Credit Value-at-Risk Constraints, Pension and Insurance Fund Capital Requirements, Credit Rationing and Monetary Policy

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November 28, 2002

Abstract

Banks, insurance companies and pension funds provide risky loans and capital to …rms which have superior information regarding the quality of their projects. Due to asymmetric information the banks and pension funds face the risk of adverse selection. For banks the new Basle II Credit Value-at-Risk regulation is intended to counter the problem of low quality, i.e. high risk, loans. Pension funds and insurance companies usually operate on a mandate which stipulates that capital is su¢cient to meet future claims and investments satisfy certain risk standards. However, such minimum capital requirements, risk standards and Credit Value-at-Risk regulation distort the operation of credit markets. We show that a binding risk constraint introduces credit rationing. This regulation a¤ects monetary policy through the credit channel of monetary policy, which assumes that imperfections in the credit market a¤ect the money supply. There is evidence that the inception of the Basle I regulation added to the mild recession at the begging of the 1990's.

[*]This background paper is based on our joint article Credit Value-at-Risk Constraints, Credit Rationing and Monetary Policy.

1 Introduction

Banking supervisors and the banking industry have been discussing the wider application of the Value-at-Risk approach to risk management and capital regulation. To tie capital requirements more closely to the underlying risk in bank loan portfolios, the new Basel II framework allows for two main approaches to evaluating credit risk inherent in individual loans. Banks may use a standardized approach to risk assessment, which involves evaluating corporate loans by employing the ratings on unsecured debt issues provided by external credit rating agencies. Under this approach, loans to corporations would be allocated among a number of risk categories, each carrying predetermined risk weights. Alternatively, banks with su¢ciently developed risk assessment systems may use an internal-ratings-based method to estimate the credit risk of their portfolios.

The consequences of the introduction of simple and risk-weighted capital adequacy requirements have been studied intensively, both empirically (see Basel Committee on Banking Supervision (1999) for an overview) and theoretically (see Freixas and Rochet (1997) for an overview). In this background paper we argue that a credit risk model based Value-at-Risk constraint distorts the operation of credit markets. This occurs, because, when the constraint becomes e¤ective, it induces credit rationing by banks. From the literature we know that imperfect information on creditors can cause credit rationing, see Stiglitz and Weiss (1981). However, the in‡uence of bank regulation is absent from their model.[1]

Pension funds and insurance companies usually operate on a mandate which stipulates that capital is su¢cient to meet future claims and that investments satisfy certain risk standards. The e¤ects of regulatory minimum capital requirements for insurance companies and pension funds requires the sale of large equity portions during times when the stock markets are depressed. This is feeding to the stock market woes. The resulting underfunding of pension plans and insurance companies has a wealth e¤ect since pensioners and other parties holding on to the stock see their wealth declining, leading to reduced consumption. Moreover, the risk quality of the credit portfolio is also declining as a result of this, possibly leading to a credit crunch.

[1] Thakor (1996) models bank lending in the case of adverse selection and bank capital requirements. However, Thakor does not model VaR regulation.

The issue is that regulation for …nancial intermediaries may deepen the business cycle through. The capital requirements, risk standards and Credit Value-at-Risk regulation distorts the functioning of credit markets. We show that a binding risk constraint introduces credit rationing. This regulation a¤ects monetary policy through the credit channel of monetary policy, which assumes that imperfections in the credit market a¤ect the money supply. The policy question is whether monetary policy should be eased in response to the credit and capital requirements on banks, insurance companies and pension funds at the time the economy dips.

Understanding the distortionary e¤ects on the credit market of Value-at-Risk based regulation is also important for the transmission of monetary policy decisions. There exists a broad literature on the transmission channels of monetary policy (see Mishkin (1996) for an overview). Dissatisfaction with conventional views of how interest rates explain the e¤ects of monetary policy has recently led to a revival of the credit channel of monetary policy. The strength of a bank lending channel of monetary policy depends both on the reliance of …rms on bank credit and on the sensitivity of the loan rate to the short term interest rate, set by the central bank. We show how solvency regulation changes the equilibrium between the loan rate en the short term interest rate, which in‡uences the e¤ectiveness of monetary policy.

The structure of the remainder of this paper is as follows. We focus on the case of bank loans for the rest of the paper, but similar results apply to the insurance sector and pension fund requirements. In section 2 we present our basic model of the bank loan market graphically. We model the supply of bank loans in case of adverse selection but in absence of regulation. The appendix provides technical details. In section 3 we introduce the Credit-Value-at-Risk (CVaR) constraint of bank credit risk regulation and show that CVaR regulation induces credit rationing. Section 4 concludes the paper.

2 The bank loan market

Our model is a one period loan market in the spirit of Mankiw (1986). Each …rm can invest in a project that has a size of one unit. All …rms are identical except for their probability of success with the investment project. Each investment project has two possible gross returns. These are (X=µ ¡ k) with probability µ and zero with probability (1 ¡ µ); where k > 0 represents …xed costs of the investment. The expected gross return for …rms thus becomes

$X - k\theta$, and the variance is $(X - k\theta)(1/\theta - 1)$. Note that in this setup the expected returns are an increasing function of risk, consistent with basic finance theory. Firms know their own risk parameter θ, but do not know the actual outcome of their project. Suppliers of external finance, i.e. banks or insurance companies, only know the sample distribution of θ for all firms. Bank loans can be obtained at the (gross) interest rate R ($R \geq 1$).

The expected net profit for a firm is $X - \theta k - \theta R$. Projects with a positive expected net return apply for a bank loan. If total costs $k + R$ are sufficiently low all projects apply for a loan (i.e. when $1 \leq \frac{X}{R+k}$). This implies and average probability of success equal to the expected value of θ, $E[\theta]$. Let the average probability of success be denoted as $\pi^d = E[\theta]$. If total costs are not so low, only firms for which $\theta \leq \frac{X}{R+k}$ apply for a loan (the other projects have a negative expected internal rate of return). This is the point where the adverse selection kicks in. Higher bank loan rates, $R > I$, are associated with lower π^s, i.e. a lower the average probability of success (only high risk high return projects can make good on the high costs of borrowing). One shows for example that if θ has a uniform distribution on $[0, 1]$, then the conditional expected value of θ for all firms that want to invest is

$$\pi^d(R) = \frac{1}{2}\frac{X}{R + k}. \qquad (1)$$

Thus the average probability of success becomes a declining function of the interest rate R. The higher the rate of interest charged on bank loans, the lower the quality of the loan portfolio becomes. Typically interest rates rise during the onset of a recession. CVaR regulation is intended to counter the adverse effects of this business cycle downturn on the quality of the loan book of a financial institution. The 'demand' curve for loans is represented by the thick curve labelled 'Firms' in Figure 1. On the horizontal axis one sees the cost of borrowing R. Along the vertical axis we measure the loan quality π, which is one-to-one with the number of loans demanded.

Now consider the supply side of loans. We assume that risk neutral banks offer standard debt contracts with limited liability. Because a firms' individual (X, θ) is private information of the borrower, R cannot be conditioned on this information. Thus the bank only knows its average return on the loan portfolio $\pi(R)R$. Banks have funding costs equal to the rate I paid on deposits. The expected per unit profit function for the bank is $\pi(R)R - I$. In a competitive market, bank profits are zero. In equilibrium the required

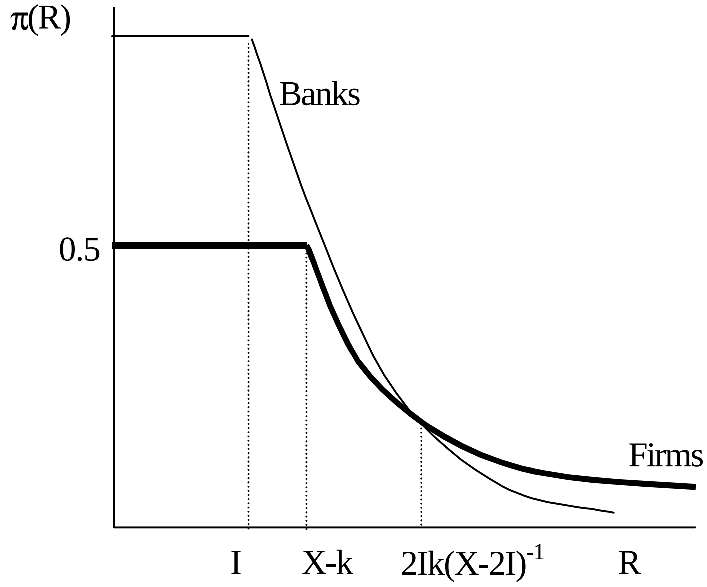

Figure 1: Bank loan market equilibrium

expected probability of repayment in the pool of borrowers would be

$$\pi^s = \frac{I}{R}. \tag{2}$$

This constitutes the supply curve for loans and is depicted by the thin line labelled ‘banks’ in Figure1.

The equilibrium in the loan market is where the demand and supply curves cross, see Figure 1. For $R > X - k$, loan demand equals loan supply when $\pi^d(R) = \pi^s$, which is the case if the interest rate R equals $2Ik/(X - 2I)$. Note that an increase in the funding costs of banks, that is an increase in the deposit rate I, shifts the Bank supply curve in Figure1 to the right, increasing the borrowing costs to firms. This increases the adverse selection problem and lowers the loan quality (increases the risk on the loan book of the financial institutions).

3 Credit risk regulation

In this section we study the effect of a Value-at-Risk constraint on bank loans. We show that a credit risk model based Credit-Value-at-Risk constraint distorts the operation of credit markets by introducing credit rationing.

The motive for the minimum regulatory risk constraint for the bank loan portfolio is to counter adverse selection. It can be shown that in a perfect information setting the loan rate R, is lower than in case of asymmetric information. A regulatory risk constraint which is equal to the equilibrium level of risk in case of perfect information abates the adverse selection problem.

3.1 The credit risk constraint

Now consider a banking supervisor and banking regulation under the new Basle II accord. We assume that the supervisor has no better information than the bank. For this reason the supervisor imposes a risk limit using the average success rate of loans π in order to improve the quality of the loan portfolio. Note that the quality of the loan portfolio is strictly increasing in $\pi(R)$. Suppose therefore that credit risk regulation imposes a lower limit on the average probability of success on repayment $\pi(R)$, say $(1 - \pi(R)) < \delta$. We call δ the CVaR constraint on the loan book.

Figure 2 displays the credit risk constraint effective at the bank loan portfolio risk level π^v, where $\pi^v = 1 - \delta$. The iso-profit curve of the firms requires that the loan rate is no higher than R^A. The risk restriction binds when $R^A < 2I_0k/(X - 2I_0)$. Here I_0 refers to the deposit rate which prevails in the unconstrained equilibrium $(2I_0k/(X - 2I_0); (X - 2I_0)/2k)$. At this lower interest rate R^A the quality (success rate) of the pool of loan contracts is higher, since more firms with relatively high quality projects apply for a loan, compared to the unconstrained equilibrium. So both the average quality as well as the number of loans demanded increases. At π^v and a given deposit rate I_0 banks require a loan rate of no less than R^B. In this situation loan demand and supply do not meet. What does it take for banks to be willing to offer $(R^A; \pi^v)$? This requires a shift in the bank iso-profit curve to the left. Note that the bank iso-profit curve implicitly defines the bank supply curve for loan (quality). From (2) it follows that the only shift parameter of this curve is the deposit rate I. By lowering I, the loan supply curve shifts to the left until it cuts the demand curve at $(R^A; \pi^v)$. Assuming that the supply curve for deposits is an upward sloping function of the deposit

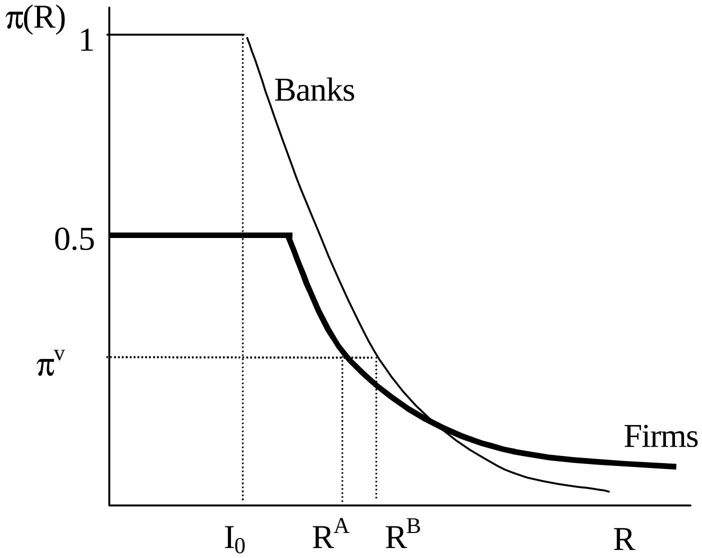

Figure 2: Bank loan market and credit risk constraint

rate, banks can reduce the deposit market rate by taking in fewer deposits. The implication of a lower deposit demand is a reduction in the supply of loans. Thus while at $(R^A; ¼^v)$ the demand for loans increases vis a vis the free market solution, the supply is reduced. Loan market equilibrium can then be achieved only if banks ration the supply of loans at the given quality level $¼^v$. Since the quality of the loan portfolio must at least be $¼^v$, banks select the loan applicants randomly. Thus the equilibrium under a binding CVaR constraint requires random credit rationing.

It is interesting to note that regulation Q in the United States had similar consequences as the risk constraint ±. By limiting the loan rate R to a maximum, banks face an excess demand for loans. To achieve equilibrium the deposit rate should again be lowered. In this case the constraint is on the interest rate rather than on quality, but the e¤ects are the same.

3.2 E¤ect on money supply

With a binding CVaR restriction imposed, the deposit rate I has to fall, lowering the volume of deposits as is explained in the previous paragraph.

Introducing a binding CVaR constraint therefore reduces the money supply. In terms of the familiar IS/LM model this can be visualized by a shift of the LM-curve to the left. Evidence in Smith (2002) suggests that this may indeed have been the case. Shortly after the implementation of the Basle I 1988 agreement on bank capital ratios, the growth rate of the money supply was reduced considerably. Moreover, credit rationing also reduces investment, and the hence IS curve will also shift inwards.[2] Without a monetary policy response, the combined LM and IS shifts due to the regulatory shock could risk a significant reduction in economic activity.

4 Conclusion

Current proposals for a new Basle capital adequacy accord sponsor the idea that banks should be allowed to use internal based credit risk models to compute the required capital adequacy on bank loans, in contrast to the existing but outdated BIS standards. We have shown that a credit risk model based Value-at-Risk constraint distorts the operation of credit markets by introducing credit rationing. The result is that in this rationing equilibrium the money supply experiences a negative shock if the risk constraint is binding. Similar observations apply to the effects of insurance and pension fund regulation. The policy question then is whether monetary policy should accommodate the negative effects of such regulation when it becomes binding, which would be the case during a recession and possibly at the inception of new regulation.

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5 Technical Appendix on the bank loan market

Our model is a one period loan market in the spirit of Mankiw (1986). We assume that each …rm can invest in a project that has a size of one unit. All …rms are identical except for their probability of success with the investment project. Each investment project has two possible gross returns. These are (X=µ ¡ k) with probability µ and zero with probability (1 ¡ µ); where k > 0 represents …xed costs of the investment. The expected return for …rms thus becomes $X - k\theta$, and the variance is $(X - k\theta)(1/\theta - 1)$. Note that in this setup the expected returns are an increasing function of risk, consistent with basic finance theory.

For expository reasons the risk parameter θ of individual firms is here assumed to be uniformly distributed on the interval $[0; 1]$, see e.g. Mankiw (1986). Firms know their own risk parameter θ, but do not know the actual outcome of their project. Suppliers of external finance, i.e. banks, only know the sample distribution of θ for all firms. Bank loans can be obtained at the (gross) interest rate R ($R \geq 1$).

5.1 The demand for bank loans

Apart from the fixed costs, the firm also has to repay the loan at the going gross rate R. Adding up, the firm per unit (loan) profit function P^F becomes

$$P^F = \frac{X}{\theta} - R - k.$$

The expected profit for the firm is

$$E[P^F] = \theta\left(\frac{X}{\theta} - R - k\right).$$

A risk neutral firm only invests if expected profit $E[P^F] \geq 0$. The participation constraint for firms is therefore satisfied when $\theta \leq \frac{X}{R+k}$. By the assumption that θ follows a uniform distribution on $[0; 1]$, all projects will be undertaken when $1 \leq \frac{X}{R+k}$, which implies $R \leq X - k$. Let the average probability of success be denoted as $\pi^d = E[\theta]$. If all firms invest, the average probability of success is

$$\pi^d = 1/2.$$

If $1 > \frac{X}{R+k}$; that is when $R > X - k$, not all firms invest, only firms with $\theta < 1$ are active. The conditional expected value of θ for all firms that want to invest is

$$\pi^d(R) = \frac{1}{2}\frac{X}{R + k}.$$

Note that at any given loan rate the firms that choose to invest and turn out to be successful are always able to repay the bank loan in full, since for these firms $R \leq \frac{X}{\theta} - k$.

5.2 The supply of bank loans

We assume that risk neutral banks offer standard debt contracts with limited liability. Because a firms' individual (X, θ) is private information of the borrower, R cannot be conditioned on this information. The expected per unit profit function for the bank is

$$E[P^B] = \pi(R)R - I.$$

This profit function consists in two parts. The first part, πR, denotes the expected gross return of all loans to firms that are successful. The second part, I, defines the funding costs of the bank loans. In a perfectly competitive market, bank profits are zero. In equilibrium the required expected probability of repayment in the pool of borrowers would be

$$\pi^s = \frac{I}{R}.$$

5.3 Equilibrium

Figure 1 displays the market equilibrium in the $(R, \pi(R))$ plane using the shape of the iso-profit curves and the shape of the expected repayment curve. As mentioned before, all firms want to participate in the loan market if $\frac{X}{R+k} \geq 1$ and this results in $\pi^d = 1/2$. This fact is represented by a straight line segment in the $R, \pi(R)$ plane until the cost of borrowing, R, becomes too high at $R = X - k$, and the firms with high θ decide no longer to invest. This is the point where the adverse selection kicks in. Higher bank loan rates, $R > I$, are associated with lower π^s. For $\pi^s = 1$ and perfect competition the bank charges the loan rate $R = I$.

For $R > X - k$, loan demand equals loan supply when $\pi^d(R) = \pi^s$, which is the case if

$$R = \frac{2Ik}{(X - 2I)}.$$

It can be shown that at the loan market equilibrium the supply curve for banks is steeper than the demand curve for firms.