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Subordinate debt, deposit insurance and market oriented monitoring of banks

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Abstract We present a model of a bank with endogenous risk choices, where delegated monitoring by an active market in subordinate debt helps in containing the bank's risk shifting in the presence of deposit insurance. In comparison to static ex ante contracting, an active market enables continuous monitoring by subordinate debt to penalise the bank's risk shifting. The model is instrumental in deriving optimal level of subordinate debt required to achieve equilibrium where banks choose risk levels consistent with the first best as envisaged by a social planner. The optimal quantity of subordinate debt further eliminates any risk shifting associated even with risk insensitive premiums.

Introduction

Banking firms are unique institutions both by the nature of their operation and also by the nature of their constitution. In the process of rendering efficient allocation of risk among depositors and firms, banks build up a book with small deposits and risky loans. These small deposits are usually held by unsophisticated depositors without the necessary information to efficiently monitor the portfolio of risky loans. Further, the claims of these depositors are usually very small which generates little incentive for them to gather costly information for monitoring.[1] This entails that the risky portfolio of banks remains largely opaque to the depositors. Therefore, as uninformed or partly informed depositors are inefficient in framing optimal contracts with the bank, they would mostly bear inordinate risk.

As deposits constitute the bulk of the liabilities, banks operate with high leverage with very small capital of their own. The high leverage makes the banks risky which when accompanied by opacity of the bank's portfolio to the depositors makes information based bank runs[2] more probable. In addition, high leverage and opaque bank portfolios can distort managerial incentives and encourage banks to look for further implicit leverage, which in turn makes the banks even more risky. Thus opaque portfolios provide risk shifting incentives to banks.

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[1] This is the basis of the representation hypothesis led by Dewatripont and Tirole (1993) in favour of an external regulator.

[2] See Jacklin and Bhattacharya (1988) for a discussion on panics and information based bank runs.

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Moreover, the nature of the balance sheet renders high degree of similarity between any two banks. Even if banks intend to differ in their asset composition, they are perceived to be similar by uninformed depositors, especially in times of distress. A run on bank A is perceived as increasing difficulties for another seemingly similar bank B. Assets of bank A are generic liabilities for bank B in a closely interconnected system of banks.[3] Thus, a run on bank A could pose immediate liquidity pressure on bank B and could further translate into solvency threats for bank B within no time. At the inception of such a loss and liquidity spiral,[4] bank B might otherwise be healthy. On account of such contagion, bank runs threaten the systemic stability by sucking up the liquidity from the system.

In an effort to address the aforesaid information asymmetry, we need agents to (i) avert information based bank runs by uninformed depositors, and (ii) monitor bank risk to restrain risk shifting. Explicit deposit insurance by government backed agents is perhaps the best aid discussed in the literature to reduce the possibility of information based bank runs.[5] Moreover, such insurance is desirable given that (i) uninformed depositors are unable to frame optimal debt contracts, and (ii) it would add the much needed implicit liquidity in the system by insulating banks from information based bank runs, as discussed in Diamond and Dybvig (1983).[6]

However, insured depositors lack the necessary incentive to monitor the risk of banks on their own. This provides banks with the risk shifting incentives to choose a level of risk which is socially suboptimal. Thus, the principal problem of checking the risk shifting incentives of banks still remains unresolved. To alleviate the risk shifting incentives of banks where depositors are insured, an important measure would be to charge risk based insurance premiums. However, government backed agents are not well equipped to estimate the risk sensitivity, and hence to estimate risk based premiums.[7]

In these circumstances, greater participation from market forces is warranted to contain the risk shifting incentives of the banks. As per Kaufman (2003), market discipline requires the existence of some de-facto at-risk stakeholders, who have an incentive to monitor the banks. A market oriented proposal to check the risk shifting incentive of a bank is the provision of subordinate debt[8] as an active monitor on banking books. Subordinate claims of these securities gives greater incentive for investors to monitor a bank's risk closely. While being active monitors, they can impart valuable signals to the markets and regulators. What would be interesting, however, is to explore conditions under which subordinate debt can act as a delegated monitor to check risk shifting incentives of the banks effectively.

In this context, this paper presents a model of a bank with endogenous risk choices, where delegated monitoring by subordinate debt helps to contain risk shifting by banks in the presence of deposit insurance. The model builds on past studies, where subordinate debt could not dynamically influence banks, largely by acting merely as a passive instrument after entering into a contract. The model here envisages an active market for subordinate debt which can continuously impart signals to the regulators and other at-risk stakeholders. This provides the necessary discipline for banks so that they may conform to solvency consistent behaviour.[9]

The joint feature is envisaged in the model (i) to reduce the possibility of bank runs by explicit deposit insurance to uninformed or partly uninformed depositors, and (ii) to check the risk shifting incentives of a bank by subordinate debt. The model helps us to derive optimal level of subordinate debt required to achieve an equilibrium where banks choose risk level consistent with the first best as envisaged by a social planner.[10] Further, subordinate debt could be resorted to, to price deposit insurance effectively.

The paper is organised as follows. The second section contains a brief review of related literature. The third section discusses the model. The fourth section describes risk shifting incentive for a bank provided with deposit insurance and subordinate debt, featuring them individually and simultaneously. The fifth section deals with pricing anomalies of deposit insurance and their rectification by subordinate debt. The sixth section discusses the implications, and the seventh section concludes the paper.

Related literature

While explicit deposit insurance could completely insulate banks from a possible run, there is no incentive for depositors to monitor the risk of the bank, which could aggravate the risk shifting incentives[11] and erode market discipline, apart from increasing systemic risk (Penati & Protopapadakis, 1988). Further, in such a scheme the government may have to tax depositors heavily for the provision of insurance, in case there is a need to provide liquidity. This may lead to possible deadweight costs in the system.[12]

[3] See Allen and Gale (2000) for domino model of bank contagion due to interrelated businesses.

[4] See Diamond and Rajan (2005) and Aghion, Bolton, and Dewatripont (2000) for contagious bank runs and subsequent system failure due to failure of one bank in an economy with several banks and the existence of interbank market.

[5] See Santos (2000) for a review of proposals to insulate banks from runs.

[6] See also Gorton and Pennacchi (1990) for theory of financial intermediation based on liquidity provisioning by banks.

[7] See Benston and Kaufman (1996) and Stiglitz (1993) for arguments discussing inability of government regulators in assessing risk.

[8] See Lang and Robertson (2002), Evanoff and Wall (2000), Calomiris (1999) and Wall (1989) for various proposals on subordinate debt.

[9] The model can be seen as a reinforcement of capital adequacy requirement in Basel 3.

[10] The social planner envisaged here is similar to a regulator or a government agent who intends to maximise social welfare.

[11] See, for example, Ioannidou and Penas (2010), Kunt and Huizinga (2004), and Cordella and Yeyati (2002) for empirical evidences on significant changes in banks risk-taking, ex post, in such deposit insurance programmes.

[12] Chan, Greenbaum, and Thakor (1992) give a contradictory view where they use a dynamic framework to show that future rents may be generated by a subsidised deposit insurance scheme, which leads banks to reduce their risk taking in order to raise the probability of reaping these future rents.

Risk shifting incentive remains with the banks when banks cannot internalise the full cost of their risk taking. This occurs when banks are charged insurance premiums other than the first best risk sensitive premiums. However, risk sensitive or market based premiums are difficult to be implemented by a government insurer for several reasons. Firstly, a deposit insurer in the form of a government backed agency lacks resources to estimate accurately the risk sensitivity[13] and hence the dynamics of market based premium. Secondly, it is structurally difficult for such an insurer to implement different premiums for all the banks in the system. Finally, market based premium would lead to profit making for the insurers, which goes against the constitution of these insurers. To avoid such profit making, the government insurer usually charges actuarially fair premiums which let the insurer break even.

Since actuarially fair insurance premiums are not the first best, risk shifting incentive remains with the bank. Pennacchi (2006) shows that actuarially fair premiums subsidise the level of capital provided by the owners. This implicit subsidisation leads banks to take on more risk than physical capital levels would call for. The increase in the risk is sought by investing in loan commitments and other off balance sheet activities with high degree of procyclicality.[14]

An effective counter mechanism to deal with the moral hazard, under these circumstances, is to subject banks under certain order of market discipline by at-risk stakeholders. Further, risk assessment by market forces could enable the deposit insurer to charge risk sensitive premiums. Uninsured subordinate debt[15] in banking books is one such at-risk stakeholder which can play an important role in banking capital structure by acting as an instrument for market discipline to supplement bank regulators, as discussed in Diamond and Dybvig (1986) and Wall (1989). Being subordinate in claims, these investors could anticipate an early loss to their stakes just after the losses have been borne by small capital in banking books, whenever the banks fail. This gives greater incentive for subordinate debt holders to monitor the bank's risk closely. Investment in such uninsured securities further ensures that the investors are true risk bearers unlike depositors who may choose banks mostly for liquidity needs rather than for bearing risks.

At the root of risk monitoring by debt holders is the nature of the contract they could frame with the banks. Unsophisticated depositors would be unable to frame optimal contracts owing to their inadequate knowledge and resources to monitor the bank. Also, these contracts may not be optimal even in case of risk being monitored by informed subordinate debt holders.[16] This is primarily because these contracts are largely passive when subordinate debt disciplines the banks ex ante or through interest rates which are decided before the investments are made. In such contracts, subordinate debt holders would anticipate the risk of a bank and enter into a contract considering possible risk shifting in transition.

The setting of rates in the contract, ex ante, would not prevent banks from shifting their risks. Blum (2002) shows that higher interest rates required by subordinate debt holders, in anticipation of risk shifting incentive of banks, further induce banks to take on an even higher level of risk. In such cases, subordinate debt helps in checking risk shifting behaviour of banks only if banks can commit to a particular risk level. However, it is difficult to realise such bank commitment in case of passive ex ante contracting by subordinate debt.

Further the benefit of risk monitoring by market forces cannot be realised if these agents cannot differentiate themselves from the regulator in terms of their monitoring technology. Sealey (2008), by assuming a monitoring technology that is the same for any bank stakeholder, shows that the quanta of claims for these agents differ and also their incentives to choose optimal monitoring efforts which depend on the size of such claims. The monitoring efforts by each agent would depend upon the monitoring exercised by the other agents. Further, due to varying and co-dependent incentives of different claimholders (such as deposit insurer, regulator, equity holders and subordinate debt claims) they expend lesser efforts in monitoring the banks than what a social planner would desire. This is due to debt-like, fixed claims of agents such as subordinate debt and private co-insurers, which have different optimal monitoring strategies than a social planner.

In the circumstances described above, this paper presents a model where enhanced market discipline by subordinate debt is envisaged. For this a competitive trading market in subordinate debt securities is assumed.[17] Such a market gives expression to the risk assessment by subordinate debt, by providing continuous signals that can be used to regulate the banks efficiently. Banks are progressively penalised for shifting

[13] Stiglitz (1993) shows that deposit insurers find themselves inferior to market forces in assessing and monitoring risks of the banks. Bazelon and Smetters (1999) show that the US government fails to incorporate systematic risk premium in its evaluations.

[14] See Jokipii and Milne (2008) and Pederzoli and Torricelli (2005) for procyclicality in banking business and capital regulation.

[15] See Board of Governors staff papers (1999) for a review of literature on subordinate debt. The Gramm–Leach–Billey Act (2000) was enacted in the US where among other proposals, market discipline is envisaged through the provision of mandatory subordinate debt for banks.

[16] The empirical evidences for risk monitoring by subordinate debt are mixed. Gorton and Santomero (1990) and Avery, Belton, and Goldberg (1988) question the effectiveness of such a scheme. Krishnan, Ritchken, and Thomson (2005) show that although subordinate debt credit spreads responds to the level of the risk, there are weak evidences of the change in credit spreads responding to the change in the risk. In contrast, Menz (2010), Jagtiani, Kaufman, and Lemieux (2002), Morgan and Stiroh (2001), Evanoff and Wall (2000), and Flannery and Sorescu (1996) find positive relationship between credit spreads and accounting and enhanced accounting risk measures, indicating the effectiveness of subordinate debt in checking the risk shifting incentives for the banks.

[17] Evanoff, Jagtiani, and Nakata (2011) show an enhanced risk-spread relationship in a market with greater depth and transparency. They found empirical evidences consistent with the idea that periods surrounding new debt issues result in improved risk pricing by subordinate debt. Further, they postulate that a market with a fully implemented subordinate debt programme would most likely be deeper and more transparent and hence would increase market discipline.

their risk by the use of continuous information from the subordinate debt market. Importantly, in such a case, banks need not pre-commit to a level of risk.[18] Moreover, banks have endogenous incentives to choose the risk so as to conform to the solvency consistent behaviour owing to adverse signalling by subordinate debt claims.

Another distinction in the paper, which underscores active monitoring by subordinate debt, is the role of superior monitoring technology assumed in the model here. Since subordinate debt claims have stronger incentives to monitor the risk of a bank, they are likely to monitor a bank's risk much more effectively than any other agent. Further, the existence of a competitive market enables subordinate debt holders to make greater use of this monitoring technology in achieving better returns for their investments independent of the monitoring by other agents and also independent of the size of subordinate debt claims. Competitive markets also complement the superior monitoring technology of investors, as investors could be good at evaluating banks but may be poor in influencing them (Flannery, 2001). Thus, such monitoring can impart valuable signals to other inferior agents.[19]

An important utility of information revealed by subordinate debt is to enable the deposit insurers to charge market based premiums with relative ease of assessing risk. Also, active monitoring by subordinate debt holders can check risk shifting incentives even in the case of actuarially fair premiums. Specifically, the model in the latter part of this paper shows that the optimal allocation of subordinate debt would eliminate any risk shifting incentive associated even with actuarially fair premiums.

The model

This paper proposes a model for a bank with endogenous risk choices for an economy with single period and two dates $t = 0$, 1. A bank has liabilities in the form of insured deposits and uninsured subordinate debt. Through this joint structure of liabilities, we seek to find the conditions under which banks choose their risk levels consistent with the first best as desired by a social planner. Subsequently, we seek the active monitoring role of subordinate debt so as to reduce the implicit subsidisation that stems from actuarially fair deposit insurance premiums.

In a risk-neutral setting, let the bank be funded by insured deposits D, uninsured subordinate debt S, and equity E. Deposits are insured with an insurer whose default probability is zero. Also, there are no premiums for the deposit insurance provided by these insurers. The bank invests these funds in a risky portfolio P at $t = 0$; the gross returns for the risky portfolio at $t = 1$ are dependent on one of the three possible states. In each of these states the returns are denoted as:

$$r_P = \begin{cases} r(p) & \text{state } 1 \\ r_2 & \text{state } 2 \\ r_3 & \text{state } 3 \end{cases} \tag{1}$$

While the gross returns in state 1 is a function of p, the gross returns in states 2 and 3 assume a fixed value depending upon the nature of initial investment. The total initial asset for investment in the risky portfolio is $(D + S + E)$. These returns describe the gross payoffs such that:

$$\begin{aligned} r(p).(D+S+E) &> r_f.D + r_s.S \\ r_f.D < r_2.(D+S+E) &< r_f.D + r_s.S \\ 0 < r_3.(D+S+E) &< r_f.D \end{aligned} \tag{2}$$

The portfolio does not default in state 1. If p is the probability that the portfolio does not default, the probability for state 1 is p and for states 2 and 3 jointly is (1-p). Further, given that the portfolio defaults, the probability for occurrence of state 2 is denoted by θ, while the occurrence of state 3 then is denoted by (1-θ). The returns for the risky portfolio in state 1 is such that $r(p)$ is decreasing function of probability p i.e. $r'(p) < 0$ and $p.r(p)$ is a strict concave function of the probability p. This is to ensure that an optimal level of default probability exists for banks to choose risk endogenously. Also, Eq. (2) above would mean bankruptcy for a bank in states 2 and 3. In these states, the gross recovery of risky portfolio is weighted average of gross returns over these states and is denoted by d, which is assumed constant such that:

$$\{\theta.r_2 + (1-\theta).r_3\} = d \tag{3}$$

Further, the distribution of deposits and subordinate debt is such that a fraction (α) of the total liabilities $(D + S)$ is subordinate debt, while (1-α) is insured deposits. Since deposits are completely insured, they would earn a riskless gross rate of return r_f, while the uninsured subordinate debt would earn a gross rate of $r_s > r_f$.

The investors in subordinate debt securities are assumed to have adequate knowledge, ability and willingness to monitor the bank risk. Further the manifestation of such monitoring is visible through a competitive trading market for subordinate debt of banks. The levels and sensitivity of credit spreads would indicate the riskiness of a bank. The monitoring technology with subordinate debt, due to its knowledge, ability and willingness, is assumed to be superior to any other economic agent except the bank owners.[20] The subordinate debt holders impart useful signals to the market with certain noise denoted by ε_i, which is assumed to be normally distributed across the range of the signals. The absolute level of noise is such that:

$$|\varepsilon_i| < r_f < r_s \tag{4}$$

The assumption of the noise takes care of the fact that while subordinate debt holders can reveal the risk of the bank,

[18] Niu (2008) showed that existing safe assets in a bank's portfolio act as a commitment for containing risk in future. Similar to Blum (2002), risk shifting by banks could not be checked in the absence of such commitment.

[19] An interesting feature of the model in Chen and Hasan (2011) is that regulatory action is triggered by the bank's failure to issue subordinate debt rather than by market spreads. This is on account of acknowledging the fact that signals may be too noisy to serve as a means for corrective actions by regulators.

[20] Since monitoring is costly, a superior monitoring technology would ensure low marginal cost of information production. This would ensure that inferior agents do not need to duplicate the efforts which may increase the spreads sought after by these agents in the market.

they still do not have the perfect knowledge possessed by bank owners. The distribution assumption of the noise ensures that although subordinate debt holders may be inferior to bank owners in possessing knowledge of the risky portfolio, bank owners cannot assume a systematic advantage to exploit this noise in their favour all the time. Since the monitoring by subordinate debt is superior to that of any other agent, no monitoring is assumed to be performed by these other agents. This is due to the fact that monitoring is costly and information is willingly provided by the market for subordinate debt without any cost being incurred by any other agent. The cost for monitoring by subordinate debt is such that it is a decreasing function of the probability p denoted by $c(p)$ such that $c'(p) < 0$. This means that the better the quality of assets, the lesser the cost of monitoring incurred and vice versa. Thus, subordinate debt holders can observe the probability p with some noise by incurring the cost of monitoring, $c(p)$.

Risk shifting incentives for the bank

To analyse and compare the risk shifting incentives for the bank, we first seek the objective function of a social planner. This objective function gives us the benchmark case against which we may be able to look at the incentives of a bank under varying provisions of deposit insurance and subordinate debt. The social planner is one who maximises the social welfare by maximising the expected surplus in the economy while choosing the optimal level of risk for the bank. The objective function can, therefore, be described as:

$$Max\left[p.\{r(p).(D+S+E)\} + (1-p).\{\theta.r_2 + (1-\theta).r_3\}.(D+S+E) - r_f.(D+S)\right] \quad (5)$$

The first order condition for Eq. (5) above is:

$$(D+S+E).\frac{\partial(p.r(p))}{\partial p} - \{\theta.r_2 + (1-\theta).r_3\}.(D+S+E) = 0 \quad (6)$$

Using Eq. (3) above, Eq. (6) can be rephrased as:

$$(D+S+E).\frac{\partial(p.r(p))}{\partial p} - d.(D+S+E) = 0 \quad (7)$$

Risk shifting with deposit insurance

Next we determine the objective function of the bank in case of deposit insurance only. This can be described as choosing the optimal level of risk so as to maximise the expected surplus of the bank. Since deposits are completely insured, the return earned on these is the riskless rate r_f. Also, as described in the model above, we have assumed the insurance premium to be zero. The bank thus maximises:

$$Max\left[p.\{r(p).(D+E) - r_f.D\}\right] \quad (8)$$

It can be noticed in Eq. (8) that the bank receives nothing in case of default by the portfolio. The first order condition for Eq. (8) above can be described as:

$$(D+E).\frac{\partial(p.r(p))}{\partial p} - r_f.D = 0 \quad (9)$$

Comparison of the first order conditions would determine the choice of p by the bank vis-à-vis the social planner. In other words, this points towards the risk shifting incentive of the bank. Let the risk level chosen by a social planner be represented by probability of no default for the risky portfolio as p_{SP} and the respective risk level for the bank provided with deposit insurance by p_{B1}. Comparing Eq. (9) and Eq. (7) and from Eq. (2) above, after setting $S = 0$, it can be seen that since,

$$r_f.D > d.(D+E), \text{ we have,}$$

$$p_{B1} < p_{SP} \quad (10)$$

Interpreting Eq. (10) would mean that risk shifting incentives exist for the banks in case of deposit insurance alone. Since the recovered value of the risky portfolio is not sufficient to pay off all the insured depositors, the bank benefits from the bankruptcy to the extent that gross payoffs to the depositors exceed the recovered value of the portfolio. Banks could anticipate the benefit and would choose lower p by taking on riskier investments. This leads to the following results.

Result 1. In case of deposit insurance only, banks have risk shifting incentives leading them to choose riskier investments than that which is desirable by a social planner. Their choice of riskier investments is represented by $p_{B1} < p_{SP}$.

Risk shifting with deposit insurance and subordinate debt

We now take up the provision of subordinate debt for a bank in two situations. We first discuss the case of typical ex ante contracting by subordinate debt. In this case, the bank would not incorporate the risk assessment by subordinate debt continuously. Subsequently, we envisage a competitive market for subordinate debt which enables the banks to incorporate such risk assessment continuously.

Ex ante contracting by subordinate debt

In this situation at $t = 0$, subordinate debt holders contract the rate of return, and the bank needs to make periodic payments to these claims as and when they are due, before going bankrupt. Owing to such contractual arrangement, risk monitoring is effective only in extreme situations where terms of the covenants are violated. Thus, there are no active or usable signals by subordinate debt in other situations. Further, there is no continuous mechanism to penalise the bank in anticipation of adverse signalling by subordinate debt. In a way, continuous signals of risk monitoring may not be available in the absence of a mechanism such as a competitive trading market in subordinate debt.

In this situation, the bank chooses the level of risk so as to maximise the expected surplus:

$$Max\left[p.\{r(p).(D+S+E) - r_f.D - r_s.S\}\right] \quad (11)$$

The absence of risk monitoring in transition by subordinate debt is evident from ex ante contracting of the required rate of return r_s. The first order condition for Eq. (11) can be described as:

$$(D+S+E).\frac{\partial(p.r(p))}{\partial p} - (r_f.D + r_s.S) = 0 \quad (12)$$

In this case, let p_{B2} be the probability of no default for risky portfolio which represents the choice of the bank for the level of risk. Since comparing Eqs. (12) and (7), and from Eq. (2) above results in:

$$(r_f.D + r_s.S) > d.(D + S + E), \text{ we have,}$$

$$p_{B2} < p_{SP} \tag{13}$$

Thus, risk shifting incentive remains in the case where subordinate debt monitors the bank through an ex ante contract with the help of typical debt covenants. Further, inequality (Eq. (13)) would also mean that there can be greater incentive for banks to shift the risk in this case as compared to the previous case of deposit insurance only. This can be seen from the fact that as the required rate of return by subordinate debt holders increases, the difference between gross payoffs to the liabilities and the recovered value of the risky portfolio increases. The larger this difference, the greater is the risk shifting incentive for the bank. Importantly, ex ante contracting of interest rates payable to subordinate debt gives incentive for banks to choose riskier investments. Further, in anticipation of such risk shifting incentive, subordinate debt can only choose to charge higher interest rates, which gives even greater incentives to shift to much riskier investments. This is the case similar to Blum (2002) with no commitment by the banks to contain risk at certain levels. The discussion is formalised in the result below.

Result 2. In case of ex ante rate contracts by subordinate debt where banks do not incorporate the risk assessment on a continuous basis, risk shifting incentives for banks persist i.e. banks choose $p_{B2} < p_{SP}$. Further, these incentives are aggravated when subordinate debt holders require higher rates in anticipation of risk shifting in transition.

Continuous incorporation of subordinate debt signals by the bank

Acknowledging the pitfalls in monitoring by subordinate debt holders in ex ante contracts, it becomes vital to continuously extract the information in credit spread signals of subordinate debt so as to penalise the bank in case of adverse signalling. Markets in these securities can provide this information on a continuous basis. The importance of subordinate debt market can be seen from this proposition.

Subordinate debt, therefore, is featured now where banks can be continuously penalised to shift the risk. The signals from subordinate debt can influence the risk taking behaviour of banks by asking banks to directly or indirectly pay for risk shifting. For example, banks can be asked by regulators to (i) pay risk based deposit insurance premiums, (ii) keep risk sensitive capital, (iii) adjust the deposit base in tune with the risk, (iv) adjust the size of the balance sheet, or (v) keep reserves to accommodate the par value of subordinate debt, or a combination of these measures. These are some of the mechanisms which can use subordinate debt signal to influence banks' risk shifting.

While the first mechanism is explored in detail in the next section, any of the last four mechanisms may lead the bank to pay for its risk shifting. To model this phenomenon, the required rate of return by subordinate debt holders is set such that it is a function of the probability of default for the risky portfolio. Further, the subordinate debt market reveals the risk of the risky portfolio with some noise. Also, the monitoring by subordinate debt holders incurs a cost.

Let $r_s(p)$ be the required rate of returns by subordinate debt claims at any time t, r_f be the risk-free rate, $c(p)$ be the cost of monitoring such that $c'(p) < 0$. Also, let the risk be revealed in the market with noise ε_i. When banks are forced to incorporate the yield spreads in their objective function, they would choose the level of risk so as to maximise the expected surplus. The objective function, then, can be described as:

$$Max\left[p.\{r(p).(D + S + E) - r_f.D - r_s(p).S\}\right] \tag{14}$$

$$\text{where, } r_s(p) = \frac{r_f + c(p)}{p} + \varepsilon_i \tag{15}$$

The expression (Eq. (15)) is an estimate of the required returns for a risk-neutral agent who is compensated with risk-free rate and the cost of monitoring of a risky portfolio. The first order condition for Eq. (14) above can be described as:

$$(D + S + E).\frac{\partial(p.r(p))}{\partial p} - \{r_f.D + (c'(p) + \varepsilon_i).S\} = 0 \tag{16}$$

Comparing Eq. (16) with Eq. (12) and owing to the fact that $c'(p) < 0$ and $|\varepsilon_i| < r_f < r_s$ we find that:

$$\{r_f.D + (c'(p) + \varepsilon_i).S\} < (r_f.D + r_s.S) \tag{17}$$

Also, setting

$$S = \alpha.(D + S) \text{ and } D = (1 - \alpha).(D + S), \tag{18}$$

Eq. (16) can be rearranged as:

$$(D + S + E).\frac{\partial(p.r(p))}{\partial p} - \{r_f.(1 - \alpha).(D + S) + (c'(p) + \varepsilon_i).\alpha.(D + S)\} = 0 \tag{19}$$

On comparing Eq. (19) with Eq. (7), the first best can be achieved if:

$$\{r_f.(1 - \alpha) + (c'(p) + \varepsilon_i).\alpha\}.(D + S) = d.(D + S + E) \tag{20}$$

The expression above can be simplified to get a closed form solution for α in Eq. (19), if we set $E = 0$ and take the limiting worst case scenario where $c'(p) = 0$. The fraction of subordinate debt required to achieve the first best, α, therefore is given by:

$$\alpha = \frac{r_f - d}{r_f - \varepsilon_i} \tag{21}$$

Or, when $\varepsilon_i = 0$,

$$\alpha = 1 - \frac{d}{r_f} \tag{22}$$

Let us assume that the bank maximises the surplus by solving Eq. (14) and chooses the level of risk represented by probability of no default for risky portfolio p_{B3}. For the level of subordinate debt given by Eq. (21) we have $p_{B3} = p_{SP}$. In other words the bank chooses the risk consistent with the first best.

Thus, in the case where banks regularly incorporate the risk assessment by subordinate debt in their objective function, the risk shifting can be completely eliminated when optimal level of subordinate debt is chosen. Importantly the result shows that α, the optimal quantity of subordinate debt, is decreasing with the recovery rate d, and increasing with the noise level ε_i. Both of these features give additional incentives to deter banks from increasing their risk. This can be seen as follows. By choosing better quality of assets with higher recovery rates, banks can operate with smaller quantity of costly subordinate debt. Further, as cost of monitoring reduces with diminishing default probabilities of higher quality assets, banks need to pay lower risk premium for subordinate debt. Also, ε_i, the noise in subordinate debt yield,[21] is a measure of volatility; it can be reduced by choosing less risky assets. Further, in an attempt to reduce the noise in yield spreads, banks would make efforts voluntarily for greater disclosure to the subordinate claim holders, which can further reduce the cost of monitoring and hence the required yield. This leads to the following result.

Result 3. In case of continuous incorporation of subordinate debt signals, the bank chooses the level of risk consistent with the social planner, i.e. $p_{B3} = p_{SP}$, provided that level of subordinate debt is given by:

$$\alpha = \frac{r_f - d}{r_f - \varepsilon_i}$$

Deposit insurance premiums and subordinate debt

This section discusses the role of subordinate debt in pricing deposit insurance premiums. In this context it is of immediate interest to reflect over the optimal deposit insurance premium for an insurer in cases where risk is actively monitored by subordinate debt. This is important as cost of monitoring is a significant component of the economic composition of insurance premiums. Essentially, insurers charge insurance premiums for the explicit guarantee they render to the depositors in case of default by a bank. Thus, insurers would require such premiums (i) to cover the cost of monitoring, and (ii) to bear the expected losses in case of default by a bank. Following this, the best possible deposit insurance would have minimum expected losses along with low cost of monitoring to the insurers and yet the explicit safety of deposits is ensured. In such a case, apart from knowing the quantum of the insurance premium, we would like to know the features of the agents who can effectively provide such insurance. We discuss these issues in detail below.

We take up the deposit insurance pricing on a market (risk sensitive) basis as well as on an actuarially fair[22] basis. Pennacchi (2006) discusses the moral hazard associated with actuarially fair premiums. The model here builds on this with subtle differences with regard to the introduction of subordinate debt as an instrument which can alleviate the moral hazard associated with deposit insurance. We show that the subordinate debt helps to counter the risk shifting incentive on several fronts. First, it reduces the implicit capital subsidy and eliminates it completely when subordinate debt is set at its optimal quantity. Second, market-based premiums can be set with relative ease by government insurers, owing to the fact that risk is observable through subordinate debt signals. Third, subordinate debt may help to account for systematic risk[23] which is a principal cause of procyclicality. The mandate to incorporate subordinate debt signals by the banks in their objective functions could even incentivise banks to invest in a counter-cyclical manner. These features of subordinate debt are explored below in detail.

Let the actual probability of no default for the risky portfolio be denoted by p_a along with the risk-neutral probability of no default p. Also, for simplicity, we assume the cost of monitoring $c(p)$ to be zero. We shall now seek to derive the market based premium for deposit insurance.

Following the design in Pennacchi (2006), first we take up the case of the bank where the deposits, D, are not insured. We assume that due to strict junior claims of subordinate debt, their payoffs are zero in case of default of the portfolio. The payoffs in this case for depositors and subordinate debt are given as:

Depositors:

$$p.X.D + (1-p).d.(D+S+E) = r_f.D \tag{23}$$

Subordinate debt:

$$p.r_s.S = r_f.S \tag{24}$$

where X is the (gross) rate of return required by depositors and the remaining terms have their standard meanings, defined earlier. If we now assume that deposits are insured, the market oriented deposit insurer would charge a premium, per unit deposit as:

$$P_M = X - r_f \tag{25}$$

Solving for X and P_M, from Eqs. (23) and (25), we get

$$P_M = \frac{(1-p)}{p.D}.\{r_f.D - d.(D+S+E)\} \tag{26}$$

Actuarially fair premiums, on the other hand, are calculated such that the deposit insurer attains the break-even on an average. The insurer in this case would rather work with actual probability of default (or no default) in place of risk-neutral probability of default. The premium can be found by solving for the break-even condition for the insurer as:

$$p_a.P_A.D - (1-p_a).\{r_f.D - d.(D+S+E)\} = 0 \tag{27}$$

which gives,

[21] A market in subordinate debt can help in the estimation of the volatility or the noise in yield spreads; thus regulators can set the required fraction of subordinate debt for each bank individually.

[22] Actuarially fair premiums would let the insurer break even on an average rather than on a risk adjusted basis.

[23] Higher systematic risk is involved in bank businesses, such as loan commitment and buying and selling of credit protection.

$$P_A = \frac{(1-p_a)}{p_a.D}.\{r_f.D - d.(D+S+E)\} \quad (28)$$

Interpreting Eqs. (27) and (28) would mean that $P_M = P_A$, if $p = p_a$. Further following Eq. (23) would mean that the expected return on risky portfolio of the bank is the risk-free rate. Empirical evidence[24] however suggests that these expected returns exceed the risk-free rate indicating $p_a > p$. Thus, $P_A < P_M$, which means banks are charged a lower premium than what a risk sensitive approach would have charged.

To explicitly deduce the impact of this pricing anomaly, Pennacchi (2006) has estimated the initial market value of the bank equity E_B for the bank with no subordinate debt. For the bank with subordinate debt, the payoffs to the bank owners in the model here are as follows:

$$\begin{matrix} r(p).(D+S+E) - (P_i + r_f).D - r_s.S & \textit{with probability}, p \\ 0 & \textit{with probability}, (1-p) \end{matrix} \quad (29)$$

where $i = \{M, A\}$. This call-option like payoff is valued using Cox, Ross, and Rubinstein (1979), to give initial market value of the bank equity E_B as:

$$E_B = \frac{p}{r_f}.\{r(p).(D+S+E) - (P_i + r_f).D - r_s.S\} \quad (30)$$

Putting values for P_i, $i = \{M, A\}$ from Eqs. (26) and (28) in Eq. (30) yields:

$$E_B = E, \text{ for } i = M \quad (31)$$

$$\text{And, } E_B = E + \frac{r_f.D - d.(D+S+E)}{r_f}\left(1 - \frac{p}{p_a}\right), \text{ for } i = A \quad (32)$$

It can be seen that the initial value of owner's capital, E_B exceeds the actual capital employed E, in case of $i = A$, or when premiums are charged on an actuarially fair basis. The excess component is the implicit subsidisation of the capital by actuarially fair premiums. To appreciate the utility of subordinate debt in alleviating the pricing anomaly in the case for actuarially fair premiums, it can be seen from Eq. (32) above that subordinate debt, explicitly and simply, has reduced the subsidisation by acting as a buffer to absorb some of the expected losses to the deposit insurer. However, subordinate debt as an active monitor of bank risk does much more than this. In cases where banks are forced to incorporate subordinate debt yield spreads in their objective function, first best level of risk can be chosen by banks.

Setting $c'(p) = 0$ and $\varepsilon_i = 0$ in (20), we have,

$$r_f.(1-\alpha).(D+S) = d.(D+S+E) \quad (33)$$

or,

$$r_f.D = d.(D+S+E) \quad (34)$$

As, we know that,

$$(1-\alpha).(D+S) = D$$

Substituting the first best condition (Eq. (34)) in Eq. (32) yields:

$$E_B = E, \text{ for } i = A$$

While we could achieve the first best by Eq. (20) and Eq. (34) above this would mean setting of gross recovery of risky portfolio equal to the gross payoffs to the insured depositors. This, as we have seen above, is feasible in cases where subordinate debt acts as a cushion to absorb some of the losses in case of default of the risky portfolio. Importantly, the condition when gross recovery is equal to the gross payoffs to the insured depositors, may not mean that we can part with deposit insurance in such a case. This is so because of at least two reasons. First, depositors need to be paid risk-free rate for the first best condition to be achieved. Second, there is an explicit guarantee attached with the form of deposit insurance provided by a government backed agency. This explicit guarantee adds an implicit liquidity in the system by averting information based bank runs on behalf of uninsured depositors.

For the optimal provisioning of subordinate debt, the results above reveal that the expected losses to the deposit insurer are zero. Further, no monitoring costs are incurred when insurers rely solely on subordinate debt market signals for setting the premiums. This implies that the deposit insurance premium in this case has to be zero.&#x[25] This is, in fact, consistent with the model above where, $P_i = P_M = P_A = 0$. In such a case where insured depositors are de facto protected, insurers cannot expect to earn a positive profit. The results are all the more important given that on an actuarially fair basis, government deposit insurers are constrained not to earn a positive profit by the constitutional and other political mandates, and yet be effective in checking bank's risk shifting as well as averting information based bank runs by depositors. In these circumstances, the first best provisioning of subordinate debt is the only condition which can optimise the objectives for the best possible insurer.

As far as insurance providers are concerned, no private insurer would provide such insurance where the expected profits are zero. Further, the quality of deposit insurance needed for best execution cannot be provided by any private entity, as the default probability for any private agent, other than the government, is greater than zero. This makes private insurers inferior to the government insurers in providing explicit guarantee. Also, this makes it difficult to set risk-free rates for insured depositors in case of private insurers. Any other gross rate of return greater than the risk-free rate will disturb the equilibrium for the first best condition and will make the optimal level of subordinate debt to be higher than what is achieved with risk-free rates. This would adversely

[24] See Pennacchi (1999) for an empirical analysis which shows that bank assets in the US, on an average, earned about 0.985% premium over the Treasury securities, in a span of more than 70 years ranging from 1926 to 1996.

[25] In the deposit insurance reforms suggested in Stiglitz (1993), an attempt to increase capital levels to very high levels would reduce the deposit insurance premiums closer to zero.

impact the profitability of banks. Following this we may infer that only the government can provide the best explicit guarantee for deposit insurance. Hence, in summary, the optimal deposit insurance premium for a social planner is zero, which can be achieved in case of effective monitoring by subordinate debt.

Further the utility of active monitoring by subordinate debt can be appreciated when it can account for systematic risk shifting. Upon observation of Eq. (32), as also described in Pennacchi (2006), the banks while paying for actuarially fair premiums assume an implicit subsidy on account of the fact that they may choose assets having a low risk-neutral probability (p) relative to the actual probability (p_a) of no default. Banks may accomplish this by choosing asset composition with a fairly high degree of systematic risk. Subordinate debt can check such risk shifting owing to the fact that it makes risk-neutral probability, p, observable. To follow this, the payoffs for subordinate debt in a risk-neutral setting in Eq. (24) above can be reiterated as:

$$p = \frac{r_f}{r_s} \tag{35}$$

This implies that by observing the yield spreads, risk-neutral probability p is observable in Eq. (35). Also, in order to keep the spreads within bounds, banks may lose the flexibility to change p relative to p_a. Further, banks may even have the incentives to choose for counter-cyclical asset composition. This is because, if the risky portfolio consists largely of assets with high systematic risk, this would entail undue variation[26] in p. This undue variation appears as increased volatility in yield spreads for subordinate debt which further appears as noise, ε_i, in Eq. (21), to determine the optimal subordinate debt. Any increase in noise, in turn, is detrimental for the profitability of banks as this would increase the allocation towards costly subordinate debt. A prudent bank would like to reduce the noise to the farthest extent possible as discussed earlier. This ex ante anticipation of increased noise would provide counter incentives to reduce systematic risk in the bank's portfolio. Thus, indirectly, the active market in subordinate debt may also account for increased systematic risk. This would foster market based counter-cyclical instincts in bank behaviour in choosing their quantum and quality of risk.

Discussion and implications

The model developed in this paper rests on the notion of truthful revelation of the risk of a bank by subordinate debt holder as an at-risk stakeholder. However, there are certain features subordinate debt must possess to qualify for such precise assessment of risk. First, subordinate debt holders must simultaneously possess knowledge, ability, and willingness to reveal the risk of a bank. This qualification indicates a keener at-risk stakeholder. Second, such a revelation must be continuous and observable by other stakeholders such as regulators, deposit insurers and retail investors, who rely on these signals. This indicates the need for a market to enable the incorporation of the risk assessment. Further such a market would ensure greater dissemination of the assessed information. Such a continuous market would also provide greater incentives for passive monitors to participate actively in the monitoring process. Third, the noise in these signals must be sufficiently small. This feature ensures the reliability of these signals from a competitive market. Importantly, a competitive market ensures willing participation by knowledgeable investors and also helps in making the information reliable enough to be used further.

Existence of a competitive market strengthens the contract between subordinate debt and the banks, and is preferable to relying on typical ex ante contracting. The strength of subordinate debt as monitor of bank risk, in such ex ante contracts, is the provision of covenants. However, some covenants, especially in case of subordinate debt, are inappropriate instruments for several reasons. Blum (2002) describes the flaws in such covenants which hinder monitoring by subordinate debt. Generally, the conditions for variation in the underlying variables, such as bank risk, are not verifiable. Specifically, covenants, such as containment of leverage, may not be imposed effectively for banks. Other covenants such as option feature may not induce monitoring once the threshold is reached. Also, the monitoring is focused around the threshold itself. This prevents continuous monitoring and also monitoring at the extremes when it is needed the most. Features such as acceleration of principal prior to maturity would again weaken the incentives for monitors in times of distress.

The model, in this paper, rules out any possibility of direct coordination between banks and subordinate debt claims.[27] Unlike in ex ante contracts, banks cannot directly determine the spreads for these securities. This is important because maximum permissible yield in some subordinate debt proposals is restricted by direct coordination between banks and debt holders. Such direct coordination reduces the incentive to monitor by making it range bound. This reduces the value of superior monitoring capabilities of active monitors. This is important, specifically, given that acquiring information is costly for monitors.

By assuming a superior monitoring technology and existence of competitive market in subordinate debt, the model ensures best possible monitoring efforts by subordinate debt holders which are not dependent upon monitoring by inferior agents. Moreover, regulation by an external agent is deemed secondary as external regulation flows *from* market signals and not otherwise. Regulators would rely on signals from the market in subordinate debt to penalise banks for shifting their risk. This is important given that when monitors attain information from external regulators, they would lose the incentive to monitor heavily regulated banks. A competitive market induces greater incentives for subordinate debt holders to acquire information to monitor, irrespective of the quantum of their claims. The nature of claims of subordinate

[26] This is because banks cannot possibly control the impact of systematic risk, if the allocation is biased towards systematic risk. However, if non-systematic risk dominates, banks can have greater control over it.

[27] Chen and Hasan (2011) show that subordinate debt can be an effective mechanism for market discipline provided (among other aspects) that regulators prohibit direct coordination between investors in subordinate debt and banks.

debt has an inbuilt option-like feature which expresses the assessment of risk for a bank on a continuous basis due to the existence of a competitive market. This in turn enables investors to achieve higher returns for their investments. Thus, active monitoring by subordinate debt has higher relevance for inferior monitors such as deposit insurers and regulators.

An important implication of superior monitoring technology is that the optimal quantity of subordinate debt is independent of the monitoring efforts of any other agent, such as the regulator. The optimal quantity rather depends upon the quality of assets and the volatility of spreads in the market. These features provide endogenous incentives for banks to choose a better risk profile for their portfolios. This is because a better quality of assets requires lesser amount of costly subordinate debt to be kept by the banks. The endogenous incentive for limiting the quantity of subordinate debt is a valuable proposition, provided we consider that the only significant role subordinate debt would play is to reveal risk. This is largely the role of a catalyst whose quantity must not disturb the well-being of banks. An inordinate quantity of subordinate debt works against the profitability of banks and could be a potential threat to their survival.

Apart from active monitoring by subordinate debt, the model above lays emphasis on adequate incorporation of subordinate debt signals by the banks in their objective functions. This can be enabled through several market oriented regulatory interventions to influence the bank's risk taking. Further, reliable signals from subordinate debt spreads may enable a regulator to enforce these contracts with minimum effort.

As discussed earlier, on the one hand, a bank with subordinate debt and uninsured deposits would be vulnerable in terms of runs. The noisy signals from subordinate debt would entail undue volatility in depositors' behaviour. This may even aggravate the tendency towards information based bank runs. On the other hand, a bank with deposit insurance and no subordinate debt would have the associated problems of moral hazard. Therefore, the joint structure of subordinate debt and deposit insurance, as proposed here, acts as a complement.

We have also presented a case for government backed agents as the best possible insurers in a system of banks. For such an insurer, apart from ensuring the best possible explicit guarantee,[28] the insurance premium can be set to zero. The provision of subordinate debt makes it feasible to quantify the risk-neutral probability of defaults of risky portfolios, with some noise. The proposed market in subordinate debt further makes such quantification verifiable. While on the one hand, such assessment of risk makes the implementation of market based premiums possible; on the other hand, it could contain the risk shifting incentive of banks in case only actuarially fair insurance premiums can be implemented by the insurers.

Further, we have argued that the tendency to carry excessive systematic risk by banks could be effectively checked in cases where banks incorporate the signal from subordinate debt spreads into their risk allocation. This is possible as optimal quantity of subordinate debt varies directly with the volatility of spreads, which further varies directly with the proportion of systematic risk chosen by the banks to allocate risky assets.

There are definite empirically testable implications for the subordinate debt proposal through market monitoring. Future research can identify if security markets could assess riskiness of the asset portfolios of opaque firms or firms with non-marketable assets. Further, it can be tested whether firms respond to market assessment. Finally, for heavily regulated firms we can check if market signals act as a complement to their regulators.

Subordinate debt proposal in this paper closely reflects the idea of capital adequacy in contemporary regulations such as Basel 3. Tier 2 capital in Basel 3 is sought to have securities subordinated in claims. However, Basel 3 puts up restrictions on the maturity of such securities. The proposal in our paper reinforces the idea of capital adequacy in two important aspects. First, the market oriented subordinate debt is more likely to be equity-like rather than debt-like security. Thus, it would have more loss absorption capacity than tier 2 capital envisaged in Basel 3. Second, through continuous market monitoring the spreads in these securities would complement the efforts of a regulator which can enforce capital adequacy through several of the means discussed in an earlier section (titled "Continuous incorporation of subordinate debt signals by the bank").

Conclusion

The paper has analysed the risk shifting incentive of a bank provided with deposit insurance and subordinate debt. While there are individual shortcomings in these instruments, their joint featuring to stabilise banks is deemed complementary in this paper. While deposit insurance can increase welfare for uninformed depositors and helps in averting information based bank runs, active monitoring by subordinate debt can counter moral hazard associated with deposit insurance. The model developed here explores conditions which can lead banks to choose the risk consistent with the risk chosen by a social planner as first best.

The model builds on the previous studies, where subordinate debt could not dynamically influence banks by being largely passive after entering into a contract. The model here envisages an active market for subordinate debt which can continuously impart signals to the regulators and other at-risk stakeholders. This provides the necessary discipline for banks so that they may conform to solvency consistent behaviour. Such active monitoring leads to better allocation of risk by a bank and provides endogenous incentives to do so.

While active monitoring is a precondition to achieve the first best, it can be ensured by inducing keener interest on part of subordinate debt holders to monitor bank risk. A market in these securities, therefore, is deemed vital which further enables the incorporation of the risk assessment by subordinate debt into the objective functions of banks.

The model also depicts the relevance of subordinate debt in eliminating the distortions in deposit insurance pricing. Specifically, subordinate debt helps in checking the risk shifting incentives even when the insurer charges a premium other than the first best, while completely eliminating these incentives where optimal quantities of subordinate debt are

[28] Which is vital requirement to avert information based bank runs.

chosen. Importantly, the paper also argues that active monitoring by subordinate debt can induce incentives for countercyclical asset allocation by banks for their risky portfolios.

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