Bankruptcy Priority for Bank Deposits: A Contract Theoretic Explanation

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Over the past decade several countries, including the US, have introduced or redesigned legislation that confers priority in bankruptcy upon all or some bank deposits. We argue that in the presence of contracting costs such rules can increase efficiency. We first show in a private information model that a borrower can reduce overall costs of finance by letting informationally heterogeneous lenders choose between junior and senior debt. In particular, we find that debt priorities reduce socially wasteful information gathering by investors. We then argue why, particularly in banking, legal standardization of debt priorities may be superior to bilateral private arrangements.

1. Introduction

One of the earliest tools used to protect the depositors of a failing bank from losses was priority in bankruptcy. However, for decades, this tool was almost forgotten. Only recently, priority regulation has made a kind of revival. Several countries have enacted new, or re-enforced existing, legislation on deposit priority. In the US, under the term "depositor preference", priority in bankruptcy was granted to all deposits in 1993. In Switzerland, long existing deposit priorities were updated and extended in 1997. Several emerging market countries, such as Hong-Kong, Malaysia, and Argentina, recently introduced deposit priority rules.

This renewed interest in priority rules reflects some disappointment with respect to deposit insurance. After 1980, several countries experienced severe banking problems that were at least partially attributed to excessive deposit insurance. The high cost to tax-payers kindled political interest in more incentive-compatible measures to protect the depositors of a failed institution. Deposit priority looked like a natural candidate: It protects depositors but preserves market discipline, since depositors are insured by junior lenders to the same bank, rather than by a third party such as an insurance fund or the taxpayer.

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Several observers have even proposed a regulatory minimum to the amount of junior, or subordinated, debt of banks.[1] While these authors stress the potential of subordinated bank debt to protect depositors and to support market discipline, bank supervisors have been reluctant to give subordinated debt a more prominent role. Under the Basle Capital Standards, only a limited amount of subordinated debt is eligible for so-called "supplementary capital", as many supervisors consider it an inferior form of capital compared to equity.

Notwithstanding important deposit priority legislation and the political debate on subordinated debt, academic economists have devoted relatively little effort to the analysis of such rules. Some critics thus warn against "the dangers of enacting important legislation . . . without exploring longer run implications" (Shadow Financial Regulatory Committee, 1996). This article tries to contribute to a better understanding of such rules.

Legal priority rules can be viewed from two sides. From one side, they are potentially costly government interventions: By giving priority to some claims, the legislator restricts contracting options of private parties and may prevent them from reaching optimal arrangements. From the other side, legal priority rules are a substitute for private covenants that would be costly to write in the presence of transaction costs. It might be cheaper to define priority in the law than in numerous private contracts. As we will set out below, legal standardization of priorities may be particularly relevant for banks with their large number of unsophisticated depositors.

Proponents of this "transaction cost view" of standardized priority rules should be able to show that debt priorities can be features of optimal contracts in the first place. This is not a trivial task. From the Modigliani and Miller (1958, 1963) irrelevance theorems it follows that in perfect markets a firm is not able to reduce its aggregate cost of finance by defining a particular hierarchy among various claims. Any reduction in interest payments to senior lenders should be exactly outweighed by a corresponding increase in interest payments to junior lenders.

An early discussion of debt priority rules, from which our model is inspired, can be found in Jackson and Kronman (1979). The authors explain the use of priorities by individual differences in lenders' costs or incentives to monitor a borrower. Priority rules help to focuse monitoring incentives on lenders, for whom monitoring is relatively cheap. Jackson and Kronman give three reasons for differences in monitoring cost:

1. Per-dollar monitoring costs fall with the size of a loan.
2. The incentive to monitor rises with the duration of a loan.
3. Some lenders may have comparative advantages in monitoring services.

[1] See e.g. Benston and al. (1986), pp. 179, 193; White (1991), p. 237; Evanoff (1992). A maximum risk spread on subordinated debt is proposed by Calomiris (1999). For a textbook discussion of subordinated debt proposals see Dewatripont and Tirole (1994), section 13.3.1. An excellent review of different proposals can be found in Board of Governors of the Federal Reserve System (1999).

While Jackson and Kronman provide a rather complete and insightful statement of what one may call the "monitoring hypothesis" of debt priorities, they do not offer a formal model. The present article tries to fill this gap. In the spirit of Jackson and Kronman, we will try to show how debt priorities can reduce duplication of monitoring efforts. In contrast to Jackson and Kronman, we abstract from differences in size and duration of loans and rather build on investor heterogeneity as a cause for differences in monitoring cost. We go beyond Jackson and Kronman by explaining simultaneously the choice of contracts, the value of information, and the level of monitoring.

Heterogeneity of investors and monitoring incentives are also at the heart of Calomiris and Kahn (1991). Their model, like our own, is focused on bank deposits. Monitoring depositors of a bank can attain implicit priority over non-monitors, as they are first in line to withdraw demand deposits following bad news. However, the authors do not explicitly model deposit priorities, and the amount of monitoring is imposed on, rather than explained in their model. We are not aware of any other article dealing with priority of bank deposits.[2] An article that also uses endogenous information expenditure is Winton (1995), where dual class debt helps prevent duplication of *ex post* verification of a borrower's returns by several lenders.

While these explanations of priorities assume some heterogeneity among investors, several explanations of priority choice build on heterogeneity of borrowers: In Diamond (1993) short-term debt can only be refinanced in bad times if it is senior to long-term debt. In Stulz and Johnson (1985) and in Hart and Moore (1993), debt priorities provide optimal incentives to shareholders and to managers.[3] In Barclay and Smith (1995) borrowers signal their earnings prospects by issuing junior or senior debt. In Scott (1977) priority to existing creditors protects these against (junior) legal damages.

This article is structured as follows. Section 2 briefly describes existing deposit priority rules in different countries. In section 3 we present a model of debt priorities as features of optimal contracts under costly monitoring. In section 4 we state some reasons why priority rules seem particularly important for bank liabilities, and why they are often standardized in the law. Conclusions are presented in section 5.

[2] Fama (1985), Gorton and Kahn (1993), Welch (1995), Hege (1997), and Repullo and Suarez (1998) explain the priority class of debt *held* by banks (by logic of banks' bargaining power in renegotiation).

[3] One implication of these models is that an insolvent debtor should be able to raise senior debt, if this allows her to finance positive net present value projects. Interestingly, some bankruptcy codes provide for this possibility: Art. 310 of Swiss Debt Enforcement and Bankruptcy Law, e.g., states that in the case of a composition agreement obligations incurred during the moratorium with the commissioner's consent bind the estate. Such obligations are thus senior to all claims established prior to the composition agreement.

2. Deposit Priority Rules in Different Countries

In the US, so-called "depositor preference" was introduced for all banks insured by the Federal Deposit Insurance Corporation (FDIC) in 1993.[4] Prior to the introduction of depositor preference on a federal level in 1993, similar rules had already been in place in 27 states (see Osterberg, 1996). Some had been introduced as early as 1909 (Nebraska), the latest in 1993 (Missouri). Under depositor preference all deposits are senior to non-deposit liabilities. While depositor preference tends to favour the holders of non-insured deposits (i.e. deposits exceeding 100,000 US$), its main beneficiary was intended to be the FDIC. When paying out depositors of a failed bank, the FDIC acquires their claims against the bank, including their priority status. This means, *ceteris paribus*, a lower expected loss to the insurer than in the absence of depositor preference.

In Switzerland, bankruptcy priority ("privilège en cas de faillite", "Konkursprivileg") for savings deposits was introduced as part of the Federal Act on Banks and Savings Banks of 1934. Before that, several Cantons (i.e. states) used collateral provisions to effectively grant priority to savings deposits. Under the present rules, savings deposits (and some similar deposits) up to an aggregate amount of 30,000 Sfr. (approximately 20,000 US$) per depositor are senior to all other deposits or liabilities.[5] In Switzerland there is no official deposit insurance. Yet, under a private agreement within the Swiss Bankers Association (SBA), banks mutually guarantee deposits that have priority in bankruptcy. Like the FDIC in the US, the SBA acquires depositors' priority claims when it pays out depositors.

Over the past decade, priority rules have been introduced in a number of emerging market countries. In Hong-Kong, deposits up to 100,000 HK$ (about 60,000 US$) are senior to all other bank liabilities.[6] This provision was introduced as an alternative to deposit insurance. In Malaysia, domestic deposits have a priority claim against domestic assets of a bank.[7] In Argentina, deposits are subject to several priority provisions;[8] like in the US, the national deposit insurance fund (SEGESA) acquires the priority status of deposits it pays out.[9] Several other countries have deposit priority rules, either in connection with deposit insurance, like Chile and Peru, or without, like Australia, Russia and Mongolia.

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[4] See Omnibus Budget Reconciliation Act of August 10, 1993, P.L. 103-66, sec. 3001; for a summary and brief comment see Shadow Financial Regulatory Committee (1996).

[5] According to Article 15, section 2, Federal Act on Banks and Savings Banks. The ceiling for priority laid down in this article was raised on two occasions (1971, 1997) to keep pace with nominal growth of deposits. Only banks (i.e. licensed institutions) are allowed to offer liabilities characterized by the term "saving". Savings deposits have traditionally been the most common bank account. They are generally perceived as the typical account for unsophisticated investors.

[6] Section 265 (db) of the Hong-Kong Companies Ordinance of 1996

[7] Section 81 of the Banking and Financial Institutions Act (BAFIA) of 1989.

[8] Articles 49e and 53 of the Law on Financial Institutions (no. 21.526)

[9] Articles 12d, and 13 to 17, Decrees no. 540/96 and 1292/96.

3. A Monitoring Model of Debt Priorities

3.1 Assumptions

A risk-neutral monopolist banker has access to a linear project with an uncertain, but observable return. The project has two outcomes: "success" and "failure". Per dollar of investment, it yields $Y \in \{\overline{Y}, \underline{Y}\}$ with $\overline{Y} > \underline{Y}$. The two possible outcomes have prior probability $p \geq 0.5$ and $(1-p)$, respectively. The banker has no wealth of her own; she tries to finance the project by borrowing from a large number of investors. As in reality, the banker must publicly announce what types of contracts she will offer, before she can raise any money. Investors can then accept one of the contracts ("make a deposit") or buy a risk-less asset with a per dollar return $R > \underline{Y}$.[10] An investor who accepts a bank contract is called a "depositor". The banker invests the funds she gets, and receives the returns from the project. Depositors get contractual payments. When the project has failed, an authority verifies the structure of deposits to ensure that priority rules are respected.

Investors are risk-neutral and together they have one dollar. Before they take a lending decision (but after available contracts have been announced), investors can observe a costly but imperfect signal on project returns. The signal is the same for all investors who get it. Investors are completely identified by their "type", i.e. by their individual (deadweight) costs of observing the signal. There is a continuum of investors, with information cost s uniformly distributed over the interval $[0, \overline{S}]$. The banker gets the signal for free. While the signal is observable to those who incur the necessary cost, it cannot be verified. Neither type nor the state of knowledge of investors are observable. Investors cannot communicate about received signals. Their actions (lending decisions) are only observable to the banker.[11] All other parameters, including the distribution of s, are publicly known.

Figure 1 illustrates the time structure of the model. In $t = 0$ agents learn all publicly known parameters, and the banker announces the menu of available contracts. In $t = 1$ agents can get the signal (from nature). In $t = 2$, investors accept a bank contract or buy the riskless asset. The banker invests borrowed funds in the project.[12] In $t = 3$, the outcome of the project (success or failure) is revealed, and pay-offs are shared according to contracts.

The signal can take two values, g, and b, for "good" and "bad". A good signal updates the chances of success from p to $q > p$ and of failure from $(1-p)$ to $(1-q)$; after a bad signal, the odds are reversed. The signal tells the investor from which of two lotteries Y is drawn. The probabilities q and

[10] Investors who are indifferent are assumed to choose the alternative preferred by the banker.

[11] Through verification after failure, the deposit structure becomes known and may reveal some ex post information on the signal.

[12] It can be shown that the banker will not invest in the riskless asset.

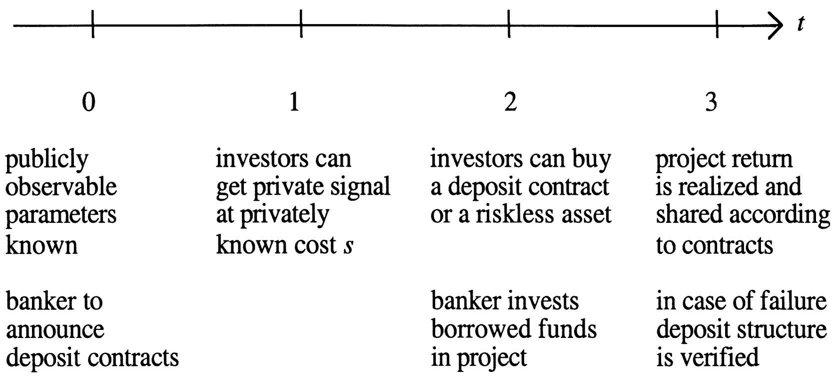

Figure 1
Time structure of the model

$(1-q)$ can be interpreted as the probabilities that the signal will be right, or wrong, respectively.[13]

The odds of receiving the signal g or b, henceforth u and $(1-u)$, follow from the prior and posterior probabilities p and q. Solving

$$p = uq + (1-u)(1-q), \text{ and } 1-p = u(1-q) + (1-u)q,$$

for u and $(1-u)$ yield

$$u = \frac{q+p-1}{2q-1}, \text{ and } 1-u = \frac{q-p}{2q-1}$$

We will denote the fraction of investors who choose to acquire the signal by k $(0 \leq k \leq 1)$. A rational investor will buy the signal if its value exceeds its cost. If the value of the signal (which depends on the contract menu offered by the banker) is V, all investors with information cost $s \leq V$ buy the signal. Therefore $k = V/\overline{S}$ $\left(\text{if } 0 \leq V \leq \overline{S}\right)$ and the total amount spent on the signal is $kV/2 = V^2/2\overline{S}$.

To ensure that at least one investor prefers to be uninformed $(k < 1)$, we assume that

$$\overline{S} > u\frac{q-p}{p}[R - \underline{Y}]. \tag{1}$$

We will denote a menu of n contracts by $\mathbf{C} = \{\mathbf{c}^1, \ldots, \mathbf{c}^n\}$. Each contract specifies promised payments to depositors in verifiable states of nature. Such states are: (1.) project outcome (success or failure), and, in case of failure, (2.) the structure of deposits, $\phi = \{f^1, \ldots, f^n\}$, where f^i is the fraction of

13 A signal with the same structure is used in Dow and Rossiensky 1998.

depositors (not of potential investors) holding contract $\mathbf{c^i}$ to total depositors. If we denote promised payments in case of success by D, and in case of failure by $M(\phi)$, contract $\mathbf{c}^i$ can be written as

$$\mathbf{c}^i = \{D, M(\phi)\}.$$

For expositional reasons we analyze contracts for the benchmark case in which the project, in expected terms, just breaks even when a bad signal has been observed. I.e. we assume that

$$(1-q)\overline{Y} + q\underline{Y} = R. \tag{2}$$

We will later relax this assumption to examine which contracts would be offered by the banker for different pairs of $\{\overline{Y}, \underline{Y}\}$.

3.2 The social optimum

The social planner maximizes the sum of expected returns from optimum investment after a good and a bad signal, minus the aggregate cost of the signal. The planner's problem can be written as

$$\max_{I_Y, I_R, k} u\{[q\overline{Y} + (1-q)\underline{Y}]I_{Yg} + RI_{Rg}\} + (1-u)\{[(1-q)\overline{Y} + q\underline{Y}]I_{Yb} + RI_{Rb}\} - \frac{1}{2}k^2\overline{S}, \tag{3}$$

where I_{Yg} and I_{Rg} are total investment in the project, and in the riskless asset, respectively, when the signal is good; while I_{Yb} and I_{Rb} are the analogous expressions when the signal is bad. As $q\overline{Y} + (1-q)\underline{Y} > R$ and $(1-q)\overline{Y} + q\underline{Y} = R$, the planner would invest all resources in the project after a good signal and be indifferent after a bad one. Individual monitoring is purely dissipative. The social optimum is characterized by

$$I^*_{Yg} = 1, I^*_{Rg} = 0; k^* = 0.$$

The social optimum can be achieved if the banker can observe investors' types. In this symmetric information case she would offer individualized contracts that pay $\mathbf{c}(s) = \{D(s), M(s)\}$ to an investor with signal cost s.[14] The banker would maximize profits by choosing $D(s)$ and $M(s)$ to:

1. Provide uninformed investors with an expected income of R. Contracts would thus satisfy

$$pD(s) + (1-p)M(s) = R. \tag{4}$$

[14] All contracts are held by an identical (infinitesimally small) fraction f of depositors. Therefore ϕ does not appear in contracts.

2. Set the value of information for each investor equal to his signal cost s. Given that (4) holds, investors accept their contract if they have a good or no signal, but not with a bad signal. The value of the signal is thus equal to the probability that the signal will be bad (and prevent the investor from buying the contract) times the amount of money the investor expects to save by buying the riskless asset rather than the bank contract when the signal is bad. Contracts therefore satisfy the information constraint

$$s = (1-u)[R-(1-q)D(s)-qM(s)]. \tag{5}$$

Under (4) and (5), investors would just accept their tailor-made contracts and lend to the bank without gathering the signal. The social optimum would be implemented.

What would optimal individual contracts look like? Solving (4) and (5) for $D(s)$ and $M(s)$ yields

$$D(s) = R + \frac{1}{u}\frac{(1-p)}{(q-p)}s \tag{6}$$

and

$$M(s) = R - \frac{1}{u}\frac{p}{(q-p)}s. \tag{7}$$

An example may illustrate these contracts. If

$$\overline{S} = u\frac{q-p}{p}R,$$

the depositor with lowest information cost (0) and the one with highest information cost ($\overline{S}$), respectively, get contracts

$$\mathbf{c}^0 = \{R, R\} \tag{8}$$

and

$$\mathbf{c}^{\overline{S}} = \left\{\frac{R}{p}, 0\right\}. \tag{9}$$

Remarkably, investors with high information costs get relatively risky contracts, while investors with low information costs are offered relatively safe contracts. This is because under observable information cost the banker can load each investor with the maximum amount of risk he is willing to bear without acquiring the signal.[15]

[15] For the social optimum in the example given in the text being implementable without negative payments to any agent, model parameters must satisfy $\overline{Y} \geq (1/2)((1+p)/p)R$, and $\underline{Y} \geq 1/2R$.

It is easy to see that this contract structure would indeed maximize the banker's profit. From each contract, the banker keeps pay-offs

$$\{\overline{Y} - D(s), \underline{Y} - M(s)\}. \quad (10)$$

As the terms in (s) in (6)(7) or in (10) disappear with integration, investors get an expected income of R, while the banker gets an expected total profit of

$$\overline{P} = p\overline{Y} + (1 - p)\underline{Y} - R. \quad (11)$$

Due to her market power, the banker thus reaps the whole net return of the project.

3.3 The banker's problem under asymmetric information

Under asymmetric information, a profit-maximizing banker will not implement the social optimum. If the bank were to announce the first best contract scheme given by equations (6) and (7), investors with low information cost would misrepresent their type. The investor with information cost of $s = 0$, to take an extreme case, instead of staying uninformed and accepting the riskless contract described in (8) would acquire the signal and, in case of good news, buy the risky contract designed for the investor with highest information cost described in (9). His expected return in the example above would be $Rq/p > R$. An equilibrium that fully separates investor types does not exist when the banker cannot observe investors' types.

The optimal menu of contracts maximizes the banker's expected profits across signals. Let $I^i_{Yg}(\mathbf{C})$ denote the amount the bank can invest from the sale of contract $\mathbf{c}^i \in \mathbf{C}$ after a good signal and $I^i_{Yb}(\mathbf{C})$ the respective amount when the signal is bad. For any contract and signal, the total amount of investment in the project is equal to $I_Y = \sum I$, while investment in the riskless asset is $I_R = 1 - \sum I$. The banker solves

$$\begin{aligned}\max_{\mathbf{C}} u \sum_i I^i_{Yg}(\mathbf{C})\big\{q\big[\overline{Y} - D^i\big] + (1-q)\big[\underline{Y} - M^i(\phi_g)\big]\big\}\\ + (1-u)\sum_i I^i_{Yb}(\mathbf{C})\big\{(1-q)\big[\overline{Y} - D^i\big] + q\big[\underline{Y} - M^i(\phi_b)\big]\big\}, \quad (12)\end{aligned}$$

where ϕ_g and ϕ_b are the structure of deposits after a good and a bad signal, respectively.

To find the best contract scheme, the banker has to decide what groups of investors (informed, uninformed) she should borrow from. *Given* any contract parameters, the banker would like to borrow as much as possible. Due to her limited liability, she can never lose from borrowing. Even when the signal is bad, borrowing and investing yield a positive expected profit.

This does not mean that the banker should *choose* contracts to attract all possible groups of investors. The banker has four different options: She can offer contract menus that appeal to (1.) no investor, (2.) only investors with a good signal, (3.) investors with a good signal and such with no signal, (4.) all investors, whatever their signal. We will examine in section 3.7 below which strategy is preferable under which model parameters. Before we can do so, we have to examine optimal contracts for each possible case. As the first and the last case are not interesting, we focus on the two intermediate strategies which are distinguished by the role of uninformed investors. We will first examine the (more interesting) case in which the banker does borrow from such investors.

3.4 The single contract

Borrowing from informed and from uninformed investors, the banker is faced with two potential groups of lenders. She can try to implement a pooling or a separating equilibrium. In this section, we examine the properties of a pooling equilibrium. In a pooling equilibrium, the banker offers the same contract to all investors. The contract menu has one single item $\mathbf{c} = \{D, M\}$. The contractual payment after failure, M, does not depend on ϕ, the structure of depositors: there is only one contract, and the fraction of depositors (not of investors) holding it is equal to one.

The banker chooses the elements of $\mathbf{c}$ in order to maximize her profits, given privately optimal behaviour of investors. She has to take into account a number of constraints.

Optimal information constraint

An investor wants to receive the signal if its value exceeds his individual cost s. The value of the signal (the expected return to an informed investor minus the expected return to an uninformed investor) to investors who accept the contract if they have no signal or a good signal is

$$V = u[qD + (1-q)M] + (1-u)R - [pD + (1-p)M],$$

Simplifying and dividing by $\overline{S}$ yields the information constraint

$$k = \frac{V}{\overline{S}} = \frac{1}{\overline{S}}(1-u)[R - (1-q)D - qM]. \tag{13}$$

Participation constraints

The single contract has to be attractive to uninformed investors as well as to informed investors when the signal is good. This leads to constraints

$$pD + (1-p)M - R \geq 0, \tag{14}$$

$$qD + (1-q)M - R \geq 0. \tag{15}$$

Wealth constraints

The banker as well as the investors have limited liability. This leads to constraints

$$\overline{Y} - D \geq 0, \tag{16}$$

$$\underline{Y} - M \geq 0, \tag{17}$$

and

$$D \geq 0, \tag{18}$$

$$M \geq 0. \tag{19}$$

The banker solves

$$\begin{aligned} \max_{\mathbf{c}} u\left\{q\left[\overline{Y} - D\right] + (1-q)[\underline{Y} - M]\right\} \\ + (1-u)(1-k)\left\{(1-q)\left[\overline{Y} - D\right] + q[\underline{Y} - M]\right\}, \end{aligned} \tag{20}$$

subject to constraints (13) to (19).

Proposition 1 (The single contract). *In a pooling equilibrium, the banker offers a uniform contract with payoffs D in case of success, and M in case of failure, where*

$$D = \frac{1}{p}R - \frac{1-p}{p}\underline{Y}, \tag{21}$$

$$M = \underline{Y}, \tag{22}$$

$$k = \frac{1}{\overline{S}}u\frac{q-p}{p}[R - \underline{Y}] > 0. \tag{23}$$

Proof. See appendix.

The single contract can be represented by a point in D-M-space as point **c** in Figure 2. Its parameters are found by the following steps.:

1. The wealth constraints restrict the area of feasible solutions for $\{D, M\}$ to the rectangle between $\{0, 0\}$ and $\{\overline{Y}, \underline{Y}\}$.
2. The three lines with negative slope, g, n, and b, are the P.C.s for investors with a good signal, no signal, and a bad signal. They intersect in $\{R, R\}$, which represents the riskless asset. (Note that, under the assumption made that $(1-q)\overline{Y} + q\underline{Y} = R$, $\{\overline{Y}, \underline{Y}\}$ lies on the P.C. for investors with a bad signal.) As $q > p$, only n, the P.C. for uninformed investors can bind. While b is never satisfied, g is slack, since it lies below n. Solutions must lie within the shaded area.

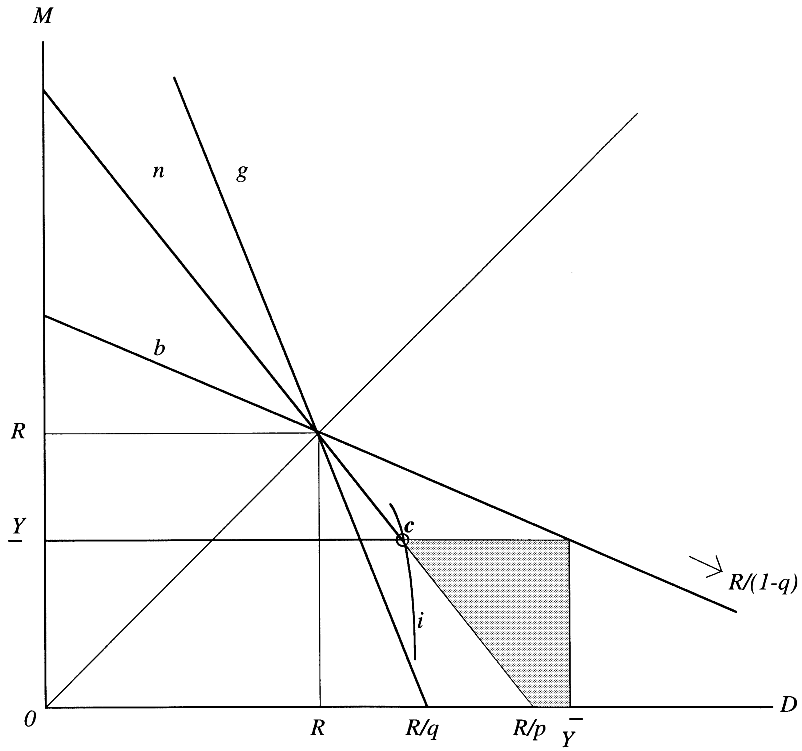

Figure 2
The single contract
The optimal contract is represented by point **c** in D-M-space.

3. Among all points that satisfy the constraints, point **c** lies on line i, the iso-profit line with the highest possible profit (the one closest to the origin).[16] In point **c** the banker leaves all income after failure to depositors. This is because a still uninformed banker, in comparison to an uninformed investor, has a stronger preference for D relative to M. Both attach the same probabilities to success and failure, respectively; yet, the banker benefits from an increase in M (along n) through the correspondent reduction in the value of the signal.

[16] Iso-profit lines have slope

$$\begin{aligned}\partial M/\partial D &= -(\partial P/\partial D)/(\partial P/\partial M)\\ &= -[p-(1-q)A]/[(1-p)-qA]\\ \text{with } A &= \frac{2}{S}[R-(1-q)D-qM],\end{aligned}$$

and $\partial^2 M/\partial D^2 < 0$.

Under the single contract, as $k > 0$, there is excess monitoring. The banker could push k down to zero by offering $\{\overline{Y}, \underline{Y}\}$, but this would wipe out her profits. Since $R - \underline{Y} > 0$, profit maximizing k is positive. The banker's expected profit under the single contract is

$$P = p\overline{Y} + (1-p)\underline{Y} - R - \frac{1}{\overline{S}}\Big(u\frac{q-p}{p}[R - \underline{Y}]\Big)^2; \tag{24}$$

this is equal to the net project return (the profit under symmetric information) minus an expression equal to $V^2/\overline{S}$ or kV. The latter amount is paid to informed investors who (in addition to R) get an expected refund of information expenditures (calculated on the basis of the highest relevant $s = V$). As a consequence, the banker pays $kV/2$ each as aggregate deadweight cost of information and as information rent to investors with $s < V$.

It is evident from (24), that it is the lack of income when the project fails ($R - \underline{Y} > 0$) that prevents the banker from implementing the social optimum. We will see in section 3.5 that this constraint can be softened (but not eliminated) by use of a separating contract.

3.5 The dual contract

To achieve a separating equilibrium, the banker offers menu $\mathbf{C}' = \{\mathbf{c}^j, \mathbf{c}^s\}$ with two contracts. One contract appeals to uninformed investors, the other to informed investors when the signal is good. (When the signal is bad, informed investors buy the riskless asset.) We will call the contract for informed investors the junior contract, $\mathbf{c}^j$, and the contract for uninformed investors the senior contract, $\mathbf{c}^s$. It will turn out that these contracts are in fact junior and senior in the sense that the senior contract is served first in case of failure of the project while the junior contract pays more when the project succeeds.

When there is more than one contract, parties may gain from contracting on the structure of depositors, ϕ. This structure becomes known in case of failure. Under the dual contract menu, there are potentially two groups of depositors, informed (junior) and uninformed (senior). As in reality, when a bank fails after good news, all depositors are still there. When a bank fails after bad news, uninformed depositors are likely to be alone, as they had no chance to react, while informed investors may not have deposited their money (or may have withdrawn it). The fractions of depositors after a good signal are thus $f_g^j = k'$, and $f_g^s = 1 - k'$, i.e. $\phi_g' = \{k', 1-k'\}$. After a bad signal $f_b^j = 0$, and $f_b^s = 1$, i.e. $\phi_b' = \{0, 1\}$.

The elements of the dual contract menu can be written on the outcome of the project and—in the case of failure—on ϕ'. However, for the junior contract, ϕ' is irrelevant. As the fraction of junior depositors is zero after a bad signal, we have $\phi' = \phi_g'$ whenever there are junior depositors. The dual contract menu has thus items: $\mathbf{c}^j = \{D^j, M^j\}$, and $\mathbf{c}^s = \{D^s, M^s(\phi_g'), M^s(\phi_b')\}$. The banker again looks for the contractual payments that maximize her profit when individual investors behave rationally. The relevant constraints to this problem are similar to those under the single contract:

Optimal information constraint

The value of the signal under the dual contract is

$$V' = u\left[qD^j + (1-q)M^j\right] + (1-u)R - [pD^s + (1-p)EM^s],$$

with $EM^s = \left[u(1-q)M^s(\phi_g') + \left(1-u\right)qM^s(\phi_b')\right]/(1-p)$. Dividing by $\overline{S}$ and slightly rearranging gives the fraction of informed investors

$$k' = \frac{1}{\overline{S}}\left\{u\left[qD^j + (1-q)M^j - R\right] + [R - pD^s - (1-p)EM^s]\right\}. \quad (25)$$

Participation constraints

The senior contract must satisfy the participation constraint for uninformed investors, while the junior contract must satisfy the participation constraint for investors with a good signal. Neither contract needs attract investors with a bad signal (although the banker would not mind getting their funds). This yields constraints:

$$pD^s + (1-p)EM^s - R \geq 0, \quad (26)$$

$$qD^j + (1-q)M^j - R \geq 0. \quad (27)$$

Incentive constraints

When the banker offers more than one contract she has to make sure that each category of investors prefer the contract designed for them. Uninformed investors are supposed to prefer the senior contract, whereas informed investors, after a good signal, buy the junior contract. This leads to two self-selection or incentive constraints:

$$p[D^s - D^j] + (1-p)[EM^s - M^j] \geq 0, \quad (28)$$

$$q[D^j - D^s] + (1-q)[M^j - EM^s] \geq 0. \quad (29)$$

Wealth constraints

An important difference to the single contract arises with the banker's limited liability constraints. Wealth constraints are no longer identical across signals. After a good signal the banker has k' junior and $(1-k')$ senior depositors; hence

$$\overline{Y} - k'D^j - (1-k')D^s \geq 0, \quad (30)$$

$$\underline{Y} - k'M^j - (1-k')M^s\left(\phi_g'\right) \geq 0. \quad (31)$$

After a bad signal there are $(1-k')$ senior depositors only; hence

$$(1-k')\overline{Y} - (1-k')D^s \geq 0, \tag{32}$$

$$(1-k')\underline{Y} - (1-k')M^s(\phi_b') \geq 0. \tag{33}$$

Investors' limited liability constraints are:

$$D^j \geq 0,\, M^j \geq 0, \tag{34}$$

$$D^s \geq 0,\, M^s\left(\phi_g'\right) \geq 0,\, M^s\left(\phi_b'\right) \geq 0. \tag{35}$$

The banker, under the dual contract, chooses contractual payments that solve

$$\begin{aligned}\max_{\mathbf{c}^j,\mathbf{c}^s} u\big\{&q\big[\overline{Y} - k'D^j - (1-k')D^s\big] \\ &+ (1-q)\big[\underline{Y} - k'M^j - (1-k')M^s\left(\phi_g'\right)\big]\big\} \\ &+ (1-u)(1-k')\big\{(1-q)\big[\overline{Y} - D^s\big] + q\big[\underline{Y} - M^s\left(\phi_b'\right)\big]\big\}.\end{aligned} \tag{36}$$

subject to (25) to (35).

Proposition 2 (The dual contract). *A separating equilibrium has two contracts: (1.) The junior contract, $\mathbf{c}^j$, pays D^j in case of success and nothing in case of failure; (2.) the senior contract, $\mathbf{c}^s$, pays $D^s < D^j$ in case of success; in case of failure, senior depositors share the intermediary's assets. Depending on deposit structure (which is a function of the signal) they get either $M^s\left(\phi_g'\right)$ or $M^s\left(\phi_b'\right)$. Contractual payments and the fraction of informed investors k' are the solutions to the following system of equations:*

$$D^j = \frac{1}{p}R - \frac{q-p}{qp}EM^s, \tag{37}$$

$$M^j = 0, \tag{38}$$

$$D^s = \frac{1}{p}R - \frac{1-p}{p}EM^s, \tag{39}$$

$$M^s\left(\phi_g'\right) = \frac{1}{1-k'}\underline{Y}, \tag{40}$$

$$M^s\left(\phi_b'\right) = \underline{Y}, \tag{41}$$

$$\begin{aligned}EM^s &= \frac{1}{1-p}\big[u(1-q)M^s\left(\phi_g'\right) + (1-u)qM^s\left(\phi_b'\right)\big] \\ &= \left(1 + \frac{u(1-q)k'}{(1-p)(1-k')}\right)\underline{Y},\end{aligned} \tag{42}$$

$$k' = \frac{1}{S}u\frac{q-p}{p}[R - EM^s]. \tag{43}$$

Proof. See appendix.

Figure 3 illustrates the logic behind the dual contract:

1. The dual contract has a senior component, given by point $\mathbf{c}^s$, and a junior component, $\mathbf{c}^j$. The senior contract is safer than the single contract (represented by point **c**); the junior is more risky.
2. The *senior* contract (point $\mathbf{c}^s$) lies on line n, the P.C. for uninformed investors. It lies above **c** as (in expected terms) the senior contract can pay more than the single contract when the project fails ($EM^s > \underline{Y}$). Only when there are no junior depositors (i.e. after a bad signal), senior depositors get exactly $\underline{Y}$; when there are junior depositors (after a good signal) the return on their investment is distributed among senior depositors. Senior depositors thus get an "add-on" to $\underline{Y}$, the return to uninformed depositors in case of failure under the single contract. This add-on is determined by the expected ratio of junior to senior depositors in case of failure. Graphically this is the vertical distance between EM^s and $\underline{Y}$.

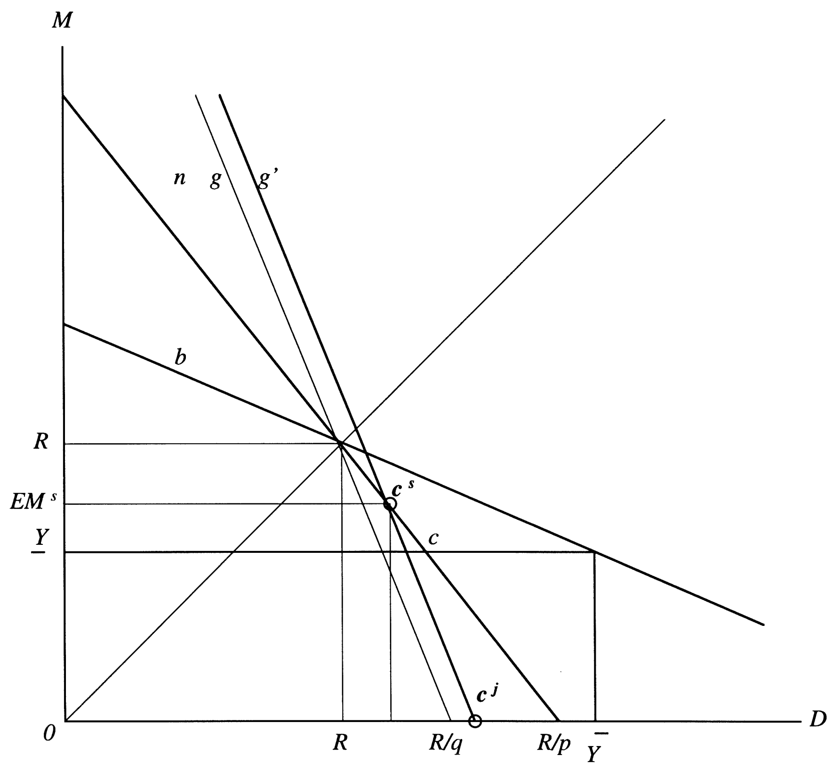

Figure 3
The dual contract
The optimal pair of contracts is represented by points $\mathbf{c}^s$ (senior contract) and $\mathbf{c}^j$ (junior contract).

In formal terms it is $u(1-q)k'/(1-p)(1-k')$, the (non-negative) fraction within parentheses in (42). The relative scarcity of failure income ($\underline{Y} < R$) that we found to cause excess monitoring under the single contract is thus partially overcome by use of a dual contract. Excess monitoring cannot be eliminated completely, though, since with EM^s getting closer to R a correspondent fall in k' dries out the very pool of junior deposits from which the difference between EM^s and $\underline{Y}$ is fed.

3. The *junior* contract, represented by point $\mathbf{c}^j$, is situated on the intersection of line g' with the D–axis. Line g' is the I.C. for investors with a good signal that runs through $\mathbf{c}^s$. It is a parallel to g, the P.C. for investors with a good signal, since both constraints have an identical rate of substitution $-\partial D^j/\partial M^j = (1-q)/q$. The junior contract, $\mathbf{c}^j$, has to lie on (or to the right of) g' to prevent investors with a good signal from buying the senior contract.

The dual contract achieves a reduction in the value of information and in the degree of excess monitoring compared to the single contract. From (43) and from $EM^s > \underline{Y}$ it follows that $k > k' > 0$, i.e. the fraction of investors who get informed is smaller under the dual than under the single contract (but still above its socially optimal value of zero). The dual contract thus induces some investors who would get the signal under the single contract to do without it. These are investors with information cost s in a "middle" range ($V' < s < V$). Investors with low information cost ($s < V'$) want the signal even under the dual contract, while investors with high information cost ($V < s$) always remain uninformed. The social return from the use of two priority classes of debt is equal to the amount of information expenditure saved by "luring" the middle category of investors into the uninformed camp.

From the dual contract, the banker gets expected profit

$$P' = p\overline{Y} + (1-p)\underline{Y} - R - \frac{1}{\overline{S}}\left(u\frac{q-p}{p}[R - EM^s]\right)^2,$$

which is more than under the single contract, as $EM^s > \overline{Y}$. The banker gets a higher expected amount of funding, plus she has to pay a smaller premium to informed depositors to reimburse them for information expenditures.

Under the dual contract there are thus three claims on the banker's terminal assets: senior debt, junior debt, and equity, the banker's claim on residual income in case of success. It is important that the model yields three, rather than two types of claims. A model with two types would only explain the existence of debt and equity, but not the existence of senior and junior debt.

The dual contract is the (privately) optimal contract when borrowing from uninformed investors maximizes the banker's profits. We have not yet examined what contract the banker offers when she gets a higher profit by raising money from informed investors only.

3.6 The monitoring contract

If the banker only borrows from informed investors the contract menu has only one item, as there is at most one category of depositors: after a good signal, all $\hat{k}$ informed investors lend, after a bad signal, nobody does. As this contract only appeals to informed investors, we call it the monitoring contract, $\hat{\mathbf{c}} = \{D, M\}$.[17] Like under the single contract discussed above, there is nothing to be gained from contracting on the structure of depositors: The fraction of depositors holding the monitoring contract to total depositors is $\hat{f} = 1$, whenever someone holds the contract at all.

Optimal information constraint

The value of the signal, $\hat{V}$, can again be derived as expected income of an informed, minus expected income of an uninformed investor. Here, this is equal to the probability u that the signal is good (which leads an informed investor to buy the contract), multiplied by the expected gain from buying the contract rather than the risk-less asset after a good signal. The number of informed investors therefore is

$$\hat{k} = \frac{\hat{V}}{\overline{S}} = \frac{1}{\overline{S}} u[qD + (1-q)M - R]. \tag{44}$$

Participation constraint

To make the contract attractive to investors with a good signal, payments must satisfy

$$qD + (1-q)M - R \geq 0. \tag{45}$$

Incentive constraint

The contract should not be attractive to uninformed investors, hence

$$R - pD + \big(1-p\big)M \geq 0. \tag{46}$$

Wealth constraints

There are wealth constraints analogous to those under the contracts examined above:

$$\overline{Y} - D \geq 0, \underline{Y} - M \geq 0. \tag{47}$$

$$D \geq 0, M \geq 0. \tag{48}$$

The banker solves

$$\max_{\hat{\mathbf{c}}} u\hat{k}\big\{q\big[\overline{Y} - D\big] + (1-q)\big[\underline{Y} - M\big]\big\},$$

subject to (44) to (48).

[17] To analyze this contract, we do not have to worry about the fact that this contract is not offered in the benchmark case where $(1-q)\overline{Y} + q\underline{Y} = R$. We will look at the choice among contracts under different values for $\{\overline{Y}, \underline{Y}\}$ more generally in section 3.7.

Proposition 3 (The monitoring contract). *The optimal contract appealing to investors with a good signal only has payments D and M which jointly solve*

$$qD + (1-q)M = R + \frac{1}{2}\left[q\overline{Y} + (1-q)\underline{Y} - R\right], \tag{49}$$

the fraction of informed depositors being

$$\hat{k} = \frac{1}{2\overline{S}}u\left[q\overline{Y} + (1-q)\underline{Y} - R\right].$$

Proof. See appendix.

The monitoring contract is illustrated by Figure 4:

1. Solutions for the parameters of the optimal contract must lie within the shaded area, i.e. between the W.C.s and between the P.C.s for investors

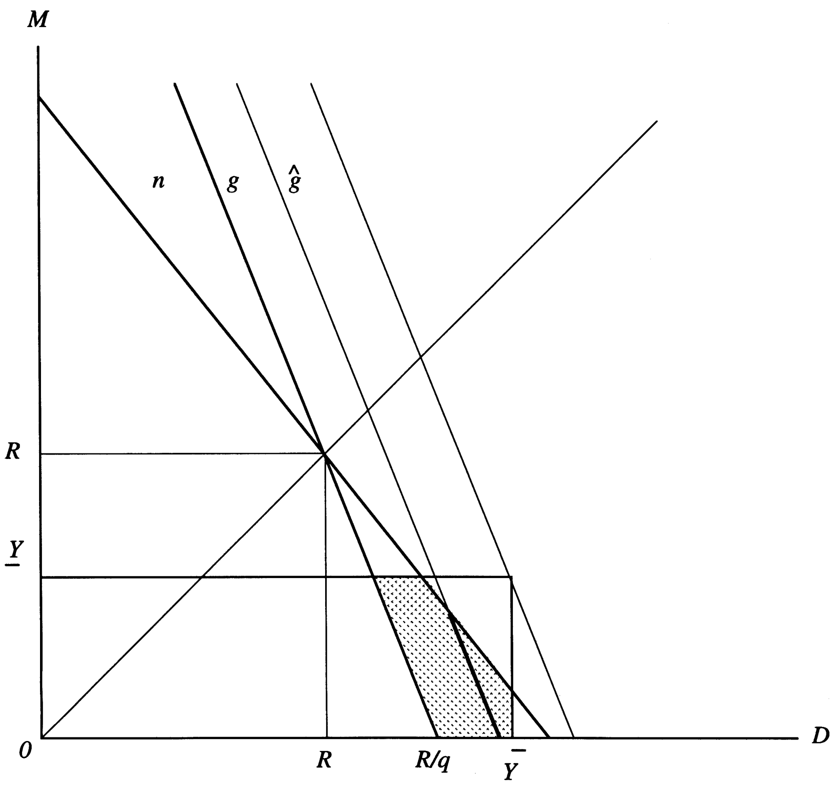

Figure 4
The monitoring contract
Optimal contracts are represented by any point on the solid section of line $\hat{g}$.

with a good signal, g, and for uninformed ones, n. However, none of these constraints binds. Along g, profits per dollar of investment are be high, but the value of the signal, and hence the number of depositors, are zero. Conversely, in $\{\overline{Y}, \underline{Y}\}$ the value of the signal and the expected number of depositors, are high, but profits per dollar are zero. The banker's problem, therefore, has a solution interior to the shaded area.

2. Any point on the solid section of line $\hat{g}$ represents an optimal contract, i.e. a pair of contractual payments $\{D, M\}$ that satisfies (49). The monitoring contract is not uniquely defined:[18] At one extreme (represented by the intersection of $\hat{g}$ with the D-axis), depositors bear the full risk of the project. At the other extreme (where $M = \underline{Y}$), depositors bear the minimum amount of risk possible under the monitoring contract. The latter case seems to be more relevant if one assumes that investors are more likely to exhibit some aversion to risk.
3. While *realized* returns can be shared according to any contract represented on the solid section of $\hat{g}$, *expected* returns are shared according to a clear rule. First, depositors get an expected return of R (conditional on a good signal) to ensure participation. Second, the remaining net expected return is shared fifty-fifty between the banker and depositors. Line $\hat{g}$ is located in the middle between g and its parallel through $\{\overline{Y}, \underline{Y}\}$.[19] While g represents an expected return (after a good signal) of R, its parallel through $\{\overline{Y}, \underline{Y}\}$ represents the full expected project return. Along $\hat{g}$ each party gets half the net expected return of the project (conditional on a good signal), $E_g(Y) - R$.

The monitoring contract stimulates information acquisition by investors and attracts those who get a good signal. It is used whenever a borrower has an interest to be monitored (like venture capital firms). Expected profit under the monitoring contract is half the net expected value of the project, or

$$\hat{P} = \frac{1}{2}u\hat{k}\big[q\overline{Y} + (1-q)\underline{Y} - R\big] = \frac{1}{4\overline{S}}u^2\big[q\overline{Y} + (1-q)\underline{Y} - R\big]^2.$$

$\hat{P}$ may be smaller or bigger than the profit from the dual contract. It depends on project parameters whether it pays the banker to attract uninformed investors or not.

3.7 Contract regions

We now turn to the question, which contract the banker chooses for different pairs of project pay-offs $\{\overline{Y}, \underline{Y}\}$ given p, q, and $\overline{S}$. To answer this question we relax our benchmark assumption (2) that the project breaks even after a

[18] With only one group of depositors whose state of knowledge is known *ex ante*, the Modigliani and Miller (1958, 1963) irrelevance theorems apply (along the solid section of $\hat{g}$).

[19] Line $\hat{g}$ is parallel to g because the rates of substitution between D and M in (45) and in (49) are the same.

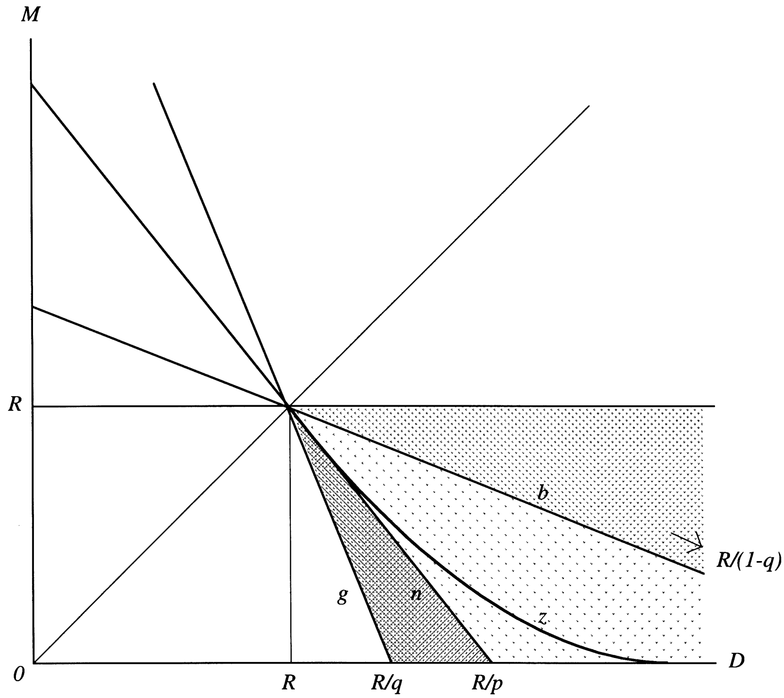

Figure 5
Contract regions
Socially optimal regions (shaded) and the banker's borderline z.

bad signal and examine a more general case only restricted by $\overline{Y} > \underline{Y}$ and $R > \underline{Y} \geq 0$. In Figure 5, $\{\overline{Y}, \underline{Y}\}$ can now lie anywhere to the right of the 45°-line between the D–axis and its parallel through R.

Four relevant regions for the location of $\{\overline{Y}, \underline{Y}\}$ can be distinguished. For each region we examine the decision of a banker maximizing her profit (solving (12)) and compare it to that of a social planner maximizing aggregate return (solving (3):[20]

1. If $\{\overline{Y}, \underline{Y}\}$ lies below g, all funds should be invested in the riskless asset ($I_Y^* = 0$, $I_R^* = 1$), whatever the signal. The banker cannot offer any profitable contract. The (trivial) social optimum is achieved.

[20] Under the more general assumptions, optimal contract parameters basically do not change, as constraints remain the same. However, profit under the dual contract, becomes

$$P' = p\overline{Y} + (1-p)\underline{Y} - R - \frac{1}{S}\left[u\frac{q-p}{p}(R - EM^s)\right]^2$$
$$+\frac{1}{S}(1-u)[R - (1-q)\overline{Y} + q\underline{Y}]\left[u\frac{q-p}{p}(R - EM^s)\right].$$

Under our benchmark case, the term on the second line was zero; this leads to the formula for P' in the text.

2. If $\{\overline{Y}, \underline{Y}\}$ lies between g and n, all funds should be invested in the project if the signal is good (i.e. $I^*_{Yg} = 1$, $I^*_{Rg} = 0$) and in the riskless asset if it is bad ($I^*_{Yb} = 0$, $I^*_{Rb} = 1$). The banker offers the monitoring contract. Information expenditure is $\hat{k} > 0$, and investment in the project is $I_{Yg} = k < I^*_{Yg}$, and $I_{Yb} = 0 = I^*_{Yb}$, respectively. There is underinvestment after a good signal.
3. If $\{\overline{Y}, \underline{Y}\}$ lies between n and b, the same socially optimal strategy as under (2.) applies. One would expect the banker to offer the dual contract. The dual contract leads to $k' > 0$ and investment policies $I_{Yg} = 1 = I^*_{Yg}$, and $I_{Yb} = 1-k' > I^*_{Yb}$, i.e. to overinvestment after a bad signal.

   However, in a part of this region, the monitoring contract is more profitable. A simple example is the case in which point $\{\overline{Y}, \underline{Y}\}$ lies just marginally above n.[21] The borderline between the two contracts is given by line z (the locus of equality of profits). Line z is convex and runs through $\{R, R\}$ (where all contracts become identical). It intersects the horizontal axis to the left of $R/(1-q)$.[22]

   As Figure 5 shows, the banker is likely to prefer the monitoring contract over the dual contract, when the project pays well after success but little after failure. This fits well with what one observes in practice: Investment, or venture capital firms (high $\overline{Y}$, low $\underline{Y}$) typically borrow from a small number of informed investors only, whereas banks ($\overline{Y}$ and $\underline{Y}$ relatively close to R) borrow from a large number of mostly uninformed depositors. Besides, transparency favours the monitoring contract, while opaqueness favours dual debt: The lower $\overline{S}$, the more line z bends to the right, as profits under the monitoring contract decrease in $\overline{S}$, whereas profits under the dual contract increase.[23]
4. If $\{\overline{Y}, \underline{Y}\}$ lies above b, all funds should be invested in the project whatever the signal, i.e. $I^*_Y = 1$, $I^*_R = 0$. (Our benchmark case used above was a borderline example to this region.) The banker offers the dual contract for a wide range of $\{\overline{Y}, \underline{Y}\}$, investment policies being $I_{Yg} = 1 = I^*_{Yg}$, and $I_{Yb} = 1 - k' < I^*_{Yb} = 1$. In this region the dual contract leads to underinvestment after a bad signal.

   The banker could afford offering a contract that sets the value of information and the fraction of informed investors k to $0 = k^*$. Such a non-monitoring contract is a uniform contract, as there is only one category of investors. It is similar to the single contract discussed above, but satisfies b instead of n. Contractual payments are $M = \underline{Y}$, and $D = R/(1-q) + \underline{Y}q/(1-q)$. This non-monitoring contract is hardly of

[21] The dual contract in this case leaves the banker with an expected profit close to zero.

[22] More precisely, by comparison of the monitoring and the single contract (which on the horizontal axis becomes identical to the dual contract) line z can be shown to intersect the horizontal axis to the left of $R(2q - p)/pq < R/(1 - q)$.

[23] This is another reason why banks would use dual class debt. On the opaqueness of banks see Morgan (1999).

any practical relevance, as the banker only prefers it to the dual contract when the project is extremely productive, i.e. when $\{\overline{Y}, \underline{Y}\}$ lies relatively far to the right of b.[24]

4. The Rationale of Dual Class Debt and of Legal Priority

Our model suggests a particular rationale for dual class debt. Dual debt becomes relevant whenever a borrower attracts informed and uninformed lenders. Contrary to what some authors (e.g. Benston et al., 1986, pp.179, 193; White, 1991, p. 237) suggest,[25] the purpose of dual class debt is *not* to provide monitoring incentives. The purpose of dual class debt is to reduce *excessive* monitoring. The senior contract leads some investors who would monitor under the single contract to stay uninformed. The junior contract (subordinated debt) does not provide any monitoring incentives: Investors who select the junior contract would become monitors even under the single contract. When a borrower seeks to provide monitoring incentives, a monitoring contract is called for. Such a contract induces some investors to buy a signal who would otherwise go uninformed. A monitoring contract is chosen when a borrower maximizes profits by raising funds from (favorably) informed investors only.

According to these findings, the use of dual class debt seems to be particularly attractive for banks. Banks are characterized by a large number of lenders, and most of these are not very sophisticated monitors.[26] A vast majority of depositors with retail banks hold relatively small balances and thus have high monitoring cost per dollar of deposit. In the US, 86 percent of all deposits have balances below 25,000 US$. In Switzerland, 88 percent of savings deposits have balances below 30,000 Sfr. (about 20,000 US$).[27] Monitoring by these depositors would in most cases be socially wasteful. Seniority for their deposits make these relatively safe claims concentrates the incentive to monitor with larger and more sophisticated junior lenders.

The large number of bank depositors also calls for some standardization of contracts. This may explain why retail banks in reality, like in our model, pre-announce a menu of a limited number of deposit contract types. These

[24] A necessary condition for the non-monitoring contract to be preferred is that $\{\overline{Y}, \underline{Y}\}$ is located to the right of a parallel to n that intersects the horizontal axis at $R/(1-q)$.

[25] To be precise, the suggestion that subordinated debt strengthens market discipline for banks can have at least three different meanings, namely:

1. Yield spreads on subordinated debt reflect bank risk;
2. A regulatory minimum to the share of subordinated debt in total liabilities (or a ceiling on its yield) leads banks to take less risk;
3. The funding of a firm by dual, rather than single class debt, reduces monitoring incentives.

In this article we find support to the third statement; we have not attempted to deal with any of the other two.

[26] This “definition” of a bank follows Dewatripont and Tirole (1994) who “consider banks as regular firms except for the fact that their debtholders are small and dispersed and thus need to be represented” (p. 117f.).

[27] See Kennickel et al. (1996), table 4, row 5, column 5, and Banque Nationale Suisse (1998), table 20. 4–5.

contracts are offered on a take-it-or-leave-it basis and are not negotiated. In contrast, investment banks and their corporate or institutional customers, who are small in numbers and relatively knowledgeable, typically bargain very hard over tailor-made contracts.[28]

There are several reasons why standardized priority rules are often defined in the law. Standardization by law treats all depositors of all banks alike; depositors do not have to read firm specific small print. A legal definition of priorities also protects existing senior depositors against the future issue of debt instruments with a higher priority.[29] In the absence of legal priority classes, a depositor would need to know not only his own contract, but also the priority provisions in all other contracts with the same borrower. Legal priority classes also save bargaining costs; in the absence of legal classes, the issue of a new claim with seniority would require negotiations with all existing holders of claims to be made junior.[30] Legal standardization also avoids inconsistencies among priority promises made to different lenders, and it reduces the risk that priority arrangements are challenged in court. The benefits of legally standardized priority rules for firms with a large number of lenders, like banks, quite likely outweigh the cost of "a few sizes fit all". This view is in line with Dewatripont and Tirole (1994) who make "a case for banking regulation as performing a monitoring service in screening, auditing, *covenant writing*, and intervention activities that depositors are unable or unwilling to do for themselves" (p. 6, our emphasis).

Finally, a legal definition of deposit priority rules may be necessary to protect the deposit insurance fund. Profit maximizing banks have an interest to make non-insured liabilities senior to insured deposits (e.g. through collateralization or repurchase agreements) unless insurance premia are adjusted accordingly. To prevent an exploitation of the insurance fund, legislators may be keen to put insured deposits into the highest priority class.

5. Conclusions

The presented model explains why borrowers may offer menus of debt instruments that differ with respect to priority in bankruptcy. When information costs differ among investors and are unobservable to the borrower, a contract menu offering junior and senior debt can reduce socially wasteful information gathering. Such dual class debt should be expected to occur whenever

[28] The importance of standardized contracts for economic growth is analyzed in Sussman (1999).

[29] In practice, legal priority rules can be complemented (or circumvented) by collateralization. Collateralization may be considered the tailor-made version of priority; legal priority being the standardized version.

[30] In contrast to seniority, the juniority of a new claim can be established by a bilateral agreement. This is, because the holders of senior debt do not suffer (but in fact benefit) from the issue of further junior debt and thus do not have to be consulted. Subordinate debt is regularly issued by banks in many countries on the basis of bilateral agreements.

a borrower raises funds from a large number of partially small, unsophisticated, or very short term lenders. The typical firm that fits this description is a bank.

Not only may banks have an incentive to issue debt with different priority status (like deposits versus non-deposit liabilities, or standard versus subordinated debt); there are also a number of reasons why priority provisions are often set by the legislator, rather than being left to private parties. The larger the number of lenders, the more substantial is the reduction in transaction cost achieved by standardization. The arguments in favour of a legal standardization of bankruptcy priorities are thus particularly strong in the case of bank deposits which are typically held by a large number of investors. Our model lends some support to the view that bankruptcy priority rules for bank deposits may not be (just another) costly government intervention but rather a substitute for bilateral contracts too costly to write for private parties.

Many aspects of deposit priority rules, in particular their joint effects with deposit insurance, may need further investigation. Yet, in the light of our model it is not surprising that priority for bank deposits exists in several countries and has recently been rediscovered by others, including the US.

Appendix

Proof of Proposition 1. We prove the proposition in three steps. First, we show that under the single contract $\mathbf{c} = \{D, M\}$ among (a) the P.C. for uninformed investors, and (b) the wealth constraint $M \leq \underline{Y}$, at least one must bind. We use the fact, all contracts $\{D, M\}$ on a line with slope $-\partial M/\partial D = (1-q)/q$ (the slope of the P.C. for investors with a bad signal) have the same fraction of informed investors

$$k = \frac{1}{\overline{S}}(1-u)[R-(1-q)D-qM].$$

Along any such line, the banker's profits decrease in D and increase in M (the banker who has no signal yet is more optimistic than investors with a bad signal). More precisely, a decrease of D by ϵq and a corresponding increase of M by $\epsilon(1-q)$ increase profits by $2\epsilon uq$. Hence, at least one of the two constraints mentioned must bind.

Second, we show that the P.C. for uninformed investors must bind even if $M = \underline{Y}$ binds. We do so by proving that the single contract $\mathbf{c} = \{R/p - (1-p)\underline{Y}/p, \underline{Y}\}$ is the most profitable among all contracts with $\{D, \underline{Y}\}$. A change of D along $M = \underline{Y}$ changes profits by

$$\begin{aligned}\frac{\partial P}{\partial(D \mid M = \underline{Y})} &= p + (1-u)(1-q)\Big(k - \frac{\partial k}{\partial D}[\overline{Y} - D]\Big)\\ &= p - B + (1-u)^2(1-q)^2,\\ \text{where } B &= \frac{2}{\overline{S}}u\frac{(q-p)^2}{p}(1-q)[R-\underline{Y}].\end{aligned}$$

As $p\overline{S} > u(q-p)[R-\underline{Y}]$ by assumption, and $2(q-p)(1-q) < p$ for all admissible values of p and q, it follows that $B < p$. As $(1-u) > 0$, and $(1-q) > 0$, it follows that

$$\frac{\partial P}{\partial(D \mid M = \underline{Y})} < 0.$$

i.e. the P.C. for uninformed investors binds.

Third, we show that $M \leq \underline{Y}$ binds, even if the P.C. for uninformed investor binds. We rewrite the banker's problem by substituting for D from $pD + (1-p)M = R$, and by use of $(1-q)\overline{Y} + q\underline{Y} = R$. The banker solves

$$\min \frac{1}{S}(1-u)^2\left(\frac{q+p-1}{p}\right)^2[R-M]$$

which is equivalent to max M. Therefore $M \leq \underline{Y}$ binds.

As at least one of the two constraints binds and as one binds if the other does, it follows that both bind. This yields the single contract. ■

Proof of Proposition 2. First, we show that the introduction of a second contract, in addition to the single contract, increases profits. Then we show that profits are maximized when the single contract becomes the senior contract, while the other contract becomes the junior contract.

We start from a contract $\mathbf{c}^\circ$ which in the beginning is identical to the single contract, i.e. $\mathbf{c}^\circ = \mathbf{c}$. Suppose that, in addition to $\mathbf{c}^\circ$, the banker offers a second contract $\mathbf{c}^g = \{D^g, M^g\}$. To make it just attractive to investors with a good signal, she sets $M^g = 0$, and $D^g = R/p - \underline{Y}(q-p)/pq$. This puts $\mathbf{c}^g$ on a line through $\mathbf{c}^\circ$ with slope $-\partial M^g/\partial D^g = q/(1-q)$. The introduction of $\mathbf{c}^g$ increases profits; in fact, $\mathbf{c}^g$ is the most profitable among all contracts that lie on the I.C. for investors with a good signal through $\mathbf{c}^\circ$. This is because the banker's iso-profit line implies a substitution rate $-\partial M^g/\partial D^g < q/(1-q)$. (The banker who does not yet know the signal is more pessimistic than an investor with a good signal will be and pays these with success income.)

Next, we compare the menu $\{\mathbf{c}^\circ, \mathbf{c}^g\}$ to contracts that have the same fraction of informed investors k. As

$$k = \frac{1}{S}\{u[qD^g + (1-q)0 - R] + [R - pD^\circ - (1-p)M^\circ]\}$$

is a function of the two P.C.s, it does not change when either $\mathbf{c}^\circ$ is moved along the P.C. for uninformed investors (the second term in brackets), or $\mathbf{c}^g$ along the P.C. for investors with a good signal (the first term in brackets).

In the presence of contract $\mathbf{c}^g$, contract $\mathbf{c}^\circ$ can pay $M^\circ > M = \underline{Y}$, as some failure returns become available to the holders of $\mathbf{c}^\circ$. It follows from the proof of Proposition 1 that $P(\mathbf{c}^\circ) > P(\mathbf{c})$. Further, as $D^\circ < D$, D^g can be made smaller than its initial value $D^g = R/p - \underline{Y}(q-p)/pq$ without inducing investors with a good signal to switch to $\mathbf{c}^\circ$. It is easy to see that, for two reasons, smaller D^g means higher expected profit. Lower D^g means a smaller payment per (informed) investor, as well as a lower value of the signal and thus a smaller fraction of informed investors (who may get a bad signal and not lend to the bank). Therefore, optimal $\mathbf{c}^g$ is defined by an I.C. that restricts D^g from below.

As optimal $\mathbf{c}^\circ$ is defined by the P.C. for uninformed investors and the wealth constraint on $\underline{Y}$, while optimal $\mathbf{c}^g$ is defined by an I.C. and by non-negativity of M^g, the contract pair $\{\mathbf{c}^\circ, \mathbf{c}^g\}$ in the optimum is identical to the dual contract described in Proposition 2. ■

Proof of Proposition 3. Under the monitoring contract, the banker's objective function has derivatives

$$\frac{\partial}{\partial D} = -\frac{1}{S}u^2 qC,$$

$$\frac{\partial}{\partial M} = -\frac{1}{S}u^2(1-q)C,$$

with $C = [q\overline{Y} + (1-q)\underline{Y} - R] - 2[qD + (1-q)M - R]$.

As $\partial/\partial D$ and $\partial/\partial M$ are linearly dependent, they yield only one F.O.C. Profit maximization requires $C = 0$, which implies

$$qD + (1-q)M - R = \frac{1}{2}[q\overline{Y} + (1-q)\underline{Y} - R],$$

as stated in Proposition 3. As the right-hand side is clearly positive, the P.C. for investors (with a good signal) on the left-hand side cannot bind. Nor can the monitoring contract have payments $\{\overline{Y}, \underline{Y}\}$ or $\{0, \underline{Y}\}$. Only one of the wealth constraints $D \leq \overline{Y}$, $M \leq \underline{Y}$, or $M \geq 0$ could bind at one time ($D \geq 0$ can never bind). But, as iso-profit lines and the P.C. have identical slope $-\partial M/\partial D = q/(1-q)$, there is always a solution to $\hat{\mathbf{c}}$ for which no constraint binds (except in the trivial case where $q\overline{Y} + (1-q)\underline{Y} - R = 0$). Any solution to $C = 0$ is an optimal monitoring contract. ■

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