

- There is a set of output realizations A for which auditing would be non-stochastically performed, given such a report of realizations from a borrower. The set A is a lower part of the support such that $[0, \acute{q}]$ where $\acute{q} \in (0, \bar{q}]$.
- In the case of the set A, the repayment to a financial intermediary is state contingent. In equilibrium, all outputs are taken from the borrower.
- If any output level that belongs to the complement set of A, namely, $[\acute{q}, \bar{q}]$, realizes, there is no auditing. The repayment is non-contingent and fixed at $\acute{q}$ (i.e. a fixed repayment).

It is straightforward to see this contract is incentive compatible. As explained in the main text, a borrower whose project realization is $q \in [\acute{q}, \bar{q}]$ does not have any incentive to misreport to the financial intermediary. Any deviation to the set A is perfectly revealed by auditing while any deviation within the range $[\acute{q}, \bar{q}]$ does not increase her payoff.

The determination of $\acute{q}$ by the financial intermediary is essentially the same as one in the main text. Following the standard setting, keep the assumption of perfect competition among financial intermediaries. The optimal financial contract maximizes the borrower's expected gains subject to the incentive compatibility constraint for the borrowers and the participation constraint for the financial intermediary:

$$\max p\hat{q} - \int_0^{\acute{q}} p\delta(q)f(q)dq - p\acute{q}[1 - F(\acute{q})], \tag{B.1}$$

where $\hat{q}$ represents the average of q and $\delta(q)$ is a contingent repayment depending on realized q.

In equilibrium, $\delta(q)$ is simply q. Thus, the participation constraint of the financial intermediary is given by

$$\int_0^{\acute{q}} p(q - c)f(q)dq + p\acute{q}[1 - F(\acute{q})] \geq r(x - k), \tag{B.2}$$

where c is the auditing cost measured in the unit of output.

In order to obtain $\acute{q}$, it is convenient to express the condition in (B.2) as follows:

$$\acute{q} - cF(\acute{q}) - \int_0^{\acute{q}} F(q)dq \geq \frac{r(x - k)}{p} \tag{B.3}$$

where integration by parts is applied for (B.2). Define the left-hand side of (B.3) as $\pi(\acute{q})$. It is immediate that $\pi(0) = 0$. However, we need additional assumptions about $F(\cdot)$ in order

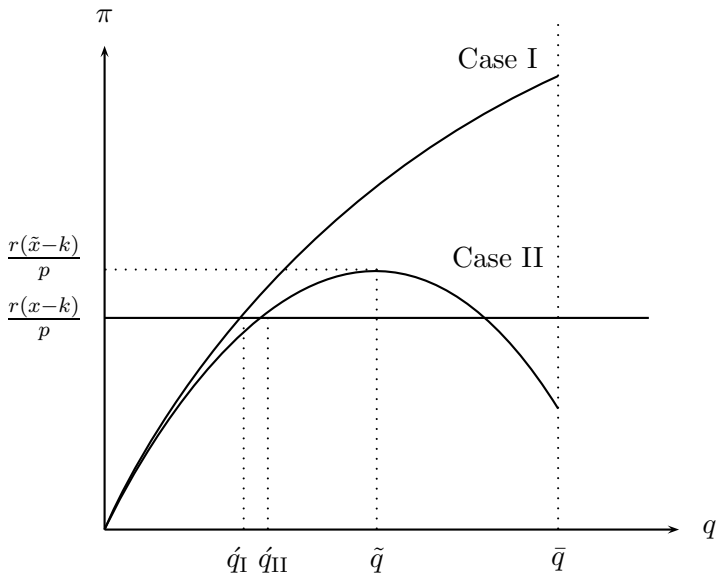

Figure 6: Determination of Lending Rates

to know the shape of $\pi(\cdot)$. Assume that $\pi(\cdot)$ is twice-differentiable for all range. Further, I consider the following two cases:

Case I $\pi'(\cdot) > 0$ for all q.

Case II There exist a unique $\acute{q}$ such that $\pi'(\acute{q}) = 0$. $\pi''(\cdot) \leq 0$ for all q.

Figure 6 exhibits the determination of the threshold project realization $\acute{q}$ in Case I and II. In Case I, the one discussed in the main text, the financial intermediary's payoff is is monotonically increasing for all range of q. Without the perfect competition, the financial intermediary would ask all project return, leaving the status-quo gain for the borrower. Thus, what pins down $\acute{q}_{\mathrm{I}}$ is the market structure of the financial service. In the figure, it is expressed as the intersection with the horizontal line at $r(x-k)/p$. The probability of auditing is given by $F(\acute{q})$. Notice that $\acute{q}$ is increasing in x and decreasing in p. These are exactly the same properties discussed in the main text.

Next, Case II similarly determines the threshold $\acute{q}$. The lower intersection value $\acute{q}_{\mathrm{II}}$ is the relevant one. However, in Case II, $\pi(\cdot)$ reaches the maximum at $\tilde{q}$. Therefore, agents with greater than $\tilde{x}$ may be refused to be financed even though they prefer project Y to project Z: there is a possibility of "credit rationing."

References

Banerjee, A. V. and Newman, A. F. (1993). Occupational Choice and the Process of Development. *Journal of Political Economy*, 101(2):274–98.

Baygan, G. and Freudenberg, M. (2000). The Internationalisation of Venture Capital Activity in OECD Countries: Implications for Measurement and Policy. *OECD STI working papers*.

Beck, T. (2002). Financial Developement and International Trade: Is there a Link? *Journal of International Economics*, 57(1):107–31.

Gale, D. and Hellwig, M. (1985). Incentive-Compatible Debt Contracts: The One-Period Problem. *Review of Economic Studies*, 52:647–63.

Grossman, G. M. (1984). International Trade, Foreign Investment, and the Formation of the Entrepreneurial Class. *American Economic Review*, 74(4):605–14.

Grossman, G. M. (2004). The Distribution of Talent and the Pattern and Consequences of International Trade. *Journal of Political Economy*, 112(1):209–39.

Grossman, G. M. and Maggi, G. (2000). Diversity and Trade. *American Economic Review*, 90(5):1255–75.

Horn, H., Lang, H., and Lundgren, S. (1995). Managerial Effort Incentives, X-inefficiency and International Trade. *European Economic Review*, 39:117–38.

King, R. G. and Levine, R. (1993a). Finance and Growth: Schumpeter Might Be Right. *Quarterly Journal of Economics*, 108(3):156–89.

King, R. G. and Levine, R. (1993b). Finance, Entrepreneurship, and Growth: Theory and Evidence. *Journal of Monetary Economics*, 32:513–42.

Kletzer, K. and Bardhan, P. (1987). Credit Markets and Patterns of International Trade. *Journal of Develpment Economics*, 27:57–70.

La Porta, R., Lopez-de Silanes, F., Shleifer, A., and Vishny, R. W. (1998). Law and Finance. *Journal of Political Economy*, 106(6):1113–54.

Levine, R., Loayza, N., and Beck, T. (2000). Financial intermediation and economic growth: Causality and causes. *Journal of Monetary Economics*, 46(1):31–77.

Matsuyama, K. (2004). Credit Market Imperfections and Patterns of International Trade and Capital Flows. *mimeo, Northwestern University*.

OECD (2003). *Science, Technology and Industry Scoreboard 2003*. The Organization for Economic Co-operation and Developemnt (OECD).

Rajan, R. G. and Zingales, L. (1998). Financial Dependence and Growth. *American Economic Review*, 88(3):559–86.

Ranjan, P. (2001). Dynamic Evolution of Income Distribution and Credit-constrained Human Capital Investment in Open Economies. *Journal of International Economics*, 55(2):329–58.

Schumpeter, J. A. (1911). *A Theory of Economic Development*. Harvard University Press, Cambridge, MA.

Townsend, R. (1979). Optimal Contracts and Competitive Markets with Costly State Verification. *Journal of Economic Theory*, 21:265–93.

Ueda, M. and Hirukawa, M. (2003). Venture Capital and Productivity. *mimeo, University of Wisconsin, Madison*.

Williamson, S. D. (1986). Costly Monitoring, Financial Intermediation, and Equilibrium Credit Rationing. *Journal of Monetary Economics*, 18:159–79.

Wynne, J. (2005). Wealth as a Determinant of Comparative Advantage. *American Economic Review*, 95(1):226–54.