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ABSTRACT

This paper focuses on two separate problems. The first is that frequently, the most profitable use of funds involves long-term investments, which militiates for long-term debt contracts. The second problem is to monitor the investor's use of funds, as exemplified by the U.S. S&L saga, and we argue that short-term debt provides investors, who can withdraw their funds, with a real threat over firms.

We show that short-term investors have both desirable incentives to exert control and invest in monitoring, and that this monitoring concern provides an explanation of the often lamented disparity between the maturity of banks' assets and liabilities. We also explore in detail the trade-off between long-term and short-term debt, including the possibility of multiple contracts and of priority rules.

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I. Introduction

Capital markets are at the heart of capitalism. The kind of capital markets that characterize modern economies developed late. Indeed, one of the factors distinguishing less and more developed countries is the extent of development of their capital markets.

That they have developed at all can be viewed as a marked accomplishment. Consider what is entailed: one person (the investor) turns over his money to another (the "entrepreneur"), to be returned, with interest, at a later date. So long as the entrepreneur does not engage in a limited number of practices ("fraud"), there is no legal penalty if he fails to return the amount promised. To be sure, he may find it hard to get future funds, but foregoing these future funds may be a small penalty in comparison with the expected returns he can get by using the funds in a way which reduces the likelihood that the investors will be repaid.

This paper focuses on two separate problems. The first is that frequently, the most profitable use of funds involves long-term investments. Classical finance theory talked of matching the maturity structure of the debt to the maturity structure of the returns, suggesting that the appropriate way to finance such long-term investments was through long-term debt.[1] But long-term debt gives the entrepreneur a long period of time before he can be held accountable. Even if the investor discovers the entrepreneur is not using the funds in the way he thinks prudent, there is little he can do. Of course, in designing the bond, he may have attempted to put covenants which restrict the entrepreneur's actions, and which allow him to intervene

[1]For the moment, we ignore equity and equity-like instruments. There is a large literature discussing why firms make limited use of equity, involving costly state verification, problems of asymmetric information, as well as moral hazard.

in specified circumstances. Yet bond covenants are rarely adequate; there are always new ways, for instance, by which entrepreneurs can decrease the value of outstanding debt and still conform with the bond covenants. The 1980s take-over movements in the United States forcefully demonstrated this, as bondholders repeatedly found that firms had undertaken greater risks, decreasing the value of their bonds, in ways which provided them no recourse.

Short-term debt provides investors with a real threat over firms. They can withdraw their funds. This is one of the reasons that some observers (such as Berle (1926)) have argued that banks (who provide short-term credit) exercise more control over firms than do those who provide funds in other forms. And, we would argue, it is one of the reasons that banks typically raise funds through short-term debt. This concern about providing discipline (here, for the banks) provides an explanation of the often lamented disparity between the maturity of banks' assets and liabilities. It is not that banks (and, even more, savings and loan associations) are unaware of the disparity; it is that capital markets "insist" on the liquidity as a discipline device.

This discipline, however, is not obtained without a cost. Short-term debt has a serious problem. Giving the investor the right to withdraw his funds for good reasons (i.e. because say the bank is making bad or risky loans) also provides the investor the right to withdraw his funds for other reasons, e.g. because he believes that he can obtain higher returns elsewhere. From an investors' perspective, in the absence of monitoring problems, contracts providing given (real) rates of return are preferable to those which provide a variable rate of return (of the same mean). Banks (and, more generally, firms) are in a good position to provide this kind of insurance against variations in real rates of return. But their ability to do so is limited if investors can, at will, withdraw their funds.[2]

Thus, if funds are provided by short-term instruments, the interest rate must be somewhat variable--it must vary with outside opportunities, so that depositors do not have the incentive to withdraw their funds--and the bank (or other firm obtaining funds) must accordingly pay a higher average interest rate.

Since the earliest principal-agent literature, attention has focused on the design of the optimal contract balancing off consideration of risk with incentives. The first task of this paper was to do that for this particular problem.

Upon further reflection, we became convinced that we may not have asked the correct question. Looking at how actual capital markets function, we see a variety of contractual forms co-existing side by side. There does not seem to be a single "optimal" contract form. We see both short-term and long-term debt. (We see similar mixed in other markets as well: McDonalds operates its own stores, and has franchisees.)[3]

The different financial instruments interact. The short-term contracts may provide discipline, some of the benefits of which accrue to

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[2]The essential problem here is one of verifiability: outside parties may not be able to distinguish the true reason for the withdrawal of funds. Issues of observability and verifiability also limit the kinds of contingent contracts that can be drawn up.

[3]There are also important changes in the mix over time. Large Japanese firms are relying increasingly on long-term debt, rather than banks loans. The explanation for these shifts has recently become the subject of considerable debate.

holders of long-term contracts.[4] The question facing the firm is then, what is the optimal mix of contracts.

We show that, not surprisingly, if all individuals are identical there is a single optimal contract, a hybrid contract allowing partial withdrawal of funds. But if different individuals differ in their risk-aversion, then it pays the firm to offer more than one contract. Risk-neutral (or more generally, individuals with low levels of risk-aversion) provide their funds short-term. They require little compensation to offset the risk which they bear. They also provide the discipline on firms, which allows the more risk-averse individuals to buy long-term bonds without worrying about the bank misusing their funds. Alternativelv. if contracts can be made contingent on other depositors' withdrawals, then it may be desirable to have some investors specializing in short-term contracts and performing the monitoring.

The second problem with which we are concerned arises when monitoring is costly. When there is a single investor providing funds to an entrepreneur, he has the incentive to monitor what the investor does with his funds. But when there are many investors within any class, there is public good problem. (See Grossman and Hart (1980) or Stiglitz (1985)). All benefit if the firm behaves well.

If monitoring is costly, then what incentive do even short-term investors have to monitor? Each investor can look at what the others are doing, and when he sees others withdrawing, then he can withdraw his own funds. He can free ride on the public information.

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[4]Thus, there may be important externalities in the design of contracts. See, e.g., Stiglitz (1985).

We argue that the system of "first come first serve" withdrawals employed by most financial institutions provides the appropriate monitoring incentives: if the bank has sufficiently large outstanding short-term liabilities, those who wait to "free ride" on others will face a high probability of finding themselves out in the cold. There is, in effect, a contest not to be the last to find out, and this contest requires each investor to spend some money on monitoring.

Even without such a contest, and even without the free rider problem, however, costly monitoring raises fundamental issues. If anyone is to have an incentive to pay the costs of monitoring, then there must be some probability that he will want to withdraw his funds, given the information provided. This, it turns out, has strong implications for the interest rates which banks pay investors. Indeed, we show that it implies that some of the "rents" that previously had accrued to the bank (in the form of returns in excess of what they paid depositors) now must be passed on to the depositor (investors). At the same time, banks must have an incentive to invest wisely, that is, there must be a cost to their losing customers. As a consequence, depositors get a rent and, as in other "reputation" models, there may be "rationing" of depositors ("investors").

II. Basic model

We focus on a contractual relationship between a bank and her creditors. We emphasize the following trade-off for contract duration. On the one hand, risk-sharing introduces a need for long-term contracts: short-term contracts cannot implement fixed returns if the future environment is uncertain. On the other hand, (the threat of) contract termination may be necessary for monitoring purposes: the threat of early withdrawals can act as a discipline device to prevent banks form shirking and invest in too risky projects. We show that it is optimal to have a mix of short-term and long-term contracts. We present below the basic features of our model.

1. The risk-sharing motive

We consider a partial equilibrium lending model. There are two periods ($t=1,2$) and a unit-mass population of infinitesimal identical risk-averse lenders, whose total initial wealth is equal to one unit of money. Each lender's objective is characterized by the same Von Neumann-Morgenstern utility function U(W), where W denotes his total wealth, evaluated at the end of the second period.

All lenders have access to publicly available short-term bonds (treasury bills, say), that yield the following short-term interest rates in each period:

- $t=1$: $i_1 = 0$,
- $t=2$: $i_2 = i_s$ with probability p_s,
  i_f with probability $p_f = 1 - p_s$.
  with $i_s > i_f$

The interest rate for period 2 is known only after the beginning (but before the end) of period 1. *Ex ante*, the lenders have thus the following reservation utility level:

$$\underline{U} = p_s U(1+i_s) + p_f U(1+i_f) \overset{def}{=} U(1+i). \quad \text{(II.1.1)}$$

We will denote by $\hat{i}$ the expected return $p_s i_s + p_f i_f$. With risk-aversion, $i < \hat{i}$.

A risk-neutral bank proposes to raise one unit of money, which she can invest either in the above short-term bonds (the treasury bills) or in two types of specific, long-term (i.e., two-periods) projects: a "safe" and efficient one and a "risky" and very inefficient one (alternatively, one could think of choosing a multitude of either independent or correlated small projects), which have the following characteristics:

- each project requires the money to be sunk for the two periods: it does not pay anything before the end of the second period; the risky project is indivisible and requires one unit of money.
- in period 2, the safe project gives a return of 1+r, whereas the risky project gives a return of 1+g with probability p, and of 0 with probability 1-p;
- the return of the safe project is higher than the expected return of the short-term bonds, which itself is higher than the expected return of the risky project; for the sake of simplicity, we will make even stronger assumptions:[5]

$$p(1+g) < 1+\hat{\imath} < 1+i_s < 1+r < 1+g. \qquad \text{(II.1.2)}$$

The safe project is thus the most efficient of the three types of investment: not only it is the safest, but it also yields a higher (long-term) return than the expected return of either the risky project or the short-term bonds. If the bank can commit herself to invest in a particular type of project and to pay given returns, the following long-term contract is optimal:

. i) the bank commits herself to invest in the safe project

[5]The assumption $r > i_s$ allows the bank to invest in the safe long-term project and yet be able to pay the same return as the public bonds. It avoids unnecessary intricacies.

. ii) the contract gives the following returns:

. $t=1$: $R_1 = 0$,

. $t=2$: $R_{2s} = R_{2f} = 1+i$. (II.1.3)

The bank and the lenders are actually indifferent between this particular contract and any distribution of contracts where $R_1=c$ and $R_{2s}=R_{2f}=1+i-c$, as long as the bank can commit herself to pay c in the first period. The bank's profit, r-i, is positive since the safe project yields higher expected returns in both states of nature.

2. Limited liability, asymmetric information and shirking

In the following, we will assume that the bank has initially an exogenously determined net worth, which she provides as collateral C to the lenders, and that wealth constraints prevent the bank from paying back more than this collateral plus what she gets from her own investment. We will further assume that lenders do not observe the returns from the bank's investment,[6] and that bankruptcy entails a pecuniary cost B. We know from the costly state verifications literature[7] that best contracts are standard debt contracts, according to which the bank does not make the return contingent on the return of her investment, but instead commits herself to pay back a given return or to go bankrupt, in which case depositors get all of the bank's net worth, minus the bankruptcy cost B.[8]

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[6]See e.g. White (1989) for a discussion of the difficulties associated with assessing the value of U.S. Savings and Loans associations.

[7]See for instance Townsend (1978) and Gale-Hellwig (1985).

[8]Note that if we assumed that returns are observed by depositors but non-verifiable by third parties and therefore non-contractible, payments to the depositors could still be made indirectly contingent on returns, for

In our framework, the above optimal contract is still valid, in the sense that if the bank invests in the safe project, she will prefer to pay back 1+i rather than go bankrupt and loose everything. However, once lenders have accepted this contract, the bank may prefer to "cheat" or "shirk" and invest in the inefficient but risky project.

Indeed, if the bank has a high enough collateral (i.e., $C \geq 1+i$), she can commit herself to pay a long-term interest rate of i, rather than going bankrupt. This leads the bank to invest correctly in the right project, as she is then the residual claimant. However, if the collateral is too low, the bank may prefer to shirk and invest in the risky project; this will be the case if, as we will assume from now on:

$$p(g-i)-(1-p)(C) > r-i,$$

or:

$$(1+r >) \; p(1+g) > 1+r-(1-p)(1+i-C). \qquad \text{(II.2.1)}$$

One can for example check that in the absence of any collateral ($C=0$), the bank would indeed prefer to shirk if the expected return of the risky project was close to the return of the safe one. If the bank could make the return she pays contingent on the return of her investment, shirking could for example be deterred by having her to give back 1+g if the return is 1+g. (See the discussion below on systematic bankruptcy.)

If the bank shirks and the lenders expect her to do so, she will have to give them a high return in the case of success in order to attract them. We will assume that investing with probability one in the risky project is not a profitable activity. This will in particular be the case if the bank would

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example through the use of convertible debt or warrants (see Green (1984)).

have to give too much when it is successful, in order to attract lenders, that is, if, as we will assume from now on, the maximum compatible with the bank's rationality constraint -- $1+g-(1-p)C/p$ -- does not suffice to attract lenders:

$$pU(1+g-(1-p)C/p) + (1-p)U(C-B) < \underline{U} \qquad \text{(II.2.2)}$$

One last remark.[9] As stated, the limited liability assumption suggests that the projects we are focusing on are large with respect to the size of the bank. Alternatively, however, one may think of "shirking" as investing in several or even a multitude of projects in a given sector, whose returns are therefore correlated, and interpret the failure of a project as being associated with a general negative shock in this particular sector. Then project failures would be highly correlated and the limited liability problems with which we are concerned here would still arise.

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[9]There is an alternative contract which needs to be considered, but which, under plausible assumptions, could be ruled out: the contract could systematically force bankruptcy in all cases, thereby allowing the interest rate paid by the bank to be contingent on the return from her investment. Such a contract essentially converts a debt contract into an equity contract (like junk bonds). In the particular case we consider here, it would indeed be easy to design such a contract which would induce the correct choice of investment. Assume for example that the bank pays $1+i$ and receives $r-i-B$ if the return is $1+i$, pays $1+g+C-B$ and receives nothing if the return is $1+g$, and finally pays $C-B$ and receives nothing if the return is zero: she then clearly prefers to invest in the safe project and get $r-i-B$ for sure rather than shirk and receive nothing for sure. However, such a scheme would be more difficult to develop for general revenue streams (the above scheme heavily relies on the assumption that any given return corresponds to only one possible investment choice). Moreover, according to this scheme, bankruptcy costs are paid for sure, which as we will see can be avoided using short-term contracts. Very high bankruptcy costs ($r-i < B$) would make such a mechanism non-profitable.

3. Short-term contracts as a monitoring device

By short-term contracts, we mean that a lender can withdraw his funds at the end of the first period and get the same return as with the public short-term bonds (i.e., $R_1=1$).

Short-term contracts are costly in the sense that they limit risk-sharing possibilities. Recall that lenders are assumed to observe during the first period the future return of the public bonds (that is, the value of the interest rate, i_s or i_f, is assumed to be known before the end of the first period.) Therefore, in order to keep the lenders' money, the bank must offer them a high enough return, particularly in the good state (n=s); otherwise the lender simply withdraws his funds. But this means that the interest rate being paid on short-term deposits must be variable. The bank is prevented from providing complete insurance for interest rate fluctuations. In fact, if the bank proposes short-term contracts to all her creditors, then her best strategy is to replicate the returns of the public bonds, i.e. she will promise a zero interest rate in the first period and, in the second period, depending on the state of nature, she will promise an interest rate of either i_s or i_f.

Although costly in terms of risk-sharing, short-term contracts may however be useful for monitoring purposes. We show below that a lender who observes shirking has indeed an incentive to withdraw his funds, and that this threat can act as a discipline device for banks.

Suppose first that the bank invests in the safe long-term project. In the end of the first period, she will have no money (besides her collateral) to reimburse the lenders. But there is no reason why the lenders would not be willing to leave their money in both periods, that is, to "renew" the deposit and wait until the second period to be reimbursed. If instead the bank shirks and invests in the risky project, and a lender happens to detect the shirking, then this lender has indeed an incentive to withdraw his funds at the end of the first period, since otherwise he would not obtain the promised return with certainty; that is, in state n (n=s,f):

$$pU(1+i_n) + (1-p)U(C-B) < U(1+i_n) \qquad \text{(II.3.1)}$$

since C-B < C < 1 < 1+i.[10]

Therefore if the bank shirks and this is detected, bankruptcy will occur at the end of the first period, making the bank lose her collateral and preventing her from getting any return from the long-term project in the second period. If the probability of being detected is high enough, the bank

[10]Condition (II.3.1) shows that "no withdraw" is not an equilibrium. Whether bankruptcy actually occurs may depend upon the precise contracts which are signed with the depositors.

If all lenders have negligible weights, then no single lender's withdrawal decision suffices to cause bankruptcy, and therefore "no (first-period) bankruptcy" cannot be part of an equilibrium, since at least some of the lenders who are supposed not to withdraw will obtain less than $U(1+i_n)$, and any of them could obtain $U(1+i_n)$ by changing his mind.

With non-negligible depositors, priority rules could be used in order to help triggering bank-runs. Alternatively, another way would be to penalize the remaining depositors whenever some withdrawals occur in the first-period. (Remaining depositors are already penalized by the fact that they will be fewer to share the burden of the bankruptcy costs. Other penalties could include reducing the promised interest rate, having depositors suffer more when bankruptcy occurs in second-period, etc.).

On the other hand, it might be a good idea to avoid undesirable bank-runs. This can be done for example by rewarding, if bankruptcy does occur in the first period, those who did not ask to withdraw their money.

will be deterred from shirking: short-term contracts will thus serve as a monitoring device.[11]

More precisely, let p_d denote the lenders' probability of detecting, during the first period, which project the bank has chosen. For now, we assume perfect correlation among lenders: either all or none of them observe the bank's choice of investment. The bank will be deterred from shirking if:

$$(1-p_d)[p(g-\hat{\imath})-(1-p)C] + p_d[-C] < r-\hat{\imath},$$

or:

$$p'(1+g) < 1+r-(1-p')(1+\hat{\imath}-C), \qquad \text{(II.3.2)}$$

where:

[11]Since bankruptcy entails inefficiencies (because of the bankruptcy costs B, but also because it eliminates the returns from the long-term project), it may be subject from renegotiation. In the following we will simply assume away the possibility of renegotiation, which can be a reasonable assumption when depositors are numerous. Introducing renegotiation would not rule out the role of short-term contracts as a monitoring device, however, provided that the bank has not all the bargaining power at the renegotiation stage.

Alternatively, the bank might try to sell his assets, i.e. his rights in risky project--if financial markets were efficient, she would then get $p(1+g)$. But in the case of bankruptcy, the revenues from this sale would first go to the depositors, and only the difference between these revenues and what is due to the depositors would help reduce the loss in collateral. Conditions (II.3.2/3) below would remain valid if the sum of these revenues and of the collateral were higher than $1+\hat{\imath}$. Otherwise, for example if financial markets are efficient and if the total value $C+p(1+g)$ is higher than $1+\hat{\imath}$, the bank would not loose her collateral, C, but only $1+\hat{\imath}-p(1+g)$; conditions (II.3.2/3) below would be harder to satisfy, yet they might be easier to satisfy than condition (II.2.1) above.

$$p' = (1-p_d)p < p. \qquad (II.3.3)$$

Although $\hat{\imath}$ is higher than i, inequality (II.3.1) is indeed easier to satisfy than the no-shirking condition associated with long-term "safe" contracts $R_1 = 0$, $R_{2s} = R_{2f} = i$ (condition 2.1), if the monitoring technique is sufficiently efficient (i.e., p_d is sufficiently high). If for example shirking is detected with probability 1, then short-term contracts can indeed serve as a monitoring device to prevent shirking. The bank's profit is given by r-$\hat{\imath}$.[12] The difference $\hat{\imath}$-i represents the cost of the inefficient risk-sharing introduced by the use of short-term contracts.

Note that we assume that only the lenders (privately) observe the bank's choice of investment. If the information were public, then contingent contracts, according to which the return of 1+i could be converted to a return of 1+g in case of detected shirking, would deter shirking while allowing perfect insurance. "Convertible bonds", which allow lenders to convert initial debt into equity, are a good example of such contingent bonds.

Although non-verifiable, the choice of investment is, however, observed (with probability p_d) by the depositors. Therefore, there may be room for more sophisticated "revelations" mechanisms, making the return contingent on "messages" sent by the depositors -- and the bank -- about the bank's choice of investment. The non observability of the returns however limits the scope of such mechanisms. Since the return scheme associated

[12]Important here is the assumption that the risky project is indivisible or, more generally, that the probability of detecting shirking is not too related to the extent of shirking. If for example the probability to be caught shirking was proportional to the size of investment in the risky project, then it might be difficult to deter limited shirking.

with a given profile of messages must be of the form "pay a return R or go bankrupt", and because of possible coordination problems among lenders, it seems difficult to construct a revelation mechanism.

Assume for example that there is no coordination problem among lenders -- meaning that they can cooperatively agree on what messages they send. One solution is then to give the choice to the lenders between a return of 1+i -- and nothing left to the bank in case of bankruptcy -- or 1+g+C -- and again nothing left to the bank in case of bankruptcy. Suppose first that the bank invests in the safe project. If lenders ask for 1+i, the bank will prefer to pay 1+i rather than to go bankrupt; if lenders ask for 1+g+C, bankruptcy will occur and lenders will obtain 1+r+C-B. It is therefore preferable to ask for only 1+i as long as bankruptcy costs are high enough (r+C-B > i). Suppose now that instead the bank shirks, and this is detected by the lenders. Then it is clearly optimal for the lenders to ask for 1+g+C, which they will get if the project is successful -- and if not, they will get the same as if they have asked for 1+i. Thus, if bankruptcy costs are high enough, according to this contract, lenders will ask for 1+i if they think the bank invested in the safe project and for more if they think the bank invested in the risky project. This mechanism clearly deters the bank from shirking and implements the first-best.[13]

Such a mechanism will not work properly, however, as soon as the lenders' decisions are decentralized: if for example the bank invests in the safe project and all the lenders decide to ask for only 1+i, every lender will

[13]This mechanism could be enhanced by introducing contingent returns in the case of bankruptcy. Also, if lenders are infintesimal, it is always a (weakly) dominant strategy to "tell the truth" if the contract is anonymous.

in fact have an incentive to ask for more, since the bank will be able to pay it without going bankrupt.

More sophisticated contracts, according to which the depositors, after having observed the bank's investment, could choose between several return schemes -- possibly renouncing to some money in case of bankruptcy -- however deserves further research. Still, the fact of the matter is that credit contracts remain remarkably simple, employing a limited number and forms of covenant; and the tack pursued here, of attempting to understand the design and consequences of relatively simple contractual forms seems to be a fruitful one for understanding how actual credit markets work.

4. Contract design

So far, we have dealt with either safe long-term contracts or purely short-term contracts. Even if these are the only possible types of contracts, it would be optimal for the bank to propose both types, in order to save on risk-sharing through long-term contracts while achieving monitoring thanks to a minimal number N_s of short-term contracts: it actually suffices that short-term lenders are numerous enough to force bankruptcy, i.e. $N_s = C$, the bank's collateral. With such a bundle of long- and short-term contracts, the bank's profits are given by:

$$r - (1\text{-}C)i - C\hat{i}. \qquad \text{(II.4.1)}$$

But the bank may get higher profits through the use of more sophisticated contracts, allowing the lender to withdraw (part of) his money at the end of the first period. Such a contract consists of a state-contingent return R_{1n} (n=s,f) if money is withdrawn in the first period, and a state-contingent return $R_{2n}=1+i$ if the money is left in the bank during the two periods.[14]

Allowing a lender to withdraw his money still introduces some limits on risk-sharing but, contrary to the case of short-term contracts, limited insurance can be provided by imposing a penalty on first-period withdrawals ($R_{1n} < 1$). The bank's problem is to design a contract so as to induce the lenders to leave their money in the bank if she invests in the safe project, but withdraw their money if they detect (with probability p_d) that the bank shirked and invested in the risky project, forcing the bank to bankruptcy. We will assume in this subsection that depositors are offered the same contract.[15] The next subsection addresses diversification issues.

Let us first focus on perfect insurance: $R_{2s}=R_{2f}=1+i$. In order to use these contracts for monitoring purposes, the first-period returns must be sufficiently high so as to force bankruptcy in period 1 in case of detected shirking. Namely, they must satisfy:

$$R_{1n} \geq C. \tag{II.4.2}$$

If first-period returns are too high, however, lenders will not leave the money in the bank even if she does not shirk. These returns thus must satisfy:

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[14]The first-period return R_{1n} can be contingent on the second-period return of the public bonds since this is observed during the first period.

[15]More precisely, we assume that all lenders are treated equally so long as bankruptcy does not occur. Differentiated treatments in the event of bankruptcy can help triggering bankruptcy when and only when desired. In the following, we only restrict the returns promised in the absence of bankruptcy (i.e., R_{tn}, for $t=1,2$ and $n=s,f$) to be the same for all lenders.

$$R_{1n}(1+i_n) \le R_{2n} = 1+i. \tag{II.4.3}$$

In the bad state, the largest return compatible with (II.4.3), $R_{1f}=(1+i)/(1+i_f)$, clearly satisfies (II.4.2), since $(1+i)/(1+i_f) > 1 > C$.[16] If the good state is much better than the bad state (and/or lenders are very risk-adverse), however, then the largest return R_{1n} compatible with (II.4.3) may not be large enough to force bankruptcy in case of detected shirking. This will be the case, if as we will now assume:

$$C(1+i_n) > 1+i. \tag{II.4.4}$$

In that case, no contract exists which provides complete insurance <u>and</u> forces the bank to go bankrupt in the good state. Thus, if we insist on perfect insurance, the no-shirking condition becomes:

$$(1-p_fp_d)[p(g-i)-(1-p)C] + p_fp_d[-C] < r-i, \text{ or:}$$
$$p''(1+g) < 1+r-(1-p'')(1+i-C), \tag{II.4.5}$$

where:

$$p' < p'' = (1-p_fp_d)p < p. \tag{II.4.6}$$

This condition, although easier to satisfy than the corresponding one in the absence of monitoring, may however not be satisfied even though short-term contracts can prevent shirking. (Greater risk-aversion makes i smaller, and hence (IV.4.5) easier to satisfy.) When this is the case,

[16]One can moreover check that the largest returns compatible with (II.4.2), $R_{1n}=(1+i)/(1+i_n)$, induce lenders to withdraw if they detect shirking, since $pU(1+i) + (1-p)U(C-B) < U(R_{1n}(1+i_n)) = U(1+i)$.

monitoring can only be achieved at the cost of inefficient risk-sharing. That is, setting R_{1s} high enough to cause bankruptcy when shirking is detected and the state of nature is good (n=s) implies, via the incentive compatibility conditions on the lenders' behavior, that the second-period returns be contingent on the state of nature. For a given R_{1s} above the critical level, the best second-period returns are given by:

$$R_{2s}(R_{1s}) = R_{1s}(1+i_s)$$

$$R_{2f}(R_{1s}) : p_s U(R_{1s}(1+i_s)) + p_f U(R_{2f}) = U(1+i). \qquad \text{(II.4.7)}$$

Since risk-sharing is more limited when R_{1s} increases, the expected rate of return to be paid by the bank, $i^*(R_{1s}) = p_s R_{2s}(R_{1s}) + p_f R_{2f}(R_{1s}) - 1$, increases w.r.t R_{1s} and it will thus be efficient to set the first-period return R_{1s} just enough to cause bankruptcy in case of withdrawal (that is, R_{1s} = C). Then, the optimal contract is given by:

$$R_1 = C$$

$$R_{2s} = C(1+i_s)$$

$$R_{2f} : p_s U(C(1+i_s)) + p_f U(R_{2f}) = U(1+i). \qquad \text{(II.4.8)}$$

The bank's profit is then r-i*(C), The higher the collateral, the more difficult it is to force bankruptcy and thus the higher the risk-sharing inefficiency and the lower the bank's profit.[17]

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[17]This profit should be compared with what the bank could obtain by promising to "go bankrupt" whatever the return is (i.e., by setting R_1 very high). However, even if depositors agree to leave something to the bank in case of bankruptcy, short-term contracts will be preferable when bankruptcy are sufficiently high.

5. Uniformity versus diversity of contracts

We have assumed so far that all lenders were offered the same contract. One can show that this is indeed the best strategy for the bank when, as we supposed, all lenders are identical and contracts must be independent from each other or first-period withdrawals are non-observable or non-verifiable.

Proposition 5.1: Assume that:

- all lenders are identical,
- the returns offered to one lender cannot be made contingent on other lenders' withdrawal decisions,
- $p''(1+g) > 1+r-(1-p'')(1+i-C)$,
- $p(1+i)/(1+i_f) \leq C \leq (1+i)/(1+i_s)$.

Then it is optimal for the bank to offer all lenders the same contract, defined by (II.4.10).

Proof: We show here that the proposed strategy is better than having two types of contracts, one of which involves complete insurance. The generalization is left to the reader.

Suppose that the bank proposes perfect insurance to 1-N lenders and another contract to N lenders. In order to force bankruptcy in the good state, the first-period return R_{1s} stipulated in the latter contract must satisfy (remember that for those who are offered complete insurance, the maximal first-period return R_{1s} is $R_{1s}=(1+i)/(1+i_s)$):

$$(1-N)(1+i)/(1+i_s) + NR_{1s} \geq C \qquad \text{(II.5.1)}$$

It is clearly efficient to choose R_{1s} as small as possible. Therefore:

$$R_{1s}(N) = [C-(1-N)(1+i)/(1+i_s)]/N, \qquad \text{(II.5.2)}$$

and the bank's profit is:

$$\begin{aligned} & r - (1-N)i - Ni^*(R_{1s}(N)) \\ = \quad & (1+r) - (1-N)(1+i) \\ & \qquad - N\, p_s \{[C-(1-N)(1+i)/(1+i_s)]/N\}\ (1+i_s) \\ & \qquad - N\, p_f\, R_{2f}(R_{1s}(N)) \\ = \quad & 1+r - (1-p_s)(1-N)(1+i) - p_s C(1+i_s) - Np_f R_{2f}(R_{1s}(N)) \\ = \quad & 1+r - p_f(1-N)(1+i) - p_s C(1+i_s) - Np_f R_{2f}(R_{1s}(N)) \end{aligned} \qquad \text{(II.5.3)}$$

The derivative w.r.t N is equal to:

$$p_f[(1+i)-R_{2f}] + p_s[(1+i)-R_{2s}][U'(R_{2s})/U'(R_{2f})] \qquad \text{(II.5.4)}$$

The sign is the same as the sign of:

$$\begin{aligned} & p_f[(1+i)-R_{2f}]U'(R_{2f}) + p_s[(1+i)-R_{2s}]U'(R_{2s}) \\ \geq \quad & p_f[U(1+i)-U(R_{2f})] + p_s[U(1+i)-U(R_{2s})] \\ = \quad & 0. \end{aligned} \qquad \text{(II.5.5)}$$

It is therefore optimal to have N as large as possible, i.e. to choose $N=1$, the second type of contract being proposed to all lenders.

Q.E.D.

The assumption that the returns to one lender cannot be made contingent on another lender's decision to withdraw in the first period is important. If such a contingency was allowed, it would be astute to propose short-term contracts to some lenders, who are free to withdraw at the end of the first period, and to offer all other lenders long-term contracts with perfect insurance, with the possibility to exchange these contracts for short-term ones as soon as the original short-term lenders do withdraw in the first period. According to this scheme, the "club" of short-term lenders (which can be pretty small) would act as an alarm which triggers bankruptcy in case of detected shirking, while all other lenders are completely insured. A more precise analysis of such mechanisms would however require a multi-period model. The next proposition shows that even if such contingencies cannot be used (either because of institutional reasons or because first-period withdrawals are not observable or not verifiable by third parties), introducing some specialization among lenders can still be a good idea when these lenders have different characteristics, particularly if they differ in their attitude towards risk:

<u>Proposition 5.2:</u> Assume that:

- $p''(1+g) > 1+r-(1-p'')(1+i-C)$,
- $p(1+i)/(1+i_f) \leq C \leq (1+i)/(1+i_s)$.
- $\underline{N}$ lenders are risk-neutral, the others being risk-averse as before,

and:

$$(1-\underline{N})(1+i)/(1+i_s) + \underline{N} > C.$$

Then it is optimal for the bank to propose $\underline{N}$ short-term contracts ($R_1=1$, $R_{2n}=1+i_n$ for $n=f,s$) and ($1-\underline{N}$) long-term contracts such that:

$$R_1 = (1+i)/(1+i_s),$$

$$R_{2n} = 1+i,\ n=f,s.$$

Proof: Since the risk-neutral lenders have $\hat{\imath}$ as a reservation level of expected rate of return, the minimal cost for the bank is $(1-\underline{N})(1+i)+\underline{N}(1+\hat{\imath})$. It is straightforward to check that, when proposing the above mix of contracts:

. lenders sort themselves out as appropriate (i.e., risk-neutral lenders choose short-term contracts and risk-averse ones choose long-term contracts),
. the total cost is equal to the minimal one,
. all lenders want to withdraw if and only if the bank shirks,
. the total sum that the lenders want to withdraw in case of detected shirking is larger than the bank's collateral.

Q.E.D.

III. Monitoring costs

So far, we assumed that monitoring was costless. More precisely, we assumed that with some probability, any lender could, at no cost, observe the bank's choice of investment. We now drop this assumption and instead assume that lenders can choose whether they invest in getting the information or not. If they do, it costs them a fixed fee f[18] and, with

[18]For the sake of simplicity, we introduce this fee "outside" the Von Neumann utility function U. It may seem more natural to count it "inside", particularly if one thinks of monetary costs. This would not however affect the nature of the analysis.

probability p_d, they observe the bank's choice. If they choose not to invest in the information, they save the cost but never observe the bank's choice.

Monitoring costs, even small, change drastically the picture. The reason is that, on the one hand, lenders must invest in monitoring in order to induce the bank not to shirk. But, on the other hand, if the lenders believe that the bank will not shirk, then they have no incentive to invest in monitoring. Therefore, some shirking or other form of (possibly limited) "disaster" must occur, at least with some probability, in order to induce the lenders to invest in monitoring.

On top of that, with costly monitoring there are free-rider problems, particularly if first-period withdrawals are observable. In that case, observing a withdrawal gives lenders the same information at no cost. We address now these two issues.

1. The incentives to monitor

In this subsection we assume that withdrawals are not observable. Therefore, bankruptcy can occur in the first period only if a sufficient number of depositors have invested in monitoring. For the sake of simplicity, we will assume that the bank proposes the same contract $(R_{1s}, R_{1f}, R_{2s}, R_{2f})$ to all lenders.

But short-term lenders will invest in monitoring only if there is some probability of shirking, that is, if with at least some positive probability the bank invests in the risky project.

Since no equilibrium can exist in which the bank shirks with certainty (we assume from the beginning that this would not be a profitable activity for the bank if borrowers anticipated this), let us consider a candidate equilibrium in which the bank shirks with probability q.

In order to force bankruptcy in the case of first-period withdrawals, the contract must satisfy:

$$\text{for } n = s,f, \qquad R_{1n} \geq C. \qquad \text{(III.1.1)}$$

To generate an equilibrium, this contract must satisfy the following conditions:

- lenders withdraw in the first-period if and only if they detect shirking:

$$\text{for } n = s,f, \quad pU(R_{2n}) + (1\text{-}p)U(C\text{-}B) \leq U(R_{1n}(1+i_n)) \leq U(R_{2n}) \qquad \text{(III.1.2)}$$

- lenders choose to invest in monitoring. At that point, we have to be more precise about what exactly happens when bankruptcy occurs in the first period, and a depositor did not ask to withdraw his money at that time – because he did not invest in monitoring, and thus, unlike the other depositors, did not detect shirking. In order to induce depositors to invest in monitoring, first-period withdrawals must be rewarded in case of bankruptcy in the first period. In fact, if there are no limited liability problems on behalf of the depositors, it is always possible to design a mechanism which penalizes sufficiently those who did not run to the bank in the first period when all other did, so as to induce investment in monitoring as soon as the probability of shirking is strictly positive. If there are limited liability problems, however, inducing investment in monitoring may not be possible if the monitoring cost is too high or the shirking probability is too low.

- lenders are willing to participate; denoting:

$$U_b = p_s U((C-B)(1+i_s)) + p_f U((C-B)(1+i_f))$$
$$\text{and } U_n = p_s U(R_{2s}) + p_f U(R_{2f})$$

(III.1.3)

this condition can be written as:

$$qp_d U_b + q(1-p_d)[pU_n + (1-p)U(C-B)] + (1-q)U_n - f \geq \underline{U}$$

(III.1.4)

- the bank is indifferent between shirking or not; denoting $\underline{R} = p_s R_{2s} + p_f R_{2f}$, this condition can be written as:

$$(1-p_d)[p(1+g-\underline{R}) - (1-p)C] - p_d C = 1 + r - \underline{R}$$
$$<=> \quad (1-p')(\underline{R}-C) = 1 + r - p'(1+g)$$

(III.1.5)

where $p' = (1-p_d)p$.

This indifference condition plays an important role, since it completely determines the expected return $\underline{R}$, regardless of the other conditions (and, in particular, of the lenders' participation constraint), as a function of the "fundamentals" p, p_d, r and g (and <u>not</u> f). This implies that, in order to induce monitoring:

i) the bank's cost of funding may be "much" higher than in the absence of monitoring costs, in the sense that the increase in cost is larger than the one associated with the mere decrease of efficiency due to the fact that the bank shirks with some probability;

ii) one or both types of lenders may obtain some rents; that is, the participation constraint may not be binding. This in turn implies that some form of rationing may be needed among lenders: if there are more than a "unit mass" of lenders, the adjustment of supply of funds to demand cannot be achieved through a diminution of the returns offered to the lenders.

Suppose for instance that the monitoring cost is very small (that is, f is negligible). Note again that the level of this cost f does not affect the required expected return $\underline{R}$. Moreover, the indifference condition (III.1.5), together, with the condition (II.3.1), which asserts the possible monitoring role of short-term contracts, implies that the expected return $\underline{R}$ must be higher than $1+\hat{\imath}$, the expected return of public short-term bonds. But if f is small, incentive compatibility about the lenders' investment decision in the detection of the bank's shirking only requires a small probability of shirking q, so that the lenders will obtain the expected level of utility associated with (R_{2s},R_{2f}) with probability almost one. It is then likely that the lenders will in that case obtain a rent above $\underline{U}$.

2. Exogenous probability of bankruptcy

It follows from the preceding analysis that monitoring costs, and the attached incentive conditions, may force the bank to pass some of her rents to the lenders. This in turn implies that the bank might benefit from the possibility of other sources of bankruptcy.

If we suppose for example that there exists a given, exogenous, probability $\underline{q}$ of bankruptcy, and that it is high enough to induce the depositors to invest in monitoring.

The expected return is then the one which is just sufficient to satisfy the lenders' participation constraint and prevent undesired withdrawals. That is, $R_{1f}=(1+i)/(1+i_f)$, $R_{1s}=C$, and (R_{2s},R_{2f}) is characterized by:

- if $U[C(1+i_s)] > \underline{U} + f$:

$$R_{2s} = C(1+i_s),$$

$$p_s U[C(1+i_s)] + p_f U(R_{2f}) = \underline{U} + f; \qquad \text{(III.2.1)}$$

- if $U[C(1+i_s)] \leq \underline{U} + f$:

$$R_{2s} = R_{2f} = R = U^{-1}(\underline{U} + f).$$

As compared with the situation where monitoring costs are zero, the only difference arises from the fact that returns must now cover these extra-costs; lenders get no extra-rents.

If there is no (or a not high enough) exogenous probability of bankruptcy, then similar reasoning shows that the firm has incentives to find other sources of bankruptcy or, more precisely, some other means of committing herself to go bankrupt with some probability. One possibility may be to invest in a risky project, in a parallel decision, and to <u>make it known</u> before to try to attract new lenders. Note that it may even be profitable for the bank, if her choice is limited, to choose a riskier project than what should be strictly necessary for inducing lenders to invest in monitoring: the bank may prefer a higher probability of bankruptcy if this helps avoiding to pass some rents to the lenders.

3. The observability of first-period withdrawals and free-rider problems

When first-period withdrawals are observable, monitoring costs give rise to free-rider problems: one depositor's gain from investing in monitoring comes from the fact that he can withdraw his money if he detects shirking. But if his withdrawals are observed by the other depositors, they can imitate him and deprive him from the benefits of monitoring.

This deserves some comments. First, this particular depositor can collude with the bank in order to "hide" this withdrawal (both will gain from that). Second, incentive mechanisms can again be devised in order to circumvent this free-rider problems. For example, first-come/first-serve rules would give an advantage to those who invested in monitoring. This advantage can moreover be amplified by covenants which "tax" the last to arrive.

Lastly, if withdrawals are not only observable but also verifiable, then astute mechanisms would consist in having a selected number of "short-term" lenders, who would be induced to sunk the monitoring costs, and to propose to other lenders a long-term contract which provides full insurance but permits but can be converted in short-term contracts whenever depositors of the first class do withdraw their money in the first period. This will permit not only to achieve better risk-sharing, as before, but would also allow to save on monitoring costs. Natural candidates for the "club" of short-term/monitoring lenders would include those who are less risk-averse, or large depositors -- who, other things being equal, are likely to have higher incentives to invest in monitoring.

Alternative solutions include setting up a monitoring agency (a regulatory solution) or a deposit insurance agency (who would be in charge of the monitoring and would have the responsibility of forcing liquidation). The question is then to analyze the incentives such agencies would have to perform their task as they are supposed to do. It is not *a priori* obvious that monitoring these agencies would indeed be easier than directly monitoring the bank, and the comparison between these alternatives clearly deserves further research.

Moreover, designing the appropriate incentives for the monitoring agencies may be quite difficult. On the one hand, the monitoring agencies has little direct financial incentive--it is not their money that is at stake. On the other hand, they also have little to lose if they pursue excessive monitoring, and since errors in which banks that should have been closed are not liquidated will be more noticeable that the opposite type of errors (banks that are closed that should have remained open), and since the monitoring agencies (unlike investors) have no direct financial stake at early liquidation, there can be a bias in that direction as well. Currently, there is a widespread perception within the U.S. banking industry that a policy of excessive caution (i.e. a proclivity towards closing institutions that are probably financial sound) is being pursued.

A standard problem in the design of monitoring structures is, "who monitors the monitor." If there is a hierarchical monitoring structure, there is always someone at the top who remains unmonitored. The advantage of the monitoring system we have discussed, where investors do the monitoring, is that this problem is avoid.[19]

[19]To be sure, there are other ways of avoiding the problem of "who monitors the monitor," e.g. associated with peer monitoring. See, e.g. Stiglitz [1991].

One of the important lessons of the above analysis is that monitoring can come from below as well as above. We noted that there can be "leveraged monitoring": with appropriately designed contracts, the monitoring activities of a few can be made highly effective. We emphasized the greater risk borne by these individuals, for which they were, to be sure, compensated; but that the relatively less risk averse should specialize in monitoring. There is another determinant of who should specialize in monitoring: those for whom the costs of obtaining the relevant information are relatively small; these may, in the case of firms, consist of suppliers or customers, or in the case of loans in less developed communities, peers within the same village.

Several of the general principles which we have noted here have more extensive applicability. We have for example highlighted the possible interaction of various contracts and, in particular, the value of monitoring generated by one contract for the returns on others. Similar issues arise in connection with bond markets and bank credit: it has been argued that bonds, representing a market form of credit, constitute a more "developed" (and therefore presumably superior) stage of the market economy. The increasing use of bond finance in Japan has, for instance, been interpreted in this light. From the perspective of this paper, this view is wrong: bond holders benefit from the monitoring provided by banks, and the increasing reliance on bond markets is a less positive development. The broader issue of alternative forms of monitoring raises the comparison of alternative financial systems, e.g. the Japanese main bank system, which entails both wider scope and greater incentives for bank interventions than does the American financial system.

IV. Policy considerations and links with the literature

The U.S. crisis of savings and loan associations (S&Ls) provide an important example of the problem we analyze. After the Great Depression, the FSLIC (Federal Savings and Loan Insurance Corporation) was created in 1934 to insure S&L deposits, with the hope that it would eliminate the repetition of undesirable bank runs. Due to the rise of interest rates which took place in the late seventies and the early eighties, the S&Ls, who essentially held long-term fixed-rate mortgages began to suffer important losses. But when interest rates fell in the mid-eighties, S&Ls losses continued to escalate. The insolvent or nearly insolvent firms began to engage in (too) risky projects. As Kane (1989) puts it: "Like football quarterbacks whose teams are trailing in the last minutes of a game,the leaders of zombie institutions are attracted to desperate plays. In many cases, the length-of-the-field financial passes they initiate take the form of advertizing nationally or regionally for extraordinarily high-rate deposits (for whose repayment FSLIC is on the hook) and investing the proceeds in improbable projects whose paramount attraction is that they offer an outside chance of restoring the zombie from solvency before FSLIC can pull its charter"[20] According to Kane, this moral hazard problem has generated a situation where zombie firms now constitute 25% of the FSLIC-insured thrift industry.[21]

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[20]Kane (1989), p. 39.

[21]On the theoretical side, these moral hazard problems have long been recognized. Hellwig (1991) identifies three types of problems which have been recognized as such, and which relate to the report of actual returns, the investment decisions and the provision of managerial effort. When combined, the first two problems, which Hellwig considers as probably the most relevant, give indeed rise to a tendency to invest in too risky projects:

In the aftermath of the S & L crisis, attention was focused on two problems: the underlying moral hazard problem facing the bank, and the mismatch of the maturity structure which originally gave rise to the low net worth of the S & L's, which exacerbated the ever-present moral hazard problem. Some intermediaries (such as FANNIE MAE), attempted to reduce the gap between the maturity of their assets and liabilities.

The perspective we have taken here is that the mismatch of maturity of assets and liabilities is not a happenstance. Short-term contacts can be used to improve incentives in the bank's investment decisions.

Of course, short-term contracts have their own costs. The costs we formalized here are derived from poor performance on risk-sharing. Other costs should be accounted for. In particular, short-term contracts entail the disintermediation risks, which may make the bank's liquidity function (providing insurance against consumption timing, as analyzed by Bryant (1980) and Diamond-Dybvig(1983)) more difficult to implement.[22] Suspending convertibility (i.e., in our framework, limiting or ruling out first-period withdrawals) can indeed help avoiding inefficient bank runs (see Baltensperger-Dermine (1987), Calomiris-Gorton (1991)). Yet, our analysis suggests that despite these costs, short-term contracts and bank runs can be socially desirable when used as a discipline device.

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as emphasized by Diamond (1984) and Gale-Hellwig (1985), asymmetric information about actual returns prevents shifting certain risks to the bank's investors, which makes the bank's objective a convex function of the return.

[22]Allowing banks to choose investment with different time-horizons, von Thadden (1991) shows that banks can still provide their liquidity even where the no-disintermediation constraint destroys the Diamond-Dybwig function of permitting intertemporal consumption shifts.

This should be contrasted with the wide-spread concerns about disintermediation and bank runs. Of course, the effectiveness and the cost of bankruptcy as a discipline device must be compared with those of alternative discipline device, such as government regulation (directly or through a Central Bank or a deposit insurance agency), private regulation (as in U.K., where the Securities and Investment Board partly delegates its task to five self-regulatory organizations). The recent U.S. S&L crisis suggests that other forms of regulation have their own difficulties (see Jaffee (1989) and White (1989) for more on that topic). In particular, regulatory capture, signalling effects in pre-elections periods, etc., may give government officials some inherent incentives to be too lenient and not force bankruptcy or other disciplinary devices when needed. Private monitors are less subject to such forbearance, but may have important short-term biases too. Whether they will be easier to monitor than the banks themselves is not necessary obvious.

Finally, let us mention that much of the analysis presented here can also highlights issues of corporate governance. Short-term loans may give those who invest in a firm a better control over the activity of this firm, and may at the same time give investors incentive to perform this monitoring. Along this line, it has sometimes been argued that the strong link of large Japanese firms with at least one important bank--which typically finance the firm through repeated short-term credit--may contribute to explain the performance of the Japanese industry.

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