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跨業經營環境下的金融中介競爭與金融脆弱性(第 2 年)
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行政院國家科學委員會補助專題研究計畫

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Extended Financial Services,

Banking Competition and Financial Fragility:

A Partial Equilibrium Framework

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Abstract

We introduce heterogeneous borrowers and underwriting business into a framework similar to that of Boyd and DeNicoló(2005), and find out that (1) more capable firms will tolerate higher risk; however this does not necessarily lead to a higher default risk than those less capable firms have; (2) when direct lending does not lead to higher default risks, no arbitrage results in higher loan rates and lower direct lending costs; (3) the availability of direct finance alleviates the undesired effect of the risk-incentive mechanisms discovered by Boyd and de Nicoló (2005).

Keywords: Extended financial services, Banking competition, Risk-taking, Financial fragility

As more financial innovations arise and the financial sector evolves into the one with more market-oriented transaction, commercial banks get involved into more securities business than before. However their roles as intermediation are still active but in different forms of financial business (see Boyd and Gertrler (1994), Berger et al. (1999), Allen (2001), and Allen and Santomero (2001)). Different forms of business change the way how intermediaries and their customers interact. Rajan (2005) argues that financial innovation promotes the convenience of, but at the same time also increases the complexity of, financial transaction. As markets become more complicated, it is more difficult for market participants to get information and agency problems become worse when agents make financial transactions through intermediation.

In discussing banking competition and banks' risk-taking behaviors, it is quite often that authors assume away securities-underwriting business. Examples include Allen and Gale (2004), Boyd and de Nicoló (2005), Koskela and Stenbacka (2000), Matutes and Vives (2000), Parlour and Rajan (2001), and Shaffer (1998). Another thread of research, such as Kroszner and Rajan (1994), Kanatas and Qi (1998), Kanatas and Qi (2003), and Puri (1999), studies the underwriting behaviors of financial intermediaries. Their discussions show the complexity of banking behaviors when involving underwriting activities.

This paper introduces securities transaction into a banking model of Boyd and De Nicoló. The extended services enlarge the strategy space of firms, complicating interactions between players. This makes our analysis different from the existing literature.

Boyd and de Nicoló (2005) argue that there exists a fundamental risk-incentive mechanism that operates in exactly opposite direction, causing banks to become more risky as their market become more concentrated. The availability of finance through issuing securities provides an alternative for firms raise their external funds. Our purpose is to show that this alternative mitigates the unpopular effects of the risk-incentive mechanisms *a lá* Boyd and de Nicoló. To serve this purpose and make the analysis tractable, we model underwriting activities to a minimum level by assuming that the underwriter charges an exogenous underwriting fee for its service and an entrepreneur has to rely on a underwriter to issue its securities.

The remainder of the paper is organized as follows: In Section 1 we specify our model environment. In Section 2 we analyze how entrepreneurs' choices of projects and the sources of external finance are affected by borrowing costs. Section 3 presents the analysis of competitive banking markets by using no arbitrage arguments. In Section 4 we analyze the decision problems of financial intermediaries (commercial banks) when they have monopoly power. Banks decide loan rates by taking into account loan applicants' reactions to loan rates. In addition we also analyze how entrepreneurs choose their production projects when they decide to issue securities through a underwriter. In Section 5 we examine how the availability of securities-finance affects the risk exposure of the economy. Section 6 summarizes what we have found and offers some concluding remarks.

1 The Environment

Heterogeneous Firms

There are heterogeneous entrepreneurs indexed by their management ability (or levels of management skill) $e \in [\underline{e}, \overline{e}]$. The distribution of e over $[\underline{e}, \overline{e}]$ has a continuous density function $f(e)$. Assume the population of entrepreneurs is one; *i.e.*, $\int_{[\underline{e}, \overline{e}]} f(e) = 1$. The type of an entrepreneur is private information and can be observed by commercial banks when they applying the costly screening technology. A firm has access to risky constant return production projects, indexed by S. Each project requires an investment of one unit of the input to produce S units of the output with probability $P(S,e)$, and zero otherwise. The probability function $P(S,e)$ satisfies:

Assumption 1 $P_s < 0$, $P_{ss} \leq 0$, $P_e > 0$, *and* $P_{se} > 0$.

The probability of success decreases as the output increases at a non-increasing rate. For the same S-project a firm with a higher e succeeds more likely than one with a lower e. An example of $P(S,e)$ is $P(S,e) = 1 - A(S/e)$. One can appropriately choose A such that $0 \leq P(S,e) \leq 1$ for all S and e.

Bank-Financed and Market-Financed Funds

A firm has no resources and has to rely on external funds to make its investment. There are two alternatives to finance a production project: applying for a loan which is financed by a commercial bank or issuing bonds which is underwritten by an investment house. For bank-financed funds, an entrepreneur goes to a commercial bank and apply for a loan. We assume a firm can apply for only one loan from one bank. The loan application is subject to the bank's approval and the bank decides the (gross) interest rate R^L (called loan rates). If an entrepreneur wants to issue bonds to raise funds for its production project, it needs find an investment house to underwrite the bonds. The (gross) interest rate of bonds (R^U, called security rates) is determined by the market and the performance of investment houses. We assume that an entrepreneur can have only one investment house to underwrite its bonds if he chooses to issue bonds. For simplicity, we also assume that a firm can choose to apply for a loan or to issue bonds, but not both.

Financial Institutions

There are two types of financial institutions, commercial banks (hereafter called them banks) and investment banks (hereafter called underwriters). Banks obtain funds by taking in deposits from the markets and paying depositors interests at a gross rate R^D. When receiving a firm's application for a loan, a bank utilizes its screening technology at a cost c to uncover the type of the firm and to sort out the type of its proposed production project. The screening outcome is only observable to the bank, not to other financial institutes and the public. The bank may and may not approve the loan application. When approving the application, the bank also decides the (gross) interest rate (R^L) it will charge for the loan. Since the screening technology yields concrete information for the type of the applicant, the loan rates is contingent only on the type of firms e.

An investment house underwrites bonds for firms in exchange of fee incomes. An investment bank delivers to the public investors the information they find out in the process of underwriting. Due to information asymmetry the public investor is not sure that the delivered information is complete and perfect. In reality, how convincing the information is depends upon many factors such as investment projects, the reputation of the firm that raises funds, and the efforts of underwriters. In particular, the more efforts an underwriter put in collecting and analyzing data, the more convincing the information is. However, the information processing is costly. The efficiency of information processing technology used by underwriters also matters. How much profit an investment bank can obtain for a underwriting case depends upon all these factors. In this paper we do not get into the details of this aspect.[1]

Instead, we assume that underwriting business is quite competitive and, thus, the underwriting fee (ϕ) an investment bank can collect from its clients is determined by market competition. We model the performance of underwriting process by a parameter of *convincing power* (denoted by θ). More specifically, we assume that the public investor understands that the probability of success $P(S,e)$ depends on who runs what kind of production technology; however they just do

[1]In this study we did try to incorporate the details of underwriting technology (its cost and outcomes) into the underwriting optimization problems. However $P(S,e)$ appears recursively in one equation. We still do not know how to solve the problem. Thus we decide put that complexity aside and move forward.

not know what (S,e) is. They make their investment decisions basing upon their belief $\tilde{P}(S,e)$. We use θ to describe how close the belief of the public to the real $P(S,e)$: $\tilde{P}(S,e) = \theta P(S,e)$, $0 < \theta < 1$.

Nowadays it is quite common to observe the mixture of direct and indirect lending for an investment project. As shown in Bolton and Freixas (2000) an equilibrium model with a mixture of bonds- and loans-financed capital structure can be very fruitful but paying a cost of analysis complexity. The purpose of this paper is to show that how competition from markets affects the risk structure discussed in banking literature. It is natural to start with a simple analytical structure and get a clear-cut picture. Only after this step we can go with more confidence to set up a more complicated framework to tackle more difficult issues.

The Gramm-Leach-Bliley Act lifted the ban of securities operation for commercial banks. Like universal banks in Europe, commercial banks in the US started to integrate both loans and securities business under the Act. In many economies, for example Taiwan, Korea and Japan, the integration of financial sector is also under way. Financial holding companies (or universal banks) become a popular form of financial organization. Economies of scale are the driving force behind this trend. The border line between banks-financed and markets-financed funds become burring. Both loans and securities issuing are substitutes and complements of each other. Obviously, universal banks and financial holding companies play an important role in such a financial environment. However. for simplicity, we do not include financial holding companies and universal banks in our analysis. We concentrate on the substitution role of both direct and indirect lending and leave the complement role as our future research topic.

2 Firm's Optimization

Firms use external funds to acquire inputs for their technologies. Let R denote the gross interest rate for obtaining one unit of external funds. One unit of input costs one unit the output. The firm's optimization problem can be written as

$$\max_{S} \quad P(S,e)[S-R] \tag{1}$$

The first order necessary condition is $P_s(S,e)\cdot S + P(S,e) = P_s(S,e)\cdot R$, which can be rewritten as

$$H(S,e) \equiv S + \frac{P(S,e)}{P_s(S,e)} = R, \tag{2}$$

where $H_S(S,e) > 1$ and $H_e(S,e) < 0$. $H(S,e)$ is the *risk(P_s)-adjusted marginal contribution* of an additional unit of output to expected outputs, and the right hand side of (2) is the *risk-adjusted marginal cost* of increasing outputs. One can easily show that the left hand side of (2) is increasing in S, while the right hand side is constant over S. When the risk-adjusted marginal cost (R) increases, the firm should respond by increasing the scale of outputs (S). Let $S^*(R,e)$ be the solution. Figure 1 describes how a change in R affect S^*. As S increases, the probability of success decreases while the expected outputs increases due to the output increase. Thus the optimal response to an increase in R is to increase S. A higher costs of

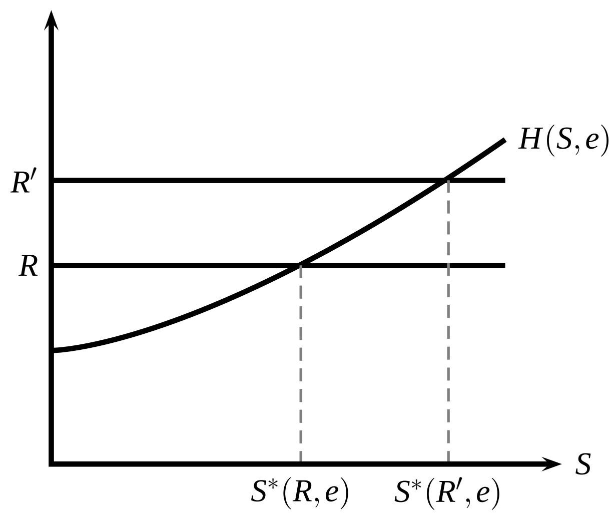

Figure 1: Loan Rates and the Choice of S

funds (higher R) results in the choice of more risky project (a higher S and a lower probability of success).

The P_s-adjusted marginal contribution of additional output $H(S,e)$ is decreasing in e, $H_e(S,e) < 0$. Given the cost of funding R, firms with different e choose different levels of production. A firm with a higher e indicates that his technology more likely succeed and leads him to choose a higher S for a higher return. In Figure 2 a greater e' corresponds to a lower curve of H and results in the optimal choice of a higher S. This shows that how heterogeneity of firms affects the choice of risky technologies. In sum, $S^*(R,e)$ has properties of $S^*_R > 0$ and $S^*_e > 0$.

Next we define the value function of the firm's optimization (1), denoted by $V(R,e)$, as

$$V(R,e) = P(S^*(R,e),e)[S^*(R,e) - R];$$

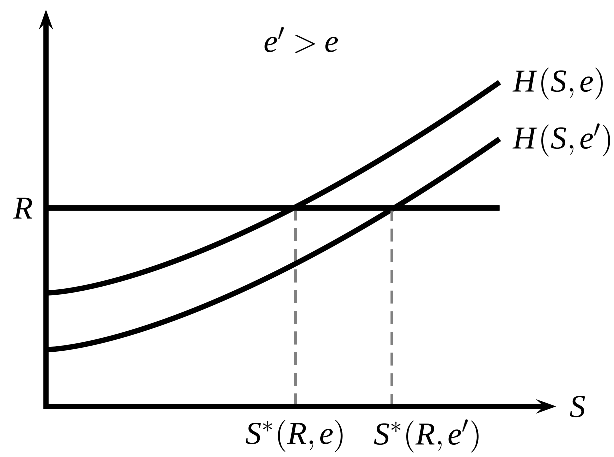

Figure 2: The Choice of S and Heterogeneity of Firms

Note that R is affordable only if $S^*(R,e) \geq R$. The value function $V(R,e)$ is increasing in e [$V_e(R,e) = P_e(S^*(R,e),e) \cdot [S^*(R,e) - R] > 0$] and decreasing in R ($V_R(R,e) = -P(S^*(R,e),e) < 0$). Moreover $V_{eR}(R,e) < 0$ if and only if $S_e^*(R,e) < -P_e(S^*(R,e),e)/P_s(S^*(R,e),e)$.[2] From this point on we assume this condition holds:

Assumption 2 $\quad S_e^*(R,e) \leq -P_e(S^*(R,e),e)/P_s(S^*(R,e),e)$.

An increase in e has two opposite effects. One the one hand, a firm with greater ability of managing production projects leads to a greater probability of success ($P_e(S,e) > 0$). On the other hand, greater ability induces an entrepreneur to choose a higher return project ($S_e^*(R,e) > 0$) and results in an decrease in the probability of success($P_s(S^*(R,e),e) < 0$. Assumption 2 states that the direct effect of an

[2] $V_{eR} = -P_e + \{[S-R]P_{es} + P_e\}S_R^* = -[P_s S_e^*(R,e) + P_e] < 0$. Hence $V_{eR} < 0$ if and only if $S_e^*(R,e) < -P_e(S^*(R,e),e)/P_s(S^*(R,e),e)$.

increase in e on the probability of success dominates the indirect effect through the choice of risk projects. This assumption plays an important role in the following analysis.

Two forms of external funds

Firms have two alternatives to raise their funds, borrowing loans from banks or issuing securities to the market. Let R^L denote the (gross) loan rate and R^U the rate in the direct lending market. In addition to R^U, a firm has to pay an amount ϕ of upfront underwriting fees for issuing securities. This upfront cost can be thought of as underwriting expenses.[3] The firm's optimization problems of obtaining funds in these two alternatives are

$$\max_{S} \quad P(S,e)\cdot[S-R^L], \quad \text{and}$$

$$\max_{S} \quad P(S,e)\cdot[S-R^U]-\phi,$$

respectively.[4] The decision of funds-raising is transformed into the following

[3]For simplicity, we assume that a firm has some resources to pay upfront costs, but they do not use them to finance their inputs. The results of our analysis is insensitive to this innocuous assumption. This upfront cost setup follows from Kanatas and Qi (1998, 2003). Puri (1999) has a similar setup.

[4]Here we assume that firms are price-takers in the borrowing markets. In a seller's market firms do not have any influence over the price he pays. Later on when we analyze the underwriting activities, we will relax this assumption. When a firm chooses the type of project, it affects what he pays through the riskiness he chooses.

problem:

$$\max \quad \{V(R^L,e), V(R^U,e)-\phi\}.$$

Recall that the value function $V(R,e)$ has properties:

$$V_e(R,e)>0, \quad V_R(R,e)<0, \quad V_{eR}(R,e)<0.$$

Consistent with empirical findings, we assume for the moment that the direct lending is less costly than loan-finance (not considering upfront costs); *i.e.*, $R^U < R^L$. (Later on we will show that when the screening cost of loan business (c) is large enough, the equilibrium in our model economy does have this property.) Then the property of $V_R(R,e)<0$ implies $V(R^U,e)>V(R^L,e)$ for all e. The property of $V_{eR}(R,e)<0$ indicates the slope of $V(R^U,e)$ with respect to e is steeper than $V(R^L,e)$ for any e. Thus we can use Figure 3 to help us understand the differences between two alternatives of raising funds.

As long as the underwriting fee ϕ is large enough, a critical value e^* exists such that firms with $e>e^*$ will choose issuing securities to raise funds, while firms with $e<e^*$ choose loans as the sources of funds. From the properties of $S^*(R,e)$ we know that a lower rate R^U leads to a choice of lower S while a firm with greater e chooses a higher S. As a result, one *cannot* infer that the S^* chosen by firms with $e>e^*$ is greater or smaller than those with $e<e^*$. One interesting question is whether the probability of success for $e>e^*$ is greater than that for $e<e^*$; that is whether

$$P(S^*(R^U,e),e)|_{e>e^*} > P(S^*(R^L,e),e)|_{e<e^*} \tag{3}$$

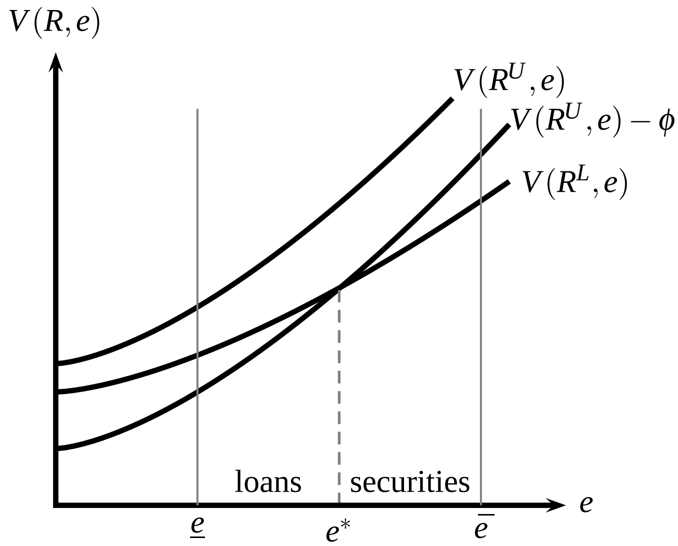

Figure 3: The cut-off level of e

holds for all relevant e and e'? Assumption 2 guarantees (3) holds.

Proposition 1 *When $R^U < R^L$, markets-financed projects succeed with a greater probability than banks-financed projects; that is* (3) *holds.*

[Proof] For $e > e^*$ and $e' < e^*$, we have

$$\begin{aligned} P(S^*(R^U,e),e) &> P(S^*(R^L,e),e) \\ &\quad (\because S_R^*(R,e) > 0 \text{ and } P_s(S,e) < 0) \\ &> P(S^*(R^L,e'),e') \quad (\because \text{Assumption 2}) \end{aligned}$$

■

3 A Competitive Financial Sector

So far the focus of our analysis is on the properties of firm's optimal behaviors. Loan rates(R^L), security rates(R^U) and underwriting fee (ϕ) are given. In a highly competitive financial environment, individuals do not have much impact on the prices of financial products and services. On either side of the supply and demand of funds, every individual takes prices as given and makes her own decisions. The prices are determined through market mechanisms. If there is any opportunity of arbitrage for profits, people flock into the opportunity and soon the opportunity is gone. Thus no arbitrage becomes an important feature of equilibrium in a highly competitive financial environment. The implication of no arbitrage is that loan rates and security rates cannot give room of profitability to individuals.

Assume there is a risk free investment technology which yields R^F as its returns. Then no arbitrage implies that all investment opportunities can provide expected returns no more than R^F.

In this section we show that no arbitrage conditions lead to high loan rates and low security rates. We discuss two scenarios: when the types of firms and projects are public information and when both of them are private information.

Public Information

In a competitive financial market with abundant funds, all profitable investment opportunities are utilized and no arbitrage implies that the expected returns to a risky contract equals the risk-free rate (denoted by R^F). When the type of firms are known to the public, the rates of borrowing are type-dependent and, thus, firm-specific and project-specific. They are determined by the following no arbitrage conditions:

$$P(S^*(R^L, e(e)), e) \cdot R^U = R^F, \quad \text{for } e \in [e^*, \overline{e}]$$

$$P(S^*(R^U, e(e)), e) \cdot R^L = R^F, \quad \text{for } e \in [\underline{e}, e^*].$$

The expected return from a loan contract cannot exceed the the risk-free rate and the expected return from a security cannot exceed to the risk-free rate. By (3), $R^U(e) < R^L(e)$ for $e \in [e^*, \overline{e}]$ and $e' \in [\underline{e}, e^*]$.

Private Information

When the lender cannot tell one type from another of borrowers, the rate of borrowing is independent of types. Notice that in a competitive market, a fund owner can fully diversify its portfolio in the financial market. Although an investor cannot identify firms and projects, they know the overall distribution of firms and the probabilistic properties of different production projects. A fully diversified portfolio of securities has an expected return: $\int_{e\in[e^*,\overline{e}]} \frac{f(e)}{F(\overline{e})-F(e^*)} \cdot P(S^*(R^U, e), e) \cdot R^U de$, where $F(e)$ is the cumulative distribution of e over $[\underline{e}, \overline{e}]$. Notice that there is no θ when calculating the expected return of a fully diversified portfolio.

Consequently, the no arbitrage condition for security investment is written as

$$\int_{e\in[e^*,\overline{e}]} \frac{f(e)}{F(\overline{e}) - F(e^*)} \cdot P(S^*(R^U, e), e) \cdot R^U de = R^F \tag{4}$$

A similar argument applies to the bank loan market. The depositors expect receive R^F as its deposit rates. A bank utilizes the screening technology to uncover the types of its loan applicants and the types of their projects. Thus a bank is able to charge firm-specific and project-specific loan rates, $R^L(e)$. No arbitrage condition for loan rates is:

$$P(S^*(R^L,e),e)\cdot R^L = c + R^F, \quad \text{for all } e < e^*. \tag{5}$$

From the determination of $R^L(e)$ we can further discuss properties of $R^L(e)$ and its relation to R^U.

Proposition 2 *Entrepreneurs with higher e receive lower loan rates; i.e.,* $R^L(e)$ *is decreasing in e for* $e < e^*$*;*

> **[Proof]** When markets are highly competitive, market forces prevent banks from exercising too much monopoly power such that pursuing revenue-maximizing stops at zero profit conditions (5) holds at inequality. One can immediately find out that R^L is decreasing in e by totally differentiating (5) and applying Assumption 2. entrepreneurs with higher capability receive lower loan rates. ■

Moreover bank optimization implies R^L is chosen such that its marginal contribution to the revenue cannot be negative; *i.e.*,

$$P(S,e) + R\cdot P_s(S,e)\cdot S_R^*(R,e) \geq 0. \tag{6}$$

This condition helps us to derive the result of $R^L(e) > R^U$ for all $e < e^*$.

Proposition 3 *Given* e^* *and* R^F*, no arbitrage implies* $R^L(e) > R^U$ *for all* $e < e^*$*.*

[Proof] For $e < e'$, $P(S^*(R,e),e) \le P(S^*(R,e'),e')$ due to Assumption 2. Thus $P(S^*(R^U,e),e) \le \int_{e\in[e^*,\bar{e}]} \frac{f(e)}{F(\bar{e})-F(e^*)} \cdot P(S^*(R^U,e),e)de$, for all $e < e^*$. Multiplying both sides of inequality by R^U, one gets, for $e > e^*$,

$$P(S^*(R^U,e),e)\cdot R^U \le \int_{e^*}^{\bar{e}} \frac{f(e)}{F(\bar{e})-F(e^*)} \cdot P(S^*(R^U,e),e)\cdot R^U de = R^F.$$

Clearly we can have $P(S^*(R^U,e),e)\cdot R^U < c+R^F$. As long as $P(S^*(R,e),e)\cdot R$ is increasing in R, $R^L(e) > R^U$ for all $e < e^*$. As argued above, (6) holds at inequality. Consequently, $R^L(e) > R^U$ for all $e < e^*$. ■

When the financial sector is highly competitive, loan rates are greater than security rates (Proposition 3), and loan-financed projects is riskier than security-financed projects (Proposition 1).

In order to complete the analysis of this section, we need to figure out what e^* is. Given e^* and R^F, from (4) we can solve R^U as a function of e^* and R^F, denoted by $\hat{R}^U(e^*,R^F)$. From (5) we can solve all $R^L(e)$ as functions of R^F and c for all $e < e^*$, denoted by $\hat{R}^L(e,e^*,R^F,c)$. By the definition of e^*, the entrepreneur of type e^* is indifferent between security-finance and loan-finance:

$$V(\hat{R}^U(e^*,R^F),e^*) - \phi = V(\hat{R}^L(e^*),e^*,R^F,c) \qquad (7)$$

(7) is used to solve for e^* as a function of R^F and c.

4 The Model with a Monopolistic Loan market

In this section we discuss the optimization problems of financial institutes. Both banks and underwriters maximizes their profits by providing financial services.

Commercial Banks

Banks take in deposits as the source of funds and lend funds to firms through loan contracts. We assume that banks are price-takers in deposit markets. This assumption deviates from Boyd and de Nicoló (2005)'s set up. They assume that banks have monopoly power in both loan transactions and deposit business. This assumption allow them to analyze strategic behaviors of financial firms in both markets of their outputs(loans) and inputs(deposits).

In our setup of banking optimization we only allow banks have monopoly power in loan markets, but not in deposit markets (or more precisely funds markets). When a firm comes to a bank and applies for a loan, the bank applies its screening technology at a cost of c to identify the type of the firm and its production project. After identifying the type, the bank determines a loan rate R^L to charge for its loan provision. Since the bank can identify loan applicants and the types of their projects, loan rates are firm- and project-specific, denoted by $R^L(e)$. We assume that the bank has monopoly power in loan markets. When a bank chooses a loan rate, it takes into account the borrower's reaction to the loan rate - the first order condition of the loan applicant's optimization problem. Banks take in deposits at a given deposit rate R^D and the cost side of a loan business only has two terms: the screening cost c and the deposit rate R^D. Thus the bank's optimization problem for a loan application is written as

$$\begin{aligned} \max_{R^L} \quad & P(S,e)\cdot R^L - (c+R^D) \\ \text{s.t.} \quad & S + \frac{P(S,e)}{P_s(S,e)} = R^L(e) \end{aligned} \tag{8}$$

Since c and R^D are exogenous to the optimization, one can solve this problem by maximizing the expected revenue. The necessary condition is written as

$$P(S^*(R^L,e),e) + R^L \cdot P_s(S^*(R^L,e),e)\cdot S^*_R(R^L,e) = 0,$$

where $S^*(R^L,e)$ is the solution of the constraint. Let $R^{L*}(e)$ denote the solution of (8). The bank will approve the loan application if

$$P(S^*(R^{L*}(e),e),e)\cdot R^{L*}(e) \geq c + R^D. \tag{9}$$

By applying the envelope theorem one can easily show that the bank's revenue (the right hand side of (9)) is increasing in e. The bank will welcome high cable firms. For large enough c and/or R^D, firms with low e might not be able to get loans from banks. We can summarize these interesting findings from bank optimization in the following proposition:

Proposition 4

[1] *The loan rate is increasing in loan applicants' capability (e).*

[2] *The bank's profit from loan business is increasing in loan applicants' capability.*

[3] *Firms with higher e choose higher S with a greater probability of success.*

[4] *For sufficiently large c and/or R^D firms with low e cannot obtain loans from banks.*

[Proof] The second order sufficient condition for the maximization problem is

$$2P_s S_R^*(R,e) + R^L[P_{ss}(S_R^*(R,e))^2 + P_s S_{RR}^*] < 0.$$

[1] Totally differentiating the first order necessary condition and rearranging terms, one can get

$$\frac{dR^L}{de} = -\frac{(P_s S_e^*(R,e) + P_e) + R^L[P_s S_{Re}^* + S_R^*(R,e)(P_s S_e^*(R,e) + P_e)]}{2P_s S_R^*(R,e) + R^L[P_{ss}(S_R^*(R,e))^2 + P_s S_{RR}^*]}$$

The denominator is negative by the sufficient condition. The numerator is negative when the term involving third derivatives of $P(S,e)$, S_{Re}^*, is insignificant.[5] Thus we have $\frac{dR^L}{de} > 0$.

[2] Define Π^B as $\Pi^B(e) = P(S^*(R^{L*}(e),e),e) \cdot R^{L*}(e) - (c + R^D)$. Then by the envelope theorem, one can easily obtain:

$$\frac{d\Pi^B}{de} = (P_s \cdot S_e^* + P_e)R^{L*}(e)$$

which is positive due to Assumption 2.

[3] Plugging $R^{L*}(e)$ into $S^*(R,e)$ and differentiating the resultant, one gets:

$$\frac{d}{de}S^*(R^{L*}(e),e) = S_R^* \cdot R_e^{L*} + S_e^*(R^{L*}(e),e) > 0.$$

[5] When $P = 1 - AS/e$, $S_{Re}^* = 0$.

Substituting $S^*(R^{L*}(e),e)$ into $P(S,e)$ and taking total differentiation, one can get:

$$\frac{d}{de}P(S^*(R^{L*}(e),e),e) = P_s \cdot (S_R^* R^{L*} + S_e^*) + P_e,$$

which is positive as long as the direct effect dominates the indirect effect (Assumption 2).

[4] Obviously, given an e, the bank profit can be negative for for sufficiently large c and/or R^D; *i.e.*,

$$P(S^*(R^{L*}(e),e),e) \cdot R^{L*}(e) - c + R^D < 0.$$

In these cases banks do not approve loan application. ■

At first glance, it looks odd that more capable firms pay higher loan rates for loans. However in our setup, as we analyze in the previous section, the direct effect of a change in e on the probability of success dominates the indirect effect. Although a more capable firm picks a project which is riskier than the one picked by a firm with smaller e, the dominant direct effect of e allows him to run the project more safely. In addition, as analyzed in the previous section, a higher loan rate induces firms to pick a higher S project. Thus it is optimal for a bank to respond by raising its loan rates for higher e firms to induce them to pick a higher S project and run them more safely.

Comparing to the competitive loan market, the risk structure of projects taken by entrepreneurs have greater likelihood of failure. When commercial banks have monopoly power in determining loan rates, they naturally charge loan rates higher than those are charged in a competitive market. A higher price leads to a choice of higher S and greater failure probability.

Proposition 5 *Other things being equal, when loan markets change from being highly competitive to being concentrated, loan-financed entrepreneurs will choose projects with higher output and also higher failure likelihood.*

[Proof] Every loan applicant face a higher loan rate when loan markets become more concentrated. It is sufficient to show that the probability of success decreases as loan rates decrease.

$$\frac{dP(S^*(R,e),e)}{dR} = P_s(S_R^*(R,e),e) \cdot S_R^*(R,e) < 0,$$

which is negative because $P_s < 0$ and $S_R^*(R,e) > 0$. ■

We follow Boyd and de Nicoló (2005) to include the risk-incentive mechanism in the asset side of balance sheet for commercial banks. Ceteris paribus, as market competition declines banks earn more rents in their loan markets by charging higher loan rates. In themselves, higher loan rates would imply (weakly) higher bankruptcy risk for bank borrowers who, when confronted with higher interest rates, optimally increase their own risk of failure. (from: Boyd and de Nicoló (2005), pp. 1329-1330).

Investment Banks

Investment banks provide firms with underwriting services. When a firm decides to raise funds directly from markets, it needs an investment bank to underwrite its securities for public offerings. Investment banks underwrite firms' securities in exchange of service fees. Unlike commercial banks, investment banks do not face default risks when they underwrite securities. Investors who buy the securities face default risks. However, investment banks earn profits by providing convincing information to investors such that the performance of underwriting activities depend upon how well the information perceived by investors. The performance of underwriting affects how much an investment bank can charge firms who ask for underwriting services. A underwriter needs put efforts in order to make information convincing to investors, those efforts are costly.

How much a firm is willing to pay for underwriting services depends upon the performance of underwriting, more specifically, the interest rate required by investors. There are a number of factors affect prices of securities (and the interest rates firms are required to pay), including macroeconomic conditions, issuers' reputation, tightness of funds in markets, ..., and so on. How an investment bank helps firms to obtain funds is certainly one of these factors. This paper focuses on the analysis of how market-oriented finance affects the risk exposure of the entire economy. For simplicity we abstract from all factors which cannot controlled by investment banks and to focus on only the performance of underwriting technology (θ).

In loan services the cost of funds faced by firms are determined in the loan contract, completely under the control of banks and firms. When raising funds through issuing bonds, the cost of funds faced by firms differs to those raised through loan contracts. Both the buyer and the seller of underwriting services have no "complete" control over the cost of funds. Market investors' belief plays an important role. The contingency on investors' belief makes the analysis of underwriting activities different from that of loan activities. We will elaborate what are differences before we analyze the strategic behaviors of both firms and underwriters.

(a) Investors' belief and the costs of funds An investor decides to buy a security mainly because he expects the returns from the investment on the security is worthwhile, and the information an investor receives determine how he expects the returns. Investors know that the type of production projects (S) and the entrepreneur's ability (e) are two of main factors determining the real returns of the investment. More specifically, investors know what $P(S,e)$ is, but do not really know what S and e are. Their information about S and e is limited, and therefore, investors are conservative about the probability of success and believe that the probability of success to be smaller than its true probability. Instead of perceiving $P(S,e) \cdot R^U$ as the expected returns, an investor uses a smaller probability, $\tilde{P}(S,e)$, to predict his expected returns. This implies that an investor asks for higher returns to justify his investment and, thus, increases the costs of funds.

(b) Convincing power Delivering convincing information to investors is one of main functions investment banks serve. Investment banks collect and analyze information about the projects in the early stage of the underwriting process. Gathering and analyzing information make investment banks be better informed of the security-issuing firms than those public investors. The investment bank's statement about the underwritten case is the main source of information public investors rely on. The more convincing the information is, public investors' belief $\tilde{P}(S,e)$ will be closer to the true probability $P(S,e)$. We assume that $\tilde{P}(S,e) = \theta \cdot P(S,e)$ to reflect the performance of underwriting efforts, and ignore the costs of underwriting for the simplicity of analysis. Given this setup, the underwriting technology is fixed and the investment bank does not have an optimization problem to solve. It simply runs underwriting business and collect fee incomes ϕ.

(c) Securities-issuing firms' best response The required payments for funds raised through markets, R^U depends on $\phi P(S,e)$. Appealing to arbitrage activities, R^U is determined by

$$\theta \cdot P(S,e) \cdot R^U = R^M, \tag{10}$$

where R^M is the market rate of returns determined by the supply and demand of funds in markets. The market rate R^M is beyond the firm's control and is given to the firm; however, the choice of S will affect the probability of success. The firm's optimization problem is written as

$$\max_{S} \quad P(S,e)\left(S - \frac{R^M}{\theta \cdot P(S,e)}\right)$$

The first order condition is $P_s(S,e) \cdot S + P(S,e) = 0$. As one can see that the problem turns to choose a project with a maximal expected output, and has nothing to do with underwriting performance (θ). This is different from what we have in Section 2 and in bank finance.

The optimal choice of S, S^{U*}, is strictly increasing in e. Furthermore the security rate $R^U = R^M/(\theta \cdot P(S^{U*}(e),e))$ is decreasing in e. Define $V^U(e, R^M, \theta)$ as $V^U = P(S^{U*}(e),e) \cdot S^{U*}(e) - R^M/(\theta \cdot P(S^{U*}(e),e))$. One can easily verify that $V_e^U > 0$, $V_{R^M}^U < 0$ and $V_\theta^U > 0$. The value function of optimization by underwriting an investment project is $V^U(e, R^M, \theta) - \phi$.

We can summarize the findings about underwriting activities in the following proposition:

Proposition 6

[1] *Firms with higher e choose higher S with a greater probability of success.*

[2] *The security rate is decreasing in firms' capability (e).*

[3] *For sufficiently large R^M and/or ϕ, firms with low e will not consider funds from markets.*

[4] *For sufficiently small θ, firms with low e will not consider funds from markets.*

[Proof] [1] Totally differentiating the first order condition, one can get

$$\frac{dS^{U*}}{de} = -\frac{P_e + S^{U*} \cdot P_{se}}{2P_s + S^{U*} \cdot P_{ss}},$$

The denominator is negative due to the second order sufficient condition. All three terms (P_e, S^{U*} and P_{se}) in the numerator are positive. Thus S^{U*}

is increasing in e. Moreover,

$$\frac{d}{de}P(S^{U*}(e),e) = P_s \cdot P_{se} + P_e > 0$$

[2] Recall that $R^U = \frac{R^M}{P(S^{U*}(e),e)\cdot\theta}$. We have

$$\frac{dR^U}{de} = \frac{R^M}{\theta} \cdot \frac{-\frac{d}{de}P(S^{U*}(e),e)}{P(S^{U*}(e),e)} < 0$$

[3] and [4] Since V^U is decreasing in R^M and increasing in e. It is clear that when R^M and ϕ are too large or θ is too small, the firm will have a negative value. ■

There is an interesting contrast between bank finance and market finance. The loan rate is increasing in firms' capability (Proposition 4 [1], page 18), while the security rate is decreasing in firms' capability (Proposition 6 [2], page 25). In market finance, a firm faces a given market rate and he can affect his security rate by choosing the type of project. More capable entrepreneurs choose higher productive projects with higher probability of success. When the probability of success is higher, public investors will require less returns. In bank finance, the loan rate is controlled by banks. Firms with higher e choose higher S with a greater probability of success. Banks take into account of firms' best responses. Due to more capable firms have incentive to choose more productive projects and high loan rates also induce them to choose more productive projects. It is optimal for banks to charge high loan rates in order to take advantage of the capability of running productive projects with less failure rates.

In the competitive financial environment in which banks do not have any monopoly power over loan rates, the loan rate is determined by the zero profit condition. Just like in the competitive underwriting market, the loan rate is decreasing in entrepreneurs' capability (e) (Proposition 2, page 15).

Concerning project choices and their risk structure, entrepreneurs with high capability always choose higher productive projects with greater probability of success than those with low capability, in both bank-finance and market-finance, and also in both competitive and monopolistic loan markets.

In the competitive financial environment we show that loan rates are lower than security rates. When intermediation cost (c) is large enough, the profitability consideration, commercial banks would charge loan rates higher than market rates.

Proposition 7 *Given e^*, R^M, and R^D, when c is sufficiently large, $R^L(e) > R^U(e')$ for all firm e who seeks loan finance and firm e' security finance.*[6]

> **[Proof]** Deposit rates and market rates have some relations due to arbitrage activities. Since our point is to show a sufficiently large c results in that loan rates are higher than security rates, we can assume $R^D = R^M$

[6] From the analysis of both loan finance and security finance, we find that the firm's expected profit is an increasing function of e, say $V^L(e)$ and $V^U(e)$. If we can show that the slope of $V^U(e)$ is greater than that of $V^L(e)$ and $V^U(e)$ has a lower vertical intercept than $V^L(e)$ such that both curve intersects at an $e^* \in [\underline{e}, \overline{e}]$. Then e^* is the cut-off level of e such that for firms with $e < e^*$ seek loan finance and the rest seek security finance.

without loss of generality. From the loan approval condition (9) and for no arbitrage condition for a security (10), we have

$$\begin{aligned} P(S^*(R^{L*}(e),e),e)\cdot R^{L*}(e) &\geq c+R^D \\ &= c+\theta\cdot P(S^*(R^U,e'),e')\cdot R^U \end{aligned}$$

which implying that

$$R^{L*}(e) \geq \frac{c}{P(S^*(R^L(e),e),e)} + \theta\cdot\frac{P(S^*(R^U(e')',e),e')}{P(S^*(R^L(e),e),e)}\cdot R^U(e').$$

When c is sufficiently large, $R^L(e) > R^U(e')$. ■

5 The Impact of Security Markets on Project Choices

How bank competition affects the incentive of risk taking has been an important topic in banking literature. Deposit insurance and other government interventions distorts banks' risk incentives. When facing stiff competition, banks intend to take more risks to keep its profits or competitive status. Deposit insurance and the government's rescue often create a payoff structure in which large gains go to bank shareholders and large loss to the tax payers. This is one popular argument for bank competition and bank risk taking.

Boyd and de Nicoló (2005) argue that there exists a fundamental risk-incentive mechanism that operates in exactly opposite direction, causing banks to become more risky as their market become more concentrated. We modify their model by incorporating market finance into the framework and show that the presence of market finance provides alternatives for firms to finance their projects. The market alternative substitutes expensive loans with security finance of lower rates, which in turn keep firms from choosing high risk projects.

As we analyze in Figure 3 high-e firms choose markets to raise their funds. When loan market becomes more concentrated, loan rates go up and $V(R^L, e)$ goes down and the critical value of e^* changes to a smaller value. More firm will choose to go for market finance. As long as such a shift to the market does not change security rate too much, those firms switching to markets choose projects with less risk. As we point out earlier, market rates are determined competitively while banks in concentrated loan markets can set loan rates. Banks' strategic responses result in both high loan rates and the choice of high-risk projects by loan-finance firms (Proposition 1).

Those firms which stay with banks when loan markets become more concentrated will choose higher risk projects (*i.e.*, higher failure probability due to the higher loan rates). Those firms which transfer into market finance face a lower rate than the rate they would face if they stay with loan finance. That is why the presence of market finance can mitigate the effect of Boyd-DeNicoló risk-incentive mechanism.

Proposition 8 *The presence of market finance mitigates the undesired effect of the risk-incentive mechanism due to higher borrowing rates in the loan market.*

6 Conclusion and Summary

In this paper we extend Boyd and de Nicoló (2005)'s model by adding heterogeneity of entrepreneurs and market finance to discuss how the availability of market finance affect risks faced by production projects . Heterogeneous entrepreneurs make their choices of risks basing on the borrowing cost they face. Boyd and de Nicoló (2005) shows that more concentrated banking markets lead to choosing riskier investment projects.

In our research we show that when entrepreneurs have market finance as an alternative to loans, they can shift from loan markets to securities markets and borrow in funds at lower costs and adjust their productivities and risk exposure accordingly. As a result, they will have higher probabilities of success. The introduction of market finance as an alternative to loans mitigates the perverse effect of risk incentive mechanisms discovered in Boyd and de Nicoló (2005) (Proposition 8).

The setup with heterogeneous entrepreneurs allows us to have more details on firms' behaviors. Entrepreneurs with higher levels of management skill face higher loan rates in concentrated loan markets (Proposition 2), while in highly competitive loan markets they face lower loan rates (Proposition 4 [1]). Moreover we show that the borrowing costs of loan finance are higher than those of security finance if the screening cost of the loan technology is high enough.

References

Allen, Franklin, "Do Financial Institutions Matter?," *Journal of Finance*, 2001, *56*, 1165–1175.

_ **and Anthony M. Santomero**, "What Do Financial Intermediaries Do?," *Journal of Banking and Finance*, 2001, *25*, 271–94.

_ **and Douglas Gale**, "Competition and Financial Stability," *Journal of Money, Credit and Banking*, 2004, *36*, 453–480.

Berger, Allen N., Rebecca S. Demsetz, and Philip E. Strahan, "The Consolidation of the Financial Services Industry: Causes, Consequences, and Implications for the Future," *Journal of Banking and Finance*, 1999, *23*, 135–194.

Bolton, Patrick and Xavier Freixas, "Equity Bonds,and Bank Debt: Capital Structure and Financial Market Equilibrium under Asymmetric Information," *Journal of Political Economy*, 2000, *108*, 324–351.

Boyd, John H. and Gianni de Nicoló, "The Theory of Bank Risk Taking and Competition Revised," *Journal of Finance*, 2005, *60*, 1329–1343.

_ **and Mark Gertrler**, "Are Banks Dead? Or Are the Reports Greatly Exaggerated?," *Federal Reserve Bank of Minneapolis Quarterly Review*, 1994, *18*, 2–19.

Kanatas, George and Jianping Qi, "Underwriting by Commercial Banks: Incentive Conflicts, Scope Economics, and Project Quality," *Journal of Money, Credit, and Banking*, 1998, *30*, 119–133.

_ **and** _ , "Integration of Lending and Underwriting: Implications of Scope Economies," *Journal of Finance*, 2003, *58*, 1167–1191.

Koskela, Erkki and Rune Stenbacka, "Is There a Tradeoff between Bank Competition and Financial Fragility?," *Journal of Banking and Finance*, 2000, *24*, 1853–1873.

Kroszner, Randall S. and Raghuram G. Rajan, "Is the Glass-Steagall Act Justified? A Study of the U.S. Experience with Universal Banking," *American Economic Review*, 1994, *84*, 810–832.

Matutes, Carmen and Xavier Vives, "Imperfect Competition, Risk Taking, and Regulation in Banking," *European Economic Review*, 2000, *44*, 1–33.

Parlour, Christine and Uday Rajan, "Competition in Loan Contracts," *American Economic Review*, 2001, *91*, 1311–1328.

Puri, Manju, "Commercial Banks as Underwriters: Implications for the Going Public Process," *Journal of Financial Economics*, 1999, *54*, 133–163.

Rajan, Raghuram G., "Has Financial Development Made the World Riskier?," Working Paper 11728, National Bureau of Economic Research November 2005.

Shaffer, Sherrill, “The Winner’s Curse in Banking,” *Journal of Financial Intermediation*, 1998, *7*, 359–392.

Extended Financial Services,

Banking Competition and Financial Fragility:

A General Equilibrium Framework

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Abstract

We develop a general equilibrium model to analyze how the presence of direct lending affects entrepreneurs' choices of production projects. We show that the presence of direct lending alleviates the perverse effect of the risk-incentive mechanisms of Boyd and de Nicoló (2005). The general equilibrium framework allows us to analyze not only the direct effects, but also the general-equilibrium(GE) feedback effects, of changes in intermediation technologies and the availability of funds. Although improvements in financial technologies reduce the cost of obtaining funds, they also increase the demand for funds and this GE feedback effect dominates the effect of cost reduction. As a result, both deposit and market rates increase. Then entrepreneurs who issue securities to finance their projects face higher market rates and chooses projects with lower probability of success. The economy faces a more fragile financial sector.

Keywords: Extended financial services, Banking competition, Risk-taking, Financial fragility

The project of the first year deals with an environment with exogenous risk-free interest rate, deposit rate and market rate, with a purpose of focusing on how market finance mitigates the perverse effect of the risk incentive mechanisms caused by high loan rates discussed in Boyd and de Nicoló (2005). In the research of the second year, we incorporate the first-year experience into a general equilibrium model and study how economic primitives affects the interaction of direct and indirect finances.

We consider a general equilibrium model with the setup of the first year as the production side of the real sector and the demand side of the financial sector. For the tractability of the analysis, we use a specific form of the probability function of success which satisfies all assumptions in the model. We endogenize the supply side in the financial sector and the consumption side of the real sector to the environment to set up a general equilibrium model.

By using a general equilibrium framework we take into account of feedback effects of technological changes in the financial sector. We find out that technological improvements in the financial sector tighten the supply of funds and cause deposit rates and market rates to rise. An increase in the deposit rate is offset by the decrease in the screening cost, and the loan rate remains unchanged. An increase in the market rate raises the cost of finance faced by securities-issuing firms and induces them to choose higher risky projects.

1 The Environment

Consider an economy with one consumption goods and one input. The consumption goods can be produced by a number of risky production technologies.

Entrepreneurs

There are a continuum type of entrepreneurs (also called firms) with different skill levels of managing risky production technologies, denoted by e; e is distributed over the interval $[\underline{e}, \overline{e}]$ with a distribution function $n\dot{f}(e)$ where n is the mass of entrepreneurs and $\int_{[\underline{e},\overline{e}]} f(e)de = 1.$ The type of the entrepreneur is private information and can be observed by commercial banks when they applying the costly screening technology. A firm does not have any unit of the input, but has access to risky production projects with different levels of productivity, indexed by S. A production project with productivity S requires an investment of one unit of the input to produce S units of the output with probability $P(S,e)$, and zero otherwise. The probability function $P(S,e)$ satisfies the following conditions:

Assumption 1 *$P_s < 0$, $P_{ss} \leq 0$, $P_e > 0$, and $P_{se} > 0$.*

A higher skill level of management indicates a higher probability of success in production. For entrepreneurs there is a trade-off between productivity and risk. The choice of a higher productive project leads to a higher possibility of failure. Here is an example satisfying Assumption 1:

$$P(S,e) = 1 - \frac{AS}{e}, \text{ where } A > 0, \text{ and } S \in [0, \overline{e}/A]. \tag{1}$$

To simplify the analysis and keep the tractability, we use this example to derive our analysis.

We assume that entrepreneurs are risk neutral and maximize their expected profits by choosing where to borrow funds and what type of projects to adopt. They borrow funds either through security markets by issuing securities or through loan markets by going to a commercial bank to apply a loan. When a firm chooses to issue securities, it needs go to an investment bank to underwrite its securities. We assume that a firm can arrange its fund sources with only one financial institutions to rule out the possibility of syndicate loans and mixtures of direct and indirect finance.

Agents

There are identical agents (also called households). The population of these identical agents is m. Each agent has one unit of input and has access to only the risk free technology which uses one unit of input to produce R^F units of output. The agents are risk averse and have a strictly concave and differentiable utility function $u(C)$. An agent chooses to allocate its endowed unit of input either to the risky free technology or lend it to entrepreneurs who have access to risky assets. We assume all lending activities have to go through either banks or financial markets. We assume that private information makes it too costly for agents to have financial transaction directly with entrepreneurs. Thus there is no possibility of pairwise meetings between agents and entrepreneurs.

Financial Institutions[1]

Assume that there are two types of financial institutions, commercial banks and investment banks (hereafter called underwriters). Banks obtain funds by taking in deposits from agents and paying depositors interests at a gross rate R^D. After receiving a firm's application for a loan, a bank applies its screening technology to uncover the type of the firm at a cost of c units of the input goods and to verify the type of its proposed production project. The screening outcome is observable only to the bank, not to all other financial institutes and the public investors. The bank may and may not approve the loan application. If it approves the application, the bank also decides an (gross) interest rate (R^L) it will charge for the loan. Since the screening technology yields exact information for the type of the applicant, the loan rates is contingent on the type of firms e.

An investment house underwrites securities for firms in exchange of fee incomes. An investment bank delivers to the public investors the information they find out in the process of underwriting. Due to information asymmetry the public investor is not sure that the delivered information is complete and perfect. In reality, how convincing the information is depends upon many factors such as investment projects, the reputation of the firm that raises funds, and the efforts of underwriters. In particular, the more efforts an underwriter put in collecting, analyzing and deliver data, the more convincing the information is. However, the

[1]The description of financial institutions mainly repeat what described in the report of the first year research with some changes to make the description relevant to this general equilibrium model.

information processing is costly. The efficiency of information processing technology used by underwriters also matters. How much profit an investment bank can obtain for a underwriting case depends upon all these factors. In this paper we do not get into the details of this aspect. Instead, we assume that underwriting business is quite competitive and, thus, the underwriting fee (ϕ) an investment bank can collect from its clients is determined by market competition. We model the performance of underwriting process by a parameter of *convincing power* (denoted by θ). More specifically, we assume that the public investor understands that the probability of success $P(S,e)$ depends on who runs what kind of production technology; however they just do not know what (S,e) is. They make their investment decisions basing upon their belief $P(\tilde{S},e)$ on $P(S,e)$. We use θ to describe how close the belief of the public to the real $P(S,e)$: $P(\tilde{S},e) = \theta P(S,e)$, $0 < \theta < 1$.

Nowadays it is quite common to observe the mixture of direct and indirect lending for an investment project. As shown in Bolton and Freixas (2000) an equilibrium model with a mixture of bonds- and loans-financed capital structure can be very fruitful but paying a cost of analysis complexity. The purpose of this paper is to show that how competition from markets affects the risk structure discussed in banking literature. It is natural to start with a simple analytical structure and get a clear-cut picture. Only after this step we can go with more confidence to set up a more complicated framework to tackle more difficult issue.

The Gramm-Leach-Bliley Act lifted the ban of securities operation for commercial banks. Like universal banks in Europe, commercial banks in the US started to integrate both loans and securities business under the Act. In many economies, for example Taiwan, Korea and Japan, the integration of financial sector is also under way. Financial holding companies (or universal banks) become a popular form of financial organization. Economies of scale are the driving force behind this trend. The border line between banks-financed and markets-financed funds become burring. Both loans and securities issuing are substitutes and complements of each other and, Obviously, universal banks and financial holding companies play an important role in such a financial environment. However. for simplicity, we do not include financial holding companies and universal banks in our analysis. We concentrate on the substitution role of both direct and indirect lending and leave the complement role as our future research topic.

2 Firm's Optimization

Firms use external funds to acquire inputs for their technologies. Let R denote the gross interest rate for obtaining one unit of external funds. One unit of input costs one unit the output. The firm's optimization problem can be written as

$$\max_{S} \quad (1-AS/e)[S-R] \tag{2}$$

The first order necessary condition is $(-A/e)\cdot S+(1-AS/e)=(-A/e)\cdot R$, which can be rewritten as

$$H(S,e) \equiv S+\frac{1-AS/e}{(-A/e)}=R, \tag{3}$$

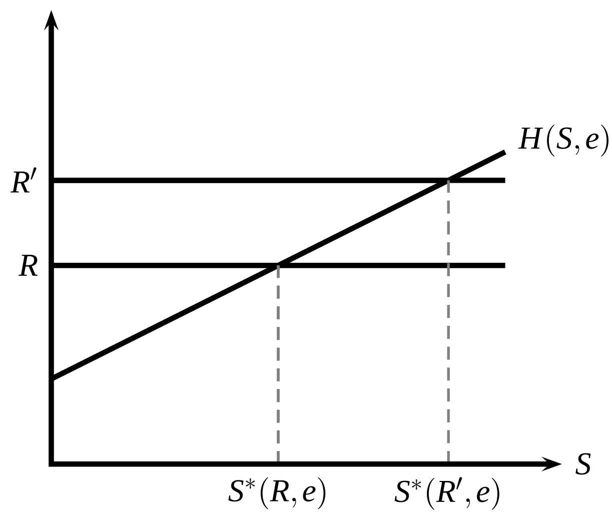

Figure 1: Loan Rates and the Choice of S

$H(S,e)$ is the *risk(P_s)-adjusted marginal contribution* of an additional unit of output to expected outputs, and the right hand side of (3) is the *risk-adjusted marginal cost* of increasing outputs. One can easily show that the left hand side of (3) is increasing in S, (*i.e.*, $H_S(S,e) > 0$ for $e \in [\underline{e}, \overline{e}]$), while the right hand side is constant over S. When the risk-adjusted marginal cost (R) increases, the firm should respond by increasing the scale of outputs (S). Let $S^*(R,e)$ be the solution. When $P(S,e) = 1 - AS/e$, $S^* = (e + AR)/(2A)$. Figure 1 describes how a change in R affect S^*. As S increases, the probability of success decreases while the expected outputs increases due to the output increase. Thus the optimal response to an increase in R is to choose a greater S. A higher costs of funds (higher R) results in the choice of more risky project (a higher S and a lower probability of success).

The P_s-adjusted marginal contribution of additional output $H(S,e)$ is decreas-

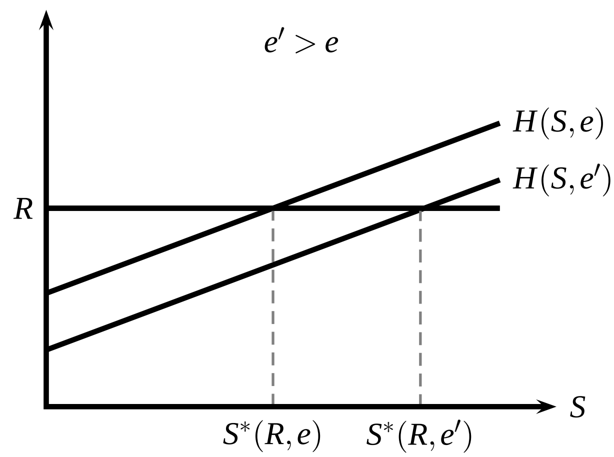

Figure 2: The Choice of S and Heterogeneity of Firms

ing in e, $H_e(S,e) < 0$. Given the cost of funding, R, firms with different e choose different levels of production. A firm with a higher e indicates that his technology more likely succeed and leads him to choose a higher S for a higher return. In Figure 2 a greater e (e') corresponds to a lower curve of H and results in the optimal choice of a greater S. This shows that how heterogeneity of firms affects the choice of risky technologies. In sum, $S^*(R,e)$ has properties: $S_R^* > 0$ and $S_e^* > 0$.

Next we define the value function of the firm's optimization (2), denoted by $V(R,e)$, as

$$V(R,e) = P(S^*(R,e),e)[S^*(R,e) - R] = \frac{(e - AR)^2}{4Ae};$$

Note that R is affordable only if $S^*(R,e) = (e + AR)/(2A) \geq R$, or $e > AR$. The value function $V(R,e)$ is increasing in e:

$$V_e = \frac{e^2 - A^2R^2}{4Ae^2} > 0.$$

and is decreasing in R:

$$V_R(R,e) = -\frac{e - AR}{2e} < 0. \tag{4}$$

Moreover $V_{Re} = -\frac{AR}{2\,e^2} < 0$. Some important result about the choice of projects and the probability of success are summarized in the following proposition:

Proposition 1 *Facing the same borrowing rate R,*

[1] *Firms with greater skill levels of management chooses more productive projects:* $S^*_e(R,e) > 0$.

[2] *the default risk decreases as the skill level of management increases:*

$$\frac{dP(S^*(R,e))}{de} = \frac{AR}{8\,e^2} > 0$$

Firms with higher e choose technologies of higher productivity than firms with lower e; however, their failure probabilities are lower. The greater productivity (S) indicates a higher failure probability ($P_s(S,e) < 0$); however a higher skill level of management indicates a higher success probability ($P(S,e_1) > P(S,e_2)$) for all S. Two impacts work in the opposite directions. However, the *direct* effect dominates the *indirect* effect.

Two forms of external funds

Firms have two alternatives to raise their funds, borrowing loans from banks or issuing securities to the market. Let R^L denote the (gross) loan rate and R^U the rate in the direct lending market. In addition to R^U, a firm has to pay an amount

ϕ of upfront underwriting fees for issuing securities. This upfront cost can be thought of as underwriting expenses.[2] The firm's optimization problems of obtaining funds in these two alternatives are

$$\max_S \quad P(S,e)\cdot[S-R^L], \quad \text{and}$$

$$\max_S \quad P(S,e)\cdot[S-R^U]-\phi,$$

respectively.[3] The decision of funds-raising is transformed into the following problem:

$$\max \quad \{V(R^L,e),V(R^U,e)-\phi\}.$$

Recall that the value function $V(R,e)$ has properties:

$$V_e(R,e)>0, \quad V_R(R,e)<0, \quad \text{and} \quad V_{Re}(R,e)<0. \tag{5}$$

Consistent with empirical findings, we will only discuss the equilibrium outcome in which the direct lending is less costly than loan-finance (not considering upfront costs); *i.e.*, $R^U < R^L$. (Later on we will show that, in our parametric

[2]For simplicity, we assume that a firm has some resources to pay upfront costs, but they do not use them to finance their inputs. The results of our analysis is insensitive to this innocuous assumption. This upfront cost setup follows from Kanatas and Qi (1998, 2003). Puri (1999) has a similar setup.

[3]Here we assume that firms are price-takers in the borrowing markets. In a seller's market firms do not have any influence over the price he pays. Later on when we analyze the underwriting activities, we will relax this assumption. When a firm chooses the type of project, it affects what he pays through the riskiness he chooses.

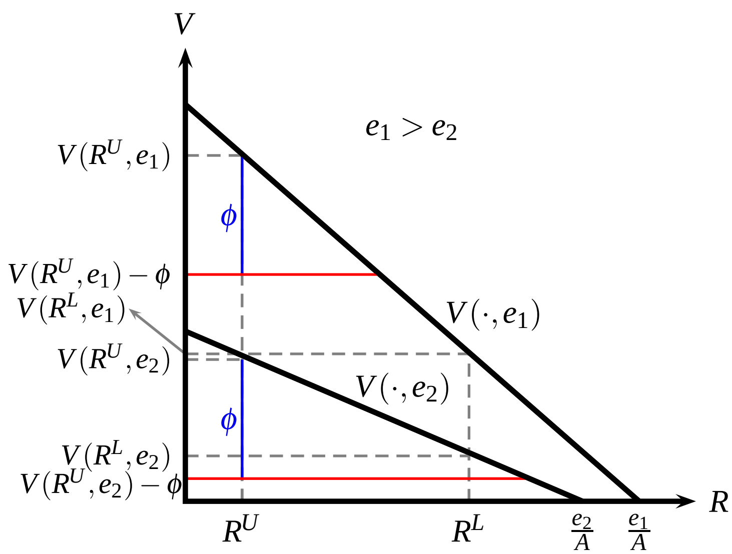

Figure 3: Underwriting Fee and Fund-Raising

example, when the screening cost of loan business (c) is large enough, the equilibrium in our model economy does have this property.) Then the the property of $V_R(R, e) < 0$ implies that $V(R^U, e) > V(R^F, e)$ for all e. We will use the properties of (5) to show that as long as the underwriting fee ϕ is large enough and R^U and R^L falls apart enough distances, high e firms will issue securities to raise their funds, while low e firms will raise their funds through loans.

We use Figure 3 to illustrate this result: when ϕ is large enough and e_1 is greater than e_2 by a significant gap, it can be the case in which $V(R^U, e_2) - \phi > V(R^L, e_2)$, while $V(R^U, e_1) - \phi < V(R^L, e_1)$. This can happen because the third property of (5). As a result, type e_1 firms choose market finance, while type e_2 firms choose loan finance. Moreover, from Proposition 1, one can easily verify that projects financed by markets have greater probabilities of success than those financed by loans. We summarize these results in the following proposition.

Proposition 2 *When $R^L > R^U$ and ϕ is large enough,*

[1] *a very high e firm chooses market finance and a very low e firm chooses loan finance;*

[2] *markets-financed projects succeed with a greater probability than banks-financed projects:*

3 Loans and Securities

In this section we discuss the optimization problems of financial institutes. Both banks and underwriters maximizes their profits by providing financial services.

Commercial Banks

Commercial banks take in deposits as the source of funds and lend funds to firms through loan contracts. We assume that banks are price-takers in deposit markets. This assumption deviates from Boyd and de Nicoló (2005)'s set up. They assume that banks have monopoly power in both loan transactions and deposit business. This assumption allow them to analyze strategic behaviors of financial firms in both markets of their outputs(loans) and inputs(deposits).

In our setup of banking optimization we only allow banks have monopoly power in loan markets, but not in deposit markets (or more precisely funds markets). When a firm comes to a bank and applies for a loan, the bank applies its screening technology at a cost of c to identify the types of the firm and its production project. After identifying the types, the bank determines a loan rate R^L to charge for its loan provision. Since the bank can identify loan applicants and their project types, loan rates are firm- and project-specific, denoted by $R^L(e)$. We assume that the bank has monopoly power in loan markets. When a bank chooses a loan rate, it takes into account the borrower's reaction to the loan rate - the first order condition of the loan applicant's optimization problem. Banks take in deposits at a given deposit rate R^D and the cost side of a loan business only has two terms: the screening cost c and the deposit rate R^D. Thus the bank's optimization problem for a loan application is written as

$$\begin{aligned} \max_{R^L} \quad & (1-\frac{AS}{e}) \cdot R^L - (c+R^D) \\ \text{s.t.} \quad & S = \frac{e+AR}{2A} \end{aligned} \tag{6}$$

Since c and R^D are exogenous to the optimization, one can solve this problem by maximizing the expected revenue. Substituting the constraint into the objective function, the maximization problem is rewritten as

$$\max_{R^L} \quad \left(1-\frac{e+AR}{2e}\right) \cdot R,$$

and the solution $R^{L*}(e) = e/(2A)$. Given $R^{L*}(e) = e/(2A)$, the firm's best choice is $S^*(R^L(e),e) = \frac{3}{4}\frac{e}{A}$, and a firm's value function becomes $V(R^{L*}(e),e) = \frac{e}{16A}$. In our parametric model with $P(S,e) = 1 - AS/e$, the probability of success of each project is the same: $P(S^*(R^L(e)),e) = 1-(A/e)(3/4)(e/A) = 1/4$.

Notice that every firm who obtains loan finance has the same probability of success. Commercial banks optimally respond to firms choice rule by setting loan rates such that all loan-financed projects will have the same probabilities of failure but with different levels of productivity. This is due to our setup of $P(S,e) = 1 - AS/e$ in which $P_{ss}(S,e) = 0$. With a more general form with $P_{ss}(S,e) < 0$, we can show that firms with greater skill levels of management choose more productive projects (greater S) and have greater probabilities of success when the direct effect of skill level of management dominates the indirect effect through the selection of projects (see Chiang (2008)).

The loan rates increases as e increases. The productivity of projects also increases as the skill level of management increases. The value of firms also increases as the skill level of management increases. The bank's profits from loan business also increase as the loan applicant's skill level of management increases. A profitable loan transaction requires a positive expected profit: $(1/4)(e/(2A)) - (c + R^D) > 0$ or $e > (8A)(c + R^D)$; that is the firm's skill level of management cannot be too low.

We summarize the findings on loan business in Proposition 3:

Proposition 3

[1] *The loan rate is increasing in the skill level of loan applicants' management.*

[2] *The bank's profit from loan business is increasing in the level of loan applicants' skill levels of management.*

[3] *Firms with higher skill levels of management choose more productive projects.*

[4] *Firms that obtain loans have the same default probability, regardless of their skill levels of management.*

[5] *Firms with sufficiently low skill level of management will be rejected for loans; more specifically for firms with* $e < (8A)(c + R^D)(\equiv \tilde{e})$.

Investment Banks

Investment banks provide firms with underwriting services. When a firm decides to raise funds directly from markets, it needs an investment bank to underwrite its securities for public offerings. Investment banks underwrite firms' securities in exchange of service fees. Unlike commercial banks, investment banks do not face default risks when they underwrite securities. Investors who buy the securities face default risks. However, investment banks earn profits by providing convincing information to investors such that the performance of underwriting activities depend upon how well the information perceived by investors. The performance of underwriting affects how much an investment bank can charge firms who ask for underwriting services. A underwriter needs put efforts in order to make information convincing to investors, those efforts are costly.

How much a firm is willing to pay for underwriting services depends upon the performance of underwriting; more specifically, the interest rate required by investors. There are a number of factors affect prices of securities (and the interest rates firms are required to pay), including macroeconomic conditions, issuers' reputation, tightness of funds in markets, ..., and so on. How an investment bank helps firms to obtain funds is certainly one of these factors. This paper focuses on the analysis of how market-oriented finance affects the risk exposure of the entire economy. For simplicity we abstract from all factors which cannot controlled by investment banks and to focus on only the performance of underwriting technology (θ).

In loan services the cost of funds faced by firms are determined in the loan contract, completely under the control of banks and firms. When raising funds through issuing bonds, the cost of funds faced by firms differs to those raised through loan contracts. Both the buyer and the seller of underwriting services have no "complete" control over the cost of funds. Market investors' belief plays an important role. The contingency on investors' belief makes the analysis of underwriting activities different from that of loan activities. We will elaborate what are differences before we analyze the strategic behaviors of both firms and underwriters.

(a) Investors' belief and the costs of funds An investor decides to buy a security mainly because he expects the returns from the investment on the security is worthwhile, and the information an investor receives determine how he expects the returns. Investors know that the type of production projects (S) and the entrepreneur's ability (e) are two of main factors determining the real returns of the investment. More specifically, investors know what $P(S,e)$ is, but do not really know what S and e are. Their information about S and e is limited, and therefore, investors are conservative about the probability of success and believe that the probability of success to be smaller than its true probability. Instead of perceiving $P(S,e)\cdot R^U$ as the expected returns, an investor uses a smaller probability, $\tilde{P}(S,e)$, to predict his expected returns. This implies that an investor asks for higher returns to justify his investment and, thus, increases the costs of funds.

(b) Convincing power Delivering convincing information to investors is one of main functions investment banks serve. Investment banks collect and analyze information about the projects in the early stage of the underwriting process. Gathering and analyzing information make investment banks be better informed of the security-issuing firms than those public investors. The investment bank's statement about the underwritten case is the main source of information public investors rely on. The more convincing the information is, public investors' belief $\tilde{P}(S,e)$ will be closer to the true probability $P(S,e)$. We assume that $\tilde{P}(S,e) = \theta\cdot P(S,e)$ to reflect the performance of underwriting efforts, and ignore the costs of underwriting for the simplicity of analysis. Given this setup, the underwriting technology is fixed and the investment bank does not have an optimization problem to solve. It simply runs underwriting business and collect fee incomes ϕ.

(c) Securities-issuing firms' best response The required payments for funds raised through markets, R^U depends upon $\phi P(S,e)$. Appealing to arbitrage activities, R^U is determined by

$$\theta\cdot\left(1-\frac{AS}{e}\right)\cdot R^U = \tilde{P}R^M, \tag{7}$$

where $\tilde{P}R^M$ is the expected return of the average portfolio in the market, $\tilde{P}$ is the average probability of success of all investment projected which are market-financed, and R^M is the market rate of returns determined by the supply and demand of funds in markets. The market rate R^M is beyond the firm's control and is given to the firm; however, the choice of S will affect the probability of success. The firm's optimization problem is written as

$$\max_S \quad (1-AS/e)\left(S-\frac{R^M}{\theta\cdot(1-AS/e)}\right)$$

The first order condition is $(-A/e)\cdot S+(1-AS/e)=0$. As one can see that the problem turns to choose a project with a maximal expected output, and has nothing to do with underwriting performance (θ). This is different from what we have in Section 2 and in bank finance.

The optimal choice of S, $S^{U*}=e/(2A)$, is strictly increasing in e. The probability of success is 1/2. Furthermore the security rate $R^U=2R^M/\theta$ is constant over different levels of management skill (e). Define $V^U(e,R^M,\theta)$ as $V^U=P(S^{U*},e)(S^{U*}-R^U)=\frac{e}{4A}-\frac{R^M}{\theta}$. One can easily verify that $V_e^U>0$, $V_{R^M}^U<0$ and $V_\theta^U>0$. The value function of optimization by underwriting an investment project is $V^U(e,R^M,\theta)-\phi$. When ϕ and/or R^M is large enough, firms with low skill level of management will have no incentive to obtain funds from securities markets. We can summarize the findings about underwriting activities in the following proposition:

Proposition 4

[1] *Firms with higher e choose higher S.*

[2] *All firms with market finance have the same default probability and the same security rate.*

[3] *For sufficiently large R^M and/or ϕ, firms with low e will not consider funds from markets.*

In a more general setting we are able to drive the result that security rates are decreasing in the level of firms' skill level of management, while loan rates are increasing. Just as in the analysis of loans, the reason for the constant security loan rates is due to the setting of $P_{ss} = 0$. It is interesting that the probability of success in market finance (1/2) is greater than that in loan finance (1/4). Markets-financed projects have lower default rates than loan-financed projects.

Now we will derive demands for funds from demands for loan finance and security finance. The decision of funds-raising is transformed into the problem of $\max \quad \{V(R^L, e), V(R^U, e) - \phi\}$. When $P(S, e)$ has a particular form of $1 - AS/e$, this problem is rewritten as

$$\max \quad \{\frac{e}{16A}, \frac{e}{4A} - \frac{R^M}{\theta} - \phi\}.$$

As one can see that both value functions are function of e, and $V(R^U, e) - \phi$ has a steeper slope; however the minus terms of $\frac{R^M}{\theta}$ and ϕ make the curve have a negative vertical intercept as shown in Figure 4. There exists a critical value of

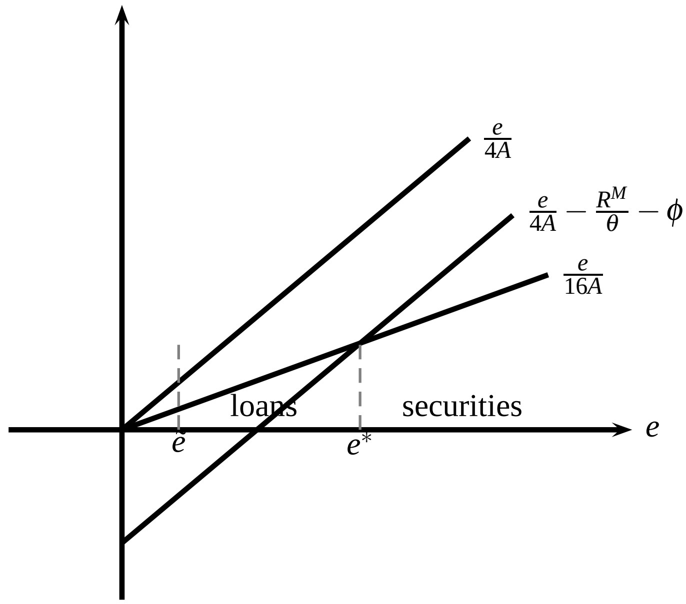

Figure 4: max $\{V(R^L,e),V(R^U,e)-\phi\}$

$e^* = \frac{16A}{3}(\frac{R^M}{\theta}+\phi)$ such that firms with $e > e^*$ choose market finance and those with $e < e^*$ choose loan finance.

From the commercial bank's optimization we know that $R^L > c + R^D$, and from no arbitrage (7) we know $R^U = \tilde{P}R^M/(\theta(1-AS/e))$. In a more general setting, we show that $R^L(e) > R^U(e')$ for all $e \in [\underline{e}, e^*]$ and $e' \in (e^*, \overline{e}]$ (see Chiang (2008) Proposition 7).

Recall that commercial banks do not lend their loans to firms with $e < \tilde{e} = (8A)(c+R^D)$ (page. 14) Given $\tilde{e}$ and e^* the demand for funds in the form of securities is

$$D^S(R^M) = n \cdot \int_{e^*(R^M)}^{\bar{e}} f(e)de \tag{8}$$

where $f(e)$ is the density function of the distribution of e. The demand for funds in the form of loans is

$$D^L(R^D, R^M) = n \cdot \int_{\tilde{e}(R^D)}^{e^*(R^M)} f(e)de. \tag{9}$$

Notice that e^* is an increasing function of R^M, implying that $D^S(R^M)$ is decreasing in R^M, while $D^L(R^D, R^M)$ is increasing in R^M and decreasing in R^D.

4 The Agent's Optimization Problem

An agent has one unit of input, but has no access to productive production project. An agent can allocate his endowment into different assets: deposits (α) and securities ($1-\alpha$). If he invests its endowment in securities, he receives uncertain incomes, while deposits give him certain amounts of repayments.

We are interested in equilibrium in which both loans and securities appear. The other type e_2 will choose loan finance in equilibrium. An agent faces uncertainty if he buys securities. Thus the agent's optimization problem is a standard portfolio selection problem in financial economics, and can be written as:

$$\begin{aligned} \max_{\alpha, c_1, c_2} \quad & \tilde{P}u(c_1) + (1-\tilde{P})u(c_2) \\ \text{s.t.} \quad & c_1 = \alpha R^D + (1-\alpha)R^M = R^U + \alpha(R^D - R^M) \\ & c_2 = \alpha R^D \end{aligned}$$

where R^D is the deposit rate and R^M is the rate of gross returns an agent expects to obtain from the market (called market rate). When there are a number of securities, R^M stands for the expected returns an agent expects to obtain from the market average portfolio he invests in, and $\tilde{P}$ is the probability with which an agent believes his portfolio will succeed to obtain the return R^M. An agent uses $\tilde{P}$ to calculate his expected utility.

We assume that commercial banks and investment banks are run by risk neutral agents whose goals is to maximize their expected profits and then consume what they earn. Similarly, the entrepreneurs are also risk neutral and consume the profits they earn from running investment projects. Thus, not like in the usual general equilibrium framework, the utility-maximizer in this model does not have distributed profits from profit earners in their budget constraint.

The first order necessary condition (with respect to α):

$$H \equiv \tilde{P}u'(c_1)(R^D - R^M) + (1-\tilde{P})u'(c_2)R^D = 0.$$

The second order sufficient condition is

$$H_\alpha = \tilde{P}(R^D - R^M)^2 u''(c_1) + (1-\tilde{P})(R^D)^2 u''(c_2) < 0.$$

By the implicit function theorem a solution $\alpha^*(R^D, R^M)$ exists and satisfies the following properties:

$$\frac{\partial \alpha^*}{\partial R^D} = -\frac{H_{R^D}}{H_\alpha}, \quad \frac{\partial \alpha^*}{\partial R^M} = -\frac{H_{R^M}}{H_\alpha}$$

where

$$H_{R^D} = \tilde{P}u'(c_1)[1 - \frac{\alpha(R^D - R^M)}{c_1}\text{RRA}(c_1)] + (1-\tilde{P})u'(c_2)[1 - \text{RRA}(c_2)], \text{ and}$$

$$H_{R^M} = -\tilde{P}u'(c_1)\cdot[1 - \frac{(1-\alpha)(R^D - R^M)}{c_1}\text{RRA}(c_1)],$$

and $\text{RRA}(c) = -c\frac{u''(c)}{u'(c)}$ is Arrow's relative risk aversion coefficient of the utility function. Assume that RRA is such that $H_{R^D} > 0$ and $H_{R^M} < 0$, and

$$\frac{\partial \alpha^*}{\partial R^D} = -\frac{H_{R^D}}{H_\alpha} > 0, \quad \frac{\partial \alpha^*}{\partial R^M} = -\frac{H_{R^M}}{H_\alpha} < 0$$

In addition, $H_{\tilde{P}} = [u'(c_1) - u'(c_2)]R^D - u'(c_1)R^M < 0$ due to $u'' < 0$ and $c_1 > c_2$. As a result we have $\alpha^*_{\tilde{P}} = -H_\alpha / H_{\tilde{P}} < 0$. Thus we have an individual funds supply in the form of deposits $\alpha^*(\underset{+}{R^D}, \underset{-}{R^M}, \underset{-}{\tilde{P}})$ and an individual fund supply for securities $\beta^*(\underset{-}{R^D}, \underset{+}{R^M}, \underset{-}{\tilde{P}}) = 1 - \alpha^*(\underset{+}{R^D}, \underset{-}{R^M}, \underset{-}{\tilde{P}})$.

5 Equilibrium

In this section we illustrate how to solve the equilibrium deposits rate (R^D) and equilibrium market rate (R^M) for our general equilibrium model. Funds markets operate in two forms in our economy: securities and loans. The market clearings for these two forms of funds are

$$n \cdot \int_{e^*(R^M)}^{\bar{e}} f(e)de = m \cdot (1 - \alpha^*(R^D, R^M, \tilde{P})), \quad \text{and} \tag{10}$$

$$n \cdot \int_{\tilde{e}(R^D)}^{e^*(R^M)} f(e)de = m\alpha^*(R^D, R^M, \tilde{P}) \tag{11}$$

respectively. Combining (10) and (11), we have the market clearing for the whole of funds markets:

$$n \cdot \int_{\tilde{e}(R^D)}^{\bar{e}} f(e)de = m. \tag{12}$$

First, we can use (12) to solve R^D as a function of m/n and other relevant parameters. To abuse the math expression we denote the solution by $R^{D*}(m/n)$.

Since the total demand of funds is decreasing in R^D, an increase in m/n results in an decrease in R^D. The result is quite intuitive. When on average an entrepreneur has more funds available to him, the cost of funds drops. We can use R^D as an index of the cost of funds.

Then we substitute $R^{D*}(m/n)$ into (10) to solve R^M. Note that $\tilde{P}$ is a function of R^M and is increasing in R^M due to the fact that entrepreneurs with higher skill levels of management have higher probabilities of success. When R^M increases, only those with higher management skill are able to obtain market finance and, thus, the average probability of success of all market-financed projects increases with R^M, *i.e.*, $\tilde{P}'(R^M) > 0$. From the above analysis we also know that $\alpha^*(R^D, R^M, \tilde{P})$ is decreasing in both R^M and $\tilde{P}$, and the supply of funds in the form of securities $(1-\alpha^*)$ is increasing in R^M. When R^M approaches zero, the supply of funds in the form of securities also approaches zero. The demand of funds in the form of securities $(n \cdot \int_{e^*(R^M)}^{\bar{e}} f(e)de)$ is decreasing in R^M and when R^M is very high, the quantity demanded for funds is zero. When R^M is very low (given loan rates), most of entrepreneurs would choose market finance. Figure 5 shows that how the market rate (R^M) is determined and its relation to the deposit rate (R^D). As R^D increase, the household diverts more funds to deposits and less funds are available to market finance, resulting in the supply of funds in the form of securities shifts to the left and, thus, the market rate R^M is pushed up.

One justification for the use of a general equilibrium model is to explore how the primitive parameters of the economy, such as intermediation technology (c,

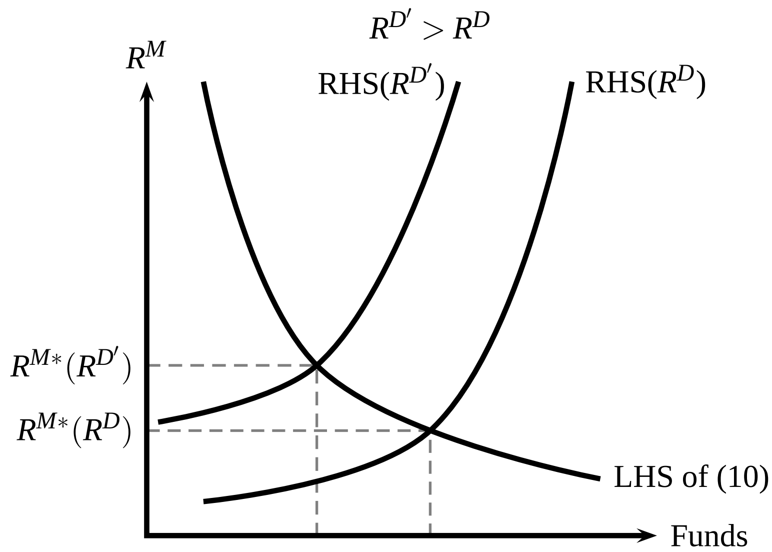

Figure 5: Determination of R^M

θ, and ϕ), the populations of households and entrepreneurs (m, and n), and the risk attitude of households, affect the financial structure of the economy. In our economy two critical value of management skills, $\tilde{e}(R^D)$ and $e^*(R^M)$, determines the ratio of market finance to loan finance. They also play an important role in understanding how economic primitive elements, such as technologies and populations of households and entrepreneurs, affect the prices of funds and the financial structure.

Using our specific form of production technologies $P(S,e) = 1 - AS/e$, and intermediation technology (c, θ, and ϕ), we are able to derive:

$$\tilde{e} = 8A(c + R^D), \quad \text{and} \quad e^* = \frac{16A}{3}\left(\frac{R^M}{\theta} + \phi\right). \tag{13}$$

To simplify the analysis, we assume that e is uniformly distributed over $[\underline{e}, \bar{e}]$ such that $f(e) = 1/(\bar{e} - \underline{e})$. From the market clearing of the whole funds market (12) one can derive

$$R^D = \frac{1}{8A}[\bar{e} - (m/n)\Delta e] - c, \tag{14}$$

where $\Delta e = \bar{e} - \underline{e}$. Notice that the underwriting technology has no impact at all on the determination of the deposit rate.

The market clearing of the funds market in the form of securities can be written as

$$\frac{\bar{e} - \frac{16}{3}A\left(\phi + A\frac{R^M}{\theta}\right)}{\Delta e} = \frac{m}{n}[1 - \alpha^*(R^D, R^M, \tilde{P}(R^M))], \tag{15}$$

and can be used to solve R^M.

Loan Technology

We start with examining how changes in loan technology affect both loan and market rates and the financial structure. From (14) we know that the screening cost (c) is negatively related to the loan rate. The bank's pricing practices always take the screening cost into account. When c decreases, the bank adjusts loan rates accordingly. This adjustment feeds back to the fund market and increases the demand for funds through loans. The bank then adjusts up the deposit rate in order to attract more deposits to meet their loan business.

An increase in R^D drives households to shift their funds from markets to deposits and, thus, reduces the funds available to market finance and results in a rise in the market rate.

From (14) we know that in respond to a change in c, the equilibrium deposit rate changes by the same magnitude as the change in c, but in the completely opposite direction. Consequently, an improvement in c pushes up the deposit rate, which in turns increases R^M (see Figure 5). The intuition is that when R^D increases, the household reallocates their funds to deposits and reduces the supply of funds through buying securities.

From (13) we can see that $\tilde{e}$ remains unchanged when c decreases; e^* increases due to an increase in R^M caused by an increases in R^D. A decrease in c is offset by its general-equilibrium feedback effect on R^D, an equal amount of changes in R^D but in the opposite direction. As a result, a change in c does not affect $\tilde{e}$, and thus does not affect the fund availability for production projects. Other things being identical, the economy becomes more loan-financed when facing an improvement in the loan technology.

We summarize the effects of an improvement in the loan technology in the following proposition.

Proposition 5 *In response to an improvement in the loan technology (a decrease in c),*

[1] *both equilibrium deposit and market rates (R^D and R^M) increase, and*

[2] *the economy becomes more loan-financed, while the total number of externally financed projects remains unchanged (i.e., e^* increases while $\tilde{e}$ remains unchanged).*

Underwriting Technology Responding to an improvement in underwriting

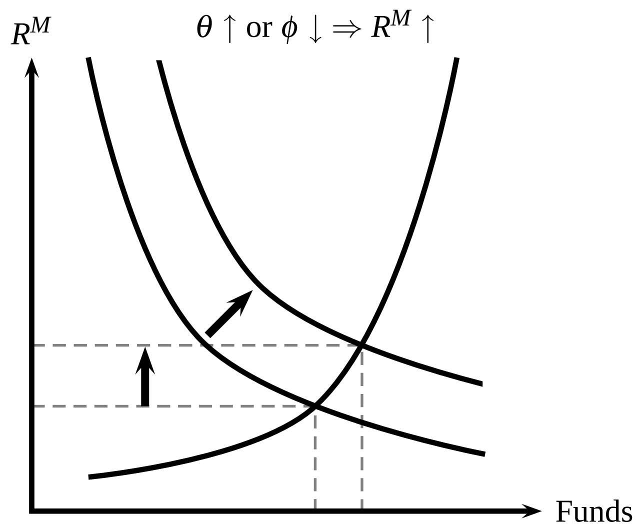

Figure 6: Underwriting Technology and R^M

technology (an increase in the convincing power θ and/or a decrease in underwriting fee ϕ), the demand for funds of market finance shifts to the right and the market rate increases (as shown in Figure 6 and equation (15).) From (14) we know that the underwriting technology has no impact on the determination of the deposit rate. This is the total demand for funds is determined by the lower bound of management skill levels ($\tilde{e}$) which is a function of R^D and is independent of R^M. The market rate matters when an entrepreneur chooses between loan finance and market finance. In our setup all those who consider market finance always have loan finance available. As a result, an improvement in underwriting technology does *not* affect total number of projects which are financed.

Concerning the change of e^*, we need more structure of the economy such as the risk attitude of households to pin down the direction of changes in e^* when θ

and ϕ change. In (13) one can see that the relative magnitude of the changes of R^M to that of θ (or ϕ) determines the direction of changes in e^*. From (15) or Figure 5 we know that the slope of the supply of funds in the form of securities determines the magnitude of the change in R^M. The risk aversion coefficient plays an important role for determining the slope of the supply curve. The implication is that the financial structure (defined by the shares of of market finance and loan finance of the economy) is determined by not only the financial technology but also the household's risk attitude. The effect of changes in the underwriting technology can be summarized as:

Proposition 6 *When the underwriting technology improves (θ or ϕ decreases),*

[1] *the market rate increases, while the deposit rate remains unchanged, and*

[2] *the total number of externally financed projects remains unchanged (i.e., $\tilde{e}$ remains unchanged), and the number of market-financed projects increases or decreases, depending on the magnitude of changes in the market rates.*

Populations of Entrepreneurs and Households

It is clear that an increase in m/n improves the availability of funds. Equation (14) indicates the deposit rate falls. From the above analysis (see Figure 5) we know that the market rate is positively related to the loan rate, implying that an increase in m/n makes both R^D and R^M decrease.

From (13) we know that a drop in R^D causes a decrease in $\tilde{e}$. The total number of externally financed projects increases. Similarly, a drop in R^M causes a decrease in e^*, the number of market-financed projects increases. However, we are unable to figure out which one has a greater drop. The change of the financial structure is indeterminate.

Proposition 7 *When the availability of funds improves,*

[1] *both deposit and loan rates drop,*

[2] *the total number of externally financed projects increases,*

[3] *the number of market-financed projects increases, while the change in the number of loan-financed projects is indeterminate.*

Financial Fragility

Boyd and de Nicoló (2005) argue that there exists a fundamental risk-incentive mechanism that operates in exactly opposite direction, causing banks to become more risky as their market become more concentrated. Chiang (2008) modifies their model by incorporating market finance into a partial equilibrium framework and show that the presence of market finance provides alternatives for firms to finance their projects. The market alternative substitutes expensive loans with security finance of lower rates, which in turn keep firms from choosing high risk projects.

In our general equilibrium framework all properties about financial fragility remain intact. Market-financed projects have greater probabilities of success than loan-financed projects. Thus the appearance of market finances help to alleviate the fragility problems caused by more concentrated loan markets.

Moreover, we are able to analyze how changes in financial technologies and the availability of funds affects loan and market rates by taking into account general equilibrium feedback effect. It is well perceived that technology improvements, both in the real and the financial sectors benefits the economy. However, our analysis shows that improvements in the loan and underwriting technologies raise both loan and market rates and induce entrepreneurs to choose more risky projects and causes more serious financial fragility problem. An improvement in financial technologies increases demands for funds due to the lower costs of obtaining funds; however, the fund supply is fixed and, thus, the cost of funds itself goes up and dominates the effect of lower funds-obtaining costs.

By adding general equilibrium feedback effects to the analysis, we are able to examine the fragility problem more extensively and convincingly.

6 Conclusions

In Chiang (2008) we show that when an entrepreneur facing a higher loan rate due to the loan-lender's monopoly power, the presence of market finance provides an alternative of external finance with a lower rate. The lower borrowing rate induces the firm chooses less risk projects and thus reduce financial fragility.

Chiang (2008)'s analysis is conducted in a partial equilibrium framework. In this paper we extend the analysis into a general equilibrium framework to explore

Table 1: General Equilibrium Effects of Changes in Model Parameters

	R^D	R^M	$\tilde{e}$	e^*
$c \downarrow$	$\uparrow$	$\uparrow$	unchanged	$\uparrow$
$\theta \uparrow / \phi \downarrow$	unchanged	$\uparrow$	unchanged	depends
$m/n \uparrow$	$\downarrow$	$\downarrow$	$\downarrow$	$\downarrow$

how financial (loan and underwriting) technologies play their roles in determining the costs of different forms of external finance. We then go further and analyze the issue of financial fragility with general equilibrium feedback effects which is beyond the scope of Chiang (2008).

Table 1 summarizes our general equilibrium effects of changes in intermediation technologies and the availability of funds. Improvements in the technologies of the financial sector reduce the cost of obtaining funds. Such a cost reduction in obtaining funds increases the demand for funds. When the available funds are fixed, a higher demand means higher costs of funds. This general equilibrium feedback effect dominates the first round effect of technology improvements and both deposit and security (market) rates (R^D and R^M) increase. A reduction in the screening cost (c) is offset by the resulting increase in deposit rate (in our setup) and the loan rate remain unchanged. As a result, the total number of externally financed projects does not change. In contrast, those entrepreneurs issuing securities to finance their projects face higher market rates and chooses projects with lower probability of success. The economy faces a more fragile financial sector.

We use a specific form of production technology $P(S,e) = 1 - AS/e$ to simplify the analysis of firms' finance behaviors. The simplification allows us to extract a clear picture of how these parameters affect the financial structure. We do not mean that the conclusion from the simplification is generally applicable. Instead, it shows a simple but clear mechanism through which economic primitives work to influence the financial structure. The full understanding of simple mechanisms makes us better equipped to handle more complex mechanisms that work in the real world.

References

Bolton, Patrick and Xavier Freixas, "Equity Bonds,and Bank Debt: Capital Structure and Financial Market Equilibrium under Asymmetric Information," *Journal of Political Economy*, 2000, *108*, 324–351.

Boyd, John H. and Gianni de Nicoló, "The Theory of Bank Risk Taking and Competition Revised," *Journal of Finance*, 2005, *60*, 1329–1343.

Chiang, Yeong-Yuh, "Extended Financial Services, Banking Competition and Financial Fragility - A Partial Equilibrium Framework," 2008. NSC 95-2415-H-004-007-MY2.

Kanatas, George and Jianping Qi, "Underwriting by Commercial Banks: Incentive Conflicts, Scope Economics, and Project Quality," *Journal of Money, Credit, and Banking*, 1998, *30*, 119–133.

_ and _ , "Integration of Lending and Underwriting: Implications of Scope Economies," *Journal of Finance*, 2003, *58*, 1167–1191.

Puri, Manju, "Commercial Banks as Underwriters: Implications for the Going Public Process," *Journal of Financial Economics*, 1999, *54*, 133–163.