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Can Relationship Banking Survive Competition?

ARNOUD W. A. BOOT and ANJAN V. THAKOR*

ABSTRACT

How will banks evolve as competition increases from other banks and from the capital market? Will banks become more like capital market underwriters and offer passive transaction loans or return to their roots as relationship lending experts? These are the questions we address. Our key result is that as interbank competition increases, banks make *more* relationship loans, but each has lower added value for borrowers. Capital market competition *reduces* relationship lending (and bank lending shrinks), but each relationship loan has greater added value for borrowers. In both cases, welfare increases for some borrowers but not necessarily for all.

RAPID CHANGES IN FINANCIAL SERVICES ARE threatening commercial banks. In the United States, mutual funds such as Fidelity and Merrill Lynch compete for banks' core deposits. Investment banks, armed with a variety of financial market innovations, challenge banks' traditional lending products. Banks also find themselves in greater competition with one another as globalization and deregulation weaken geographic boundaries and encourage cross-border (Europe) and interstate (U.S.) banking.

These developments raise numerous fundamental questions. Will the relationship-oriented European bank system survive competitive pressures in this changing environment? Will U.S. banks focus more on "relationship banking"¹—whereby banks invest in building relationships with borrowers—on "transaction banking," which involves "arm's length" transactions rather

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¹ The benefits of such relationships are many, ranging from ameliorating project-choice moral hazard (Diamond (1991)) to more broadly restoring the desired behavioral incentives for borrowers which result from the bank's ability to sell promises to make (subsidized) credit available in the future (Boot, Greenbaum, and Thakor (1993)).

than relationships? What impacts the viability of relationship lending in an increasingly competitive environment, even if its form adapts to the evolving environment? How does the source of competition—interbank competition or competition from the capital market—affect the type of financing offered? Does the source of competition matter for borrower welfare?

These questions require careful analysis of the nature of relationship-specific finance and how it is affected by the changing nature of competition. Such an analysis is our goal. Existing theories provide a useful start; however, they fail to provide complete answers because they draw a sharp distinction between relationship and transaction lending, assigning the former to banks and the latter to the capital market. Banks are portrayed as providing screening (e.g., Allen (1990) and Ramakrishnan and Thakor (1984)), monitoring (e.g., Diamond (1984) and Winton (1995)), or liquidity transformation (e.g., Diamond and Dybvig (1983)), all of which are part of relationship banking. These relationships involve borrower-specific information available to only the bank and the borrower (e.g. Bhattacharya and Chiesa (1995) and Yosha (1995)). In contrast, the capital market—populated by investment banks and underwriters—is viewed as an arm's length provider of finance, focusing on transactions rather than relationships. In a sense, the difference between bank and capital market financing is similar to that between qualitative asset transformation (banks) and brokerage (financial market).² Indeed, this distinction has been used to describe a borrower's choice between bank and capital market financing (e.g., Diamond (1991), Rajan (1992), and Sharpe (1990)).

Although the distinction is incisive and theoretically convenient, the evolution of banking is making it blurred. Banks engage in *both* relationship and transaction banking. Moreover, how much of each the bank does is a matter of strategic choice, and is affected by technology, competition, regulation, and other factors. To make this choice, banks must examine their distinctive competitive edge.

We address these issues with a model in which there are banks and the capital market. Each bank can offer either a relationship or a transaction loan. A relationship loan adds more value to the borrower, but it also imposes a greater cost because it requires the bank to develop costly expertise to enable it to add value; we call this expertise "sector specialization." The bank begins by choosing its level of sector specialization. This determines the added value borrowers experience from a relationship loan, and this added value is decreasing in borrower quality. There is imperfect competition among banks that choose different levels of sector specialization because they have different costs of acquiring this specialization. At the next stage, after observing the types of borrowers it faces, each bank determines how to allocate its fixed lending capacity between relationship and transaction lending. There is also competition from the capital market, where investment banks underwrite bonds.

² See Bhattacharya and Thakor (1993).

Capital market underwriting is a close cousin of transaction lending by banks and thus competes most directly with it. But it also competes indirectly with relationship lending. We examine the effect of interbank and capital market competition on the bank's choices of sector specialization and whether to engage in relationship or transaction lending.

Before describing the details of the model, we sketch the intuition. Suppose we start with a situation in which the bank faces no competition from either banks or the capital market. The (monopolist) bank makes relationship loans to low- and intermediate-quality borrowers since it captures all the rents from the incremental value these loans add for borrowers relative to transaction loans. However, there are borrowers of sufficiently high quality for whom relationship lending adds little value and does not warrant the additional cost to the bank. These borrowers receive transaction loans from the bank.

When interbank competition is introduced, the first effect is that banks' marginal rents from relationship lending are smaller; each bank thus reduces its investments in sector specialization. This result is consistent with the existing wisdom that, by threatening relationships, competition reduces relationship-specific investments (see Harris and Holmstrom (1982)).

Although this effect is important, there is more to the story. Interbank competition affects the bank's profits from *both* relationship and transaction lending, but *asymmetrically*. A relationship orientation helps to partially insulate the bank from pure price competition, so that an increase in competition from other banks hurts the bank's profits from transaction lending more than its profits from relationship lending. Thus, interbank competition encourages banks to shift from transaction to relationship lending, and banks do more transaction lending in a noncompetitive banking industry than in a more competitive environment. We combine this result with that of the reduction in sector specialization to conclude that the *nature* of relationship lending itself changes with increasing interbank competition; relationship lending becomes more important but each loan has less added value.

Surprisingly, capital market competition produces a diametrically opposite effect on relationship lending and investments in sector specialization. Such competition lowers banks' *ex ante* rents from lending, which reduces entry into banking. The consequent reduction in interbank competition results in lower relationship lending but with greater bank investments in sector specialization.

For borrower welfare, there is thus an important difference between increasing competition among banks and increasing competition from the capital market. Greater interbank competition, by reducing banks' sector specialization investments, makes banks more like one another. In contrast, whenever the capital market becomes more competitive vis-à-vis banks, banking rents decrease and entry into banking declines. This is a case in which the overall financial system is more competitive, but with

fewer banks.³ The result is a drop in relationship lending, but a greater differentiation among banks due to higher investments in sector specialization by banks. In both cases, borrowers of intermediate and high quality are unambiguously better off, whereas the low-quality borrowers may be either better off or worse off.

Our paper is related to the vast literature on oligopolistic rent generation through product differentiation. There are three relevant strands of this literature. One involves spatial models (e.g., Salop (1979)), which predict that competition often produces excessive variety. Another strand focuses on monopolistic competition (e.g., Spence (1976) and Dixit and Stiglitz (1977)), where the equilibrium may entail too much or too little variety. In both approaches, consumers' heterogeneous preferences result in different reservation values for the different brands of the product being produced.⁴ This is different from the problem we study, in which borrowers with identical linear preferences have different credit risks, and the focus is on banks' decisions about the allocation of lending service capacity across two different types of products and choices related to sector specialization.

The third strand deals with *ex post* rent generation in banking relationships. Sharpe (1990) and Rajan (1992) show that private information produced during a bank-borrower relationship can create *ex post* monopoly rents for the bank, and thus affect loan pricing and investment efficiency over the duration of the relationship. The focus in these papers is primarily on intertemporal taxes and subsidies in loan pricing, but Petersen and Rajan (1995) also discuss the effect of competition on relationship lending, concluding that greater competition reduces banks' lending rents and hence decreases relationship lending. Our analysis shows that this result depends critically on banks engaging only in relationship lending. When banks can do *both* relationship and transaction lending, a *substitution effect* arises across these two forms of lending. Depending on the source of the increased competition—from other banks or from the capital market—the substitution effect could lead banks to invest *more* in relationship lending because such lending provides better insulation against pure price competition.

The rest of the paper is organized as follows. Section I contains the model, Section II the initial analysis, and Section III additional results. Section IV takes up welfare issues. Section V discusses model extensions, robustness issues, and empirical implications. Section VI concludes. Proofs are in the Appendix.

³ The current global trends in the financial services industry reflect this, although those trends also include a reduction in the number of banks through consolidation, which we do not model.

⁴ Deneckere and Rothschild (1992) provide a unifying treatment, and Tirole (1988) presents a survey. Bagwell and Riordan (1991) and Shapiro (1982) show the profitability relevance of a quality attribute in products, but do not consider competition.

I. The Model

A. General Remarks and Motivation

There are four major players in the model: commercial banks, investment banks/underwriters, borrowers, and depositors/investors. In this subsection we motivate the roles we ascribe to these players.

Commercial Banks: Traditionally, commercial banks (banks henceforth) have held nonmarketable/ illiquid assets funded largely with deposits. There is typically little uncertainty about the value of these (core) deposits, which are often withdrawable on demand. This deposit liquidity is achieved through a combination of the qualitative asset transformation services provided by banks and the regulatory safety nets such as deposit insurance and the lender of last resort role of the central bank.

The regulatory safety net means that depositors face little risk, regardless of the bank's financial health. Consequently, the bank's deposit supply depends on the overall availability of deposits in its operating area. In combination with the fact that the bank's branches provide it with ready access to deposits, this means that the bank can obtain the deposits it needs without incurring search costs. The expected cost of these deposits will be the riskless rate plus an add-on reflecting the cost of bank regulations that come with the regulatory safety net.⁵

The liquidity of bank deposits stands in sharp contrast to the illiquidity of bank assets. These assets are illiquid largely because of their information sensitivity. In originating and pricing loans and monitoring borrowers, banks acquire information about the loans that inhibits their marketability.⁶ However, the illiquidity also encourages banks to invest in developing enduring relationships with borrowers, to make long-term commitments,⁷ and to restructure the debt contracts of borrowers in financial distress.⁸ These qualitative asset transformation activities generate a surplus that the bank and the borrower can share. This surplus may take the form of enhanced expected payoffs from projects the borrower finances with bank loans. The increase in project payoffs makes relationship-oriented bank lending special relative to capital market debt. In our model, we introduce the benefits of relationship finance by allowing a bank to *specialize* in specific sectors. We thus define a *relationship loan* as a loan that permits

⁵ This should be thought of as a cost that goes beyond the deposit insurance premium. This includes the cost of complying with regulations imposed on insured banks, such as the Community Reinvestment Act.

⁶ See James (1987), Lummer and McConnell (1989), and Shockley and Thakor (1997) for empirical evidence.

⁷ Mayer (1988) and Hellwig (1991) discuss the commitment nature of bank funding.

⁸ Dewatripont and Maskin (1995) suggest that banks impose a "soft" budget constraint on the borrower—that is, they are more willing than the capital market to renegotiate with a financially distressed borrower.

the bank to use its expertise to improve the borrower's project payoff.⁹ The extent of the payoff improvement depends on the bank's sector-specific expertise.

We note here two points. First, to engage in meaningful relationship lending, the bank will need expertise in specialized sectors. This sector specialization is costly and is a choice variable for the bank. Second, our definition of relationship lending does *not* preclude nonbanks. For example, venture capitalists, possessing professional expertise in specialized fields, also engage in relationship financing when they fund start-up firms. This view of relationship lending is consistent with the empirical findings of Carey, Post, and Sharpe (1998) that banks are not unique in serving information-sensitive borrowers.

As an alternative to relationship loans, the bank could make transaction loans. A transaction loan is a pure funding transaction, a "commodity product" with none of the sector-specific investments connected with relationship lending. A good example of this is mortgage lending where the bank acts as an originator and then securitizes the loans. We assume that with transaction lending, the borrower's expected project payoff is unaffected by the bank's participation. Thus, in this capacity, the bank is a pure broker, a role similar to that of the underwriter which we describe next.

Investment Banks / Underwriters: The investment bank helps the borrower to access public capital markets by underwriting its debt issue. Thus the investment bank/underwriter (underwriter henceforth) acts as a broker, matching buyers and sellers for securities. However, despite the transaction-oriented nature of this activity, the underwriter's role differs from that of a commercial bank making a transaction loan since the underwriter does not have federal deposit insurance and cannot obtain elastically supplied funds. The underwriter must incur search costs and use its network of contacts to locate investors with the highest valuations for the firm's securities.¹⁰ We assume that this introduces randomness in the firm's cost of funding, since this cost depends on the realized demand for the firm's securities.

⁹ Relationship lending can enhance the borrower's project payoff in various ways. For example, a bank could provide additional financing to a liquidity-constrained firm after gaining inside information about the firm. This financing may come via a loan commitment, with an accompanying enhancement in the borrower's payoff. In Shockley (1995) this payoff enhancement comes about because the commitment increases the firm's optimal debt-equity ratio. Another example is the payoff-increasing restructuring of the debt of a financially distressed borrower by a lowering of its near-term repayment obligation in exchange for a higher repayment later (Petersen and Rajan (1995)). A third example is a small-business bank loan in an industry in which the bank holds other loans. The bank may know more about where the industry is headed than any of its borrowers in that industry because it knows something about what *each* of them intends to do, whereas none of them know that much about their competitors' plans. Even without violating borrower confidentiality, the bank could give each borrower valuable advice about product pricing, inventory planning, and capital budgeting, and thereby improve payoffs.

¹⁰ Ross (1989) points out that too little attention is paid to *marketing* of financial claims in the finance literature. Madan and Soubra (1991) explicitly model search/marketing costs.

One way to think about the difference between bank lending and underwriting is that these are two different modes of funding *and* investment.¹¹ In the first mode, the lender (venture capital fund, commercial bank, or finance company) raises money *in advance*, storing any excess in Treasuries and other liquid instruments. The lender reassures investors that it will do a good job by maintaining capital, diversifying its assets, and accepting covenants or regulatory oversight—all of which increase its cost of funds. This allows it to use the funds as needed to make and hold loans, possibly also achieving relationship advantages. In the second mode, the underwriter tries to convince investors that a *particular issue* is not a lemon, and then sells the issue, giving up direct control over the borrower. Viewed this way, the difference between bank lending and underwriting is not tied to insured core deposits per se.

Borrowers: We model borrowers in the usual fashion. Each borrower has a publicly observable credit attribute—say its credit rating—and can invest in a project for which it needs financing. This financing can be raised either from the capital market or from a bank. A borrower who chooses to go to a bank will receive either a relationship loan or a transaction loan.

Depositors/Investors: We model depositors and investors as risk neutral agents who demand an expected return at least equal to the riskless rate. They purchase corporate debt in the capital market and invest in bank deposits for investment purposes.

B. Model Details

Preferences and Time Line: There is universal risk neutrality, with r_f representing the riskless interest factor (one plus the riskless interest rate). There are four dates, $t = 1, 2, 3, 4$. At $t = 1$, banks choose their sector-specialization parameter γ . At this stage a bank does not know the quality of the loan portfolio it will service with this capacity and borrowers do not know the bank's γ 's. Underwriters determine at this time whether they want to underwrite corporate debt in the capital market.

At $t = 2$, borrowers decide whether to borrow in the capital market or from banks. Each borrower who chooses bank borrowing is stochastically matched with a bank, which subsequently observes the "quality" (we will define this when we describe borrowers) of its borrower pool. The bank then decides whether to use its service capacity for relationship lending or transaction lending, and the borrower observes the bank's γ . Similarly, if borrowers choose capital market funding, underwriters search for investors to sell securities to at $t = 2$. The demand for these securities is random, and each borrower's funding cost depends on the actual demand realization.

At $t = 3$, loans are made by banks and security sales are completed by underwriters. Finally, at $t = 4$, payoffs on loans are realized and banks/investors are paid off in accordance with contractual stipulations and project payoff realizations. These are shown in Figure 1.

¹¹ We thank the referee for suggesting this.

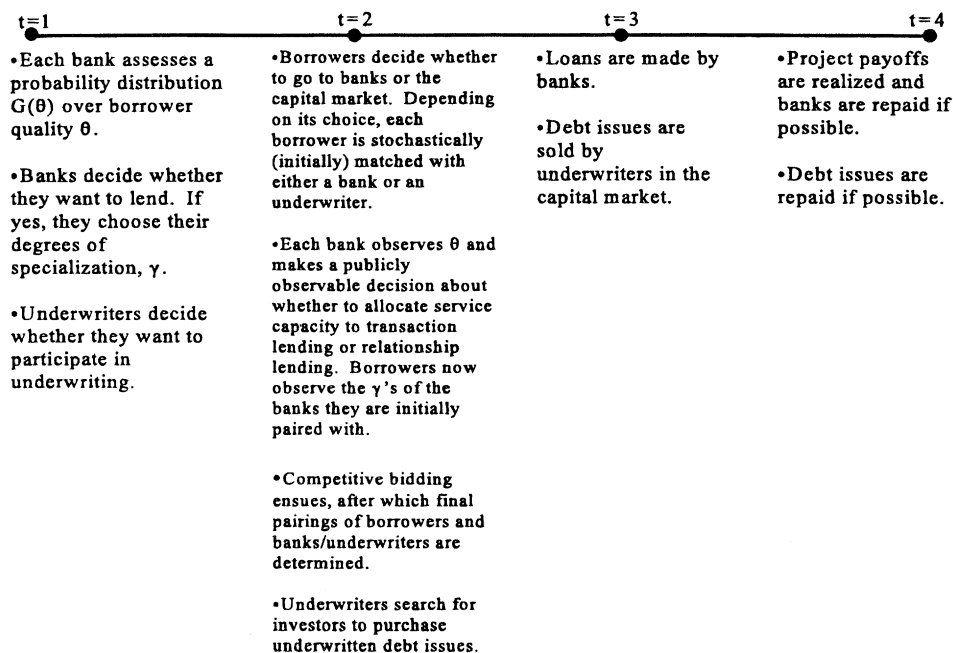


Figure 1. Sequence of events.

Types of Securities: All securities are unsecured loans (banks) or unsecured corporate debt (market).

Borrowers: A borrower needs a single-period loan of \$1 to finance a project. With either transaction lending by a bank or capital market borrowing, the payoff on the project is Y with probability (w.p.) $\theta \in (0, 1)$ and 0 w.p. $1 - \theta$. With a relationship loan, the payoff is Y w.p. $\theta + v_i [1 - \theta]$ and 0 w.p. $[1 - \theta][1 - v_i]$, where $v_i \in (0, 1)$ is a variable that depends on the bank's "type" i , which represents the sector specialization of the bank. Each borrower's θ is common knowledge. Think of θ as the borrower's "credit reputation" or "credit rating." Cross-sectionally, $\theta \in [\underline{\theta}, \bar{\theta}]$, with $\underline{\theta}$ sufficiently high to make lending to these borrowers viable. $G(\cdot)$ represents the probability measure of θ .

Depositors/Investors: Banks can obtain completely-insured deposits at an expected all-in cost (interest factor) of $r_d > r_f$; the relationship of r_d to r_f is derived later. Underwriters, however, must search for investors. The total supply of securities that the underwriter is selling in the market is \$1 as before. Let the demand, $\bar{D}$, for these securities be random with a uniform density function with support $[0, D^+ \theta [1 - \theta]^{-1}]$, where $D^+ > 0$ is a finite-valued positive scalar. If $\bar{D} \geq \$1$, then the underwriter can raise the desired funds at $r_f \theta^{-1}$. If $\bar{D} < \$1$, then the funding cost is $r_f \theta^{-1} + \tau$, where $\tau > 0$ is a "penalty cost." We can view τ as (one plus) the additional return that must be promised to investors to induce them to buy the securities when the initial demand falls short of what is being offered for sale. These

could be investors whose security valuation (or their reservation price) is such that their demand is zero if the expected return is less than $r_f + \tau\theta$ and perfectly elastic if it is $r_f + \tau\theta$ or greater. The assumed density function of $\tilde{D}$ is such that the upper endpoint of its support shifts to the right as θ increases (note $\partial D^+ \theta [1 - \theta]^{-1} / \partial \theta > 0$). Thus, the probability that demand will fall short of the supply of the security is decreasing in θ , the idea being that it is easier to find investors for higher quality issues.

Banks: Each bank starts out with a lending capacity of \$1 and makes two decisions: one about the degree of sector specialization for its relationship loans, and the other about the allocation of its lending capacity across relationship and transaction lending.

The bank's sector-specialization decision determines its "effectiveness" in relationship lending. We model this as a costly investment by the bank at $t = 1$. This cost is captured by the function $\bar{C}_i(\gamma) = \mu_b(\theta)C_i(\gamma)$, where $\mu_b(\theta)$ is a function that depends on the measure of the set of borrower θ 's served by banks with relationship loans, $\gamma \in (0,1)$ is the degree of sector specialization, and $C_i(\gamma) \geq 0$, with $C_i' > 0$, and $C_i'' > x$ (for x sufficiently large). The function $\bar{C}_i(\gamma)$ varies in the cross section of banks, so that banks choose potentially different values of γ , and we assume that each bank learns its cost function only after it enters the banking industry. Moreover, $\bar{C}_i(\gamma)$ depends also on how many borrower types are served, which captures the idea that the diversity of borrower types served by the bank affects the cost of specializing in serving borrowers.

We assume that a bank choosing $\gamma = \gamma_i$ enhances the borrower's success probability by $v_i = v_L + \gamma_i[v_H - v_L]$, with $v_H > v_L$. Thus, if a bank chooses not to specialize at all ($\gamma_i = 0$), then $v_i = v_L$.

The second decision has to do with the allocation of the bank's lending capacity. The bank decides whether to allocate its capacity to relationship loans or transaction loans. This decision is made at $t = 2$ after the quality, θ , of the borrower pool becomes publicly known. In addition to the sector specialization cost $\bar{C}_i(\gamma)$, relationship lending involves a variable cost of $S > 0$ per loan for the bank. That is, the bank incurs a higher processing cost for each relationship loan. It should be clear that a bank will choose a positive level of sector specialization only if the potential benefit of a relationship loan exceeds the variable costs S . We assume throughout that

$$S < v_L[1 - \theta]Y. \quad (\text{R1})$$

Restriction (R1) means that relationship loans are feasible for all γ , and even if $\gamma = 0$ the incremental value added by a relationship loan exceeds the cost for at least the lowest-quality borrower.

Underwriters: Underwriters face a random demand $\tilde{D}$ for a firm's securities in the capital market. We view the "penalty cost" τ as a measure of underwriting efficiency or reputation; a lower τ means that underwriters search more efficiently for investors when initial demand is below supply.

Competitive Environment: Banking is imperfectly competitive. A bank prices its loans knowing that, even without competition from other banks, it can lose the borrower to the capital market. This allows us to capture the impact of capital market competition on bank loan pricing.

We endogenize N , the number of banks in the economy, and this determines the degree of competition among banks. Each bank faces a cost $E > 0$ for entering into the banking business. Competition among banks works along the following dimensions. First, the number of banks affects the probability that a particular bank will transact with a borrower. Second, a borrower who has received an offer from one bank can receive a competing offer from a second bank. The probability of receiving a competing offer is $q(N) \in (0, 1)$,¹² with $dq(N)/dN > 0$. When such an offer is received, the borrower knows the γ 's of the incumbent bank as well as of the competing bank. Hence, N and $q(N)$ reflect the degree of interbank competition—higher values of N (and q) mean more competition.¹³

Underwriting could be modeled along similar lines. However, because our focus here is on the banking sector, we have fixed the competitive structure of the underwriting industry. An analysis of the underwriting industry along the lines of banking is discussed in Section V.A.

The competitive structure is such that the pricing of loans is anchored by prices available in the capital market. That is, regardless of the degree of competition in banking, no borrower can receive an expected payoff net of funding cost that is less than what the capital market could offer.

A remark on the aggregate demand for and supply of loans is in order. To simplify, we normalize aggregate loan demand to \$1, with all loans realizing the common borrower pool quality θ at $t = 2$. We also assume that, conditional on borrowers realizing a quality θ such that it is optimal for them to seek bank financing, all of the initial loan demand from these borrowers will come to one bank. Because all banks are observationally identical to borrowers who choose to go to banks, this means each bank has a probability $1/N$ of receiving all of the initial loan demand. Given the probability q that a borrower successfully elicits a competing offer from a second bank, the probability is $1/[N - 1]$ that a bank that did not see any

¹² Strictly speaking, this is the probability that *at least* one competing second offer will be received. If multiple banks come forward with competing offers, then we assume, without loss of generality, that the bank that ends up competing with the first bank is the one with the highest γ from among the banks that come forward. This allows us to keep the analytical structure that there is only one competing second bank. What we have in mind is a situation in which there are N banks, one of which is the initial recipient of loan demand from the borrower pool. The probability of a randomly chosen bank being this recipient is $1/N$. At the next stage, there is a probability $\hat{q} \in (0, 1)$, exogenous and independent of N , that a randomly chosen bank other than the initial recipient of the loan demand will be able to bid for the borrower pool's business. Thus, the probability that at least one other bank will make a competing second bid for the borrower's business is $q(N) \equiv q(N, \hat{q})$, which is a function of both N and $\hat{q}$. As an illustration, note that $q(1, \hat{q}) = 0$, $q(2, \hat{q}) = \hat{q}$, $q(3, \hat{q}) = 2\hat{q} - \hat{q}^2$, and so on.

¹³ Besides $dq(N)/dN > 0$, we assume that $d(q(N)/N)/dN < 0 \forall N \geq 2$, and $\lim_{N \rightarrow \infty} q(N) = 1$, $\lim_{N \rightarrow 1} q(N) = 0$.

initial loan demand will be approached for a counteroffer. Because each bank has \$1 in lending capacity, it is able to accommodate loan demand if it needs to meet this demand.

II. The Initial Analysis

A. Events at Date $t = 4$

Using backward induction, we begin at $t = 4$. However, what happens then is not important for the analysis in previous periods because the repayment to the bank/investors is based on the borrower's projected payoff, which is determined purely stochastically, and not on a strategic choice by the borrower. For simplicity, we assume that at $t = 4$ the bank also pays its fairly priced deposit insurance premium.

B. Events at Date $t = 3$

At this date, the bank makes its loans and the underwriter completes raising the funds for the borrowers whose debt issues it has taken to the market. In the case of bank financing, because deposits are completely insured, the promised interest factor is r_f . With transaction lending, the actuarially fair deposit insurance premium equals $[1 - \theta]r_f/\theta$, and the bank's expected all-in funding cost is

$$\theta \left[r_f + \frac{[1 - \theta]r_f}{\theta} \right] + \text{add-on reflecting regulatory costs} = r_f + \text{add-on} = r_d.$$

With relationship lending, r_f obtains as well with the deposit insurer observing the bank's success probability $\theta + v_i[1 - \theta]$ and conditioning the insurance premium on this probability. This makes the bank's *expected* funding cost independent of θ and precludes deposit-insurance related moral hazard.

In the capital market, an underwriter will be able to raise funds at r_f/θ when $\tilde{D} \geq \$1$ and at $r_f\theta^{-1} + \tau$ when $\tilde{D} < \$1$. The borrower's expected capital-market funding cost is

$$\begin{aligned} & \theta \left\{ \int_0^1 [r_f\theta^{-1} + \tau] \times \frac{1}{D^+ \theta [1 - \theta]^{-1}} dD + \int_1^{D^+} [r_f\theta^{-1}] \times \frac{1}{D^+ \theta [1 - \theta]^{-1}} dD \right\} \\ &= r_f + \frac{\tau[1 - \theta]}{D^+} \\ &= r_f + A[1 - \theta] \quad \text{where } A \equiv \tau/D^+. \end{aligned} \tag{1}$$

Throughout, when we talk about the capital market becoming more competitive (vis-à-vis banks), we are referring to a lowering of A . In the analysis we will assume that

$$A[1 - \theta] > r_d - r_f. \tag{R2}$$

The restriction (R2) ensures that there may be *some* borrowers who choose not to go to the financial market because the expected funding search costs in the capital market $A[1 - \theta]$ are too high relative to the additional cost of bank financing $[r_d - r_f]$.

C. Events at Date $t = 2$

The key aspect of events at this date is the bank's choice of allocation of its capacity to relationship versus transaction lending, taking as *given* banks' choices of sector specialization γ , the number of competing banks N , and the pricing available in the capital market. To analyze an individual bank's service capacity allocation choice, we need to characterize the rents the bank can earn on relationship loans (denoted by RR) relative to the rents it can earn on transaction loans (denoted by TR).

How are these rents determined? Consider transaction loans first and suppose, for the moment, that the bank is a monopolist, constrained only by competition from the capital market. Then, the bank will charge the borrower an interest rate on its transaction loan that will leave the borrower indifferent between capital market borrowing and obtaining a transaction loan from the bank. The borrower's expected payoff from capital market financing is (see equation (1))

$$\theta Y - r_f - A[1 - \theta]. \quad (2)$$

If it borrows from the bank, the borrower must cover the bank's funding cost and also pay the bank a rent of TR in expectation. Thus, the expected payoff is

$$\theta Y - r_d - \text{TR}. \quad (3)$$

The borrower is indifferent between the bank and the market when equations (2) and (3) are equated:

$$\text{TR}(\theta) = A[1 - \theta] - [r_d - r_f]. \quad (4)$$

Thus, on a borrower of quality θ , the monopolist bank can earn a rent of $\text{TR}(\theta)$ on a transaction loan.

Consider now a relationship loan. The monopolist bank can determine its rent RR in such a way that the borrower is indifferent between a relationship loan and a transaction loan. The borrower's expected payoff with a relationship loan is

$$[\theta + v_i\{1 - \theta\}]Y - r_d - \text{RR} - S, \quad (5)$$

where we recognize that the borrower must bear not only r_d but also the bank's cost of servicing a relationship loan, S , and the rent RR . We are assuming here that transaction loans are viable for all $\theta \in [\theta, \bar{\theta}]$. Equating equations (3) and (5) yields

$$RR(\theta, \gamma_i) = TR(\theta) + v_i Y[1 - \theta] - S. \quad (6)$$

With competition, the bank cannot extract the full amount of the surplus described in equation (4) or (6). Let $\hat{TR}(\theta, q)$ be the surplus from a transaction loan to a borrower of quality θ when the degree of interbank competition is q , and let $\hat{RR}(\theta, q, \gamma)$ be the rent the bank with specialization γ can earn on a relationship loan to a borrower of quality θ with interbank competition q . We assume that the first bank with sector specialization γ competes with banks whose γ 's are distributed according to the density function $f(\gamma)$, and $f(\bullet)$ is uniform over $(0, 1)$.¹⁴

If the first bank has offered a transaction loan to the borrower, then it earns at best only zero rents if the borrower locates a second, competing bank. Because this happens with probability q , we have

$$\hat{TR}(\theta, q) = [1 - q]TR(\theta). \quad (7)$$

The rent $RR(\theta, \gamma_i)$ on a relationship loan is exposed to imperfect competition even if the borrower finds a second bank. To see this, use equation (6) to write this rent for a bank with specialization γ :

$$RR(\theta, \gamma) = TR(\theta) + \{\gamma v_H + [1 - \gamma]v_L\}Y[1 - \theta] - S, \text{ or}$$

$$RR(\theta, \gamma) = TR(\theta) + v_L Y[1 - \theta] - S + \gamma[v_H - v_L]Y[1 - \theta]. \quad (8)$$

The introduction of interbank competition q completely exposes the "generic" rents $TR(\theta)$ and $\{v_L Y[1 - \theta] - S\}$, conditional on the borrower finding a second bank. The specialization rents $\gamma[v_H - v_L]Y[1 - \theta]$ are not exposed to the same extent to this form of competition. That is, if the borrower finds a second bank, a first bank with specialization parameter γ_o could preserve

$$\int_0^{\gamma_o} [\gamma_o - \gamma][v_H - v_L]Y[1 - \theta]f(\gamma) d\gamma = \gamma_o^2[v_H - v_L]Y[1 - \theta]/2$$

¹⁴ The cross-sectional distribution of γ 's depends on the bank-specific specialization costs $\bar{C}_i(\gamma)$. We assume that the cross-sectional (across i) distribution of $\bar{C}_i(\cdot)$ is such that it yields choices of γ that are cross-sectionally distributed according to a uniform density over $(0, 1)$.

of its rents. Since the probability that a second bank will appear on the scene to compete is q , the expected rent for a bank with specialization γ will equal $\{q[\gamma^2/2] + [1 - q]\gamma\}[v_H - v_L]Y[1 - \theta]$. Henceforth, we will use the definition $\bar{\gamma} \equiv q[\gamma^2/2] + [1 - q]\gamma$. That is, $\hat{RR}(\theta, q, \gamma) = [1 - q]\{\text{TR}(\theta) + v_L Y[1 - \theta] - S\} + \bar{\gamma}[v_H - v_L]Y[1 - \theta]$. Rearranging this yields

$$\hat{RR}(\theta, q, \gamma) = \hat{TR}(\theta) + [1 - q]\{v_L Y[1 - \theta] - S\} + \bar{\gamma}[v_H - v_L]Y[1 - \theta]. \quad (9)$$

We can now prove the following result.

THEOREM 1: *There exist values of interbank competition q and a cutoff q_1 such that:*

Case i: For all $q \in (0, q_1)$, borrowers with qualities $\theta \in (0, \theta_R]$ obtain relationship loans, and those with qualities $\theta \in (\theta_R, \theta_T]$ obtain transaction loans from banks. All borrowers with $\theta > \theta_T$ go directly to the capital market. The relationship lending cutoff $\theta_R = \theta_R(\theta, q)$ depends on both the bank's sector specialization γ and the degree of interbank competition q . The transaction lending cutoff θ_T depends only on the competitiveness of the capital market. Explicit expressions for $\theta_R(\gamma, q)$ and θ_T are provided in the proof in the Appendix.

Case ii: For all $q \in (q_1, 1]$, borrowers with $\theta \in (0, \theta_R]$ obtain relationship loans from banks and all borrowers with $\theta > \theta_R$ go directly to the capital market. The functional form for $\theta_R = \theta_R(\gamma, q)$ is the same as that for Case i.

The two cases stated in the theorem are shown in Figures 2 and 3. Let us first consider Case i, which is characterized by low to intermediate competition (see Figure 2). This is the case in which the lowest-quality borrowers take relationship loans, the intermediate-quality borrowers take transaction loans, and the highest-quality borrowers go to the capital market.

To see the intuition, note that borrowers benefit from relationship loans relative to transaction loans *ceteris paribus*. When competition is low ($q \in (0, q_1)$ in Case i), the bank can capture most of the incremental benefit of a relationship loan. Thus, the bank makes relationship loans to low-quality borrowers. However, the incremental benefit of a relationship loan is decreasing in borrower quality θ , and it costs the bank more to provide a relationship loan than to provide a transaction loan; that is, a cost S is incurred for relationship loans. Because this cost is independent of borrower quality but the benefit is decreasing in borrower quality, at a sufficiently high quality the cost of a relationship loan exceeds its marginal benefit. This leads to a cutoff such that the bank prefers to provide relationship loans to borrowers with qualities below that cutoff and transaction loans to those with qualities above that cutoff.

However, the bank cannot serve with transaction loans all the borrowers who do not take relationship loans. This is because the bank's expected funding cost on transaction loans is independent of borrower quality, whereas the borrower's expected cost of capital market funding is declining in borrower quality. So the bank's rents on a transaction loan decline as borrower quality improves because the competition banks face from the market is greater on higher quality borrowers. This means that there will be another cutoff given by a sufficiently high borrower quality at which the bank's rent on transac-

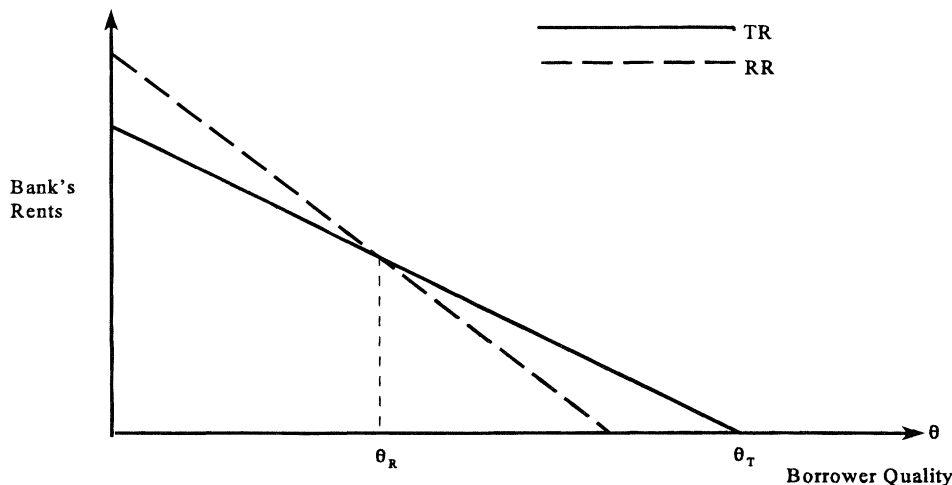


Figure 2. The bank's rents from relationship and transaction lending as a function of borrower quality for low to moderate competition $[0, q_1]$. For low to moderate levels of interbank competition this figure gives the rents available to banks when offering transaction loans (called TR or Transaction Rents and represented by the solid line) and relationship loans (called RR or Relationship Rents and represented by the broken line). Banks offer relationship loans to borrowers with qualities $\theta \in (0, \theta_R]$ and transaction loans to borrowers with qualities $\theta \in (\theta_R, \theta_T]$. Borrowers with $\theta > \theta_T$ go to the capital market.

tion loans becomes zero, with this rent becoming negative for higher borrower qualities. Thus, the highest-quality borrowers go to the capital market, and intermediate-quality borrowers seek transaction loans from banks.

We can now see what happens when interbank competition intensifies (Case ii). When interbank competition is fierce, the rents from transaction lending are so low that the bank prefers to make the incremental investment in relationship lending for every borrower. This is because transaction lending is an undifferentiated product, whereas relationship lending is a differentiated (sector-specialization-dependent) product that is inherently less vulnerable to competition; this also explains why the cutoff θ_R depends on interbank competition q (see also Theorem 3). Consequently, all borrowers who approach banks receive relationship loans, regardless of borrower quality (see Figure 3). We will now focus exclusively on Case i, in which the bank makes both relationship and transaction loans. Figure 4 shows how borrower quality is related to the choice of financing for this case.

D. Events at Date $t = 1$

Banks: The key event at $t = 1$ is the bank's choice of specialization γ , holding fixed the level of competition, N (and $q(N)$). We specify the following cost function:

$$\bar{C}_i(\gamma) = C_i(\gamma)\mu_b(\theta) \equiv C_i(\gamma) \int_{\theta}^{\theta_R(\gamma, q)} [1 - \theta] dG(\theta).$$

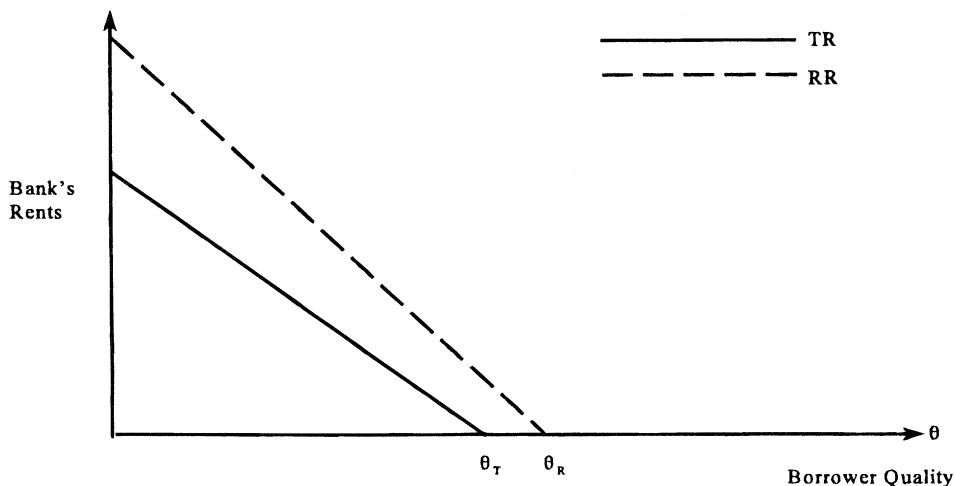


Figure 3. The bank's rents from relationship and transaction lending as a function of borrower quality for high competition ($q \geq q_1$). As in Figure 2, this figure gives the rents available to banks when offering transaction loans (solid line) and relationship loans (broken line), but now for high levels of interbank competition. Banks now provide only relationship loans, and these go to borrowers with qualities $\theta \leq \theta_R$. Borrowers with qualities $\theta > \theta_R$ go to the capital market.

This means that the sector specialization costs $\bar{C}_i(\gamma)$ depend on the range of borrowers served, $(\underline{\theta}, \theta_R(\gamma, q))$, with higher costs for lower-quality borrowers. The idea here is that the bank chooses γ before it knows the quality of its borrowers. It could get any quality from the range of borrower qualities served by the banking industry. Thus, the bank's sector specialization cost depends on this range. To see how differences in banks' cost functions matter, we need a definition.

Definition: Bank i is better than bank j if $C_i(\gamma) < C_j(\gamma)$ and $C'_i(\gamma) < C'_j(\gamma) \forall \gamma \in (0, 1)$.

We can now define the equilibrium in our model.

Equilibrium: Given the exogenous parameters A , E , $G(\theta)$, $C_i(\gamma)$, S , Y , r_f , v_H , v_L , and r_d , a Nash equilibrium in banking and the capital market is such that the following hold.

- Each borrower conjectures a θ_T and a $\theta_R(\gamma, q) < \theta_T$ for each bank, and makes a privately optimal decision to seek bank funding if its own $\theta \leq \theta_T$ and capital market funding if $\theta > \theta_T$.
- Each bank makes conjectures about the number of banks N , the density function $f(\gamma)$ over the cross-sectional distribution of γ 's chosen by other (entering) banks, and $\theta_R(\gamma, q)$ and θ_T , and then chooses whether or not to enter, and if so it chooses its privately optimal γ .

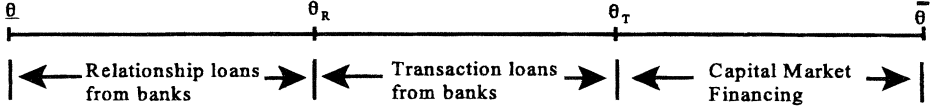


Figure 4. Borrowers' choice of financing. This figure relates borrower quality θ to the choice of financing. Borrowers with qualities $\theta \in (\theta, \bar{\theta}_R]$ obtain relationship loans, and those with qualities $\theta \in (\theta_R, \theta_T]$ get transaction loans from banks. Borrowers with qualities $\theta \in (\theta_T, \bar{\theta}]$ get funding in the capital market.

- The privately-optimal choice of γ is consistent with the conjectured $f(\gamma)$.
- The $\theta_R(\gamma, q)$, θ_T , and N that emerge from the optimizing actions of agents validate the conjectures of all agents.

III. Further Analysis

In this section we analyze the impact of interbank competition (i.e., changes in entry cost E) and the competitive strength of the capital market (changes in A) on the bank's sector specialization and lending decisions. We first characterize the optimal entry strategy of commercial banks.

A. Entry Strategy of Commercial Banks

How many banks (N) will choose to enter the banking industry? Prior to entry, banks do not know their cost function $\bar{C}_i(\gamma)$ and can only assess their expected costs, given by the cost function of the “representative” bank, $\bar{C}(\gamma)$. So all banks are a priori identical. The equilibrium N^* equates bank profits to the entry cost E . The bank's profits (with $\bar{C}_i(\gamma) = \bar{C}(\gamma)$) equal¹⁵

$$\begin{aligned}
 \mathcal{H}_N = & \int_{\theta}^{\theta_R(\gamma, q)} \frac{1}{N} \{ [1 - q] \{ A[1 - \theta] - [r_d - r_f] + v_L Y[1 - \theta] - S \} \\
 & + \{ [1 - q] \gamma + q \gamma^2 \} [v_H - v_L] Y[1 - \theta] \} dG(\theta) \\
 & + \int_{\theta_R(\gamma, q)}^{\theta_T} \frac{1}{N} [1 - q] \{ A[1 - \theta] - [r_d - r_f] \} dG(\theta) \\
 & - \int_{\theta}^{\theta_R(\gamma, q)} [1 - \theta] dG(\theta) C_i(\gamma).
 \end{aligned} \tag{10}$$

LEMMA 1: *For each bank, there is an optimal level of sector specialization γ , and better banks choose higher levels of γ .*

¹⁵ Equation (10) includes $\{ [1 - q] \gamma + q \gamma^2 \}$, that is $[\bar{\gamma} + \{ q \gamma^2 / 2 \}]$ times the benefit $[v_H - v_L] \times Y[1 - \theta]$ of relationship loans. This is because the bank acquires borrowers in “the first round” with probability $1/N$, and in “the second round” with probability $[1 - (1/N)] \times q/[N - 1]$. In the latter case, it competes with the first bank and $0.5 \gamma^2 [v_H - v_L] Y[1 - \theta]$ in expected rents can be earned. Also note that equation (10) has a unique optimum at γ^* for each bank type i (see the proof of Lemma 1).

Next, we focus on the optimal entry strategy. The number of banks in the industry, N^* , is such that¹⁶

$$\mathcal{H}_{N^*} \geq E \text{ and } \mathcal{H}_{N^*+1} < E. \quad (11)$$

From equation (11), it is easy to establish that lowering the entry cost E will increase N^* .

LEMMA 2: *The higher the entry cost E , the smaller is the number of banks in equilibrium.*

We assume that E is small enough so that $N^* \geq 2$. As a first result, we show the effect of increased competition from the capital market (lower A) on bank entry.

THEOREM 2: *Greater capital market competition reduces the equilibrium number of banks; that is, $\partial N^*/\partial A \leq 0$.*

Recall that bank pricing is anchored by pricing in the capital market. As the market becomes a stronger competitor, banking rents shrink and entry is discouraged.

B. Impact of Interbank Competition on Bank Lending Allocation Decisions

We now examine the impact of interbank competition on the bank's preference for relationship versus transaction lending.

THEOREM 3: *An increase in interbank competition (a higher probability, q , of a competing offer due to a higher number of banks N) increases the relationship lending cutoff θ_R and leaves unchanged the transaction lending cutoff θ_T , thus inducing the bank to increase relationship lending relative to transaction lending.*

This key result prescribes an optimal lending strategy for the bank. The intuition is that relationship lending rents are less vulnerable to interbank competition than transaction lending rents. This is due to the differentiation resulting from sector specialization, as discussed earlier.

C. Analysis of Capital Market Competition

We now consider the impact of capital market competition (A) on bank lending decisions. A lower A implies lower expected capital-market borrowing costs for firms and hence a more competitive market. From Theorem 2 we know that increased competition from the capital market depresses bank profits and reduces entry into banking. It also *lowers* q . Thus, competition from the capital market will *lessen* interbank competition in an ex post sense.

¹⁶ Observe that the discreteness in the number of entering banks explains the conditions $\mathcal{H}_{N^*} \geq E$ and $\mathcal{H}_{N^*+1} < E$ that determine N^* .

LEMMA 3: *An increase in the competition banks face from the capital market (lower A) reduces the transaction lending cutoff θ_T and reduces the relationship lending cutoff $\theta_R(\gamma, q)$. Thus, capital market competition reduces both total bank lending and relationship lending.*

It is intuitive that increased competition from the capital market diminishes both transaction and relationship lending. As the capital market competes more aggressively with banks, transaction loans from banks become less attractive, reducing banks' rents from this type of lending and lowering the transaction lending cutoff. The concomitant reduction in interbank competition (lower q) reduces relationship lending, and hence the relationship lending cutoff moves left as well.

D. Effect of Competition on Sector-Specialization Decisions

Thus far we have focused on the effect of competition on the bank's capacity allocation decision at $t = 2$. We now examine the effect of competition on its sector specialization decision at $t = 1$.

How is the bank's optimal investment in sector specialization (γ^*) affected by an increase in either interbank competition (higher N and q) or capital market competition (lower A)?

THEOREM 4: *The bank's optimal investment in sector specialization, γ^* , is decreasing in interbank competition (N); that is, $\partial\gamma^*/\partial N < 0$.*

The intuition is that sector specialization affects the likelihood of both retaining a borrower if a rival bank appears and attracting a borrower from a rival bank that has already made a bid. Greater competition among banks leads to more of the (ex post) rents being competed away, so that each bank's optimal investment in sector specialization is smaller. Thus, although an increase in interbank competition leads to more relationship lending—because the rents *relative* to transaction lending are better protected—there is a decline in sector specialization because a bank's absolute lending rents are lower.

The impact of capital market competition (lower A) on the bank's optimal investment in sector specialization is the opposite of that in Theorem 4.

THEOREM 5: *An increase in competition banks face from the capital market (lower A) causes an increase in the bank's optimal investment in sector specialization, γ^* ; that is, $\partial\gamma^*/\partial A < 0$.*

To see what underlies Theorem 5, note that as competition from the capital market increases, the rents earned by the existing banks decline.¹⁷ For any given entry cost E , this makes de novo bank entry less attractive, so

¹⁷ This does not mean that as competition increases, banks will vanish, but rather that, in the limit, *new* entry into banking will go to zero. The incumbent banks will continue to exist. Of course, Lemma 2 says that as A declines, total bank lending falls, so banking industry size depends on how small A becomes. However, restriction (R2) puts a lower bound on A and ensures that banking does not vanish with competition.

that N decreases. This reduces q , the interbank competition parameter, and increases the rents banks earn on investment in sector specialization γ . Thus, γ^* goes up.

We can now summarize the main lessons of this subsection.

- An increase in interbank competition increases relationship lending and reduces transaction lending. However, it also decreases the optimal investment in sector specialization, γ^* . Thus, as banks compete more aggressively with one another, they make more relationship loans, but each loan has lower added value (lower γ) relative to transaction loans.
- An increase in the competition banks face from the capital market results in banks cutting back on relationship lending. However, each relationship loan has greater added value (higher γ), relative to transaction loans.

IV. Welfare Analysis

What we look into now is how capital market competition among underwriters and interbank competition affect borrower welfare.

A. Capital Market Competition

A simple proxy for borrower welfare is the expected rents earned by borrowers net of their funding costs. In the case of capital market funding, the borrower's net expected rent is maximized by minimizing the funding cost. The expected funding cost for a borrower going to the capital market is given by equation (1). We now have the following result.

THEOREM 6: *An increase in capital market competitiveness (lower A) unambiguously improves the welfare of borrowers in the capital market.*

This result follows from the observation that, as capital market competitiveness increases, the financing costs for all those who borrow in the capital market decline, increasing their welfare. But this theorem addresses only those borrowers who go to the capital market. What happens to the others?

Lemma 3 shows that as capital market competitiveness improves, both θ_T and θ_R decrease, which means aggregate bank lending and relationship lending both decline. We can now establish the following effects of increasing capital market competitiveness on borrowers who initially receive bank loans:

- (i) Some borrowers who previously received transaction loans from banks now borrow in the capital market. Given the competitive pricing condition that ties everything to capital market pricing, and given the improved competitiveness of the market (lower A), these borrowers are *better off*.
- (ii) Some borrowers who previously received relationship loans now get transaction loans from banks. These borrowers may be *worse off* if relationship loans offered substantial benefits to these borrowers; recall that even with imperfect competition, the borrowers obtain part of these benefits.

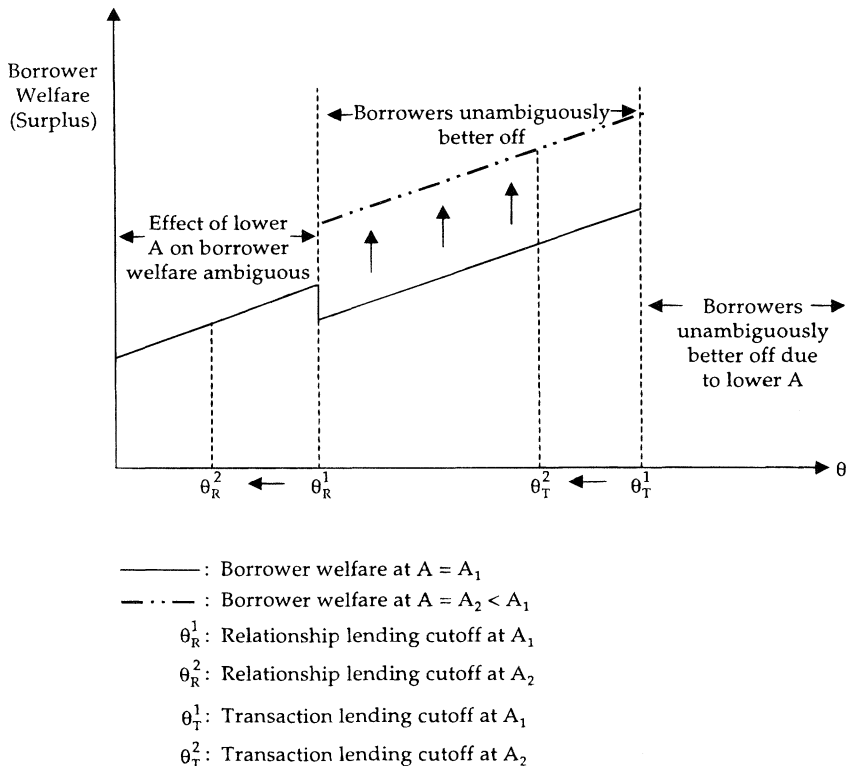


Figure 5. Changes in borrower welfare as capital market competition increases. This figure shows how borrower welfare changes if the competitiveness of the capital market increases (A change from A_1 to $A_2 < A_1$). The solid lines indicate borrower welfare at $A = A_1$. The broken line indicates borrower welfare at $A = A_2$. Also θ_R^1 and θ_R^2 are the transaction lending cutoffs at A_1 and A_2 respectively.

- (iii) Borrowers who previously received relationship loans and continue to receive them *might* be *worse off*. For these borrowers there is a trade-off between lower ex post interbank competition (lower q due to diminished entry caused by more competition from the capital market), better pricing due to a lower A , and more added value due to a higher γ^* (see Theorem 5).

This discussion is summarized in Figure 5, where A_1 is the initial level of capital market competition and $A_2 < A_1$ indicates increased competition.

B. Interbank Competition

Now we consider what happens to the welfare of borrowers in the capital market when the number of banks (and hence q) increases due to a reduction in the cost of entry, E .

THEOREM 7: *Changes in interbank competition (q) do not affect the welfare of capital market borrowers.*

Though the welfare of capital market borrowers is unaffected, what happens to bank borrowers? We know from Theorem 3 that an increase in q does not affect θ_T , but does elevate θ_R . We can now establish the effects of higher interbank competition:

- (i) Borrowers who previously received transaction loans and continue to get these loans are *better off*.
- (ii) Some borrowers who previously received transaction loans now receive relationship loans. These borrowers are *better off* too, because relationship loans are priced relative to transaction loans and, as long as there is *some* competition, the additional value created by a relationship loan compared to a transaction loan is shared between the bank and the borrower.
- (iii) Borrowers who previously obtained relationship loans all continue to receive these loans. The effect on the welfare of these borrowers is *ambiguous*. This is because a higher q leads to better loan pricing for borrowers but it also causes banks to cut back on their sector-specific investments (γ^*). This means that each relationship loan has a lower added value (Theorem 4).

The above observations are summarized in Figure 6, where q_1 is the initial level of interbank competition and $q_2 > q_1$ indicates a higher level of competition.

We can now combine all of our results about the welfare effects of capital market and interbank competition in the following result.

THEOREM 8: *Suppose the starting point is a capital market competitiveness denoted by A_1 and interbank competition denoted q_1 . Then as we increase capital market competitiveness by moving to $A_2 < A_1$ and/or interbank competition by moving to $q_2 > q_1$, the following welfare effects will be observed:*

- (i) *Those who borrowed in the financial market at A_1 and q_1 are better off going from A_1 to A_2 and are unaffected going from q_1 to q_2 .*
- (ii) *Those who took transaction loans from banks at A_1 and q_1 are always better off moving from A_1 to A_2 or q_1 to q_2 .*
- (iii) *Those who were relationship borrowers at A_1 and q_1 face ambiguous welfare effects when moving from A_1 to A_2 or q_1 to q_2 .*

We see then that increased competition could have ambiguous welfare effects for relationship borrowers, but the cause of the ambiguity differs depending on the source of the competition. When it comes from other banks, the ambiguity arises because banks reduce their sector specialization investments. When it comes from the capital market, the ambiguity arises because banks cut back on relationship lending and there is less bank competition *ex post*.

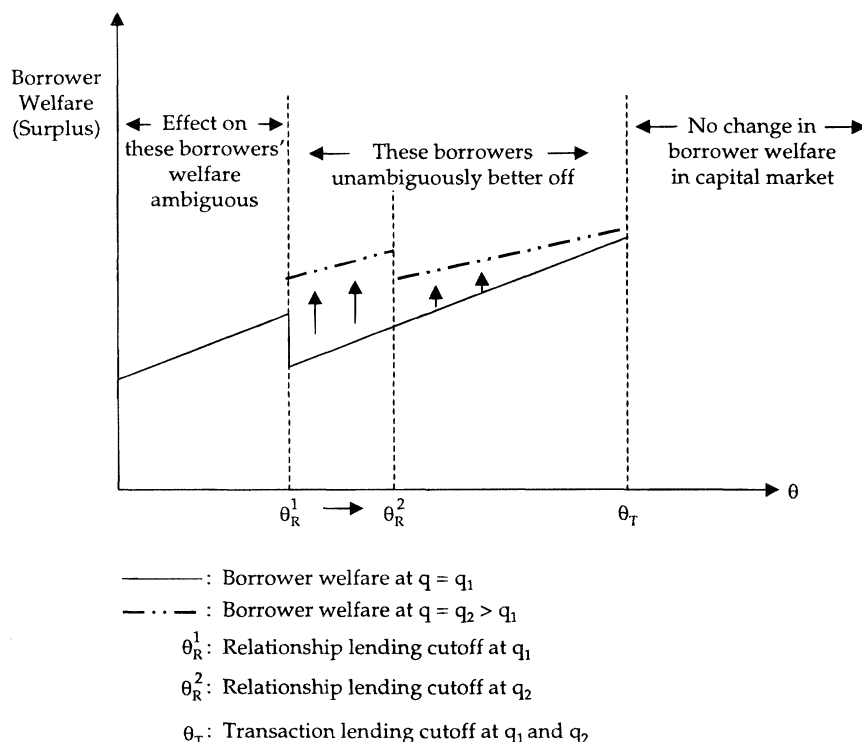


Figure 6. Changes in borrower welfare as interbank competition increases. This picture shows how borrower welfare changes as interbank competition increases from q_1 to $q_2 > q_1$. The solid lines indicate borrower welfare at q_1 , and the broken lines indicate borrower welfare at q_2 . θ_T is the transaction lending quality cutoff and θ_R^1 and θ_R^2 are the relationship lending cutoffs at q_1 and q_2 respectively.

V. Model Extensions, Robustness, and Empirical Implications

In the following subsections, we discuss some generalizations and implications of our analysis. Specifically we examine (A) endogenization of capital-market competition, (B) endogenization of the total scale of the bank, (C) the contrast of our results with the existing literature, (D) imperfect competition with a spatial model rather than with our “random-matching” model, and (E) the empirical implications of our analysis.

A. Endogenizing Underwriter Competition

We have also formally analyzed the endogenization of underwriter competition similar to competition among banks; however, we have excluded this from the paper to limit the algebraic clutter (details are available from the authors upon request). The main insights are as follows.

We assume that the value of τ —the “penalty cost” of borrowing in the capital market—depends on the underwriter’s *choice of search efficiency*. The cost of acquiring this search efficiency differs across underwriters, so that different underwriters choose different search efficiencies. This cross-sectional dispersion in costs is viewed as a measure of underwriter heterogeneity. There is an elastic supply of zero-search-efficiency underwriters which provides us with the desired competitive fringe for pricing purposes and helps us to anchor *all* of the pricing in the model. There is also a fixed cost of entering the underwriting business, and this determines the number of positive-search-efficiency underwriters in equilibrium. Competition among underwriters is modeled by assuming that a borrower who receives an offer from one underwriter can search for a second underwriter. This search will succeed with a probability that increases in the degree of competition among underwriters.

Our main results are as follows. Each underwriter chooses a unique search efficiency, with better (lower cost) underwriters choosing higher search efficiencies. The rest of our results concern the overall competitiveness of the capital market and its welfare implications.

The competitiveness of the capital market is affected by three factors. The first is the cost of entry into underwriting, which determines how many underwriters there are and the degree of competition among them. The second is the cost at which underwriters can raise funds. This cost is affected by exogenous factors such as financial innovation, disclosure requirements for exchange-listed firms, and information technology improvements. The third is the degree of underwriter heterogeneity, the idea being that underwriters who are more alike will compete more aggressively.

Somewhat surprisingly, greater competition among underwriters does *not* necessarily make the capital market more competitive vis-à-vis banks. This is because an increase in the number of underwriters produces two contradictory effects. On the one hand, it reduces underwriters’ profit margins, which benefits borrowers. On the other hand, competition lowers underwriters’ investments in search efficiencies, which raises borrowers’ financing costs. The net effect on the competitiveness of the capital market—as measured by borrowers’ financing costs—is ambiguous.

Similarly, improvements—induced by exogenous factors—in the cost at which underwriters raise funds do not necessarily make the capital market more competitive. This is because technological improvements *could* induce underwriters to invest less in search efficiency, counterbalancing the direct positive effect of increased competitiveness on funding costs.¹⁸ Moreover, changes in capital market competition could also induce entry into or exit from underwriting, which then affects the competitiveness of the capital market.

¹⁸ If the reduction in the cost of raising capital market funds is truly exogenous and affects all underwriters equally without changing the incentives (and thus the effectiveness) of investing in search efficiency, the capital market becomes unambiguously more competitive. An example of this is a tax reduction such as the removal of a “stamp duty” on financial market borrowing.

Finally, a reduction in underwriter heterogeneity appears to make the capital market more competitive vis-à-vis banks. Greater similarity among underwriters makes underwriter competition less imperfect. This will improve capital market competitiveness as long as the increase in underwriter competition does not cause too much exit from the industry.

B. Endogenizing Bank Scale

We have taken the total scale (lending capacity) of the bank as exogenous, so that the focus is on allocating this capacity to relationship loans versus transaction loans. However, in an earlier version of the model, we had endogenized the bank's choice of total lending capacity. The idea is that there is a cost function that determines how much it costs the bank to set up a particular lending capacity at the outset. The bank can then lend any amount up to this lending capacity but not more. If realized loan demand falls short of lending capacity, the excess capacity is wasted, and if there is demand in excess of lending capacity, it cannot be met. At a later date, the bank determines the allocation of lending capacity across transaction and relationship loans.

The bank's choice of lending capacity is now determined by the trade-off between the expected rents from future lending and the cost of setting up lending capacity now. As these expected rents decline, so does the optimal lending capacity chosen by the bank.

Because competition lowers expected rents from future lending, the bank chooses a smaller total lending capacity when faced with more competition, no matter where this competition comes from. Consequently, the volume of relationship lending is related to competition in a *nonmonotonic* way. Initially, for low levels of competition, the bank allocates its lending capacity to transaction lending for most borrower qualities. As competition increases beyond a certain level, the bank shifts lending capacity to relationship lending, as in the present model. However, because total lending capacity is shrinking as competition rises, relationship lending volume first surges due to the reallocation of lending capacity and then falls due to the decline in lending capacity, as shown in Figure 7.

C. Contrast of Results with Existing Literature

This analysis clarifies how our paper differs from the existing literature. In Petersen and Rajan (1995), for example, the bank, as an exclusive relationship lender, faces a one-dimensional decision about how much to lend. We have a three-dimensional bank decision: how much to lend in total, how much of the total lending to allocate to relationship versus transaction loans, and how much sector specialization to develop in relationship lending. This leads to both *absolute* and *relative* (substitution) effects of competition on relationship lending. Consider the absolute effect. As in Petersen and Rajan, we find that the absolute volume of relationship lending declines with increasing competition, but *only* for competition beyond a certain point (Fig-

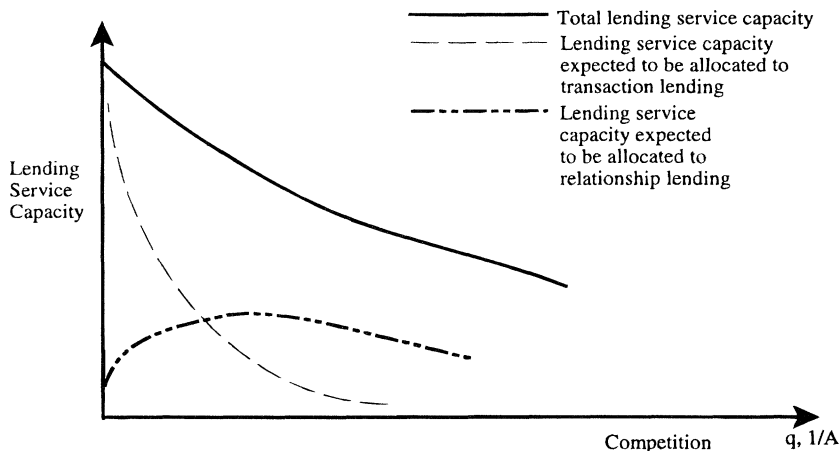


Figure 7. Expected allocation of lending service capacity. This figure shows the allocation of bank lending service capacity in a generalized model where banks endogenously choose their optimal lending service capacity. The total lending capacity (solid line) is decreasing in competition. When competition is low, banks allocate all capacity to transaction lending. When competition increases, relationship lending gains at the expense of transaction lending.

ure 7). Moreover, our result that greater interbank competition reduces the bank's sector-specialization investment represents another absolute effect, one that has been previously ignored. These absolute effects notwithstanding, the relative effect—the increase in the proportion of total lending devoted to relationship loans—means that relationship lending does *not* become less important with greater interbank competition. An increase in interbank competition causes the bank to allocate more capacity to relationship lending.

D. Modeling Imperfect Competition in a Different Way: A Spatial Model

In our model interbank competition works through a random matching of borrowers to banks. An alternative would be a spatial model. Would such a model affect our results? To maintain symmetry of observability assumptions across our model and the spatial setting, suppose we continue to assume that sector specialization γ is unobservable at $t = 1$ and that the analog of the physical positioning of banks relative to each borrower is observable. For simplicity, suppose each borrower approaches the bank closest to it, and the borrower discovers the bank's γ after it receives an offer. Suppose the subsequent competing offer, if received by the borrower, comes from the bank second closest to the borrower and the probability of receiving this offer is decreasing in the distance of this bank from the borrower. Thus, the more banks there are, the closer is each bank to the borrower, and the higher is the probability that the borrower will receive an offer from a competing bank. The competing bank's γ is revealed to the borrower only after it receives that bank's offer.

With this, the spatial model will not affect things much. As one increases the number of banks that lie equally spaced along a straight line or the circumference of a circle, one increases the probability that the borrower will receive a competing offer. If the competing offer is received, which bank is chosen will depend now on the γ s of the two banks—as in our random-matching model—and the distances of the two banks from the borrower. What is different from our model is that the incumbent bank will capture the borrower's business even when the competing bank has a slightly higher γ , as long as the competitor's γ is not high enough to offset the incumbent's distance advantage. This means that the incumbent bank will be able to keep a bit more of its relationship lending rent than in the random-matching model. Other than this, our results will be qualitatively unaffected. Increased interbank competition will still lead to more relationship lending with reduced sector specialization.

But what if γ is a priori observable? In our random-matching model, the bank's benefit from investing in γ with a relationship loan is $\{q[\gamma^2/2] + [1 - q]\gamma\}[v_H - v_L]Y[1 - \theta]$. This benefit is strictly decreasing in interbank competition q , so that the bank invests less in γ when q is higher.¹⁹ It is also true, however, that the borrower is better off when γ is observable. To see this, note that, conditional on a competing bank being present, the borrower surplus with relationship lending equals $[\gamma - \{\gamma^2/2\}][v_H - v_L]Y[1 - \theta]$ in our analysis.²⁰ This is increasing in γ , so that if borrowers select banks on the basis of the γ s they observe a priori, then they benefit from choosing a higher- γ bank. This holds for any $q > 0$ that a competing bank will come along.

In the spatial model, with a priori observable γ , the borrower's choice of bank will depend both on the bank's γ and on its distance from the borrower. Thus, each borrower will first seek the bank that can produce the highest borrower surplus $\gamma[v_H - v_L][1 - \theta]Y - t(d)$, where $t(d)$ is the transportation cost associated with this bank. Competing offers can then be sought from other banks. It now follows that the higher the γ , the wider is the range of θ 's for which the bank can overcome the transportation cost associated with

¹⁹ One could argue that, when γ is observable, q should be a function of γ . Suppose we write $q(\gamma) = q^o \xi(\gamma)$, where q^o is an exogenous parameter that measures interbank competition and $\xi'(\gamma) < 0$ denotes the fact that the higher the bank's γ , the lower is the probability a competing bank will appear. We can interpret q^o the same way we interpret q in our present random-matching model. Then, defining $Z \equiv q(\gamma)[\gamma^2/2] + [1 - q(\gamma)]\gamma$, we see that $\partial Z/\partial q^o < 0$ even in this case.

²⁰ To see how one gets this expression, start with an "incumbent" bank with sector specialization γ_0 . The borrower surplus associated with this sector specialization, conditional on a competing bank being present, is

$$\left\{ \int_0^{\gamma_0} \gamma[v_H - v_L]Y[1 - \theta]f(\gamma) d\gamma + \int_{\gamma_0}^1 \gamma_0[v_H - v_L]Y[1 - \theta]f(\gamma) d\gamma \right\}.$$

This expression simplifies to the one given in the text.

any borrower. Thus, a bank's market share will be increasing in γ .²¹ However, as interbank competition increases, there will be more banks with $\{\gamma, t(d)\}$ pairs that the borrower can get competing offers from. This will reduce the surplus that can be captured by the highest-borrower-surplus bank and thus reduce banks' investments in γ .

This discussion clarifies the robustness of our results that greater interbank competition leads to relatively more relationship lending with less sector specialization by banks. Our random-matching specification and a spatial model produce similar results.²²

E. Empirical Implications

The main empirical predictions of our analysis are as follows:

- There is more transaction lending at low levels of interbank competition than at higher levels of competition.
- For sufficiently high levels of interbank competition, banks make only relationship loans.
- An increase in interbank competition reduces banks' investments in sector specialization.
- An increase in competition banks face from the capital market reduces entry into banking. This, in turn, reduces (ex post) interbank competition and causes an increase in banks' investments in sector specialization.

²¹ Conditional on a competing bank being present, the borrower surplus associated with relationship lending is

$$\begin{aligned} & \int_0^{\gamma_0 + T(\theta)} \{[\gamma - T(\theta)][v_H - v_L]Y[1 - \theta] - t(d_1)\}f(\gamma) d\gamma \\ & + \int_{\gamma_0 + T(\theta)}^1 \{[\gamma_0 + T(\theta)][v_H - v_L]Y[1 - \theta] - t(d_2)\}f(\gamma) d\gamma, \end{aligned}$$

where d_1 is the distance of the borrower from the first bank, $t(d_1)$ is the associated transportation cost, and $t(d_2)$ is the higher transportation cost associated with the second bank, $T(\theta) \equiv [t(d_2) - t(d_1)]/[v_H - v_L]Y[1 - \theta]$. This expression simplifies to

$$[\gamma - \{\gamma^2/2\} - T(\theta)\gamma - \{T(\theta)^2/2\}][v_H - v_L]Y[1 - \theta] - t(d_2).$$

This surplus is increasing in γ if $t(d_2) - t(d_1)$ is not too large.

²² Two other robustness issues are worth mentioning. First, we have made assumptions that result in transaction lending rents being invariant to bank specialization. Weaker assumptions would suffice. All we need is that relationship lending rents are *more* sensitive to the bank's specialization than are transaction lending rents. Second, we have assumed that banks prearrange their funding prior to making loans and that this funding can be viewed as coming from core deposits. This is consistent with the notion that core deposits and relationship lending go hand in hand; see Berlin and Mester (1996), Berger and Udell (1995), and Qi (1998). This is not to deny that banks also raise funds through uninsured CDs, subordinated debt, and equity; the important difference is that the bank lends from prearranged funds whereas the underwriter links its search for funds to each specific borrower.

- Increased capital market competition reduces *total* bank lending, but increased interbank competition leaves total bank lending unchanged when total bank lending capacity is exogenously fixed. With an endogenous lending capacity choice, increased interbank competition also reduces total bank lending.

We now briefly discuss how one might confront these predictions with the data. To the best of our knowledge, all but the last prediction have yet to be tested.

Our prediction that relatively noncompetitive banking systems will be dominated by transaction loans could be tested using data on banking systems in emerging economies or on banking oligopolies elsewhere. For example, China's banking system has been dominated by transaction lending with "soft-budgeting" and insufficient monitoring by banks (see Aoki and Dinc (1997)).

As for our result pertaining to the impact of competition on relationship lending, many aspects of relationship financing need to be considered. One of these is additional financing to small liquidity-constrained firms that banks may provide after gaining inside information about them. Anecdotal evidence suggests that large banks are increasingly focusing on middle-market lending. The credit market for such relationship-oriented borrowers has traditionally not been as competitive as for larger borrowers, so this may reflect a surge in relationship financing in response to increased competition.

Although there is no direct evidence for our prediction that greater interbank competition should lead to less sector specialization by banks, this is reminiscent of the Petersen and Rajan (1995) finding that competition reduces the value of investing in relationship lending. Our prediction should be tested by examining the data for signs of diminishing industry focus in bank lending. This will require a careful assessment of the composition of bank loan portfolios, with loans being segregated by industry focus as well as by whether they are transaction or relationship loans, because our sector specialization prediction applies only to relationship lending. Similar comments apply to our prediction that an increase in competition banks face from the capital market will increase banks' sector specialization investments.

Finally, our prediction that greater capital market competition will reduce total lending is consistent with the evidence in Berlin and Mester (1996). Recall, however, that our analysis indicates that such competition will cause the banking sector to shrink, but will not eliminate it.

VI. Conclusions

We have developed a banking model to answer questions about the nature of relationships, how they depend on competition, and the changing nature of competition. In our model, banks choose how much to specialize in a particular borrower sector, how much lending service capacity to build, and how to allocate this capacity across relationship and transaction lending. The

bank faces competition from other banks as well as from the capital market, where bond issues are underwritten. Borrowers choose between bonds and bank loans; the latter can be either transaction or relationship loans.

Our key results are that (i) there is more transaction lending at lower levels of interbank competition than at higher levels; (ii) increased interbank competition will increase relationship lending, but each loan will have less added value for borrowers; (iii) higher competition from the capital market will reduce total bank lending as well as relationship lending, but each relationship loan will have higher added value for borrowers; and (iv) increased competition, whether from the capital market or from other banks, will improve borrower welfare for some but not necessarily for all.

The predictions of our analysis should be helpful in guiding future empirical research on relationship and transaction lending as well as that on the evolving nature of bank asset portfolios in the face of increasing interbank and capital market competition. Our model has identified new control variables that should be important in such empirical work, including the state of development of the capital market, which suggests international comparisons. Moreover, the analysis is policy relevant because it identifies the conditions under which greater competition is good for borrowers and those under which it is not.

Future research could further develop our thesis that the boundaries between banks and capital markets are blurring. This means banks can return to their relationship lending roots or become more like the capital market underwriters they compete with. This is a fundamental choice for banks, and also of great relevance for regulators because much of bank regulation is rooted in the way banks fund themselves and in the types of loans they make.

Appendix

Proof of Theorem 1: Consider θ_T first and ignore for now the possibility of relationship loans. Because the transaction lending rent for the bank was derived under the condition that the borrower is indifferent between bank and capital market borrowing, θ_T is the θ at which the bank is indifferent between lending and not lending to the borrower—that is, the θ at which the bank's transaction lending rent is zero. Setting $\hat{\text{TR}}(\theta, q)$ in equation (7) equal to zero gives us

$$\theta_T = \frac{A - r_d + r_f}{A}. \quad (\text{A1})$$

Note also that $\partial \hat{\text{TR}}(\theta, q) / \partial \theta < 0$, which means that $\hat{\text{TR}}(\theta, q) > 0 \ \forall \ \theta < \theta_T$ and $\hat{\text{TR}}(\theta, q) < 0 \ \forall \ \theta > \theta_T$. Thus, the bank will offer transaction loans to borrowers with $\theta \leq \theta_T$ and permit borrowers with $\theta > \theta_T$ to go to the capital market. It is apparent that θ_T is independent of γ and q .

Now consider relationship lending, and assume for the moment that banks make both relationship and transaction loans. Then, θ_R should be the θ at which the bank is indifferent between transaction lending and relationship lending. That is, the θ_R is such that

$$\hat{\text{TR}}(\theta, q) = \hat{\text{RR}}(\theta, q, \gamma). \quad (\text{A2})$$

Solving equation (A2) yields

$$\theta_R(\gamma, q) = 1 - \frac{S}{Y[v_L + \bar{\gamma}[v_H - v_L][1 - q]^{-1}]}. \quad (\text{A3})$$

Note that $\partial \hat{\text{RR}}(\theta, q, \gamma) / \partial \theta < 0$ and $\partial \hat{\text{TR}}(\theta, q) / \partial \theta < 0$. Moreover, $|\partial \hat{\text{RR}}(\theta, q, \gamma) / \partial \theta| > |\partial \hat{\text{TR}}(\theta, q) / \partial \theta|$. This means that the bank will prefer to make relationship loans to all borrowers with $\theta \leq \theta_R(\gamma, q)$ and transaction loans to borrowers with $\theta \in (\theta_R(\gamma, q), \theta_T]$. It is apparent that θ_R is a function of γ and q .

With this in hand, we can now examine the two cases delineated in the theorem. Case i corresponds to Figure 2. As is apparent from this figure, the following two conditions must hold for Case i to obtain:

$$\hat{\text{RR}}(\theta_T, q, \gamma) < 0 \quad (\text{A4})$$

$$\hat{\text{TR}}(\theta, q)|_{\theta=0} < \hat{\text{RR}}(\theta, q, \gamma)|_{\theta=0}. \quad (\text{A5})$$

Consider equation (A4) first. Evaluate $\hat{\text{RR}}(\theta, q, \gamma)$ at $\theta = \theta_T$ by substituting for θ_T into the expression for $\hat{\text{RR}}$ given by equation (9). This yields

$$\begin{aligned} \hat{\text{RR}}(\theta_T, q, \gamma) &= [1 - q][v_L Y[r_d - r_f]A^{-1} - S] \\ &\quad + \bar{\gamma}[v_H - v_L]Y[r_d - r_f]A^{-1}. \end{aligned} \quad (\text{A6})$$

With a little algebra, we see that equation (A6) implies that $\hat{\text{RR}}(\theta, q, \gamma) < 0$ whenever $q \in [0, q_1)$, where

$$q_1 = 1 - \frac{[v_H - v_L]Y[\gamma^2/2]}{SA[r_d - r_f]^{-1} - v_L Y - [\gamma - \{\gamma^2/2\}][v_H - v_L]Y}. \quad (\text{A7})$$

Next consider equation (A5). Substituting for $\hat{\text{TR}}$ from equation (7) and for $\hat{\text{RR}}$ from equation (9), and using restriction (R1), we see that equation (A5) holds. Thus, Case i holds $\forall q \in [0, q_1)$.

Now consider Case ii. From Figure 3 it is clear that this case requires that the following conditions hold:

$$\hat{R}R(\theta_T, q, \gamma) > 0 \quad (\text{A10})$$

$$\hat{T}R(\theta, q)|_{\theta=0} < \hat{R}R(\theta, q, \gamma)|_{\theta=0}. \quad (\text{A11})$$

From our earlier analysis it follows that equations (A10) and (A11) will hold if $q \in (q_1, 1]$. Q.E.D.

Proof of Lemma 1: We first show that, for any N , there is a unique optimal $\gamma = \gamma^*$. The first-order condition, using equation (10), is

$$\begin{aligned} 0 = \partial \mathcal{H}_i / \partial \gamma = & \frac{1}{N} \int_{\theta}^{\theta_R(\gamma^*, q)} [1 - \theta] dG(\theta) \{ [2q\gamma^* + [1 - q]] [v_H - v_L] Y \} \\ & - C'_i(\gamma^*) \int_{\theta}^{\theta_R(\gamma^*, q)} [1 - \theta] dG(\theta). \end{aligned} \quad (\text{A12})$$

Note that we have ignored the derivative of $\int_{\theta}^{\theta_R(\gamma^*, q)} [1 - \theta] dG(\theta)$ with respect to γ^* because it cancels out. The second-order condition is

$$2q \left[\frac{1}{N} \right] [v_H - v_L] Y - C''_i(\gamma^*) < 0. \quad (\text{A13})$$

Thus, a unique γ^* exists. This follows immediately from equation (A12) that a better bank chooses a higher γ^* . Q.E.D.

Proof of Lemma 2: At a lower level of E , $\mathcal{H}_{N^*+1}$ may exceed E . This will induce the $(N^* + 1)^{\text{st}}$ bank to enter. If $\mathcal{H}_{N^*+1}$ is still less than E , the $(N^* + 1)^{\text{st}}$ bank will stay out. This explains the weak inequality in the lemma. Q.E.D.

Proof of Theorem 2: Observe from equation (10) that $\mathcal{H}$, the expected profits of banks, are negatively affected when A decreases. Using the equilibrium entry policy stated in equation (11), we see that N^* decreases. Q.E.D.

Proof of Theorem 3: Observe that a higher N will increase q . Differentiating equation (A3) with respect to q gives

$$\partial \theta_R(r, q) / \partial q = \frac{S[\gamma^2/2]Y[v_H - v_L][1 - q]^{-2}}{[Y\{v_L + \bar{\gamma}[v_H - v_L][1 - q]^{-1}\}]^2} > 0. \quad (\text{A14})$$

Moreover, differentiating $\theta_T = [A - r_d + r_f]/A$ gives us $\partial \theta_T / \partial q = 0$. Thus, as interbank competition increases, the relationship lending cutoff shifts to the right, whereas the transaction lending cutoff remains unchanged. This

means that the bank will engage in relatively more relationship lending when faced with higher interbank competition; aggregate bank lending will not change. Q.E.D.

Proof of Lemma 3: Observe that θ_T is a function of A but *not* q , whereas $\theta_R(\gamma, q)$ is a function of q but not A . Capital-market competition (lower A) reduces N^* and hence reduces q .

Define

$$\Delta_T \equiv -[\partial\theta_T/\partial A]$$

and

$$\Delta_R \equiv -[\{\partial\theta_R(\gamma, q)/\partial q\} \times \{\partial q/\partial N\} \times \{\partial N/\partial A\}].$$

Thus, a positive Δ implies an increase in the cutoff in the face of greater capital-market competition. Now,

$$\Delta_T = -A^{-2}[r_d - r_f] < 0,$$

and

$$\Delta_R = \frac{S[\gamma^2/2]Y[v_H - v_L][1 - q]^{-2}}{[Y\{v_L + \bar{\gamma}[v_H - v_L][1 - q]^{-1}\}]^2} \times \{\partial q/\partial N\} \times \{-\partial N/\partial A\} < 0.$$

Thus, as the competition banks face from the capital market intensifies (lower A), relationship lending retreats and aggregate bank lending diminishes. Q.E.D.

Proof of Theorem 4: The first-order condition in equation (A12) can be stated as

$$Y[1/N][v_H - v_L][2q\gamma^* + 1 - q] = C'_i(\gamma^*). \quad (\text{A15})$$

Totally differentiating equation (A15) yields

$$\frac{d\gamma^*}{dN} = - \left\{ \frac{C'_i(\gamma^*) - Y[v_H - v_L][2\gamma^*\{dq/dN\} - dq/dN]}{C''(\gamma^*)N - 2Yq[v_H - v_L]} \right\}. \quad (\text{A16})$$

Now, from equation (A13) we know that $C''(\gamma^*)N - 2Yq[v_H - v_L] > 0$. Moreover, because $C'_i(\gamma^*) > 0$ and $dq/dN > 0$, it is clear that $C'_i(\gamma^*) - Y[v_H - v_L][2\gamma^*\{dq/dN\} - dq/dN] > 0$ for $\gamma^* \leq 0.5$. Further, because $d(q/N)/dN < 0$, we know that $dq/dN < q/N$. Given this, we see that $d\gamma^*/dN < 0$ in equation (A16) when the condition $C'_i(\gamma^*) > Y[v_H - v_L] \times [q/N][2\gamma^* - 1]$ holds for $\gamma^* > 0.5$. Given equation (A15), it is clear that this condition holds. Q.E.D.

Proof of Theorem 5: The competitiveness of the capital market (A) enters the analysis through its effect on N^* . Because $dN^*/dA > 0$ and by equation (A16) we have $d\gamma^*/dN < 0$, we immediately have $d\gamma^*/dA < 0$. Q.E.D.

Proof of Theorem 6: The borrower's expected cost of capital market funding is $\beta = r_f + A[1 - \theta]$, where $A = \tau_o/D^+$. It follows immediately that $d\beta/dA > 0$. Thus, a more competitive capital market lowers the funding costs of borrowers in the market. Q.E.D.

Proof of Theorem 7: From the proof of Theorem 3 we know that θ_T is unaffected by changes in q . This is because, at borrower quality $\theta = \theta_T$, rents to banks are zero and changes in q do not affect the welfare of these borrowers. Also, the competitiveness of banks serving borrowers with $\theta = \theta_T$ does not change. Thus, the welfare of capital-market borrowers (all with $\theta > \theta_T$) is unaffected. Q.E.D.

Proof of Theorem 8: These results follow readily from the discussion in the text and Figures 5 and 6. Q.E.D.

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