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Banks as Liquidity Providers: An Explanation for the Coexistence of Lending and Deposit-Taking

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ABSTRACT

What ties together the traditional commercial banking activities of deposit-taking and lending? We argue that since banks often lend via commitments, their lending and deposit-taking may be two manifestations of one primitive function: the provision of liquidity on demand. There will be synergies between the two activities to the extent that both require banks to hold large balances of liquid assets: If deposit withdrawals and commitment takedowns are imperfectly correlated, the two activities can share the costs of the liquid-asset stockpile. We develop this idea with a simple model, and use a variety of data to test the model empirically.

WHAT ARE THE DEFINING CHARACTERISTICS of a bank? Both the legal definition in the United States and the standard answer from economists is that commercial banks are institutions that engage in two distinct types of activities, one on each side of the balance sheet—deposit-taking and lending. More precisely, deposit-taking involves issuing claims that are riskless and demandable, that is, claims that can be redeemed for a fixed value at any time. Lending involves acquiring costly information about opaque borrowers, and extending credit based on this information.

A great deal of theoretical and empirical analysis has been devoted to understanding the circumstances under which each of these two activities might require the services of an intermediary, as opposed to being implemented in arm's-length securities markets. While much has been learned from this work, with few exceptions it has not addressed a fundamental question: why is it important that *one institution carry out both functions*

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under the same roof?[1] For example, Diamond (1984) provides a convincing argument that some types of loans should be made by intermediaries, but it is hard to see in his model why the intermediary cannot be a nonbank finance company funded with short term debt, rather than a commercial bank funded with demand deposits. Similarly, Gorton and Pennacchi (1990) show that intermediation can be valuable in creating adverse-selection-free demand deposits, but it is again not obvious why this cannot be accomplished by mutual funds that invest only in liquid securities (e.g., high-grade commercial paper and T-bills) and that do not make any loans involving monitoring.

The question of whether or not there is a real synergy between deposit-taking and lending has far-reaching implications. On the one hand, if one takes the view that there is no synergy, the fact that banks engage in both activities might be interpreted as resulting from either past or current distortions in the regulatory environment. For example, it might be argued that deposit insurance has encouraged an artificial gluing together of the two activities, as banks attempt to maximize the value of the insurance put option by engaging in risky lending. Under this view, one would naturally tend to be sympathetic to "narrow banking" proposals, which effectively call for the breaking up of banks into separate lending and deposit-taking operations that would resemble finance companies and mutual funds, respectively.[2] On the other hand, if there is a real synergy, a forced switch to narrow banking could lead to large inefficiencies.

In a similar vein, models of the monetary transmission mechanism—particularly those that stress the so-called "bank lending channel"—often hinge crucially on the assumption that banks engage in both deposit-taking and lending.[3] In particular, central-bank open-market operations that affect the level of reserves in the economy can only have a direct effect on bank loan supply if banks are financed by reservable demand deposits. To the extent that there is an active lending channel, if the issuing of reservable deposits were to be decoupled from the function of extending credit to individuals and businesses, the conduct of monetary policy could be noticeably altered.

In this paper, we argue that there may indeed be significant synergies between deposit-taking and lending. We focus on a product that, in our view, is important in distinguishing banks from other lenders such as insurers and finance companies: loan commitments or credit lines (we use the two terms interchangeably in what follows). We take the central feature of a commitment to be that a borrower has the option to take the loan down *on*

[1] These exceptions include Calomiris and Kahn (1991), Flannery (1994), Qi (1998), and Diamond and Rajan (2001). We discuss some of these papers in more detail below.

[2] For narrow-banking arguments along these lines, see Simons (1948), Bryan (1988), Litan (1988), and Gorton and Pennacchi (1992).

[3] See, for example, Bernanke and Blinder (1988) and Stein (1998) for the theory behind the lending channel; Bernanke and Blinder (1992), Kashyap, Stein, and Wilcox (1993), Kishan and Opiela (1998), Ludvigson (1998), Morgan (1998), and Kashyap and Stein (2000) for supporting evidence; and Kashyap and Stein (1994) for a survey.

demand over some specified period of time.[4] Simply put, once the decision to extend a commitment has been made, it behaves *just like a demand deposit*: The customer can show up any time and withdraw funds, and these withdrawals will be somewhat random from the bank's perspective. Or said differently, both demand deposits and loan commitments offer to bank customers a very similar service: the provision of liquidity on demand to accommodate unpredictable needs.[5]

The next step in the argument is the observation that an institution that offers liquidity on demand must invest in certain costly "overhead" in order to carry out its job effectively. In particular, the overhead in our model consists of the large volume of cash and securities that a bank holds as a buffer stock on the asset side of its balance sheet.[6] Such a buffer stock is required to the extent that capital markets are imperfect, so that a bank cannot accommodate liquidity shocks simply by raising new external finance on a moment's notice. Moreover, this form of overhead is burdensome for a number of reasons. First, on the cash component, there is obviously the foregone interest. Second, even securities that bear a market rate of interest impose a cost on bank shareholders, because of the double taxation of the interest income in the corporate form. Finally, as is frequently argued in the corporate finance literature, a large balance of highly liquid assets gives managers a great deal of discretion, and is likely to increase agency costs (see Flannery (1994) and Myers and Rajan (1998)).

Once it is recognized that both deposits and loan commitments require overhead in the form of liquid-asset holdings, and that this overhead is costly, the potential for synergy between the two activities becomes clear. There will be a synergy to the extent that the two activities can "share" some of the costly overhead, so that a bank that offers both deposits and loan commitments can get by with a smaller total volume of liquid assets on its balance sheet than would two separate institutions that each specializes in only one of the functions. The synergy exists as long as deposit withdrawals and commitment takedowns are not too highly correlated. Intuitively, a deposit-taking bank holds a buffer stock of cash and securities as a hedge against a state of the world where there are large deposit outflows. But in many other states, there are no deposit outflows, and the buffer stock just sits idle. If the buffer stock can instead be used to accommodate commitment takedowns in these states, efficiency will be enhanced.

[4] Holmstrom and Tirole (1998) also stress that a key function of an intermediary is to provide liquidity in the form of loan commitments. However, they do not link the commitment function to the intermediary's liabilities.

[5] Diamond and Dybvig (1983) point to the intermediary's role in smoothing aggregate liquidity shocks through diversification, but do not emphasize that this can be done across both sides of the bank balance sheet.

[6] Over the period 1992 to 1996, a typical "small" bank with assets on the order of $36 million held roughly 5 percent of these assets in cash and another 35 percent in securities. For a "large" bank with assets on the order of $9.5 billion, the corresponding figures were 6 percent and 25 percent. See Table II below.

A simple example helps to illustrate the logic of our model. Imagine two intermediaries, *F* (for finance company) and *B* (for bank) who compete for the same pool of borrowers. The difference is that while *F* is financed entirely with long-term bonds, *B* has a "deposit franchise"—that is, it has a monopoly position that allows it to pay below-market rates on $100 of demand deposits. The only hitch with these deposits is that there is some probability that $20 of them will be withdrawn unpredictably. Assuming that *B* cannot raise external finance on short notice, it will have to keep $20 in cash on hand in order to exploit the rents from its deposit franchise. Now think about *F* and *B* competing to attract $20 worth of loan commitment business from a firm *X*. If we further assume for simplicity that commitment takedowns are perfectly negatively correlated with deposit withdrawals, it is clear that *B* will be a lower-cost producer of commitments, because it does not have to add to its cash balance to offer this service.[7]

Thus in this example, the bank *B* wins firm *X*'s commitment business. Moreover, once it has sunk the cost of investigating *X* to ensure that it is a good credit for the commitment, *B* will also have an advantage in competing with *F* for other business from *X* where liquidity provision plays no role—for example, it might be in a better position to offer *X* a term loan in addition to the commitment.

The example suggests two broad empirical implications of our theory. First, across types of financial institutions, we should see banks doing: (1) more commitment-based lending than other intermediaries such as finance companies or insurance companies as well as (2) more long-term lending to those particular borrowers who are also relatively heavy users of commitments. Second, within the commercial banking sector, those banks with the most pronounced advantage in offering demandable deposits (as measured, e.g., by the ratio of transactions deposits to total deposits) should: (1) hold more in cash and securities; and (2) do a greater fraction of their lending on a commitment basis.[8]

In the remainder of the paper, we develop this theory more fully, and test some of its principal implications. We start in Section I with a brief history of the commercial banking industry which suggests that our basic story is well motivated. In Section II, we sketch a simple model that formalizes the intuition from the example above. In Sections III and IV, we conduct our empirical tests. To preview, we find strong evidence for two basic propositions. First, banks do more commitment-based lending—especially via unsecured lines of credit—than any other type of lending intermediary. Second, within the banking sector, those banks with high ratios of transactions deposits to total deposits also have high ratios of loan commitments to loans—

[7] In our formal model, we relax these assumptions, so that: (1) external finance is costly but not impossible to raise; and (2) deposit withdrawals and commitment takedowns need not be negatively correlated, only less than perfectly positively correlated.

[8] Our focus on explicit loan commitments may arguably be too narrow. A broader interpretation of the model would encompass "implicit" commitments upheld by reputational considerations, whereby long-standing customers might come to rely on a bank to meet their unexpected liquidity demands even absent a formal contract. Unfortunately, the problem from an empirical perspective is that such implicit commitments cannot be measured.

that is, banks specializing in demandable deposits also seem to specialize in commitment-based lending, consistent with our theory. Conclusions follow in Section V.

I. Historical Overview

The following sketch is somewhat selectively culled from existing histories and is intended to provide broad motivation for our theory, not systematic evidence.

A. Deposits

The consensus among historians (see De Roover (1948), Lane and Mueller (1985), and Usher (1943) for example) is that deposit banking in Continental Europe evolved from the activity of money changing. The early Middle Ages saw an increasing use of coins rather than barter in trade. There was, however, a problem with the available coins. Coinage was imperfect, so coins could contain very different quantities of metal even when newly produced by the same mint. There were many mints in even a small area, each of which had its own method of production and standard of honesty. Moreover, even after production, the coins could be deliberately clipped or sweated (by shaking them in a bag with other coins so as to remove metal), or the edges could be filed (milling of the edges was introduced only in the 16th century). Further, the coins were subject to normal wear and tear. Sometimes, a mint reduced the precious metal content in coins, bringing its prior coinage into disrepute. Given that coins were of differing quality, traders offered the worst acceptable coins in their possession for trade, further reducing the quality of coins in circulation. So while money eliminated the problem of double coincidence of wants inherent in barter, a new problem arose—uncertainty about the value of the money.

Money changers helped to mitigate this uncertainty. The money changer specialized in coins, so he knew both foreign and local coins, could distinguish the counterfeit from the genuine, knew bullion and exchange rates, as well as the extent to which different coins were depreciating. He could therefore make an assessment as to whether a debased coin would be acceptable at face value or be valued only for its metal content. He used this knowledge to perform two functions.

First, he valued the foreign or debased coins that a customer brought in and exchanged them for local coins that could circulate easily. Of course, for the money changer to play a useful role, not only did he have to have expertise in coins, but he also had to have a reputation for honesty in his dealings—or else the public would fear rather than welcome his expertise.

Second, the money changer separated the coins into those he would send back to the mint for recoinage and those he could reintroduce into circulation. He chose to whom to give which coins. For instance, debased coins were less valuable in large payments where coins were weighed but they could still fetch their face value in small payments. Thus the money changer also served what might be termed a placement function today.

It was a small step from changing money to opening deposit accounts. When a trader brought in coins, the money changer could open an account for the trader rather than giving him new coins. If the trader wanted to pay a supplier money, the money changer would simply make an accounting entry, debiting the trader's account. If the supplier had an account with the money changer, the money changer would credit the account, thus reducing the entire payment transaction to pen strokes. It was not much harder to make the payment if the supplier had an account with another money changer. Over a period—say a day—the money changers would cumulate all the payments and receipts for their respective clients and make only the net payment to each other in cash, after which the necessary accounting entries would be made. Because payments were pooled then netted, deposit banking reduced the overall volume of payments made in coins. Furthermore, it allowed merchants to leave the business of dealing in uncertain coinage entirely to the network of money changers, letting merchants focus on what they knew best: production and trade. Thus, deposit banking and banking networks were born to facilitate payments.

B. Overdrafts

The money changer had to maintain a reserve of coins so as to make net payments to other bankers and to meet withdrawals by depositors. But not all the cash that was initially deposited had to be maintained as reserve since only a fraction of depositors would need their money at any time. Fractional reserve theories of banking suggest that banks channeled idle cash into loans to entrepreneurs.

However, the nature of the loans made, as well as the identity of the recipients, was determined by the deposit business. Banks typically did not make long-term loans (though these were no more risky than the unsecured loans they did make). Instead, the early private banks allowed depositors to borrow by overdrawing their account (e.g., Usher (1943)). These overdrafts were thus loans obtained virtually on demand by depositors. From the perspective of the money changer, the overdraft facility (or its modern equivalent, the line of credit) was essentially the same as a deposit. Both products required the money changer to come up with cash on demand, that is, they were products through which the money changer provided liquidity. With the overdraft facility, the money changer was not legally required to make the loan (he could refuse to allow the overdraft). In practice, the difference was probably moot; once customers came to rely on the money changer's overdraft facility, it would hurt his reputation almost as much if he refused to allow it without good reason as it would if he refused to pay out on deposits.

Given that deposits and overdrafts were essentially the same product, the money changer could spread his fixed costs over a larger volume of business if he offered both. Once the money changer had invested in the physical infrastructure—building, strongbox, guards—to keep the cash reserves he needed to meet unexpected deposit withdrawals, and once he had established a network with other money changers (so that he could call on their liquidity if his own reserves proved inadequate), he could use the same security arrangements and relationships to meet unexpected overdrafts.

Moreover, in the small trading economies of that period, he probably did not have to keep much more additional cash as reserve to service the overdrafts, and any reserve could be worked much harder. There typically must have been a balance between deposit inflows and overdraft outflows in a closed trading economy. As a somewhat simplistic example, at harvest time, the farmer would sell grain and be flush with cash so he would be a net depositor while the grain merchant would carry an overdraft. During the rest of the year, the grain merchant would pay down the overdraft as he sold the grain while the farmer's deposit balances would lapse into overdraft before the next harvest. The lending and borrowing by the farmer and the grain merchant would covary naturally in such a way as to minimize the demands on the bank's reserve. Only a dramatic failure of the harvest, or disproportionate growth of a particular sector, would upset the natural harmony and destabilize the bank. Thus, the liquidity demands of customers could be diversified in natural ways if the money changer offered both deposits and overdrafts.

Early bankers thought this natural diversification of liquid reserves across demands to be the primary advantage of banks. Hammond (1957, pp. 55–58) cites Senator Robert Morris of Pennsylvania, who made the following statement to the Philadelphia Assembly in 1785.

> By becoming stockholders in a bank, the merchants had pooled their cash to make it go further. But there were very few of them, Mr. Morris said "who do not stand in need of the whole of their money in the course of business, and when in need they borrow occasionally perhaps the whole amount or more." Further, "it is upon these principles the merchants generally remain stockholders—when one does not want his money, it is earning his share of the dividend from another; and by thus clubbing a capital together, as it were, the occasional wants of all are supplied." Why, he asked in substance, should not the merchants do collectively and conveniently what they had used to severally and inconveniently?

It is clear that the term "stockholder" is used in the same sense as we have used "depositor" above. What is interesting is that Morris makes little attempt to distinguish between merchants withdrawing the money they had previously deposited and their borrowing anew. Thus deposits and lines of credit were thought of then, much as we advocate in this paper, as similar products drawing on common resources. In what follows, we formalize this historical rationale for a bank.

II. The Model

A. Framework

The model is designed to capture in a minimalist fashion the following characteristics of a bank: (1) the bank's role is to provide funds to its customers on demand; but (2) it finds it costly to raise external finance unexpectedly; so (3) it maintains a buffer stock of liquid assets; and (4) holding the buffer stock is also costly. Note that (2) and (4) imply that the model will have to incorporate two distinct capital market frictions: There needs to be an ex post *flow* cost of raising new external finance, as well as an ex ante *stock* cost of holding liquid assets.[9] As we discuss further below, the former can be motivated based on an adverse-selection argument in the spirit of Myers (1984) and Myers and Majluf (1984), while the latter can be motivated based on a variety of factors, including taxes and agency costs.

There are three dates: 0, 1, and 2. The short-term interest rate on securities is exogenously fixed in this partial-equilibrium framework, and is i, both between date 0 and date 1, as well as between date 1 and date 2. For notational simplicity, we assume that all interest—as well as all other fees and charges—is paid out at date 2. This avoids compounding, and means that someone investing a dollar in securities at date 0 will accumulate total interest of $2i$ at date 2.

A.1. Assets

The bank makes term loans L at date 0 which mature and are paid off at date 2. The two-period rate on these loans is $r(L)$. We assume that the bank has some market power in lending (see Hannan (1991) and Cosimano and McDonald (1998)) which implies that $r_L < 0$. The assumption of market power is only to limit the scale of lending activities, and an assumption about increasing costs of making loans would achieve the same end. The details of what drive loan demand are unimportant for our purposes, so this simple reduced-form approach is sufficient.

In addition to term loans, the bank can also hold an amount S_0 of liquid assets—for example, cash, central bank reserves or Treasury bills—on its balance sheet between dates 0 and 1. These assets earn the security-market interest rate of i, but we assume this is partially offset by a proportional deadweight cost of τ per dollar held. Thus the net return on liquid assets from date 0 to date 1 is $(i - \tau)S_0$. As suggested above, one can attach a number of interpretations to the parameter τ. Perhaps the simplest case is to think of S_0 as invested in cash or non-interest-bearing reserves, so that $\tau = i$.[10] Alternatively, τ might be taken to reflect the (unmodeled) tax or agency costs associated with holding financial slack. Flannery (1994) and Myers and Rajan (1998) argue that for financial institutions, the agency problems associated with holding liquid assets may be particularly severe,

[9] Froot and Stein (1998) develop a model of a bank with exactly this structure.

[10] Somewhat more subtly, one might make a similar argument for banks' holdings of short-term T-bills, to the extent that the prices of these T-bills reflect a general equilibrium liquidity premium above and beyond what would obtain in a standard perfect-markets model. In other words, because they can be used in an almost money-like fashion in a variety of transactions (repurchase agreements, etc.) short-term T-bills may, like money, have an implicit "convenience yield" and thus offer a lower rate of return relative to other assets than can be explained solely by differences in risk. For a related discussion of the equilibrium premium for asset liquidity, see Holmstrom and Tirole (2001).

as there is much scope for asset substitution. Thus the ex ante expected return on liquid assets, net of financing costs, may be negative.[11]

At date 1, some of the liquid assets may be drawn down, leaving a remaining balance of S_1 to be held until date 2. This remaining balance continues to earn the rate i between date 1 and date 2, but for simplicity we assume that there is no longer any deadweight cost τ. Under the interpretation where the liquid assets had to be held in cash between date 0 and date 1 to meet unexpected liquidity demands, this would correspond to assuming that the cash can now be rolled over into interest-bearing securities, thereby eliminating the opportunity cost. Alternatively, under the interpretation where there are tax or agency costs of holding securities, one can imagine that the quantity S_1 is actually deployed more efficiently by paying down some of the bank's existing market-rate debt (see below). In this case, S_1 is not literally held on the asset side of the balance sheet, but rather represents a "contra" account against the liability side, an account which is implicitly earning an economic return of i.

A.2. Liabilities

The total assets to be financed at date 0 are $L + S_0$. They are financed partly by demandable deposits. Demand deposits pay no interest at any time, so the bank will take all it can get at date 0. We assume that this amount, D_0, is exogenously determined, for example, by the kind of customers living in the immediate neighborhood of the bank.[12] Thus D_0 can be thought of as a measure of the value of the bank's deposit-taking franchise. The disadvantage of deposits is that a random fraction ω of those who deposit at date 0 may withdraw at date 1, where ω is 0 or 1 with equal probability.[13]

In addition to deposits, the bank can also issue claims in the public market at either date 0 or date 1, denoted by e_0 and e_1, respectively. These claims mature at date 2, and can be thought of as either bonds or equity. We assume that there are no information asymmetries between the bank and

[11] Given the costs, banks naturally have an incentive to economize on their holdings of cash and securities. Risk management can be a partial substitute for such holdings, and thus can be somewhat helpful in this regard (Stulz (1996) and Froot and Stein (1998)). Nevertheless, as long as it is impossible to fully hedge against liquidity shocks, some liquid assets will have to be held in equilibrium, which is all we really need for our story to go through.

[12] All that really is needed is that the deposit rate be less than i, so the bank earns rents on its deposit franchise and will be willing to invest in securities to support it.

[13] We are ruling out the possibility that the bank tries to stem deposit outflows by raising deposit rates. However, our conclusions continue to apply even with endogenously determined deposit rates, so long as depositors' liquidity demands are somewhat inelastic. It is also not important for our results that all deposits be at risk for withdrawal—all we require is that some non-zero fraction be at risk. Even with a very large number of depositors, this is likely to be the case as long as there is some systematic component to liquidity demand. One can imagine many factors that might give rise to such a systematic component. (A bank run is an extreme example.)

investors at date 0, so that the cumulative rate paid on any (two-period) claims issued at this time is $2i$.

However, at date 1, there is the potential for adverse selection in the capital market, perhaps because the bank has gained some inside information as to the quality of its loan portfolio, and can use this information to exploit new investors. We could model this adverse-selection problem explicitly; however, for the sake of transparency, we adopt a very simple quadratic formulation where the total cost of incremental funds e_1 raised at date 1 is given by $ie_1 + \alpha e_1^2/2$. Here α measures the degree of capital market imperfection—the larger it is, the more costly is external financing relative to the frictionless case.[14]

A.3. Commitments

Finally, the bank may issue loan commitments at date 0, which obligate it to provide funds to borrowers on demand at date 1. We do not explicitly model why firms or consumers might wish to enter commitment arrangements. One important motivation may be that commitments provide insurance against a future inability to borrow. As Holmstrom and Tirole (1998) argue, upon the realization of an adverse shock, a firm may have insufficient collateral to raise external finance, and may be liquidated, even though it has significant nonpledgeable value as an ongoing concern. To protect against such inefficient liquidation, the firm may wish to buy a commitment which is effectively an insurance policy against the adverse state.[15]

In any case, we do not formalize these effects, but instead just assume an exogenous demand for commitments, and again endow the bank with some market power. Specifically, if the bank sells C dollars of commitments at date 0, it receives total revenue of fC, where we assume that $d(fC)/dC > 0$ and $d^2(fC)/dC^2 \leq 0$.[16] At date 1, a random fraction z of the commitments are taken down, where z is 0 or 1 with equal probability. Those borrowers who do take down the commitments pay an interest rate of i on the balance

[14] Although this quadratic formulation may appear ad hoc, Stein (1998) derives almost exactly the same reduced form in a more formal model where there is adverse selection with respect to a bank's uninsured nondeposit liabilities. Our α parameter can be mapped directly into the parameter A in that paper, which is a measure of the information asymmetry between bank managers and investors.

[15] In reality, loan commitments often have "material adverse change" clauses which allow a bank get out of its obligation under certain circumstances. Thus, while commitments may, in the spirit of Holmstrom and Tirole (1998), provide insurance to borrowers against *some* types of negative shocks (e.g., moderate declines in credit quality), this insurance is incomplete: it does not cover certain extreme negative outcomes, such as managerial fraud and so forth. Presumably, reputational concerns help deter banks from invoking the clause in the former sorts of cases.

[16] The second derivative of commitment revenue with respect to commitment volume, $d^2(fC)/dC^2$, can be written as $2f_C + Cf_{CC}$. Thus a sufficient condition for the second derivative to be negative is that the demand for commitments be sufficiently price elastic—that is, that f_C be sufficiently negative.

outstanding between date 1 and date 2.[17] We assume that the probability that deposits are withdrawn ($\omega = 1$) conditional on commitments being drawn down ($z = 1$) is ρ. So if $\rho = \frac{1}{2}$, the withdrawal of demand deposits and the takedown of loan commitments are independent events; if $\rho = 1$, they are perfectly positively correlated; and if $\rho = 0$, they are perfectly negatively correlated.[18]

B. Solving the Model

With all the assumptions in place, we are now ready to solve for the bank's optimal choice of L (term loans), C (commitments), and S_0 (liquid assets). The bank seeks to maximize its expected net income, denominated in date-2 dollars:

$$\text{Max}\, E\{rL + fC + izC + (i - \tau)S_0 + iS_1 - 2ie_0 - ie_1 - \alpha e_1^2/2\}. \tag{1}$$

In so doing, it faces the following constraints:

$$L + S_0 = D_0 + e_0 \tag{2}$$

$$L + S_1 + zC = D_0(1 - \omega) + e_0 + e_1 \tag{3}$$

$$S_1 \geq 0. \tag{4}$$

Constraints (2) and (3) are simply balance sheet identities for date 0 and date 1, respectively. Since it is costly to raise money from the public at date 1, the bank will, if need be, liquidate its entire portfolio of liquid assets at date 1 to meet the demands of depositors or borrowers. However, if this is not sufficient, any new funds will have to be obtained through a costly public issue and not through short sales. This is reflected in (4), which indicates that date-1 liquid-asset holdings cannot become negative.

The first order conditions are given by:

$$L: \quad r + Lr_L = 2i \tag{5}$$

$$C: \quad f + Cf_C = \alpha/2\, dE(e_1^2)/dC \tag{6}$$

$$S_0: \quad \tau = -\alpha/2\, dE(e_1^2)/dS_0. \tag{7}$$

[17] Setting the interest rate on the outstanding balance to i in this way is an innocent normalization.

[18] The withdrawal of demand deposits and the takedown of loan commitments can be less than perfectly correlated even if there are large numbers of depositors and borrowers. Depositors and borrowers may come from different segments of the population and so may have different liquidity demands. Alternatively, the two groups may have different incentives. For example, in a bank run, depositors have an incentive to withdraw their money, while borrowers have little incentive to take down commitments. Indeed, Saidenberg and Strahan (1999) document a pronounced *negative* correlation between deposit flows and commitment takedowns at large banks during the period of bond-market turmoil in the fall of 1998.

The intuition is straightforward. At the margin, loans are financed by issuing two-period claims at date 0; hence (5). An additional dollar in commitments sold will increase the bank's fee income but will also increase the expected costs of external finance at date 1; hence (6). In contrast, the bank will incur the cost τ by holding more liquid assets at date 0, but will save on expected issue costs at date 1; hence (7).

Substituting (2) into (3) and applying (4), we have the following expression for the date-1 external financing need:

$$e_1 = \mathrm{Max}[zC + \omega D_0 - S_0, 0]. \tag{8}$$

As can be seen from (8), the value of e_1—and hence the nature of the solution to the model—depends on the magnitude of the optimal value of liquid assets, S_0^*, relative to the initial deposits, D_0, and the optimal level of commitments, C^*. In particular, we can identify four different regions:

Region 1: $S_0^* \leq \min(C^*, D_0)$.

Region 2: $C^* \leq S_0^* \leq D_0$.

Region 3: $D_0 \leq S_0^* \leq C^*$.

Region 4: $S_0^* \geq \max(C^*, D_0)$.

It turns out that our key results are driven by what happens in Region 1. So for the purposes of exposition, our focus in the text is primarily on understanding the comparative statics properties of an equilibrium that lies in this region. (In the Appendix, we provide a fuller analysis of the other regions.) In Region 1, the bank is forced to raise external finance in three out of the four possible states of the world—if outflows take place on either commitments or deposits, or on both. Using (8), this implies that:

$$E(e_1^2) = \rho/2[(C + D_0 - S_0)^2] + (1-\rho)/2[(D_0 - S_0)^2 + (C - S_0)^2]. \tag{9}$$

Substituting (9) into (7), and differentiating, we obtain:

$$\tau = \alpha/2[C^* + D_0 - S_0^*(2-\rho)]. \tag{10}$$

Therefore,

$$S_0^* = [C^* + D_0 - 2(\tau/\alpha)]/[2-\rho]. \tag{11}$$

Similarly, substituting (9) into (6) and differentiating, we have:

$$f + C^* f_C = (\alpha/2)[\rho D_0 + C^* - S_0^*]. \tag{12}$$

Substituting S_0^* from (11) in the right-hand side of (12) and simplifying, we get:

$$f + C^* f_C = \frac{\alpha[(2\rho - \rho^2 - 1)D_0 + (1-\rho)C^* + 2(\tau/\alpha)]}{(4 - 2\rho)}. \tag{13}$$

Implicitly differentiating leads to the following comparative statics result:

$$\frac{dC^*}{dD_0} = \frac{-\dfrac{\alpha(1-\rho)^2}{(4-2\rho)}}{\dfrac{d^2(fC)}{dC^2} - \dfrac{\alpha(1-\rho)}{(4-2\rho)}}. \tag{14}$$

The denominator on the right-hand side is negative, and the numerator is negative so long as commitment takedowns and deposit withdrawals are not perfectly positively correlated ($\rho < 1$). So C^* increases with an increase in D_0. Thus we have established the following proposition.

PROPOSITION 1: *For parameters such that the equilibrium is in Region 1 where* $S_0^* \le \min(C^*, D_0)$*, both the holdings of liquid assets* S_0^* *and the quantity* C^* *of commitments that the bank issues at date 0 are increasing in the amount of demand deposits* D_0.

Why is there a synergy between demand deposits and commitments in Region 1? Given that they compete for the same scarce resource at date 1—the store of liquid assets—why do they not tend to crowd each other out? The answer lies in recognizing that the stock of liquid assets is not fixed, but rather is optimally adjusted with changes in deposits. In this region, an increase in deposits leads the bank to bump up liquid-asset holdings to cover the increased withdrawal risk. These extra liquid assets are also available to help if a commitment takedown occurs instead. As long as the commitment and deposit outflows are not perfectly correlated, this explains our synergy.

Another way to understand the source of the synergy is to see when it breaks down. If liquid-asset holdings exceed either the maximum possible deposit withdrawal or the maximum commitment drawdown, so that we are no longer in Region 1, commitments are locally independent of deposits. In particular, we show in the Appendix that the analogs to equation (13) for these other regions are given by:

In Region 2: $$f + C^* f_C = \alpha\rho(1-\rho)C^*/2 + \rho\tau. \tag{15}$$

In Regions 3 and 4: $$f + C^* f_C = \tau. \tag{16}$$

Consider as a specific example Region 3, where liquid assets exceed the maximum possible deposit outflow. In this case, a deposit withdrawal that occurs by itself does not stress the bank's liquidity position. There is only a problem (and hence a need for external finance) when both deposit and commitment outflows occur simultaneously. Thus if there is an increase in deposits in this region, the bank will raise its holdings of liquid assets, but just enough to cover the extra risk that both outflows happen at the same time. Consequently, the extra liquid assets which are added provide no scope for the bank to increase its commitments. Indeed, this can be seen from (16), which tells us that the optimal level of commitments in this region is already pinned down, by balancing the (constant) marginal cost of holding liquidity with the marginal revenue from offering the commitments.

Having said something about the local nature of equilibrium within each of the four regions, the next step is to pose the global question: As the level of deposits D_0 increases from zero to infinity, what happens to liquid-asset holdings and commitments? In Appendix A, we prove the following.

PROPOSITION 2: *(i) As D_0 moves from zero to infinity, both S_0^* and C^* are weakly increasing, continuous functions. (ii) Define C^τ as that value of C such that $f + Cf_C = \tau$. If τ is sufficiently large, such that $C^\tau < 2\tau/\alpha\rho$, then Region 4 does not exist. Rather, as D_0 increases, the equilibrium moves from Region 3 (where S_0^* is rising and C^* is flat), to Region 1 (where both S_0^* and C^* are rising), and then to Region 2 (where S_0^* is rising and C^* is flat).*

Figure 1 provides a concrete illustration of the proposition, for a case where $f(C) = 1 - 0.025C$; $\rho = 0.5$; $\alpha = 0.1$; and $\tau = 0.45$. The proposition and the figure suggest a variety of related empirical implications of our theory. First, comparing across types of financial institutions, nonbank lenders (e.g., finance companies), who are presumably in Region 3 with no demand deposits, should on average hold fewer liquid assets and do less in the way of commitment-based lending than deposit-taking banks, to the extent that at least some banks have sufficient deposits to wind up in Regions 1 or 2. Similarly, within the banking sector, those banks that have more in the way of demandable deposits should hold more liquid assets and do more commitment-based lending.

More specifically, in our empirical work below, we test the following three predictions of the model. The first has to do with comparing banks to nonbank lenders, while the latter two involve within-banking-sector comparisons.

Prediction 1: Deposit-taking banks will offer relatively more commitments than other lending intermediaries.

Prediction 2: Across a sample of banks, an increase in demand deposits should lead to an increase in liquid-asset holdings.

Prediction 3: Across a sample of banks, an increase in demand deposits should lead to an increase in loan commitments.[19]

[19] As can be seen from Figure 1B, we do not require all (or even any) banks to be in Region 1 for Prediction 3 to hold in the cross section. The prediction only fails if all banks are in Region 3 or if all are in Region 2. Of course, if we could identify into which region a given bank falls, we could construct sharper tests of the theory. However, this would require precise estimation of the underlying structural parameters of the model, a very difficult task.

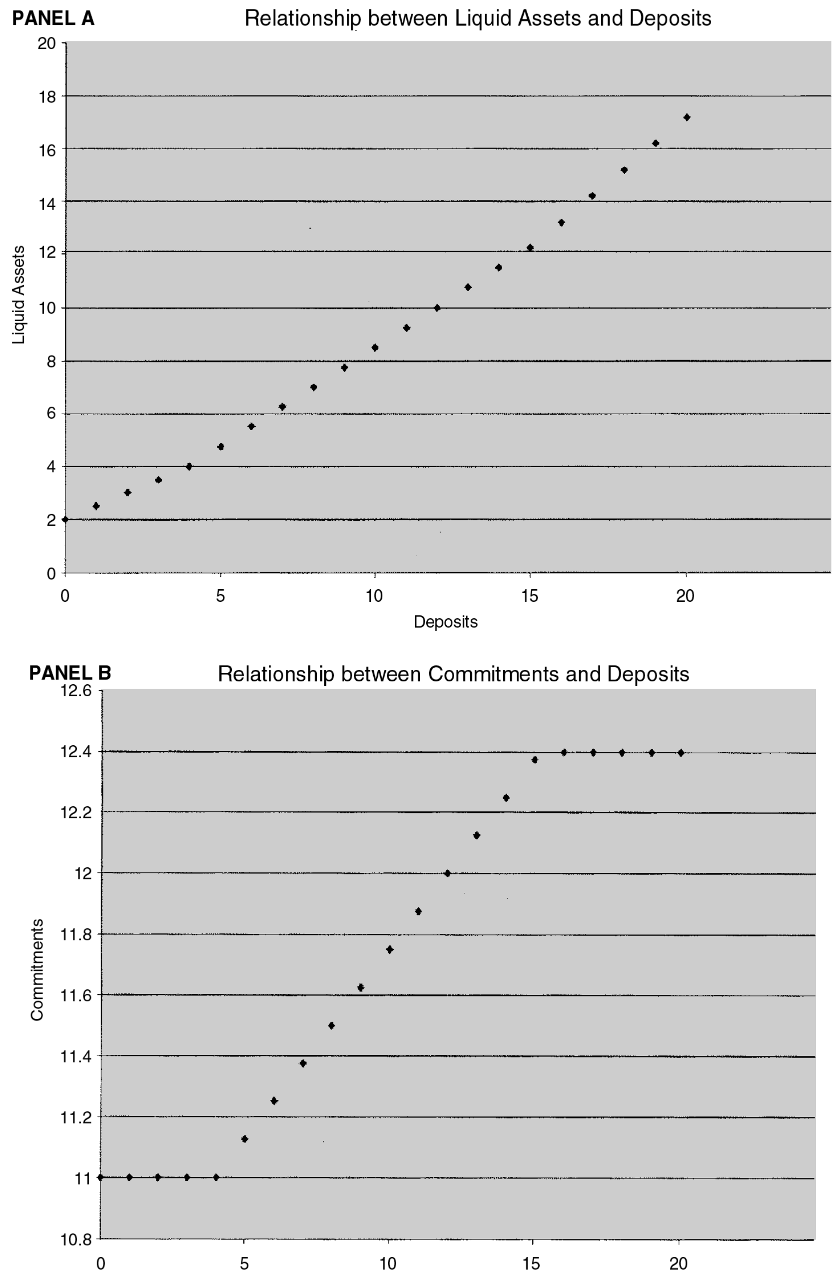

Figure 1. Liquid assets and commitments versus deposits. The figure plots the solution to the model for the following parameter values: $f(C) = 1 - 0.025C$; $\rho = 0.5$; $\alpha = 0.1$; and $\tau = 0.45$. The function $f(C)$ represents the fee on commitments; C is the volume of commitments issued; ρ is the correlation between commitment outflows and deposit outflows; α is a measure of the flow costs of external finance; and τ is a measure of the deadweight costs of holding financial slack. Panel A shows the relationship between liquid assets and deposits. Panel B shows the relationship between commitments and deposits.

Predictions 2 and 3 are conceptually straightforward, and we test them with separate cross-sectional ordinary-least-squares (OLS) regressions. However, an alternative way to think about these two predictions jointly is in terms of an instrumental variables (IV) regression. If both Predictions 2 and 3 are borne out in the data, this implies—purely as a matter of algebra—that we would also obtain a positive coefficient in an IV regression where commitments are regressed against liquid assets, with demand deposits serving as an instrument for liquid assets.[20] The intuitive interpretation of such an IV regression would be that commitments are correlated *with that component of liquid-asset holdings which is driven by demand deposits*. This is a concise way of articulating the main idea of our model.

By contrast to this IV thought experiment, our model *does not* necessarily predict that commitments and liquid assets will be unconditionally positively correlated. Suppose banks differ in terms of the parameter α, which measures costs of external finance. According to equations (11) and (13), banks with high values of α will hold more liquid assets but may make fewer commitments, thereby potentially inducing a negative correlation in an OLS regression with these two variables.

C. An Extension: Implications for Term Lending

As the model is currently set up, there is no synergy between a bank's deposit-taking activities and its term lending. The amount of term lending is given by (5), and is a function solely of loan demand and the security-market interest rate i. However, it is easy to extend the model so as to generate an additional synergy that links the term lending in with commitments, and thus by extension with deposits. Suppose that when a bank offers a line of credit, it must spend some resources to investigate the potential borrower, so as to ensure that he is creditworthy. Once this cost is sunk, the bank will clearly be at an advantage in making a term loan to the same borrower.

Thus it would be inappropriate to interpret our model as saying that banks should be expected to do *only* commitment-based lending. Quite to the contrary: to the extent that having a deposit franchise encourages a bank to get into the commitment business, being in the commitment business in turn might naturally spill over into doing some non-commitment-based term lending. A potentially more precise implication of this line of reasoning is that one might predict that banks' term lending would be disproportionately tilted towards those types of customers that make relatively heavy use of commitments. For example, if a particular small firm has very volatile working capital needs and is hence a heavy user of bank credit lines, it might be

[20] In this IV interpretation, the OLS regression of liquid assets on demand deposits (corresponding to Prediction 2) would serve as the first-stage IV regression which generates a fitted value of liquid assets to be used in the second stage. The second stage of the IV procedure would then involve running commitments against this fitted value of liquid assets. If the fitted value is just an increasing linear function of demand deposits, the second stage regression is equivalent to checking whether commitments are positively related to demand deposits, which in turn corresponds to a test of Prediction 3.

more likely than the average firm to raise its longer-term funding for plant and equipment from banks too, as opposed to from finance companies.

D. Related Theories

We are not the first to draw a link between a bank's lending and deposit-taking activities. Calomiris and Kahn (1991) describe demand deposits with sequential service as a way to provide incentives for the most efficient outside investors to monitor a borrower. Depositors who are the first to withdraw get paid in full, giving them an endogenous incentive to monitor for value-decreasing actions by the borrower. Furthermore, their rush to withdraw in turn alerts passive outside investors that the borrower may be acting against their interest. But industrial firms do not issue demandable claims, at least not as much as banks (see Flannery (1994)). So the distinguishing feature of a bank in their model has to be that it suffers from more severe agency problems than an industrial firm. Flannery suggests that this is indeed the case. Bank loans give off regular cash repayments, and these can be redeployed quickly into new loans. It is hard to restrict such redeployment because making new loans is central to a bank's business. Thus bank assets can be more easily transformed than industrial-firm assets, which may explain why bank investors need tighter control through demandable claims.[21] Diamond and Rajan (2001) take a somewhat different tack by arguing that demandable claims allow banks to promise more than the market value of their assets, thus allowing banks to "create" liquidity.

Our paper differs from these in that its primary focus is not on why banks' term loans and demand deposits go together, but rather on why *lines of credit* and demand deposits go together. We argue that both are claims on liquidity. Therefore offering both may help a bank to diversify across claimants with different takedown patterns, thus enabling it to hold the minimum necessary reserve. Others have recognized diversification possibilities across depositors (for example, see Diamond and Dybvig (1983)) or across borrowers (Holmstrom and Tirole (1998)) or even across banks (Bhattacharya and Gale (1987)). Our contribution is to point out the potential for diversification across both sides of a bank's balance sheet. Our model does have subsidiary implications for term loans, as noted earlier, but they are strictly a byproduct of the synergy between deposits and commitments.

III. Evidence on Banks versus Other Lending Institutions

A. Data Description

To investigate Prediction 1, we use the 1993 National Survey of Small Business Finances (NSSBF). This survey, conducted in 1994 through 1995

[21] While Myers and Rajan (1998) are in agreement with Flannery (1994) that banks have assets subject to transformation risk, they disagree about what those assets are. In Myers and Rajan, the liquid assets held by the bank as reserve to meet demandable claims are the ones subject to transformation risk.

for the Board of Governors of the Federal Reserve and the U.S. Small Business Administration, covers a nationally representative sample of small businesses. The target population is all for-profit, nonfinancial, nonfarm business enterprises that had fewer than 500 employees and were in operation as of year-end 1992. The data set contains 4,637 firms, and describes all the loans each firm has as of year-end 1992, as well as the institutions these loans came from.

We want to obtain a picture of the kinds of loans each institution makes. For each firm, we assign each loan to a bin based on both its type (e.g., line of credit, mortgage, etc.) and the type of financial institution it comes from (e.g., bank, finance company, etc.). We then add up the loans in each bin across all firms. If we divide the total loans in a bin by the total loans made by that type of institution, we obtain the fraction of the particular loan type in the institution's portfolio. Our theory suggests that an overdraft (a negative balance) on a demand deposit is identical to a takedown on a line of credit. Therefore, we treat a negative balance on a demand deposit as a takedown of an unsecured line of credit.

B. Results

In Table I, we describe the kinds of loans that each type of institution makes to small firms. Approximately 70 percent of banks' lending is through lines of credit, with 31 percent coming from unsecured lines of credit. By comparison, only 51 percent of finance company lending is through lines of credit, and hardly any of these—just 5 percent—are unsecured lines. Interestingly, insurance companies also offer unsecured lines of credit, perhaps because some of them maintain substantial amounts of liquid assets. No other type of institution offers significant amounts of unsecured credit lines.

An unsecured line may be the closest analog to the concept in our model, since it does not require the borrower to arrange for collateral to cover the loan, and hence may be more unpredictable in its drawdown behavior than a secured line. However, this conjecture is hard to validate directly. Fortunately, the database also contains responses to the following questions, which are highly relevant to our unpredictable-drawdown idea: "Has your firm ever required financing for seasonal or unexpected short term credit needs? If so, to what source does the firm first look for financing these needs?" Over 70 percent of respondents mentioned a bank as the primary source for this type of credit. Barely 1 percent mentioned a finance company, while a fraction of a percent mentioned an insurance company, even though these institutions account for 11 percent and 2 percent of *overall* lines of credit to small firms. The most important sources other than banks were family and friends. Thus, even relative to their overall market share in lines of credit, banks are the most important source that small firms use to fund *unexpected* credit needs.

IV. Within-Banking-Sector Tests

Next, we look across a sample of banks to see if Predictions 2 and 3 are supported. To get started, we must identify the empirical counterparts to

Table I

Banks versus Other Lending Institutions: Fraction of Each Institution's Lending Accounted for by Loan Type (by Dollar Volume)

The data in this table come from the 1993 National Survey of Small Business Finances, and cover a sample of 4,637 for-profit, nonfinancial, nonfarm enterprises that had fewer than 500 employees as of year-end 1992. Each loan is sorted into bins based on its type (line of credit, mortgage, etc.) and the type of financial institution it comes from. The loans in each bin are added up across all firms. The fraction of a particular loan type in an institution's portfolio is obtained by dividing the total loans in a bin by the total loans made by that type of institution.

	Unsecured Lines of Credit	Secured Lines of Credit	Total Lines of Credit	Leases	Mortgages	Auto Loans	Equipment Loans	Other
Commercial banks/S&Ls	0.31	0.39	0.70	0.02	0.13	0.01	0.06	0.07
Finance/leasing company	0.05	0.45	0.51	0.15	0.08	0.10	0.11	0.01
Insurance company	0.11	0.05	0.16	0.00	0.51	0.00	0.00	0.31
Brokerage firm	0.01	0.12	0.13	0.00	0.65	0.00	0.00	0.22
Mortgage bank	0.00	0.00	0.00	0.00	0.98	0.00	0.00	0.02
Venture capitalist	0.00	0.03	0.03	0.00	0.01	0.00	0.00	0.95
Other	0.01	0.02	0.04	0.04	0.34	0.01	0.09	0.49

our model's key variables. We must also determine the time horizon over which to measure these variables and the set of banks to be used in our analysis. We begin by discussing these choices and describing the basic characteristics of the data. Appendix B provides a more detailed description of exactly how each of our variables is constructed.

A. Measuring Deposits, Liquid Assets, and Commitments

Our data come from the "Call Reports," the regulatory filings that all commercial banks having insured deposits submit each quarter. The Call Reports include detailed information on the composition of bank balance sheets and some additional data on off-balance-sheet items. These data are reported at the level of the individual bank. Since many banks are part of multibank holding companies, we aggregate up the individual-bank data to form holding-company-level balance sheets; henceforth, any time we refer to the empirical properties of our sample of "banks," the entities we have in mind are these holding companies.[22] However, it should be noted that our results are quite similar if we do not bother to do the aggregation, and instead work directly with the individual-bank data.[23]

The Call Reports identify several items that could serve as proxies for our liquid-assets variable S_0. The most obvious of these is cash, since not only is it held for liquidity purposes, it also pays no interest and therefore is costly for banks to hold. However, as discussed above, interest-bearing securities also fit with the spirit of the model, as one can appeal to tax or agency considerations to rationalize a cost of holding them. To measure securities, we begin with the basic Call Report definition of securities holdings, and add to it Federal Funds sold.[24] Thus our baseline proxy for S_0, which we denote by LIQRAT, includes the sum of cash plus securities plus Fed Funds sold, all normalized by assets.[25] We do not include in the numerator of LIQRAT assets held in trading accounts—which are tracked separately in the Call Reports—since these assets may not represent a passive and readily available store of liquidity.

One point to note about the LIQRAT measure is that by including cash, it includes required reserves, which only offer a bank short-horizon liquidity protection when a commitment takedown occurs. More precisely, a bank can accommodate a commitment takedown out of required reserves, but absent

[22] To be a bit more precise: the aggregated balance sheets we create represent all the banks in a given holding company, but do not capture any of the holding company's nonbank assets or liabilities.

[23] Even though multibank holding companies are the norm among larger institutions—accounting for 88 of the 100 biggest entities in our sample—stand-alone banks still dominate the overall sample: of the total of 9,262 entities in our full sample, 87.6 percent are stand-alones.

[24] After March 1994, the Call Reports break securities into two classes, those which are expected to be held to maturity and those which are available for sale. We continue to focus on the sum of the two.

[25] Alternatively, one might include unused loan commitments in the denominator. Normalizing by either total assets or total assets plus loan commitments gives virtually identical results.

an offsetting inflow, would have to find some way (e.g., selling off securities) to replace these reserves by the end of its next reporting period. While buying a week or two of time in this way may be an extremely important function, this suggests that the type of buffer-stocking role played by cash may be distinct from that played by securities. Thus we also experiment with a second liquid-assets measure, SECRAT, which removes the cash and is just the ratio of securities plus Fed Funds sold to assets.

With regard to measuring loan commitments, ideally we would like to isolate the credit that has been extended by the bank which can be drawn down upon demand by borrowers. However, the model also presumes that these withdrawals should be somewhat unpredictable so that they generate a liquidity-management problem for the bank. The Call Reports identify three types of obligations which potentially fit this description. A feature that is common to all three is that the Call Reports only measure the level of *unused* commitments. As we discuss below, this method of measuring commitments could potentially cause problems for our tests and will require us to proceed with care.

The first set of obligations that could be included are standard loan commitments. The borrowers for these commitments range from consumers (through home equity lines of credit), to construction firms (through real estate commitments and construction and development commitments), to other businesses (through commercial letters of credit, securities underwriting commitments, and "other commitments" which are mainly obligations to supply loans to commercial and industrial firms). These conventional commitments clearly fit the notion of liquidity provision embodied in the model.[26]

The second set of obligations to be considered are credit-card commitments. The aggregate lines associated with credit cards are large, equal to roughly the amount of all the other commitments in the first category.[27] However, we have a couple of concerns about lumping credit cards together with the aforementioned types of commitments. First, we worry that a significant fraction of credit-card lines are unlikely to ever be drawn upon, since many credit-card customers—often those with the highest limits—pay their balances in full each month. This implies that the amount of real liquidity services offered through a dollar's worth of credit-card commitments may be much less than the comparable figure for conventional commitments. A further issue is that the credit-card business is dominated by a small number of banks: as of the second quarter of 1995, 78 percent of all balances outstanding reflected cards issued by the top 25 banks. On the one hand, this suggests that the results of our equal-weighted regressions should hardly change if we do lump together credit card commitments and conventional commitments; we have verified that this is in fact true. On the other hand, we doubt that our model captures many of the factors governing card

[26] See Shockley and Thakor (1997) for a detailed analysis of the contractual structure of loan commitments.

[27] For instance, as of the end of 1995, the ratio of credit card commitments to the sum of credit card commitments and all other types of commitments was 0.516.

issuance at the leading credit-card banks. Consequently, we opt to exclude credit cards from our baseline definition of commitments.[28]

Similarly, our baseline proxy for commitments also excludes a third type of commitment-like obligation: standby-letters-of-credit (SLOCs). The regulatory guidelines indicate that SLOCs are distinguished from other letters of credit and loan commitments because of "the fact that the funding is triggered by some failure to repay or perform some obligation." This wording suggests that—counter to the spirit of our model—a bank is likely to have some warning that it may be called upon to provide funding with an SLOC, if, for example, it can predict when a client is approaching financial distress. As a practical matter, these subtleties make little difference because the aggregate volume of SLOCs is quite small relative to other forms of commitments.[29] Indeed, we have verified that all our results are virtually identical if we include SLOCs in our measure of commitments.

Having settled on a measure of commitments, we again need a way to purge it of pure size effects. In doing so, we also want to avoid comingling the lending decision with the liquid-assets-holding decision. This desire to abstract from capital-structure considerations means that we cannot use assets as our denominator. Instead, we look at the magnitude of commitments relative to loans. To do this, and to minimize the impact of any outliers, we use the ratio of conventional commitments over the sum of commitments plus loans as our proxy, and call this variable COMRAT.

In addition, in a robustness test that we describe below, we seek to isolate those commitments associated with a single specific type of lending activity, C&I (commercial and industrial) lending. To do this, we take those commitments labeled "other commitments" in the Call Reports—which are predominantly, though not exclusively, commitments to make C&I loans—and divide them by the sum of C&I loans plus other commitments. We call this variable CICOMRAT.

The construction of our deposit proxy raises many of the same considerations as the commitment proxy. Specifically, we need to decide which of the various types of deposits identified in the Call Reports are most similar to the variable D_0 in the model. We also need to find a scaling procedure that eliminates size effects in a sensible way. Historically, one might have been able to use what the Call Reports label "demand deposits" (defined as non-interest-bearing deposits which are payable on demand) as a clean measure of D_0. Clearly these deposits (which as of 1995 still accounted for about 21.5 percent of all deposits) fit with the concept described in the model. However, over the last 20 years, a number of other accounts have emerged

[28] As a robustness check, we have also rerun all our regressions with a sample that excludes the most credit-card-intensive banks—those in the top 10 percent of the sample as ranked by the ratio of credit-card commitments to total commitments. The results are very close to those we report below.

[29] At the end of 1995 for all banks, the ratio of net performance SLOCs plus net financial SLOCs to total commitments (including credit cards) plus all net SLOCs is about 7.1 percent. Also, SLOCs seem to be much more prevalent among large banks.

which provide transactions services while paying some interest to depositors. In this case, the regulations embedded in the Call Reports offer a convenient classification scheme since all accounts that can be used for transactions purposes are aggregated into a single category called "transactions deposits." We use transaction deposits in the numerator of our deposit proxy.

In focusing on transactions deposits, we exclude certain types of deposits which may be accessible on demand but subject to certain limitations. For instance, a money market deposit account restricts the holder to writing no more than three checks per month but typically offers a return close to the Treasury-bill rate. We suspect that this type of account is closer to a savings account than to the deposits described in our model.[30] However, we find that using a broader measure that includes both money market deposit accounts and transactions accounts makes no difference to our main results.

To normalize our deposit proxy, we could, in principle, scale by a variety of measures of bank liabilities. We opt to use total deposits as our baseline denominator. Thus our empirical deposit variable, which we call DEPRAT, is the ratio of transactions deposits to total deposits. We have also experimented with narrower measures—such as the sum of transactions deposits and time and savings accounts—in the denominator of this ratio, and find that this also has little effect on our results.

B. Sample Formation

We try to minimize the number of banks that are excluded from our sample, in an effort to avoid creating any sample-selection biases. Therefore, we do not condition on whether banks are continuously in our sample or whether they engaged in mergers. (Fortunately, it turns out that screening on these criteria does not change any of our principal findings.) The only condition for inclusion is that a bank has at least eight quarters' worth of data during the period between 1992 and 1996.

We collect data over this five-year window because we believe that having some time-series data helps us to address a potential econometric problem. This problem arises because the commitment data from the Call Reports capture *the actual volume of unused* commitments. At high frequencies, this may differ from the concept in our model, which is, roughly speaking, the bank's *target level of unused* commitments. Consider the following example of how things might go awry econometrically. Suppose that a small bank has as one of its major customers a local builder, who is both a depositor and a commitment borrower. Now imagine that this builder experiences a liquidity shock. In an effort to cope, he drains his checking account—thereby reducing transactions deposits—and also draws down his line of credit. Given the way things are measured, this will show up as a reduction in commitments,

[30] We also exclude items such as wholesale CDs. In addition to the fact that they are not demandable, another rationale for excluding them is that they pay roughly security-market rates of interest. In the context of our model, it is crucial that deposits pay below-security-market rates, so that the bank earns rents from issuing them.

and we may spuriously estimate a positive correlation between transactions deposits and commitments that is not due to the liquidity synergy that we hypothesize, but rather to high-frequency liquidity-demand shocks.

Having several years' worth of data helps us to address this concern in a number of ways. Our first, most basic approach is to time-average the bank-level data. By doing so, we remove any high-frequency variation in liquidity demand that might be generating the sort of mechanical correlation just described. Intuitively, over a period of several years, a bank's average observed level of unused commitments should closely approximate its target level of unused commitments. So our baseline sample uses the average values of all of our proxies over the last five years for which complete data is available. As an aside, the particular five year interval we use (1992 through 1996) also has the advantages of excluding any business cycle turning points and having had the Basle risk-based capital standards fully in place.[31]

In addition to the time averaging, we have in unreported robustness tests investigated two other alternatives that draw on the panel structure of the data to assess the importance of high-frequency shifts in liquidity demand. One set of tests involves running panel regressions to see if any correlations increase when we just pool all the data without doing the time averaging. It turns out that the correlations in the raw, unaveraged data are, if anything, slightly weaker than those we report below, suggesting that spurious hard-wiring due to high-frequency liquidity shocks is not very important.

As another alternative to time averaging, we have also conducted instrumental variables estimation in which the lagged (four or eight quarters) value of DEPRAT is used to instrument for the current value. The results are very similar to those shown below. This also suggests that the results are driven by the permanent across-bank variation in the data, and not by high-frequency within-bank variation in liquidity demand. To conserve space, we only report results for the time-averaged data.

C. Descriptive Statistics

Table II shows information on our principal variables, COMRAT, DEPRAT, LIQRAT, and SECRAT, for both the entire sample of banks and for three subcategories of banks based on the size of average assets. The data reveal several noteworthy patterns. First, large banks generally do more commitment-intensive lending—the median value of COMRAT for the 100 largest banks is 0.262, as opposed to 0.075 for the smallest banks. On the other hand, as is well known, small banks hold substantially more in the way of liquid assets (median LIQRAT = 0.404) than their larger counterparts (median

[31] For banks with less than five years of data, we use all the available observations to form the averages. However, the results from analyzing a sample where only banks with five full years of data are available and the banks have not undergone any significant mergers (defined as acquiring another bank with more than 10 percent of the acquiring bank's assets) are very similar to those shown below.

Table II

Basic Descriptive Statistics for Deposits, Liquid Assets, and Commitments: Full Sample

The sample begins with all federally insured banks between 1992 and 1996. All banks within the same holding company are aggregated together to form a single holding-company-level observation, and observations for which there are less than eight quarters of data are then dropped. Size categories are based on the average level of real total assets: Large banks are the 100 banks with the highest values of average real assets; medium-sized banks are the next 500 banks; and small banks are the remaining banks. LIQRAT is the ratio of cash plus securities to assets. SECRAT is the ratio of securities to assets. DEPRAT is the ratio of transactions deposits to total deposits. COMRAT is the ratio of loan commitments to loan commitments plus loans. Q1 indicates the first quartile, Med. refers to the median, and Q3 denotes the third quartile.

1992–1996 Time-averaged	All Banks (N = 9,262)			Large Banks (N = 100)			Medium-sized Banks (N = 500)			Small Banks (N = 8,662)		
Data	Q1	Med.	Q3	Q1	Med.	Q3	Q1	Med.	Q3	Q1	Med.	Q3
LIQRAT	0.319	0.401	0.511	0.264	0.313	0.369	0.293	0.369	0.453	0.322	0.404	0.515
SECRAT	0.262	0.344	0.454	0.198	0.249	0.302	0.244	0.318	0.399	0.264	0.347	0.458
DEPRAT	0.223	0.281	0.345	0.241	0.293	0.327	0.167	0.263	0.327	0.225	0.282	0.346
COMRAT	0.041	0.078	0.127	0.186	0.260	0.333	0.086	0.134	0.180	0.039	0.075	0.120

LIQRAT = 0.313). Lastly, the table shows that there is considerable variation in DEPRAT within each subsample, but no clear correlation for this measure with bank size.

D. Regression Results

Having established the basic properties of the data, we now present some evidence regarding our two within-banking-sector predictions. Given the overwhelming importance of bank size documented in Table II, we take two steps to control for size. First, we conduct the analysis for both the full sample and separately for each of the size-based subsamples. Secondly, we also control for size within each sample by including the log of real bank assets in all of our regressions. In unreported robustness checks, we have also tried including two further size terms, corresponding to the square and the cube of the log of bank assets. These additional terms have no effect whatsoever on our results.

Finally, the regression results shown in the subsequent tables also include a set of regional dummy variables (for each Federal Reserve District), and information on the composition of each bank's loan portfolio, specifically: the ratio of commercial and industrial loans to total loans; the ratio of real estate loans to total loans; and the ratio of loans to individuals to total loans. We view the loan composition and regional dummies as further attempts to soak up variation in customer liquidity demand—in this case, across-bank variation—that might be problematic. More specifically, these proxies should help control for any propensity of different types of borrowers to have simultaneously greater demand for both transactions deposits and commitments. This helps counter an objection of the sort: "Bank *X* has high levels of both transactions deposits and commitments not because of any liquidity synergy, but rather because it caters to a particular type of client base that likes both of these products."

An extreme version of this concern is the possibility that, in the cross section, a correlation between transactions deposits and loan commitments might be induced mechanically by compensating balance arrangements, whereby commitment users are required to hold some money in a checking account with the bank providing the commitment. While we cannot get at this possibility directly with the Call Report data, we can provide some comfort from two other sources. First, Berger and Udell (1995) show that loan commitments only rarely (in seven percent of the contracts they examine) involve compensating balance agreements. Second, from the NSSBF, we obtained data on both the total unused lines of credit each firm has, as well as its total deposits. A cross-sectional regression of the former against the latter produces a coefficient that is statistically and economically indistinguishable from zero.

D.1. Prediction 2: Liquid Assets versus Transactions Deposits

In Table III, we report the results of OLS regressions in which we run both LIQRAT (in Panel A) and SECRAT (in Panel B) against DEPRAT. For both measures of liquid assets, we obtain positive coefficients, consistent

Table III

Liquid Assets versus Transactions Deposits

Dependent variable in Panel A is LIQRAT, the ratio of cash plus securities to assets. In Panel B, the dependent variable is SECRAT, the ratio of securities to assets. Each cell displays the point estimate, *t*-statistic, and "explanatory power" for the OLS coefficient on DEPRAT, the ratio of transactions deposits to total deposits. Explanatory power is defined as the coefficient on DEPRAT, times the standard deviation of DEPRAT, divided by the standard deviation of the dependent variable. The other independent variables whose coefficients are not reported include the log of real bank assets, the ratio of commercial and industrial loans to total loans, the ratio of real estate loans to total loans, the ratio of loans to individuals to total loans, and Federal Reserve district dummies. The sample begins with all federally insured banks between 1992 and 1996. All banks within the same holding company are aggregated together to form a single holding-company-level observation, and observations for which there are less than eight quarters of data are then dropped. Size categories are based on the average level of real total assets: Large banks are the 100 banks with the highest values of average real assets; medium-sized banks are the next 500 banks; and small banks are the remaining banks.

	Sample			
	All Banks	Large Banks	Medium-sized Banks	Small Banks
Number of observations	9,262	100	500	8,662
Panel A: Dependent Variable = LIQRAT: (cash + securities)/assets				
Coefficient on DEPRAT	0.227	0.313	0.105	0.235
(t-statistic)	(16.62)	(2.94)	(1.82)	(16.67)
Explanatory power of DEPRAT	0.172	0.309	0.084	0.177
Panel B: Dependent Variable = SECRAT: securities/assets				
Coefficient on DEPRAT	0.153	0.255	0.056	0.158
(*t*-statistic)	(10.83)	(2.64)	(0.95)	(10.84)
Explanatory power of DEPRAT	0.114	0.280	0.045	0.118

with Prediction 2.[32] When we look at either the full sample or the subsample of small banks, the *t*-statistics in both panels are huge, ranging from 10.83 to 16.67.[33] When we look at the large- and medium-sized banks, where the samples sizes are greatly reduced (as we have defined our size classes, we have 100 large banks, 500 medium-sized banks, and 8,662 small banks), the

[32] We also obtain very similar results if we use the ratio of cash to assets as an alternative liquid-assets measure.

[33] To ensure that our full-sample *t*-statistics are not inflated due to some unobserved cross-correlation structure, we performed the following check: We split the full sample into 10 randomly drawn subsamples, and reran all of our regressions separately for each of the subsamples. We could then look to see if the coefficients from the subsample regressions cluster as closely together as implied by the full-sample standard errors. As it turns out, they do. We thank Gene Fama for suggesting this idea.

point estimates are very similar in magnitude, though the *t*-statistics are naturally much lower, ranging from 0.95 to 2.94.

In an effort to help gauge the economic (as opposed to merely statistical) significance of our results, we also report the "explanatory power" of DEPRAT in each of the regressions, where explanatory power is defined as the coefficient estimate on the DEPRAT variable, times the standard deviation of DEPRAT, divided by the standard deviation of the dependent variable. This can be thought of as measuring what fraction of the variation in the dependent variable is explained by just DEPRAT alone. As can be seen from the table, the explanatory power of DEPRAT for both LIQRAT and SECRAT is generally quite high, taking on values in the range of 0.10 to 0.30 in most of the regressions.

One caveat about these results (suggested to us by the referee) is that our liquidity measures include pledged securities, some of which are pledged against state and municipal deposits. This pledging can induce a relatively mechanical relationship between DEPRAT and either LIQRAT and SECRAT. To ensure that this is not driving our results, we have rerun the regressions in Table III with two modifications. First, we have subtracted pledged securities from the numerator of our left-hand side variables (either LIQRAT or SECRAT). And second, we have subtracted state and municipal transactions deposits from the numerator of DEPRAT. It should be noted that this approach most likely creates a downward bias in the estimated coefficient on DEPRAT. This is because whatever the Call Reports classifies as state and municipal transactions deposits may not correspond exactly to those deposits which require the pledging of securities; consequently, we may be introducing some measurement error into DEPRAT. Nevertheless, even this conservative adjustment has only a modest impact on the results, and does not change the qualitative conclusions reported above, particularly when one focuses on the full sample. For example, in the LIQRAT regression with all banks, the coefficient on DEPRAT is 0.227 (*t*-statistic = 16.62) in Table III, and it is 0.150 (*t*-statistic = 10.45) when we adopt these alternative definitions of LIQRAT and DEPRAT.

D.2. Prediction 3: Commitments versus Transactions Deposits

Table IV displays the results of regressing COMRAT on DEPRAT. These regressions test the most basic prediction of our theory, namely that commitment intensity and transactions-deposit intensity should be positively correlated. The table shows that there is indeed a very strong positive correlation. The pattern holds within each size category of banks and is always strongly significant—the *t*-statistic is 20.21 for the full sample and even attains a value of 3.35 for the 100-observation sample of large banks. Moreover, the explanatory power of the DEPRAT variable is again quite high in these regressions, ranging from 0.181 to 0.242, suggesting that our results reflect a substantial economic effect.

As discussed above, the results of Tables III and IV can be jointly interpreted in terms of an instrumental variables (IV) specification: Taken to-

Table IV

Commitments versus Transactions Deposits

Dependent variable is COMRAT, the ratio of loan commitments to loan commitments plus loans. Each cell displays the point estimate, t-statistic, and "explanatory power" for the OLS coefficient on DEPRAT, the ratio of transactions deposits to total deposits. Explanatory power is defined as the coefficient on DEPRAT, times the standard deviation of DEPRAT, divided by the standard deviation of the dependent variable. The other independent variables whose coefficients are not reported include the log of real bank assets, the ratio of commercial and industrial loans to total loans, the ratio of real estate loans to total loans, the ratio of loans to individuals to total loans, and Federal Reserve district dummies. The sample begins with all federally insured banks between 1992 and 1996. All banks within the same holding company are aggregated together to form a single holding-company-level observation, and observations for which there are less than eight quarters of data are then dropped. Size categories are based on the average level of real total assets: Large banks are the 100 banks with the highest values of average real assets; medium-sized banks are the next 500 banks; and small banks are the remaining banks.

	Sample			
	All Banks	Large Banks	Medium-sized Banks	Small Banks
Number of observations	9,262	100	500	8,662
Coefficient on DEPRAT	0.116	0.232	0.160	0.113
(t-statistic)	(20.21)	(3.35)	(5.80)	(19.35)
Explanatory power of DEPRAT	0.181	0.207	0.242	0.188

gether, these results imply that if one runs an IV regression of COMRAT on LIQRAT (or SECRAT), with DEPRAT serving as an instrument for LIQRAT (or SECRAT), the estimated coefficient will be positive. Again, the intuition behind such an IV regression—which nicely summarizes the workings of our model—is that commitments are related specifically to those liquid assets which are held to back transactions deposits. By contrast, note that our model does not predict that there will be an unconditional positive correlation between COMRAT and LIQRAT (or SECRAT). For example, this correlation could be negative if there is substantial heterogeneity across banks in costs of external finance. And indeed, this is what we see in the data: A simple OLS regression of COMRAT on LIQRAT for our full sample of banks uncovers a significant *negative* correlation.

D.3. Robustness to Endogeneity Concerns: A Look at C&I Commitments

One final and potentially serious econometric concern that we have not yet addressed is that there may be an endogeneity bias that gives rise to a spurious positive correlation between COMRAT and DEPRAT. There are a number of specific mechanisms that could lead to such a bias, but one natural story (suggested to us by the referee) goes as follows. Suppose there are two banks, 1 and 2, that are initially identical. Now imagine that Bank 1 has a surge in loan demand, which it finances at the margin by issuing nontransactions deposits. This can be thought of as Bank 1 following a pecking-order-type of financial policy, where nontransactions deposits rank high in the pecking order. As we have scaled our variables, this leads mechanically to a decrease in both COMRAT and DEPRAT for Bank 1, and hence might generate an artificial positive correlation between the two in a cross section.

Notice that the problem we face here is not just about scaling per se, but rather is a specific version of the generic problem that plagues the entire literature on investment and financial constraints: We are running an "output" variable (COMRAT) on a capital-structure variable (DEPRAT), and the worry is that the latter is not exogenous, but rather is endogenously linked to the former. To take a concrete example from the financial-constraints literature, consider Lang, Ofek, and Stulz (1996). There the real variable is firm investment, and the capital-structure variable is the firm's leverage ratio, but the fundamental endogeneity problem is the same.

To address the problem, we draw on an insight—due originally to Lamont (1997)—that has been helpful in the financial-constraints literature, and that has been subsequently used by Lang et al. (1996), Houston, James, and Marcus (1997), and several others. Lamont's idea is that it can be informative to look at how the *investment of certain divisions with firms* responds to firm-wide variations in cash flow or capital structure. In the specific Lang et al. context, the endogeneity problem is resolved by looking at the investment of *small divisions* within a firm. The implicit assumption is that even if a firm's overall capital structure is endogenously linked to its overall investment prospects, it is unlikely to be driven by the investment prospects of one of its smaller divisions.

The analogy in our setting is that we can look at the commitment ratio for one small "division" of a bank, namely its C&I lending business. As noted above, we have already constructed an alternative commitment variable, CICOMRAT, which is the ratio of "other" commitments (mostly C&I commitments) to C&I loans plus "other" commitments. We now restrict our attention to a subsample (the "C&I sample") of our universe of banks, those for whom the ratio of C&I loans to total loans is between 10 percent and 50 percent. We use the lower cutoff so as to exclude banks whose involvement in C&I lending is negligible, and the upper cutoff to remove those for whom the C&I business might be a dominating influence on their balance sheets. Fortunately, our conclusions are not sensitive to the use of these particular cutoffs; we have experimented with looser and tighter screens, with very similar results.

Table V displays summary statistics for our C&I sample. As can be seen, 4,257 of our original 9,262 banks—a little less than half—meet the criteria for inclusion in the C&I sample. We lose 20 of our 100 largest banks, and 235 of our 500 medium-sized banks. However, those that remain have similar median values of LIQRAT, SECRAT, and DEPRAT. The medians of our new variable, CICOMRAT, are 0.526 for the largest banks, 0.364 for the medium-sized banks, and 0.241 for the small banks.

In Table VI, we present regressions that are identical to those in Table IV, except that in this case it is CICOMRAT (instead of COMRAT) that is run

Table V

Basic Descriptive Statistics for Deposits, Liquid Assets, and C&I Commitments: C&I Sample

The sample begins with all federally insured banks between 1992 and 1996. All banks within the same holding company are aggregated together to form a single holding-company-level observation, and observations for which there are less than eight quarters of data are then dropped. Size categories are based on the average level of real total assets: Large banks are the 100 banks with the highest values of average real assets; medium-sized banks are the next 500 banks; and small banks are the remaining banks. The sample is then further screened to remove any banks whose ratio of C&I loans to total loans is less than 10 percent or greater than 50 percent. LIQRAT is the ratio of cash plus securities to assets. SECRAT is the ratio of securities to assets. DEPRAT is the ratio of transactions deposits to total deposits. CICOMRAT is the ratio of C&I commitments to C&I commitments plus C&I loans. Q1 indicates the first quartile, Med. refers to the median, and Q3 denotes the third quartile.

1992–1996	All Banks (N = 4,257)			Large Banks (N = 80)			Medium-sized Banks (N = 265)			Small Banks (N = 3,912)		
Time-averaged Data	Q1	Med.	Q3	Q1	Med.	Q3	Q1	Med.	Q3	Q1	Med.	Q3
LIQRAT	0.322	0.397	0.498	0.273	0.313	0.376	0.310	0.387	0.452	0.325	0.399	0.503
SECRAT	0.263	0.338	0.441	0.208	0.251	0.301	0.258	0.330	0.394	0.265	0.341	0.446
DEPRAT	0.248	0.301	0.361	0.260	0.302	0.335	0.252	0.300	0.358	0.247	0.301	0.362
CICOMRAT	0.149	0.251	0.350	0.458	0.526	0.575	0.270	0.364	0.439	0.140	0.241	0.334

Table VI

C&I Commitments versus Transactions Deposits

Dependent variable is CICOMRAT, the ratio of C&I commitments to C&I commitments plus C&I loans. Each cell displays the point estimate, t-statistic, and "explanatory power" for the OLS coefficient on DEPRAT, the ratio of transactions deposits to total deposits. Explanatory power is defined as the coefficient on DEPRAT, times the standard deviation of DEPRAT, divided by the standard deviation of the dependent variable. The other independent variables whose coefficients are not reported include the log of real bank assets, the ratio of commercial and industrial loans to total loans, the ratio of real estate loans to total loans, the ratio of loans to individuals to total loans, and Federal Reserve district dummies. The sample begins with all federally insured banks between 1992 and 1996. All banks within the same holding company are aggregated together to form a single holding-company-level observation, and observations for which there are less than eight quarters of data are then dropped. Size categories are based on the average level of real total assets: Large banks are the 100 banks with the highest values of average real assets; medium-sized banks are the next 500 banks; and small banks are the remaining banks. The sample is then further screened to remove any banks whose ratio of C&I loans to total loans is less than 10 percent or greater than 50 percent.

	Sample			
	All Banks	Large Banks	Medium-sized Banks	Small Banks
Number of observations	4,257	80	265	3,912
Coefficient on DEPRAT	0.209	0.389	0.406	0.198
(t-statistic)	(9.64)	(2.62)	(4.39)	(8.80)
Explanatory power of DEPRAT	0.127	0.283	0.246	0.128

against DEPRAT.[34] Just to restate, our key identifying assumption in this table is that even if DEPRAT is influenced by total bank lending, it is much less likely to be as strongly influenced by a bank's C&I lending, especially if C&I lending is not the bank's dominant line of business. As it turns out, the point estimates in Table VI imply explanatory power very similar to that seen in Table IV. And even with more than half the observations gone, the t-statistics also continue to indicate strong significance, ranging from 9.64 for the whole C&I sample to 2.62 for the remaining large banks. Overall, these results give us a good deal of comfort that our earlier findings are not the product of an endogeneity bias of the sort described above.

[34] We continue to include in the regression all the same controls as before. In particular, it is important that we keep in the ratio of C&I loans to total loans. This is because the numerator of CICOMRAT is "other commitments," which in addition to C&I commitments also encompasses some other commitments. This measurement problem in CICOMRAT is clearly correlated with the extent of a bank's C&I lending. For example, if a bank's ratio of C&I loans to total loans is zero, but it has a lot of "other commitments" (and hence a high value of CICOMRAT) these are very unlikely to be C&I-related commitments. Thus including the ratio of C&I loans to total loans in the regression helps to sop up this measurement error.

V. Conclusions

Recent research on financial intermediation has remained largely silent on the question of what ties together the traditional commercial banking functions of deposit-taking and lending. Our main point is that in a sense, they are just two different manifestations of the same function—the provision of liquidity on demand. This is especially true to the extent that banks are heavily involved in commitment-based lending. After all, once the decision to extend a line of credit has been made, it is really nothing more than a checking account with overdraft privileges, or a demand deposit account with a negative balance.

Once it is recognized that loan commitments and demand deposits represent very similar products, it is an easy step to argue that there may be synergies to offering both. In this paper, we have focused on developing a theoretical and empirical case for one particular such synergy, namely the sharing of the burden of holding liquid assets on the balance sheet. However, it should be noted that there may be other synergies which operate in a broadly similar manner, with commitments and demand deposits sharing the cost of a common resource that helps in the provision of liquidity.

Consider an institution facing the choice of whether it should acquire a commercial banking charter or instead set itself up as a nonbank intermediary. On the one hand, there are clearly a variety of costs associated with being a commercial bank—one has to submit to additional regulation and supervision, capital requirements, reserve requirements, and so forth. On the other hand, one gains access to such valuable government-provided services as the Federal Reserve's discount window, as well as the payments system, with the associated large daylight overdraft privileges. If an institution is going to bear the costs, it will be better off to the extent that these costs can be spread over not just a deposit-taking franchise, but other activities that can also take advantage of the discount window and access to the payments system. Again, lending on a commitment basis would seem to fit this description perfectly.

From a policy perspective, our work suggests that the resilience of the institutional form of the commercial bank may be attributable to real considerations of economic efficiency, rather than simply to historical accident or the distortions inherent in policies such as deposit insurance. Therefore, calls for narrow banking—which are typically premised on the idea that deposit-taking and lending are two totally different and unrelated activities—may be leaving out an important consideration.

A narrow banking advocate might argue that, absent deposit insurance, money market mutual funds would be more efficient at performing the deposit-taking function than banks. One key advantage that money market funds have as deposit-takers is that their deadweight cost of holding securities, as given by τ, is much smaller. To the extent that τ reflects tax factors, the mutual fund form does not suffer from the same double taxation as a banking corporation. Moreover, to the extent that τ reflects agency problems, these too are likely to be greatly mitigated in a money market fund, whose charter—by restricting it to holding highly liquid, investment-grade securities, and requiring it to mark its assets to market on a daily basis—gives its managers much less discretion to engage in the sort of risk-shifting activities that drive bank agency problems.[35]

Of course, the flip side of this sort of narrowly defined charter is that a money market mutual fund simply cannot be in the business of making loan commitments and term loans. In other words, it cannot both have its cake (a deposit franchise without any tax or agency costs) and eat it too (the discretion to engage in traditional, opaque lending-type activities). This is why it may be hard to design a narrow banking structure that delivers the same *overall* economic performance as a bank, even if a money market fund dominates a bank on the pure deposit-taking dimension.

To be more specific, imagine a situation where a traditional commercial bank converts itself into a holding company with two legally distinct subsidiaries: a finance company and a money market mutual fund. Let us grant the narrow banking advocate's point: that having the mutual fund structure allows the deposit franchise to be more efficiently exploited. Is the holding company better off overall? Not necessarily, because an important synergy is lost with the holding company structure. The finance company sub can no longer raise funds internally by tapping the liquid assets of the money market mutual fund sub. In other words, if the finance company sub decides to get into the commitment business and it experiences a liquidity shock, it will now have to resort to a costly new issue in the external capital market, since the mutual fund sub is not allowed to invest in loan commitments. By contrast, in an integrated bank, managers have the discretion to sell off liquid assets and rebalance the overall asset portfolio towards illiquid loans if they so choose. This discretion may give rise to agency costs, but, as our model illustrates, it also can have important benefits.[36]

Beyond the particular issue of narrow banking, this paper points more generally to the merits, as well as the potential pitfalls, of the functional approach to financial regulation advocated by Merton (1995). On the positive side, few economists would quarrel with the idea that regulators should look at the underlying function that a financial product provides, rather than its nomenclature. The danger arises if one defines the functions too narrowly, and therefore fails to see the complementarities between closely related activities. For example, since there are some institutions (like money market funds) that specialize in an activity much like deposit-taking, and others (like finance companies) that specialize in lending, an overly simplis-

[35] A related advantage of money market funds—at least in a world without deposit insurance—is that by precommitting not to engage in risky lending, they ought to be able to offer lower returns to their depositors.

[36] This is just a specific version of the general argument that integration can create value by giving managers the authority to make value-enhancing transfers across lines of business. See, for example, Stein (1997) for a recent treatment.

tic application of the functional logic might lead one to claim that what commercial banks do is spanned by other types of intermediaries. This in turn might be used to argue that there is no need for regulation to be tailored in any way to the particulars of the commercial banking industry; for example, the lending side of a bank might be thought of and treated as functionally indistinguishable from that of a finance company.

In our view, this kind of reasoning misses the key point that bank lending is fundamentally different in nature, and is inextricably tied up with banks' deposit-taking activities. If one insists on assigning activities to functional buckets, it may make more sense to stick both commitment-based lending and deposit-taking into a single bucket, and label the function "liquidity provision." According to this definition, banks are not so obviously spanned by other types of intermediaries, and may legitimately deserve to be thought of as a special type of financial institution.

Appendix

A. Proof of Proposition 2

First, let us derive the optimal commitments and liquid-asset holdings in the various regions. We showed in the text that in Region 1 where $S_0^* < \text{Min}[C^*, D_0]$, we have

$$S_0^* = [C^* + D_0 - 2(\tau/\alpha)]/[2 - \rho] \tag{A1}$$

and C^* solves

$$f + Cf_C = \alpha/(4 - 2\rho)[(2\rho - \rho^2 - 1)D_0 + (1 - \rho)C + 2(\tau/\alpha)]. \tag{A2}$$

The same basic method of solution can be applied to the other regions, with e_1 evaluated differently in each case, according to equation (8) in the text. In Region 2 where $C^* \leq S_0^* < D_0$, this yields

$$S_0^* = D_0 + \rho C^* - 2\tau/\alpha \tag{A3}$$

and C^* solves

$$f + Cf_C = \alpha\rho(1 - \rho)C/2 + \rho\tau. \tag{A4}$$

In Region 3 where $D_0 \leq S_0^* < C^*$, we obtain

$$S_0^* = \rho D_0 + C^* - 2\tau/\alpha \tag{A5}$$

and C^* solves

$$f + Cf_C = \tau. \tag{A6}$$

In Region 4 where $S_0^* \geq \text{Max}[C^*, D_0]$, we have

$$S_0^* = D_0 + C^* - 2\tau/\alpha\rho \tag{A7}$$

and C^* solves

$$f + Cf_C = \tau. \tag{A8}$$

We now trace how C^* and S_0^* move with D_0. Start with $D_0 = 0$. Since $S_0^* \geq 0$, we must be in Region 3 or Region 4. However, we cannot be in Region 4 because (A7) would imply that $S_0^* < C^*$ when $D_0 = 0$, which is incompatible with being in Region 4. Therefore, we start in Region 3. Let us assume continuity of S_0^* and C^* in D_0 in what follows. We will verify this assumption later.

Let C^τ be the value of C that solves (A6). Then $C^* = C^\tau$ in the region. As a result, $dS_0^*/dD_0 = \rho < 1$ in Region 3. This implies that either D_0 will eventually hit S_0^* (and we will move to Region 1) or S_0^* will hit C^τ (and we will move to Region 4). Substituting S_0^* for D_0 in (A5), solving for S_0^*, and recognizing that $S_0^* < C^\tau$ in Region 3, we get the necessary condition to move into Region 1 as $C^\tau < 2\tau/\alpha$. By contrast, if $C^\tau > 2\tau/\alpha$, it is easily shown that S_0^* will eventually hit C^τ and we move to Region 4. So we have two cases to examine.

Case 1: $C^\tau > 2\tau/\alpha$.

Let us quickly describe what happens in Region 4. C^* does not vary with D_0, and has constant value C^τ. Therefore, $dS_0^*/dD_0 = 1$. This implies that we will not leave Region 4 since liquid assets are greater than deposits and commitments to begin with, and while commitments do not change with D_0, liquid assets grow one for one with it. Thus liquid assets will always be greater than deposits and commitments and we will not leave Region 4 however high the level of deposits. So if $C^\tau > 2\tau/\alpha$, we move from Region 3 to Region 4. Commitments are invariant with deposits in both regions.

Case 2: $C^\tau < 2\tau/\alpha$.

In this case, we move from Region 3 to Region 1. Totally differentiating (A1), we get

$$\frac{dS_0^*}{dD_0} = \frac{1}{2-\rho}\left(1 + \frac{dC^*}{dD_0}\right). \tag{A9}$$

In differentiating (A2), we can show that dC^*/dD_0 is less than $(1 - \rho)$. Substituting in (A9), $dS_0^*/dD_0 < 1$. So we do not move to a region where $S_0^* > D_0$. We can only move to Region 2. In Region 2, $dC^*/dD_0 = 0$. Therefore, $dS_0^*/dD_0 = 1$. So S_0^* will continue to be below D_0 as D_0 increases, while S_0^* will continue to be above C^* as D_0 increases. So we will never leave the region.

Having determined the regions we move between as D_0 increases, we now have to show that commitments and holdings of liquid assets are (weakly) increasing in D_0. We know S_0^* and C^* are weakly increasing in D_0 in each region. To show that they (weakly) increase throughout, we have to show that they are continuous in D_0. Clearly, they are continuous within a region. We now show that they are continuous as they transit between regions.

Let us consider the transition between Region 3 and Region 1; the other transitions are similar. Consider Region 3. Let the value of D_0 at which $S_0^* = D_0$ be D^τ. Substituting for S_0^* in (A5) and solving, we get

$$D^\tau = C^\tau/(1-\rho) - 2\tau/[\alpha(1-\rho)], \tag{A10}$$

and this is also the value of S_0^*. We know the value of $C^* = C^\tau$. These are the left-hand limits of the functions S_0^* and C^* as D_0 increases to the boundary between the regions. To show the functions S_0^* and C^* are continuous, we have to show the right-hand limits are the same.

In Region 1, S_0^* is described by (A1). Substituting D^τ as described in (A10) for D_0 and simplifying, we get

$$S_0^* = \frac{C^*(1-\rho) + C^\tau}{(2-\rho)(1-\rho)} - \frac{2\tau}{\alpha(1-\rho)}. \tag{A11}$$

Substituting D^τ as described in (A10) for D_0 and S_0^* as described by (A11) into (A2), C^* is obtained by solving

$$f + C^* f_C = \frac{\alpha}{2}\left[\frac{(1-\rho)^2(C^* - C^\tau)}{(1-\rho)(2-\rho)}\right] + \tau. \tag{A12}$$

Clearly C^τ solves this. As a result, the right-hand limit of $C^* = C^\tau$. Substituting in (A11), we get that the right-hand limit of S_0^* is $C^\tau/(1 - \rho) - 2\tau/[\alpha(1 - \rho)]$. Therefore, the right-hand limits equal the left-hand limits and C^* and S_0^* are continuous in D_0 at the boundary between regions. It is a tedious but straightforward task to show continuity across the other borders also. Thus S_0^* and C^* are weakly increasing in D_0 throughout. Q.E.D.

B. Data Appendix

The underlying source for our bank-level data are the regulatory filings (known as the Call Reports) that all commercial banks having insured deposits submit each quarter. We build up "holding-company" balance sheet data by summing the variables for all the banks in the same holding company, defined as the highest holding company to which a bank belongs (item RSSD9348).

We opt to build up from the underlying individual-bank-level data in the Call Reports rather than try to break out the bank data from filings that are submitted by the actual holding companies themselves. We do so for two reasons. First, thousands of banks are not part of any holding company, and thus data for these single banks must be taken from the Call Reports. Second, and more importantly, there is no easy way to reliably recover the banking activities of a holding company that also has nonbank subsidiaries from the reports that are filed at the holding company level—the accounts between the different parts of the holding company are deeply comingled and are effectively impossible to mechanically separate.[37] The only cost of forming the holding company data in this way is that it is impossible to net out interholding company transfers.

For many of the variables, we can directly use items reported by the banks, but in a few cases, we need to construct our variables. There is also one series where definition changes force us to splice together several series. The remainder of this Appendix identifies the variables that we use and highlights any significant choices we make.

Liquid Assets Proxies

Constructing our proxy for the ratio of securities to assets, SECRAT, is a bit complicated because banks report their holdings of different securities in different items, and the classification system distinguishing the items changes during our sample. Up until March 1994, banks were asked to report all their securities holdings in a single variable, RCFD0390. After that time, there are two series that identify those securities expected to be held to maturity and those that would be available for sale, RCFD1754 and RCFD1773, respectively. We believe that the reporting change did not much affect the estimated total level of securities, which, for our purposes, is what really matters. Following the convention in the reports, we do not count assets that are held in trading accounts—which are ostensibly tied in to trading operations—as securities. However, we do consider Federal Funds that have been sold (RCFD1350) as a liquid asset. Putting all this together means that prior to March 1994, SECRAT is defined as the sum of RCFD1350 plus RCFD0390, divided by RCFD2170. Starting in March 1994, SECRAT is defined as the sum of RCFD1350, RCFD1754, and RCFD1773, all divided by RCFD2170. To get LIQRAT, which is the ratio of cash plus securities to assets, we add cash

[37] There are further problems that arise because the reporting frequency of the holding company reports vary by size, with smaller holding companies only reporting twice per year, and because multiple banking holding companies can exist under one large holding company, generating many duplicate filings. For example, the reporting tree breaking out the subsidiaries of current Citigroup holding companies runs 40 pages.

(RCFD0010)to the numerator of SECRAT. In one of our sensitivity tests, we also work with pledged securities, which correspond to RCFD0416.

Loan Commitment Proxies

As mentioned in the text, banks report data on a number of commitment-like items. The six items that we sum in the numerator of COMRAT are RCFD3814, RCFD3816, RCFD3817, RCFD3818, RCFD6650, and RCFD3411. These items cover home equity lines of credit, real estate commitments, securities underwriting commitments, "other" commitments, construction and development commitments, and commercial letters of credit, respectively. (This means that we ignore credit-card commitments (RCFD3815) and stand-by letters of credit (RCFD3820 and RCFD3822); though as we discuss in the text, we have investigated the impact of these other items in various sensitivity checks.) To create COMRAT, we then divide this numerator by the sum of commitments plus total gross loans (RCFD1400). In our tests using CICOMRAT, we divide "other" commitments (RCFD3818) by commercial and industrial loans (RCFD1766) plus "other" commitments.

In our regressions, we also include as control variables the ratios of (1) C&I loans to total loans, (2) loans to individuals to total loans, and (3) real estate loans to total loans. For each of these three ratios, the denominator is RCFD1400. The numerators are RCFD1766, RCFD1975, and RCFD1410, respectively.

Deposit Proxies

The deposit variable, DEPRAT, is the simplest of indicators to construct because both transactions deposits (RCON2215) and total deposits (RCFD2200) are directly reported. As noted in the text, we also experimented using just demand deposits (RCON2210) in the numerator of DEPRAT and found that this makes little difference. The one piece of judgment we apply is to include both domestic and foreign deposits in the definition of our denominator, total deposits. There is no detailed information available for the maturity (or intended purpose) of foreign deposits, so we cannot get data on foreign deposits for the numerator of our ratio. For the vast majority of banks there are no foreign deposits, so this choice makes absolutely no difference. For the very largest banks, this means we will be understating DEPRAT. However, this seems preferable to completely ignoring the presence of foreign deposits. Finally, in one of our sensitivity checks, we also make use of RCON2203, transactions deposits of states and political subdivisions in the United States.

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