Debt Maturity and the Deadweight Cost of Leverage: Optimally Financing Banking Firms

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Levered firms operate with distorted investment incentives: they will fail to implement some investment projects with positive net present value (NPV) and may undertake negative-NPV projects which sufficiently increase their portfolio risk.[1] These investment distortions reduce firm value, and in efficient financial markets firm shareholders fully bear the costs of inappropriate investments. Accordingly, shareholders employ debt-contracting mechanisms that reduce their investment distortions. Several contracting devices are commonly employed: restrictive covenants (Clifford W. Smith, Jr., and Jerold B. Warner, 1979), secured debt (René M. Stulz and Herb Johnson, 1985; Elazar Berkovitch and E. Han Kim, 1990), short-term debt (Steward C. Myers, 1977), and operating with low leverage. The optimal structure for a firm's financial liabilities maximizes its net benefits of leverage and should depend importantly on the nature of the firm's business endeavors.

This paper examines the capital structure of financial intermediary firms which finance relatively illiquid, informationally intensive securities. These firms include commercial banks, thrifts, finance companies, and some insurance companies. Financial firms' investment incentives are influenced by debt in the same way as any other firm's, yet they operate with unusually high leverage. For example, at year-end 1990, commercial-bank equity comprised approximately 6.5 percent of their total assets. The corresponding capital ratio was 2.9 percent for Savings Association Insurance Fund (SAIF)-insured thrifts, and 8.1 percent for domestic finance companies. By contrast, the average U.S. nonfinancial firm's capital ratio was about 55 percent. In addition to their high leverage, many financial firms issue liabilities with shorter maturity than their assets. Since many financial-firm assets are illiquid, this short funding exposes them to substantial liquidity risk (Charles Goodhart, 1988). Some writers (e.g., John H. Kareken, 1985) suggest that bank maturity-mismatching occurs only because the existing federal "safety net" subsidizes liquidity risk-taking. Though government regulation has surely exacerbated banks' exposure to illiquidity risk, this risk appears to be an intrinsic feature of banking-firm operations. For example, Gary Gorton (1984 p. 5) reports that 12 substantial banking panics erupted in the United States between 1800 and 1915, causing problems for "even solvent banks" which "could [not] meet the demands of large numbers of depositors trying to withdraw funds at one time." Banking trade publications from the early 1930's contain numerous references to bank liquidity risks, including the assertion that "Every commercial banker knows that his deposits can and may be withdrawn at any

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[1] The stockholder–bondholder conflict has been analyzed by Stewart C. Myers (1977), Clifford W. Smith, Jr., and Jerald B. Warner (1979), and others. My model does not reflect the possibility that managers and shareholders may also have important agency problems (see e.g., Michael C. Jensen and William H. Meckling, 1976; Eugene F. Fama and Jensen, 1983).

time" (William Hayes, 1932 p. 327). Y. C. Jao (1974) reports that the Hong Kong banking sector was essentially unregulated before a series of depositor panics in 1965. Nonetheless, banks operated with substantial liquidity risk.

Financial firms also tend to issue unusual types of financial claims, including bonds with a put option which "protects against adverse price fluctuations caused by ...changes in the perceived risk of the issuer" (Robert E. Chatfield and R. Charles Moyer, 1986 p. 27). Chatfield and Moyer (1986) report that 68 of the 90 "puttable" bonds in their sample were issued by "banking and other finance companies" (p. 27). For example, the General Electric Capital Corporation had eight puttable bonds outstanding in 1988, with a par value of $1.85 billion (Larry D. Wall, 1989). Puttable bonds are common among the long-term liabilities of other finance companies. Another unusual financing tool employed primarily by financial firms is "money-market preferred" stock. This security carries a floating dividend rate, which is reset periodically to maintain the stock's market value at par. (Usually, the dividend reset occurs every 49 days, which permits corporate investors to deduct 80 percent of dividend payments from their taxable income.) The most common reset mechanism has become a Dutch auction, in which the stock's current holders specify the lowest dividend rate at which they will continue holding the stock. In this fashion, current information about the banking firm promptly becomes impounded into the rate it pays to capital suppliers.

Why do highly levered intermediary firms find it optimal to issue such short-term liabilities?[2] This paper argues that general corporate financial considerations may cause uninsured institutions ("banks") to finance bank-type assets with short-term liabilities.[3] Market forces give banks a comparative advantage in financing investment projects whose information is expensive and difficult to evaluate. (In other words, real investment allocations are improved by banks' financing and monitoring activities.) Because bank assets do not have contractible, easily described risk properties, covenants governing firm risk changes are unusually ineffective for banking firms. Moreover, banks confront numerous opportunities for asset substitution in the course of their normal business, which involves routine refinancings and the granting of new loans. My argument is that banking firms confront unusually severe debt-related investment distortions and must therefore employ special devices to control the associated deadweight costs. I assume that bank creditors can estimate a bank's riskiness at any point in time, but they cannot write binding contacts on the basis of those assessments. This makes short-term debt an unusually valuable contracting device for banking firms: changes in bank risk will be promptly reflected in financing costs, leaving the bank free to acquire any investment which seems profitable.

This conclusion has important implications for bank regulatory reform. Banking firms' exposure to liquidity risks ("depositor runs") has traditionally been considered a

[2]Written discussions of the issue include Fisher Black (1975 p. 326), Fama (1980, 1985), George Benston et al. (1986), Gorton and George C. Pennacchi (1992), and many others. Charles W. Calomiris and Charles M. Kahn (1991) (CK) present a model in which bank asset-value reductions induce the manager to undertake socially wasteful activities. Outside investors can prevent these activities, but it is costly for them to determine whether asset values have fallen. CK demonstrate that demandable debt (with a sequential servicing constraint) induces the most efficient outsiders to monitor firm value, thereby maximizing the market value of banking firms. The present paper differs from CK in two regards. First, I formalize the costs of outside debt, in the form of distorted bank investment incentives. Second, I assume that outsiders form (noisy) estimates of firm value at no cost and impound those estimates in the terms they require on new bank debt.

[3]I am not concerned here with the usual type of interest-rate risk exposure: a firm which funds long-term assets with short-term debt will be subject to liquidity risk but need not be exposed to interest-rate risk if its assets carry (suitably) variable contract rates.

social "bad," which can be corrected by government regulation and deposit insurance. However, if short-funding bank assets provides important incentive benefits, regulations that limit a bank's ability to employ this funding device may reduce social welfare rather than increase it. Several recent proposals for regulatory reform would reduce the regulatory costs of the present deposit-insurance system by forcing banks to match-fund (Robert E. Litan, 1987; Lowell L. Bryan, 1988; James L. Pierce, 1991; Robert C. Merton and Zvi Bodie, 1993). These "narrow bank" proposals implicitly deny that the practice of funding long-term asset portfolios with short-term liabilities produces any social benefits.

This paper is organized as follows. Section I reviews the effects of debt on a firm's investment incentives, by presenting a model that summarizes earlier work initiated by Myers (1977). Section II discusses why the informationally intensive nature of bank assets creates a particularly difficult funding problem for uninsured banking firms and describes the alternative means by which they can limit their investment distortions. The paper's basic conclusion is that banks' asset characteristics will lead them to mismatch their asset and liability maturities, thereby enhancing the financial services available to the economy. Liquidity risk thus reflects a bank's optimal response to the problem of financing its asset portfolio. The last section discusses the implications for bank regulation.

I. Debt and Firm Investment Incentives

This section restates Myers (1977) in a form which permits ready application to banking firms' optimal-capital problem. Put-call parity implies that a levered firm has equity value

$$(1) \quad V_{eq} = V_a - \left[Fe^{-rt} - P(\sigma_a, F, V_a) \right]$$

where V_{eq} is the market value of the firm's equity, V_a is the market value of the firm's assets, F is the face value of outstanding (pure-discount) debt, t is the debt maturity date, r is the riskless interest rate, $P(\sigma_a, F, V_a)$ is the value of the shareholders' option to put the firm's assets to debtholders at a price F, at time t, and σ_a is the standard deviation of asset returns. Note that the bracketed term in (1) is the market value of outstanding debt: the present value of a riskless bond less the value of the shareholders' default option. It is convenient to rewrite (1) as

$$(2) \quad V_{eq} = V_a - D(\sigma_a, F, V_a)$$

where $D(\cdot,\cdot,\cdot)$ is the market value of outstanding debt. Merton (1973) derives the following properties for the market value of risky debt:

(i) The debt's value falls with an increase in asset risk ($D_1 \leq 0$).
(ii) The debt's value rises with an increase in its face value, though never more than that increase ($1 \geq D_2 \geq 0$).
(iii) The debt's value rises with an increase in the current value of firm assets, though never by more than that increase ($1 \geq D_3 \geq 0$).

Firms confront occasional new investment opportunities, each requiring an expenditure of one dollar. A representative new investment's market value is $1+\pi$, where $\pi \gtrless 0$. (Some of these investments are value-enhancing, and some are not.) New investments may also change the firm's asset risk. Equity-holders undertake only investments that benefit themselves, and this benefit depends on how the investment is financed. Financing options include the issuance of new debt, issuance of new equity, or the sale of assets in place.

Equation (2) must be modified to reflect the possible issuance of new debt. Any new debt will be fairly priced,[4] but changes in asset risk will generally influence the value

[4] I assume that outsiders fully understand the firm's *current* risk exposure and price its debt accordingly. However, for reasons discussed in what follows, outsiders cannot perfectly anticipate or control shareholders' *future* actions.

of debt already outstanding. If market participants are always fully informed about the firm's true risk and new debt has the same seniority as old debt, the market value of new debt (D_N) will be:

$$(3)\quad D_N = \frac{F_N}{F_O + F_N} D(\sigma_a, F_O + F_N, V_a)$$

where D_O (D_N) is the market value of old (new) debt and F_O (F_N) is the face value of old (new) debt. This condition implies a unique value for the additional promised payment (F_N) required to sell new debt worth D_N. Differentiating (3) at $F_N = 0$, one gets[5]

$$(4)\qquad \frac{\partial F_N}{\partial D_N} = \frac{F_O}{D_O}.$$

In words, F_N is negotiated to make D_N equal to the price new bondholders pay for their claim. There is no guarantee that the old debt will always trade at its initial price, because new investments can change V_a and σ_a and firm leverage can be changed through the issuance of new debt.

Incorporating (3) into (2), the postinvestment value of firm equity is

$$(5)\quad V_{eq} = V_a - D_N - D_O$$
$$= V_a - D_N - \left[\frac{F_O}{F_O + F_N}\right] D(\sigma_a, F_O + F_N, V_a)$$

where σ_a and V_a refer to the postinvestment asset portfolio. The effect of new investments on equity value can be computed by totally differentiating (5) with respect to the firm's decision variables (V_a, σ_a, and D_N). The value of this derivative (at $F_N = 0$) is

$$(6)\quad dV_{eq} = (1 - D_3)\, dV_a - D_1\, d\sigma_a - D_2 \frac{F_O}{D}\, dD_N.$$

From Merton (1973), one has $(1 - D_3) \geq 0$ and $D_1 \leq 0$. The term $D_2 F_O / D$ is nonnegative and (weakly) less than unity.[6]

A firm's evaluation of potential investment projects can be assessed via equation (6). Consider first an all-equity firm, which finances new investments entirely with owners' equity. Then (6) reduces to $dV_{eq} = dV_a$, and the firm's owners will accept a project if and only if $\pi > 0$.[7] This constitutes a first-best investment policy, which maximizes the firm's total market value. By contrast, a levered firm's shareholders consider the extent to which new investments transfer value between themselves and the old bondholders. A levered firm's willingness to implement an investment project thus depends on the project's value, risk, and the way it is financed. The resulting investment decisions reduce firm value to the extent that they deviate from the first-best policy. New investment projects can be financed in two alternative ways.

Case 1: New Securities Issued To Finance Additional Investment.—A levered firm has some assets in place and receives a single (nontransferable) opportunity to purchase an additional project for one dollar. The

[5]This calculation assumes that new debtholders anticipate that the firm will encounter no further investment opportunities. David S. Bizer and Peter M. DeMarzo (1992) evaluate debt pricing when the lender anticipates that the borrower will subsequently seek additional debt.

[6]To see this, recall that D_2 measures the market value of the firm's promise to pay an additional (marginal) dollar, starting from F_O. By contrast, (D/F_O) is the market value of the firm's average (i.e., inframarginal) promise to pay one dollar. As F_O rises, ceteris paribus the market value of the promise to pay an additional dollar falls, meaning that D_2 is always (weakly) less than (D/F_O). Another way to say the same thing is that the value of the shareholders' default (put) option is convex in the exercise price $(F_O + F_N)$, ceteris paribus.

[7]Kose John and Lemma W. Senbet (1990) show that limited liability can induce an all-equity firm to overinvest in highly risky assets. I ignore this possibility because my primary interest concerns highly levered banking firms.

project's market value is $1+\pi$, and it would change the portfolio's risk by $d\sigma_a$. To finance this new project, the firm would issue new debt worth d (where $0 \le d \le 1$), and shareholders would contribute $1-d$ of additional equity funds via a dividend reduction or the sale of new shares. From (6), one has $dD_N = D$, and current equity-holders must raise new equity of $1-d$. For the existing shareholders to accept a project, the increase in their equity value must exceed their additional contribution to the firm:

$$(7)\quad dV_{eq} = (1+\pi)(1-D_3) - D_1 d\sigma_a - \left[D_2 \frac{F_O}{D}\right] d \ge 1-d.$$

Solving (7) for the relation between π and $d\sigma_a$, which defines when an investment will be undertaken, one obtains

$$(8)\quad \pi \ge \frac{D_3 + d\left[D_2 \frac{F_O}{D} - 1\right]}{1-D_3} + \frac{D_1}{1-D_3} d\sigma_a.$$

Because $1-D_3 \ge 0$, the slope term in (8) is negative, while the intercept term has an ambiguous sign. Condition (8) implies that some projects with $\pi > 0$ are rejected if they also reduce the firm's portfolio risk. Similarly, some negative-NPV projects will be undertaken if they cause a sufficiently large increase in σ_a. Both of these effects reduce firm value.

Case 2: Existing Assets Sold To Purchase New Ones.—Shareholders could also finance new investments by selling some of the firm's assets in place. Thus, a bank could sell government bonds to finance a new loan or could securitize mortgages to finance the acquisition of junk bonds. With no new financing, (6) indicates that shareholders would be willing to substitute new assets whenever

$$dV_{eq} = (1-D_3)\, dV_a - D_1\, d\sigma_a \ge 0.$$

That is, when

$$(9)\quad dV_a > \frac{D_1}{1-D_3} d\sigma_a.$$

As in (8), the slope term in (9) is negative. Accordingly, a levered firm will sometimes pass up a valuable investment project that reduces asset portfolio risk. Conversely, the firm will accept even investments with negative expected returns if the project raises overall asset volatility.

A levered firm's distorted investment incentives will be anticipated by rational investors, who will therefore pay less for the firm's debt claims. Thus, shareholders fully bear the cost of the distorted investment incentives described by (8) and (9). These distortions can be mitigated by several standard corporate finance devices, including reduced leverage, restrictive debt covenants (Smith and Warner, 1979), and the issuance of secured bonds (Stulz and Johnson, 1985), callable bonds (Amir Barnea et al., 1980), or convertible bonds (Richard C. Green, 1984; James K. Seward, 1990). An alternative way to reduce investment distortions is to issue only short-term corporate debt. Because outstanding short-term debt can be repriced promptly after any possible change in the asset portfolio, shareholders' choice of marginal investments has little influence on the value of outstanding bonds.[8] Consequently, shareholders pay less attention to a new investment's effect on portfolio risk when deciding whether or not to undertake that investment. Exclusive reliance on short-term debt is not a dominant solution for most firms, because its incentive benefits are offset by a cost: if the market possesses a noisy estimate of true firm value, the firm may be forced to liquidate even though it is "truly" solvent (see Douglas W. Diamond,

[8]Mathematically, the slope terms on the right-hand side of (8) and (9) go to zero as debt maturity declines because the debt's market value becomes correspondingly less sensitive to changes in the underlying asset portfolio.

1991).[9] Equity-holders will compare the costs and benefits of the alternative debt-contracting arrangements to determine a value-maximizing combination of leverage, bond characteristics, and maturity.

II. Implications for Financing Uninsured Banking Firms

The basic investment distortions of debt described in the preceding section apply to all corporations. The key distinguishing feature of banking firms is that they specialize in financing nonmarketable, informationally intensive assets such as business and consumer loans. An individual bank may confront positive-NPV investment opportunities of three types. First, bankers may compete for loan or deposit *relationships*, which then provide a stream of quasi-rents from repeated customer dealings (see Edward J. Kane and Burton G. Malkiel, 1965; Stuart I. Greenbaum et al., 1989; Steven A. Sharpe, 1990). Second, a banker's decision about how to monitor borrowers' performance is also an investment decision, which largely determines the bank's value added in the financial market (Diamond, 1984). Third, bank markets may be imperfectly competitive, so that banks earn monopoly loan or deposit profits. This section argues that investments in these types of assets are much more difficult to control via the standard debt-contracting devices (restrictive covenants, leverage constraints, secured debt, etc.), leaving an unusually large role for the use of short-term debt—and hence liquidity risk and mismatched maturities—as a disciplining and corporate governance device for banking firms.

A. *Some Unusual Features of Bank Asset Portfolios*

Bank products and services can be characterized by several "stylized facts" which prominently influence the way banks finance themselves. First, the true risk of bank assets is not readily verifiable by outsiders. Because many bank loans entail high information costs, outsiders cannot verify true bank asset risks, except perhaps at a prohibitively high cost. Outside investors can readily form a noisy assessment of bank risk and asset values, which imply fair market prices for bank debt and equity.[10] However, such noisy assessments would not permit low-cost contracts to govern asset substitutions and the type of new investments a bank may undertake. In the sense of Oliver Hart and John Moore (1989), bank asset risks are *observable* but not *contractible*. Though this is somewhat true for any firm, the selective nature of bank assets means that noncontractibility will be an unusually large problem for banks.

A second important feature of bank operations is their unusual opportunity for rapid changes in asset composition. Banks lend to a variety of borrowers and for many purposes. The composition of their asset portfolios changes frequently, for a variety of good business reasons. Many loans are made with an expectation that they will be renewed, perhaps after substantial monitoring and renegotiation (Mitchell Berlin and Jan Loeys, 1988; Diamond, 1990). Similarly, borrowers exhibit seasonal and cyclical variations in their loan demands, and many customers wish to purchase prepayment or credit availability options. The net result is a dynamic asset portfolio in which important investment decisions are made daily via new loan evaluations and renewal deci-

[9] Myers (1977 pp. 156–57) also points out that shorter-term debt improves investment incentives, although he does not discuss its offsetting liquidity risks.

[10] It is important to note that outsiders do price and hold bank claims, despite the fact that true bank risk and asset values may be measured with error. This can occur, in part, because assessment errors are diversifiable. Thus, an investor holding a large number of securities could be confident that the overall portfolio is more accurately priced than any single security can be. In Flannery (1991), I discuss how risk-measurement errors influence the fair price of bank debt claims.

sions.[11] In comparing banks with nonfinancial firms, Diamond and Philip H. Dybvig (1986 p. 62 [footnote 10]), conclude that "...bank assets are similarly illiquid, yet their composition can be changed quickly relative to the physical capital of a nonfinancial corporation. Ability to change asset composition quickly explains *the larger moral hazard problem faced by banks*" (emphasis added).

Third, intermediary lenders must honor reasonable credit requests from their customers, especially if those customers have shared investments in relationship-specific assets. How can a banker obtain the funds to honor these credit requests? She must either sell existing assets to finance the new ones (which raises the possibility of an asset substitution detrimental to debtholders), or issue new debt or equity (which raises the possibility that a leverage change will influence the value of outstanding bonds). Because the bank has a legitimate reason to change its asset composition and leverage on short notice, it will be costly to accept debt covenants limiting its ability to do so.

In sum, bank shareholders encounter numerous opportunities for asset substitution, and new investment options arise continuously in the course of their daily business operations. Consequenly, banking firms will (potentially) experience larger investment distortions from leverage than nonfinancial firms do. Can these features of bank operations and assets account for their unusual reliance on short-term debt financing?

[11]An analogous situation exists in leveraged buyout (LBO) situations in which the new owners intend to sell off a number of the firm's existing assets. These LBO's have frequently been financed with "reset bonds" whose coupon rates are reset (by an impartial investment banker) at predetermined intervals in order to keep them trading near par (see Laurie S. Goodman and Alan A. Cohen, 1989). The choice of assets to sell and the timing of those sales is difficult to specify *ex ante*, and resetting the bond coupon protects investors from managers' *ex post* opportunistic behavior. The LBO situation thus resembles a bank's normal course of business: there are many opportunities to sell or replace assets, and good business reasons for the borrower to resist covenants that impair his flexibility.

B. *Alternative Financial Structures*

The distorting effects of debt in nonfinancial firms are limited via several contracting mechanisms, in addition to the possible use of short-term debt. In each case, however, banks are likely to find these alternative mechanisms more costly or less effective than they are for nonfinancial firms, leading the bankers to rely to a greater extent on maturity mismatching as the best means of financing their asset portfolios.

Restrictive covenants constitute one common device for controlling firm efforts to expropriate bondholders (Smith and Warner, 1979). Industrial firms operate with well-defined assets (e.g., plant and equipment) whose composition does not normally change in the course of their operations. By contrast, bank asset qualities are difficult for outsiders to verify, and normal bank operations provide particularly cheap and frequent opportunities for asset substitution. Covenants forbidding asset risk increases would be prohibitively expensive to enforce for banks.[12] An indication of the ease with which risk can be changed in a financial portfolio is provided by Smith and Warner's (1979 p. 125) finding that "Bond covenants frequently restrict the extent to which the firm can become a claimholder in another business enterprise." The authors explain that this restriction is frequently employed because shareholders wish "to limit their ability to engage in asset substitution after the bonds are issued" (Smith and Warner, 1979 p. 126). In short, it seems that restrictive covenants offer a less attractive solution to the distorting effects of debt for financial firms than for nonfinancial firms.

Banks could improve their investment incentives by operating with lower leverage. But the basic features of banking firms make high leverage valuable for several reasons which are not reflected in the model presented in Section I. First, Jensen (1986) and

[12]A covenant could cheaply prohibit certain classes of lending (e.g., commercial real estate or high-leverage transactions), but portfolio risk can be varied widely within any loan category.

Milton Harris and Artur Raviv (1990) argue that debt limits managerial discretion. This type of control seems particularly important for banks, given the high cash flows and numerous investment opportunities associated with their daily reinvestment decisions. Second, managers must be provided with the appropriate incentives to monitor loan customers. With a smaller amount of outstanding equity, managers can own a larger share of the firm, which more closely aligns their interests with those of equity-holders. Hence, managerial monitoring should be more effective when a bank is highly levered. Finally, several theoretical models indicate that debt is the best security to sell to outside investors when they cannot observe a firm's actual cash flows and asset payoffs. The basic idea in these models (e.g., Diamond, 1984; Stephen D. Williamson, 1984) is that outsider claimants will need to establish actual cash flows less frequently if their claims have a fixed (debt) payoff instead of equity.[13] Because banking assets are difficult to value, banks reduce outside investors' expected monitoring costs by operating with high leverage.

Secured debt provides another contractual mechanism for limiting the distortive effects of debt finance. The underinvestment problem arises in part because new depositors acquire a claim on the bank's *entire* portfolio. An alternative arrangement would provide new depositors with a secured claim on the marginal loans financed with their funds.[14] If a bank can profitably originate low-risk loans which the shareholders do not wish to finance in their own portfolio, loan sales provide a way for the bank to profit from its underwriting expertise. Although uninsured banks would likely partake in more secured debt and loan sales then they presently do, this contracting device generates a set of special problems for banking firms. First, the institutional ability to sell existing loans from the portfolio may *worsen* bank investment incentives by substantially broadening the scope of potential underinvestment and asset-substitution decisions. For this reason, Smith and Warner (1979 p. 123) report that more than one-third of their sample firms include debt clauses prohibiting "the firm's disposition of assets." Moreover, it is difficult to securitize (sell) a bank credit that includes a valuable "availability" option, such as revolving credit agreements or prepayment options. Market investors may find it relatively costly to honor such commitments, leaving them to be made by specialized firms that resemble today's commercial banks.[15] Thus, even if loan securitization were the optimal contract for bank term loans, it will work less well for revolving credits, letters of credit, and so forth, which generate almost 80 percent of total bank commercial lending. A third limitation on banks' use of loan sales (or secured debt) involves an important set of agency problems between the loan purchaser and the banker, who must diligently monitor the loan to maintain its value (George G. Pennacchi, 1988). In other words, a bank confronts incentive-related limits on its ability to sell secured liabilities when the underlying security is costly to evaluate and must be "maintained" by the seller. Finally, if a bank collateralized all of its debt, there would be separate markets in numerous classes of distinct securities, rather than a single, active market in undifferentiated bank CD's. That is, secured debt

[13]The model in Section I assumes that bondholders know the value and riskiness of a bank's assets in place but that contract covenants specifying permissible asset substitutions cannot be enforced at reasonable costs. Similarly, outside shareholders might "know" that inside shareholders have underreported asset values (and hence bank income), but establishing these asset values in court would be costly.

[14]Current institutional arrangements prohibit commercial banks from issuing secured deposits to private parties (see Marvin Goodfriend, 1991 p. 16 and footnote 37). Lawrence M. Benveniste and Allen N. Berger (1987) and Christopher M. James (1988) demonstrate that secured debt is equivalent to a loan sale with recourse.

[15]For example, when credit-card receivables are securitized, the seller absorbs all subsequent fluctuations in the value of the outstanding accounts. This suggests that specialist institutions can best provide credit-availability options.

(or loan sales) might reduce bank liabilities' liquidity, and hence their price.

C. *A Special Role for Mismatched Maturities?*

Given the costs uninsured banks would encounter in employing covenants, reduced leverage, or secured debt, there appears to be an unusually important role for short-term debt in banks' optimal capital structure. Short-term deposits maintain steady market value because their terms are frequently renegotiated to reflect the bank's current riskiness. Accordingly, shareholders can expropriate relatively little from old bondholders by changing the firm's asset risk or leverage. In the limit (with instantaneous debt), bank shareholders evaluate new investments according to first-best rules: they undertake all positive–NPV projects and reject those with negative NPV.

Incentive-compatible short-term debt could take two institutional forms. First, fixed-term debt ("CD's") could be issued with a very short maturity. Each issue would be repaid from the proceeds of a new short-term debt issue whose terms fully reflect the bank's current condition and the current risk-free rate of interest. If the bank's portfolio risk and leverage remain relatively constant, one would see few changes in the spread of CD rates over treasury. In this case, bank debt could efficiently take a second alternative form: puttable and callable debt. (Demand deposits, savings accounts, (some) federal funds, and "money market preferred" stock exemplify this arrangement.) Deposits would have no stated maturity, and their contract rate would float at a fixed spread over some riskless market rate. Depositors could put the debt to shareholders at par whenever they wished. Even though this type of debt might remain outstanding for a long time, the *ability* to withdraw funds would dissuade bank owners from increasing portfolio risk or leverage unless an investment opportunity were truly profitable. Conversely, the bank could call the debt whenever it thought the market's required risk premium had declined (e.g., due to lower portfolio risk or leverage). Debt whose terms continue until informed depositors wish to terminate or renegotiate would provide the same investment incentives as debt that *must be* rolled over each day.[16]

What are the costs of maintaining such a short-term (or puttable) liability structure? First, it may require higher administrative and operating costs than a similar-sized portfolio of longer-term liabilities. Second, it may raise the cost of hedging overall interest-rate risk exposure, by enforcing a large on-balance-sheet mismatch. Finally, and most important, this mismatch creates the potential for costly runs against the bank. Since bank assets are informationally intensive, outsiders can (reasonably) estimate asset values only with error. This means that a truly insolvent bank will sometimes be permitted to continue operating, and a truly solvent bank may sometimes be unable to issue new debt to replace what is maturing. Maturity mismatching raises the expected number of erroneous failures because the bank has no alternative to reissuing debt. By contrast, a maturity-matched bank can provide cash to repay maturing deposits by curtailing new lending and is therefore less likely to suffer an erroneous failure.

A value-maximizing bank will balance the costs and benefits of each contract mechanism. If the existing federal safety net were removed or curtailed, today's banking firms would tend to shrink and would almost surely reduce their leverage. One would also probably observe greater use of secured, recourse-debt claims on portfolios of bank term loans. However, financial firms very

[16] Wall (1989) recommends that banks be required to issue puttable subordinated debentures, whose owners would have strong incentives to monitor bank risk and solvency. His idea is consistent with this paper's view of bank financing problems. If the bank issued enough equity and subordinated debentures, the senior debt (deposits) would be riskless, and their maturity would not affect bank value. Whenever the bank could become risky enough to make the senior debt risky, however, investors would prefer that their deposits be short-term, and shareholders would have better investment incentives with short debt.

much like today's banks would persist, financing the most informationally intensive loans and efficiently providing credit-availability options. Maturity mismatching would retain an important role in these institutions' financial structures.

III. Summary and Policy Implications for Banking Reform

This paper has evaluated the optimal means of financing a portfolio of "bank-type" loans, whose informational properties make them unsuitable for deep secondary-market trading. Because bank asset portfolios are unusually fluid (compared to the assets of nonfinancial firms), standard debt-contracting mechanisms cannot control levered banks' investment distortions as sucessfully as they can control those of nonfinancial firms. Consequently, even uninsured banks would mismatch their asset–liability maturities more than nonfinancial firms do. The resulting liquidity-risk exposure reflects the economic properties of the banks' capital-market functions, rather than being an artifact of government intervention in the financial sector.

Two important regulatory implications follow from this conclusion. First, banking firms' illiquidity risk is not caused by the transaction nature of their deposits. Rather, bank value is enhanced by short-term debt, and transaction-account balances provide bank owners with the same incentives as would short-term, nonnegotiable debt. Consequently, policy concerns about financial firms' liquidity can (and must) be distinguished from concerns about payment-system stability. Second, illiquidity risk is more than a privately rational response to the existing federal safety net. Maturity mismatching facilitates the efficient provision of banking services; forcing banks to match-fund would reduce their effectiveness in providing valuable financial services. Moreover, if new, unregulated firms emerge to fund bank-type loans with short-term liabilities, the economy might be no more stable "because new firms that move in to fill the vacuum left by banks may inherit the problem of runs" (Diamond and Dybvig, 1986 p. 57).

These two regulatory implications come together in the widely discussed "narrow bank" proposals, which would separate illiquidity from the payment system by forcing payments institutions to match-fund their assets. (As such, this reform can be viewed as an extreme type of restrictive asset covenant.) This requirement would not eliminate illiquidity risk from the economy, but would only transfer that risk to institutions that are not directly involved in the payments system. "Nonbank" lenders would continue to assume illiquidity risk in order to provide financial services efficiently, and some of these firms would almost surely suffer inappropriate liquidations. It must be determined whether there are social costs to these liquidations (perhaps as in Ben Bernanke's [1983] analysis of underwriting services) and whether these social costs exceed the efficiency gains provided by maturity mismatching. Finally, on a more pragmatic level, regulators may confront irresistible, *ex post* political pressures to mitigate investors' losses from nonbank failures. Such bailouts would vitiate any benefits of the narrow bank reform by replacing the existing formal guarantees with a set of conjectural guarantees whose effects on private incentives would be similarly distortive.

In assessing the value of narrow bank reforms, the crucial policy question is not whether transaction accounts can be secured by liquid, marketable assets, but whether the illiquidity risks assumed by private nonbank firms constitute a cause for public-policy concern. This remains an issue for further research.

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