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Loan Sales as a Response to Market-Based Capital Constraints

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Abstract

Models of bank loan sales often appeal to regulatory constraints to motivate this off-balance-sheet activity. Here, we present a market-based model of bank asset sales in which information asymmetries create the incentive for unregulated banks to originate and sell loans to other banks, rather than fund them with deposit liabilities. Banks have a comparative advantage in locating and screening projects within their locality. However, because of private information, banks can fund projects in their portfolio only to the extent that their capital can adequately buffer potential losses on these investments. A loan sales market allows a banker having adequate capital to acquire profitable projects originated by a banker whose own capital is insufficient to support the additional risk.

1. Introduction

Loan sales and securitized loan pools, which are both commonly referred to as asset-backed lending, are two examples of an increasingly important mode of funding for particular types of credit. The proliferation of asset-backed lending by banks is popularly viewed as a response to regulatory costs in tandem with the provision of the federal safety net. These government policies affect the profitability of financing investments with deposit liabilities versus that associated with off-balance-sheet funding. Benveniste and Berger (1987) formalize this view, showing how asset-backed lending with recourse allows a bank to maximize the value of deposit insurance by issuing claims that are senior to those of the FDIC. However, the current trends in bank regulation and the growth of asset-backed lending by nonbank firms raise the question of whether these activities are largely regulatory artifacts or represent an efficient means of facilitating credit flows in an unregulated environment.

Asset-backed lending occurs in many forms and for many reasons.[1] This paper presents a model offering information-based motives for banks to engage in a particular type of asset-backed lending: loan sales for which there is no recourse on the sellers associated with the performance of the claims. These transactions seem inconsistent with the notion that because information about bank borrowers is private, bank loans are illiquid.

We develop a general equilibrium model in which localized information creates the incentive for some banks to originate investments and sell them to other investors rather than fund them on their balance sheets. The framework builds on the work of Bernanke and Gertler (1987) and Samolyk (1989). These papers do not describe asset-backed lending, but motivate limits to on-balance-sheet intermediation that can cause banks to forgo profitable investment opportunities. In these models, the prohibitive cost of monitoring banks causes depositors to limit the risk of bank portfolios to that which bank capital can absorb. Hence, bankers may be constrained from funding profitable but risky projects because they have insufficient capital. We examine how loan sales can mitigate yield differentials across banks that arise due to information-based capital constraints.

In our model, bankers are localized in the sense that they have a comparative advantage in locating and screening certain projects. These localities are meant to reflect the information costs between banks that lend to certain regions or to certain types of borrowers. Bankers are limited in the volume of local projects they can fund on-balance-sheet, because it is sufficiently costly to monitor the performance of a bank's portfolio. They can hold risky projects in their portfolios only to the extent that bank capital can buffer potential losses on these investments. Here, yield differentials arise because some bankers have more profitable projects than they can support with their capital. We show that a banker with excess capital may be willing to purchase projects originated by a constrained banker, although he would not fund the banker's acquisition of the same investments. Thus, loan sales facilitate certain investments by separating the return on these projects from the performance of the originating bank's portfolio.

In this paper, we do not model longer-term imbalances in regional banking conditions that would be associated with a structural reallocation of bank capital in equity markets. Rather, we consider a short-run scenario in which bank equity capital is given and each banker has an advantage in obtaining information about certain *local* investment opportunities, which other bankers do not have. In this setting, we characterize shorter-term variations in local market conditions that give rise to the need for a "market" in which loan sales can occur. Specifically, although bankers face identical long-run market conditions, short-run differences in the profitability of investment opportunities (in tandem with localized information) drive the loan sales market.[2] Moreover, although we analyze an unregulated banking sector, the model yields insights that are valuable in a setting in which a government regulator represents depositors' interests by imposing regulatory capital constraints.

Several other authors have characterized various dimensions of asset-backed lending as a nonregulatory phenomenon. Greenbaum and Thakor (1987) and James (1988) depict asset-backed lending by banks as an alternative to traditional on-balance-sheet funding. In both of these models, off-balance-sheet funding involves some recourse or claim on the originating bank in the event of default.

In Greenbaum and Thakor, asset-backed lending arises as an alternative funding mode that signals the quality of an asset to nonbank investors (eliminating their need to screen the project themselves). The amount of bank collateralization (recourse) signals project quality. Alternatively, in James, loan sales with recourse are a means of financing certain projects by issuing claims that are senior to those funding banks' on-balance-sheet assets. This may mitigate an underinvestment problem by allowing banks to originate and fund investments at better terms than they could obtain on their balance sheets.

Because we model asset-backed lending as an alternative funding mode for intermediaries, our paper is similar to both Greenbaum-Thakor and James. In these models, however, the recourse on the originating bank is a key factor that drives asset-backed lending. Although this captures an important feature of securitized loan pools involving the provision of credit enhancements, a bank loan sale frequently provides no recourse against the bank selling the loan (Gorton and Haubrich [1990]). The present model attempts to explain why loan sales will occur even when there is asymmetric information about asset quality and there is no recourse against the bank selling the loan.

Our model is also related to that of Boyd and Smith (1989), who consider informationally segmented markets in which credit may be rationed. In their paper, asset-backed lending takes the form of an intermediary coalition of local borrowers who desire funds. This intermediary pools and monitors loans, funding them by issuing claims to investors in other markets. Like Diamond's (1984) model of intermediation, diversification by this intermediary coalition allows the ultimate investors (lenders in the unrationed market) to delegate monitoring--albeit here, to an intermediary in the credit-rationed market where the loans are originated. In their model, as in ours, asset-backed lending occurs in order to equalize the expected return on investments across markets. However, whereas Boyd and Smith model asset-backed lending as the formation of an intermediary, we characterize it as a process by which an intermediary funds a share of its investments off-balance-sheet.

The paper is organized as follows: Section 2 outlines the model of a banking sector that is localized due to information costs. Section 3 describes the local banker's maximization problem and motivates loan sales as a response to regional imbalances in investment opportunities. Section 4 formalizes the loan sales transaction. Section 5 presents alternative allocations in the loan sales market under different pricing scenarios, and section 6 concludes.

2. The Basic Setup of the Model

2.1 Investment Opportunities

We consider an endowment economy made up of risk-neutral individuals who will subsequently be described as bankers and depositors. These individuals are distributed across informationally segmented markets. In each market, there is an unlimited supply of safe, perfectly divisible projects available to all individuals. Denoted by s, safe projects yield a gross risk-free rate of return of R^f in the next period. Each banker also has N local risky investment opportunities, each of which costs $1 and yields two possible outcomes in period 2: θ_L if the project fails and θ_H if it succeeds. These projects are assumed to be indivisible (bankers may not invest in a fraction of a project). The probability of success for each risky project is a random variable that is independently and identically distributed with $\pi_{i,j} \sim U(0,1)$, where $\pi_{i,j}$ is the probability that a given project i in market j will succeed. Once the set of $\pi_{i,j}$'s is realized, each local banker ranks the success probabilities of his local projects from high to low, $\pi_{1,j} <\ldots< \pi_{N,j}$. It is assumed that $\theta_L < R^f < \theta_H$, so that bankers will be willing to hold both safe and risky projects. In addition, because there are only a finite number of local projects, a banker cannot completely diversify project risks. The distribution of information about risky project returns will be described subsequently.

2.2 Depositors and Bankers

In this economy, both bankers and depositors live for two periods. In period 1 they are distributed evenly across informationally segmented markets. To simplify the derivation of the market equilibria, we assume that there is one banker per region.[3] In addition, the number of depositors per region is normalized to unity. All individuals are risk-neutral and care only about the expected value of their wealth in period 2.

In period 1, a banker in market j takes his endowment of bank capital, w_j^b, as given, and contracts to finance investments that maximize expected second-period profits. We assume that w_b is identical across all banks in all regions. Without loan sales, bankers invest their endowments and attract local deposits to fund their on-balance-sheet portfolios. When loan sales are feasible and profitable, bankers use their endowments, local deposits, and the proceeds from loan sales to undertake profitable investment opportunities. In period 1, the representative depositor in each market receives an endowment, w^d, which is identical across markets. Although depositors can directly hold safe projects, we assume that if bank deposits yield an expected return of at least R^f in period 2, depositors will supply their entire endowment to bankers. Moreover, as will be discussed shortly, information costs will cause depositors to fund banks only within their own regions; thus, $w^b + w^d$ is the total amount of local funds available per region. However, $N < w^b + w^d$, so that it is feasible for all risky project opportunities in a region to be funded locally. This setup allows us to characterize equilibria in which the amount of total deposits per bank will equal the representative depositor's endowment, w^d, and to focus on other factors driving loan sales across markets.

2.3 Information Assumptions

We make the following assumptions about the distribution of information in the economy. Bankers possess an information technology that enables them to screen the ex ante *quality* and monitor the ex post *performance* of certain risky projects. Each banker can costlessly screen the success probabilities of locally available project opportunities before choosing which projects to fund. Depositors and other bankers cannot observe the *quality* of a given banker's projects, as the banker's draw of $\pi_{i,j}$'s is private information. However, all individuals know the distribution of the success probabilities for risky projects ($\pi_{i,j}$ ~ U[0,1]), as well the possible payoffs. Bank technology also allows a banker to privately observe the ex post *performance*, (θ_L or θ_H), of the projects that are *owned directly* in the sense of being funded on-balance-sheet. We assume that it is prohibitively costly for depositors and other bankers to monitor the ex post performance of risky projects that they do not hold directly. Finally, although the ex ante quality and the ex post performance of risky projects are privately observed, the portfolio decisions of all bankers are publicly observable within and across regions.

2.4 Imperfect Information and Loan Sales

We model loan sales as a response to the limits of on-balance-sheet intermediation. The extreme nature of the information asymmetries allows us to characterize these limits in a parsimonious fashion. First, the assumption of prohibitive monitoring costs easily allows us to characterize the use of deposit liabilities as a source of funds by bankers. Here, as in Bernanke and Gertler (1987), because ex post *performance* cannot be monitored, on-balance-sheet funding cannot be associated with a contractual return that is contingent on the performance of risky project returns. In addition, infinite monitoring costs make it easy to characterize how individuals limit the risks taken on by banks. Depositors limit the portfolio decisions of bankers in order to ensure that the institutions can meet their liabilities.

Although the ex post performance of a project is private information, if a project is sold, the new owner will be privy to this information.[4] Alternatively, a banker's comparative advantage in screening the ex ante quality of a local project cannot be transferred. It is this dimension of the bank information technology that is assumed to be immobile in the sense that it is localized. The private nature of information about ex post *performance* underlies the market-based capital constraint that limits a bank's risky lending. However, the prohibitive cost of screening nonlocal project *quality* prevents interregional direct investment and creates the need for a loan sales market.

Given our short-term focus, the assumption of localized screening does not seem to be unwarranted. It is consistent with banks having the capacity to develop expertise in locating projects in other regions over time, for example by setting up a loan office, should longer-term profit opportunities arise. In the short run, banking markets are identical ex ante and differ only after they receive their draws of local project opportunities. Hence, there is no ex ante incentive for bankers to incur the technological costs associated with screening nonlocal projects. This setting allows us to focus on how short-term variations in local banking conditions--specifically in loan demand as characterized by the profitability of local investment opportunities--might give rise to a "market" for loan sales. It should be noted, however, that localized screening does give firms a degree of short-run market power.

3. Market-Based Capital Constraints

3.1 Bank Profit Maximization

We now present the general bank profit-maximization problem solved by each banker. (The indices indicating the market of the local banker will be omitted for simplicity when possible.) We then describe the market equilibria when loan sales are prohibited. This allows us to characterize more fully the nature of the loan sales market as a response to market-based capital constraints.

After project draws are realized, region j is characterized by a particular realization of $\pi_{i,j}$'s (for $i = 1 \ldots N$). At this time, banker j originates local risky projects, contracts with depositors, and funds a set of investments. In choosing the number of risky projects to hold, a banker chooses the n **best** projects having expected returns associated with the n highest success probabilities. In addition, a loan sales market facilitates the outright sale of a subset of projects originated locally as well as the acquisition of nonlocal projects. Our model implies that bank portfolio choices occur simultaneously. However, to simplify the exposition, we will describe each banker 's choices sequentially; a banker first chooses the loans that he will fund on-balance-sheet and then decides whether to contract with another banker to buy or sell loans.

Banker j may offer to sell a *pool* of loan projects, L_p, to a nonlocal banker. He chooses the n best projects to hold on-balance-sheet, and given the informational assumptions is indifferent between selling the next best project available (with success probability of π_{n+1}), versus those of lower quality, (π_i, $i = n+2, \ldots N$). We will make the standard assumption that when selling a pool of loans, a banker will include the best of the remaining local projects.[5] A set of loans, $L_p = \{n+1 \ldots n+\ell_p\}$, sells for a per-project price, $P(\ell_p)$, where the price per loan depends on the number of projects in the pool, ℓ_p. The proceeds from the transaction are used by the seller to originate the projects, at which time they are transferred to the purchasing banker. Although the purchaser of the pool knows that it includes the seller's best remaining investment opportunities, the individual projects in a loan pool cannot be distinguished from one another. This implies that the value of any particular project is evaluated as the average of the value of the pool. Hence, both the price and yield of a loan that is sold will depend on the scale of the seller's activity in the market.

Symmetrically, a banker (such as banker j) may purchase a pool of nonlocal loans, $L_{p,k}$, from a banker in market k, who has pooled the $\ell_{p,k}$ best unfunded projects in his market. Thus, a loan purchase stipulates the acquisition of a set of projects, $L_{p,k} = \{n_k+1 \ldots n_k+\ell_{p,k}\}$, from banker k for a per-project price of $P(\ell_{p,k})$. The proceeds from the transaction are used by banker k to originate the projects in the pool, which are then transferred to the purchasing banker.

A main theme in our subsequent analysis is how the profitability of a nonlocal loan pool is assessed. Since banker j cannot distinguish among the different projects in the pool $L_{p,k}$, he assesses the expected return of any given loan in the pool as the average of the projects in the pool:

$$(1)\quad E(R(L_{p,k})) = \frac{1}{\ell_{p,k}} \sum_{i=1}^{\ell_{p,k}} E(\pi_{n_k+i})(\theta_H - \theta_L) + \theta_L,$$

where n_k is the number of projects that banker k has funded on-balance-sheet.

In period 1, banker j maximizes expected period 2 profits of

$$(2)\quad \Pi = \sum_{i=1}^{n} [\pi_i\theta_H + (1-\pi_i)\theta_L] + R^f s + E(R(L_{p,k}))\ell_{p,k} - R^d d,$$

where R^d is the gross rate of return paid on deposit liabilities of d, $n \in [1 \ldots N]$ is the number of local risky projects originated *and* funded *on-balance-sheet*, and s is banker j's investment in safe projects. As defined by equation (1), $E(R(L_{p,k}))$ is the expected period 2 return on a pool of $\ell_{p.k}$ projects purchased from banker k. Banker j maximizes equation (2) subject to the portfolio-balance constraint,

(3) $d + w^b + (P(\ell_p) - 1)\ell_p = n + s + P(\ell_{p,k})\ell_{p,k}.$

The left side of equation (3) indicates that any proceeds from loan sales net of origination costs, $(P(\ell_p) - 1)$, augment bank capital and deposits as a source of funds for on-balance-sheet activities. The right side of (3) comprises on-balance sheet investments, specifically, the outlay for a pool of $\ell_{p,k}$ nonlocal projects and the origination of n local risky projects and s safe projects.

Because depositors cannot observe the ex post returns on a bank's risky investments, the banker must offer a return on deposits that is not contingent on the return on bank projects. Deposit contracts must also offer a return that is greater than or equal to the opportunity cost of funds. These two considerations imply that

(4) $R^d \geq R^f.$

Finally, since the number of indivisible risky bank projects is finite and hence there is some probability that a bank could realize θ_L on all of its risky investments (including loan purchases), depositors impose what amounts to a solvency constraint on a bank as a prerequisite for supplying on-balance-sheet funding:

(5) $\theta_L(n + \ell_{p,k}) + R^f s \geq R^d d.$

Equation (5) states that in order to attract deposits, banker j must hold a portfolio that allows the contractual return, R^d, to be paid, even if risky projects (including loan purchases) yield θ_L. The deposit contract follows from the assumption that it is prohibitively costly to monitor ex post project performance; depositors require that a banker limits ex ante portfolio risk to ensure payment.[6]

3.2 Market-Based Capital Constraints with No Loan Sales

We first describe bank profit maximization when loan sales and purchases are prohibited, $(\ell_{p,k} = 0, \ell_p = 0)$. In period 1, banker j contracts with local depositors and chooses n and s to maximize equation (2), subject to constraints (3), (4), and (5). The profit-maximizing choice of n is equivalent to the choice of a cutoff success probability for investment in local risky projects. Substituting (3) into both (2) and (5) for d, the first-order conditions for n and s can be written as

(6) $\pi_n(\theta_H - \theta_L) + \theta_L(1+\beta) = R^d(1+\beta)$,

(7) $s > 0 \Rightarrow R^f(1+\beta) \geq R^d(1+\beta)$,

where the multiplier β is positive when (5) is binding for the profit-maximizing level of risky investments.[7]

In characterizing the local equilibria, we consider outcomes in which there are interior solutions for n and s in all markets. It is assumed that a bank intermediates all local funds. Hence, $d = w^d$ and $N < w^b + w^d$ indicate that all bankers hold some safe projects.

Constraints (4) and (7) imply that depositors are paid the risk-free rate, $R^d = R^f$. Hence, (6) can be rewritten as

(8) $\pi_n(\theta_H - \theta_L) + \theta_L = R^f + \beta(R^f - \theta_L)$.

This expression states that when constraint (5) is binding, (β>0), the expected return on the marginal risky project that is funded exceeds the risk-free rate. It is this inability to fund "profitable" local projects on-balance-sheet that will lead to loan sales.

In addition, using equation (3), (5) can be written as

(9) $\theta_L n + R^f(w^b + w^d - n) \geq R^f w^d$,

when loan sales are prohibited. Solving equation (9) for n yields the constraint on the on-balance-sheet funding of risky projects,

(10) $$n \leq \frac{R^f w^b}{(R^f - \theta_L)} \equiv n_c,$$

where n_c is the maximum number of risky projects that the banker's capital can support. We refer to n_c as the *market-based capital constraint* on a banker's risky investments. Upon realizing a draw of project opportunities, a banker invests in the best local projects available subject to this constraint. We assume that $n_c < N$; thus, a banker cannot fund all risky project opportunities in his locality.

3.3 Alternative Equilibria: Constrained vs. Unconstrained Banks

In a world without asymmetric information, a risky project is profitable as long as its success probability is such that it yields an expected return greater than the risk-free rate. Setting β=0 in (8), the cutoff probability that equates the expected return on the marginal project with the safe rate is

(11) $\pi_{uc} = \frac{(R^f - \theta_L)}{(\theta_H - \theta_L)}$.

A local banking market is *unconstrained* when $\pi_{n_c,j} < \pi_{uc}$ (hence it is unprofitable to invest in n_c projects). In this situation, a banker funds $n_{uc,j}$ projects where $\pi_{n_{uc},j} = \pi_{uc}$ (note that the equality may not hold exactly because of integer conditions). All remaining local funds are invested in safe projects, hence $s_{uc,j} = w^b + w^d - n_{uc,j}$. It is useful to note that the subscript *j* indicates that the mix of $s_{uc,j}$ and $n_{uc,j}$ will differ across banking markets. For each unconstrained banker, the number of projects with success probabilities greater than π_{uc} depends on the particular draw of project opportunities in each market. However, all individuals can observe how many projects each banker has funded.

A banking market is *capital-constrained* whenever the draw of local risky project opportunities yields a quantity of "good" investments ($\pi_{i,j} > \pi_{uc}$) that exceeds n_c. In a constrained market, the number of profitable projects is *too* large relative to the banker's available capital. In this scenario, the banker originates and funds the n_c best projects as given by (10) and the expected return on the marginal project funded is greater than the risk-free rate, $\pi_{n_c,j} > \pi_{uc}$. The banker invests all remaining deposits in safe projects; hence, $s_c = w^d - \theta_L w^b / (R^f - \theta_L)$.

What is important for the subsequent analysis is that the investment decision by each risk-neutral banker is not only a function of the expected profitability of local projects, but also of capital adequacy. An otherwise identical banking market is capital-constrained when the number of profitable local projects exceeds that which bank capital can support. Given our setup, the portfolio mix of investments in each constrained banking market (n_c and s_c) is the same because all markets are identical except for their draws of project opportunities. Moreover, since both depositors and nonlocal bankers can observe a banker's investment decisions, they know whether bankers in these markets are funding their *financial capacity,* defined as the maximum number of risky projects that bank capital can support. However, unlike unconstrained markets, the quality of the marginal investment funded in each constrained market ($\pi_{n_c,j}$) cannot be inferred from portfolio behavior.

In the absence of loan sales, the marginal expected returns of risky projects may be different across localized markets. Market-based capital constraints imposed by depositors as a prerequisite for funding can prevent a banker who is receiving a relatively *good* draw of projects from funding them. At the same time, capital adequacy is not a constraint on a banker with relatively *bad* investment opportunities. Although it is known that banking markets are constrained because they have too many profitable projects, banks in unconstrained regions will not *lend* funds to a capital-constrained bank because they, just like local depositors, cannot monitor the ex post performance of another bank's risky investments. At the same time, unconstrained bankers cannot directly invest in projects in constrained regions because they cannot screen the success probabilities of the unfunded projects. As we will show, loan sales can help mitigate these intermarket yield differentials.

4. Loan Sales as a Response to Market-Based Capital Constraints

4.1 Incentives for Loan Sales

In this section, we permit loan sales to take place in response to intermarket yield differentials. In the following discussion, we posit that the draws of project opportunities in the economy are such that some banking markets are constrained and some are not. The incentive for loan sales is obvious. The market-imposed capital constraints on banks reflect the private nature of the ex post returns on risky bank projects. If banker k is constrained and banker j is not, then $\pi_{n_c,k} > \pi_{n_{uc},j} = \pi_{uc}$, and banker k has profitable projects that are unfunded. Although banker j will not lend to banker k, he would be willing to purchase some projects outright if he could ascertain that they were of sufficiently good quality. Hence, loan sales arise when an unconstrained banker determines that the expected return on a constrained banker's best unfunded project exceeds the risk-free rate.[8] Below, we describe bank profit maximization when loan sales are permitted.

4.2 Profit Maximization with Loan Sales

In period 1, after local success probabilities are realized, each banker assesses the number of projects to originate as well as whether to sell or buy loans. To simplify the analysis, we will consider a constrained banker k and an unconstrained banker j and impose the following conditions that can easily be proven. First, unconstrained banker j will buy but not sell loans (as $n_{uc,j} < n_c$ signals that the next-best loan has an expected return less than R^f). Second, constrained banker k will sell but not buy loans (as funding n_c loans signals that he has good project opportunities).

Allowing for loan sales, constrained banker k contracts with local depositors and chooses $\{n, s, \ell_p, d\}$ in period 1 to maximize equation (2) subject to (3), (4), (5), and the non-negativity constraint, $\ell_p \geq 0$. (The indices for market k have been omitted, indicating that banker k is the local banker--albeit a loan seller.) Some obvious substitutions yield the following conditions associated with banker k's decision to sell loans:

(12) $\ell_p > 0 \;\; \textit{if} \;\; R^f(1+\beta)\{P(1)-1\} \geq 0$,

(13) $\ell_p > 0 \Rightarrow R^f(1+\beta)\{P(\ell_p)\ell_p - P(\ell_p - 1)(\ell_p - 1) - 1\} = 0$.

Equation (12) simply says that a constrained banker will sell at least one loan if the price it receives for the loan exceeds the origination cost (recall that each project costs one unit of endowment). Equation (13) states that if a constrained banker sells loans, he will do so until the profits on the pool are maximized.

Unconstrained banker j contracts with local depositors and chooses $\{n, s, \ell_{p,k}, d\}$ in period 1 to maximize equation (2) subject to (3), (4), (5) and the non-negativity constraints, $\ell_{p,k} \geq 0$ (again, the indices for market j are omitted). The solution to this problem yields the conditions associated with unconstrained banker j's loan purchases from banker k:

(14) $\ell_{p,k} > 0 \;\; \textit{if} \;\; E(\pi_{n_k+1})(\theta_H - \theta_L) + \theta_L \geq R^f P(1)$,

(15) $\ell_{p,k} > 0 \;\; \Rightarrow \;\; E(\pi_{n_k+\ell_{p,k}})(\theta_H - \theta_L) + \theta_L = R^f\{P(\ell_{p,k})\ell_{p,k} - P(\ell_{p,k} - 1)(\ell_{p,k} - 1)\}$.

These conditions also have useful interpretations. Equation (14) states that an unconstrained banker will purchase at least one loan from a constrained banker in region k, if the period 2 return exceeds the return forgone by not funding safe projects (the risk-free rate multiplied by the period 1 price of the loan). Equation (15) states that if an unconstrained banker buys loans, he will do so until the profits on the pool are maximized.

Combining equations (12) and (14), a necessary condition for the sale of at least one loan to arise is that the expected return (from an unconstrained banker's point of view) of a constrained banker's marginal unfunded project exceeds the risk-free rate. The appendix shows that a sufficient condition for this to occur is for the number of total project opportunities to be large relative to local bank capital. Notice that the price of loan sales is indeterminate, since loan sales occur between bilateral monopolies. As we shall discuss subsequently, the price of a loan can vary anywhere from its origination cost to the expected period 2 return on a loan discounted by the risk-free rate.

In allowing for loan sales, we continue to assume that bankers intermediate all local funds. Thus, using $d = w^d$, substituting (2) into (4) yields the capital constraint of constrained banker k as a loan seller:

$$(16)\quad n \leq \frac{R^f[w^b + \ell_p(P(\ell_p)-1)]}{(R^f - \theta_L)} \equiv \hat{n}_c.$$

Expression (16) states the constrained banker's risky investments (here banker k's) must not exceed $\hat{n}_c$. It also shows that *selling* loans does not impinge on bank capital because the projects are sold without recourse. In fact, the net proceeds from loan sales, $\ell_p(P(\ell_p)-1)$, indicate that loan sales may be a source of internal funds that augment bank capital in supporting on-balance-sheet investments.

Alternatively, the capital constraint for an unconstrained banker who purchases loans is

$$(17)\ n + \ell_{p,k} \leq \frac{R^f w^b}{(R^f - \theta_L)} \equiv n_c.$$

The maximum level of on-balance-sheet risky investments is the same as in the no-loan-sales equilibrium. Moreover, equation (17) indicates that loan purchases are subject to the same capital-adequacy requirements as local risky investments. Capital must adequately buffer the potential losses on these risky acquisitions.

5. Alternative Equilibria in the Loan Sales Market

5.1 Pricing Loan Sales Contracts

We now characterize how alternative pricing scenarios in the transaction between banker j and banker k affect the equilibria in terms of the bilateral loan sales contract. While the incentive for a bilateral trade is obvious, the size and price of the pool of projects are not. Pure arbitrage suggests that mutually beneficial exchange can occur via a loan sale by constrained banker k to unconstrained banker j as long as $E(R(L_{p,k}))/R^f \geq P(\ell_{p,k}) \geq 1$. However, the bilateral nature of the contract does not pin down an equilibrium price. Thus, we will characterize the allocations in the loan sales market when $P(\ell_{p,k}) = 1$ and $P(\ell_{p,k}) = E(R(L_{p,k}))/R^f$, respectively. In the first pricing scenario, a loan purchaser accrues all of the profits from the transaction; we therefore refer to this scheme as a buyer's market. In the second scenario, a loan seller receives all of the rents from the sale, so we refer to this scheme as a seller's market.

5.2 A Buyer's Market

When $P(\ell_{p,k}) = 1$, the loan purchaser obtains the maximum rents from the transaction. Note that in a buyer's market, banker k obtains no net proceeds from the sale; he continues to hold n_c projects and as a result, the next-best project included in the pool is $n_c + 1$. Assuming that banker j has sufficient capital to acquire the profit-maximizing number of projects (β=0 after the transaction), equation (15) becomes

(18) $E(\pi_{n_c + \ell_{p,k}})(\theta_H - \theta_L) + \theta_L = R^f$,

which states that a buyer will buy loans until the expected return of the marginal project funded equals the risk-free rate. As (15) indicates, banker k, as a seller, is indifferent to the trade at this price.

This pricing scenario implies a relatively simple equilibrium allocation. Constrained banker k continues to fund n_c loans on-balance-sheet and sells $\ell_{p,k}$ projects to unconstrained banker j.

Although banker j cannot verify that banker k has $\ell_{p,k}$ profitable remaining projects, based on his assessment, he expects to receive a pool of projects in which the marginal project included has an expected return equal to the risk-free rate. Thus, when $P(\ell_{p,k}) = 1$, loan sales occur until the marginal project funded in market k has an assessed return equal to the risk-free rate. As we have described, banker j's choice of $\ell_{p,k}$ is conditional on the knowledge that banker k is lending at his financial capacity and that banker k's remaining projects are likely to be more profitable than safe projects. It should be noted that if banker k could acquire sufficient capital, he would fund the number of risky projects that would reflect his particular draw of project opportunities ($n_{uc,k}$). This may or may not equal $n_c + \ell_{p,k}$.

In an economy where unconstrained bankers have sufficient capital (to acquire all loan pools deemed as profitable), the buyer's market results in the following market allocations. All bankers can observe which banking markets are funding their financial capacity, n_c, on-balance sheet. As indicated, conditioning on this information, bankers with excess financial capacity ($n_{uc,j} < n_c$) will finance and acquire "extra" projects originated by the bankers in constrained regions. Constrained bankers continue to hold the no-loan-sales allocation of n_c on-balance-sheet. However, they each will originate $n_c + \ell_p$ projects and sell ℓ_p projects to an unconstrained banker (note that the subscript identifying the market has been dropped, indicating that all constrained markets have the same allocation). When the profit-maximizing volume of loan purchases does not impinge on the capital adequacy of purchasers, then loan purchases merely augment local risky investments as each loan buyer holds $n_{uc,j} + \ell_p$ risky projects (where local investments reflect the local draw of project opportunities).

Unconstrained bankers vary in their excess financial capacity, $(n_c - n_{uc,j})$, because each market's particular draw of projects determines $n_{uc,j}$. This implies that the profit-maximizing volume of loan sales may not be feasible for some banks, in particular, those with local projects of better quality. However, each project in a pool is observationally equivalent to a loan purchaser. Thus, constrained bankers could pool their projects and let the risk-neutral purchasers pick a random subset of the ℓ_p projects offered by each constrained banker. In this scenario, if aggregate capital is sufficient, the market can fund the optimal volume of loan sales.

We can also compare how the level of investment with a loan sales market compares to that which would occur if all regions had enough capital to fund all profitable projects locally $(n_j = n_{uc,j} \vee j)$. Consider an economy that is made up of many markets (both constrained and unconstrained) and has sufficient capital to support the optimal volume of loan sales. We know that the level of local investment in unconstrained markets is optimal. Moreover, the optimal volume of loan sales is such that the marginal project funded has an expected return that equals the risk-free rate. Thus, although some constrained markets are selling too many projects, $(n_c + \ell_p > n_{uc,k} > n_c)$, and others too few, $(n_{uc,k} > n_c + \ell_p > n_c)$, on average the loan sales market can support the optimal *level* of risky investments in the economy.

5.3 A Seller's Market

We now describe the loan sales transaction when a loan seller receives the maximum profits from a transaction: $P(\ell_{p,k}) = E(R(L_{p,k})) / R^f$. This pricing conjecture complicates the analysis in two ways. First, the assessment of the expected return on unfunded projects is inferred from *observed* portfolio behavior. Therefore, if $P(\ell_{p,k}) > 1$, unconstrained bankers may have the incentive to mimic constrained bankers. This would involve funding some unprofitable local projects in order to appear to have received a good draw of investment opportunities. When $P(\ell_{p,k}) > 1$, however, loan sales yield period 1 profits that can be used to support additional investments.. Hence, it may be profitable for a banker to fund some marginally unprofitable projects in order to appear to be constrained and thus sell loans. We initially refrain from discussing this issue and characterize the loan sales market assuming that unconstrained bankers do not mimic constrained bankers.

The second complication is that when $P(\ell_{p,k}) > 1$, a loan seller increases his on-balance-sheet capacity by engaging in loan sales, $\hat{n}_c > n_c$. Here we will assume that the proceeds from loan sales do not increase capacity enough to eliminate the binding nature of the capital constraint in otherwise-constrained markets.

Substituting $P(\ell_{p,k}) = E(R(L_{p,k})) / R^f$ into equation (15) indicates that a loan purchaser is indifferent to the size of the loan pool because the expected return from adding each loan to the pool just equals the risk-free rate. Substituting this pricing scheme into equation (13), rearranging and using expression (1) yields

(19) $E(\pi_{\hat{n}_c+\ell_{p,k}})(\theta_H - \theta_L) + \theta_L = R^f,$

which indicates that a seller will include loans in a pool until the return on the marginal project (as assessed by the buyer) equals the risk-free rate: Interestingly, this is the *same* criterion used in determining the size of the pool in a buyer's market. These results reflect the fact that a buyer's assessment ultimately determines the profitability of the pool, no matter who gets the profits. Thus, the same number of risky loans will be originated by a constrained bank no matter which party receives the profits from loan sales.

When the price exceeds unity, banker k's financial capacity is increased by

(20) $\hat{n}_{c,k} - n_c = R^f (P(\ell_{p,k}) - 1)\ell_{p,k} / (R^f - \theta_L).$

Thus, a smaller share of a constrained banker's loan originations will be sold. This result reflects that, in a seller's market, a purchaser's assessment of $E(R(\ell_{p,k}))$ will be conditioned on a higher level of on-balance-sheet investment by banker k. Knowing that banker k will use the proceeds from the loan sale to fund more loans, banker j will assess a lower success probability on the remaining projects, $i = \hat{n}_c + 1, \ldots, N$. The size of the loan pool in this pricing scheme will be smaller than in a buyer's market. However, in the previous section we showed that banker j would be willing to purchase ℓ_p projects from banker k. Conditional on banker k's higher level of on-balance-sheet funding, banker j will assess that $\ell_{p,k}(\hat{n}_c) = \ell_{p,k}(n_c) - (\hat{n}_c - n_c)$ projects have a return that exceeds the risk-free rate. Thus, the higher on-balance-sheet funding by sellers in a seller's market is offset by a lower volume of projects sold in each bilateral contract.

In an economy with sufficient capital to fund all loan pools, the seller's market (with no mimicking) results in the following allocation. All bankers can observe which banking markets are funding their financial capacity. Using this information as well as the knowledge that loan sellers will use the proceeds to fund additional projects, purchasers will assess the quality of remaining project opportunities. After transacting in the loan sales market, constrained bankers will hold $\hat{n}_c$ projects. They will originate $\hat{n}_c + \ell_p(\hat{n}_c)$, where $\hat{n}_c > n_c$ and $\ell_p(\hat{n}_c) < \ell_p$ (note again that the subscript identifying the market has been dropped, indicating that all constrained markets have the same allocation). Loan purchases merely augment local risky investments as each loan buyer holds $n_{uc,j} + \ell_p(\hat{n}_c)$ risky projects. Hence, as in the buyer's market, if economywide capital is sufficient, a loan sales market may facilitate the economy's optimal level of risky investments.

In general, it is not possible to characterize the number of loan sales without pinning down the pricing function $P(\ell_p)$. The preceding two sections assumed two different forms of $P(\ell_p)$ and showed that the same level of risky investment will be undertaken no matter which pricing function is chosen. It can also be shown that a linear combination of these two prices will also yield the same level of investment. Although this level of investment is not the first-best (the investment that would take place if all profitable projects in the economy could be identified and funded), it is a first-best given the information constraints. A third party, such as the government, could not improve on the investment decisions in the economy unless it had a better information technology.

5.4 Incentive Compatibility

As we have mentioned, a potential friction in the loan sales market is that an unconstrained banker may have the incentive to mimic a constrained banker in order to sell loans (when such sales generate profits and entail no recourse upon the seller). For example, an unconstrained banker, whose local project opportunities are *almost* good enough to merit the constrained level of investment, could undertake the small number of unprofitable projects necessary to reap the profits from loan sales by acting as if profit opportunities are better than they actually are.[9]

In our setting, these incentive compatibility considerations will make it more likely that buyers will accrue the rents from loan sales transactions. If, for example, a loan purchase involves paying origination costs plus a marginal fee to the seller, the incentive for profitable loan sales would remain and the incentives for misrepresentation would be mitigated. Alternatively, if a constrained banker could publicly signal that he is indeed constrained (although he cannot signal the actual success probabilities of his projects), misrepresentation would not be an issue. Finally, given that bankers are localized, if the local economy served as an accurate indicator of general lending conditions in the region--albeit not of individual project returns--loan sales of the type described would be feasible.

6. Conclusion

This paper has presented a market-based rationale for loan sales with no recourse. The analysis emphasizes the importance of internal bank funds as a determinant of local investment when bankers have a comparative advantage in screening and monitoring these projects. Costly information and the attendant importance of bank capital in limiting on-balance-sheet lending cause loan sales to arise. Here, loan sales are effectively a means of employing nonlocal bank capital to support local investments. The model characterizes how outright loan sales can occur even when acquiring banks cannot perfectly screen the ex ante quality of the loans they are purchasing; purchasers assess that banks are selling loans because they do not have the capital to hold them. Thus, an important prediction emerges: Banks that are capital-constrained in the face of high loan demand are more likely to engage in loan sales.

Interestingly, regional disparities in real sector conditions have been a hallmark of the U.S. economy. In tandem with imbalances in regional banking conditions, this indicates that the emergence of a loan sales market may, to some degree, reflect a need to match lending opportunities with able lenders. Berger and Udell (1993) find evidence that loan sales with no recourse do separate the risk of the claims from the balance sheet of the seller. In addition, Haubrich and Thomson (1993) conclude that (controlling for bank size, region, and holding company affiliation) loan sales are related to bank capitalization and local investment opportunities in the manner predicted by our model.

The loan sales market no doubt reflects the impact of government regulations that limit the industry's scale and scope. Nevertheless, localized or specialized lending by banks as well as nonbank intermediaries also reflects the very costs of identifying, monitoring, and funding bank borrowers that make financial structure important. Our framework focuses on these financial market imperfections--emphasizing that the nature of the information produced by financial firms can affect the form of external finance. Admittedly, our results reflect some extreme assumptions about the distribution of information across regions and individuals. In particular, we assume that it is prohibitively costly for depositors to monitor ex post returns as an expedient means of characterizing intermarket yield differentials. This assumption is not crucial. Finite monitoring costs can produce differential returns across markets because a bank's capital position will still influence the terms of finance it extends (and hence affect local banking conditions). Thus, when the amount of capital affects a banker's marginal investment decision, asset sales may be an efficient way of funding local loans in times of high loan demand.

Endnotes

1 Berger and Udell (1993) present a comprehensive review of both theoretical and empirical studies of off-balance-sheet activities by banks. Bhattacharya and Thakor (1991) survey the broader theoretical literature exploring intermediation.

2 Here, constrained regions are those where there are more profitable investments than in other areas. Similarly, to the extent that local recessions can serve to deplete bank capital, poor banking conditions may also make it more difficult for a region to fund local investments once economic conditions improve (see Bernanke and Gertler [1989]). Loan sales can potentially mitigate the problems arising from both of these sources of regional imbalances.

3 The assumption of a local monopoly banker allows us to easily pin down the rate paid to depositors. Although it implies that bankers face positive expected profits, here we are interested in examining how loan sales affect the expected return to aggregate investment, rather than the distribution of this return.

4 The assumption that ex post project returns can be observed only by the project owner simplifies the contractual nature of loan sales. If a loan is sold, only the purchaser observes the actual return of the project. This allows us to rule out contracts where the price of a loan depends on the outcome of that loan.

5 Alternatively, we could assume that banks within a region can screen a local loan, but that for a cost c, loan quality information could be acquired by banks in other regions. Banks in other regions, however, cannot directly perform the screening function, so the local bank has a comparative advantage in writing up a prospectus on local opportunities. Once the prospectus is written, however, banks in other regions can pay a fee to read the prospectus and ascertain a loan's quality.

6 The deposit contract is similar to those presented in Bernanke and Gertler (1987) and in Samolyk (1989). For brevity, we shall not present a rigorous discussion of the derivation of the contract here.

7 Because of integer conditions, equation (6) may not hold with equality. The assumption that safe loans are divisible implies that (7) will hold with equality when $s > 0$. For simplicity, we assume throughout the paper that there exists an integer, n, such that (6) will hold with equality.

8 Recall that we assume that a constrained bank will sell its next-best investment opportunity versus its worst investment opportunity.

9 Similarly, a marginally constrained banker must mimic other constrained bankers when the proceeds from loan sales eliminate the binding nature of the capital constraint. Even if he does not have enough profitable unfunded projects, he must invest the proceeds from the loan sale on-balance-sheet, or else he will not be able to sell loans.

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Appendix

As indicated by condition (14), unconstrained banker j (β=0) will buy one loan project from constrained banker k if $E(\pi_{n_c+1})(\theta_H - \theta_L) + \theta_L \geq R^f P(1)$. Symmetrically, (14) states that constrained banker k will sell one project as loan $P(1) \geq 1$. Thus, mutually beneficial exchange can occur if banker j can assess that $E(\pi_{n_c+1})(\theta_H - \theta_L) + \theta_L > R^f$.

A banker views the success probabilities of projects in another market as random variables. However, a banker can observe the level of investment in other markets and knows that a market is constrained when it has too many good projects. Banker j, therefore, observing that banker k is funding n_c projects, views the remaining $N - n_c$ investment opportunities in market k as potentially profitable. Thus, the banker assesses the quality of these nonlocal projects by forming a conditional expectation of the success probabilities of these investment opportunities. This assessment is based on the knowledge that banker k is constrained because $n_{uc,k} \geq n_c$ for all k such that $n_k = n_c$.

Given that banker k is funding $n_k = n_c$ projects on-balance-sheet, the expected return on the marginal unfunded project in the region is

(A.1) $$E(R(1)) = E[(E(\pi_{n_c+1} | \pi_N \leq \ldots \leq \pi_{n_{c+1}} \leq \pi_{n_c} \leq \ldots \leq \pi_1) | \pi_{n_c} \geq \pi_{uc}](\theta_H - \theta_L) + \theta_L,$$

where π_{uc} is given by (10). Henceforth $E(\pi_{n_c+i})$ will be used to refer to the expectation of the i^th^ marginal success probability conditioned on the ranking $\pi_1, \ldots, \pi_N$ and $\pi_{n_c} > \pi_{uc}$. The assessment of one project equals

(A.2) $$E(R(1)) = [1 - \frac{1}{2^{(N-n_c)}}]\frac{(1+\pi_{uc})}{2}(\theta_H - \theta_L) + \theta_L.$$

Thus, it is easy to verify that if $N - n_C$ is large, the next project available will have an expected return that exceeds the yield on safe projects. Expression (A.2) implies that a necessary and sufficient condition for project $n_c + 1$ to have an expected rate of return that exceeds R^f is given by

(A.3) $$\frac{1+\pi_{uc}}{(1-\pi_{uc})} < 2^{(N-n_c)}.$$

This expression is more likely to hold when $N - n_c$ is larger. The intuition behind this result is as follows: When the marginal project funded on-balance-sheet has an expected return greater than R^f, the greater the number of remaining projects available, the more likely it is that the next-best project will also have an expected return that exceeds the risk-free rate. Hence, if (A.3) is satisfied, for any price such that $E(R(1))/R^f \geq P(1) \geq 1$, banker j will purchase a loan from banker k.