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The Bank Lending Channel Revisited*

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Abstract

A central proposition in research on the role that banks play in the transmission mechanism is that monetary policy imparts a direct impact on deposits and that deposits, insofar as they constitute the supply of loanable funds, act as the driving force of bank lending. This paper argues that the emphasis on policy-induced changes in deposits is misplaced. A reformulation of the bank lending channel is proposed that works primarily through the impact of monetary policy on banks' balance sheet strength and risk perception. Such a recasting implies, contrary to conventional wisdom, that greater reliance on market-based funding enhances the importance of the channel. The framework also shows how banks, depending on the strength of their balance sheets, could act either as absorbers or amplifiers of shocks originiating in the financial system.

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1 Introduction

A central proposition in research on the role that banks play in the transmission mechanism is that monetary policy imparts a direct impact on deposits and that deposits, insofar as they constitute the supply of loanable funds, act as the driving force of bank lending. These ideas are manifested most clearly in conceptualizations of the bank lending channel of monetary transmission, as first expounded by Bernanke and Blinder (1988). Under this view, tight monetary policy is assumed to drain deposits from the system and will reduce lending if banks face frictions in issuing uninsured liabilities to replace the shortfall in deposits. Essentially, much of the driving force behind bank lending is attributed to policy-induced quantitative changes on the liability structure of bank balance sheets.

The tight association between monetary policy and deposits is typically premised either on the concept of the money multiplier or a portfolio-rebalancing view of households' assets. The former starts from the proposition that changes in the stance of monetary policy are implemented through changes in reserves which, in turn, mechanically determine the amount of deposits through the reserve requirement. The latter argues that monetary policy actions alters the relative yields of deposits (money) and other assets, thus influencing the amount of deposit households wish to hold. Either way, the underlying mechanism is one in which a policy tightening induces a fall in deposits that then forces banks to substitute towards more expensive forms of market funding, contracting loan supply. Changes in deposits are seen to drive bank loans.

This paper contends that the emphasis on policy-induced changes in deposits is misplaced. If anything, the process actually works in reverse, with loans driving deposits. In particular, it is argued that the concept of the money multiplier is flawed and uninformative in terms of analyzing the dynamics of bank lending. Under a fiat money standard and liberalized financial system, there is no *exogenous* constraint on the supply of credit except through regulatory capital requirements. An adequately capitalized banking system can always fulfill the demand for loans if it wishes to.

To this end, an alternative mechanism for the bank lending channel is presented which does not rely in any way on the ability of central banks to directly affect the quantity of deposits in the banking system. The underlying premise is that variations in the *health* of financial intermediaries, in terms of leverage and asset quality, as well as in perceptions of risk constitute the more relevant mechanisms through which the effects of monetary policy shocks may be propagated. The focus will be on financial frictions at the level of financial intermediaries themselves and how policy-induced variations in their external finance premium is reflected in the cost of funds to borrowers that are dependent on these institutions. In doing so, quantitative constraints on bank lending, such as the level of deposits or reserves, are greatly de-emphasized. Such a recasting of the bank lending channel has been articulated by Bernanke (2007) and this paper makes the proposition more concrete through a very simple and intuitive model.

The reformulated framework suggests that some of the key conclusions from the traditional bank lending channel literature need to be reconsidered. In particular, structural developments that increase banks' accessibility to non-deposit sources of funds are seen under the traditional view as mitigating the importance of the bank lending channel (Romer and Romer, 1990). In contrast, the mechanism set out in this paper would contend that greater reliance on market-based funding may actually *enhance* the importance of this channel by increasing the sensitivity of banks' funding costs to monetary policy. The same applies to increased usage of marked-to-market accounting. Moreover, the same underlying mechanism should apply also to non-bank intermediaries, broadening the potential importance of this channel to non-depository institutions that may nonetheless play an integral part in the transmission mechanism.

On the empirical side, the framework suggests new interpretation of existing evidence for the bank lending channel as well as potential alternative identification strategies that may be adopted. Indeed, much of the empirical research on the bank lending channel has been premised only very loosely on the traditional theory. While the intuition offered is invariably based upon changes in deposits as the driving force, the latter are typically neglected in actual regressions and the focus is directly on the relationship between bank loans and monetary policy. One contribution of this paper is to provide a framework that helps to reconcile the empirical results with a theoretical basis that takes into account significant structural changes that have taken place in the financial system over the past decade.

Finally, by focusing on financial frictions of banks themselves, this paper shares the thrust of recent research in the wake of the global financial crisis that emphasize the potential for the real economy to be affected by shocks that originate from within the financial sector itself. In this regard, it is demonstrated how banks can act, depending on the state of their balance sheets, either as absorbers or amplifiers of such shocks. The framework presented also helps to shed light on the risk-taking channel and the link between monetary policy and banking system risk. Indeed, a key feature of the model is that it establishes the close relationship between monetary policy, credit spreads, leverage, and economic activity that is often observed in practice.

The rest of the paper is organized as follows. Section 2 highlights the key problems associated with the standard conceptual underpinnings of the bank lending channel and proposes a more realistic alternative mechanism. Section 3 presents the model and sets out the solution. Section 4 demonstrates how the reformulated bank lending channel might work and discusses some of the key implications of such an alternative view. Section 5 concludes.

2 The Role of Banks in the Transmission Mechanism

The role of financial frictions in the transmission mechanism of monetary policy has been extensively studied under the banner of the credit channel. The key tenet of this mechanism is that informational asymmetries give rise to frictions that amplify the effects of monetary policy on the cost and availability of credit relative to what would have been implied by the associated movements in risk-free interest rates. The credit channel has traditionally been characterized into two separate channels: the balance sheet channel and the bank lending channel (Bernanke and Gertler, 1995). The balance sheet channel focuses on informational frictions at the firm level that give rise to an external finance premium which acts to propagate changes in policy. It is very closely related to the financial accelerator mechanism of Bernanke and Gertler (1989). The bank lending channel emphasizes the potential amplification effects that may be generated by the banking sector, primarily through the impact that monetary policy imparts on the supply of loans to bank-dependent borrowers. This paper questions the validity of the conceptual framework that underpins the traditional bank lending channel and offers an alternative mechanism that is both more plausible and increases the potential relevance of this channel.

The underlying idea behind the bank lending channel is that banks' cost of funds increases in response to restrictive monetary policy. The various depictions of the mechanism essentially differ in the way in which the rise in the marginal cost of funding is modeled. Traditional conceptualizations (Bernanke and Blinder, 1988; Kashyap and Stein, 1995; Stein, 1998; Walsh, 2003) are premised on the ability of central banks to directly manipulate the level of deposits through the money multiplier mechanism. More recent interpretations (Kishan and Opiela, 2000; Ehrmann et al., 2001) rely on portfolio substitution arguments whereby a policy tightening reduces the relative yields on deposits, inducing households to economize on them. A common thread in all depictions is the assumption that the central bank can closely, if not directly, influence the amount of deposits in the banking system, which then forces banks to alter the composition of their financing away from relatively cheap insured deposits towards more expensive managed liabilities. Changes in the quantity of deposits are viewed as the catalyst for the reduction in loan supply.

2.1 Deconstructing the Traditional Mechanism

In evaluating the traditional theoretical framework behind the bank lending channel, a natural first step is to reconsider the concept of the money multiplier. Inherent in this view, which has a long heritage in monetary economics, is that policy changes are implemented via open market operations that change the amount of bank reserves. Binding reserve requirements, in turn, limit the issuance of bank deposits to the availability of reserves. As a result, there is a tight, mechanical, link between policy actions and the level of deposits.

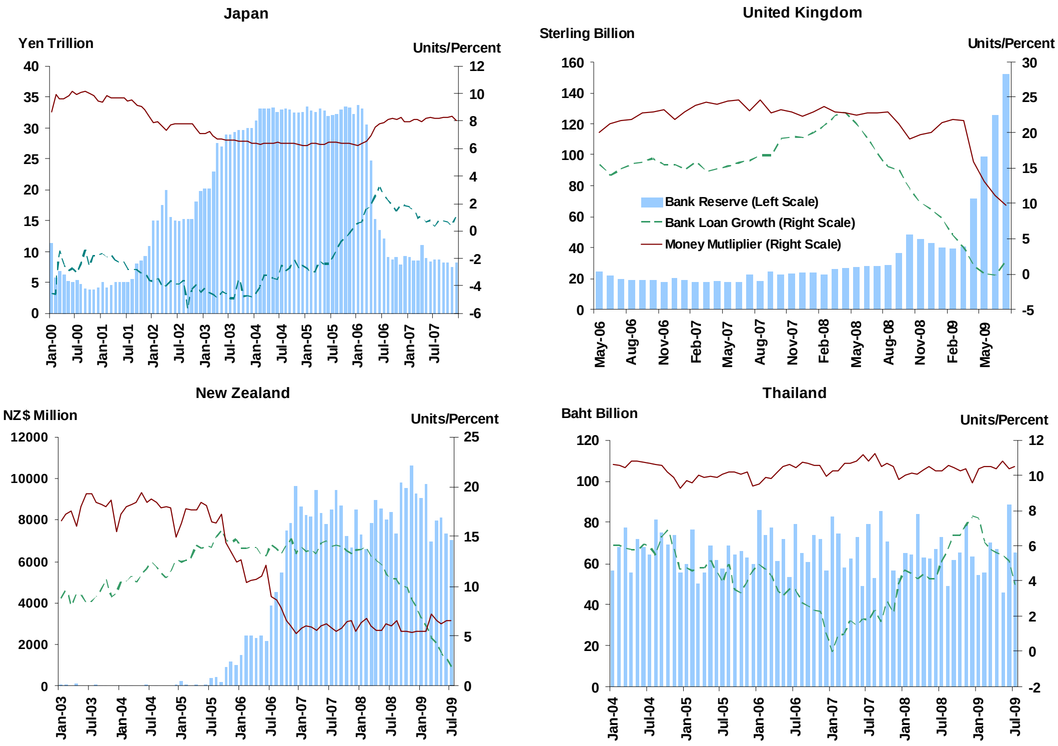
However, with monetary policy implementation nowadays focused predominantly on achieving a target for a short term interest rate, the money multiplier has ceased to be a meaningful concept.[1] Banks hold reserves for two main reasons: i) to meet any reserve requirement; and ii) to provide a cushion against uncertainty related to payments flows. The quantity of reserves demanded is then typically interest-inelastic, dictated largely by structural characteristics of the payments system and the monetary operating framework, particularly the reserve requirement. When reserves are remunerated at a rate below the market rate, as is generally the case, achieving the desired interest rate target entails that the central bank supply reserves as demanded by the system. In the case where reserves are remunerated at the market rate, they become a close substitute for other short-term liquid assets and the amount of reserves in the system is a choice of the central bank.

In either case, the interest rate can be set quite independently of the amount of reserves in the system and changes in the stance of policy need not involve any change in this amount. The same amount of reserves can coexist with very different levels of interest rates; conversely, the same interest rate can coexist with different amounts of reserves. There is thus no direct link between monetary policy and the level of reserves, and hence no causal relationship from reserves to bank lending. The decoupling of interest rates from reserves is discussed in detail in Borio and Disyatat (2009) and Disyatat (2008).

The absence of a link between reserves and bank lending implies that the money multiplier is an uninformative construct. As an illustration, Figure 1 shows the evolution of the money multiplier, reserves, and bank lending growth for Japan, the United Kingdom, New Zealand, and Thailand during different periods. In all cases, it is clear that movements in the money multiplier largely reflects changes in reserves, with the latter showing no perceptible link to the dynamics of bank lending. In the case of Japan and the United Kingdom, the abrupt change in reserves was the result of each central bank's quantitative easing policy. In New Zealand, the increase reflected the reform of the central bank's monetary operating framework in July 2006 to a "fully cashed-up system" where reserves are remunerated at the policy rate (see Nield, 2008). Finally, with respect to Thailand, the money multiplier has been relatively stable absent changes in the reserve requirement.

Thus the money multiplier varies largely with the amount of reserves in the banking system, which as noted above, is determined predominantly by exogenous structural factors. When those factors change, central banks simply accommodate whatever new level of reserves is required by the system. For example, when a central bank raises reserve requirements, the level of reserves must be increased to allow the system to meet this requirement. Deposits are

[1] That said, the money multiplier view of credit determination is still pervasive in standard macroeconomic textbooks including, for example, Abel and Bernanke (2005), Mishkin (2004), and Walsh (2003).



Source: National central banks

Note: Money multiplier is calculated as the ratio of broad money to base money.

Figure 1: Money Multiplier and Credit Growth

unaffected and the money multiplier simply falls. This reduction has no economic significance. The same applies to those rare cases where reserves are changed as part of unconventional monetary policy, as in the examples of Japan and the United Kingdom above.[2] Consider two scenarios involving the purchase of an asset by the central bank. In one case, the purchase is financed by reserves. In the other, it is financed by issuing one-week central bank bills. Given the very high substitutability between the two funding methods, the macroeconomic impact will be largely identical. In the first case, however, the money multiplier falls while in the latter, it remains unchanged. Again, the money multiplier is uninformative, its movements only reflecting innocuous liability management of the central bank.

Turning to the alternative way of motivating the link between monetary policy and deposits, consider the mechanics of household portfolio rebalancing. Here, the presumption is that policy

[2] As explained in detail in Borio and Disyatat (2009), this can only happen when the opportunity cost of reserves has been eliminated either because interest rates are at the zero floor or reserves are remunerated at the policy interest rate.

actions that change the opportunity cost of holding deposits act as a catalyst for portfolio rebalancing that affects the level of deposits. This view essentially rests on the conventional interest elasticity of money demand as applied to deposits. There are a number of reasons to be skeptical of this mechanism. For one, deposit rates in many countries are closely linked to money market rates so that changes in policy would not significantly change the opportunity cost of holding deposits. For deposit accounts that pay little or no interest (for example, checking accounts), it would stand to reason these funds are not interest-sensitive to begin with anyway, being held primarily for transaction purposes. Moreover, while it is easy to envision changes in deposits for individual banks, for the system as a whole, a substantial change in the *aggregate* amount of deposits suggests an overall shift in the degree of bank intermediation.[3] This is more likely to be driven by structural factors like the level of competition in the financial system and underlying preferences than monetary policy. In any case, shifts in retail deposits will likely occur with lags that are too long for them to be the main driving force in the transmission mechanism.

More generally, quantitative constraints on bank lending should be de-emphasized. Even if one accepts the notion that deposits fall in response to tight policy, banks nowadays are able to easily access wholesale money markets to meet their funding liquidity needs.[4] Importantly, since banks are able to create deposits that are the means by which the non-bank private sector achieves final settlement of transactions, the system as a whole can never be short of funds to finance additional loans. When a loan is granted, banks in the first instance create a new liability that is issued to the borrower. This can be in the form of deposits or a cheque drawn on the bank, which when redeemed, becomes deposits at another bank. A well-functioning interbank market overcomes the asynchronous nature of loan and deposit creation across banks. Thus loans drive deposits rather than the other way around.[5]

This is the key feature that differentiates bank lending from non-bank credit. Capital market intermediation, like barter and commodity money or cash-based systems, requires that the creditor have on hand the means of payment to deliver to the debtor *before* the credit is extended. In modern financial systems, credit transaction between non-bank agents essentially involves the transfer of deposits. Bank lending, on the other hand, involves the *creation* of bank

[3] For the system as a whole, deposits cannot fall unless banks issue new liabilities to replace them or sell an asset to non-banks (including loan repayment). Individual agents' attempt to dispose of their deposit holdings by buying assets from other non-bank private sector agents simply redistributes deposits within the system leaving aggregate deposits unchanged.

[4] For the US, Carpenter and Demiralp (2009) document the strong link between loans and banks' managed liabilities with the former driving the latter. They also find that reservable deposits play little role in explaining loan dynamics.

[5] Depending on the non-bank public's preference for deposits relative to other assets, the ultimate counterpart to additional loans may be either deposit or non-deposit liabilities. The fact that loans drive deposits has been emphasized by Palley (2008), Wray (2007), and Moore (2006).

deposits that are themselves the means of payment. A bank can issue credit up to a certain multiple of its own capital, which is dictated either by regulation or market discipline. Within this constraint, the growth of bank lending is determined by the demand for and willingness of banks to extend loans. More generally, all that is required for new loans is that banks are able to obtain extra funding in the market. There is no quantitative constraint as such. Confusion sometimes arises when the *flow* of credit is tied to the *stock* of savings (wealth) when the appropriate focus should in fact be on the flow.

2.2 Towards a New Framework

Clearly the reliance on shifts in deposits as the driver of the bank lending channel needs to be reconsidered. Nonetheless, the underlying idea that the existence of agency costs generates a disproportionate impact of monetary policy on loans to bank-dependent firms is highly plausible. The primary proposition of this paper is that the bank lending channel works through the impact of monetary policy on banks' external finance premium as determined by their perceived balance sheet strength. The underlying mechanism at work is thus largely one of the same as that of the balance sheet channel. But instead of focusing on the impact of policy on financial frictions at the firm level, the emphasis is instead on the bank level. In this respect, the paper can be seen as a formalization of Bernanke's (2007) recasting of the bank lending channel. Such a characterization is more reflective of the way in which financial intermediation has evolved over the last decade or so. By putting more emphasis on the broader effects that monetary policy can have on banks' loan supply function, the narrow quantity mechanism featured prominently in the traditional perspective is downplayed significantly. Changes in deposits are not the driving force but rather a by-product of banking and real sector adjustments to policy changes.

The model, adapted from Disyatat (2004), builds on the conceptual footsteps of Gale and Hellwig (1985) and Holmstrom and Tirole (1997) by introducing credit market imperfections in a setting where firms are dependent on bank credit for their operations. Explicit modelling of the banking sector and formal consideration of the role of bank balance sheets, makes it possible to discuss how differences in the health of the banking system influence the real effects of monetary policy changes. Instead of relying on shifts in the composition of bank funding, the model focuses on policy-induced variations in the external finance premium that affect banks' cost of funds even if their relative sources of funds remain unchanged. By emphasizing the impact of policy on banks' perceived financial health, as determined by leverage and asset quality, a bank lending channel exists even when banks have full access to market-based funding. This point is made particularly stark by neglecting altogether reservable liabilities and focusing only on market-based financing. For non-banks this is an accurate depiction of the funding structure. For banks the assumption captures the fact that their marginal source of funding invariably comes from the market, where credit risk matters.

In this context, the impact of policy will be transmitted through changes in required rates of return rather than changes in the quantity of deposits. View another way, while traditional models assume that a monetary tightening leads to a shortage of liquidity for banks, the presumption here is that it leads to a disproportionate rise in the price of funding liquidity, which is readily available. The only constraint on credit is capital. There are two dimensions to capital's role in influencing the supply of credit. First, from the banks' perspective, the presence of regulatory capital requirements acts like a hard constraint on asset expansion. Second, from the perspective of banks' creditors, the amount of capital signifies the extent to which any losses will be cushioned and this, in turn, influences the rate at which they are willing to lend to banks. It will be apparent that the latter matters more than the former, simply because it binds more.

There is ample evidence that banks' cost of funds are sensitive to their underlying financial health and that the latter influences the real economy. Maechler and McDill (2006) provide evidence that riskier banks or banks in poorer conditions have to pay a risk premium on their uninsured deposits. Hubbard et al. (2002) show that differences in the capital positions of individual banks affect the rate at which their clients can borrow. Guiso et al. (2002) find that measures of bank health – as well as bank size, efficiency, and market share – are useful instruments for the interest rate that banks charge on their loans, while Peek et al. (2003) show that variations in aggregate bank health has a significant effect on the real economy. Finally, Carlson et al. (2008) find that the health of financial intermediaries has a significant impact on capital investment in the US. They also find that changes in their measure of financial sector health Granger causes changes in lending standards.

3 The Model

Consider an economy that produces a single good using labor as the only input. The model has three types of agents: firms, banks, and households, each of equal number. All agents are risk-neutral and subject to limited liability. To produce, firms need to obtain bank credit to pay wages to households before production takes place. Households have the option of either keeping their wages as deposits at the bank or investing in a risk-free government bond. Banks finance loans through deposits. As will be apparent, in an equilibrium, the return on deposit offered by banks must be high enough to ensure that households keep all of their wages in the form of bank deposits. Since the focus of the paper is on the process of credit extension, it will abstract from general equilibrium determination of prices.[6] The price of the good as well as wages are thus taken as given. This effectively makes goods demand perfectly elastic at the given price level. Finally, in moving away from quantitative constraints, the focus will be on the impact of monetary policy on the flow of new loans rather than outstanding levels.

3.1 Firms

The representative firm must obtain credit to finance their working capital (labor costs) prior to production and sale of output. They are not able to borrow directly from the capital market and must therefore rely on banks for funds. Each firm is matched randomly with one bank and though they may choose to switch banks, they must obtain all their financing from a single bank. All firms have access to the same technology and are subject to an aggregate random productivity shock that is common to all firms. In particular, a firm's output is governed by

$$y = N^{\beta}(1+\varepsilon), \qquad 0 < \beta < 1$$

where N represents units of labor employed and ε is the aggregate productivity shock. This shock is assumed to be binomially distributed such that

$$\varepsilon = \begin{cases} 0 & \text{with probability} \quad \theta \\ -1 & \text{with probability} \quad (1-\theta). \end{cases}$$

Thus output equals zero with probability $(1-\theta)$ in which case firms have no choice but to default. This can be thought of as the state of bankruptcy.

Denoting output price by P, the cost of labor by P_N, and the bank lending rate by r_L, expected profits of the firm is given as

$$\Pi^e = \theta\left(PN^{\beta} - (1+r_L)P_N N\right). \tag{1}$$

Note that the existence of limited liability implies that firms only repay their debt if the productivity shock turns out to be favorable.

Labor is assumed to be supplied elastically at the given wage level and firms choose how much to employ in order to maximize expected profits, taking r_L as given. The first order condition of this simple problem gives optimal employment as

$$N = \left[\frac{P\beta}{(1+r_L)P_N}\right]^{\frac{1}{1-\beta}}. \tag{2}$$

[6] To do so, preferences must be specified for aggregate consumption and market clearing imposed. While this is relatively straightforward, doing so adds little to the underlying message at hand.

Since firms operate only when expected profits is non-negative, (1) implies that they can always repay their loans if the productivity shock turns out to be favorable. Multiplying (2) through by the wage rate, P_N, yields the amount of nominal borrowing desired by firms

$$L \equiv P_N N = P_N \left[\frac{P\beta}{(1+r_L)\, P_N} \right]^{\frac{1}{1-\beta}}, \tag{3}$$

which represents firms' loan demand schedule as a function of the bank lending rate.

3.2 Banks

Banks are risk neutral and operate in a competitive market. They use no resources in the process of intermediation and earn no expected profits in equilibrium. New loans are financed completely by issuing deposits to households, which are not insured and hence subject to default risk. This captures the fact that the marginal source of funds for banks in practice is the wholesale funding market, where credit risk matters, since retail deposits are insufficiently responsive to funding needs. Introducing deposit insurance would not affect the analysis. As long as the market for deposits is competitive, banks would bid for deposits until the rate of return offered equals the rate on uninsured market funding.[7] In the event of default, the bank gets liquidated and its net worth transferred to depositors.

The balance sheet of a representative bank is captured simply by

$$w = A - D, \tag{4}$$

where A and D denote existing assets and liabilities, respectively, all valued at market prices. Thus w is the net worth or capital position of a representative bank at the start of the period. To capture a key uncertainty for potential creditors, banks' net worth are exposed to a random disturbance which is not realized until the end of the period. The idea is that banks are subject to risks, such as operation risk and risk associated with existing assets and liabilities, in addition to the marginal risk inherent in new lending. This will be captured by the variable u, which is uniformly distributed over $[\underline{u}, \overline{u}]$ with $-1 < \underline{u} < 0 < \overline{u}$. The net worth of a representative bank at the end of the period before any claims are settled will therefore be given by

$$\psi \equiv w(1+u).$$

[7] The reason why deposits pay a lower rate of return in practice is often due to market segmentation. With the emergence of retail money market funds, the spread on deposit rates relative to money market rates has been reduced significantly in many countries (for example, certificate of deposits and money market savings accounts typically pay rates comparable to that in wholesale markets). Hence an alternative way to justifty suppressing the distinction between deposits and wholesale funding is to assume that there exists a competitive money market that arbitrages away any margins that banks may impose on depositors.

In the case where a firm defaults, the bank that lent to it will be able to repay its creditors only if $\psi > (1 + R) L$, where R is the interest rate at which it borrowed from households and L is the size of the loan made to firms. This defines the critical value of shock to net worth

$$u^* = \frac{(1 + R) L}{w} - 1, \tag{5}$$

such that a domestic bank whose loan goes bad (firm fails) will still be able to repay its creditors provided that $u > u^*$. The probability that a representative domestic bank will default, given that the firm to which it lent to failed, is then

$$\begin{aligned} q &\equiv \Pr(\psi < (1 + R) L) \\ &= \Pr(u < u^*) \\ &= \frac{u^* - \underline{u}}{\overline{u} - \underline{u}}. \end{aligned} \tag{6}$$

This will be referred to as the *conditional default probability* of banks.

The next step is to calculate the *unconditional* probability of a bank defaulting. Since a bank will default if and only if firms fail *and* its net worth turns out to be insufficient to cover its debts, this probability is

$$1 - x = (1 - \theta) q,$$

where x is the probability that domestic banks will repay fully.

Given that banks can obtain funds from households at the rate of R, their lending rate will be determined by[8]

$$\theta (1 + r_L) L = x (1 + R) L + (1 - x) \psi^e. \tag{7}$$

where ψ^e is the expected net worth of a domestic bank which defaults. It represents how much each bank expects to lose when it is unable repay investors. It also reflects the cushion that depositors receive to withstand shocks and can be thought of as a measure of banking system health. Formally,

$$\begin{aligned} \psi^e &= E[\psi | \psi < (1 + R) L] \\ &= w \left[1 + \frac{\int_{\underline{u}}^{u^*} u g(u) \, du}{G(u^*)} \right], \end{aligned}$$

where $g(u)$ and $G(u)$ represent the probability and cumulative density functions of u, respectively.

In summary, the main function of banks is to intermediate between firms and households, implicitly pledging their own capital as collateral for the loans. In the process, they absorb

[8] Note that the expected cost of funds takes into consideration the case where households are repaid out of bank's net worth. The expected cost of this outcome is $(1 - \theta)(1 - q)(1 + R) L$.

much of the firm risk stemming from the productivity shock. Exactly how much risk banks are able to absorb depends on the size of their capital relative to firms' desired borrowing, that is their leverage ratio.

3.3 Households

Households are risk-neutral and provide labor to firms in return for wage payments in the form of bank deposits. They have the choice of keeping their income as deposits or instead investing in a risk free government bond. The return on the latter is assumed to be set by the central bank and is denoted by $(1 + r_f)$. This represents households' opportunity cost of deposits. Given the existence of a competitive money market, the rate of return that banks must pay depositors, R, will be determined by

$$(1 + r_f)L = x\,(1 + R)\,L + (1 - x)\,(\psi^e - cL)\,, \tag{8}$$

where c represents the contract enforcement costs in the event of a default, assumed to be proportional to the the size of the loan. It captures the costs associated with bankruptcy proceedings to claim the net worth of the defaulting bank and can be thought of also as the degree of financial market imperfection.[9]

The presence of credit market imperfection implies that banks borrow at a premium from households and this, in turn, translates into higher cost of capital for firms. This will lead to a lower equilibrium level of output than in the case where credit markets are perfect and can be interpreted as a form of credit-rationing in similar spirit to Gale and Hellwig (1985). In what follows, the contract enforcement cost is assumed to be small enough such that

$$\frac{\theta\,(1 + r_f)}{(1-\theta)\left[\frac{(1+\overline{u})}{(\overline{u}-\underline{u})} + \frac{(1-\theta)}{2}\right]} > c. \tag{9}$$

Appendix 6.1 shows that the deposit rate can be represented as a mark-up rule where it exceeds households' opportunity cost of funds by the sum of two terms: the first is the expected revenue lost in the case of default, and the second captures the expected costs of contract enforcement. That is,

$$R - r_f = \frac{(1-\theta)}{L}\left[\int_{\underline{u}}^{u^*} \left[w\,(u^* - u)\right] g\,(u)\,du + cL\int_{\underline{u}}^{u^*} g\,(u)\,du\right]. \tag{10}$$

[9] The cost of contract enforcement can be related to the idea of costly state verification as in Gale and Hellwig (1985). Modelling the cost as fixed rather than proportional to the size of the loan does not affect the underlying mechanics of the model.

3.4 Loan Market Equilibrium

The model can be thought of as a one-shot game with three stages played repeatedly over time with different starting values (ie. different prices and bank balance sheet values). Banks enter the game with predetermined assets and liabilities – possibly the outcome of a previous iteration of the game. The level of the risk free interest rate is then set by the central bank in the first stage. During the second stage, banks, firms, and households determine lending contracts (interest rates) and make output decisions taking prices as given. In the final stage, all remaining uncertainty is resolved (productivity shock and shock to banks' net worth) and all claims settled.

The solution of the model can be fully characterized by equilibrium in the market for loans, which will be depicted in the $(1 + r_L)$ and L space. The only complication involves the derivation of the bank loan supply schedule since this will depend on banks' conditional probability of default (q), which varies endogenously with the amount of loan extended (L). The first step, then, is to establish this link. The zero-profit condition for households, (8), can be combined with (5), (6), and rearranged as[10]

$$H \equiv \frac{w(1-\theta)(\overline{u}-\underline{u})}{2}q^2 + \left[(1-\theta)cL - (\overline{u}-\underline{u})w\right]q - w(1+\underline{u}) + (1+r_f)L = 0. \tag{11}$$

For a given amount of loans (L) desired by firms and a given level of net worth (w), (11) gives the associated conditional probability of default of domestic banks (q) taking into account the implied rate of interest demanded by depositors. Since q is a probability, it will be restricted to lie between 0 and 1. From (11), it follows that

$$q = 0 \qquad \text{for} \quad L = \frac{w(1+\underline{u})}{(1+r_f)} \equiv L_L \tag{12}$$

and

$$q = 1 \qquad \text{for} \quad L = \frac{w(1+\underline{u}) + w(\overline{u}-\underline{u}) - \frac{w(1-\theta)(\overline{u}-\underline{u})}{2}}{(1+r_f) + (1-\theta)c} \equiv L_H. \tag{13}$$

Given the restriction (9), it can be verified that $L_H > L_L$ and $\frac{\partial q}{\partial L} > 0$ for $q \in (0,1)$, establishing a unique positive relationship between L and q over the possible range of q. Intuitively, as the size of the desired loan gets larger, it becomes more likely that a bank will not have enough capital to payback its creditors if the firm to which it lent defaults. That is, the increased leverage associated with an expansion of bank balance sheets stretches the cushion for losses provided by a given level of capital. The conditional probability of default can be characterized by

$$q = \begin{cases} 1 & \text{for} \quad L \geq L_H \\ \{\min(q) : H = 0\} & \text{for} \quad L_L < L < L_H \\ 0 & \text{for} \quad L \leq L_L. \end{cases} \tag{14}$$

[10] See Appendix 6.1 for details.

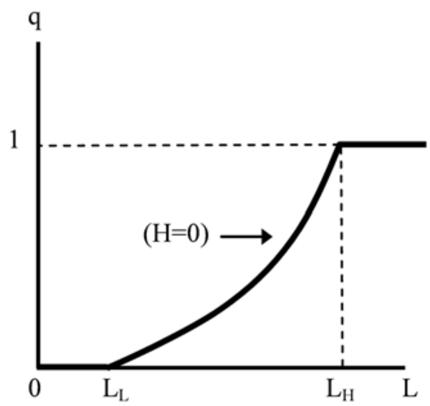


Figure 2: Conditional Probability of Default

The schedule is illustrated in Figure 2.

Combining (7) with (8) yields the non-linear loan supply schedule

$$(1+r_L)=\begin{cases}\dfrac{(1+r_f)}{\theta}+\dfrac{(1-\theta)\,c}{\theta} & \text{for} \quad L\geq L_H \qquad (q=1)\\ \dfrac{(1+r_f)}{\theta}+\dfrac{(1-\theta)\,c}{\theta}q & \text{for} \quad L_L<L<L_H \qquad (0<q<1)\\ \dfrac{(1+r_f)}{\theta} & \text{for} \quad L\leq L_L \qquad (q=0)\,,\end{cases} \tag{15}$$

which is illustrated as L_S in Figure 3. In the figure, $\overline{(1+r_L)}\equiv\frac{(1+r_f)}{\theta}+\frac{(1-\theta)c}{\theta}$ and $\underline{(1+r_L)}\equiv\frac{(1+r_f)}{\theta}$ represent the upper and lower bounds of possible bank loan rates, respectively. The presence of financial frictions at the bank level generates an upward sloping section in the loan supply curve which is necessary for the bank lending channel to operate.

The demand for loans is straightforward and is given by (3). It is depicted as the downward sloping line, L_D, in Figure 3. The loan market equilibrium is then determined by the intersection of loan supply with loan demand, yielding an equilibrium L^* and $(1+r_L)^*$. Importantly, an equilibrium with $q\in(0,1)$ will obtain as long as the following conditions are satisfied

$$L_H>\underline{L} \quad \text{and} \quad L_L<\overline{L}, \tag{16}$$

where

$$\underline{L}\equiv L_D|_{q=1}=P_N\left[\frac{\theta P\beta}{(1+r_f)+(1-\theta)\,c}\right]^{\frac{1}{1-\beta}}$$

and

$$\overline{L}\equiv L_D|_{q=0}=P_N\left[\frac{\theta P\beta}{(1+r_f)}\right]^{\frac{1}{1-\beta}}.$$

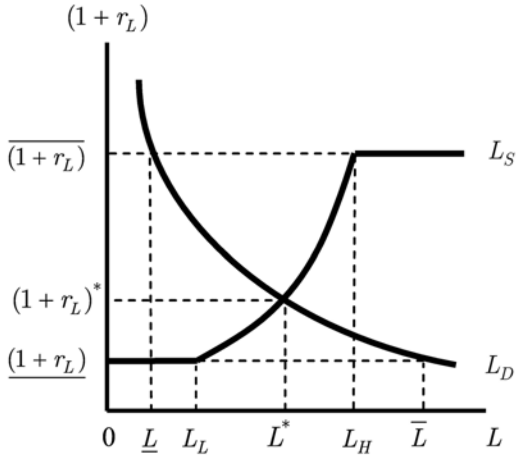


Figure 3: Loan Market Equilibrium

As shown in Appendix 6.2, this is equivalent to restricting the initial net worth of banks (w) to lie within a given range

$$\underline{w} < w < \overline{w}. \tag{17}$$

If the net worth of banks lie within this range, its size will affect the conditional probability of default and therefore the equilibrium output level.

Before proceeding, it is useful to reflect on the role that deposits play in this economy. That the availability of deposits does not act as a constraint on bank lending can be seen in the process by which they are created. This process begins with firms deciding how much to borrow given the loan rate, output price and wages. Once a loan is granted, a deposit is created in the name of the firm. Upon commencement of production, the firm pays wages to households and their deposits are transferred to households. These are then transferred back to the firm when output is sold. Finally, the deposit is extinguished when firms pay back their loans. The crucial element that underpins this process is the fact that bank deposits are the means by which the non-bank sector achieves final settlement.[11] Indeed, this is what makes them 'money', but unlike fiat or commodity money, its supply originates from *within* the financial system and is determined to a large extent by the demand for credit.[12]

[11] For banks, the final means of settlement is bank reserves (deposits at the central bank). The circular flow of money payments underlies most theories in the Wicksellian tradition, including the Robertsonian sequence analysis (see Kohn 1981).

[12] It is useful to constrast with non-bank intermediaries whose activity increases total credit market debt but

Thus in contrast to traditional views of the bank lending channel, expansions and contractions in banks' balance sheets are initiated by borrowers rather than depositors. Banks, as retailers of credit, are price-setters and quantity-takers in the market for loans and deposits. Lending and deposit rates are determined as mark-ups over the risk-free rate set by the central bank. The supply of deposits (inside money), rather than being exogenous, is determined endogenously by the quantity of credit that firms demand to finance their working capital. Reflecting this, the model here takes stocks of loans and deposits as given and focuses on the impact of monetary policy on their flows. Since new loans are financed by new deposits, there is no quantitative constraint on bank lending. Any outward shift in the loan demand curve can always be accommodated.[13] It is in this sense that borrowing creates its own funding so that in the absence of externally imposed capital requirements, there is no anchor for credit expansion except for the interest rate governing loan demand.[14] Monetary policy exerts a critical influence on the latter.

4 The Bank Lending Channel Redux

This simple setup serves as a transparent framework within which to analyze how monetary policy changes may be propagated through the banking system. To focus on the intuition, the analysis will be carried out graphically. Formal analytical solutions are sketched out in Appendix 6.3. As a benchmark case, Figure 4 shows the effects of a monetary policy tightening that raises $(1 + r_f)$. By raising the opportunity cost of deposits, banks are forced to raise deposit rates to retain funds and the loan supply schedule shifts from L_S to $L_S^{'}$. Given a fixed nominal wage rate, the rise in loan rates increases real factor costs which discourages firms from hiring labor, reduces loan demand and output contracts.

As opposed to the standard interest rate channel, a policy tightening here does not result in a one-for-one change in firms' cost of borrowing. Starting from an initial situation where $0 < q < 1$, (15) indicates that the interest rate that firms face changes by $\frac{1}{\theta} + \frac{(1-\theta)c}{\theta} \frac{\partial q}{\partial(1+r_f)}$. Thus the spread that firms are charged over the risk free rate is not constant but varies in

leaves deposits (and hence money supply) unchanged. They effectively intermediate the transfer of deposits from the bank accounts of investors to those of the ultimate borrowers, but cannot themselves create new deposits.

[13] This feature of monetary systems was already well recognised by Wicksell: "No matter what amount of money may be demanded from the banks, that is the amount which they are in a position to lend... The 'supply of money' is thus furnished by the demand itself." (Wicksell 1898 [1936, p.110-11]).

[14] The fact that bank loans are inherently demand-determined also helps to reconcile the observation that bank lending sometimes increases after a monetary policy tightening. If banks extend loan commitments, for instance, their usage may increase when access to capital markets becomes more difficult following tighter policy. This is not possible in a world of quantitative constraints on bank lending that is assumed to become more binding with policy tightening.

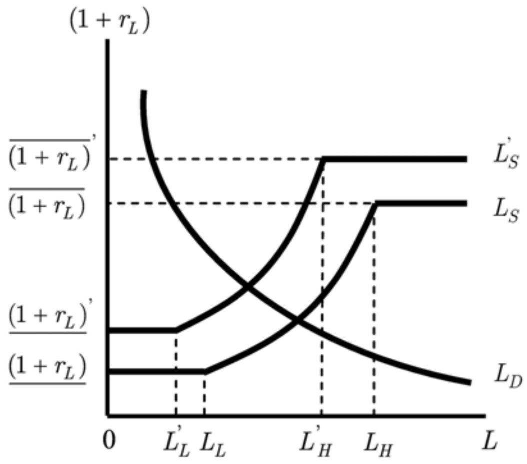


Figure 4: A Monetary Policy Tightening

conjunction with the impact of policy on banks' conditional probability of default. Policy changes give rise to endogenous variations in financing conditions through the banking system that are driven by changes in the extent to which bank capital can serve to cushion depositors from possible loan losses. It can be verified that $\frac{\partial q}{\partial(1+r_f)} < 0$ so that a policy tightening results in a reduction in the conditional probability of bank failure. This reflects the fact that higher interest rates are associated with smaller loan size relative to bank capital, and the smaller leverage provides a greater cushion for banks to absorb losses. In this way, the model establishes a close relationship between i) accommodative monetary policy; ii) lower credit spreads; iii) growth of financial intermediaries' balance sheets; and iv) higher economic activity that often characterize credit cycles.

Starting from this benchmark case, potential amplification mechanisms of the bank lending channel can be illustrated through a straightforward extension of the basic model. Two main avenues are considered, one based on the impact of monetary policy on bank balance sheets and the other on the link between policy and risk perceptions. In all cases, the underlying propagation mechanism derives from the impact that monetary policy has on banks' external finance premium, which depends on their expected probability of default. The latter, in turn, varies inversely with banks' financial strength as measured by the level of net worth and perceptions regarding the risk profile of their asset portfolio. The bank lending channel operates if a tigthening of policy increases banks' external finance premium, subjecting them to higher cost of funds which are then passed on to firms. More expensive credit then discourages firms from borrowing, reducing the equilibrium level of employment.

In what follows, the analysis focuses on how these extensions affect the response of the loan

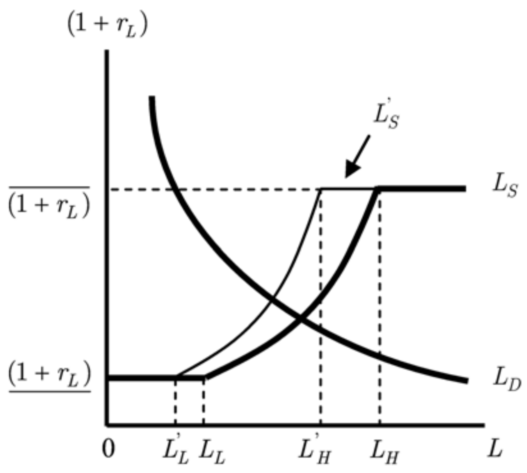


Figure 5: A Decline in Bank Net Worth

supply schedule to monetary policy *over and above* that captured already in the basic model. Thus the starting point of the loan supply curve in the figures below (L_S) should be seen as one that already incorporates the impact of monetary policy tightening in the basic model ($L_S^{'}$ in Figure 4).

4.1 Endogenous Bank Capital

The main channel through which the banking system may propagate policy shocks is via endogenous variations in bank capital. This may occur in a number of ways. Most directly, changes in interest rates may affect cash flows, net interest margins, and the valuation of assets through the discount factor. Less directly, they can also affect banks' asset quality through induced changes in the balance sheets of firms and economic activity. Increased bank holding of market sensitive securities along with an expanded trading book that is marked to market is likely to have increased the sensitivity of bank balance sheets to interest rates (see Adrian and Shin (2008)). Greater reliance on short-term market based borrowings to fund long-term asset growth may also have materially increased banks' interest rate risk exposure.

These effects can be incorporated into the model by assuming that banks' net worth, w, falls in response to a rise in $(1+r_f)$. As illustrated in Figure 5, a deterioration in bank net worth will shift the loan supply curve even more inward relative to the benchmark case (from L_S to $L_S^{'}$). Intuitively, smaller bank capital implies less protection for depositors for a given amount of loan contracted and hence a higher cost of funds for banks as well as a larger spread between firms' borrowing rate and the risk-free rate. Overall, a tightening of policy that also induces a fall in net worth results in higher rates on bank loans and lower output relative to the benchmark case. Such recasting of the bank lending channel is very much along the lines as that described by Bernanke (2007) and underscores the important role that financial sector health may have in influencing the transmission mechanism.

In practice, the impact of monetary policy on bank capital is likely to vary with the macroeconomic context as well as the characteristics of banks' balance sheets. Other things equal, the effect of tighter policy would likely be stronger when financial conditions are weaker. Empirical studies, for example, by Kishan and Opiela (2000, 2006) in the US, Altunbas et al. (2002) for the European Union, and Gambacorta (2005) in the Italian context support the notion that banks with low-capital ratios are more responsive to monetary policy. One implication is that one would also expect possible asymmetries between tightening and loosening of policy, partly depending on initial conditions.

4.2 Endogenous Risk Perceptions

The bank lending channel may also be reinforced by the impact of monetary policy on perceptions of risk and/or willingness to bear risk. The case for such links has been put forward, for example, by Bernanke (2003) and Borio and Zhu (2007). The latter refer to this mechanism as the "risk-taking channel".[15] One avenue through which such effects may work is via the impact of interest rates on financial buffers or the perceived vulnerability of agents to future economic shocks. For example, a policy tightening may raise firms' perceived riskiness by increasing tensions on cash flows and weakening their balance sheets. Anticipation of slower economic activity may raise the risk of bankruptcy. As emphasized by Borio and Zhu (2007), the procyclical behavior of estimates of probabilities of default and loss given default can also be seen as a manifestation of the influence of risk perceptions that is driven in part by monetary policy. The level of interest rates may also influence risk-taking behavior. In times when interest rates are low, the search for yield is often associated with the expansion of investments into riskier assets and borrowers as downside risks are played down.

Changes in risk perceptions and willingness to bear risk is likely to amplify the impact of policy on the real economy by compressing or expanding risk spreads that directly impact on firms' cost of funds. Empirical support for such a mechanism is growing. Bernanke and Kuttner (2003) finds that unanticipated changes in monetary policy affect stock prices not so much by influencing expected dividends or the risk-free interest rate, but rather through their impact on perceived riskiness of stocks. Jiménez et al. (2006, 2007) provide evidence that Spanish banks grant more risky loans and reduce lending standards at lower levels of short-

[15] The original exposition of the bank lending channel by Bernanke and Blinder (1988) also raised the possibility of a link between perceived riskiness of loans and banks' supply of loans, but not in the context of changes in monetary policy.

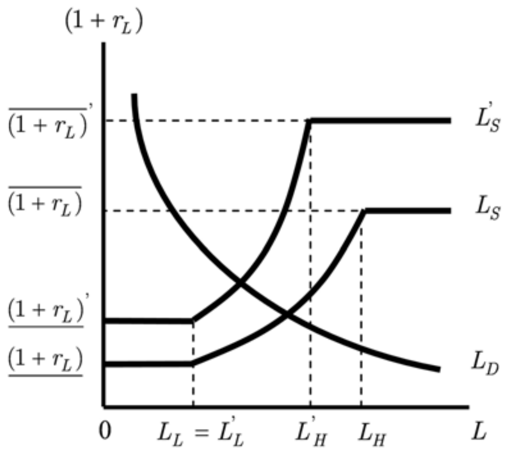


Figure 6: A Rise in Firm's Probability of Default

term interest rates. Using a large sample of European banks, Altunbas et al. (2009a) also find that banks characterized by lower expected default frequency are able to offer a larger amount of credit and to better insulate their loan supply from monetary policy changes.

The assumption of risk neutrality in the current setup obviously limits the extent to which issues related to changes in risk perceptions and/or appetite can be analyzed.[16] Nevertheless, the impact of policy-induced changes in risk perceptions can be captured heuristically within the present framework in two ways. The first is to allow the expected default probability of firms to be endogenous to policy. In particular, suppose now that only firms know the true distribution of shocks to productivity, so that banks and households make decisions based on their *perceptions* of firms probability of repayment, θ^e. Suppose, in addition, that tighter policy results in a lower expected repayment probability. This may reflect, for example, a less optimistic assessment of future growth prospects in the context of more restrictive monetary conditions. The model is exactly the same as before with θ replaced by θ^e. As illustrated in Figure 6, a decrease in θ^e will result in a further inward shift of the loan supply curve (from L_S to L_S') and hence a lower equilibrium level of employment relative to the benchmark case. Note that a rise in the expected probability of default by firms can also be thought of as being due to a worsening of firms' balance sheets. As such, it is observationally equivalent to the balance sheet channel. This makes it clear that the bank lending channel and the balance sheet channel reinforce each other and both act to increase the sensitivity of output to monetary

[16] That said, relaxing the risk neutrality assumption would not affect the underlying message of the model. Allowing for risk aversion would only result in extra compensation being required for bearing risk that would tend to widen interest rate spreads.

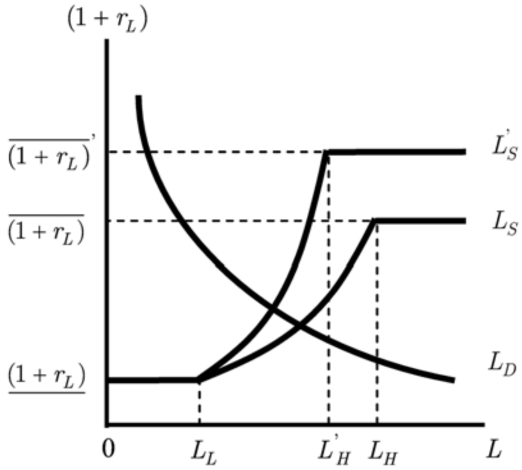


Figure 7: A More Pessimistic Outlook for Net Worth

policy through their effects on the supply of credit.

The second way to analyze risk perceptions in the present framework is through households' perception of bank risk. A monetary policy tightening may lead agents to adopt a more pessimistic outlook for the banking sector if, for instance, higher interest rates are associated with higher losses on outstanding loans. This is supported by empirical evidence presented in Jiménez et al. (2007). Tighter policy may also reduce banks' expected profitability to the extent that it flattens the yield curve, thereby compressing interest margins. Such effects can be captured in the model by making agents' assessment of the risk profile of banks' net worth sensitive to monetary policy. Specifically, suppose that a rise in $(1+r_f)$ is associated with a reduction in $\overline{u}$, the perceived upper bound of shock to banks' net worth. Figures 7 illustrates how this extension would also reinforce the inward shift in banks' loan supply schedule (from L_S to $L_S^{'}$) and lead to a larger reduction in output relative to the benchmark case.

4.3 The Role of Bank Capital

It is useful to relate the role of bank capital in this paper to that in the existing literature. A prominent strand of research has followed Holmstrom and Tirole (1997) in motivating the role of bank capital as a solution to a moral hazard problem between banks and depositors (see Meh and Moran, 2004; Chen, 2001). Because banks may shirk on their monitoring efforts, investors demand that banks invest some of their own capital into each project they lend to. Capital serves as a signalling mechanism to alleviate informational asymmetries between banks and their creditors. If the project fails, both the bank and investor lose their investments. In this respect, the arrangement is more akin to a venture capital setup than intermediation per se. Another strand of the literature has motivated bank capital through regulatory requirements (Van den Heuvel 2007; Bolton and Freixas, 2006). Here, the focus is on how a policy-induced decline in bank capital interacts with capital regulation to constrain bank lending. Banks curtail loans either because the capital requirement is binding or out of fear that it may bind in the future.

In contrast, the role of bank capital in this paper is to help cushion the losses for depositors in situations when firms default on their loans. A sufficiently large capital cushion can effectively insure depositors against default. The nature of bank funding is thus more closely aligned with uncollateralized market-based funding that is used heavily by banks in practice. One advantage of this approach compared to the imposition of exogenous regulatory capital requirements is that the bank lending channel may operate even when banks are well capitalized by regulatory standards. Indeed, regulatory capital may matter less than those imposed by the market. As highlighted by the recent global financial crisis, despite efforts by many banks to tout the fact that their capital level is significantly above regulatory requirement, the large uncertainty surrounding the underlying quality of assets as well as large potential recourse from implicit off balance sheet vehicles have nonetheless made investors wary of lending to these banks.[17]

To underscore the role of bank capital in this paper, Figure 8 illustrates how the equilibrium amount of loan contracted, and hence output, changes as banks' net worth varies. For banking systems with $w < \underline{w}$ or $w > \overline{w}$, there will be no bank lending channel that derives from policy induced variations in bank capital. If banks' net worth is low enough, households know that they will not be repaid in full if firms fail. They therefore lend at an interest rate which takes into account the fact that they are completely exposed to firm risk. Firms' cost of funds in this case would be

$$(1 + r_L) = \frac{(1 + r_f)}{\theta} + \frac{(1 - \theta)\, c}{\theta}.$$

On the other hand, with a large enough capital base, banks are able to completely absorb firms' risks and transform a risky asset into a risk-free one, which is then sold to households. Here banks improve overall economic performance because they allow firms to borrow at the most favorable risk-discounted interest rate

$$(1 + r_L) = \frac{(1 + r_f)}{\theta}.$$

This is as if firms could borrow directly from households and financial frictions in the banking sector no longer exerts an influence. With households being completely insured, they demand

[17] It is straightforward to extend the model in this paper to incorporate regulatory capital requirements. This would simply make the supply schedule vertical once the requirement becomes binding.

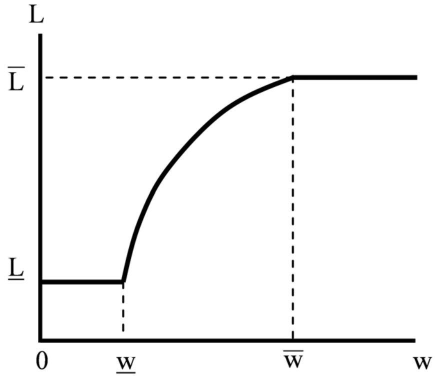


Figure 8: Net Worth and Loan Market Equilibrium

only that they earn as much as the rate they could obtain on government bonds. Again, with banks' external finance premium unaffected by changes in capital, the bank lending channel is attenuated. For economies with banks that have net worth in the intermediate range, $w \in (\underline{w}, \overline{w})$, households are not completely insured against firm failures and variations in net worth will affect the degree with which banks absorb firm risk. Here, the bank lending channel will amplify the effects of changes in monetary policy on the firms' cost of funds and overall economic activity.

The inherent non-linearity in the link between capital and banks' cost of funds also sheds light on a fundamental relationship between the banking system and financial stability. Depending on the state of bank balance sheet, the model illustrates how the banking system can alternatively play the role of shock absorber or shock amplifier. This is illustrated in Figure 9. Starting with a situation where bank capital is high enough such that $w > \overline{w}$, so that there is slack in banks' balance sheets, a representative equilibrium is one where L_S intersects L_D at L_0 and a loan rate of $(1 + r_L)_0$. From here, a small negative shock to bank asset values – for example due to a reversal of investor sentiment or unexpected loan losses – that reduces capital will shift of the loan supply curve to L_S^1. Such shocks will be completely absorbed by the banking system with no impact on the lending rate nor equilibrium employment. The banking system helps to insulate the real economy from financial shocks. On the other hand, once bank capital is below a certain threshold, $w < \underline{w}$, a similar shock to bank assets results in a higher loan rate and a lower equilibrium amount of lending. This is illustrated by a shift of the loan supply schedule from L_S^1 to L_S^2, and a reduction in the amount of loan contracted from L_0 to L_1. The financial shock is now amplified through the banking system onto the real economy.

At the same time, the framework in this paper also helps to illustrate how monetary policy

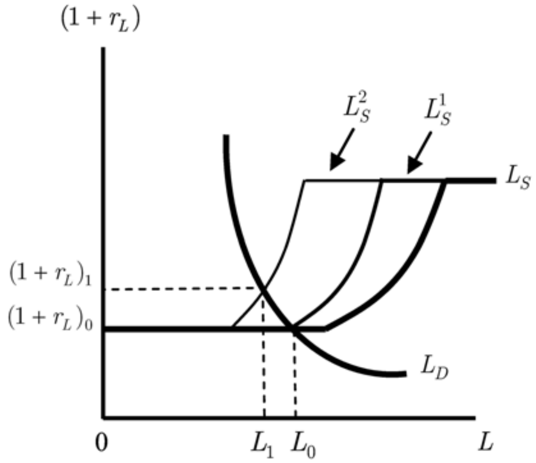


Figure 9: Asymmetric Role of Banking System

may have financial stability implications. Starting initially with an interest rate of $(1 + r_L)_0$ and the loan supply schedule L_S^0 in Figure 10, the probability of bank default is zero. As interest rates are cut from this point, bank lending expands as the loan supply curve shifts down first to L_S^1, and eventually the probability of bank default becomes non-zero at $(1 + r_L)_2$ with loan supply L_S^2. Looser monetary policy is associated with an increase in leverage that makes the banking sector and depositors more vulnerable to firm default.[18] This increase in vulnerability is not due to a deliberate expansion of risk-taking but simply the result of the banking sector accommodating greater demand for loans at low interest rates to the point that the size of their loan portfolio stretches their capital cushion. Lending booms are then associated with heightened sensitivity of the banking system to aggregate shocks, rendering the system more vulnerable in the event of an economic downturn. To the extent that a tightening of monetary policy lower banks' net worth and increases their overall costs of funds, a countercyclical monetary policy will help to offset some of the inherent procyclical tendencies of the financial system. In boom times when capital cushions appear large and banks' funding costs low, a monetary policy tightening would help to moderate the expansion of credit and contain the buildup of potential financial imbalances. Conversely, during busts, monetary easing may help to offset capital constraints on bank lending.[19]

Finally, the model can also capture the adverse impacts that explicit or implicit government

[18] Altunbas et al. (2009b) provide empirical evidence consistent with this. Using a panel encompassing banks in 16 countries, they find a strong link between monetary policy and bank risk.

[19] Disyatat (2010) discusses the practical implications and challenges of incorporating financial stability considerations into the conduct of monetary policy.

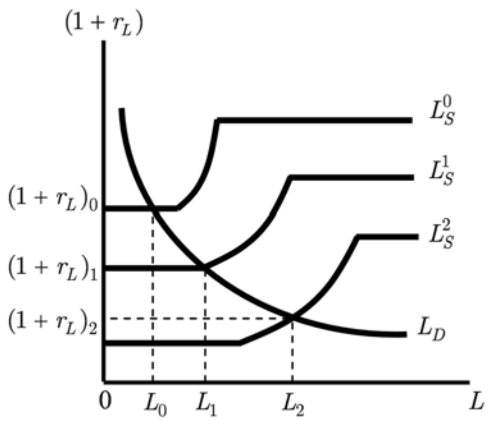


Figure 10: Monetary Policy and Banking System Risk

guarantees can have on market discipline. In situations where the government may not be willing to let banks fail and will step in to repay their debts if banks themselves are unable to do so, the *effective* net worth could be quite large. Provided that investors believe that this is quite credible, they will demand a lower premium on their funds than they would have otherwise. In this way, the idea that implicit bail out guarantees contribute to lending booms can be captured in this model.

4.4 Discussion

The reformulation of the bank lending channel in this paper suggests that some of the key implications of the traditional literature need to be reconsidered. The premise that changes in deposits act as the key catalyst, in particular, potentially leads to erroneous inferences regarding the channels' relevance in light of recent developments in the financial sector. Lower reserve requirements that apply to a smaller share of deposits (and the complete absence of reserve requirements in many countries), more developed capital markets that have tremendously improved bank's access to alternative non-deposit sources of funding, and the emergence of near banks (asset-backed security issuers, government-sponsored enterprises, finance companies, and brokers and dealers) that hold similar assets to banks but rely almost exclusively on market-based finance all suggest that the bank lending channel as traditionally conceived would not be quantitatively important at all, except for highly bank dependent economies with less developed capital markets. Indeed, one may conclude that the channel is more important when the financial system is repressed: "Bank lending channels were likely to have been more important during periods in which financial markets were more heavily regulated. . . In an environment in which interest rates are free to adjust, the bank lending channel of monetary policy is likely to be of lesser importance." Walsh (2003, p. 345)

On the contrary, the conceptualization of the bank lending channel in this paper suggests that it would be *more* important in well developed financial systems and that recent changes in the structure of the intermediation process, if anything, are likely to have enhanced its relevance. By linking the bank lending channel to policy-induced variations in banks' external finance premium, it becomes clear that greater reliance on market-based sources of funds – which are more sensitive to banks' financial health than deposits – should be associated with more responsive loan supply schedules. Thus in complete contradiction to the implication of traditional conceptualizations, it is likely to be the case that banks which are funded predominantly by insured deposits will be *more* insulated from monetary policy shocks.[20]

Certainly for near banks that not only rely almost exclusive on market-based finance but also mark their assets to market to a greater extent than banks, balance sheet strength is more sensitive to market conditions. At the same time, the development of securitization does not necessarily negate the bank lending channel. On the one hand, securitization and loan sales may reduce the interest sensitivity of bank assets by facilitating the transfer of risky assets off balance sheet. On the other hand, such instruments are essentially alternative forms of non-deposit financing where the effective cost will generally depend on the perceived financial strength of the institutions involved as this affects the credibility of recourse clauses and various guarantees that are common features of securitized structures. An example is the asset-backed commercial paper market where banks effectively retain much of the credit risk (Acharya and Schnabl, 2009). Similarly, covered bonds entail a tight link between bank balance sheet strength and their cost of funds as all obligations related to a covered bond are the bank's obligation and not just limited to the cash flow from the assets in the cover pool.

More broadly, the underlying mechanism emphasized in this paper blurs the distinction between banks and non-banks in the process of intermediation. In economies where capital markets are highly developed, it may be more appropriate to refer to the bank lending channel as the financial intermediary channel to reflect the recognition that the underlying mechanism may apply both at the level of banks as well as non-banks. Developments in the financial sector over the past decade imply that characterizing monetary transmission channels along the lines of institutions may be overly restrictive. Such a recognition also weakens one of the fundamental assumption for the traditional bank lending channel to work, namely the existence of bank dependent borrowers. Thus in many ways, the mechanism highlighted in this paper is broader and more consistent with salient features of modern financial systems.

[20] Banks consider non-maturity deposits (current and savings accounts) as reliable, low cost sources of funding that provide them with greater control over the timing and extent of the re-pricing of its funding structure. Black et al. (2007) present evidence that the lending of US banks with relatively high reliance on core deposits are not significantly affected by monetary policy.

The conceptual underpinning of the bank lending channel also has implications for the appropriate identification strategies to be employed in empirical studies and how existing empirical results should be interpreted. A number of papers have documented the less pronounced response of bank lending to monetary shocks for big, liquid, and well capitalized banks (Gambacorta, 2008; Kashyap and Stein, 1995, 2000; Kishan and Opiela, 2000; Stein, 1998; Van den Heuvel, 2002). More recent studies have also shown that banks with large global operations (Cetorelli and Goldberg, 2008) as well as those that securitize heavily (Altunbas et al. 2009c) are less prone to monetary policy shocks. Based on the traditional framework, these results have been interpreted as identifying the characteristics that facilitate banks' ability to offset policy-induced declines in deposits: big and well capitalized banks can more easily access markets for uninsured funding, those with global networks can rely on internal capital markets to make up for any shortfall in deposits, while liquid banks or those that securitize heavily may simply draw down cash and securities.

Under the alternative formulation in this paper, these results would suggest that the factors that attenuate the response of loans to monetary policy do so because they lessen the interest rate sensitivity of banks' external finance premia, rather than the composition of such financing. That is, bank specific characteristics shape how sensitive their external cost of funds are to changes in monetary policy. Bigger, more liquid, and better capitalized banks may be less affected by monetary policy because these characteristics are associated with strong balance sheets, a smaller degree of informational asymmetries and hence less variability in their external finance premium. Large internationally active banks may be less exposed to changes in the health of their balance sheets if they obtain a substantial fraction of their funding from foreign affiliates, who are less likely to change the mark-up they require. Similarly, banks that rely more heavily on securitization may appear to be less responsive to monetary policy because they are more likely to shift risky assets off balance-sheet (for example through SIVs), resulting in a less interest-sensitive asset portfolio. More generally, these considerations highlight potential inadequacies in the controls employed in many empirical studies for cross-sectional differences in banks' asset portfolios. To the extent that bank-specific characteristics serve as proxies for the interest rate sensitivity of their loan portfolios, demand effects are not adequately purged.

It may be more pertinent for empirical work to focus on characteristics that make banks' marginal cost of funds more or less responsive to changes in relative asset yields, funding conditions, and/or perceived riskiness of loans following changes in short-term interest rates rather than characteristics that influence banks' ability to replace lost deposits. Altunbas et al. (2009a) provides a first step in this direction and their results confirm the hypothesis that bank risk conditions, which to some extent are proxied by traditional indicators such as size, liquidity and capitalization, are key drivers of banks' ability and willingness to supply new loans. More generally, the framework in this paper suggests that identification schemes that focus on interest rate spreads may be more appropriate for empirical estimation of the bank lending channel and micro data on interest rates, where available, are likely to be more informative about financial conditions than quantity variables.

5 Conclusion

The bank lending channel has been a much studied segment of the monetary transmission mechanism and one that has received considerable attention in policy deliberations. The conceptual underpinnings of the channel, however, have largely remained unchanged since the influential work of Bernanke and Blinder (1988), with the bulk of the research being empirical. This paper has provided a reformulation of the bank lending channel that is more consistent with developments in the financial system over the last decade. At a minimum, it highlights more concretely the preconditions that must be in place for the channel to remain relevant in a world where monetary policy does not work through a quantity-centric view of policy implementation and banks are much more reliant on wholesale funding. By moving away from quantitative and compositional changes on bank balance sheets and focusing instead on endogenous variations in external finance premia that are driven by changes in bank health, the framework helps to reconcile several aspects of existing empirical evidence with the theory and sheds new perspective on others. And whereas the traditional conceptualization of the bank lending channel implies waning significance, the relevance of the channel as set out in this paper only looks set to grow in the future.

The central theme of the paper has been that bank balance sheet strength and their response to changes in market interest rates constitute a potentially key determinant of the transmission mechanism through the banking system. A corollary is that the prevailing *level* of interest rate, and not just their expectation in the future, matters to the extent that it influences the degree of leverage and banking system risk. Moreover, the impact of monetary policy shocks can be both amplified or attenuated by concurrent shifts in the health of the banking sector. This could justify more aggressive policy responses both on the upswing as well as during a downturn. The recent global financial crisis offers a stark example of the effect that variations in bank balance sheet strength, both perceived and real, can have on the real economy. Going forward, shifts in the willingness and the terms on which banks are prepared to lend, and the way these manifest in movements in interest rate spreads, are likely to become a standard component of macroeconomic models used for policy advice.

6 Appendix

6.1 Household's Zero-Profit Condition

Equation (8) can be written as

$$\begin{aligned}(1+r_f)\,L &= (1+R)\,L+(1-\theta)\,q\,[\psi^e-cL-(1+R)\,L]\\ &= (1+R)\,L-(1-\theta)\,qcL+(1-\theta)\,q\left[w\left(1+\frac{1}{q}\int_{\underline{u}}^{u^*}ug\,(u)\,du\right)-(1+R)\,L\right].\end{aligned}$$

Using (5), this can be expressed as

$$(1+r_f)\,L=(1+R)\,L-(1-\theta)\,qcL+(1-\theta)\,w\int_{\underline{u}}^{u^*}(u-u^*)\,g\,(u)\,du.$$

Expanding the integral gives

$$(1+r_f)\,L=(1+R)\,L-(1-\theta)\,qcL-\frac{(1-\theta)\,w}{2}\left[\frac{(u^*-\underline{u})^2}{(\overline{u}-\underline{u})}\right],$$

which simplifies to

$$(1+r_f)\,L=(1+R)\,L-(1-\theta)\,cqL-\frac{w\,(1-\theta)\,(\overline{u}-\underline{u})}{2}q^2. \tag{18}$$

Finally, using (5) and (6) to substitute in for $(1+R)\,L$ yields (11) in the text.

6.2 Restriction on w

Firstly, note that, $L_H=\underline{L}$ implies that

$$w=\frac{[(1+r_f)+(1-\theta)\,c]\,\underline{L}}{(1+\underline{u})+(\overline{u}-\underline{u})\left[1-\frac{(1-\theta)}{2}\right]}\equiv\underline{w}, \tag{19}$$

while $L_L=\overline{L}$ yields

$$w=\frac{(1+r_f)\,\overline{L}}{(1+\underline{u})}\equiv\overline{w}. \tag{20}$$

Given that $\overline{L}>\underline{L}$, it can be easily verified that the restriction (9) guarantees that $\underline{w}<\overline{w}$. Finally, the fact that L_L and L_H are increasing in w implies restriction (17) in the text.

6.3 Equilibrium and Comparative Statics

The model can be summed up by two key relations. The first is equilibrium in the loan market as determined by equating (3) with (15) to yield the relation

$$G\equiv\frac{(1+r_f)}{\theta}+\frac{(1-\theta)\,c}{\theta}q-\frac{P\beta}{P_N^{\beta}L^{1-\beta}}=0, \tag{21}$$

and the second is the link between the size of the loan and the conditional expected probability of bank default as given by (11) . Together, these two relations determine the equilibrium values of q and L. Given these, (3) can be used to infer the equilibrium value of $(1 + r_L)$, while $(1 + R)$ can be determined by (18).

The system is characterized by

$$\begin{aligned} \frac{\partial G}{\partial L} &= (1-\beta)\frac{P\beta}{P_N^{\beta} L^{2-\beta}} > 0 \\ \frac{\partial^2 G}{\partial L^2} &= -(1-\beta)(2-\beta)\frac{P\beta}{P_N^{\beta} L^{3-\beta}} < 0 \\ \frac{\partial G}{\partial q} &= \frac{(1-\theta)c}{\theta} > 0; \qquad \frac{\partial^2 G}{\partial q^2} = 0, \end{aligned} \tag{22}$$

and

$$\begin{aligned} \frac{\partial H}{\partial q} &= (1-\theta)cL - w(\overline{u} - \underline{u})x < 0; \quad \frac{\partial^2 H}{\partial q^2} = w(1-\theta)(\overline{u} - \underline{u}) > 0 \\ \frac{\partial H}{\partial L} &= (1-\theta)cq + (1+r_f) > 0; \qquad \frac{\partial^2 H}{\partial L^2} = 0. \end{aligned} \tag{23}$$

The effects of monetary policy tightening can be analyzed through

$$\begin{bmatrix} \frac{\partial G}{\partial L} & \frac{\partial G}{\partial q} \\ \frac{\partial H}{\partial L} & \frac{\partial H}{\partial q} \end{bmatrix} \begin{bmatrix} \frac{\partial L}{\partial(1+r_f)} \\ \frac{\partial q}{\partial(1+r_f)} \end{bmatrix} = \begin{bmatrix} -\frac{1}{\theta} \\ -L \end{bmatrix}.$$

Applying Cramer's Rule yields

$$\frac{\partial L}{\partial(1+r_f)} = \frac{-\frac{1}{\theta}\frac{\partial H}{\partial q} + L\frac{\partial G}{\partial q}}{|J|}$$

and

$$\frac{\partial q}{\partial(1+r_f)} = \frac{-\frac{\partial G}{\partial L}L + \frac{1}{\theta}\frac{\partial H}{\partial L}}{|J|},$$

where $|J|$ is the Jacobian determinant. From (22) and (23) it is clear that $|J| < 0$ so that $\frac{\partial L}{\partial(1+r_f)} < 0$. It can also be verified that $\frac{\partial q}{\partial(1+r_f)} < 0$ in equilibrium by nothing that $\frac{\partial G}{\partial L}\big|_{L=L^*} = (1-\beta)\frac{(1-\theta)cq+(1+r_f)}{L}$. The analytical solution method stretched out here can be straightforwardly extended to the case where w, θ, and $\overline{u}$ are negatively related to $(1 + r_f)$ as well, which are illustrated graphically in the text.

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