Financial Structure, Productivity and Risk of FDI[1]

Jiarui Zhang[2] Lei Hou[3]

(paper in progress, comments and suggestions are highly welcome)

Abstract:

This paper investigates how heterogeneous firms choose their lenders when they raise external finance to do FDI and how the choices of the external financing structure affect the FDI's performance. We establish an asymmetric information model to analyze why some firms use private bank loans while others use public bond to finance foreign production. The hidden information is the productivity shock that happens when the firms begin FDI. Banks are willing to spend resources to acquire information about the coming shock while bondholders are not. We show that productivity, risk in foreign investment and relative financing cost are three key determinants for firm's financing choice. We also predict that countries with higher productivity, less risky investment and higher bank cost use more bond finance over bank finance. We test the theory with country level data and get consistent results.

Keywords: financial structure, bank finance, bond finance, productivity, risk, foreign direct investment

JEL: F21, F23, G14, G21, G32, G33

---

[1] For helpful comments and discussions, we thank Prof. Dr. Dalia Marin, Prof. Dr. Gerhard Illing, Prof. Dr. Schnitzer, Dr. Alexander Tarasov and all the participants of International Economics Workshop, Macro Seminar and IO & Finance Seminar at University of Munich, and also the participants of Chinese Economist Society 2010 annual conference at Xiamen, 2010 China Economics Annual Conference at Zhengzhou, 2010 Hong Kong Economic Association Biennial Conference at Tianjin and BGPE Research Workshop 2011 at Passau. All errors and inconsistencies are our own.

[2]Department of economics, University of Munich. Schackstrasse 4, D-80539. Email: jiarui.zhang@campus.lmu.de.

[3]Department of economics, University of Munich and Jilin University of China. Ludwigstrasse 28, D-80539. Email: lei.hou@lrz.uni-muenchen.de.

1. Introduction

Firms differ in financial structure, which is even more significant between FDI and non-FDI firms. Buch et al. (2009) provides evidence that German multinational firms and domestic firms differ significantly in financial structure in terms of cash flow and debt ratio. We also find that in the countries with bank-based financial system like Germany and Japan, their FDI is less volatile compared to those countries with market-based financial system like U.S. and U.K. (see Figure1). These observations trigger our interest in investigating whether there are any potential links between firms' choices of their financial structure and their performances in FDI. What determines firms' financial structure? How does the financing choice affect firms' expanding strategy abroad? We address these research questions to further provide policy suggestions about how to structure the financial system to assist firms' internationalization.

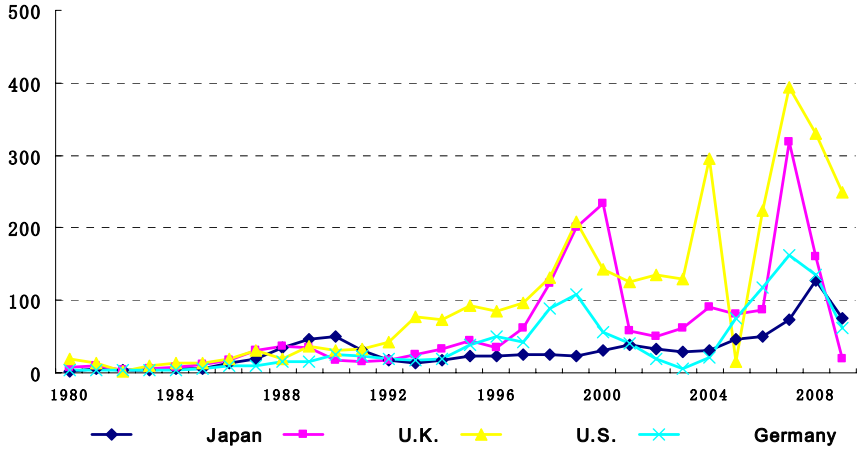


Figure 1. Financial Structure and Volatility of Outward FDI

Note: This graph shows the annual outward FDI flow for Japan, U.K.,U.S. and Germany over 1980-2009. The data is in US dollars at current prices and current exchange rates. Data source: UNCTAD.

Our topic is highly related with literatures on the following three questions. First, why do countries differ in financial system? Fiore and Uhlig (2005) show that the financial system in European countries is significantly different from that in U.S.. Due to higher efficiency of banks in acquiring information and less availability of public information about the firms' credit worthiness in Europe, bank based financial system prevails in Europe while bond finance is much more popular in U.S. Second, how do firms choose their financial structures? The existing literature, either theoretically or empirically, argues that firm size, leverage, profitability and growth opportunities are important determinants for firm's financial structure. Third, what is the impact of the environment for raising external finance on firms' internationalization. Manova (2007) and her followers find that financial development could relax the financial constraint. Better access to external finance (bank credit) promote more firms to export or invest abroad and enjoy more sales in foreign market.

Based on these prior studies, we are aiming to build a model that links firms' financial structure choices and their FDI decision and provide more insights to the impact of financial system on FDI.

In this paper, we develop a partial equilibrium model based on information asymmetry where the hidden information is the productivity shock, which happens when the firms engage in FDI. A firm enters the model with a given amount of initial wealth as internal fund and draws its productivity. After knowing its own productivity, the firm makes two decisions, one for production, i.e. doing domestic production only or doing domestic and foreign production both; the other for financing, i.e. borrowing from bank or issuing corporate bonds directly.

Compared to domestic production, producing abroad faces a productivity shock, which is unknown to all the parties (either bank, bondholder or firm) ex ante but only freely observable by the firm ex post. Banks are willing to spend some resources to collect information about this shock and convey the information to the borrowing firms after they pay the information acquisition fee. The individual bondholder, in contrast, has no incentive to monitor the firm since the risk is shared by all the investors. Therefore, if the firm issues bond, it signs debt contracts with bondholders and there is a Costly State Verification problem since the shock is not freely observable by the bondholders ex post.

If the firm borrows from bank, it can acquire the information before making the decision on FDI or not. If the bank tells that a good shock will happen, the firm will engage in FDI and get positive profit. While if a bad shock is coming such that FDI is not profitable, the firm will abstain from FDI trial. Thus, when firms choose bank financing, they pay an extra fee to protect themselves from the risk of productivity shock. In contrast, if the firm goes to bond financing, it saves the information acquisition fee but expose itself to the risk. When facing a good shock, the firm gets positive net profit from FDI abstracting a fixed repayment to bondholders. However, it could happen that the firm is not able to repay the bondholders when suffering from a bad shock. In this case, the firm defaults and gets nothing whereas the bondholders have to pay a verification cost to completely seize all the generated revenues in the hands of the firm.

To avoid such an inefficiency situation, those firms trying to do FDI but with medium productivities prefer to go to banks to reveal the information on productivity shock, which is similar to purchasing insurance. Otherwise, if they go to bond market, they are required to pay higher risk premium compared to firms with high productivities because they are more likely to default, which also keeps them out of bond financing. By comparison, those firms with high productivities have confidence in the success of FDI so they have incentive to skip the costly middleman and issue bond directly. Furthermore, the high productivities of those firms reduce the probability of default and label their good credit ratings, which also attract the bond investors.

In the above model, we use productivity as the key medium to link financial structure with firm's FDI. Based on this setting, we derive the first result on firm's segmentation in

production activity and financial structure in terms of productivity such that, in an environment of identical countries, more productive firms engage in FDI while less productive ones only produce domestically; among those FDI firms, more productive firms prefer bond finance whereas less productive ones are willing to borrow from banks. This result is consistent with the firm-level evidences as well as the predictions in capital structure literatures. We further infer that in aggregation countries with higher productivity or a larger share of productive firms enjoy more outward FDI and more bond finance over bank finance.

Secondly, we show that, besides firm's own productivity, the variance of the uncertainty of doing FDI (indicator of risk) has impacts firms' financing choices. In our model, there is no risk for domestic production. Therefore, domestic firms are indifferent to the two financing sources. However, in case of FDI firms, if they invest in low-risk host country, they prefer bond finance since in this case insurance from bank is not worth. In comparison, those firms who engage in more risky location or face more volatile prospects are more likely to use bank finance. This result links the financial structure of FDI source country with the characteristics of its host country.

Thirdly, in an environment of heterogeneous countries, we argue that the two parameters in our model, information acquisition fee charged by banks and verification cost incurred by bondholders, which reflect the financial development of the country, are important for firms' financing choices and margins of FDI. Decrease in either of them helps to reduce the productivity threshold and product price of FDI as a result of lower financial cost.

In addition, our research complements the existing literature with the result that FDI firms' productivities need not be significantly higher than non-FDI firms'. In our model, when the firms go to banks, they pay to know the information on productivity shocks. Facing fairly good shocks, the firms whose own productivities are not so high will also engage in FDI as long as the non-risky profit from FDI is positive, which lowers the productivity gap of FDI over domestic production. This finding could explain the inconsistency between theoretical prediction and the evidence mentioned in Buch et al. (2009) that the productivity difference between FDI and non-FDI firms is not significant in Germany. Our explanation is a bank-finance-dominant financial system in Germany helps to reduce the threshold for foreign investment and promote outward FDI.

The most important contribution of this research to the literature on financial constraint and firm's internationalization strategy lies in our paper emphasizing the impact of the type other than the availability of external finance on FDI. A general conclusion in existing literature is with financial development of a country, firms could have a better access to external finance, which relaxes financial constraint and promotes firm's internationalization. In this work, we also derive a consistent result that the decrease of bank cost or verification cost in bond finance as a result of financial development benefits FDI. Besides, our model shows given financial resources, the financial structure also influence outward FDI, which implies a new direction of policy on reforming the financial systems to promote firm's internationalization.

This paper also contributes to a huge body of capital structure literature in the following two aspects: first, we use productivity as a reference to segment firms in the choice of financing. We argue that productivity, besides leverage, size or cash flow focused in existing literatures, could be a key indication for firm's profitability and default probability, and affect firm's financing choices. Second, we incorporate product market into a financial structure model. Instead of calculating return of investment as in prior studies, we derive firms' pricing and the revenues generated in product market such that the impact of financing on the intensive margin of FDI is discussed. In addition, we introduce the continuous stochastic states so that cutoff productivities are calculated.

The remainder of this paper is organized as follows. Section 2 derives the model and propositions. Section 3 discusses further the results and policy implications. Section 4 provides empirical analysis. Section 5 concludes.

2. Model

Consider a world with two identical countries, one home country and one potential host country of FDI. We focus on the behavior of firms from home country.

There is a continuum of firms. Firm i is born with a certain amount of internal fund n_i and draw its productivity φ_{1i} from a common distribution $g(\varphi)$, (Melitz 2003). After the productivity is revealed, the firm has three possible choices to follow at period t=0: (1) Does nothing but get gross return of Rn_i at period t=1. R is the exogenous safe investment return in the economy; (2) Produces domestically and serves the domestic market; (3) Invests both domestically and abroad, and serves the domestic market as well as foreign market. Compared to domestic production, foreign investment faces productivity shock φ_{2i}.

We assume that the labor must be prepaid before production, and the firm has no enough internal fund to finance the production (either domestic or foreign production). Therefore, the firm has to borrow external finance.

To get the finance for production, firms could either go to a bank or issue corporate bond in the bond market. Therefore, there are two types of external creditors: one is bank, the other is a group of bondholders.

As the delegated monitor of investors (Diamond 1984), banks are willing to collect information on investment projects of their borrowers. When a firm wants to do FDI, banks offer it the loan as well as the information about the uncertainty of φ_{2i} which is acquired by the bank. The firm can decide whether to do FDI or not after knowing $\varphi_{2i,}$ which helps to eliminate the uncertainty in foreign investment. However, the bank is costly middleman. The firm must pay the bank the information acquisition fee, which is a share of the internal fund τn_i. This assumption implies that larger firms is more costly to monitor.

In comparison, the bondholders also offer the firm options to obtain fund, but there is no ex ante information acquisition about the uncertainty because the risk is shared by a number of bondholders. As a result of free riding problem, no information is collected, hence the firm does not know any information about $\varphi_{2i,}$ ex ante. Compared to bank finance, bond finance is more risky for the firm but it saves the intermediary cost. On the other hand, when FDI production is completed, $\varphi_{2i,}$ is realized but it is only freely observable by the firm. If the firm could get a net positive profit after the repayment to bondholders, the firm will repay the borrowing. Otherwise, the firm will default. When default happens, the bondholders seize the generated profit after pay a verification cost which is a fraction μ of the realized profit. The optimal contract between the firm and bondholders is debt contract with costly state verification. (CSV hereafter, Townsend1979, Gale & Hellwig 1985).

2.1 Demand

The utility function of a representative household at home country is:

$$U = \left[\int_{i \in \Omega} q_{iD}^{\frac{\varepsilon-1}{\varepsilon}} di \right]^{\frac{\varepsilon}{\varepsilon-1}}$$

where the set Ω represents the mass of available varieties and ε denotes the elasticity of substitution between any two varieties. Defining the aggregate good $Q \equiv U$ with aggregate price

$$P = \left[\int_{i \in \Omega} p_{iD}^{1-\varepsilon} di \right]^{\frac{1}{1-\varepsilon}}$$

and solving the EMP (Expenditure Minimization Problem) of the consumer, we have the demand function for every variety i:

$$q_{iD} = \left(\frac{P}{p_{iD}} \right)^{\varepsilon} Q \tag{1}$$

Analogously, the utility function of a representative household at host country is:

$$U = \left[\int_{i \in \Omega} q_{iF}^{\frac{\varepsilon-1}{\varepsilon}} di \right]^{\frac{\varepsilon}{\varepsilon-1}}$$

And the price index is given by:

$$P = \left[\int_{i \in \Omega} p_{iF}^{1-\varepsilon} di \right]^{\frac{1}{1-\varepsilon}}$$

Hence the demand function at host country is:

$$q_{iF} = \left(\frac{P}{p_{iF}} \right)^{\varepsilon} Q \tag{1'}$$

We assume the host country and the home country are segmented market but they have the same price index and aggregate good index.

2.2 Production

Each firm i produces a distinct variety. Labor is the only input. If the firm produces domestically, the cost function is given as:

$$l_{iD} = \frac{q_{iD}}{\varphi_{1i}} + f \tag{2}$$

where l_{iD} is the labor input, q_{iD} output and f the fixed cost for production in home country. There is no uncertainty in domestic production.

If the firm does FDI, it faces a productivity shock φ_{2i} such that the cost function for FDI is given as:

$$l_{iF} = \frac{q_{iF}}{\varphi_{1i}\varphi_{2i}} + f \tag{3}$$

where φ_{2i} has the expected value of 1 and follows a Pareto distribution:

$$F(\varphi) = 1 - \left(\frac{b}{\varphi}\right)^k \tag{4}$$

where b is the lower bound of the productivity shock and k is distribution parameter that is assumed to be greater than ε+1. This distribution is motivated by the observation that the productivity distribution of firms follows roughly Pareto distribution (see Helpman et. al 2004). Here we fix $E[\varphi_2] = 1$.

2.3 Production and Financing Decisions of Firms

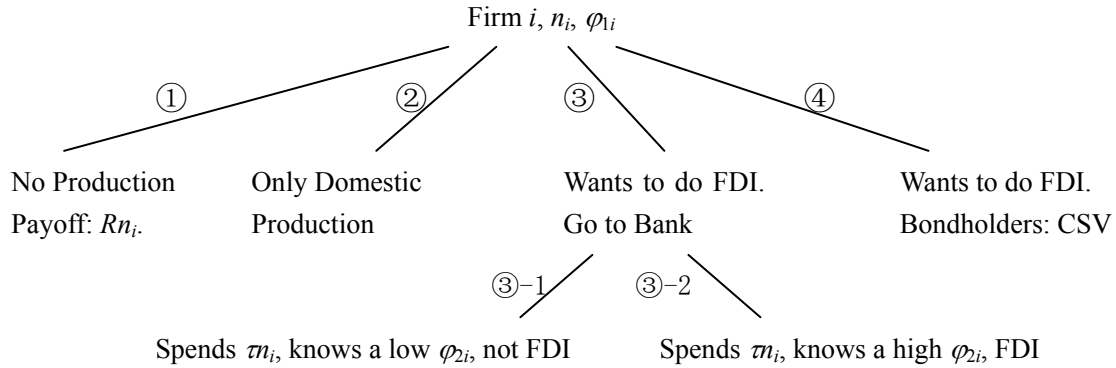


Figure 2

At t=0, according to its initial productivity, the firm makes the decision on production or not as well as how to finance if produce. There are four possible cases all together, which are shown in Figure 2. The firm will compare the payoff of each case and choose the most profitable one. We solve the model backwards and get the cutoff productivities that segment

the four cases.

2.3.1 No Production

Route ①: the firm is unlucky to draw a very low productivity such that production is not profitable. In this case, the firm abstains from production and deposits all its internal fund to get a safe return Rn_i at t=1.

2.3.2 Domestic Production Only

Route ②: the firm has a decent productivity such that it produces only for domestic market. The productivity is not high enough, hence the firm is reluctant to bare additional risk to invest abroad. Remember the cost function for domestic production is

$$l_{iD} = \frac{q_{iD}}{\varphi_{1i}} + f$$

To finance the production, the firm needs $w_D l_{iD}$ as the working capital where w_D is the domestic wage which we normalize to 1. The firm borrows X_{iD} to fill the gap of working capital over internal fund:

$$X_{iD} = l_{iD} - n_i \tag{5}$$

Since no uncertainty with the domestic production, there are no information asymmetry and agency cost when the firm borrows. Moreover, no default happens. Bank and bondholder are indifferent in this case. The creditor and the firm sign a contract specifying the borrowing X_{iD} and the repayment M_{iD}. The participation constraint of the creditor requires that:

$$M_{iD} = RX_{iD} \tag{6}$$

The profit of the firm is given as:

$$\pi_{iD} = p_{iD} q_{iD} - l_{iD} + X_{iD} - M_{iD} \tag{7}$$

The firm maximizes its profit subject to demand function (1), technology (2), financing conditions (5) and (6), which gives the optimal pricing strategy:

$$p_{iD} = \frac{\varepsilon}{\varepsilon - 1} \frac{R}{\varphi_{1i}} \tag{8}$$

The optimal output is therefore:

$$q_{iD} = \left(\frac{\varphi_{1i} (\varepsilon - 1) P}{R\varepsilon} \right)^{\varepsilon} Q \tag{9}$$

For the existence of Route ① as outside option, the firm will choose Route ②only when its productivity is higher than a threshold. The cutoff productivity is given by comparing the profits from Route ② to Route ①:

$$\pi_{iD} \geq Rn_i - n_i \tag{10}$$

The RHS of (10) is the profit under Route ①, and the cutoff is derived when (10) binds. Plugging all the expressions in (10) using (8) and (9), we solve the first cutoff productivity that distinguishes firms from choosing Route ② and Route ①:

$$\varphi_D^* = \left\{ \frac{(\varepsilon - 1) f}{Q} \left(\frac{R\varepsilon}{(\varepsilon - 1) P} \right)^{\varepsilon} \right\}^{\frac{1}{\varepsilon - 1}} \tag{11}$$

2.3.3 FDI and Bank Finance

Route ③: the firm has a high productivity such that it could make profit in foreign market besides domestic market. FDI has an additional risk φ_{2i} on the technology. φ_{2i} could be considered as a productivity shock due to unanticipated institution or policy change or systematic risk in foreign economy.

As we argued above, when the firm goes to a bank, the bank is willing to spend resources on acquiring information about the technology shocks. For simplicity, we assume that the bank can provide accurate information for the firm about how large φ_{2i} is so that the uncertainty in FDI could be completely eliminated. However, the firm has to pay a fee for the information. Here we assume the information acquisition fee is a fixed share of its internal fund, which implies that larger firms in terms of internal fund are more costly to acquire information. Denote the share for the fee as τ so that after the payment, the firm has disposable fund $(1-\tau)n_i$ left.

2.3.3.1 Sub-Route ③-1

If the firm is told that a bad shock will be realized, i.e., φ_{2i} is below some threshold value so that the firm cannot make profit from FDI, the firm will abstain from FDI trial but borrow and produce for domestic market only. In this case, the technology for domestic production is given by (2), but the firm now needs to borrow:

$$X_{A1} = l_{iD} - (1 - \tau) n_i \tag{12}$$

There is no ex post risk for bank financing so that the financial contract specifies a safe repayment M_{A1} which satisfies the bank's participation constraint:

$$M_{A1} = RX_{A1}$$

The profit of the firm is therefore:

$$\pi_{A1} = p_{iD} q_{iD} - l_{iD} + X_{A1} - M_{A1}$$

That is

$$\pi_{A1} = p_{iD} q_{iD} - R l_{iD} + (R - 1)(1 - \tau) n_i$$

The firm maximizes its profit subject to (1) and (2), and get the optimal pricing strategy:

$$p_{iD} = \frac{\varepsilon}{\varepsilon - 1} \frac{R}{\varphi_{1i}}$$

which has the same expression as (8). The optimal output has the same expression as (9). Note that the profit in Sub-Route ③-1 is lower than the profit in Route ② because the firm pays additional information cost.

2.3.3.2 Sub-Route ③-2

If the firm is told to realize a good shock, i.e., φ_{2i} is above a certain threshold value and FDI is profitable, the firm will do domestic production as well as FDI. After paying the information acquisition fee, the firm needs to borrow

$$X_{A2} = l_{iD} + l_{iF} - (1-\tau)n_i \tag{13}$$

FDI technology is given by (3), and here we only consider a horizontal FDI case in a sense that the firm sells the output at the host country. Given that the firm already knows φ_{2i} before doing FDI, a certain amount of repayment M_{A2} is ensured which fulfils the bank's participation constraint:

$$M_{A2} = RX_{A2}$$

The profit of the firm is therefore:

$$\pi_{A2} = p_{iD}q_{iD} - l_{iD} + p_{iF}q_{iF} - l_{iF} + X_{A2} - M_{A2}$$

The firm maximizes the profit

$$\pi_{A2} = p_{iD}q_{iD} - Rl_{iD} + p_{iF}q_{iF} - Rl_{iF} + (R-1)(1-\tau)n_i$$

subject to (1), (1'), (2), (3), which gives the optimal pricing strategies for domestic market and foreign market respectively:

$$p_{iD} = \frac{\varepsilon}{\varepsilon - 1}\frac{R}{\varphi_{1i}}$$

$$p_{iF} = \frac{\varepsilon}{\varepsilon - 1}\frac{R}{\varphi_{1i}\varphi_{2i}} \tag{14}$$

2.3.3.3 Expected Total Profit of Route ③

The total profit of Route ③ depends on both the payoffs and probabilities of sub-route ③-1 and ③-2 while the probability of ending up with ③-1 or ③-2 relies on the realization of φ_{2i}. The firm chooses ③-2 rather than ③-1 if and only if $\pi_{A2} \geq \pi_{A1}$, that is

$$p_{iD}q_{iD} - Rl_{iD} + p_{iF}q_{iF} - Rl_{iF} + (R-1)(1-\tau)n_i \geq p_{iD}q_{iD} - Rl_{iD} + (R-1)(1-\tau)n_i$$

which gives the threshold value of φ_{2i}:

$$\varphi_2^* = \left\{\frac{(\varepsilon-1)f}{Q}\left(\frac{R\varepsilon}{(\varepsilon-1)P}\right)^{\varepsilon}\right\}^{\frac{1}{\varepsilon-1}}\varphi_{1i}^{-1} \tag{15}$$

That means only if the bank tells the firm that the realized productivity shock φ_{2i} is greater than φ^*_2 will the firm actually do FDI.

Therefore the ex ante probability of doing FDI, given that the firm chooses bank finance Route ③, is

$$\Pr\left(\varphi_{2i} \geq \varphi_2^*\right) = 1 - F\left(\varphi_2^*\right)$$

Hence the expected total profit of choosing Route ③ is

$$E[\pi_A] = \int_b^{\varphi_2^*} \pi_{A1} dF(\varphi) + \int_{\varphi_2^*}^{\infty} \pi_{A2} dF(\varphi)$$

Using the Pareto distribution of $F(\varphi)$ in (4), and inserting expressions for π_{A1} and π_{A2}, we have:

$$E[\pi_A] = \pi_{A1} - Rf\left(1 - F\left(\varphi_2^*\right)\right) + \frac{Rkb^k}{(\varepsilon-1)(k+1-\varepsilon)}\left(\frac{(\varepsilon-1)P}{R\varepsilon}\right)^{\varepsilon} Q\Gamma^{\frac{\varepsilon-1-k}{\varepsilon-1}} \varphi_{1i}^k \tag{16}$$

where $\Gamma = \left\{\frac{(\varepsilon-1)f}{Q}\left(\frac{R\varepsilon}{(\varepsilon-1)P}\right)^{\varepsilon}\right\}$.

2.3.3.4 Cutoff Productivity of FDI Trial with Bank Finance

The firm will choose ③ rather than ② if and only if:

$$E[\pi_A] \geq \pi_{iD}$$

The cutoff productivity for this distinction is given when the above inequality binds. Substituting the inequality by (16) and (7), we have:

$$\frac{Rkb^k}{(\varepsilon-1)(k+1-\varepsilon)}\left(\frac{(\varepsilon-1)P}{R\varepsilon}\right)^{\varepsilon} Q\Gamma^{\frac{\varepsilon-1-k}{\varepsilon-1}} \varphi_{1i}^k = Rf\left(1 - F\left(\varphi_2^*\right)\right) + (R-1)\varpi n_i$$

Therefore the cutoff productivity above which the firm will choose ③ rather than ② is given by

$$\varphi_A^* = \left[\frac{(k+1-\varepsilon)(R-1)\varpi n_i}{Rfb^k(\varepsilon-1)}\right]^{\frac{1}{k}} \left\{\frac{(\varepsilon-1)f}{Q}\left(\frac{R\varepsilon}{(\varepsilon-1)P}\right)^{\varepsilon}\right\}^{\frac{1}{\varepsilon-1}} \tag{17}$$

or equally

$$\varphi_A^* = \left[\frac{(k+1-\varepsilon)(R-1)\varpi n_i}{Rfb^k(\varepsilon-1)}\right]^{\frac{1}{k}} \varphi_D^* \tag{17'}$$

Proposition 1: *the cutoff productivity for firms to do FDI trial with bank finance φ^*_A is increasing with the bank cost τ and firm size n_i.*

τ is the information acquisition fee as a share of firm's initial wealth. A higher τ means a higher cost for bank finance, which leads to a higher threshold for firms to access bank loans. τ acts as an indicator for country-specific financial development level. With the financial

development, the threshold for firms to do FDI with bank financing will be lower. Moreover, the cutoff φ^*_A is increasing with firm size n_i since larger firms pay higher information fee τn_i with given τ.. Therefore, bank finance is less attractive for larger firms. This result is consistent with the one delivered by capital structure literature (Cantillo& Wright, 2000).

Also note that the variance of productivity shock φ_{2i} under Pareto distribution is:

$$\mathrm{var}(\varphi_{2i}) = \left(\frac{b}{k-1}\right)^2 \frac{k}{k-2}$$

We have assumed that the $E[\varphi_{2i}]=1$, which gives:

$$E[\varphi_{2i}] = \frac{kb}{k-1} = 1$$

and $b=(k-1)/k$. Then we have the variance:

$$\mathrm{var}(\varphi_{2i}) = \frac{1}{k(k-2)} \tag{18}$$

Note that $b<1$, therefore, when k increases, φ^*_A is increasing while the variance in (18) is decreasing, which implies that the cutoff φ^*_A is decreasing in the variance of the productivity shock. In other words, if the variance is smaller (k is larger), φ^*_A will be higher.

Proposition 2: *the cutoff productivity for firms to do FDI trial with bank finance φ^*_A is decreasing with the uncertainty in foreign investment.*

The intuition is as follows: when a firm goes to a bank, it pays a fee to eliminate the uncertainty in future investment, which is similar to purchasing an insurance with a fixed payment. If the variance of the shock is small (lower risk), it is not worth for the fixed fees, hence going to banks is a less attractive choice. On the other hand, if the variance is large (higher risk), it is more valuable to pay a fixed fee to reduce the risk in foreign production, hence the insurance is more attractive and more firms will go to bank finance.

Note that in our setting, the cutoff productivity for FDI trail with bank finance is not necessarily higher than that for domestic production, i.e. $\varphi^*_A > \varphi^*_D$ does not always hold, which implies bank financing system help to reduce the uncertainty in foreign investment and promote domestic firms growing into multinationals. Buch et al.(2009) shows that the productivity difference between German multinational firms and domestic firms is not significant, which is inconsistent with theoretical prediction and the evidences in other countries. We argue that the bank-based financial system might matter for this unusual case in Germany.

2.3.4 FDI and Bond Finance: Route ④

If the firm is lucky enough to draw a very high productivity such that it feels "confident" to overcome the risk of bad shock and make profit from FDI, the firm has no interest in revealing φ_{2i} ex ante but prefer to skip the costly middleman (banks) and borrow directly

from bondholders in bond market. On the other hand, a large number of bondholders, as free riders, have no incentive to spend any resources to acquire information for the firm. Consequently, no information about φ_{2i} is revealed ex ante. After FDI is done, the productivity shock φ_{2i} is realized, which is hidden information that is observable only by firms. If the firm default (under the case that the firm incurs a distressfully bad shock), the bondholders verify the firm with a cost and take all the leftover. The firm, in contrast, completely loses its investment.

The optimal financial contract between the firm and bondholders is a CSV debt contract, as proposed by Townsend (1979) and Gale and Hellwig (1985). In our model, there are two points that worth mentioning: first, the traditional CSV contract considers investment return only. Our model incorporates product market so that the verification cost impacts firms' pricing strategy in the market; second, there are two investment projects in our model: domestic production and FDI. The hidden information problem happens on FDI only. For simplicity, we assume that the firm signs CSV contract for FDI only while the financial contract for domestic production is the same as in Route ② and ③ in which case the firm returns a safe repayment to creditors. We further assume that the firm can not cross subsidize the two investments. This assumption can be justified by the facts that firms could raise fund for FDI in host countries which is difficult to be used for domestic production in home country due to the regulation on international transfer. Moreover, in one-period case, the firm of course can be better off to transfer all the profit from FDI back home and default on FDI. But in multi-period case, if the firm defaults one time, it is not easy for him to raise fund any more. With this assumption, we rule out the channel via which the prices for home country and host country are correlated, which makes consistency with the segmented markets assumption at the beginning.

2.3.4.1 Pricing in Domestic and Foreign Markets

The technology for domestic market is given by (2), while that for FDI is given by (3). The firm makes expectation on the productivity shock φ_{2i} and decides the optimal labor input: l_{iD} and l_{iF}. According to (3), ex post the realized output of FDI is:

$$\tilde{q}_{iF} = \varphi_{1i}\varphi_{2i}\left(l_{iF} - f\right) \tag{19}$$

while the firm expects that FDI has output (target output):

$$E[\tilde{q}_{iF}] = q_{iF} = \varphi_{1i}\left(l_{iF} - f\right)$$

which gives the relationship of actual output and target output

$$\tilde{q}_{iF} = \varphi_{2i} q_{iF}$$

Since there is no information acquisition fee, the firm has disposable internal fund n_i when it borrows. To finance both domestic production and FDI, the firm needs to borrow

$$X_B = l_{iD} + l_{iF} - n_i \tag{20}$$

Without loss of generality, we assume that n_i is devoted to domestic production. In other words, the firm borrows $X_{BD}=l_{iD}-n_i$ to finance domestic production and borrows $X_{BF}=l_{iF}$ to

finance FDI. The corresponding repayments are M_D and M_F, which are independent. There is no uncertainty for domestic production, hence the repayment is

$$M_D = R(l_{iD} - n_i) \tag{21}$$

On the other hand, the firm will repay M_F if and only if the leftover after repayment is greater than 0.

$$\tilde{p}_{iF}\tilde{q}_{iF} - M_F \geq 0 \tag{22}$$

The optimal debt contract specifies M_F and the rule for the firm and the bondholders to distribute the revenue from FDI:

if $\tilde{p}_{iF}\tilde{q}_{iF} - M_F \geq 0$, the firm gets: $\tilde{p}_{iF}\tilde{q}_{iF} - M_F$

the bondholders get: M_F

if $\tilde{p}_{iF}\tilde{q}_{iF} - M_F < 0$, the firm defaults and gets: 0

the bondholders get: $(1-\mu)E[\tilde{p}_{iF}\tilde{q}_{iF} \mid \tilde{p}_{iF}\tilde{q}_{iF} - M_F < 0]$

where μ is a share of total revenue as the ex post verification cost when firms default.
Note that the condition (22) can be expressed by some probability. According to the demand function (1'), the actual price (different from the target price) will be:

$$\tilde{p}_{iF} = \left(\frac{Q}{q_{iF}}\right)^{\frac{1}{\varepsilon}} P\varphi_{2i}^{-\frac{1}{\varepsilon}} = p_{iF}\varphi_{2i}^{-\frac{1}{\varepsilon}}$$

where p_{iF} is the target price. Therefore (22) says:

$$p_{iF}q_{iF}\varphi_{2i}^{\frac{\varepsilon-1}{\varepsilon}} - M_F \geq 0$$

The firm will not default if and only if the realized productivity shock

$$\varphi_{2i} \geq \left(\frac{M_F}{p_{iF}q_{iF}}\right)^{\frac{\varepsilon}{\varepsilon-1}} \equiv \Delta \tag{23}$$

According the financial contract, the firm has expected payoff from FDI:

$$E[\pi_{BF}] = \int_{\Delta}^{\infty} \tilde{p}_{iF}\tilde{q}_{iF} - M_F dF(\varphi) + \int_0^{\Delta} 0 dF(\varphi) = \int_{\Delta}^{\infty} \tilde{p}_{iF}\tilde{q}_{iF} - M_F dF(\varphi) \tag{24}$$

The bondholders expect to get:

$$\int_{\Delta}^{\infty} M_F dF(\varphi) + \int_b^{\Delta} (1-\mu)\tilde{p}_{iF}\tilde{q}_{iF} dF(\varphi)$$

The contract specifies (X_{BF}, M_F) to maximize firm's expected payoff subject to bondholders' participation constraint. That is

$$\max \quad \int_{\Delta}^{\infty} \tilde{p}_{iF}\tilde{q}_{iF} - M_F dF(\varphi)$$

$$s.t. \quad \int_{\Delta}^{\infty} M_F dF(\varphi) + \int_b^{\Delta} (1-\mu)\tilde{p}_{iF}\tilde{q}_{iF} dF(\varphi) = Rl_{iF}$$

By some manipulation, this equals to:

$$\max \quad \frac{\varepsilon-1}{\varepsilon k-\varepsilon+1} M_F\left(1-F(\Delta)\right)$$

$$s.t. \quad M_F\left(1-F(\Delta)\right)=\left[Rl_{iF}-\frac{\varepsilon(1-\mu)kb^{\frac{\varepsilon-1}{\varepsilon}}}{\varepsilon k-\varepsilon+1} p_{iF} q_{iF}\right] \frac{\varepsilon k-\varepsilon+1}{\varepsilon\mu k-\varepsilon+1}$$

Deriving the first order condition with respect to the target price, we have:

$$p_{iF}=\frac{\varepsilon}{\varepsilon-1}\frac{R}{\varphi_{1i}}\frac{1}{1-\mu}\frac{\varepsilon k-\varepsilon+1}{\varepsilon k b^{(\varepsilon-1)/\varepsilon}} \tag{25}$$

Proposition 3: *the price in foreign market for firms to do FDI trial with bond finance P_{iF} is increasing in verification cost μ and increasing in the uncertainty in foreign investment (decreasing in k).*

Intuitively, higher verification cost leads to higher financial cost, which is reflected in the product price. Moreover, facing higher uncertainty, the bondholders will charge a higher risk premium which also pushes up the price.

Similar to previous cases, the pricing strategy for domestic market is to maximize:

$$\pi_{BD}=p_{iD}q_{iD}-l_{iD}+X_{BD}-M_D$$

which yields the same optimal price for domestic market

$$p_{iD}=\frac{\varepsilon}{\varepsilon-1}\frac{R}{\varphi_{1i}}$$

2.3.4.2 Cutoff Productivity of FDI Trial with Bond Finance

The firm's total expected profit under Route ④ is

$$E[\pi_B]=\pi_{BD}+E[\pi_{BF}]=p_{iD}q_{iD}-l_{iD}+X_{BD}-M_D+\frac{\varepsilon-1}{\varepsilon k-\varepsilon+1}M_F\left(1-F(\Delta)\right)$$

Therefore the threshold productivity for a firm to choose Route ④ rather than Route ② is given by the inequality:

$$E[\pi_B]\geq\pi_{iD}$$

Then we solve the threshold productivity for firms to do FDI trial with bond finance

$$\varphi_B^*=\left\{\frac{Rf}{Q\left(\varepsilon/(\varepsilon-1)-R\right)}\left(\frac{\varepsilon R(\varepsilon k-\varepsilon+1)}{P(\varepsilon-1)(1-\mu)\varepsilon k b^{(\varepsilon-1)/\varepsilon}}\right)^{\varepsilon}\right\}^{\frac{1}{\varepsilon-1}} \tag{26}$$

Proposition 4: *the cutoff productivity for firms to do FDI trial with bond finance φ^*_B is increasing with the verification cost and increasing in uncertainty in foreign investment.*

With higher verification cost as financial cost, the requirement for firms to use bond finance is also higher. Meanwhile, the default probability is lower for less risky foreign investment, therefore, bond finance is more attractive.

Proposition 5: *the cutoff productivity gap between bond finance and bank finance (φ^*_B-φ^*_A) is positive and increasing in uncertainty in foreign investment.*

The proposition tells that for the existence of uncertainty in foreign investment, the threshold productivity for bond finance is usually higher than bank finance. With the decrease of uncertainty, the threshold for bond finance decreases whereas that for bank finance increases, hence the difference between the two decreases, which means facing lower uncertainty in foreign investment, firms are inclined to use bond finance over bank finance.

3. Discussion

3.1 Determinants of Financing Choice

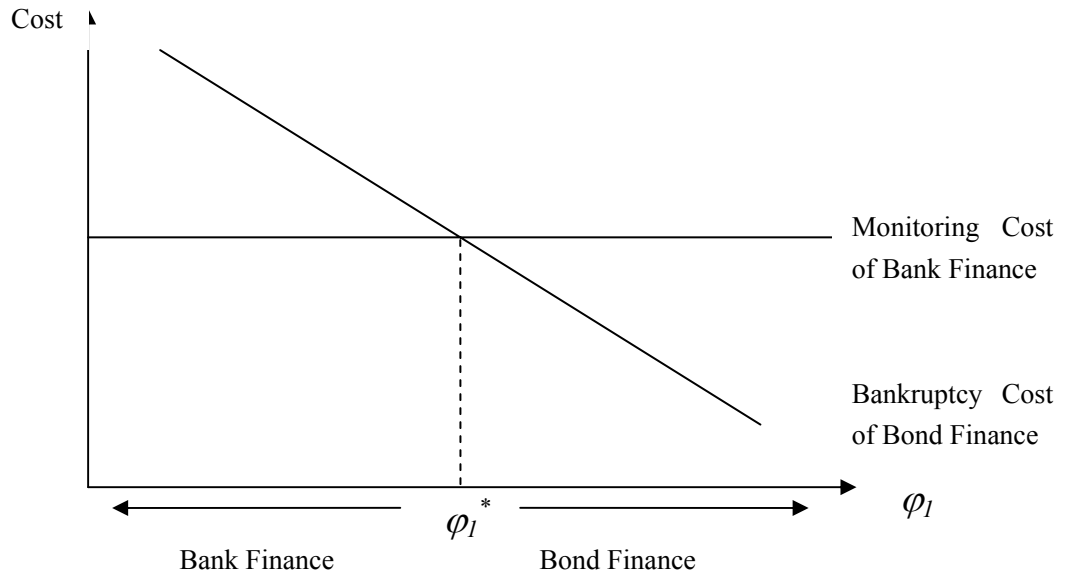


Figure 3

In our model, firm's initial productivity φ_{1i} is a key determinant on the choice of financing. Banks charge the same monitor cost however productive the firm is while the bankruptcy cost of bond finance is lower for more productive firm taking the default probability into account (see Figure 3). Firms trade off the cost for the two financing sources and always choose the one with lower cost. Therefore, firms are partitioned into using bank finance and using bond finance in terms of productivity. More productive firms tend to use bond finance whereas less productive ones prefer bank finance. On the other hand, firm's own productivity φ_{1i} as common knowledge works as a label of credit rating. When all the firms go to bond market to issue corporate bonds, a high productivity indicates a good credit and low probability to default, which attracts the bondholders. In comparison, a low productivity

implies the firm is more fragile to the investment risk in FDI and more likely to default in the future. A higher risk premium will be charged by the bondholders, which also keeps the firms with low productivities out of the bond market. As an aggregation outcome, we predict that countries with a larger fraction of more productive firms will finance more from bond over bank. Detailed proofs see the appendix.

The uncertainty in foreign investment is another important element in financing choice. The advantage of banks over bondholders in information helps to reduce the risk in investment and protects firms from inefficient liquidation. Therefore, firms could choose different financing after evaluating the risk of investment projects. As for multinational firms, the choice of financing depends on the characteristics of the targeting host countries. Investment in countries with more dissimilarity to home country such as in institution, culture, currency, language or even long distance, faces more uncertainty, hence bank finance is a better choice in this case.

In addition, the bank information cost τ and bondholder verification cost μ, as parameters to indicate the development of bank sector and bond market in a country respectively, affect the financing choice directly. Firms are always inclined to the relatively cheaper finance. This point is widely discussed in financial structure literature (see Fiore and Uhlig 2005 for example).

3.2 The Impact of Financing on FDI

For the impact on the margins of FDI, one result our model delivered is more efficiency of banks in information acquisition reduces the cost of external finance and hence lowers the threshold for going abroad; the other result is lower verification cost leads to higher output in foreign market. Both results can be considered as a size effect of external financial resources and are consistent with the predictions in the existing literatures on financial constraint and firm's internationalization decision.

Besides, we find that the type of financing, bank finance or bond finance, also matters. In our model, bond market sets a higher threshold than banks. Therefore, a firm could firstly borrow from banks until they establish the credibility to obtain financing from bond market. Moreover, due to the information advantage, firms borrowing from banks experience less volatility in FDI than those financing from bond market. Based on these arguments, we conclude that an efficient bank sector in collecting information is more important for FDI starters, which finances the FDI trail on one hand, and reduces the risk and volatility in foreign investment on the other. Therefore, a bank-dominating financial system is more helpful for domestic firms growing into multinationals. In contrast, a well-functioning bond market helps to save the intermediation cost so that firms with high productivity and safe investment projects benefit more from bond finance, especially for those with frequent short-term investments.

4. Empirical Analysis

4.1 Model Predictions for Empirical Analysis

The aggregation outcome of firms' financing choices is the endogenous financial structure of a country. The financial structure is measured by the ratio of bond finance over bank finance. Based on the propositions derived from the model, we summarize the following hypotheses for empirical test with country level data.(Details on the aggregation calculation see Appendix)

Hypothesis 1 *(Financial Structure and Risk):* Countries investing in less risky locations have a higher ratio of bond finance over bank finance.

Hypothesis 2 *(Financial Structure and Productivity):* Countries with higher productivities have a higher ratio of bond finance over bank finance.

Hypothesis 3 *(Financial Structure and Cost of Finance):* Countries with higher bank agency cost or lower bankruptcy cost have a higher ratio of bond finance over bank finance.

4.2 Data

In the empirical analysis, we examine the determinants of financial structure at aggregate country level using the panel data including 25 countries (Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, South Korea, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States) over 1990-2009 period. The share of outward FDI flow of the 25 countries in the total world amounts to 80.1% in 2006. We test the impacts of FDI-related elements on financial structure by regressing the financial structure of FDI on the country-level productivity, bank efficiency and aggregate FDI risk the country is exposed to. Among these variables, the data on productivity and bank efficiency are available directly while the data on aggregate FDI risk and financial structure of FDI are calculated with our own constructions.

4.2.1 Aggregate Risk of FDI

We get the country-specific risk rating data in grade ranging from 0 to 100, which takes four categories of risk: economic, political, structural and credit access risk into account. Higher risk grade implies lower risk.

Consider a country i investing in N foreign countries. Its risk in FDI is the aggregate risk of location portfolio. To assess the aggregate risk, we construct an index for FDI sourcing country which is the average risk of its host countries weighted by the share of outward FDI flow of each host country in the total outward FDI flow of the sourcing country.

For example, consider country i a FDI sourcing country, which invests in N foreign countries. Denote the outward FDI flow to each foreign country as $F_1, F_2, \ldots\ldots F_N$ and the risk grade of

each foreign country as $R_1, R_2, \ldots R_N$. Then the aggregate FDI risk for country i is

$$Agg.Risk_i = \sum_{j=1}^{N} R_j \frac{F_j}{\sum_{j=1}^{N} F_j}$$

Assume country risk grade R_j is constant over time during the period we examine. For the change of the share $\frac{F_j}{\sum_{j=1}^{N} F_j}$, the weighted average risk is time variant. Also note that it is not necessary that $AggRisk_i \in [0,100]$ although $R_j \in [0,100]$. Consider country i disinvesting from a risky country and transfering the investment to a safer foreign country. In this case, the share weight $\frac{F_j}{\sum_{j=1}^{N} F_j}$ could be larger than 1, hence the $Agg.Risk_i$ is out of the range of [0, 100].

4.2.2 Financial Structure of FDI

We have financial structure data for the whole economy of each FDI sourcing country which includes the finance for FDI as well as for domestic investment. Remember that we are trying to build a relationship between the financial structure and FDI risk where the financial structure is the one for FDI only. Therefore, we need to isolate the finance for FDI from that for domestic investment and figure out the financial structure of only FDI firms (aggregate FDI firms' financial structure). Our data remains at macro level.

Table 1 Denotations of Variables for Constructions

Variable	Label	Description
T	national total investment	Gross Capital Formation as proxy, data available directly
F	total outward FDI flow	data available directly
I	total inward FDI flow	data available directly
D	domestic firms' total investment	$D = T - I + F$, investment of domestic firms, both FDI firms and non FDI firms, in both home country and foreign country, data available by calculation
R_F	risk of OFDI	the inverse of the above index of *Agg.Risk*, data available by calculation
R_D	risk of domestic production	the inverse of sourcing country risk, data available directly
S_F	financial structure of OFDI firms	variable of interest
S_D	financial structure of non FDI firms	intermediate variable
S	financial structure of the whole economy	data available directly

Since we have assumed that all firms raise their finance at their home countries, the investment that has impact on S of home country is just D while Inward FDI I is financed from foreign country. Remember D includes investment in home country as well

as in foreign country. Hence, the financial structure S is the overall outcome of S_D and S_F where the weight on S_D is $\frac{T-I}{D}$ and the weight on S_F is $\frac{F}{D}$. We then have:

$$\frac{T-I}{D}S_D + \frac{F}{D}S_F = S \tag{27}$$

The relationship between S_D and S_F is tricky. According to the model and theories on financial structure, the higher the investment risk is, the more bank finance will be used compared to bond finance, which suggests an inverse relationship between risk and financial structure where financial structure means the ratio of bond finance over bank finance. For simplicity, we assume the relationship follows equation (28):

$$S_D R_D = S_F R_F \tag{28}$$

We have $S_D = \frac{R_F}{R_D}S_F$. Inserting it into equation (27) we have the financial structure for FDI

$$S_F = \frac{S}{\frac{T-I}{D}\frac{R_F}{R_D} + \frac{F}{D}}.$$

The definitions and data sources of all relevant variables are listed in Table 2.[4]

Table 2 Variable Definition and Data Source

Variable	Label	Measurement	Data Source
S	financing structure of the whole economy, including the finance for both domestic production and FDI.	ratio of private bonds over bank credit	authors' own calculation based on Beck (2009) Financial Development Dataset
S_F	financing structure for FDI	ratio of private bonds over bank credit, for FDI only	authors' own calculation
Prod	productivity	GDP per hour	authors' own calculation based on OECD Dataset
Bankcost	bank efficiency	ratio of operating expenses over loans	authors' own calculation based on OECD Dataset
Risk	country risk	grade from 0 to 100. Higher grade, lower risk.	Euromoney Country Risk (ECR) www.Euromoney.com
F	outward FDI flow	absolute value	UNCTAD
I	inward FDI flow	absolute value	UNCTAD
T	gross capital formation	absolute value	OECD Dataset

[4] A key variable to measure the cost of bond finance is missing here due to the proxy absence and data availability problem. We are currently working on proxy variable constructions.

4.3 Empirical Evidences

We now turn to the aggregate country data for the relationships we are interested in. Figure 4 suggests a positive relationship between a country's productivity and its financial structure. Figure 5 and 6 tell that bond finance are preferred to bank finance for lower aggregate risk. Figure 7 shows the cost effect of financing choice: the higher bank cost, the more bond finance over bank finance.

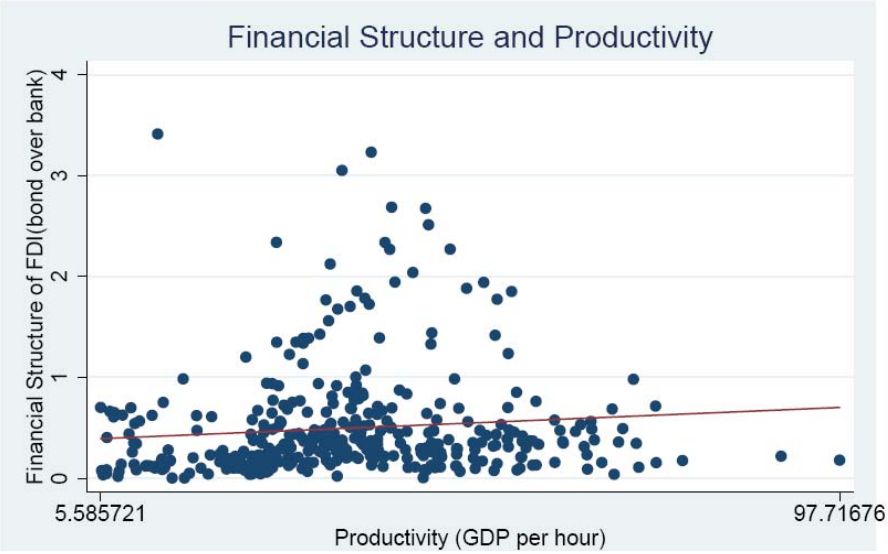


Figure 4 Financial Structure and Productivity

Note: This graph shows the relationship between a country's financial structure for FDI and its productivity. Financial structure is measured as the ratio of bond finance over bank finance. The x-axis gives the GDP per hour as a country-level measurement of productivity. It is the pooled data for 25 countries over 1990-2009. Number of observation = 389. corr.= 0.0987, coeff. = .0033555*.

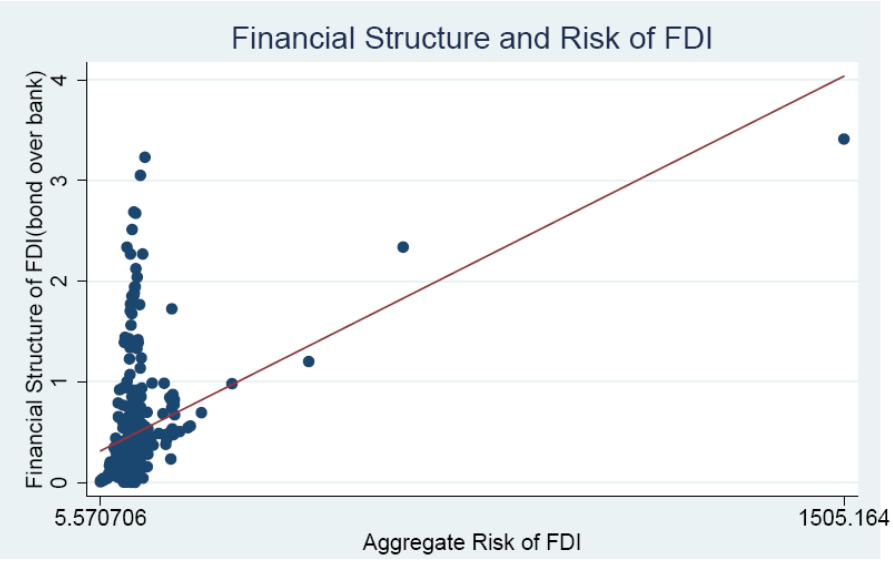


Figure 5 Financial Structure and Aggregate Risk of FDI (1)

Note: This graph shows the relationship between a country's financial structure for FDI and its aggregate risk of FDI. The aggregate risk is the grade for country risk. Higher grade means lower risk. It is the pooled data for 25 countries over 1990-2009. Number of observation = 396. corr.= 0.3942, coeff. = .0024902***

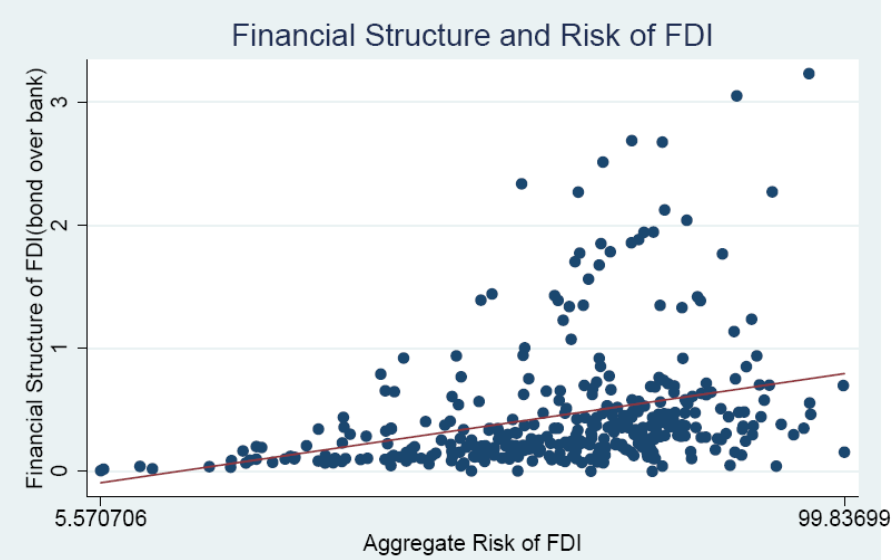


Figure 6 Financial Structure and Aggregate Risk of FDI (2)

Note: It is the pooled data for 25 countries over 1990-2009 with Risk data truncated at 100 ($AggRisk_i \in [0,100]$). Number of observation =361. corr.= 0.3104, coeff. = .0094097***

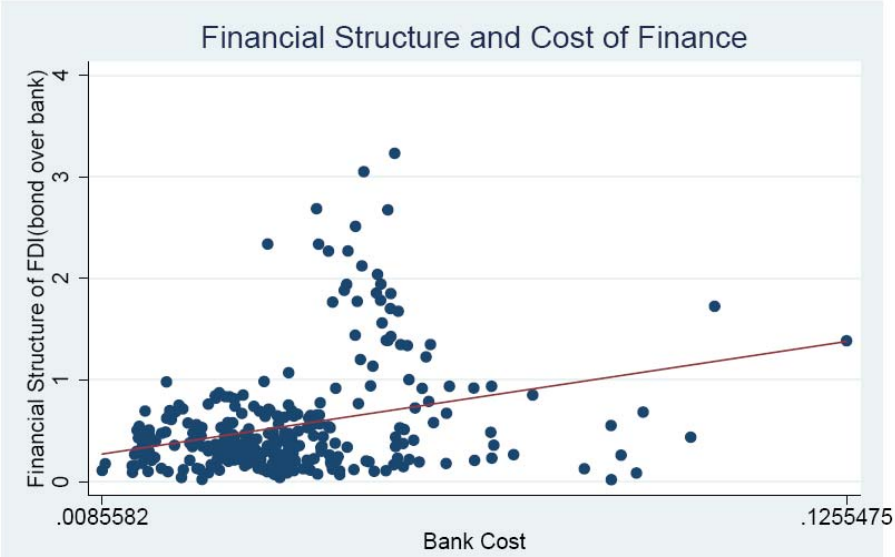


Figure 7 Financial Structure and Cost of Finance

Note: This graph shows the relationship between a country's financial structure for FDI and its bank cost. Bank cost is measured by bank operating expenses over loans. It is the pooled data for 25 countries over 1990-2009. Number of observation = 322. corr.= 0.2972, coeff. = 9.479015 ***

4.4 Empirical Results

We focus on the determinants of financial structure for FDI. The main estimation equation of interest is

$$FS_{it}^{FDI} = \beta_0 + \beta_1 Prod_{it} + \beta_2 Risk_{it} + \beta_3 Bankcost_{it} + \eta_i + \eta_t + \varepsilon_{it}$$

where FS_{it}^{FDI} is the financial structure for FDI (S_F in above calculation), $Prod_{it}$ is a country's productivity, $Risk_{it}$ is aggregate risk of FDI, $Bankcost_{it}$ is the cost for bank finance. η_i and η_t present for country and year fixed effect respectively.

The descriptive statistics of the variables used in econometric analysis are provided in Table 3.

Table 3 Descriptive Statistics

Variables	Mean	Std. Dev.	Min	Max
FS^{FDI}	.4910646	.5325126	.0004964	3.414207
Prod	36.25337	15.68415	5.585721	97.71676
Risk	77.06056	84.32817	5.570706	1505.164
Bankcost	.0371499	.0167164	.0085582	.1255475

As outlined in Hypotheses 1, 2 and 3, we expect that all the three coefficients of interest β1, β2 and β3 are positive. We estimate the equation with ordinary least square (OLS). The results are reported in Table 4.

Table 4

Dependent Variable FS^{FDI}						
	(1)	(2)	(3)	(4)	(5)	(6)
Prod	.0033555*	.0036321**	.005695***	.0074666***	-.00051478	-.00434344
	(.00172)	*(.0015798)*	*(.0019473)*	*(.0025999)*	*(.0017246)*	*(.0037938)*
Risk		.0024983***	.0037175***	.0035685***	.00383799***	.00386161***
		(.0002925)	*(.0005615)*	*(.0005925)*	*(.0003525)*	*(.0003665)*
Bankcost			12.63914***	12.46575***	6.95987***	7.07543***
			(1.752794)	*(1.881013)*	*(1.50782)*	*(1.667664)*
Constant	.3742429***	.1716961***	-.4193274***	-.5293317***	-.3572899***	-.445855***
	(.067842)	*(.0666589)*	*(.12888911)*	*(.1839298)*	*(.1304702)*	*(.1640125)*
Year Fixed Effect	No	No	No	Yes	No	Yes
Country Fixed Effect	No	No	No	No	Yes	Yes
R^2	0.0097	0.1671	0.2206	0.2317	0.7629	0.7751
Adj. R^2	0.0072	0.1628	0.2131	0.1800	0.7451	0.7416
Obs.	389	389	317	317	317	317

Note: *$p<0.1$, ** $p<0.05$, *** $p<0.01$. Standard errors are in parentheses. Year dummies and country dummies are not reported.

In simple OLS regression, all the estimation results are consistent with the model predictions

in Hypotheses 1, 2 and 3 (see column (3)). When we control for the year fixed effect, the coefficients are still in expected signs and significant (column (4)). When the country fixed effect is controlled for, the coefficient of productivity is negative and insignificant (column (5) and (6)). The coefficient of *Bankcost* is smaller. However, *Risk* has a larger effect when controlling for the country-specific characteristics.

5. Conclusions

Countries with different financial structures vary in the performance of FDI, especially in volatility and locations. We develop a theory on how heterogeneous firms choose financing instrument between borrowing bank loans and issuing corporate bonds to finance FDI, and we investigate the determinants on the choices of external financing structure and FDI's performance of multinational firms. We establish an asymmetric information model where the hidden information is the productivity shock that happens when the firms begin FDI. As the delegated monitors of investors, banks are willing to spend resources to acquire information about the coming shock in FDI while bondholders are not motivated to do so as a result of free riding problem. Our model predicts that firms with higher productivity, hence with more resistance to bad shocks, are more likely to use corporate bonds whereas those firms with lower productivities resort to bank loans since banks, as better informed creditors compared to bondholders, help to reduce the uncertainty ex ante in FDI. On the other hand, the risk expectation in potential FDI host countries is a key determinant on firm's financing choice. Firms investing in more risky countries prefer bank finance to bond finance. In addition, altering the relative cost of bank finance and bond finance affects firm's financing choice and margins of FDI. For the intensive margin of FDI, lower financing cost, either in bank finance or in bond finance, leads to higher output in foreign market. Meanwhile，for the extensive margin of FDI, only the cost reduction in bank finance could induce more FDI entries. Putting the development of bank sector in the policy priority could promote less productive domestic firms growing into multinationals while the development of bond market benefit the incumbent multinational firms by saving the intermediary cost. We test the theory with the panel data including 25 large FDI sourcing countries over 1990-2009. We find that countries with higher aggregate productivity, less risky investment portfolio of locations, and higher cost of bank finance, have higher ratio of bond finance over bank finance, which are consistent with the model's predictions.

Our paper contributes to the emerging literature on financial constraint and firms' internationalization with emphasis on the type other than the availability of external financial resources on FDI. It also differs from the body of capital structure literatures in proposing productivity as a determinant of financing choices.

References

1. Allen, F. and D. Gale(2001). "Comparative Financial System: A Survey", Financial Institutions Center at The Wharton School, Working Paper No.01-15.
2. Altunbas, Y., A. Kara and D. Marques-lbanez(2009). "Large Debt Financing: Syndicated Loans versus Corporate Bonds", ECB Working Paper No.1028.
3. Bolton, P. and X. Freixas(2000). "Equity, Bonds, and Bank Debt Capital Structure and Financial Market Equilibrium under Asymmetric Information", *Journal of Political Economy* 108(2), pp.324-351.
4. Buch, C., I. Kesternich, A. Lipponer and M. Schnizer (2009). "Financial Constraints and the Margins of FDI", GESY Discussion Paper No.272.
5. Cantillo, M. and J. Wright (2000). "How Do Firms Choose Their Leaders? An Empirical Investigation", Research Program in Finance, Working Paper Series 354616.
6. Denis, D.J. and V.T.Mihov (2003). "The Choice among Bank Debt, Non-bank Private Debt, and Public Debt: Evidence from New Corporate Borrowings", *Journal of Financial Economics* 70, pp.3-28.
7. Diamond, D.(1984). "Financial Intermediation and Delegated Monitoring", *The Review of Economic Studies,* 51(3), pp.393-414.
8. Fiore, F., and H. Uhlig (2005). "Bank Finance versus Bond Finance What Explains the Differences between US and Europe?", ECB Working Paper No.547.
9. Gale, D. and M. Hellwig (1985). "Incentive-Compatible Debt Contracts: The One-Period Problem." *The Review of Economic Studies,* 52(4), pp. 647-663.
10.Holmström**,** B. and J. Tirole (1997). "Financial Intermediation, Loanable Funds, and the Real Sector", *The Quarterly Journal of Economics*, 112(3), pp.663-691.
11.MacKie-Mason, J. K. (1989). "Do Firms Care Who Provides Their Financing?" NBER Working Paper w3039.
12.Manova, K. (2007). "Credit Constraints, Heterogeneous Firms, and International Trade" Standford University Working Paper.
13.Melitz, M. (2003). "The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity," *Econometrica* 71(6), pp. 1695-1725.
14.Russ, K. and D. Valderrama (2009). "A Theory of Banks, Bonds, and the Distribution of Firm Size" NBER Working Paper w15454.
15.Townsend, R. M.(1979). "Optimal Contracts and Competitive Markets with Costly State Verification", *Journal of Economic Theory*, 21(2), pp. 265-293.

Appendix: Aggregation and Simulations

To calculate the aggregate financial structure of a sourcing country, we first need to investigate what type of external finance each firm uses and how much they borrow. Then we sum up all the firms that borrow from banks and those borrow from bond market respectively. The financial structure is the ratio of the two summations. Based on the aggregation results, we can do comparative static analysis and motivate our empirical specification.

Firm i is born with initial wealth n_i and it draws its productivity φ_{1i} that follows Pareto distribution $G(\varphi_1) = 1 - (\alpha / \varphi_1)^{\beta}$ with probability distribution function $g(\varphi_1) = \beta \alpha^{\beta} \varphi_1^{-\beta-1}$. The Pareto distribution assumption follows the empirical finding by Helpman et.al (2004). Note that the cutoff productivity for domestic production only (the one that distinguishes Route ① from Route ②) is:

$$\varphi_D^* = \left\{ \frac{(\varepsilon - 1) f}{Q} \left(\frac{R\varepsilon}{(\varepsilon - 1) P} \right)^{\varepsilon} \right\}^{\frac{1}{\varepsilon - 1}} \tag{A1}$$

Firms with productivities that is lower than φ_D^* will not produce at all.

The cutoff productivity that distinguishes Route ③ from Route ② is:

$$\varphi_A^* = \left\{ \frac{(k + 1 - \varepsilon)(R - 1) \varpi n_i}{R f b^k (\varepsilon - 1)} \right\}^{\frac{1}{k}} \varphi_D^* \tag{A2}$$

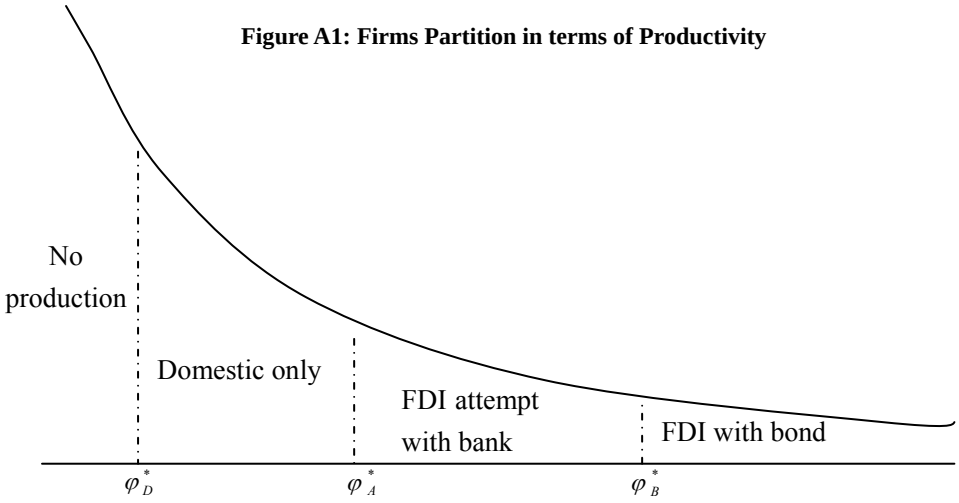
Firms with productivity between φ_D^* and φ_A^* will only produce for domestic market (unless extreme and unreasonable parameters, we have $\varphi_A^* > \varphi_D^*$).

The cutoff productivity that distinguishes Route ④ to Route ② is:

$$\varphi_B^* = \left\{ \frac{Rf}{Q(\varepsilon / (\varepsilon - 1) - R)} \left(\frac{\varepsilon R(\varepsilon k - \varepsilon + 1)}{P(\varepsilon - 1)(1 - \mu) \varepsilon k b^{(\varepsilon - 1)/\varepsilon}} \right)^{\varepsilon} \right\}^{\frac{1}{\varepsilon - 1}} \tag{A3}$$

Firms with productivity that is between φ_A^* and φ_B^* will attempt to do FDI and borrow from banks while those whose productivity is higher than φ_B^* will do FDI and issue bonds.

Figure A1: Firms Partition in terms of Productivity



It is special for firms whose productivity lies in φ_A^* and φ_B^*. When they go to banks, they pay an information acquisition fee which is a share of their initial wealth to know the productivity shock of FDI. The cutoff shock above which the firm can actually do FDI in this situation is given by:

$$\varphi_2^* = \left\{ \frac{(\varepsilon-1)f}{Q} \left(\frac{R\varepsilon}{(\varepsilon-1)P} \right)^{\varepsilon} \right\}^{\frac{1}{\varepsilon-1}} \varphi_1^{-1} \tag{A4}$$

Note that the cutoff shock depends on the firms' own productivity because the higher the initial productivity of a firm, the better protected of the firm from bad shock.

To know how much the total bank finance is, we pick a firm with productivity $\varphi_{1i} \in [\varphi_A^*, \varphi_B^*]$ and calculate its borrowing. Then we integrate all the borrowings by the firms whose productivities are in the same set as this picked firm. Such a firm goes to the bank. It either borrows X_{A1} and abstains from FDI with the probability of $F(\varphi_2^*)$ or borrows X_{A2} and does FDI with the probability of $1-F(\varphi_2^*)$ where $X_{A1} = l_{iD} - (1-\tau)n_i$, $X_{A2} = l_{iD} + l_{iF} - (1-\tau)n_i$ according to equations (12) and (13) and recall that the productivity shock φ_2 follows a Pareto distribution $F(\varphi_2) = 1-(b/\varphi_2)^k$.

Incorporating the firm's optimization decision, we know:

$$X_{A1} = \left(\frac{P(\varepsilon-1)}{\varepsilon R} \right)^{\varepsilon} Q\varphi_{1i}^{\varepsilon-1} + f - (1-\tau)n_i \tag{A5}$$

$$X_{A2} = \left(\frac{P(\varepsilon-1)}{\varepsilon R} \right)^{\varepsilon} Q\varphi_{1i}^{\varepsilon-1} + \left(\frac{P(\varepsilon-1)}{\varepsilon R} \right)^{\varepsilon} Q\varphi_{1i}^{\varepsilon-1}\varphi_2^{\varepsilon-1} + 2f - (1-\tau)n_i \tag{A6}$$

Since φ_2 is uncertain ex ante, we need to calculate the expected value of X_{A2} (conditional).

$$E[X_{A2}]=\left(\frac{P(\varepsilon-1)}{\varepsilon R}\right)^{\varepsilon} Q\varphi_{1i}^{\varepsilon-1}+\left(\frac{P(\varepsilon-1)}{\varepsilon R}\right)^{\varepsilon} Q\varphi_{1i}^{\varepsilon-1}\int_{\varphi_2^*}^{\infty}\varphi_2^{\varepsilon-1}dF(\varphi_2)+2f-(1-\tau)n_i$$

The integration of φ_2 starts from φ_2^* because the firm will do FDI only if $\varphi_2>\varphi_2^*$. This gives:

$$E[X_{A2}]=\left(\frac{P(\varepsilon-1)}{\varepsilon R}\right)^{\varepsilon} Q\left(\varphi_{1i}^{\varepsilon-1}+\frac{kb^k}{k+1-\varepsilon}\left\{\frac{(\varepsilon-1)f}{Q}\left(\frac{R\varepsilon}{(\varepsilon-1)P}\right)^{\varepsilon}\right\}^{\frac{\varepsilon-1-k}{\varepsilon-1}}\varphi_{1i}^{k}\right)+2f-(1-\tau)n_i \quad \text{(A 6')}$$

Therefore the total bank finance is given by:

$$BANK_T=\int_{\varphi_A^*}^{\varphi_B^*}\{X_{A1}F(\varphi_2^*)+E[X_{A2}][1-F(\varphi_2^*)]\}dG(\varphi_1) \quad \text{(A7)}$$

On the other hand, the total bond finance can be calculated analogously. Firm j with productivity $\varphi_{1j}>\varphi_B^*$ issues bond: $X_B=l_{jD}+l_{jF}-n_j$. From equation (25) we know

$$l_{jF}=\left(\frac{(\varepsilon-1)(1-\mu)\varepsilon k b^{(\varepsilon-1)/\varepsilon}P}{\varepsilon R(\varepsilon k-\varepsilon+1)}\right)^{\varepsilon} Q\varphi_{1j}^{\varepsilon-1}+f$$

Hence:

$$X_B=\left[\left(\frac{P(\varepsilon-1)}{\varepsilon R}\right)^{\varepsilon} Q+\left(\frac{(\varepsilon-1)(1-\mu)\varepsilon k b^{(\varepsilon-1)/\varepsilon}P}{\varepsilon R(\varepsilon k-\varepsilon+1)}\right)^{\varepsilon} Q\right]\varphi_{1j}^{\varepsilon-1}+2f-n_j \quad \text{(A8)}$$

The total bond finance is given by:

$$BOND_T=\int_{\varphi_B^*}^{\infty}X_B dG(\varphi_1) \quad \text{(A9)}$$

Further, (A7) becomes:

$$BANK_T=\int_{\varphi_A^*}^{\varphi_B^*}\left(\frac{P(\varepsilon-1)}{\varepsilon R}\right)^{\varepsilon} Q\varphi_1^{\varepsilon-1}F(\varphi_2^*)+(f-(1-\tau)n_i)F(\varphi_2^*)+\left(\frac{P(\varepsilon-1)}{\varepsilon R}\right)^{\varepsilon} Q\varphi_1^{\varepsilon-1}(1-F(\varphi_2^*))$$

$$+\left\{(2f-(1-\tau)n_i)+\left(\frac{P(\varepsilon-1)}{\varepsilon R}\right)^{\varepsilon}\frac{Qkb^k}{k+1-\varepsilon}\left\{\frac{(\varepsilon-1)f}{Q}\left(\frac{R\varepsilon}{(\varepsilon-1)P}\right)^{\varepsilon}\right\}^{\frac{\varepsilon-k-1}{\varepsilon-1}}\varphi_1^k\right\}(1-F(\varphi_2^*))dG(\varphi_1)$$

Denote

$$\Gamma=\left(\frac{P(\varepsilon-1)}{\varepsilon R}\right)^{\varepsilon}\frac{Qkb^k}{k+1-\varepsilon}\left\{\frac{(\varepsilon-1)f}{Q}\left(\frac{R\varepsilon}{(\varepsilon-1)P}\right)^{\varepsilon}\right\}^{\frac{\varepsilon-k-1}{\varepsilon-1}}$$

$$\Theta = \left\{ \frac{(\varepsilon-1)f}{Q} \left(\frac{R\varepsilon}{(\varepsilon-1)P} \right)^{\varepsilon} \right\}^{\frac{1}{\varepsilon-1}}$$

We have:

$$BANK_T = \left(\frac{P(\varepsilon-1)}{\varepsilon R} \right)^{\varepsilon} \frac{Q\beta\alpha^{\beta}}{\beta+1-\varepsilon} \left(\varphi_A^{*\,\varepsilon-\beta-1} - \varphi_B^{*\,\varepsilon-\beta-1} \right) + \left(f - (1-\tau)n_i \right) \left(\left(\frac{\alpha}{\varphi_A^*} \right)^{\beta} - \left(\frac{\alpha}{\varphi_B^*} \right)^{\beta} \right)$$

$$+ \frac{fb^k\Theta^{-k}\beta\alpha^{\beta}}{k-\beta} \left(\varphi_B^{*\,k-\beta} - \varphi_A^{*\,k-\beta} \right) + \frac{\Gamma b^k\Theta^{-k}\beta\alpha^{\beta}}{2k-\beta} \left(\varphi_B^{*\,2k-\beta} - \varphi_A^{*\,2k-\beta} \right)$$

(A10)

where $k \neq \beta$. Now we have total bank finance expressed all by exogenous parameters. No matter $k > \beta$ or $k < \beta$, we will have $BANK_T > 0$ since $\varphi_B^* > \varphi_A^*$ and we assume Pareto distribution parameter $\beta > \varepsilon + 1$.

Meanwhile, (A9) becomes

$$BOND_T = \int_{\varphi_B^*}^{\infty} \left[\left(\frac{P(\varepsilon-1)}{\varepsilon R} \right)^{\varepsilon} Q + \left(\frac{(\varepsilon-1)(1-\mu)\varepsilon k b^{(\varepsilon-1)/\varepsilon} P}{\varepsilon R(\varepsilon k - \varepsilon + 1)} \right)^{\varepsilon} Q \right] \varphi_{1j}^{\varepsilon-1} + 2f - n_j dG(\varphi_1)$$

With another denotation:

$$\Omega = \left(\frac{P(\varepsilon-1)}{\varepsilon R} \right)^{\varepsilon} Q + \left(\frac{(\varepsilon-1)(1-\mu)\varepsilon k b^{(\varepsilon-1)/\varepsilon} P}{\varepsilon R(\varepsilon k - \varepsilon + 1)} \right)^{\varepsilon} Q$$

we have

$$BOND_T = \frac{\Omega\beta\alpha^{\beta}}{\beta+1-\varepsilon} \varphi_B^{*\,\varepsilon-\beta-1} + (2f - n_i) \left(\frac{\alpha}{\varphi_B^*} \right)^{\beta} \tag{A11}$$

And finally we define the financial structure as:

$$FinStr = \frac{BOND_T}{BANK_T} \tag{A12}$$

The simulation results on the defined FinStr and exogenous parameters are given in Figure A2 to A5.

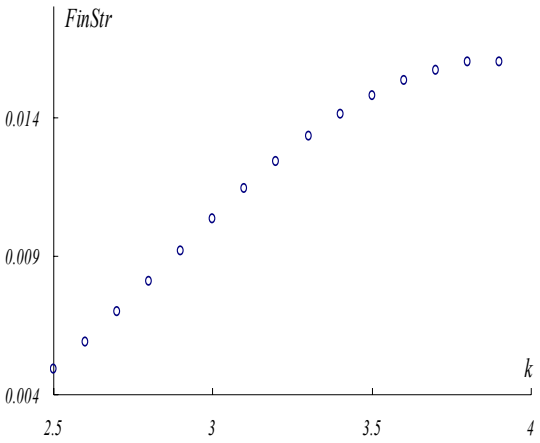


Figure A2

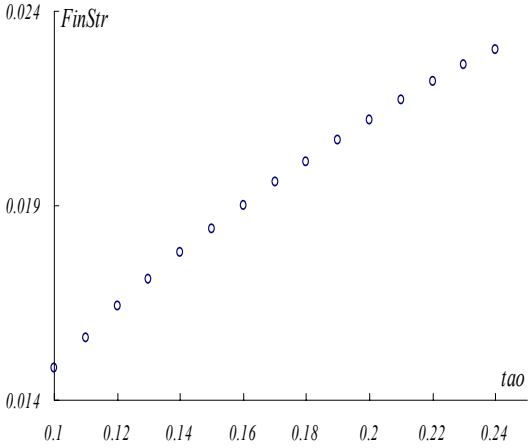


Figure A3

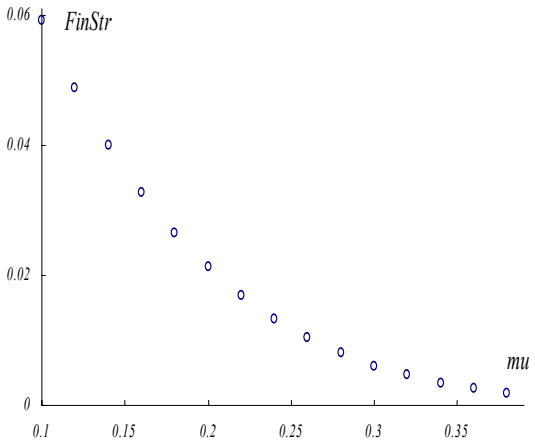


Figure A4

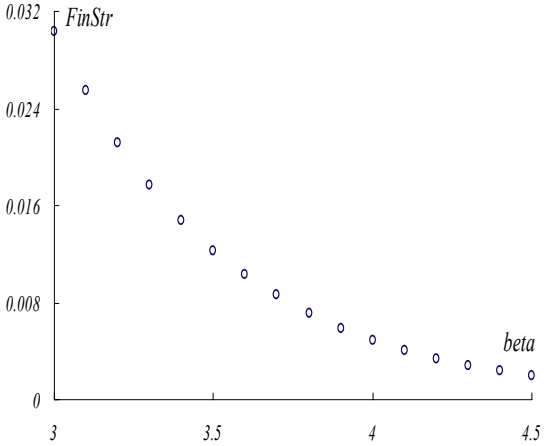


Figure A5

In figure A2, an increasing k means decreasing risk of FDI. The cutoff productivity for bond financing is decreasing in the risk while the cutoff productivity for bank financing is increasing in the risk. This means with lower FDI risk, more firms will pledge to bond finance and less firms will use bank credit, and we have the Bond/Bank ratio increased. Other parameters are: elasticity of substitution $\varepsilon = 2$, fixed cost of investment f=5, aggregate price index P=1, aggregate consumption index Q=20, safe return rate on investment R=1.2, productivity distribution parameter β=4, α=1, firm's initial wealth n=5, bank information acquisition fee multiplier τ=0.1, bondholders' verification cost multiplier μ=0.2. As we assumed the expected productivity shock of FDI is 1, we have $b=k/(k-1)$. We simulate A1 letting k change from 2.5 to 3.9.

In figure A3, an increasing in τ means it is more expensive to acquire information from banks. Therefore τ reflects the inefficiency of banks. Not surprisingly, the Bond/Bank ratio is increasing in τ. Other parameters are the same as in A2 except we fix k=3.5 and τ changes from 0.1 to 0.24[5].

[5] In empirical work, we use the operating expenses of banks over total bank loans to measure τ, and we select the parameters in a reasonable range.

In figure A4, an increasing in μ means higher verification cost of bond finance when there is default. μ directly affects the cost of issuing bond. If the liquidation cost of bond is higher, firms will be reluctant to issue bond because the liquidation cost is included in the financial contract. Therefore, the Bond/Bank ratio is decreasing in μ. Other parameters are the same as in A2 except we fix k=3.5 and let μ range from 0.1 to 0.38[6].

α, β are the parameters of the distribution of φ_1. When we fix α=1, the expected productivity of firms equals to $\alpha\beta/(\beta-1)$, which is decreasing in β. A higher β means lower average productivity in one country. In this case, less bonds will be issued compared to bank credit considering the potential risk of FDI. Therefore the Bond/Bank ratio is decreasing in β. Other parameters are the same in A2 except we fix k=2.5 and β increases from 3 to 4.5.

[6] There are many literatures that try to measure the liquidation cost. Based on the evidences in US and Europe, the bankruptcy cost in the share of total revenue ranges from 0.1 to 0.4. See Warner (1977), Mello and Parsons (1992), Fiore and Uhlig (2005).