NBER WORKING PAPER SERIES

AN ADVERSE SELECTION MODEL OF BANK ASSET AND LIABILITY MANAGEMENT WITH IMPLICATIONS FOR THE TRANSMISSION OF MONETARY POLICY

Jeremy C. Stein

Working Paper No. 5217

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
August 1995

This research is supported by the National Science Foundation and MIT's International Financial Services Research Center. Thanks to Maureen O'Donnell for help in preparing the manuscript, and to Charlie Hadlock, Brian Hall, Owen Lamont, Julio Rotemberg, David Scharfstein and seminar participants at the Federal Reserve Bank of Boston and NBER Summer Institute for helpful discussions. This paper is an outgrowth of joint work with Anil Kashyap, to whom I am especially grateful for large doses of insight and inspiration. This paper is part of NBER's research programs in Corporate Finance, Economic Fluctuations, and Monetary Economics. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

NBER Working Paper #5217
August 1995

AN ADVERSE SELECTION MODEL OF BANK ASSET AND LIABILITY MANAGEMENT WITH IMPLICATIONS FOR THE TRANSMISSION OF MONETARY POLICY

ABSTRACT

This paper develops a model of bank asset and liability management, based on the idea that information problems make it difficult for banks to raise funds with instruments other than insured deposits. The model can be used to address the question of how monetary policy works. One effect it captures is that when the Fed reduces reserves, this tightens banks' financing constraints and thereby leads to a cutback in bank lending -- this is the "bank lending channel" in action. However, in addition to providing a specific set of microfoundations for the lending channel, the model also yields a novel account of how monetary policy affects bond-market interest rates.

Jeremy C. Stein
Sloan School of Management
MIT
E52-448
50 Memorial Drive
Cambridge, MA 02139
and NBER

1. Introduction

This paper develops an adverse-selection-based model of bank asset and liability management. In the model, banks raise funds from individual investors, and then turn around and lend these funds out to borrowers, who can be thought of as bank-dependent corporations. The typical bank's job is complicated by the fact that individual investors are not as well informed as bank management about the value of the bank's existing assets. Depending on the type of liability the bank issues to finance itself, this may or may not create an adverse selection problem that interferes with the bank's ability to make positive-NPV loans. In particular, if the bank is able to fund itself completely with insured deposits, no adverse selection problem arises, and lending behavior is undistorted. However, if the bank's ability to issue insured deposits is somehow constrained, it will have to turn to non-insured sources of finance, in which case adverse selection does become an issue, and lending behavior can be affected.

The paper has two primary goals. The first goal is simply to provide a reasonable microeconomic account of bank portfolio choice. For example, in a multi-period version, the model developed here makes a number of testable predictions about how banks optimally allocate their assets amongst loans and securities, and about how these allocations respond to shocks in the availability of insured deposit finance.[1]

The second, more ambitious goal of the paper is to address the macroeconomic question of how the monetary transmission mechanism works. To the extent that the Federal Reserve can

[1]In this vein, the paper is related to recent work by Lucas and McDonald (1992), who also construct a model of bank portfolio behavior based on asymmetric information. The similarities are discussed in more detail below.

control the aggregate level of real insured deposits available to banks, it will be able to influence loan supply. Loosely speaking, when the Fed drains reserves from the system, it forces banks to substitute away from insured deposit financing and towards adverse-selection-prone forms of non-deposit finance. This in turn leads to an overall cutback in bank lending. In this sense, the model provides a specific set of microfoundations for the notion of a "bank lending channel" of monetary transmission, which has been the subject of much recent research.[2]

Interestingly, while the model's macroeconomic predictions fit with the broad spirit of less formal accounts of the so-called "lending view", they differ in one key way. An important conclusion of the lending view is that monetary policy can be effective even in the polar case where households are indifferent between holding money and bonds. (See, e.g., Bernanke and Blinder 1988). However, several earlier works on the lending channel seem to accept the conventional textbook wisdom that, in this polar case, the Fed cannot influence bond-market interest rates (i.e., the rate on Treasury bills), and can therefore only operate on the spread between bond-market rates and the rates on bank loans.[3]

It turns out that this conventional wisdom is not correct, at least in the context of the model studied here. Even if households are completely indifferent between holding, say, deposits and T-bills, the Fed can still directly affect both T-bill rates as well as the spread

[2]See, e.g., Bernanke and Blinder (1988, 1992), Romer and Romer (1990), Kashyap, Stein and Wilcox (1993), and Kashyap and Stein (1994a, 1994b).

[3] For example, in Kashyap and Stein (1994a), we wrote: "...take an extreme example where households view the two assets that they do hold--money and bonds--as very close substitutes. In this case, a decrease in reserves that leads to a decline in the money supply will have a minimal impact on the interest rate on publicly-held bonds."

between T-bills and bank loans. Intuitively, this is because unlike households, banks are not indifferent as to the composition of their balance sheets--on the liability side, some banks will have a distinct preference for deposit finance over uninsured forms of security-market finance. This in turn induces these banks to have a demand for non-interest bearing reserves, to the extent that such reserves are needed to issue deposits. By exploiting this demand for reserves on the part of banks, the Fed can manipulate bond-market rates.

One reason that this conclusion is attractive is that it suggests that one can develop a fairly rich model of monetary policy transmission by focusing only on frictions at the level of banks and non-financial firms, and completely ignoring frictions at the household level. In other words, even if money plays no special role for households--i.e., they face no cash-in-advance constraints--monetary policy can still influence both bond rates and loan-bond spreads, and thereby have a direct impact on both firms that finance themselves in the open market, as well as those that rely on banks.

The remainder of the paper is organized as follows. In Section 2, I sketch a partial-equilbrium model of the behavior of a single bank. In this partial-equilibrium set-up, the bond-market rate is exogenous, and individual banks face shocks to their own deposit bases--shocks they cannot offset by competing away deposits from other banks. Although this is not very realistic, it provides a useful starting point for developing the basic microeconomic intuition about bank portfolio behavior. In Section 3, I extend the model to allow for inter-bank competition for deposits. As will become clear, this makes it easier to interpret the model as being about the consequences of monetary policy. Moreover, if prices are assumed to be sticky, it is precisely this inter-bank competition for deposits that will endogenously determine the bond-market rate. Section 4 questions the institutional realism of the model's assumptions, and assesses the extent to which the qualitative conclusions carry over to alternative institutional/regulatory environments. Section 5 discusses how the model can be further embedded in a complete macroeconomic framework, thereby delivering implications for aggregate movements in investment and output. Section 6 compares this paper with related work. Section 7 concludes.

2. A Partial-Equilibrium Model of Bank Behavior

The partial equilibrium model will be built up in two steps. First, I will construct an extremely simple one-period version. This version captures the important insight that changes in bank deposits translate into changes in bank loan supply, but leaves much else out. In particular, in a one-period setting, it is impossible to capture the notion that banks hold "buffer stocks" of marketable securities as a means of coping with potential shocks to their deposits. In order to remedy this deficiency, I next extend the model to a two-period setting.

2.A A one-period version with no securities holdings

The basic assumptions are as follows. On the asset side of the balance sheet, banks have three items: 1) reserves, denoted by R; 2) new loans, denoted by L; and 3) "old assets", denoted by K. The reserves are non-interest bearing, and are held to satisfy reserve requirements. The volume of new lending L is a choice variable for banks. Finally, the old assets can be thought of as loans made at an earlier time that are still on the books; the volume of these old assets cannot be adjusted. However, the old assets will be relevant to the analysis because there is asymmetric information about their value, as will be described momentarily.

On the liability side of the balance sheet, banks have two sources of funding: 1) insured deposits M; and 2) uninsured, non-deposit external finance E. Here E refers to the incremental amount of external finance raised at the time the new loans are made. For simplicity, it is assumed that the old assets K do not require any new external funding--i.e., these assets have already been financed from non-deposit sources. Consequently, the bank's balance sheet constraint is:

$$L + R = M + E; \quad \text{or} \quad L \leq M(1-\phi) + E \tag{1}$$

where ϕ is the fractional reserve requirement on insured deposits.

Banks are assumed to be monopolists in the loan market.[4] They face a loan demand schedule of the form:

$$L^D = a - br \tag{2}$$

where r is the rate charged to borrowers. Thus b is a measure of the elasticity of loan demand.[5]

---

[4]While this is an admittedly extreme simplification, the work of Sharpe (1990), Rajan (1992), Petersen and Rajan (1994), and Slovin, Sushka, and Polonchek (1993) provide theoretical and empirical support for the idea that "informational lock-in" leaves banks with some degree of market power over their customers.

[5]This sort of loan demand schedule can, if desired, be trivially derived from optimization on the part of borrowers--all that one needs to do is to assume that borrowers are themselves price-takers and have output that is a quadratic function of the amount invested.

The new loans made by the bank are all assumed to be riskless. This is done to abstract away from issues of risk-shifting--it removes any incentives for banks to overlend so as to take advantage of government-provided deposit insurance.

The required return on all other financial instruments--including deposits M and uninsured external finance E--is exogenously fixed, and for convenience, normalized to zero. Thus in this simple version of the model, r should really be interpreted as the spread between loans and securities; this is all that can be pinned down given the model's current partial equilibrium nature.

As noted above, there is asymmetric information about the value of the old assets K. In particular, if the bank is a type G (for good) these assets will ultimately be worth K^H; if the bank is a type B (for bad) these assets will ultimately be worth $K^L < K^H$. Bank managers are assumed to know their type, but outside investors do not. In order to streamline the notation, it will be useful to assume that both K^L and K^H are infinitely large relative to L. In this case, a simple measure of the magnitude of the information asymmetry that will come in handy momentarily is $A \equiv (1 - K^L/K^H)$.

Asymmetric information is relevant because of two key features of bank liabilities. The first feature is that uninsured external finance carries with it some degree of exposure to bank type. The simplest way to capture this in the model is to restrict all uninsured bank liabilities to be of the same priority.[6] For example, one might assume that the bank's pre-existing assets K are all equity-financed, and that the bank is also restricted--either by regulation or by

[6]This sort of restriction appears in Myers and Majluf (1984) and in numerous papers that have followed it.

covenants on the existing equity--to also using equity for all incremental non-deposit finance E. Therefore, even though the new loans are riskless, any incremental non-deposit liabilities inheret some of the exposure to the old assets.

The restriction that all non-deposit liabilities be of the same priority is clearly unrealistic, but it simplifies the analysis substantially. In principle, one could obtain similar results while allowing for a richer priority structure of uninsured liabilities--e.g., wholesale CD's, subordinated debt, preferred stock, etc.--so long as all these uninsured liabilities were sufficiently junior so as to be somewhat exposed to bank type.[7]

The second key feature is that, unlike with non-deposit external finance, the cost to a bank of using deposits does not depend on investors' perceptions of that bank's type. There are two ways that this feature can be incorporated into the model. First, one can assume that when it issues "deposits", the bank is really issuing exactly the same priority (risky) liabilities that it does when it raises non-deposit finance, but that the government attaches insurance to these liabilities. Thus if one thinks of the bank's non-deposit liabilities as being all equity, deposits are just the same equity with a government guarantee.[8]

Alternatively, one can assume that the government grants deposits a special exemption

[7]The notion that investors are concerned with issuer quality even when purchasing relatively senior uninsured bank debt liabilities such as wholesale CD's would certainly seem to fit with what is observed in practice. Bank CD's are evaluated by no less than five rating agencies, and the rates paid by issuers with different credit ratings can vary considerably.

[8]For the purposes of this section, it does not matter what premium the government charges for deposit insurance. This is because banks take deposit inflows and outflows as exogenous, and hence would not react to a change in deposit insurance pricing by competing more or less aggressively for deposits. However, the pricing of deposit insurance does matter in the analysis of Section 3, where it is taken up in more detail.

from any existing priority restrictions, and allows them to be made effectively senior to all other bank liabilities. Thus if the pre-existing bank liabilities are all equity, deposits can be issued senior to this old equity, but new non-deposit finance is restricted to being pari passu.[9] In this case, the deposits are riskless without the need for any explicit guarantee, thanks to the assumption that all the new loans are riskless. In effect, financing the new loans with deposits is equivalent to doing perfectly secured project finance.

Under either interpretation, what is special about deposits in this set-up is that they are the only way for a bank to raise "asymmetric-information-proof" external finance. Any attempt to substitute away from deposits brings with it the potential for adverse selection problems.

To foreshadow the macroeconomic discussion a bit, what will give monetary policy its potency in the model is the correspondence between reservable forms of bank finance and asymmetric-information-proof forms of bank finance. More specifically, I will assume that the only way the value of a bank liability can be completely insensitive to perceived bank type is if this liability is subject to reserve requirements.[10] This implies, as we shall see below, that if the Fed can shrink the real supply of bank reserves, it can make it more difficult for banks in the aggregate to raise funding.

For the time being, however, I entertain an even simpler sort of shock than a system-

---

[9]This sort of formulation can be loosely rationalized by observing that short maturity debt is, in economic terms, effectively senior to longer-maturity debt. (See, e.g., Gertner and Scharfstein 1991 and Diamond 1993) Thus the demandable nature of deposits naturally makes them less sensitive to bank type than non-demandable liabilities.

[10]This assumption does not correspond exactly to the current institutional reality in the U.S. Individual time deposits (e.g. small-denomination CD's) are insured, but are not subject to reserve requirements. This and related issues are taken up in Section 4.

wide contraction in reserves. I simply ask: suppose a given bank is faced with an exogenous outflow of insured deposits--that is, its M falls. How will the bank react?[11]

Given the assumptions that have been made, this question is easy to answer. Indeed, the logic is exactly parallel to that of Myers and Majluf (1984), who demonstrate that a decrease in internal liquidity for a non-financial firm decreases its physical investment. For a bank, insured deposits are exactly analogous to internal liquidity, and loans are exactly analogous to physical investment.

The details are as follows. There will be a unique separating equilibrium that survives the standard refinements.[12] In this equilibrium, the type B's lend in an undistorted fashion--that is, they simply maximize their interest income. This is accomplished by setting $L^B = a/2$, which implies that the type B's must raise an amount of external finance given by:

$$E^B = \max(0, \ a/2 - M(1-\phi)) \qquad (3)$$

The type G's in contrast, raise less external finance, and therefore lend less. Let the lending volume of the type G's be given by $L^G \equiv L^B - Z$. Thus Z is the amount by which type G's underlend. Correspondingly, the type G's raise a lesser amount of external finance, $E^G =$

[11]Under certain conditions, such an exogenous deposit outflow does indeed characterize the situation that individual banks face when the Fed drains reserves from the system as a whole. For example, if banks are prohibited from competing amongst each other for deposits because of interest rate ceilings, they will be unable to take any action to offset a Fed-induced contraction in their own deposits. Thus banks will view deposit shocks as effectively exogenous.

[12]For example, the equilibrium I focus on below is the only one that satisfies the intuitive criterion of Cho and Kreps (1987).

E^B - Z. If one denotes the profits of the two types by π^G and π^B respectively, it is easy to show that $\pi^G = \pi^B - Z^2/b$.

The key incentive constraint is that a type B not be tempted to mimic a type G. On the one hand, if a type B does mimic, its profits from lending fall by Z^2/b. On the other hand, it is able to gain by selling overpriced equity. Given our earlier simplifying assumptions, this gain is simply equal to AE^G. The low-cost separating equilibrium (the one that survives the usual refinements) is that one where the incentive constraint holds with equality. That is, the equilibrium satisfies:

$$Z^2/b = AE^G \tag{4}$$

It is easy to show that the solution to (4) is given by:

$$Z = -Ab/2 + (A^2b^2 + 4AbE^B)^{1/2}/2 \tag{5}$$

This solution has an intuitive interpretation. When M exceeds $a/2(1-\phi)$, banks have enough deposits available to fund the first-best level of loans, without having to turn to any new non-deposit external finance. In this case, both types lend at this first-best level. However, as M falls, there is a divergence in the behavior of the two types. The type B's make up the deposit shortfall one-for-one with uninsured external finance, and leave their lending insulated. The type G's, in contrast, are reluctant to use uninsured sources of finance, and only make up a fraction of the shortfall. Thus as M falls (and hence, as E^B rises) the type G's cut lending relative to the first-best level. Moreover, the effect of M on type G lending is stronger when the degree of information asymmetry A is larger in magnitude--i.e., $d^2L/dMdA > 0$ for a type G. Finally, note that all this occurs even though the level of M is itself assumed to be common knowledge.

The bottom line is that to the extent that a significant fraction of banks are type G's, a shock to deposits will translate into a noteworthy effect on lending behavior. This is the opposite of the conclusion reached by Romer and Romer (1990), who contend that banks can always insulate their lending decisions from shocks to insured deposits by making use of other forms of finance, such as wholesale CD's. Essentially, the Romer and Romer argument is an application of the Modigliani-Miller proposition to the banking firm. However, if wholesale CD's and other forms of uninsured external finance are subject to adverse selection problems, this M-M logic no longer is valid.

2.B A two-period version with buffer stocks of securities

One obvious objection to the model sketched above, is that by failing to account for banks' holdings of marketable securities, it is both unrealistic and potentially misleading. After all, the typical bank holds somewhere between 30% and 40% of its assets in cash and securities. And, intuition suggests that by holding securities, banks can better insulate themselves against deposit outflows. Even if a bank is unwilling--due to adverse selection problems--to react to a \$1 deposit outflow by raising an additional \$1 of uninsured external finance, it might be able to draw down on its stock of securities, thereby protecting its lending activity.

To address this issue, I now extend the model to a two-period setting, with banks facing an adverse selection problem in the market for uninsured external finance in each of the two periods. This extension allows one to derive banks' optimal securities holdings in the first period, and to analyze how first-period lending volume, securities holdings and external finance jointly respond to changes in the availability of deposits.

The notation and assumptions are basically the same as above, with a few generalizations and additions. There are now two time periods, 1 and 2. On the asset side, banks now have an additional option at time 1--they can hold securities. Let L and S denote a bank's holdings of loans and securities respectively at time 1. The key distinction between the two is that any securities held at time 1 can be costlessly liquidated at time 2. In contrast, it is costly to liquidate loans. Specifically, at time 2, a bank can liquidate an amount J (for "jettison") of the loans made at time 1. The net costs of such liquidation are θJ^2.[13]

On the liability side, banks continue to fund themselves with insured deposits and common equity. As before, deposits are exogenous, and are given by M_1 and M_2 at times 1 and 2 respectively. It is now important to specify the stochastic structure of deposit shocks, which can be captured simply by assuming that, conditional on the realization of M_1, M_2 is uniformly distributed on $[\rho M_1 + (1-\rho)M - \gamma/2, \quad \rho M_1 + (1-\rho)M + \gamma/2]$. In this formulation, the parameter ρ is a measure of the persistence of deposit shocks, while the parameter γ is a measure of the variance of these shocks. To further streamline the exposition, I assume that it is always the case that $M_1 > \rho M_1 + (1-\rho)M - \gamma/2$--i.e., no matter how low M_1 is, there is always some probability that deposits will decline between time 1 and time 2.

---

[13]The assumption that it is costly to prematurely liquidate loans is a common one--see, e.g., Diamond and Dybvig (1983).

With regard to common equity, E_1 and E_2 now denote the incremental amounts raised at times 1 and 2 respectively. Thus by time 2, a total of $E_1 + E_2$ will have been raised.

Loan demand at time 1 continues to be given by (2). Now the interest rate r refers to the return on the loan if it is not liquidated--that is, if it remains outstanding beyond time 2. Other than loans, all other financial instruments have a return that is fixed at zero. This now includes the securities S held by the bank.

Finally, as before, there is asymmetric information with respect to the ultimate value of the old assets K. To capture this asymmetric information in a multi-period setting, I assume that the value of the old assets evolves gradually over time according to a binomial process, and that bank management is always "one step ahead" of outside investors in terms of their respective information sets.[14]

Specifically, the unconditional value of the assets (before anyone has any information) is K_0. After time 1, an initial public signal arrives. If the signal is "good", which happens with probability p, the value of the assets rises to uK_0, with $u > 1$. If the signal is "bad", which happens with probability (1-p), the value of the assets falls to dK_0, with $d < 1$. Although outside investors do not observe the signal until after time 1, bank managers already have observed it by the time they make their time-1 lending and financing decisions. Similarly, after time 2, a second public signal arrives. If the signal is good, value again increases by a factor of u. If the signal is bad, value again falls by a factor of d. Thus two consecutive good signals lead to a final asset value of u^2K_0, two consecutive bad signals lead to a final value of d^2K_0, and so forth. Bank managers again observe the signal before the rest of the market, in this case

[14]A similar assumption is used by Lucas and McDonald (1990).

before making their time-2 financing decisions.

A "type G" now refers to any bank whose private information--either at time 1 or 2--leads it to expect an increase in asset values when the next public signal is released. Conversely, a "type B" is any bank whose private information leads it to expect a decrease in asset values. By construction, the ratio of type B value to type G value is always equal to d/u. Thus by analogy to above, we can construct a time-invariant measure of the magnitude of the information asymmetry, $A \equiv (1 - d/u)$.

Having stated all the assumptions, we can now solve the model backwards, starting with time 2. As before, the focus is on the low-cost separating equilibrium at this time. The nature of such an equilibrium is almost exactly identical to that in the one-period model. Type B's will raise an amount $E_2^B = \max(0, L - E_1 - M_2(1-\phi))$. That is, type B's raise enough so as to not have to liquidate any loans at all, given their time-1 financing choice E_1, and their time-1 lending volume L.

The type G's raise a lesser amount $E_2^G = E_2^B - J$, and therefore have to liquidate an amount of loans J. The incentive constraint is now of the form:

$$\theta J^2 = AE_2^G \qquad (6)$$

The solution to (6) is given by:

$$J = -A/2\theta + (A^2 + 4\theta AE_2^B)^{1/2}/2\theta \qquad (7)$$

Given (7), the next step is to compute the ex-ante expected costs of liquidation as of time 1, which will be denoted by X. These costs can be shown to have the following form:

$$X = pC(L - E_1 - (1-\phi)(\rho M_1 + (1-\rho)M - \gamma/2)) \tag{8}$$

where recall that p is the time-1 probability that the bank will be a type G at time 2--i.e., p is the probability of an "up" move on the binomial tree--and where C( ) is an increasing convex function, with C(0) = 0.

Equation (8) summarizes the key point to be taken away from the analysis of the time-2 equilibrium: There is the potential for adverse selection in the time-2 market for external finance, and this generates ex ante expected liquidation costs for banks that are of both type G and type B at time 1. For a given M_1, these expected liquidation costs can be reduced by raising E_1 relative to L--that is, by holding a buffer stock of securities at time 1. Indeed, by making E_1 and hence the buffer stock S large enough, X can be driven to zero. Thus banks will in general find it attractive to hold securities in their portfolios in spite of their lower (risk-adjusted) yield relative to loans. The greater liquidity of securities--the fact that they can be unloaded frictionlessly at time 2--compensates for the lower yield.

This logic explains why banks will not fully insulate loans from shocks to M_1 simply by drawing down on their securities holdings. Cutting securities is costly. Hence the optimal time-1 response to a given financing shortfall will be to do only <u>some</u> of the adjustment by drawing down on securities, and the rest by reducing lending.

To make this more precise, we now fold back the analysis to time 1. Again, the focus is on the low-cost separating equilibrium at this time. In this equilibrium, type B's lend in an undistorted fashion, setting $L^B = a/2$. Type B's also raise enough external finance at time 1, and thereby also hold sufficient securities, so that they never have to raise further external funds at time 2. That is, they raise an amount at time 1 given by:

$$E_1^B = \max\left(a/2 - (1-\phi)(\rho M_1 + (1-\rho)M - \gamma/2),\ 0\right) \tag{9}$$

which implies that securities holdings satisfy:

$$S^B \geq (1-\phi)((1-\rho)(M_1 - M) + \gamma/2) \tag{10}$$

This policy ensures that $X^B = 0$. From here on, I will focus on the more interesting case where E_1^B is strictly positive, and hence where (10) holds with equality.[15] Note that in this case, the greater is the variance of the time-2 deposit shock, as parametrized by γ, the larger the required buffer stock of securities for a type B at time 1. Also, securities holdings react more sensitively to time-1 deposit shocks when these shocks are relatively transitory in nature--i.e., when ρ is close to zero. In contrast, when a time-1 deposit shock is permanent, a type B reacts by raising more outside finance E_1^B at this time, and not by drawing down on securities. This makes intuitive sense, if one thinks of securities holdings as a mechanism for allowing banks to smooth their use of uninsured external finance over time.

---

[15]This just amounts to assuming that loan demand--as measured by a/2--is sufficiently strong as to make the typical bank's problem challenging, given the amount of insured financing that it has available.

Type G's raise a lesser amount E_1^G at time 1. In doing so, they invest less in <u>both</u> loans and securities than do the type B's, and thereby suffer a net cost $W(E_1^G)$, where W( ) is defined as follows:

$$W(E_1^G) = a^2/4b - \max\{(aL - L^2)/b - pC(L - E_1^G - (1-\phi)(\rho M_1 + (1-\rho)M - \gamma/2))\} \quad (11)$$

Thus W( ) is a decreasing function, with $W(a/2 - (1-\phi)(\rho M_1 + (1-\rho)M - \gamma/2)) = 0$. Analogous to before, the low-cost separating equilibrium then satisfies:

$$W(E_1^G) = AE_1^G \quad (12)$$

We can now see what the model has to say about a bank's portfolio behavior at time 1, and how that behavior depends on the realization of the deposit shock M_1. The key implications can be summarized as follows:

Implication 1: As in the simpler model, type G's react to a decrease in M_1 by cutting lending. Also as before, the link between M_1 and L is stronger when the information asymmetry A is larger in magnitude--i.e., $d^2L/dM_1dA > 0$ for the type G's.

Implication 2: In general, both type G's and type B's react to a decrease in M_1 by cutting securities holdings. For type G's, the link between M_1 and S can become either stronger or weaker when the information asymmetry A increases in magnitude. When the elasticity of loan demand b is high, it is more likely that $d^2S/dM_1dA < 0$--i.e., that securities are more sensitive to M_1 for low-information asymmetry banks. Conversely, when loan demand is relatively inelastic, it is more likely that $d^2S/dM_1dA > 0$.

The intuition for Implication 1 is straightforward and probably does not require much further elaboration by now. The one point worth emphasizing is that for type G's, the presence of a buffer stock of securities on the balance sheet still does not result in loans being fully insulated from shocks to deposits at time 1.

Implication 2 is subtler, and is the product of two competing effects. On the one hand, the existence of an adverse selection problem at time 2 makes it more attractive for high-A banks to hold large buffer stocks of securities, as it is the high-A banks who most want to avoid being forced to seek external funds at time 2. This suggests that high-A banks will value securities more highly, and will be less inclined to cut them as M_1 falls. On the other hand, we have just seen that high-A banks cut their loans by more at time 1. This means that the loan-security spread r rises by more for high-A banks. This latter effect tends to make high-A banks rebalance their portfolios so as to put more weight on loans and less on securities--that is, it tends to make them cut securities by more in response to a deposit outflow. When loan demand is relatively inelastic, the movement in r will substantial, and the latter effect will dominate.

If one can come up with a reasonable proxy for the magnitude of the information asymmetry A, these implications lend themselves to direct empirical testing. In Kashyap and Stein (1994b), we performed just such tests, using bank size as our proxy for A--large banks were taken to face less severe problems in raising uninsured finance.[16] The results were as follows: First, consistent with Implication 1, we found fairly strong evidence that small (i.e., high-A) banks cut loans by more in response to monetary-policy-induced deposit outflows. Second, we found weaker evidence that small banks also cut securities holdings by more in response to the same deposit outflows. According to Implication 2, the latter finding is consistent with the joint presence of adverse selection problems in external finance and relatively inelastic loan demand.

In addition to these more focused tests of the theory, we also documented in Kashyap and Stein (1994b) a number of more basic facts about banks that fit closely with the spirit of the model. First, smaller banks make almost no use of non-deposit debt liabilities such as unsecured fed funds borrowing or subordinated debt. In contrast, these are very important sources of funds for the largest banks. This fits with the view that information asymmetries essentially preclude the use of risky debt by small banks. Second, small banks hold substantially more in the way of cash and marketable securities than do large banks. This is precisely what the two-period version of the model would lead one to expect.

3. Inter-Bank Competition for Deposits and Interest Rate Determination

Thus far, the partial-equilibrium nature of the model has meant that: 1) the potential for inter-bank competition for deposits has been ignored; 2) the model has been silent in terms of

[16]In Kashyap and Stein (1994b), we presented results similar to those in Implications 1 and 2. However, rather than deriving these results in an adverse selection setting, we took a somewhat more ad hoc approach and just assumed that banks face quadratic costs of raising non-deposit external finance.

the determination of the rate of return on securities. This makes it harder to think of the model as providing a complete picture of the monetary transmission mechanism.

With regard to the first point, the partial-equilibrium approach might almost be sufficient for studying monetary transmission if banks were prohibited by regulation from competing amongst each other for deposits; e.g., if there were interest rate ceilings on deposits. In this case, a contraction in reserves that ultimately reduced the economywide level of insured deposits would have much the same effect as the exogenous deposit outflows modelled above--on average, individual banks would lose deposit financing and be unable to do anything about it.

However, to the extent that banks can compete among each other for deposits, the story becomes a bit more complicated. Now, even if the Fed can reduce the aggregate level of deposits, they cannot control which banks raise the bulk of the deposit financing. For example, intuition suggests that in the version of the model sketched above, the type G's--who are reluctant to raise uninsured external finance--might attempt to bid deposits away from the type B's--who face no such problem with uninsured finance. This might attenuate the effects of aggregate deposit shocks on the lending behavior of type G's.

In light of this motivation, I now extend the model to allow for inter-bank competition for deposits. To streamline the exposition, I build on the one-period version of the model developed in Section 2.A, and add a few new wrinkles. First, the market for deposits is now perfectly competitive, so individual banks perceive themselves as price-takers. Second, households are totally indifferent between holding deposits and any other security; this implies that there is a common interest rate on deposits and bonds. This interest rate is denoted by i, and as will be seen shortly, it will be determined endogenously.

The assumption that households are indifferent between deposits and securities is made just to render the results of the model starker. It is worth emphasizing that the only distinction between deposits and securities comes from banks' preferences, not those of households. Loosely speaking, type G banks will have a preference for insured deposit financing over uninsured security market financing because the former does not involve an adverse selection problem. This imperfection at the level of the banks is effectively the Fed's only lever over the economy. Without it, households' indifference between money and securities would leave monetary policy impotent.

The overall level of real reserves available to the banking system is R. If monetary policy is to have any real effects, I must assume that the Fed can control R. This amounts to assuming that prices are at least partially sticky. In other words, like any other model of monetary transmission, I require some imperfect price adjustment in addition to the other frictions that have been assumed thus far. Since I have nothing to add in terms of the primitive sources of this price stickiness, I simply assume its existence.

The final key assumptions have to do with the non-interest costs to banks of financing themselves with insured deposits. First, I have to be more specific about the terms on which banks obtain deposit insurance. These terms clearly matter here; if, for example, banks can avail themselves of underpriced deposit insurance, they will compete more aggressively to raise deposits, all else equal.

Perhaps the cleanest assumption to make is that any bank that raises deposits obtains deposit insurance on "fair" terms--i.e., there is no potential for subsidy to any type of bank from the government insurance fund. This no-subsidy feature could arise in one of two ways. One possibility is that banks could issue otherwise risky liabilities and the government insurer could charge risk-based premiums for guaranteeing these liabilities. To implement this, the government insurer would have to be able to observe bank types, so as to be able to charge the type B's more for insurance. Alternatively, as discussed in Section 2 above, the government could simply allow deposits to be made senior to all other bank liabilities. In this case, deposits become riskless without the need for further government insurance, and hence a premium of zero results in no subsidy to banks of either type. Thus under this latter interpretation, there is no need for an insurer that can observe bank types.

While I will focus on the no-subsidy case in the analysis below, the qualitative conclusions that emerge are not critically dependent on this assumption. For example, I have also explored a variant of the model where the government cannot observe bank types, and follows the simple policy of offering deposit insurance to all banks on terms that are appropriate for the type G's, up to some fixed coverage limit. In this case, there is clearly a subsidy to type B banks. Yet I obtain results very similar to those discussed below.[17]

The second key assumption about deposit finance is that it entails holding reserves which do not pay interest. This implies that although deposits have the advantage of being insured (on fair terms), they are subject to an offsetting cost, in the form of a reserve tax that is not borne by uninsured sources of finance. The simplest way to generate this feature is to just assume,

[17]The primary effect of changing the assumptions in this way is to raise the equilibrium interest rate i relative to that given by equation (18) below. The intuition for this result will become clear once the reader has understood the mechanics of the baseline model. Loosely speaking, when they can take advantage of underpriced insurance, type B banks will be more tempted to issue deposits. Hence their induced demand for reserves will be greater. In order for the reserves market to clear, the opportunity cost of holding reserves--which is given by the interest rate i--must therefore rise.

as I have been doing throughout, that all insured deposits are subject to legal reserve requirements. However, in Section 4 below, I discuss the applicability of the model in the alternative cases where: 1) there exist some bank liabilities which are insured but are not subject to reserve requirements; or 2) there are no legal reserve requirements whatsoever.

Before diving into the algebra, it may be useful to give some intuition for how the monetary mechanism works in this set-up. Essentially, if the Fed can control real reserves, it controls the aggregate real supply of "permits" for issuing insured liabilities. Thus when the Fed tightens, it contracts the supply of such permits. This means that the relative price of these permits will have to rise. This relative price is given by ϕi, which is the reserve tax on deposits. Therefore, when the Fed tightens, the bond-market rate i must rise. The shortage of permits also means that type G banks will raise less financing in the aggregate, and will do less lending. So the loan rate r faced by their customers will also rise.

To formalize these ideas, I begin by describing the timing of the game. First, the Fed moves and sets the level of real reserves R. Next, individual banks choose their level of uninsured external finance, and the market draws inferences about bank type accordingly. Finally, with their uninsured finance in place, the banks choose their optimal levels of insured deposits and loans, taking the market-clearing interest rate i as given.

In this setting, one can, as before, construct a separating equilibrium--i.e., an equilibrium in which the quantity of external finance chosen by a bank reveals its type. In such an equilibrium, the type B's will do the first best level of lending, which is now given by:

$$L^B = (a - bi)/2. \tag{13}$$

(The only difference from before is the presence of a non-zero cost of funds for type B banks.)

On the financing side, the type B's will completely shun the use of deposit financing, and use only uninsured external finance--that is, $E^B = L^B$. This represents the most cost-effective form of financing for the type B's, since they completely avoid the reserve tax.

Type G's will raise an amount of uninsured finance $E^G < E^B$. The type G's balance sheet constraint is:

$$E^G = L^B - Z - M^G(1-\phi) \tag{14}$$

Thus for a given shortfall of uninsured funds relative to the type B's, the type G's can adjust in one of two ways: 1) they can raise insured deposits in an amount M^G; or 2) they can cut lending by an amount Z. The total cost of these two distortions relative to the first-best strategy of the type B's is given by $Z^2/b + \phi i M^G$. Therefore, for a fixed E^G, the optimal tradeoff between these two choices involves setting Z as follows:

$$Z = \phi ib/2(1-\phi) \tag{15}$$

As before, the key incentive constraint is that a type B not mimic a type G. This incentive constraint is given by:

$$Z^2/b + \phi i M^G = AE^G \tag{16}$$

where the left-hand side of (16) represents the loss that a type B would incur if it switched to the type G strategy and had to cut loans by Z and raise deposits of M^G, and the right-hand side represents the gains from issuing overpriced securities.

Combining the four equations (13)-(16) yields:

$$M^G = (Aa/2 - Abi/2(1-\phi) - i^2\phi^2 b/4(1-\phi)^2)/(\phi i + A(1-\phi)) \quad (17)$$

Equation (17) gives the demand for deposits by a representative type G bank as a function of the interest rate i. The total supply of deposits is determined by the amount of reserves available, and is equal to R/ϕ. If there are n banks in total, and we denote the fraction of type G's in the population by α, then the equilibrium interest rate is the solution to:

$$R/\alpha n\phi = (Aa/2 - Abi/2(1-\phi) - i^2\phi^2 b/4(1-\phi)^2)/(\phi i + A(1-\phi)) \quad (18)$$

It is easy to see from (18) that the interest rate i is a decreasing function of the amount of real reserves R. Again, the intuition is as follows. All else equal, type G banks would prefer using insured deposits to using uninsured external finance. Since deposit financing requires banks to hold reserves, there is an induced demand for reserves on the part of the type G's. Given that reserves are non-interest-bearing, the total demand for reserves is a decreasing function of the interest rate i. Thus to the extent that prices are sticky and the Fed can control the supply of real reserves, it can also control the interest rate.

Once the interest rate has been determined, it is a simple matter to solve for type G lending volume, and to show that it is negatively impacted by a contraction in reserves. Correspondingly, the loan rate r increases, with the magnitude of the increase depending on the elasticity of loan demand b. The more inelastic is loan demand, the greater will be the rise in r. Thus this version of the model can be thought of as pinning down both the bond-market interest rate, as well as the loan-bond spread.

4. Alternative Institutional/Regulatory Environments

A key feature of the model to this point is that all insured bank liabilities are subject to reserve requirements. In practice, this feature does not always hold true. For example, in the U.S., reserve requirements on personal time deposits were phased out gradually beginning with the passage of the Monetary Control Act of 1980. Thus some types of accounts such as small-denomination (less than $100,000) CD's are currently insured, but not subject to reserve requirements. Moreover, there are some countries--e.g, Switzerland, Canada--where there are currently no legal reserve requirements whatsoever. A natural set of questions to ask is: 1) do the qualitative conclusions of the model carry over in such environments?; and if so, 2) what additional assumptions must one make for this to be true?

4.A. Legal reserve requirements are not a binding constraint

Given the other assumptions of the model, legal reserve requirements are binding--i.e., banks choose not to hold excess reserves. In reality, this does not seem to be too far off the mark for the U.S. case: in recent years, excess reserves of the banking system have been on the order of only 1%-2% of total reserves. (Economic Report of the President, 1995) However, the basic story I am telling does not hinge on legal reserve requirements being binding. All that really matters is that for some reason--be it legal or economic considerations--banks view non-interest-bearing reserves as necessary for issuing insured liabilities.

To see this point most simply, suppose for the moment that the government only insures demand deposits. Because of their demandable nature, banks will have to hold some level of reserves against these deposits, whether or not they are required to by law, simply so they can accomodate unpredictable withdrawals.[18] In this case, one might think of ϕ as representing not legal requirements, but rather the (fixed-coefficient) "deposit production technology" that relates a bank's use of reserves to its level of deposits.

4.B. Individual time deposits are insured, but do not require reserves

A somewhat more subtle issue arises when there are bank liabilities that are eligible for government insurance, but that do not require reserves, either in the legal sense, or in the "technological" sense described just above. Small-denomination CD's are a good example of this, because not only are they currently exempt from legal requirements, but it is also unlikely that they impose any significant technological need for reserves, in light of the penalties for early withdrawal.

Given the ingredients that are currently in the model, introducing a perfect market for insured, non-reservable small-denomination CD's would have a radical effect. First of all, this

[18] As an illustration, consider the fact that some small banks apparently now hold substantial excess reserves simply because the amount of cash they must keep in their ATMs exceeds required reserves. (Kohn, 1994)

instrument would be the dominant form of financing for banks--it would be strictly preferred to both uninsured, non-reservable liabilities such as wholesale CD's, as well as insured, reservable liabilities such as demand deposits. Second, if banks financed themselves exclusively with non-reservable instruments, monetary policy would, in the context of this model, be rendered completely impotent.

Since in reality small-denomination CD's and other insured, non-reservable liabilities are not the single dominant form of bank financing, it must be that the model as currently cast is missing something. In particular, there must be some countervailing cost to using such instruments. There are a number of possibilities in this regard, but one simple story goes as follows. Because they are not negotiable, (in contrast to wholesale CD's) small-denomination CD's are a less attractive investment vehicle than either demand deposits, T-bills, or wholesale CD's. Thus households will only purchase small-denomination CD's if they are offered a return greater than the bond-market/demand-deposit rate of i.

To see what this implies for the determination of interest rates, denote the return on small-denomination CD's as $i+c$, and assume that household demand for these CD's is given by $h(c)$, where $h(\,)$ is an increasing function. In other words, the larger the illiquidity premium c, the more households will invest in small-denomination CD's. Now observe that in an interior equilibrium, it must be the case that the all-in cost to a bank of obtaining a dollar of insured funding--inclusive of the opportunity cost of holding idle reserves--is the same for small-denomination CD's and demand deposits. This implies that: $i+c = i/(1-\phi)$, or equivalently, that $c = \phi i/(1-\phi)$. With this in mind, it is straightforward to show that the appropriate modification of equation (18) is given by:

$$R/\alpha n\phi \;=\; (Aa/2 - Abi/2(1-\phi) - i^2\phi^2 b/4(1-\phi)^2)/(\phi i + A(1-\phi)) \;-\; h(c)/\alpha n(1-\phi) \qquad (19)$$

Thus the only change in the equation is that the quantity $h(c)/\alpha n(1-\phi)$ has been subtracted from the the right-hand side. In other words, the aggregate demand for reserves on the part of banks is now lower, and therefore the interest rate is lower too, all else equal. The intuition is straightforward. Suppose that we were intially at an equilibrium in the world of Section 3, where there is no possibility of issuing small-denomination CD's. When small-denomination CD's become available, banks will compete to attract them, and offer a rate premium of $c = \phi i/(1-\phi)$, since these CD's economize on reserve holdings. This will call forth a supply of CD's h(c) from the household sector, thereby reducing the overall banking sector demand for reserves and hence the interest rate i.

In the polar case where households' willingness to supply small-denomination CD's is inelastic--i.e., where h(c) is roughly constant over the relevant range of interest rates--we are led to the same qualitative conclusion as in Section 3: the impact of monetary policy on both the bond-market rate i and the loan rate r is shaped entirely by banking sector imperfections, rather than by any considerations at the household level. This illustrates that the central ideas of this paper are not neccessarily sensitive to the introduction of insured, non-reservable bank liabilities, so long as there is some other friction that prevents these liabilities from becoming the single dominant form of bank financing.[19]

---

[19]Of course, one can think of frictions other than the one emphasized here that would also prevent personal time deposits from becoming the dominant form of bank financing. For example, it may be that because small depositors cannot costlessly and continuously monitor the rates paid by all banks, banks face increasing marginal search/advertising costs in attracting such depositors. Introducing this sort of friction into the model might thus be another way to

5. Building a Complete Macroeconomic Model

While the model above is capable of endogenizing both bond-market and bank loan rates, it stops short of being a complete macroeconomic model. However, it is a straightforward task to embed it into a richer structure, thereby capturing the effects of monetary policy on aggregate investment and output.

There are three key frictions that drive the results so far: 1) an imperfection at the level of the banking firm--i.e., the adverse selection problem associated with uninsured bank liabilities; 2) an imperfection at the level of some non-financial firms, that forces these firms to borrow from banks rather than in the open market; and 3) some form of price rigidity. The primary contribution of the paper is to show that these three frictions, taken together, are sufficient to allow the Federal Reserve to move real interest rates on both loans and bonds. But once this has been established, and given that prices are already assumed to be sticky, is not very difficult to go the next step and argue that the changes in real rates will in turn be associated with movements in aggregate output. Indeed, this final step can be accomplished using a number of "off-the-shelf" macro models, depending on the tastes of the modeller.

As one concrete example, I have embedded the model of Section 3 directly into a two-period monopolistic competition framework of the sort studied by Kiyotaki (1988).[20] I will spare the reader the mathematical details and only give a very brief sketch of the set-up. As in Kiyotaki, there are households and monopolistically competitive firms. I assume that the monopolistically competitive firms produce a differentiated set of goods in both periods, have

---

preserve the qualitative conclusions of Section 3.

[20]See also Lamont (1994) for a simplified adaptation of the Kiyotaki model.

a constant returns to scale technology, and can borrow directly in the bond market at the rate i. They can be interpreted as large, non-bank-dependent firms. Their desired investment depends on both the rate i that prevails in the first period, as well as the anticipated level of output in the second period.

In addition, there are banks, as well as a set of competitive firms that produce an undifferentiated good and that can only borrow from the banks. These two sets of agents are exactly as described in the model above; thus the competitive firms can be thought of as smaller, bank-dependent firms. Unlike the large monopolistic competitors, the small competitive firms produce output only in the second period; in the first period they simply borrow and invest.

The investment input of both the large and small firms is, in equilibrium, an equally-weighted mix of the first-period goods produced by the large, monopolistically competitive firms. Thus its composition is the same as that of first-period consumption. This simplifying assumption also follows Kiyotaki.

If one assumes that first-period prices are rigid, the analysis goes as follows. The stance of monetary policy--as measured by the level of real reserves R--determines both the real interest rate i and the level of investment by the small competitive firms, exactly as in the model of Section 3. Once the real interest rate i is fixed, one can solve jointly for both the second-period output by the large monopolistic competitors, as well as their investment demand, exactly as is done by Kiyotaki. Given the constant returns to scale assumption, there is a unique solution for a given rate i.

Having done this, we will now have in hand the aggregate first-period investment demand, which is just the sum of the investment by the two types of firms. Given the assumption that first-period prices are rigid, total first-period output will be demand-determined, as the sum of desired consumption plus desired total investment at the prevailing interest rate i.[21] The bottom line is that a contraction in reserves that raises the real interest rate on loans and securities can now be seen to also reduce both types of investment, as well as aggregate first-period and second-period output.

Incidentally, if one assumes instead that first-period prices are fully flexible, the model of Section 3 can now be used to pin down the price level, instead of the real interest rate. In the flexible price setting, first-period output will be completely determined by household labor supply considerations. (Again, see Kiyotaki.) Equating this level of output to aggregate demand will in turn pin down an interest rate i. Now the price level has to adjust so that real reserves satisfy the equilibrium condition in equation (18) above, given the interest rate i.

6. Comparison to Related Work

This paper is related to several distinct strands of research. First, in terms of providing a microeconomic account of bank portfolio behavior based on costs of uninsured external finance, the two-period partial equilibrium model in Section 2.B resembles that in Lucas and McDonald (1992). Like I do, they consider a multi-period set-up in which banks face exogenous deposit outflows. And like I do, they are able to derive banks' "precautionary" demands for marketable securities. However, their model differs quite a bit from mine in its details, and

[21]Arguably, the sticky-price assumption is made more palatable by virtue of the fact that all the output in the first period is produced by monopolistic competitors. In this case, second-order "menu costs" will be sufficient to prevent price adjustment by these firms, even when such a failure to adjust prices is associated with first-order output effects. See, e.g., Mankiw (1985), Blanchard and Kiyotaki (1987), among others.

more importantly, in its empirical implications.[22]

Second, there are a couple of recent papers which share with this one the broad theme that money can be a device for reducing adverse selection problems. In Williamson and Wright (1994), adverse selection makes a non-monetary barter equilibrium inefficient--consumers are reluctant to directly exchange goods with each other, for fear of receiving low-quality goods. A universally recognized fiat money ameliorates this problem and improves efficiency. In a somewhat similar spirit is Gorton and Pennacchi (1990). They observe that adverse selection may also be a problem if consumers settle up with each other using, say uninsured corporate securities such as equity or risky debt. They then suggest that insured claims such as bank deposits can help resolve the adverse selection problem, and facilitate exchange.

What both of these papers have in common with each other, and what distinguishes them from this one, is that they focus on adverse selection problems in exchange between consumers. Indeed, both can be thought of as providing the microfoundations for something like a cash-in-advance constraint at the consumer level. In contrast, I focus on an adverse selection problem between banks and purchasers of bank liabilities.

To see the import of this distinction, note that adverse selection problems between consumers can be solved in a number of ways other than with insured bank liabilities. Thus Williamson and Wright discuss, in addition to fiat money, using other perfectly recognizable and

[22] In the Lucas-McDonald model, unlike in mine, there is the potential for exploiting government deposit insurance via a risk-shifting strategy. Thus holding riskless securities tends to be unattractive to banks, and is done only as a dissipative signalling mechanism. This leads to their principal empirical conclusion, which is that higher-asset-quality banks will hold more securities, in order to signal their higher quality to the marketplace.

durable objects such as precious metals, to solve their adverse selection problem. And Gorton and Pennacchi note that if there is a sufficient volume of Treasury securities outstanding, this too will allow consumers to engage in adverse-selection-free exchange. In contrast, neither of these alternative mechanisms will help banks to finance themselves more effectively, and therefore neither helps to resolve the sort of inefficiencies that can arise in my model. Thus neither the Williamson and Wright nor the Gorton and Pennacchi papers draw any link between money and intermediary lending behavior.

In terms of its emphasis on the link between monetary policy and bank lending behavior, the model is much closer in spirit to that of Bernanke and Blinder (1988), who use a simple IS-LM-style model to illustrate the "bank lending view" of monetary transmission. Indeed, my model can be thought of as an attempt to provide some of the microfoundations for theirs. That is, my model uses adverse selection to endogenously deliver several key features that theirs simply assumes, e.g.: 1) on the asset side, banks have well-defined portfolio preferences across loans and securities; and 2) a contraction in reserves leads banks to shrink their assets.[23]

As emphasized earlier, there is one key distinction between my model and that of Bernanke and Blinder, which is seen most clearly in the polar case where households are indifferent between money and securities. In Bernanke and Blinder, this leads the bond-market interest rate to be insensitive to monetary policy; while in my model monetary policy can still

---

[23]Another paper that can be thought of as rationalizing the lending view is Greenwald, Levinson and Stiglitz (1991). However, the mechanism in their paper is quite different from that here and in Bernanke and Blinder: they consider a regulated setting where deposits pay below-market rates of interest. Thus expansionary policy which increases deposits acts as a direct subsidy to the banking sector. When combined with the assumption that banks are wealth-constrained in their lending behavior (because of capital market imperfections) this subsidy is seen as a stimulus to bank lending.

affect the bond-market rate.

Finally, another recent attempt to model the bank lending channel of monetary policy transmission is Fisher (1994), who develops a dynamic general equilibrium model with limited participation and cash-in-advance constraints. Although it is difficult to compare the two directly, it appears that the limited participation feature in Fisher's model plays a role that is analogous to that played by adverse selection in my model. The limited participation feature in Fisher implies that when the Fed drains reserves from the banking sector, banks cannot immediately neutralize the effect on their balance sheets by transacting with the household sector. Similarly, in my model, adverse selection deters banks from making the sorts of transactions with the household sector that would otherwise offset a Fed-induced shortfall in their funding bases.

7. Conclusions

One contribution of this paper is that it gives more fully articulated microfoundations to the notion of a bank lending channel of monetary policy transmission. But at the same time, it suggests that much of the recent debate over the lending channel has framed the issues in a way that may be neither the most economically meaningful nor the most practically useful.[24]

To oversimplify slightly, this debate can be thought of as pitting the polar "money" and "lending" views of the transmission mechanism against each other. The traditional "money" story hinges on the Fed's being able to move bond-market rates of interest, by exploiting households' preferences for money as a transactions medium. In the money story, banks play

[24]Mea culpa--see, e.g., Kashyap and Stein (1994a).

a minimal role. Indeed, one can basically tell the money story without invoking the banking sector at all--logically, things work just as well if the Fed introduces money into the household sector directly via helicopter drops of currency. In contrast, the usual rendition of the "lending" story focuses on the Fed's ability to move just the spread between bond-market rates and bank loan rates, by exploiting banks' inability to substitute frictionlessly between deposit and non-deposit sources of finance.

Now suppose that one accepts this dichotomization. Suppose further that empirical evidence is produced that somehow shows that the effects of monetary policy on the economy work primarily through changes in bond-market rates of interest, and that the role of the spread between loan and bond rates is minimal. This would be seen as cutting in favor of the traditional money view, and against the lending view. Given the dichotomy that has been drawn, it would logically follow that monetary policy ultimately derives its potency from cash-in-advance types of imperfections at the household level. In contrast, imperfections in the banking sector would be seen as relatively unimportant. Thus a helicopter-drop model of monetary policy might be viewed as a good description of reality.

The analysis in this paper suggests that such a conclusion would be unwarranted. Even if monetary policy does in fact work primarily through its effects on bond-market interest rates, this does not mean that imperfections in the banking sector are less important than imperfections at the household level. Indeed, as has been demonstrated, monetary policy may affect bond-market interest rates solely because of imperfections in the banking sector.

The bottom line is that rather than asking whether monetary policy works more through bond-market rates versus loan-bond spreads (as in the usual discussion of the lending view) it might be more useful to instead adopt a different dichotomy, and ask: "how critical are imperfections in the banking sector for the transmission of monetary policy, either through bond-market rates or loan-bond spreads?" In other words, the two competing theories of monetary transmission would be: 1) a "bank-centric" theory which is broader than the usual treatment of the lending channel; versus 2) a "household-centric" theory.[25]

One reason that this different dichotomy could be useful is because it seems more appropriate for addressing a number of policy-related questions. To take just one example, suppose technological innovations (e.g., "smart cards", etc.) promise to make households less and less dependent on money for transactions purposes. How will the potency of monetary policy evolve over time? The most direct way to answer the question would be to ascertain whether monetary policy currently works via a "bank-centric" or "household-centric" mechanism. If it is the former, further innovations in household transactions technologies would not be as directly relevant, regardless of whether or not monetary policy currently appears to influence bond-market interest rates.

---

[25]Of course, these theories need not be mutually exclusive.

References

Bernanke, Ben S. and Alan S. Blinder 1988. "Credit, Money, and Aggregate Demand", American Economic Review, Papers and Proceedings 78: 435-39.

Bernanke, Ben S. and Alan S. Blinder 1992. "The Federal Funds Rate and the Channels of Monetary Transmission", American Economic Review, 82: 901-921.

Blanchard, Olivier and Nobuhiro Kiyotaki 1987. "Monopolistic Competition and the Effects of Aggregate Demand", American Economic Review, 77: 647-666.

Cho, In-Koo and David Kreps 1987. "Signaling Games and Stable Equilibria", Quarterly Journalof Economics, 102: 179-222.

Diamond, Douglas 1993."Seniority and Maturity of Debt Contracts", Journal of Financial Economics, 33: 341-368.

Diamond, Douglas and Philip Dybvig 1983. "Bank Runs, Deposit Insurance and Liquidity", Journal of Political Economy, 91: 401-419.

Fisher, Jonas D.M. 1994. "Credit Market Imperfections and the Heterogeneous Response of Firms to Monetary Shocks", University of Western Ontario working paper.

Gertner, Robert and David Scharfstein 1991. "A Theory of Workouts and the Effects of Reorganization Law", Journal of Finance, 46: 1189-1222.

Gorton, Gary and George Pennacchi 1990. "Financial Intermediaries and Liquidity Creation", Journal of Finance, 45: 49-71.

Greenwald, Bruce C., Alec Levinson, and Joseph E. Stiglitz 1991. "Capital Market Imperfections and Regional Economic Development", in Giovannini, ed.: Finance and Development: Lessons and Experience, CEPR, 65-93.

Kashyap, Anil K. and Jeremy C. Stein 1994a. "Monetary Policy and Bank Lending", in Monetary Policy, edited by N. Gregory Mankiw. Chicago: University of Chicago Press, 221-256.

Kashyap, Anil K. and Jeremy C. Stein 1994b. "The Impact of Monetary Policy on Bank Balance Sheets", in Carnegie-Rochester Conference Series on Public Policy, forthcoming.

Kashyap, Anil K., Jeremy C. Stein and David W. Wilcox 1993. "Monetary Policy and Credit Conditions: Evidence from the Composition of External Finance," American Economic Review, 83: 78-98.

Kiyotaki, Nobuhiro 1988. "Multiple Expectational Equilibria under Monopolistic Competition", Quarterly Journal of Economics, 103: 695-713.

Kohn, Meir 1994. Financial Institutions and Markets, New York: McGraw Hill.

Lamont, Owen 1994. "Corporate Debt Overhang and Macroeconomic Equilibrium", MIT working paper.

Lucas, Deborah J. and Robert L. McDonald 1990. "Equity Issues and Stock Price Dynamics", Journal of Finance, 45: 1019-1043.

Lucas, Deborah J. and Robert L. McDonald 1992. "Bank Financing and Investment Decisions with Asymmetric Information About Loan Quality", RAND Journal of Economics, 23-1: 86-105.

Mankiw, N. Gregory 1985. "Small Menu Costs and Large Business Cycles: A Macroeconomic Model of Monopoly", Quarterly Journal of Economics, 100: 529-539.

Myers, Stewart and Nicholas Majluf 1984. "Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have", Journal of Financial Economics, 13: 187-221.

Petersen, Mitchell and Raghuram G. Rajan 1994. "The Benefits of Lending Relationships: Evidence from Small Business Data", Journal of Finance, 49: 3-37.

Rajan, Raghuram 1992. "Insiders and Outsiders: The Choice Between Relationship and Arm's Length Debt", Journal of Finance, 47: 1367-1400.

Romer, Christina D. and David H. Romer 1990. "New Evidence on the Monetary Transmission Mechanism", Brookings Papers on Economic Activity, 149-213.

Sharpe, Steve 1990. "Asymmetric Information, Bank Lending and Implicit Contracts: A Stylized Model of Customer Relationships", Journal of Finance, 45: 1069-1087.

Slovin, Myron B., Marie E. Sushka and John A. Polonchek 1993. "The Value of Bank Durability: Borrowers as Bank Stakeholders", Journal of Finance, 48: 247-266.

Williamson, Steve and Randall Wright 1994. "Barter and Monetary Exchange Under Private Information", American Economic Review, 84: 104-123.