Credit, Bankruptcy, and Intermediary Market Structure

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Abstract: We use a model of costly monitoring to study the determinants of savings mobilization, capital allocation and entrepreneur bankruptcy rates under different market structures of financial intermediation. Borrower-entrepreneurs have access to the same investment project but differ in the value of their collateralizable assets. The main finding is that monopolistic intermediation mobilizes less savings and induces higher entrepreneur bankruptcy rates than competitive intermediation. These two types of monopoly distortions are due to the monopoly power with lenders and with borrowers respectively. Under both market structures, an increase in available credit or a reduction in monitoring costs imply that more collateral-constrained entrepreneurs obtain funds, but bankruptcy rates are reduced only under competitive intermediation. Implications to financial market liberalization are derived.

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1. Introduction

The role of the banking sector in economic development has been the subject of an extensive literature. Substantial empirical macroeconomic evidence shows that the size of the intermediation sector is positively correlated with growth. King and Levine (1992, 1993) use time-series data to show that measured value of services provided by the financial intermediation sector helps predict economic growth. The evidence suggests that development of the intermediation sector is more than just a by-product of economic growth, but to understand this on a theoretical level requires a model that can compare the credit market under different market structures.

A few recent studies have emphasized the positive effect of banking concentration on bank lending. Diversification of lending risks is arguably easier in concentrated market banking systems, reducing agency costs in lending relationships (Diamond, 1984, and Winton, 1997). Petersen and Rajan (1995) show that with incomplete markets and imperfect information, monopoly power can increase the incentive of intermediaries to finance new firms with no record of performance. These theoretical studies have been related to historical examples that purport to demonstrate the positive role of monopoly power in the intermediary sector. See, for instance, Gerschenkron’s (1965) discussion of the Great Banks in Germany and Credit Mobilier in France, and Mayer’s (1990) discussion of the role of Keiretsu in the industrial development of post-war Japan. Recently however, more comprehensive empirical evidence on the role of banking concentration has emerged that points to the opposite direction. In a cross-sectional study of U.S. firms, Black and Strahan (2000) find a smaller number of newly financed firms in states with a higher level of bank concentration. Extending the international dataset compiled by Rajan and Zingales (1998), Cetorelli and Gambra (2001) find that bank concentration has on average a depressive effect on industrial growth.

The objective of our paper is to propose a simple model that generates implications that are consistent with the recent empirical evidence of the negative impact of bank concentration on lending and growth. The main features of our model that distinguish it from the previous literature are: (i) firms can collateralize their assets in loan contracts
to alleviate the intermediary’s problem of costly auditing output projects, (ii) firms differ in the value of their collateral and hence have different rates of bankruptcy, and (iii) the implications of banking concentration are explored in a general equilibrium setting in which the deposit market and the loan market are jointly modeled.

Our main discovery is that market structure of the intermediary sector is crucial to the performance of the credit market. Monopolistic intermediation mobilizes less savings and results in higher entrepreneur bankruptcy rates than competitive intermediation. A monopoly intermediary lends less because it has the monopoly power with lenders and perceives a higher marginal cost of credit than competitive intermediaries. In contrast, the monopoly distortion in higher business bankruptcy rates arises from the market power with borrowers. As the monopoly intermediary extracts more surplus from entrepreneurs by raising debt repayments, entrepreneurs are more likely to forfeit collateral and declare default.

Our comparison results between monopolistic and competitive intermediation contrast with the established wisdom that a greater level of competition among intermediaries leads to higher bankruptcy rates (Winton, 1997, Yosha, 1997, and Matutes and Vives, 2000), and have important policy implications. Credit market liberalization is especially crucial in economies with an inelastic supply of credit and significant monitoring costs. Government policies of promoting savings may have limited result in facilitating growth of the credit market if the intermediary sector remains uncompetitive, because the benefits of an expansion of credit mostly accrue to the intermediaries with no impact on bankruptcy rates or the demand for credit by entrepreneurs. Similarly, in a monopolized credit market reducing monitoring cost merely transfers greater profits to the monopoly intermediary without reducing bankruptcy rates.

We adopt a costly monitoring framework that follows from Townsend (1979) and Diamond (1984). In Townsend’s (1979) original contribution, borrower-entrepreneurs have ex post private information about the outcome of their projects, and monitoring (auditing)

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1 Williamson (1987b) uses a similar costly monitoring framework in a real business cycle setup to show that endogenous financial intermediation helps to account for monetary phenomena such as the positive correlation between the price level and real output. Bernanke and Gertler (1989) address similar questions with a model of collateral.
is costly for lenders. Diamond (1984) shows that intermediaries arise as “delegated” monitors to economize on the monitoring cost and solve the free-rider problem among lenders. The monitoring cost plays an important role in our model, and should be interpreted to include not only the cost of auditing, but also the transaction cost of bankruptcy to the intermediary. Bankruptcy costs can be a substantial portion of the claims, thus having potentially important implications to allocation of capital.2

Another essential feature of our model is that entrepreneurs differ in the amount of non-liquid wealth that they can lodge as collateral in loan contracts. Entrepreneurs are endowed with some fixed assets that are needed for production and rely entirely on outside funds to finance a unit of investment good to carry out the production project. Since the assets of the firm are necessary for the production, they cannot be liquidated to finance the project. Examples of such assets are patents or lab equipment of a biotech firm, or airplanes of an airline company. Although illiquid, these assets can be used as collateral to reduce the cost of the ex post moral hazard problem to the intermediary in monitoring the firm’s output. In practice, collateralization of a borrowing firm’s assets is common in lending agreements.

The model is presented in the next section. Sections 3 and 4 analyze monopolistic intermediation and competitive intermediation respectively. We characterize the loan contracts and deposit interest rate for each intermediary structure. Section 5 compares the two representative structures in terms of aggregate lending and entrepreneur bankruptcy rates, and discusses how changes in available credit and monitoring cost affect the performance of credit market under the two structures. Section 6 derives some implications of our analysis to credit market liberalization. We answer policy questions about the priority of introducing competition for lenders and for borrowers, and also try to understand why credit market liberalization often faces strong political resistance even though it is beneficial to economic growth.

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2 Altman (1984) finds that the average administrative bankruptcy costs are 6% of the claims under Chapter 11 and 6.2% under U.K. Receivership. Franks and Torous (1994) discuss the direct and efficiency bankruptcy costs under alternative bankruptcy codes. They find that U.S. companies spend an average of 27 months in Chapter 11 and 17 months in workouts outside the bankruptcy process, while the U.K. Insolvency Code generally results in a speedier settlement of claims.
2. A Costly Monitoring Model with Collateral

The economy consists of three types of agents, borrowers, lenders, and intermediaries. Borrowers are entrepreneurs who make investment by obtaining loans from intermediaries. Intermediaries in turn receive credit from lenders by promising repayment with interests. There are three types of goods in the economy, investment good, collateral, and consumption good.

There is a continuum of risk-neutral borrower-entrepreneurs, each of whom has access to a risky project. The project takes one unit of the investment good and transforms it into a non-negative random output of \( w \) units of the consumption good. The output \( w \) is assumed to be i.i.d. across projects. The range of distribution of \( w \) is \([w_1, w_2]\), with mean \( w \), distribution \( F(w) \) and continuous density \( f(w) \). Each entrepreneur can observe costlessly the outcome of his project, but output verification costs \( g > 0 \) units of the consumption good for any other agent. To focus on the role of collateral in capital allocation, we assume that this monitoring cost is the same for all projects.

Entrepreneurs rely entirely on outside funding to provide one unit of the investment good to carry out the project. However, they have different units of divisible and non-liquid wealth that can be (partially or wholly) used as collateral in the loan contract with lenders.\(^3\) For analytical convenience, we assume that the non-liquid wealth is liquidated after completion of the project, and the liquidation value can be costlessly verified by lenders.\(^4\) Collateral represents the lender’s claim on the return of the borrower’s project, when the latter is unable to honor the repayment obligation specified in the loan contract. The range of the liquidation value of collateralizable assets is \([k_1, k_2]\), in units of the

\(^3\) Since all entrepreneurs have access to the same investment project, the role of collateral in our model is different from that in Besanko and Thakor (1987), where borrowers with private information regarding the prospects of their investment projects use collateral as a signal of credit-worthiness. Our model also differs from the ex ante moral hazard model of Holmstrom and Tirole (1997), who assume that entrepreneurs’ own funds are entirely liquid and can be used to finance the project together with outside funds. In their model, the more own funds entrepreneurs have, the more credible their commitment of not misusing the outside fund, and the more likely they can obtain outside funds.

\(^4\) The same assumptions on collateral are made, for example, in Schmidt-Mohr (1997). Adding a disparity in collateral valuation by the entrepreneur and by the lender, as in Barro (1976), will not change the results in the present paper.
consumption good. The measure of entrepreneurs with non-liquid wealth greater than \( k \), denoted as \( U(k) \), is a decreasing continuous function of \( k \). As we will see, putting up more illiquid asset as collateral helps alleviate the ex post monitoring problem and lowers the cost of capital to entrepreneurs.

We represent lenders by a non-decreasing and differentiable aggregate savings function \( S(r) \), where \( r \) is the risk-free deposit rate. The savings are measured in the investment good. Since each entrepreneur needs one unit of the investment good, the supply of credit represented by the function \( S(\cdot) \) and the demand for loans represented by the function \( U(\cdot) \) are measured in the same unit. The savings function \( S(r) \) can be substantiated by specifying endowments and preference for a representative consumer. We simply take \( S(r) \) as a primitive, and assume that it is defined for all non-negative deposit rates. We also make the following assumption:

**Assumption 2.1:** \( r + S(r)/S'(r) \) increases with \( r \).

This assumption implies that the marginal cost of obtaining loans from depositors for a monopoly intermediary is increasing in the deposit rate. As can be seen in the next section, it is a sufficient condition for the second-order condition of the monopoly’s optimization problem. Assumption 2.1 is satisfied as long as the slope of the savings function decreases in the deposit rate or does not increase too fast.

There is no direct contact between lenders and entrepreneurs. Instead, supply of credit meets with demand for loans indirectly through intermediaries, who offer contracts to both borrowers and lenders. The contracts between intermediaries and lenders are characterized by a risk-free deposit arrangement. Diamond (1984) shows that intermediaries arise as delegated monitors to economize on the cost of monitoring the entrepreneurs and to solve the free-rider problem among lenders. Deposits earn a risk-free return because an intermediary that deals with a continuum of borrowers with independent projects can perfectly diversify.

### 2.1. Risky debt

The building block for subsequent sections is the loan contract between an intermediary and an entrepreneur. Regardless of the collateral value \( k \) put up by the entrepreneur, any
optimal contract that maximizes a weighted sum of the expected profits of the entrepreneur and the intermediary subject to the participation constraints of the two takes the form of "risky debt." A risky debt contract is characterized by a single number $x$, called the "face value of debt." If the realized output $w$ exceeds $x - k$, the entrepreneur declares "success" and pays $x$. If $w < x - k$, the entrepreneur "defaults" or declares "bankruptcy," and then the intermediary incurs the cost $g$ to verify the output and gets all the output plus collateral $k$. The logic of risky debt contracts is that it is in the interest of the entrepreneur as well as the intermediary to discourage the entrepreneur from falsely declaring bankruptcy. To do so requires making the punishment for default as severe as possible, which is to forfeit all collateral and any output from the project. The proof that any optimal contract takes the form of risky debt is given by, for example, Townsend (1979), Gale and Hellwig (1985), Williamson (1987a, 1987b). The adaptation of the proof to our model of intermediation with collateral is straightforward and omitted.

Let $P(x, k)$ be the expected payment from an entrepreneur with collateral value $k$ to the intermediary under a risky debt contract with face value $x$, before the intermediary incurs the monitoring expenses. Then,

$$P(x, k) = \begin{cases} 
  x, & \text{for } x \leq w_1 + k \\
  \int_{w_1}^{w_2} f(w) dw + \int_{x-k}^{w_2} f(w) dw, & \text{for } x \in (w_1 + k, w_2 + k) \\
  \overline{w} + k, & \text{for } x \geq w_2 + k. 
\end{cases}$$

The probability of default is 0 if $x \leq w_1 + k$, strictly between 0 and 1 if $x \in (w_1 + k, w_2 + k)$, and 1 if $x \geq w_2 + k$. A higher face value $x$ leads to a greater probability of default for $x \in (w_1 + k, w_2 + k)$, and a greater expected payment $P$ for $x < w_2 + k$. Denote the expected profits of the entrepreneur with collateral $k$ from the risky debt contract with face value $x$ as $B(x, k)$. Then, $B(x, k)$ is the difference between the expected output $\overline{w}$ and $P(x, k)$:

$$B(x, k) = \begin{cases} 
  \overline{w} - x, & \text{for } x \leq w_1 + k \\
  \overline{w} - P(x, k), & \text{for } x \in (w_1 + k, w_2 + k) \\
  -k, & \text{for } x \geq w_2 + k. 
\end{cases}$$  \quad (2.1)

5 We rule out stochastic monitoring. As Townsend (1979) first pointed out, random monitoring can be more efficient. Since the focus here is comparison of alternative structures of intermediation, and since any efficiency gain will occur under both monopolistic and competitive intermediation, ruling out random monitoring does not change the basic results in the present paper.
Since $P(x, k)$ weakly increases with $x$, $B(x, k)$ weakly decreases with $x$. Denote the gross return to an intermediary of a risky debt with face value $x$ and collateral $k$ as $L(x, k)$. Then, since the intermediary incurs the cost of auditing the output, $L(x, k)$ is the difference between $P(x, k)$ and the expected monitoring expense:

$$L(x, k) = \begin{cases} 
  x, & \text{for } x \leq w_1 + k \\
  P(x, k) - gF(x - k), & \text{for } x \in (w_1 + k, w_2 + k) \\
  \bar{w} - g + k, & \text{for } x \geq w_2 + k.
\end{cases}$$ (2.2)

Finally, let $T(x, k) = B(x, k) + L(x, k)$ be the sum of the entrepreneur’s profits and the expected loan return, given by

$$T(x, k) = \begin{cases} 
  \bar{w}, & \text{for } x \leq w_1 + k \\
  \bar{w} - gF(x - k), & \text{for } x \in (w_1 + k, w_2 + k) \\
  \bar{w} - g, & \text{for } x \geq w_2 + k.
\end{cases}$$ (2.3)

Note that the total gross profit $T$ decreases with $x$ for $x \in (w_1 + k, w_2 + k)$ because a higher face value means a greater default probability and hence a greater expected monitoring expense.

We now make a simplifying assumption to facilitate the analysis in subsequent sections. For $x \in (w_1 + k, w_2 + k)$, we can rewrite $L(x, k)$ as:

$$L(x, k) = \int_{w_1}^{x-k} (w - g)f(w)dw + \int_{x-k}^{w_2} (x - k)f(w)dw + k,$$

where the first two terms depend on face value $x$ only through $x - k$. The following assumption implies that for any collateral value $k$, the gross return $L(x, k)$ is a concave function of face value $x$.

**Assumption 2.2:** $\int_{w_1}^{w} (v - g)f(v)dv + \int_{w}^{w_2} w f(v)dv$ is concave in $w$ on $[w_1, w_2]$ and achieves maximum at an interior point $w^*$. 

In our costly monitoring model, a higher face value of debt increases the probability that the entrepreneur defaults, and can therefore decrease the loan return to the intermediary due to greater monitoring expenses. Assumption 2.2 is a simple way of capturing this idea. Although global concavity of the loan return is a strong assumption, it simplifies
the analysis of loan contracts and allows us to focus on the comparison of monopolistic and competitive intermediation.\textsuperscript{6} Note that in our model all entrepreneurs have the same investment project, so Assumption 2.2 is stated independently of the collateral value. The assumption that the loan return function is concave has been a standard one since Stiglitz and Weiss (1981), who argue that credit rationing occurs because the market interest rate need not equate the supply of funds to the demand. Two reasons that the interest rate does not clear the market are stressed by Stiglitz and Weiss: adverse selection of borrowers, where a higher interest rate attracts borrowers who are on average less likely to repay the loan, and moral hazard of borrowers, where a higher interest motivates borrowers to select riskier projects. In both cases, an increase in the interest rate will decrease the return to the intermediary from loans, and may therefore contradict the zero-profit condition for intermediaries. Here, as in Williamson (1987a, 1987b) and Bernake and Gertler (1989), costly output verification plays a similar role as adverse selection and moral hazard of borrowers.

By taking derivatives, we find that \( w^* \) satisfies

\[
1 - F(w^*) - g f(w^*) = 0. \tag{2.4}
\]

Regardless the intermediary market structure, for any collateral value \( k \), the maximum face value of debt that will occur in a loan contract is \( w^* + k \): if the face value of debt exceeds \( w^* + k \), then since by Assumption 2.2 \( L \) is concave in \( x \) with maximum reached at \( x = w^* + k \) and since \( B \) decreases with \( x \), a reduction in \( x \) would increase profits for both the intermediary and the entrepreneur. It follows that the maximum default rate in any loan contract is \( F(w^*) \). For this reason, we call the loan contract with the face value \( w^* + k \) the “maximum default contract.” The maximum default contract plays a special role in our analysis. Define

\[
p^* = \int_{w_1}^{w^*} w f(w)dw + \int_{w^*}^{w_2} w^* f(w)dw.
\]

\textsuperscript{6} Regardless of the cost of monitoring \( g \), concavity is assured as long as the density \( f(\cdot) \) is non-decreasing, such as the uniform distribution. If \( f(\cdot) \) is decreasing, concavity still obtains if it does not decrease too fast or \( g \) is not too great. The function in Assumption 2.2 is always decreasing around \( w_2 \). For it to have an interior maximizer on \((w_1, w_2)\), the function has to be increasing around \( w_1 \). A sufficient condition is \( g f(w_1) < 1 \).
Then, under the maximum default contract, we have:

\[ P(w^* + k, k) = p^* + k; \]
\[ L(w^* + k, k) = p^* + k - gF(w^*); \]
\[ B(w^* + k, k) = \bar{w} - (p^* + k). \]

We can verify that \( p^* \) lies between \( w_1 \) and \( \bar{w}. \)

For future references, we denote

\[ k^* = \bar{w} - p^*; \]
\[ t^* = \bar{w} - gF(w^*). \]

Then, \( k^* \) is the highest collateral value such that the maximum default contract gives the entrepreneur non-negative expected profits, and \( t^* = T(w^* + k, k) \) is the sum of the expected profits of the entrepreneur and the loan return to the intermediary under the maximum default contract.

3. Credit Market with Monopolistic Intermediation

A monopoly intermediary maximizes its expected profits by choosing a deposit rate to obtain savings from lenders and by offering a menu of contracts to entrepreneurs to lend the capital. The monopoly intermediary makes take-it-or-leave-it offers to entrepreneurs according to their collateral value. This assumes that the value of collateralizable assets of each entrepreneur is known to the intermediary. We first characterize the monopoly loan contracts and then the deposit rate.

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7 By taking the derivatives of the equation that defines \( p^* \), we can show that \( p^* \) is an increasing function of \( w^* \). Further, \( w^* = w_1 \) implies that \( p^* = w_1 \), and \( w^* = w_2 \) implies \( p^* = \bar{w} \). Since \( w^* \) is in \((w_1, w_2)\), \( p^* \) is between \( w_1 \) and \( \bar{w} \).

8 We can show that \( t^* > 0 \) so that gains of trade exist between depositors and the entrepreneur (through intermediaries) under the maximum default contract, regardless of the collateral value \( k \) of the entrepreneur. Indeed, we have \( t^* > k^* + w_1 \), because by Assumption 2.2 at \( w = w^* \) the function \( \int_{w_1}^{w_1} (v - g) f(v) dv + \int_{w_2}^{w^*} w f(v) dv \) reaches the maximum of \( p^* - gF(w^*) \), which is greater than \( w_1 \), the value of the function at \( w = w_1 \).

9 Our comparison results are robust to the alternative assumption that the collateral value is private information and loan contracts must give entrepreneurs incentives to reveal it.
Figure 1. $L(x, k)$ and $T(x, k)$ as functions of $x$ for fixed $k$.

3.1. Monopoly loan contracts

For an entrepreneur with any collateral $k$, the monopoly intermediary chooses the face value of debt $x$ to maximize the expected loan return $L(x, k)$ subject to the entrepreneur’s participation constraint that his expected profit $B(x, k)$ is non-negative. The loan return $L$ as a function of $x$ is given by (2.2). It is convenient to rewrite the entrepreneur’s participation constraint as $L(x, k) \leq T(x, k)$, where $T$, given by (2.3), is the sum of the loan return $L$ to intermediary and the expected profits $B$ of entrepreneur.

Figure 1 plots $L(x, k)$ and $T(x, k)$ for a given $k$ as functions of face value $x$, for the case in which the random output $w$ is uniformly distributed on $[w_1, w_2]$. How the two functions intersect with each other depends on $k$, as we will see in the proof of the following proposition. We can verify that the uniform distribution satisfies Assumption 2.2 if $g < w_2 - w_1$. In this case, from equation (2.4) we have $w^* = w_2 - g$, which is between $w_1$ and $w_2$, as desired. Under the uniform assumption, for face value of debt $x \in [w_1 + k, w_2 + k]$, the total gross profit $T$ is linear and the loan return $L$ is quadratic. These properties are special, but for any output distribution $F$ that satisfies Assumption 2.2, $T$ is decreasing and $L$ is concave with the maximum reached at $x = w^* + k$, as shown in Figure 1.

Let $x_m(k)$ denote the solution to the problem of max$_x L(x, k)$ subject to $L(x, k) \leq$
\( T(x, k) \), as a function of collateral value \( k \). We now show that \( x_m(k) \) is given by

\[
x_m(k) \begin{cases} 
= w^* + k, & \text{for } k < k^* \\
\text{satisfies } B(x_m(k), k) = 0, & \text{for } k \in [k^*, \overline{w} - w_1) \\
= \overline{w}, & \text{for } k \geq \overline{w} - w_1.
\end{cases}
\] (3.1)

The following proposition gives this result in words.

**Proposition 3.1.** Under monopolistic intermediation, among entrepreneurs that obtain loans, (i) maximum default contracts are optimal for low collateral values, (ii) expected profits are zero for intermediate collateral values, and (iii) probability of default is zero for high collateral values.

**Proof.** Consider the two functions \( L(x, k) \) and \( T(x, k) \) for any given \( k \), as \( x \) varies from 0 to above \( w_2 + k \). Since the two functions are continuous, and since \( L(0, k) = 0 < \overline{w} = T(0, k) \) and \( L(w_2 + k, k) = \overline{w} - g + k > \overline{w} - g = T(w_2 + k, k) \), there is at least one intersection in \((0, w_2 + k)\). There cannot be two or more intersections. To see this, note that since \( L(x, k) \) is increasing and \( T(x, k) \) is decreasing in \((0, w^* + k]\), there can be at most one intersection in this range. If there is one, then there cannot be another intersection in \((w^* + k, w_2 + k)\), because both \( L(x, k) \) and \( T(x, k) \) are decreasing in \([w^* + k, w_2 + k)\) but \( T(x, k) \) decreases faster (compare (2.2) with (2.3); note that \( P(x, k) \) is increasing in \( x \)).

For the same reasons, if there is no intersection in \((0, w^* + k] \) (in which case \( T \) is entirely above \( L \) in this range), then there is exactly one intersection in \((w^* + k, w_2 + k)\).

The two functions \( L(x, k) \) and \( T(x, k) \) can intersect in \((0, w_1 + k], (w_1 + k, w^* + k), \) or \([w^* + k, w_2 + k)\), depending on the collateral value \( k \). The solution \( x_m(k) \) to the problem of \( \max_x L(x, k) \) subject to \( L(x, k) \leq T(x, k) \) depends on where the intersection is and thus also on \( k \). For \( k \geq \overline{w} - w_1 \), we have \( L(0, k) < T(0, k) \) and \( L(w_1 + k, k) = w_1 + k \geq \overline{w} = T(w_1 + k, k) \), so the intersection occurs in \((0, w_1 + k] \). Since \( L(x, k) = x \) and \( T(x, k) = \overline{w} \) in this range, the intersection is at \( x = \overline{w} \). In this case, \( L \) increases in \( x \) for \( x < \overline{w} \) and \( L > T \) for \( x > \overline{w} \), so we have \( x_m(k) = \overline{w} \). For \( k \in [k^*, \overline{w} - w_1) \), we have \( L(w_1 + k, k) < T(w_1 + k, k) \) and \( L(w^* + k, k) = p^* + k - gF(w^*) \geq t^* = T(w^* + k, k) \), so the intersection occurs in \((w_1 + k, w^* + k)\). In this case, \( L \) is increasing in \( x \) before the intersection and \( L > T \) after the intersection, so the intersection gives \( x_m(k) \). It satisfies \( B(x_m(k), k) = 0 \) because
\(L = T\) at the intersection. Finally, for \(k < k^*\), we have \(L(w^* + k, k) < T(w^* + k, k)\) and \(L(w_2 + k, k) > T(w_2 + k, k)\), so the intersection occurs in \((w^* + k, w_2 + k)\). Since in this range \(L\) is decreasing in \(x\), the solution \(x_m(k)\) is not given by the intersection. Instead, it is given by \(w^* + k\), because this maximizes \(L\) while satisfying \(L \leq T\).  

Q.E.D.

Proposition 3.1 can be explained as follows. In lending to the entrepreneurs, the monopoly intermediary uses the face value of debt of the loan contract to discriminate among different collateral values. Under Assumption 2.2, to maximize the return \(L\) on a loan to an entrepreneur with collateral \(k\), the monopolist should choose the maximum default contract with face value \(w^* + k\) if it satisfies the entrepreneur’s participation constraint. This is precisely the case for entrepreneurs with little collateral \((k < k^*)\)—recall that \(k^*\) is the highest collateral value such that the maximum default contract yields non-negative expected profits to the entrepreneur. The participation constraint of these entrepreneurs does not bind under the monopoly loan contract. For all entrepreneurs with collateral values higher than \(k^*\), the maximum default contract with \(x = w^* + k\) would leave them negative profits. In this case, the monopolist optimally lowers the face value of debt, and hence the expected payment \(P\) from the entrepreneur, from \(w^* + k\) to the point \(x_m(k)\) where the participation constraint just binds, i.e., \(B(x_m(k), k) = 0\). For entrepreneurs with intermediate values of collateral \((k^* \leq k < \overline{w} - w_1)\), the participation constraint binds at a point where the probability of default is strictly between 0 and 1. (This is the case depicted in Figure 1.) For those entrepreneurs who can provide sufficient collateral \((k \geq \overline{w} - w_1)\), the participation constraint binds at a point where “full collateralization” is achieved: the intermediary extracts all output from the entrepreneur by charging \(\overline{w}\), and the collateral committed by the entrepreneur is so high that he will never default.

Under the optimal schedule of face value characterized above, the loan return to the monopoly intermediary can be shown to increase with collateral value \(k\). For collateral values below \(k^*\), the intermediary obtains the highest return \(k + t^* - k^*\) on the loan to an entrepreneur with collateral \(k\), under the maximum default contract with face value \(w^* + k\). For these entrepreneurs, an increase in collateral is matched with an increase in the face value of debt by the same amount. This has no effect on the probability of
default, but increases the expected profits for the intermediary because more collateral is forfeited.\footnote{Since $x_m(k) = w^* + k$, we have $B(x_m(k), k) = \bar{w} - (p^* + k)$, so entrepreneurs’ expected profits decrease with the collateral value for $k < k^*$. However, the expected amount of consumption goods that the entrepreneurs receive after completion of the projects, including any returned collateral, is equal to $\bar{w} - p^*$, independent of the collateral level. Thus, these entrepreneurs cannot benefit by destroying part of their collateral. The monopoly loan contracts with $x_m(k) = w^* + k$ are no longer incentive compatible when the value of collateralizable assets owned by an entrepreneur is known only to himself, because the entrepreneurs will want to hide part of their assets.} For collateral levels between $k^*$ and $\bar{w} - w_1$, the probability of default under the optimal contract $x_m(k)$ is strictly between 0 and 1. The intermediary charges a lower face value of debt to entrepreneurs with more collateral for them to break even, because for any given face value of debt they make greater expected payment to the intermediary. Formally, taking derivatives of $B(x_m(k), k) = 0$ with respect to $k$, we have:
\[
\frac{dx_m(k)}{dk} = -\frac{F(x_m(k) - k)}{1 - F(x_m(k) - k)} < 0.
\]
Using the above expression, we have
\[
\frac{dL(x_m(k), k)}{dk} = \frac{gf(x_m(k) - k)}{1 - F(x_m(k) - k)} > 0.
\]
Thus, even though the monopoly lowers the face value of debt for entrepreneurs with more collateral, the expected loan return $L(x_m(k), k)$ increases with collateral, as the intermediary incurs a smaller monitoring expense due to a lower probability of default. Finally, for collateral levels above $\bar{w} - w_1$, the probability of default is zero and the collateral value does not affect the intermediary’s profit.

### 3.2. Monopoly deposit rate

To attract funds from lenders, the monopoly intermediary sets a deposit rate. Since the loan return $L$ to the monopoly intermediary increases with collateral value $k$ under the loan contracts characterized above, the profit optimization problem of the monopoly intermediary comes down to choosing the deposit rate $r$ and a “cutoff” collateral value $k$, such that only the entrepreneurs with collateral higher than $k$ will be financed. This problem can be stated as:
\[
\max_{k, r} \int_k^{k_2} L(x_m(z), z)dU(z) - S(r)r
\]
subject to $U(k) \leq S(r)$. Let $r_m$ and $k_m$ be the solution to the above maximization problem. An interior solution satisfies the following first-order condition

$$
L(x_m(k_m), k_m) = r_m + S(r_m)/S'(r_m),
$$

(3.2)

and the “market-clearing condition” $U(k_m) = S(r_m)$. The second-order condition is satisfied because the loan return increases with the collateral value and by Assumption 2.1 the cost of loan $r + S(r)/S'(r)$ increases with deposit rate.\footnote{The second-order condition requires that $(L(x_m(k)), k) - r - S(r)/S'(r))U''(k)$ have negative derivatives with respect to $k$ at the solution $k_m$, where $r$ is a decreasing function of $k$ via the market-clearing condition.}

The first-order condition (3.2) can be interpreted as the familiar monopoly condition of marginal revenue equals marginal cost—the left-hand-side is the marginal revenue from lending to the entrepreneur with the cutoff value, and the right-hand-side is the cost of attracting an additional unit of loan from lenders. Note that unless the savings function is perfectly elastic, marginal cost of attracting the funds is strictly greater than the cost, so that the monopoly intermediary makes a positive profit on the loan to the marginal entrepreneur.

Due to the ex post monitoring problem not all entrepreneurs get loans; that is, typically we have $k_m > k_1$. Entrepreneurs with low collateral values cannot obtain loans, even though they have access to the same projects as the entrepreneurs who get loans, more interestingly, the nature of the borrowing constraint that the collateral-poor entrepreneurs face depends on whether $k_m > k^*$ or $k_m < k^*$. In the first case, the marginal entrepreneur with collateral $k_m$ earns zero expected profits, and the entrepreneurs with lower collateral values do not get loans simply because they cannot offer the monopoly intermediary a loan return that covers the cost of obtaining credit for the monopoly. In contrast, when $k_m < k^*$, the marginal entrepreneur with collateral $k_m$ earns strictly positive profits. For the entrepreneurs with collateral values just below $k_m$, the monopoly loan contracts given by (3.1), which are all maximum default loan contracts, would give them positive expected profits. These entrepreneurs would be willing to give up part of the profits to avoid being rationed, but due to the ex post monitoring problem, there is no credible way to transfer
the profits to the intermediary. As a result, the entrepreneurs with collateral values just below $k_m$ do not get loans.

4. Credit Market with Competitive Intermediation

Competitive intermediaries engage in price competitions in both the loan market and the deposit market. We will argue that this double-sided competition yields a unique “perfect competitive outcome” where intermediaries earn zero expected profits, with the expected return on each unit of loan equal to the cost of raising the capital. Competitive loan contracts and deposit rate will then be characterized. The results will be used in the next section to compare with monopolistic intermediation.

4.1. Competitive loan contracts

Since our focus is on competition among intermediaries, we assume both entrepreneurs and lenders simply decide whether to participate in the markets, and if they do, choose the best-termed contracts offered by intermediaries. To concentrate on the comparison between monopolistic and competitive intermediation, we assume that the number of competitive intermediaries is fixed and finite. The exact number of intermediaries does not affect our results; we adopt the convention that if lenders (entrepreneurs) face some contracts that are equally favorable, they divide their savings (credit applications) evenly among them.\(^\text{12}\) Each intermediary is dealing with a continuum of entrepreneurs and can therefore offer risk-free returns to depositors, as under monopolistic intermediation.\(^\text{13}\)

We model competition among intermediaries as simultaneously offering loan contracts to entrepreneurs and deposit contracts to lenders.\(^\text{14}\) We look for a menu of loan contracts

\(^\text{12}\) Since it is inefficient for multiple intermediaries to monitor a single entrepreneur, this convention requires some coordination among entrepreneurs to ensure that each of them is financed by a single intermediary.

\(^\text{13}\) For results on intermediation when diversification is imperfect, see Winton (1997) and Yosha (1997).

\(^\text{14}\) In general, the perfect competition outcome need not obtain because intermediaries have incentives to corner one of the two markets in order to secure monopoly power in the other. This is the case when the intermediaries compete in the loan market and in the deposit market sequentially, as in Yanelle (1997).
and a deposit rate, offered by each intermediary, and the decisions by the entrepreneurs and the depositors, such that no agent deviates. We assume that the intermediaries may not ration either depositors or entrepreneurs.\textsuperscript{15} Formally, we say that an intermediary is “bankrupt” if either deposits taken exceed loan applications or loan applications exceed deposits. In either case, a bankrupt intermediary receives an arbitrarily large negative payoff. If an intermediary receives either loan applications or deposits, we say that the intermediary is “active.” Since it may not ration either depositors or entrepreneurs, an active intermediary has exactly the same units of deposits and loan applications. All active intermediaries offer the same deposit rate, for otherwise those offering lower deposit rates would be bankrupt. Finally, each loan contract maximizes the expected profits of the entrepreneur subject to the intermediary making non-negative profits. Otherwise, intermediaries would deviate and offer alternative contracts.

The outcome of competitive intermediation can therefore be characterized by a single deposit rate, and a menu of competitive loan contracts that maximize the expected profits of the entrepreneur subject to the constraint that the intermediary makes non-negative profits. Formally, given any deposit rate $r$, the loan contracts for entrepreneurs with collateral $k$ solve the optimization problem of $\max_x B(x, k)$ subject to the participation constraint of the intermediary $L(x, k) \geq r$, where $B(x, k)$ is given by (2.1). The participation constraint can be rewritten as $B(x, k) \leq T(x, k) - r$, where $T(x, k)$ is the sum of the loan return to intermediary and the expected profits of entrepreneur, as given (2.3). We now show that under this characterization, the participation constraint of the intermediaries is always binding so that all active intermediaries make zero expected profits.

Figure 2 plots $B(x, k)$ and $T(x, k) - r$ as functions $x$, for given $r$ and $k$, for the case in which $w$ is uniformly distributed on $[w_1, w_2]$ and $g < w_2 - w_1$. The relative position of the two functions depends on $k$ and $r$, as we will see in the proof of the following proposition. Under the uniform assumption, for face value of debt $x \in [w_1 + k, w_2 + k]$, the total net

\textsuperscript{15} This assumption helps us to focus on the competitive outcome where all capital raised by intermediaries are lent out, as in the monopoly case. More importantly, it rules out cornering of markets. As pointed out by Stahl (1988) and Yannelle (1989), even when intermediaries compete simultaneously in the two markets, competitive outcomes can be sensitive to assumptions of the competitive environment. These complications of competitive intermediation are important, but we ignore them here since our focus is on a direct comparison of monopolistic and competitive intermediation.
profit $T - r$ is linear and the expected profit of the entrepreneur $B$ is quadratic. These special properties do not extend to general output distributions, but two properties shown in Figure 2 that do hold for any distribution satisfying Assumption 2.2 are: $B(x, k)$ and $T(x, k) - r$ decrease for $x \in (w_1 + k, w_2 + k)$, and $B(x, k)$ decreases faster than $T(x, k) - r$ in $(w_1 + k, w^* + k)$ and slower in $[w^* + k, w_2 + k)$. The latter property is due to Assumption 2.2, because $L$ is the difference between $T$ and $B$ and is increasing in $(w_1 + k, w^* + k)$ and decreasing in $[w^* + k, w_2 + k)$.

Let $x_c(k)$ denote the solution to the problem of $\max_x B(x, k)$ subject to $B(x, k) \leq T(x, k) - r$, as a function of $k$, for a given $r$. We now show that the participation constraint of the intermediaries always binds, and the competitive loan contract $x_c(k)$ is given by

$$x_c(k) \begin{cases} 
\text{does not exist, } & \text{for } k < r + k^* - t^* \\
\text{satisfies } L(x_c(k), k) = r, & \text{for } k \in [r + k^* - t^*, r - w_1) \\
= r, & \text{for } k \geq r - w_1.
\end{cases}$$

(4.1)

The following proposition gives the result in words, where “competitive intermediation” refers to simultaneous price competition in the deposit and loan markets by a finite number of intermediaries which may not ration lenders or borrowers.

**Proposition 4.1.** Under competitive intermediation, (i) entrepreneurs with low collateral values do not get loans, (ii) the face value of debt is determined by intermediaries’ zero-profit condition for intermediate collateral values, (iii) probability of default is zero for entrepreneurs with high collateral values.
PROOF. Fix $r$, and consider $B(x,k)$ and $T(x,k) - r$ as functions $x$ for each collateral value $k$. Depending on $k$, the two functions may not intersect, and may intersect more than once, as in Figure 2. Since $B$ is weakly decreasing for all $x$, the solution $x_c(k)$ to the problem of $\max_x B(x,k)$ subject to $B(x,k) \leq T(x,k) - r$ corresponds to the intersection with the smallest $x$ when there are multiple intersections.

For $k \geq r - w_1$, we have $B(0,k) = \overline{w} \geq \overline{w} - r = T(0,k) - r$ and $B(w_1+k,k) = \overline{w} - (w_1+k) \leq \overline{w} - r = T(w_1+k,k) - r$, so $B$ intersects $T - r$ in $[0, w_1+k]$. Since $B(x,k) = \overline{w} - x$ and $T(x,k) - r = \overline{w} - r$ in this range, the intersection is at $x = r$. The solution $x_c(k)$ in this case is given by the intersection and equals $r$. For $k \in [r + k^* - t^*, r - w_1)$, we have $B(w_1+k,k) > T(w_1+k,k) - r$ and $B(w^*+k,k) = \overline{w} - (p^*+k) \leq t^* - r = T(w^*+k,k) - r$, so the first intersection occurs in $(w_1+k, w^*+k]$. The intersection gives $x_c(k)$, which satisfies $L(x_c(k),k) = r$ because $T = L + B$ and at the intersection $B = T - r$. Finally, for $k < r + k^* - t^*$, we have $B(w^*+k,k) > T(w^*+k,k) - r$. Because $B(x,k)$ decreases faster than $T(x,k) - r$ for $x \leq w^* + k$, this means that the two curves do not intersect for $x \leq w^* + k$. Further, since $B(x,k)$ decreases slower than $T(x,k) - r$ for $x \in (w^* + k, w_2 + k)$, and since both $T - r$ and $B$ become constant for $x \geq w_2 + k$, it follows from $B(w^*+k,k) > T(w^*+k,k) - r$ that the two functions do not intersect for $x > w^* + k$ either. Since $B$ lies above $T - r$ for all $x$, there is no solution to the problem of $\max_x B(x,k)$ subject to $B(x,k) \leq T(x,k) - r$. Q.E.D.

We can explain the intuition behind Proposition 4.1 as follows. In competing for the loan business, intermediaries strive to maximize the profits of the entrepreneurs subject to their own participation constraint that the loan return is at least $r$. The highest return on the loan to an entrepreneur with collateral $k$ is $k + t^* - k^*$, achieved by the maximum default contract with face value $w^* + k$. Entrepreneurs with too little collateral ($k < r + k^* - t^*$) do not get loans because there is no way for the intermediary to make non-negative profits from a loan to these entrepreneurs. For all entrepreneurs with adequate collateral ($k \geq k^* + r - t^*$), since the expected payment $P$ from the entrepreneur decreases with the face value of debt $x$, competition among intermediaries means that the face value of debt will be the lowest that allows the intermediaries to break even. Thus, the participation
constraint of the intermediaries always binds. For entrepreneurs with intermediate values of collateral \((k^* + r - t^* \leq k < r - w_1)\), the participation constraint binds at a point where the probability of default is strictly between 0 and 1. (This is the case depicted in Figure 2.) Note that for the lowest collateral value \(k = k^* + r - t^*\) in this range, the two functions \(B(x, k)\) and \(T(x, k) - r\) are tangent at \(w^* + k\), so that the competitive loan contract is the maximum default contract. For entrepreneurs who can provide sufficient collateral \((k \geq r - w_1)\), full collateralization is achieved: they pay back \(r\) to the intermediaries regardless of the realized output \(w\), which allows competitive intermediaries to just break even, and collateral values are so high that default will never occur.

Under the competitive loan contracts described by Proposition 4.1, the expected profits of entrepreneurs increase in collateral value \(k\). To see this, note that for the same loan contract, entrepreneurs with more collateral are less likely to default. This tends to reduce the monitoring expenses incurred by the intermediaries and increase the loan returns to them. Competition among the intermediaries then forces down the face value of debt, and allows the entrepreneurs to keep more of the project output. Formally, for the intermediate collateral values \(k \in (k^* + r - t^*, r - w_1)\), we can differentiate \(L(x_c(k), k) = r\) to get

\[
\frac{dx_c(k)}{dk} = \frac{-F(x_c(k) - k) - g f(x_c(k) - k)}{1 - F(x_c(k) - k) - g f(x_c(k) - k)}. \tag{4.2}
\]

Since \(x_c(k) < w^* + k\), equation (2.4) and Assumption 2.2 imply that the denominator in the above equation is positive. Thus, face value \(x_c(k)\) decreases with the collateral value \(k\), implying that the probability of default decreases and the expected profits to the entrepreneurs increase.

### 4.2. Competitive deposit rate

Since the expected profits of entrepreneurs increase in collateral value \(k\), the equilibrium deposit rate is associated with a cutoff collateral value and only those entrepreneurs with collateral values greater than the cutoff value obtain loans in equilibrium. To determine the equilibrium deposit rate and the cutoff value, we first characterize the cutoff collateral level as a function of deposit rate \(r\), or the demand function for loans. This is accomplished by combining Proposition 4.1 with the participation constraint of the entrepreneur. From
Proposition 4.1, the lowest collateral value that allows a competitive intermediary to break even is $k^* + r - t^*$, and the corresponding competitive contract is the maximum default contract. We distinguish two cases, depending on the deposit rate $r$.

For $r$ lower than $t^*$, we argue that the cutoff collateral value is precisely $k^* + r - t^*$. Recall that $k^*$ is the highest collateral value such that under the maximum default contract the entrepreneur makes non-negative profits. For deposit rate $r$ lower than $t^*$, we have $k^* + r - t^* < k^*$, so that the maximum default contract for collateral value $k^* + r - t^*$ allows a competitive intermediary to break even and the entrepreneur to make positive profits. The cutoff collateral value in this case must be $k^* + r - t^*$: if it were lower, intermediaries would not be able to cover the cost of capital (this is shown in Proposition 4.1); if it were higher intermediaries would deviate and make positive profits by offering the maximum default contract to the entrepreneurs who do not get loans. Note that for this portion of the demand function (i.e. $r < t^*$), the marginal entrepreneurs with the cutoff collateral value $k^* + r - t^*$ make positive profits.

For any deposit rate $r$ higher than $t^*$, we have $k^* + r - t^* > k^*$. The competitive contract given by (4.1) for entrepreneurs with collateral value $k^* + r - t^*$, which is the maximum default contract, would leave them with negative profits. In this case, the cutoff value $k$ is higher than $k^* + r - t^*$, and is determined by the entrepreneur’s participation constraint $B(x_c(k), k) = 0$.

We can now show that the demand function defined above is downward sloping. The part corresponding to $r < t^*$ is downward sloping: if the deposit rate is $r$, the cutoff collateral value is $k^* + r - t^*$, so a higher deposit rate means a higher cutoff and hence a lower demand for loans. The part corresponding to $r > t^*$ is downward sloping too: using equation (4.2), differentiating $B(x_c(k), k) = 0$ with respect to $r$ and noting that $x_c(k)$ also directly depends on $r$ through $L(x_c(k), k) = r$, we have

$$\frac{dk}{dr} = \frac{1 - F(x_c(k) - k)}{gf(x_c(k) - k)},$$

Note that the demand function is continuous at $t^*$. For the part corresponding to $r \leq t^*$, the cutoff $k$ is equal to $k^*$ at $r = t^*$. For the part corresponding to $r \geq t^*$, at $r = t^*$ the entrepreneur’s participation constraint $B(x_c(k), k) = 0$ is satisfied for $k = k^*$ and $x_c(k) = w^* + k^*$, so the cutoff $k$ is also equal to $k^*$. 

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which is positive. Thus, a higher deposit rate $r$ means a higher cutoff collateral value $k$ that satisfies $B(x_c(k), k) = 0$ and hence a lower demand for loans.

The deposit rate $r_c$ and the cutoff collateral value $k_c$ in the competitive equilibrium can be then jointly determined by the intersection of the supply function $S(r)$ and the demand function characterized above. Since both the demand and supply functions are continuous and monotone, a unique crossing of these two functions exists if supply exceeds demand at the highest deposit rate and demand exceeds supply at the lowest rate. Sufficient conditions are easy to find. The highest deposit rate at which there is a positive demand for loans is $\overline{w}$. Recall that the sum of the expected loan return and the entrepreneur’s profit is at most $\overline{w}$, when the probability of default is zero. For both the intermediary and the entrepreneur to break even when the deposit rate is $\overline{w}$, the collateral level has to be at least $\overline{w} - w_1$ so that default will never occur (see equation 4.1). The demand for loans at $r = \overline{w}$ is therefore $U(\overline{w} - w_1)$. The lowest deposit rate is 0, in which case any entrepreneur can afford a loan, so the demand is $U(k_1)$. Then, if $S(\overline{w}) > U(\overline{w} - w_1)$ and $S(0) < U(k_1)$, a competitive equilibrium exists and is unique.

The equilibrium deposit rate $r_c$ may be located on either of the two parts of the demand function. If $r_c \geq t^*$ (or equivalently $k_c \geq k^*$), marginal entrepreneurs with collateral $k_c$ make zero profits, while if $r_c < t^*$ (or equivalently $k_c < k^*$), marginal entrepreneurs earn positive expected profits. In the first case, the marginal entrepreneur with collateral $k_c$ earns zero expected profits. The entrepreneurs with lower collateral values do not get loans because the deposit rate $r_c$ is too high: there are no loan contracts which provide the competitive return $r$ to the intermediaries and make positive profits for these entrepreneurs. In contrast, when $k_c < k^*$, the marginal entrepreneur with collateral $k_c$ earns strictly positive profits. As in the case of monopolistic intermediation when $k_m < k^*$, there is a discontinuity in the expected profits of the entrepreneurs at the cutoff collateral value $k_c$: the entrepreneurs with collateral values just below $k_c$ are not financed even though the marginal entrepreneur obtains a loan and makes positive expected profits. The entrepreneurs with collateral just below $k_c$ would be willing to accept the loan contract for the marginal entrepreneur and promise part of the profits to the intermediaries. But the loan returns are already at their unconstrained maximum for the marginal entrepreneur.
There is no credible way to transfer the profits to the intermediaries due to the ex post monitoring problem.

5. Does Intermediary Market Structure Matter?

In the previous two sections we have analyzed two representative market structures of intermediation: monopoly and competition. In both cases, capital is allocated to entrepreneurs with sufficient collateralizable assets. There is a transfer of surplus from the monopoly intermediary to entrepreneurs as one moves from monopolistic intermediation to competitive intermediation. But besides this transfer of surplus, does intermediary market structure matter?

5.1. Comparison results

In this section we compare the performance of credit market under the two structures. Two variables are important in the comparison. One is the equilibrium deposit rate, since it determines the total amount of borrowing and lending in both cases. The other one is the schedule of the face value of debt, since the face value of debt in a loan contract determines the probability of default and hence the amount of goods produced in excess of resources consumed by costly monitoring. We will show below that the credit market performs unambiguously better under competitive intermediation than under monopolistic intermediation: under competition the deposit rate is higher and the total profits generated in each unit of loan contract are greater. We show how the monopoly distortions in terms of less lending and more bankruptcy arise from the monopoly’s market powers with the lenders and with the borrowers.

First, comparing the extent of savings mobilization under alternative market structures of intermediation, we have $r_m \leq r_c$ and $k_m \geq k_c$.

**Proposition 5.1.** Competitive intermediaries mobilize more savings than a monopoly intermediary does.
**Proof.** Consider the marginal entrepreneur with collateral $k_c$ under competition. If $r_m > r_c$, then $k_m < k_c$ so this marginal entrepreneur with collateral $k_c$ also gets funded under monopoly. There are two cases. In the first case, $k_c > k^*$ and $r_c > t^*$. Then, $B(x_c(k_c), k_c) = 0$. Since $k_c > k^*$ and the entrepreneur with $k_c$ gets a loan under monopoly, Proposition 3.1 implies $B(x_m(k_c), k_c) = 0$. In the second case, $k_c \leq k^*$ and $r_c \leq t^*$. Then, from Proposition 4.1, $x_c(k_c) = w^* + k_c$. From Proposition 3.1, since $k_c \leq k^*$ and the entrepreneur with $k_c$ gets a loan under monopoly, $x_m(k_c) = w^* + k_c$. In both cases, $B(x_c(k_c), k_c) = B(x_m(k_c), k_c)$, implying $x_c(k_c) = x_m(k_c)$ and thus $L(x_c(k_c), k_c) = L(x_m(k_c), k_c)$. Since $L(x_c(k_c), k_c) = r_c$ and $r_m > r_c$, we have $L(x_m(k_c), k_c) < r_m$, contradicting the optimality of loan contracts under monopoly. Q.E.D.

The intuition behind the above proof is simple. If under monopoly the deposit rate is higher and more entrepreneurs get loans, then the last entrepreneur to get a loan under competition is also funded under monopoly. Since competitive intermediaries always make zero-profits, the monopoly intermediary makes negative profits on the loan to this marginal entrepreneur due to a higher deposit rate, which is impossible. The above proof makes this argument formal by showing that this last entrepreneur would be funded with the same loan contract under monopoly and under competition.

The result that competitive intermediaries mobilize more savings than a monopoly intermediary may not seem surprising. After all, under-production distortions are often associated with monopolies. However, the monopoly intermediary in our model is a not a usual one because it has monopoly power over both the borrowers and the lenders. Are the monopoly distortions in mobilizing less savings the result of monopoly power in the loan market or in the deposit market? The above reasoning suggests that the distortions arise from the monopoly power in the deposit market. The basic point is that marginal entrepreneurs in both cases have the same form of loan contract, and monopoly mobilizes less savings because the cost of capital for the monopoly is higher than that for competitive intermediaries. For the monopoly intermediary, the cost of raising an additional unit of capital in the deposit market is $r + S(r)/S'(r)$ when the deposit rate is $r$ (equation 3.2), instead of the deposit rate itself faced by competitive intermediaries. When the savings
function \( S(r) \) is perfectly elastic, the cost of capital is the same for the monopoly and for competitive intermediaries. In this case, monopoly intermediary will mobilize the same amount of savings as competitive intermediaries. More generally, greater elasticity of the savings function \( S(r) \) reduces the monopoly distortions in terms of less lending.

The next result demonstrates monopoly distortion in each loan contract granted. Comparing the face value of debt for entrepreneurs with any fixed collateral value \( k \), we have \( x_m(k) \geq x_c(k) \).

**Proposition 5.2.** For entrepreneurs with any fixed collateral value who obtain loans under alternative market structures, default rates are higher under monopoly than under competitive intermediation.

**Proof.** By Proposition 5.1, any entrepreneur with collateral \( k > k_m \) is also funded under competition. There are two cases. In the first case, \( k > k^* \). Then, by Proposition 3.1, \( B(x_m(k), k) = 0 \). In contrast, Proposition 4.1 implies that under competition all entrepreneurs that obtain loans earn non-negative expected profits, implying \( x_c(k) \leq x_m(k) \). In the second case, \( k < k^* \). Then, by Proposition 3.1, \( x_m(k) = w^* + k \). But under competition, \( x_m(k) \leq w^* + k \), with strict inequality except for the marginal entrepreneur with collateral \( k_c \). Thus, \( x_c(k) \leq x_m(k) \). In either case, default rates are lower under competition for each \( k \) above \( k_m \).

The intuition behind Proposition 5.2 can be simply stated as follows. Raising the face value of debt in the loan contract necessarily increases the expected payment to the intermediary. Under competition the loan contract minimizes the expected payment subject to the zero-profit condition of intermediaries, while under monopoly it maximizes the expected payment subject to the monitoring cost incurred by the intermediary and participation of the entrepreneur. Thus, the face value of debt is higher under monopoly than under competition. Higher face value of debt under monopoly implies higher default rates for each collateral value.

Comparing Propositions 3.1 and 4.1, we see that the monopoly distortion in terms of greater default rates for each loan granted varies across entrepreneurs with different
collateral values, and it is the greatest for entrepreneurs with little collateral. Indeed, for entrepreneurs with enough collateral (greater than $\bar{w} - w_1$) full collateralization is achieved and default rate is zero under both monopolistic and competitive intermediation. The reasons for monopoly distortion in more bankruptcy do not depend on the monopoly’s market power with lenders as represented by the elasticity of savings function. Monopoly’s distortions in higher bankruptcy rates arise solely from its market power with borrowers.

A common belief is that competition among intermediaries leads to higher bankruptcy rates (Winton, 1997, and Yosha, 1997). This is the case when one focuses on the failure rates of the intermediation sector, as in Matutes and Vives (2000). These results have led to the suggestion that regulatory policies limit “excess competition”, for example by introducing a ceiling on deposit rates. Our result illustrates the opposite possibility of greater bankruptcy rates in an ex post monitoring model in which collateral can be used to reduce the value-at-risk for intermediaries.

5.2. Comparative statics

Propositions 5.1 and 5.2 can be used to compare impacts on the credit market when exogenous changes in the economy occur. We are particularly interested in different impacts on the credit market as available credit or the monitoring cost changes. These findings will be exploited later to derive implications to credit market liberalization.

First consider what happens when available credit increases as represented by an outward shift of the savings function $S(r)$. Under both monopolistic intermediation and competitive intermediation, there will be an expansion of credit to collateral-poor entrepreneurs.\footnote{The opposite scenario occurs when entrepreneurs with little collateral are squeezed out of the loan market first as loanable funds become scarce. This is what Holmstrom and Tirole (1997) call “flight to quality,” and our model provides an alternative explanation. In their model of intermediation, the monitoring problem is ex ante instead of ex post and entrepreneurs’ own capital is liquid but insufficient without outside funding. When outside capital becomes scarce in a credit crunch, entrepreneurs with little capital of their own lose funding because they have too little at stake and cannot credibly commit to proper management of their projects.} Under monopoly, a lower cutoff collateral value results, with no changes in the loan contracts for entrepreneurs who obtained loans before the expansion and thus no change in the default rate (see equation 3.1). Gains in loan businesses and profits are
absorbed by the monopoly intermediary. Under competition, a lower equilibrium deposit rate due to the credit expansion affects all loan contracts for entrepreneurs (see equation 4.1). The face value of debt decreases for each loan, and default rates fall across all entrepreneurs. Thus, while a monopoly intermediary internalizes the impact of a credit expansion, competitive intermediaries spread the impact throughout the market.

Next, consider the impact of changes in the monitoring cost $g$. Under both monopolistic and competitive intermediation, a reduction in the cost decreases the cutoff collateral value and increases the deposit rate, but the impact on bankruptcy rates is different. A smaller monitoring cost makes it profitable for a monopoly intermediary to extend credit to more entrepreneurs by increasing the deposit rate. However, since the monitoring expense is directly incurred by the intermediary, a cost reduction has no effect on the face value of debt, and hence no effect on bankruptcy rates (see equation 3.1). The benefits of the reduction of the monitoring expense accrue to the monopoly intermediary. In contrast, under competitive intermediation, not only more savings will be mobilized because a decrease in the monitoring cost moves the demand function to the right, but also all entrepreneurs that obtain loans in equilibrium will benefit from a smaller monitoring cost (see equation 4.1). Although the monitoring cost is directly incurred by the intermediaries, competition forces them to transfer the greater surplus to the entrepreneurs through lower face values of debt.

6. Implications to Credit Market Liberalization

In this section we discuss the implications of the model for credit market liberalization. By “liberalization” we mean introducing greater competition into the intermediation sector. The two market structures that we have considered in sections 3 and 4 can be thought of respectively as prototypes of an extremely concentrated credit market and of a completely liberalized market. The transition process from monopoly to competition is not modeled. Instead, we compare monopolistic and competitive intermediation, and try to infer about the transition process.

Credit market liberalization is an important part of economic reform in former centrally planned economies in Eastern Europe and in Asia. In China, for example, the
intermediation sector is still largely monopolized by the state. The country’s central bank (People’s Bank of China) controls the financing of all the state enterprises. The growing private sector has very little direct access to the vast savings by the Chinese people. In the wake of the East Asian financial crisis in 1997, the government has taken some steps to liberalize the intermediation markets, such as introducing limited financial autonomy to the central bank’s regional and functional branches. The result is increased competition among the branches for deposits and for lending opportunities. This should make the Chinese financial sector better prepared for the imminent membership in the WTO.

Even for developed economies, cross-border financial liberalization is far from being fully achieved. Despite general trading agreements that have largely eliminated trading barriers for goods, countries in continental Europe have traditionally protected their domestic intermediation sector from foreign investment. It was only very recently that large banks such as Deutsche Bank, Barclays, and Abbey National set up deposit-taking branch offices in Italy, Spain and France. Protective measures of the domestic intermediary sector have limited competition in the market. Rajan and Zingales (2001) find that “by most measures countries were more financially developed in 1913 than in 1980 and only recently have surpassed their 1913 levels.” After 1980 restrictions on capital flows were loosened in Japan, Western Europe and Scandinavia and the financial sector became less concentrated. The nascent European Monetary Union, with the almost complete removal for the first time of barriers to capital movements among the member countries, is finally introducing cross-border competition in the intermediation sector.

Financial market liberalization can be crucial to economic development.\(^{18}\) Economic development calls for efficient allocation of capital investment, but a heavily regulated financial intermediary market often becomes the development bottleneck. A monopolized intermediary creates distortions in less lending, limits entry of new entrepreneurs in the production sector and induces higher bankruptcy rates. These distortions are likely significant in economies with inelastic credit supply and high monitoring cost.\(^{19}\) The latter

\(^{18}\) Levine (1997) summarizes the relation between credit markets development and economic growth. Our results add to the list of the positive effects of developing credit markets on growth.

\(^{19}\) Since Harberger’s (1954) seminal contribution, economists have debated about the size of monopoly
is a common feature in the absence of an efficient financial intermediation sector. In our model, the monitoring cost includes both the auditing cost and the bankruptcy cost. In many developing countries, not only there is a lack of trained expertise in intermediation, but also auditing and bankruptcy procedures are not properly established, so that transaction costs are high. Reducing the monitoring cost is an important part of credit market reform in developing economies. However, our results suggest that efforts in reducing the monitoring cost may not result in reducing monopoly distortions of higher bankruptcy rates, if they are not combined with transforming the structure of the intermediary market. If the intermediary market remains monopolized, reduction in the monitoring cost would just enrich the monopoly intermediary, without reducing the bankruptcy rates.

6.1. Priority in liberalization policies

The comparison results in section 5 reveal that monopoly distortions in less lending and higher bankruptcy rates are due to the monopoly power with both lenders and borrowers, and therefore liberalization in the intermediation sector should eventually introduce competition for funds and competition for loans. However, suppose that liberalization cannot be achieved in the two fronts at once and a choice must be made as to whether to open up competition for lenders first or for borrowers first. Competition for funds can be introduced without eliminating the existing monopoly’s control of access to the borrowers by, for example, giving lenders access to international credit markets. On the other hand, competition for loans may be introduced by giving borrowers access to international credit markets, without affecting the domestic monopoly intermediary’s control of the access to the lenders. Then, which should be given the priority, tackling the monopoly’s market power with the lenders or with the borrowers?

Our comparison analysis allows us to make an informed judgment on the priority issue. Monopoly distortions in less lending arise from the monopoly power with lenders, distortions in manufacturing industries. Ignored in this literature are intermediary monopolies that extract rents from both borrowers and lenders.

\[20\] In China, for example, bankruptcy laws did not even exist for much of the reform era that started at the end of 1970’s.
while distortions in more bankruptcy arise from the monopoly power with borrowers. Which market power of the monopoly intermediary should be tackled with greater urgency depends on which type of distortions is more costly to economic development, which in turn depends on factors such as the comparison between the monopoly deposit rate and the international competitive rate, the credit supply elasticity, and the monitoring cost. Compare the full monopoly intermediary to an intermediary that has the sole access to entrepreneurs but has to pay depositors a competitive international rate. Giving the depositors access to the international credit market produces no effect in terms of increasing lending and reducing bankruptcy rates if the monopoly’s optimal domestic deposit rate is higher than the interest rate in the international market, which is a likely scenario for a developing country with a high return on capital investment. Even if the deposit rate in the international market is high, the effect may be small if the credit supply is relatively elastic, because in this case the monopoly distortions in less lending are small to begin with. On the other hand, if borrowers are given access to the international credit market, then low international interest rate implies that entrepreneurs can get good deals from the international loan market. The presence of international competitive intermediaries will force the monopoly to offer competitive loan contracts to the borrowers and reduce bankruptcy rates. These effects are greater if the monitoring cost is high, which is likely to be true in an economy without an efficient financial market.

6.2. Liberalization and interest groups

The comparison results in section 5 imply that intermediary competition generates higher investment and income by increasing lending and reducing bankruptcy, so financial liberalization can make all agents better off with appropriate redistribution. Then, why has the intermediation sector in many economies long been protected from competition?

If economy-wide redistribution policies are not feasible, credit market liberalization need not be Pareto-improving, and may face strong resistance. This is the case when the intermediation sector is a separate income entity since credit market liberalization means that the incumbent intermediaries lose monopoly rents. However, it can also occur if the intermediation sector is owned by depositors, a plausible scenario since intermediaries
can be viewed as delegated monitors for depositors. In this case, the economy has only two groups of agents, borrower-entrepreneurs and lender-depositors. Entrepreneurs are unambiguously better off with liberalization: for entrepreneurs who obtain loans from the monopoly intermediary, Proposition 5.2 implies that they will have more favorable contracts under competitive intermediation; for those who do not get loans, Proposition 5.1 implies that some of them will from competitive intermediaries. For lenders, the expected loan return to intermediaries represents the surplus on each unit of loan granted. Under competitive intermediation, the loan return is constant for all loans and equal to the deposit interest rate. Under monopolistic intermediation, the loan return first increases linearly with the collateral value, and continues to increase until all output is extracted. The monopoly intermediary squeezes entrepreneurs on each loan and transfer the surplus to depositors. However, the monopoly grants fewer loans than competitive intermediaries, so the surplus from all the loans can still be lower than under competitive intermediation.

Therefore, competitive intermediation may not Pareto improve on monopolistic intermediation: while entrepreneurs are unambiguously better off with competition, lenders may be either better or worse off. Lenders are more likely to be better off under monopoly if it does not reduce lending by too much relative to competitive intermediation, which can happen if credit supply is elastic. In such an economy credit market liberalization can face resistance from lenders because competition transfers the profits from the intermediation sector to entrepreneurs and makes depositors worse off.

Compared with liberalization in other sectors of the economy, liberalization of the intermediary market is often more difficult to achieve. In continental Europe, for example, not even the European Economic Community was able to open up the intermediary markets of the member countries to cross-border investments. Only the creation of a more powerful super-national entity as part of the process of the European Monetary Union seems to be finally working. The observation is that continental European countries have elastic domestic credit supply due to wide-ranging investment opportunities available to depositors, including well-developed government debt markets. This is consistent with our results and suggests that the difficulty of credit market liberalization may have been generated by its distributional implications.
References


