

Acharya, Viral V.; Mehran, Hamid; Thakor, Anjan

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Caught between Scylla and Charybdis? Regulating bank leverage when there is rent seeking and risk shifting

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Regulating Bank Leverage When There Is
Rent Seeking and Risk Shifting

Viral V. Acharya
Hamid Mehran
Anjan Thakor

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Caught between Scylla and Charybdis? Regulating Bank Leverage When There Is Rent Seeking and Risk Shifting

Viral V. Acharya, Hamid Mehran, and Anjan Thakor

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Abstract

Banks face two different kinds of moral hazard problems: asset substitution by shareholders (e.g., making risky, negative net present value loans) and managerial rent seeking (e.g., investing in inefficient “pet” projects and consuming perquisites that yield private benefits). The privately optimal level of bank leverage is neither too low nor too high: It balances efficiently the market discipline imposed by owners of risky debt on managerial rent seeking against the asset substitution induced at high levels of leverage. However, when correlated bank failures can impose significant social costs, governments may have no option but to bail out bank creditors. Anticipation of this generates an equilibrium featuring systemic risk in which all banks choose inefficiently high leverage to fund correlated assets and market discipline is compromised. A minimum equity capital requirement can rule out asset substitution but also compromise market discipline by making bank debt too safe. The optimal capital regulation requires that a part of bank capital be unavailable to creditors upon failure, and be available to shareholders only contingent on good performance.

Key words: market discipline, asset substitution, systemic risk, bailout, forbearance, moral hazard, capital requirements

Acharya: New York University, CEPR, and NBER (e-mail: vacharya@stern.nyu.edu). Mehran: Federal Reserve Bank of New York (e-mail: hamid.mehran@ny.frb.org). Thakor: ECGI and Washington University in St. Louis (e-mail: thakor@wustl.edu). For helpful comments, the authors thank Mitch Berlin, Doug Diamond, Mark Flannery, Itay Goldstein, Beverly Hirtle, Yaron Leitner, Meg McConnell, Loretta Mester, Marc Saldenberg, Kevin Stiroh, Joseph Tracy, participants at the Federal Reserve Bank of New York Conference on Contingent Capital (April 2010), and seminar participants at Gothenburg University (May 2010), the Bank for International Settlements, Basel (June 2010), and the Federal Reserve Bank of Philadelphia (August 2010). The views expressed in this paper are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

CAUGHT BETWEEN SCYLLA AND CHARYBDIS? REGULATING BANK LEVERAGE WHEN THERE IS RENT-SEEKING AND RISK SHIFTING

“In many things, the middle have the best / Be mine a middle station.”

—Phocylides

In the wake of the recent financial crisis, the prudential regulation of banks has come to the fore once again as an issue of critical importance. The central question being asked is: what is the socially-optimal amount of capital that banks should be required to hold on their balance sheets? Underlying this question is the recognition that the private cost of bank equity capital may exceed its social cost, so that the amount of capital a bank will typically choose as its private optimum may diverge from the social optimum. This creates the *raison d’etre* for capital regulation. The exact form that such capital regulation should take is however still under debate.¹ In this paper, we address this central question with a theoretical approach that recognizes the well-known frictions in banking and seeks to generate an implementable policy prescription for regulating bank capital. Broadly speaking, our proposal is aimed at *preserving* bank capital in a way that does not compromise bank discipline by uninsured creditors and yet keeps in check bank incentives to take excessive leverage and risks that are correlated with those of other banks.

We begin with the simple observation that banks face two kinds of moral hazard problems (both outlined in Jensen and Meckling, 1976): (i) managerial rent-seeking, which can take the form of the pursuit of private benefits by managers via investments in “pet projects” and the inefficient consumption of perquisites (see also discussion of the free cash flow problem in Jensen (1986)); and, (ii) asset-substitution or risk-shifting, which is the shareholder-creditor conflict that bank equity value may be enhanced by engaging in excessively risky, negative net present value projects. The problem of managerial inefficiency via various forms of rent-seeking and excessive perks is a well-recognized

¹ Numerous creative ideas have been put forth recently for how capital regulation – which has traditionally focused on tier-1 capital (common equity and some hybrid claims combining debt and equity features) – ought to be redone. It has been proposed, for example, to use “contingent capital” (Flannery, 2005), which infuses capital into banks via conversion of debt into equity when banks get close to insolvency individually and/or collectively, without overburdening them with excessively onerous capital regulation in good times.

problem, and it has been proposed that (uninsured) debt can provide the necessary market discipline to ameliorate this moral hazard (Calomiris and Kahn (1991) and Diamond and Rajan (2001)). The problem that bank managers can pursue excessive asset risks to transfer wealth from the creditors of the bank to its shareholders is also well recognized and is considered to be most effectively dealt with by ensuring that the bank has sufficient equity capital (e.g. Merton (1977)).² A study of bank failure by the Office of the Comptroller of the Currency (OCC (1988)) confirmed that these moral hazard problems seem simultaneously relevant in understanding bank failures.³ The emerging evidence from the financial crisis of 2007-09 appears also to lead to a similar conclusion.⁴

We combine these agency problems in a model and show that there is a tension between the need to have enough bank leverage for market discipline and the need for enough bank capital to attenuate asset-substitution incentives. If leverage is too low, creditors lack the incentive to monitor and discipline the rent-seeking behavior of bank managers; whereas if leverage is too high, managers are inclined to choose risky assets and bet the bank with the creditors' money. The optimal capital structure of the bank navigates tightly between this Scylla (rent-seeking) and Charybdis (asset-substitution). Formally, there are conditions under which there is a range of incentive-compatible leverage levels for the bank, and as long as bank leverage is in this range, all forms of moral hazard are well addressed. In this case, private contracting between the bank and its financiers leads to an optimal capital structure in which ex-ante bank

² While the problem can apply to corporations also as pointed out by Jensen and Meckling (1976), it is exacerbated in the case of financial firms by implicit and explicit guarantees such as deposit insurance (Bhattacharya and Thakor(1993)) and the ease with which financial risks can be altered (Myers and Rajan(1998)).

³ The OCC's study was based on an analysis of banks that failed, became problems and recovered, or remained healthy during the period 1979-1987. The study analyzed 171 failed banks to identify characteristics and conditions present when bank health deteriorated. The study concludes: "Management-driven weaknesses played a significant role in the decline of 90 percent of the failed and problem banks the OCC evaluated. Many of the difficulties the banks experienced resulted from inadequate loan policies, problem loan identification systems, and systems to ensure compliance with internal policies and banking law. In other cases, directors' or managements' overly aggressive behavior also resulted in imprudent lending practices and excessive loan growth that forced the banks to rely on volatile liabilities and to maintain inadequate liquid assets."

⁴ For instance, on April 12, 2010, Senator Carl Levin, D-Mich., chair of the U.S. Senate Permanent Subcommittee on Investigations, issued a statement prior to beginning a series of hearings on the Financial Crisis. In the statement, he addressed some of the lending practices of Washington Mutual, the largest thrift in the U.S. until it was seized by the government and sold to J.P. Morgan Chase in 2008 (see U.S. Senate Press Release, "Senate Subcommittee Launches Series of Hearings on Wall Street And The Financial Crisis," April 12, 2010). The statement confirms evidence both of poor lending but also fraudulent documentation and lack of disclosure.

liquidity is maximized by choosing the highest level of leverage that does not induce asset substitution, but that is sufficiently high to induce discipline by creditors resulting in the choice of the first-best project by the bank. There are also restrictions on the usage of capital that eliminate inefficient consumption of perquisites by the bank manager. However, there are also other conditions under which it is impossible to simultaneously choose leverage that is high enough to induce creditor discipline but low enough to deter asset substitution. In this case, the bank's (second-best) choice of capital structure must tolerate either the inefficiency of the manager choosing a rent-seeking project or the inefficiency of an excessively risky project, neither of which leads to the first-best outcome. This, however, is an inefficiency of private contracting that does not justify regulatory intervention.

This benchmark model can be viewed as capturing the problem of an individual bank that is one of arbitrarily many banks with uncorrelated project choices. However, asset substitution at banks is often correlated across banks. Reinhart and Rogoff (2008) show, for instance, that most financial crises are preceded by a secular credit boom and asset price inflation (often, but not restricted to, the real-estate sector) fueled by the financial sector. We argue that this phenomenon is attributable to the presence of government guarantees and the Lender of Last Resort (LOLR), which are triggered when banks (or financial firms, in general) fail together; in this circumstance, it is time-inconsistent for regulators to refuse to bail out banks. In particular, when bank failures are correlated, there can be sufficiently high social costs associated with a systemic collapse of financial intermediation and markets, as witnessed in 2008 following the failure of Bear Stearns, Fannie Mae, Freddie Mac, Lehman Brothers, American International Group (AIG), and some of their global counterparts.

In the absence of rules precluding forbearance or facilitating orderly low-cost resolution (which to an extent may be practically infeasible if not theoretically impossible), the regulator -- but more broadly the government -- has a strong incentive to exercise discretion and step in to rescue banks. We take such forbearance as given⁵ and show that the anticipation of such regulatory response generates

⁵ Acharya and Yorulmazer (2007), Acharya (2009), and Farhi and Tirole (2009) build formal models of the regulator's time-inconsistency when banks fail together and of the induced herding behavior in bank risk choices.

multiple Nash equilibria in bank leverage choices. In one equilibrium, there is inefficient systemic risk in that banks over-lever and take on excessive levels of correlated asset risk. As creditors anticipate to be bailed out, increasing bank leverage is not met with a higher cost, and somewhat perversely, banks' ability to raise leverage is enhanced when they take excessive risk: with riskier projects, creditors can be promised a higher upside but their downside risk is socialized. This enables banks to "loot" the taxpayer (in the sense of Akerlof and Romer, (1993)) by paying out dividends and eroding bank capital even as bank risk and leverage rise. Equally perversely, greater leverage leads to a loss of market discipline, which is the opposite of the beneficial role of leverage absent regulatory forbearance.

A regulatory capital requirement can potentially address the systemic risk in this inefficient equilibrium. Under the conditions that guarantee that the privately-optimal capital structure in the absence of regulatory forbearance can resolve different forms of moral hazard, a simple minimum equity capital requirement (or conversely, a limit on maximum leverage) does the job of restoring the first-best project choice and eliminating correlated risk taking and excessive leverage. But under the conditions that make it impossible for private contracting to simultaneously resolve different moral hazards, the formal analysis reveals that the minimum equity capital requirement is not efficient: the amount of equity capital that renders asset-substitution unattractive makes debt so safe that it provides little market discipline. Instead, the optimal capital requirement in general features a two-tiered structure that has three special features.

First, the bank should be required to keep a minimum amount of equity capital, which may be viewed as being similar to a leverage-ratio restriction or a tier-1 capital requirement. This capital can be invested in any assets permissible for the bank.

Second, the bank must also be required to keep an additional "special capital account". This capital belongs to the bank's shareholders when the bank is solvent, like any other form of capital. But in the event of non-systemic (or in other words, idiosyncratic) failure of a bank, this capital is unavailable to cover the claims of (uninsured) creditors. It belongs instead to the regulator who can employ it, for instance, to reduce its operational costs or make transfers to solvent institutions. The purpose of making

the special capital account unavailable to creditors is to make sure that creditors view the bank as having sufficiently low capital (and hence sufficiently high leverage) so that their monitoring incentives are not diluted and the managerial rent-seeking problem is adequately dealt with.

Third, the special capital must be invested by the bank in pre-designated securities like risk-free government bonds. This feature is intended to limit the free cash flow problem associated with the bank raising this additional capital and then having it diverted for excessive perquisites consumption by the manager. This investment restriction makes the special capital account look like a cash-asset reserve requirement, but it goes beyond that because (as explained above) it stipulates a particular form of ownership or contingent distribution rights. Also, unlike a reserve requirement, the special capital account can be “leveraged” to acquire assets equal to a multiple (the inverse of the capital requirement) of the amount of capital.⁶

In terms of practical implementation, when the regular tier-1 capital account of a bank is depleted due to negative earnings shocks or unexpected losses, capital can be *mechanically* transferred from the special capital account to the regular capital account and dividend payments halted/restricted until the special capital account regains its mandated level. Further, while we do not preclude the use of equity issues to raise capital for the special capital account, we recognize that banks may face costs in raising external capital needed to fill the special capital account, especially during an economic recession or in the midst of a financial crisis. These costs may include recessionary risk premium, adverse selection and direct transaction costs of raising capital. To minimize these costs, the special capital account can be built up gradually through capital preservation in the form of earnings retentions that are facilitated by dividend-payment restrictions.

Finally, we note that the specific capital regulation proposal based on our theory is close to a new model for capital regulation proposed by the U.S. Treasury Secretary Timothy Geithner in his first public

⁶ The special capital account is also different from a deposit insurance premium in that the premium is paid upfront and thus does not necessarily address the moral hazard issues ex post (that is, after the premium is paid). The special capital account is more like a “deductible” that the bank can keep provided it avoids distress.

speech since the enactment of the Dodd-Frank Act of 2010:⁷ *“Under the framework now being built, firms will be subject to two tiers of capital requirements. All firms will need to hold a substantial minimum level of capital. And they will be required to hold an added buffer of capital set above the minimum. If a firm suffers losses that force it to eat into that buffer, it will have to raise capital, reduce dividends, or suspend share repurchases. This will help make the system more stable over time, in part by forcing banks to move more quickly to strengthen their balance sheets as the risk of potential losses increases.”*

The rest of this paper is organized as follows. Section I discusses the related literature. Section II develops the single-bank model with managerial rent-seeking, perquisite consumption and risk-shifting problems. Section III contains the analysis of privately-optimal bank leverage in this benchmark model. Section IV examines the important extension when bank leverage is affected by correlated defaults, the associated externality costs and induced regulatory forbearance. Section V discusses optimal intervention in the form of capital preservation with implications for current regulatory proposals. Section VI discusses how one can derive endogenously within the model our maintained assumption that creditors are more effective than shareholders in monitoring and disciplining the manager’s rent-seeking behavior. Section VII concludes. All proofs are in the Appendix.

I. RELATED LITERATURE

Dewatripont and Tirole (1994) consider optimal regulation of bank capital structure in a model where too much debt can lead to excessive creditor intervention, whereas too much equity can lead to managerial shirking.⁸ Our model shares some of their seminal insights, but focuses on the leverage distortions and correlated risk-taking induced to game government guarantees and LOLR (see footnote 5 for the related literature on this point). Acharya and Thakor (2010) highlight that, while bank liquidity is enhanced by short-term debt, such debt can endanger financial stability by increasing the likelihood of contagious asset liquidations by creditors. These induce *ex post* regulatory bailouts of banks and

⁷ Secretary of Treasury Timothy F. Geithner Speech at New York University’s Stern School of Business “Rebuilding the American Financial System”, August 2, 2010: <http://www.ustreas.gov/press/releases/tg808.htm>.

⁸ Stulz (1990) also models rent-seeking moral hazard in a corporate finance setting in which financing policies are used to reduce the costs of investment distortions.

ultimately reduce market discipline *ex ante*. They refer to this as the “dark side” of leverage-based liquidity creation, but also highlight that addressing it through a lender-of-last-resort or regulatory forbearance runs the risk of eliminating all market discipline role of debt. While they model the micro-foundations of contagious creditor liquidations, we focus instead on the design of capital regulation that can ameliorate the distortions induced by correlated risk-taking and bailouts. The point that excessive systemic risk may ultimately be rooted in government safety nets and time-inconsistency of regulation has been recognized as early as by Kindeberger (1978) and also made recently by Kane (2010).

We also briefly discuss the relationship of our work to the many capital regulation proposals currently on the table. Flannery (2005) makes a case for Contingent Capital Certificates (CCC)⁹ as part of bank regulatory capital. He argues that when a bank’s stock price drops and the bank’s viability becomes questionable, then its contingent capital (debt) should be converted into equity. Hart and Zingales (2009) and Duffie (2010) and focus on forced equity issues by banks when their performance is deteriorating. Hart and Zingales (2009) argue that banks should be required to issue equity if the prices of their Credit Default Swaps indicate that they are very risky; refusal to issue equity would result in the bank’s shareholders losing control to regulators. Recognizing adverse selection problems associated with equity issues, Duffie (2010) advocates forced deep-discount rights offers. To provide incentives for banks to issue equity and overcome the problem of risk-shifting, Admati and Pfleiderer (2009) propose the idea of expanding the limited liability of equity, thereby transferring more risk to bank shareholders than at present, but question the usefulness of leverage in general as a device to provide discipline of banks. Kashyap, Rajan and Stein (KRS, 2008) discuss the concept of “capital insurance”, where a bank can purchase insurance against the risk of system-wide defaults. They argue that this approach would make banks more willing to issue equity, and would create a priced mechanism for regulatory capital infusion during a crisis. Acharya, Pedersen, Philippon and Richardson (2010a, 2010b) propose taxing the

⁹ For a detailed discussion of contingent capital, see also Boris, Jaffee and Tchisty (2010), Basel Committee on Bank Supervision (2009), Dudley (2009), McDonald (2010), Squam Lake (2009), Pennacchi (2010), Sundaresan and Wang (2010), and Vermaelen and Wolf (2010). Admati, DeMarzo, Hellwig and Pfleiderer (2010) provide a critique of contingent capital proposals.

systemic risk of financial institutions. This is a tax based on the expected loss of a financial firm, conditional on the occurrence of a systemic crisis. They advocate that a bank be required to purchase private capital insurance against its own losses contingent upon market or system-wide crisis.

Our approach has similarities and differences compared to these proposals. Our proposal of the special capital account expands the shareholders' capital at risk, and on this dimension is similar to Admati and Pfleiderer's (2009) idea of increasing bank shareholder liability. However, our proposal does not rely purely on equity to improve bank-level incentive issues as this can compromise market discipline role of debt. Our focus is also not on security issues and reliance on capital markets (unlike Flannery (2005), Hart and Zingales (2009), and Duffie (2010)). In addition, we do not rely on private insurance protection (unlike Kashyap, Rajan and Stein (2008) and Acharya, et al. (2010b)) which raises counterparty risk issues.¹⁰ In our theoretical framework, banks are compelled to internalize the consequences of all their decisions, including inadequate capital. Rather than investing in insurance, they build up the capital they need in good times. Our approach relies on the accumulation of retained earnings (and savings) in a capital account to be used in difficult times when capital is needed. This accumulation would eventually require dividend cuts, which were not commonly adopted by banks in the most recent crisis (Scharfstein and Stein (2008), and Acharya, Gujral, Kulkarni and Shin (2009)). Finally, the design of special capital account does not depend on triggers (based on market or book values) or supervisory intervention, and since its dynamics are mechanical, there is no news or stigma associated with drawing it down or building it up via retained earnings.

II. MODEL

We present in this section a simple model that shows how the extent of leverage in a bank's financial structure determines the discipline imposed by creditors on the bank manager's project choices, and thus explains the economic role played by bank capital in this process.

¹⁰ In the limit, for there to be no counterparty risk, the insurer must hold 100% of risk-free government securities against insurance sold. The insurer would pass on the costs of holding this liquidity to the insured, but then the insured might as well as keep the liquidity itself (unless it is better to designate liquidity management to an insurance firm to avoid free-cash-flow problem). We prefer that banks (the insured) keep liquidity with a regulator rather than a private insurance firm in the form of designated securities such as government bonds.

The Economy

Consider an economy in which all agents are risk-neutral and the risk-free rate of interest is zero. There are three dates: $t=0, 1$ and 2 . At $t=0$, the bank is owned by shareholders, and possesses internal liquidity of E due to current earnings and retentions of past earnings. The bank also has “legacy” leverage in that D_0 needs to be repaid to (uninsured) creditors at $t=0$. That is, the bank has already invested in the project that will yield terminal cash flow at $t=2$, and the investment was financed in the past with a mix of equity and debt, with that legacy debt now having to be refinanced at $t=0$.¹¹ If this legacy debt is not repaid, the creditors may liquidate the bank, in which case the payoff to the shareholders is zero. If the bank continues, it will have an opportunity to modify its project choice at $t=0$ and then again at $t=1$; think of this as possible portfolio adjustments that the bank can make. As noted by Myers and Rajan (1998), it is relatively easy for financial institutions to make asset portfolio adjustments. The project will generate two stochastic cash flows: one at $t=1$, denoted as Z_1 , and another one at $t=2$, denoted as Z_2 . The probability distributions of Z_1 and Z_2 depend on the project choice adjustments made by the bank (to be further clarified shortly). To repay the legacy creditors, the bank can use its (inside) equity E plus whatever it raises from a *new* debt issue at $t=0$ that will be repaid from Z_1 and Z_2 . We assume that bank shareholders are constrained and cannot provide additional equity (in Section VI, we introduce possible issuance of outside equity and compare its role to that of debt). Raising outside equity costs the bank a transaction cost of T per dollar of financing raised. To reduce notational clutter, we will set $T=0$ but indicate where a positive (even if small) T plays a role.

The bank is run by a manager who (1) executes the shareholders’ instruction about how much of new debt financing to raise (D) at $t=0$, and (2) decides based on his own incentives which project to choose at $t=0$ and how to adjust this choice at $t=1$. This delegated project choice not only reflects reality, but is also necessary for any meaningful incentive conflict between the manager and the shareholders.

¹¹ For example, consider Bear Stearns having to roll over its (short-term) paper every 30 days.

The Pricing of External Financial Claims on the Bank

We assume that the capital market is competitive and investors are risk-neutral so that the expected return that must be provided to investors purchasing bank's securities is zero.

Who Decides What and When

The shareholders of the bank hire the manager and also choose the amount of new debt financing to raise at $t = 0$ as well as the contract terms ($t = 1$ promised payment and $t = 2$ repayment) to raise this financing. If the legacy creditors are paid off at $t = 0$, the bank continues. We will assume that the bank always has sufficient capacity at $t = 0$ to do so. We will discuss later the implications of relaxing this assumption. The manager then chooses the adjustment to make in the bank's project ("project choice" henceforth) at $t = 0$, but can alter the project choice after the realization of $t = 1$ cash flow. Only the manager knows the type of the project he has chosen at $t = 0$. New creditors choose whether or not to monitor and intervene at $t = 1$ (to influence the project choice) and whether to liquidate the bank then. Terminal payoffs are realized at $t = 2$. The sequence of events in the model is summarized in Figure 1.

Figure 1 here

Project Attributes

There are three mutually exclusive projects the bank's manager can choose from after raising funds at $t = 0$: a good project (G), a project (A) that may be preferred by shareholders due to asset-substitution moral hazard, and a project (B) that maximizes the manager's private benefits and thus may be preferred by the manager. We describe next the cash flow structure of the three projects available to the bank manager for investment.

Cash Flows at $t = 1$:

For projects A and G ,

$$Z_1^A = Z_1^G = \begin{cases} x & \text{with probability (w.p.) } \theta \in (0,1) \\ y & \text{w.p. } 1 - \theta \end{cases}$$

For project B ,

$$Z_1^B = y \text{ w.p. } 1$$

Cash Flows at $t = 2$:

For proje:

$$Z_2^i = \begin{cases} H_i Z_1^i & \text{w.p. } p_i \in (0,1) \\ 0 & \text{w.p. } 1 - p_i \end{cases}$$

For now, assume that for every project the date-1 cash flow, Z_1^i , as well as the date 2 cash flow, Z_2^i , (conditional on the realized date-1 cash flow) are independently and identically distributed (i.i.d.) in the cross-section of banks.

It is assumed that (i) in terms of date-1 cash flow, the good (and asset substitution) project dominate the bad project: $x > y > 0$, (ii) in terms of the likelihood of success in date-2 cash flow, the good project dominates the asset substitution one, which in turn dominates the bad project: $p_G > p_A > p_B$, (iii) in terms of the level of date-2 cash flow, the asset substitution project dominates the good project, which in turn dominates the bad project: $H_A > H_G > H_B$, and (iv) in terms of expected cash flow at date 2, the good project dominates the asset substitution one and by a sufficient margin: $p_G H_G - p_A H_A > p_G - p_A$. The “sufficient margin” in (iv) will be shown later to imply that the highest level of debt that can be issued without giving bank shareholders incentives to choose the asset-substitution project over the good one does not imply risk-free debt. This assumption is easily met as left hand side captures difference in expected cash flows of projects, whereas the right hand side the difference in probabilities which is bounded above by one. We also assume that

$$p_G H_G > p_A H_A > D_0 \tag{1}$$

While the first inequality is already implied by (iv) above, the second inequality implies that the expected date-2 payoff from good and asset-substitution projects each exceeds the repayment to the legacy creditors necessary to prevent liquidation of the bank.

Note that (ii) and (iii) above imply that the good project and the asset-substitution project dominate the bad project in terms of date-2 expected cash flows. Given (i), this is true also in terms of date-1 expected cash flows, and hence, overall project value at date 0. However, the bad project is still relevant to bank decision-making since the bank manager derives a private benefit of $\beta > 0$ from investing in project B , where

$$\beta < [p_G H_G - p_B H_B] y. \quad (2)$$

Combined with (i), the restriction in (2) ensures that B is socially inefficient relative to G , regardless of the date-1 cash flow Z_1 .

First Best

Given the project cash flows above, it is clear that absent any agency problems, the first-best outcome is for the bank to choose the project G at $t = 0$ and also at $t = 1$. This maximizes the bank's *ex-ante* liquidity.

In what follows, our model development will focus on deriving the second-best solution and characterizing when it achieves the first-best.

Managerial Objective

The bank manager's objective is to maximize a weighted average of the value of wealth of the initial shareholders of the bank and his private benefits. The manager maximizes

$$E(U) = \sum_{t=0}^2 \alpha_1 E(v_t) + \sum_{t=0}^1 \alpha_2 \beta \cdot 1_{B,t} + \sum_{t=0}^1 b C_t, \quad (3)$$

where $E(U)$ is the manager's date-0 expected utility, and $E(v_t)$ is the expected value of the date- t *residual* cash flows available to the bank's initial shareholders, $t = 0, 1, 2$, where "residual" implies after any payments to creditors and net of any cash diverted by the manager for personal consumption. $1_{B,t}$ is an indicator function for the manager choosing project B at date t (in which case he derives a private benefit β), $t = 0, 1$. And, C_t is the cash flow diverted by the manager out of the bank's cash at date t for

perquisites consumption (before that period's project is chosen and end-of-period cash flows are realized), $t = 0, 1$. The idea is that the manager has the ability to divert for personal perquisites consumption any "free cash flow" left over after all of the bank's payment obligations to creditors and shareholders have been met. Because the bank's cash flow is observable, the manager cannot hide cash and consume it secretly if financiers demand that it be paid out to them (as he can, for example, in the costly-state-verification model of Townsend (1979)), but he can consume any excess cash as perquisites if financiers leave this money in the bank and it is not needed for rolling over debt or payments to financiers (as in Jensen (1986)). By contrast, the manager is assumed to be committed to paying out all cash to financiers at $t=2$, since financiers have no reason to leave anything in the bank and will thus contractually hardwire payment of all cash flow at that time. So the issue of perquisites consumption does not arise at $t=2$. However, it may arise at $t=0$ if the manager raises more financing at that date than needed for rolling over legacy debt, and it may arise at $t=1$ if there is cash left over from the project cash flow at $t=1$ after financiers have been paid off.

The utility weights $\alpha_1 > 0$, $\alpha_2 > 0$ are taken to be exogenous and we assume that $b \in (\alpha_1, 1)$. The assumption $b > \alpha_1$ means that the manager prefers personal consumption of any current cash through perquisites over his share of this cash if kept in the firm, and $b < 1$ means that such consumption out of the bank's cash is socially inefficient. Were this last assumption not true, the shareholders would want the manager to consume all of the current cash at each date and would reduce his compensation accordingly.

The Debt Contract between the Creditors and the Bank

The debt issued at $t = 0$ can be viewed as long-term debt due at $t = 2$, but with an interim promised payment at $t = 1$ that has associated with it a "covenant" that stipulates the consequences of missing the payment. The face value of the debt issued at $t = 0$ is F , the repayment obligation at $t = 2$. Alternately, the debt is short-term but has to be rolled over and offers the right to creditors to either roll over or deny continued funding (which also serves the same role as a covenant). We do not examine any conflicts

between old and new creditors, so they could be assumed to be the same or different. The ability of creditors to intervene at $t = 1$ is predicated on the violation of the date 1 repayment covenant or the bank's failure to roll over its debt. Moreover, absent any contractual obligation to make a debt repayment or a dividend payment, we assume that the manager can divert any cash flow at $t = 0$ or the date-1 cash flow, Z_1 , for personal consumption.

Monitoring Ability of Creditors

Consistent with the previous literature (e.g. Calomiris and Kahn (1991)), we assume that the new creditors who come on board at $t = 0$ have the technology to monitor the bank's manager and learn about his project choice. The cost of intervention and discovering the manager's project choice is $c > 0$ for the creditors. Our analysis will show that the equilibrium amount of leverage will be such that creditors have the incentive to threaten liquidation of the bank at $t = 1$ if the project choice made at $t = 0$ was not to their liking. For now, we will simply assume that shareholders do not possess either the monitoring technology or the incentives to employ it. We endogenize this difference between intervention ability and rights of creditors and shareholders in an extension in Section VI.

New Creditors' Liquidation Decision at $t = 1$

Creditors may choose to liquidate the bank at $t = 1$ in the event of a failure by the bank to make a promised repayment. The liquidation value of any project at $t = 1$ is $L \in (0, p_G H_G y)$.

Observability Assumptions

At $t = 0$ only the manager observes his project choice. At $t = 1$ if creditors expend c to monitor, then they can observe whether the manager chose the rent-seeking or private benefits project B or not, but they cannot distinguish between asset-substitution project A and the socially efficient project G ¹². Also, we assume that all cash flows are pledgeable and no one other than the manager observes the date-1 cash

¹² This is a standard assumption which ensures that there is asset-substitution moral hazard. If creditors could distinguish between projects A and G , there would be no shareholder-bondholder incentive conflict.

flow. Given full cash-flow pledgeability, the manager will be unable to renege on a promised repayment to either the creditors or the shareholders if Z_1 is large enough to accommodate it.

The Manager's Project Choice at $t=1$

We will assume that the manager prefers the private-benefit project B to the good project G if the interim cash flow is $Z_1 = y$. That is:

$$\alpha_1 y [p_G H_G - p_B H_B] < \alpha_2 \beta \quad (4)$$

Further, we assume that the manager prefers project G to project B if $Z_1 = x$, even when the entire debt rollover D_0 is financed with debt and none of the date-1 cash flow is used to pay creditors:

$$\alpha_1 \left[x p_G H_G - \frac{D_0 [p_G - p_B]}{p_G} - p_B H_B x \right] > \alpha_2 \beta \quad (5)$$

In the latter case, the repayment promised to the new creditors, conditional on the choice of project G being ensured, is D_0 / p_G , so that the value of the shareholders' equity with project G is $p_G [x H_G - \{D_0 / p_G\}]$, and given that promised repayment, the wealth of the shareholders with project B is $p_B [x H_B - \{D_0 / p_G\}]$, all in the absence of creditor intervention. This makes it clear that the manager will prefer project G to project B as long as (5) is satisfied (this is a sufficient condition as creditor intervention would only reduce the attractiveness of project B).

At the cost of repeating some of the key assumptions of the model, we summarize them before analyzing the model's outcomes:

Summary of Assumptions:

Assumption 1 (Financing Choices and Number of Banks): Each bank has legacy debt D_0 that it rolls over by using inside equity and outside debt at $t = 0$. There is an arbitrarily large number of banks in the economy.

Assumption 2 (Project Choices): The manager makes a project choice at $t=0$ from among three mutually exclusive projects, A , G and B , where G is the efficient (highest expected value) or the good project, A is a “risk-shifting” project, and B yields the manager private benefits. The manager’s project choice at $t = 0$ is unobservable and the manager can switch projects at $t=1$ unless explicitly prohibited from doing so due to intervention by creditors. Across all banks choosing the same project, the terminal project cash flows are *i.i.d.* random variables.

Assumption 3 (Preferences and Pricing): There is universal risk neutrality and there is competitive pricing in the capital market with a zero riskless interest rate.

Assumption 4 (Managerial Objective): The manager maximizes a weighted average of the wealth of the initial shareholders, his private benefits and the utility from consuming perquisites out of cash in the bank. Consumption of perquisites and investing in projects for private benefits are both (socially) inefficient.

Assumption 5 (Project Preferences): All financiers prefer project G unless the firm’s leverage is so high that shareholders prefer project A to project G . The manager prefers project B to all others when the cash flow at $t = 1$ is y and project G to project B when the cash flow at $t = 1$ is x . Because managerial perquisites consumption is inefficient, financiers (both shareholders and creditors) prefer to take out of the bank any excess cash at either $t = 0$ or $t = 2$ via interest or dividend payments.

Assumption 6 (Creditor Monitoring): Creditors can monitor the manager’s project choice at $t = 1$ and can force a project choice from project B to another project, but they cannot distinguish between projects A and G . We assume that:

- (i) The face value of debt F is large enough to ensure that creditors will wish to intervene and continue with project G rather than liquidate the bank at $t = 1$; and,

- (ii) When creditors intervene and force the manager to abandon project B , the manager will prefer project G to project A .

In the analysis that follows, we will present the restrictions on exogenous parameters that ensure satisfaction of *Assumptions 5* and *6* above. At this stage, there is no regulator in the model and our focus is on optimal private contracting. A rationale for regulatory intervention will be provided in Section IV.

III. ANALYSIS OF THE BENCHMARK MODEL

In this section, we present the base model in which under some conditions private contracting between the bank and its financiers results in leverage that resolves different agency problems fully and the first-best is attained. We will also indicate the conditions under which it is impossible for private contracting to simultaneously resolve both rent-seeking and asset-substitution moral hazards, as a result of which first-best is not attained. In both cases, however, the bank's privately-optimal capital structure is the socially-optimal capital structure given the agency problems, that is, it is *constrained efficient* or *second best*. We solve this model by backward induction, with the main result summarized in Proposition 2.

Events at $t = 1$:

At this stage, the main issues of interest are whether the manager will switch his project choice after observing Z_1 and what the creditors will decide to do. Suppose that at $t = 0$, the manager financed the bank with an amount D in debt. Let y be the interim payment on debt at $t = 1$ and F be the promised repayment on debt at $t = 2$ that enables D in debt financing to be raised at $t = 0$.

Then it follows from the structure of the model that to raise maximum debt financing:

Lemma 1: *The debt contract will be designed so that the new creditors are promised a repayment at $t = 1$ of $\hat{y} = x$.*

The intuition for this result is rooted in the moral hazard associated with inefficient perquisites consumption by the manager. If the repayment to creditors at $t=1$ is less than x , the manager will consume any excess cash left over as perquisites, and this is an inefficiency the banks wishes to avoid. Now,

conditional on the creditors *not* being fully paid $\hat{y} = x$ at $t = 1$, they have three choices: liquidate the bank without investigation, investigate the project choice and continue with the chosen project, or investigate the project choice and force a change.

For costly investigation and continuation to be preferred by the creditors, it must be true that: (i) the creditors know that the manager chose project B at $t = 0$, and (ii) the payoff from unconditional liquidation is lower than that from investigation and continuation. (Recall that creditors cannot distinguish between project G and project A .)

Case 1: $Z_1 = x$. In this case, creditors need to be assured that the manager will not voluntarily wish to switch from project G to project A or project B when $Z_1 = x$ is realized (*Assumption 5*). These incentive compatibility (IC) conditions are:

$$\alpha_1 p_G \{xH_G - F\} \geq \alpha_1 p_A \{xH_A - F\} \quad (6)$$

$$\alpha_1 p_G \{xH_G - F\} \geq \alpha_1 p_B \{xH_B - F\} + \alpha_2 \beta \quad (7)$$

In equilibrium, at least one of these two IC constraints must be binding, or else a Pareto superior outcome can be found. Note that (7) is guaranteed by (5), so the constraint (7) is not binding under our maintained assumptions. Thus, (6) must be binding. Solving (6) as an equality yields:

$$F^* = \frac{x[p_G H_G - p_A H_A]}{p_G - p_A} \quad (8)$$

such that if $F \leq F^*$, the bank manager prefers the efficient project G to the asset-substitution project A .

Case 2: $Z_1 = y$. To keep the problem interesting, we need to identify conditions such that the manager *will* switch to project B in the absence of creditor intervention, so creditors will find it sub-game perfect to intervene (*Assumption 5*). The condition for this is:

$$\alpha_1 p_G \{yH_G - F\} < \alpha_1 p_B \{yH_B - F\} + \alpha_2 \beta \quad (9)$$

Note that this is guaranteed by (4). Thus, this constraint is also not binding.

Next, we verify that the creditors will indeed wish to intervene and continue with project G rather than liquidate it unconditionally (*Assumption 6, part (i)*). That is:

$$p_G F - c \geq \min\{L, F\}. \quad (10)$$

Note that if F is sufficiently low so that $F < L$, it is impossible to satisfy (10) and creditors will always unconditionally liquidate. So, assume F is large enough to satisfy $F > L$, i.e.:

$$F > F^0 \equiv L \quad (11)$$

Then we see that to satisfy (10) requires:

$$F \geq \hat{F} \equiv [c + L] p_G^{-1}. \quad (12)$$

It is easy to see that $\hat{F} > F^0$, so we just need to make sure that (12) is satisfied.

Moreover, we need to ensure that when creditors intervene and force the manager to drop the private benefits project B , he will indeed prefer the efficient project G to the riskier project A (*Assumption 6, part (ii)*). That is,

$$\alpha_1 p_G \{yH_G - F\} \geq \alpha_1 p_A \{yH_A - F\} \quad (13)$$

This requires:

$$F \leq \tilde{F} \equiv \frac{y[p_G H_G - p_A H_A]}{[p_G - p_A]} \quad (14)$$

It is easy to verify that the feasibility condition for debt is met, that is, $\tilde{F} < yH_G$.

From (8) and (14), we have $\tilde{F} < F^*$, where F^* is defined in (8). Hence, our analysis implies that the binding constraints are that $F \leq \tilde{F}$ and $F \leq \hat{F}$. That is, we need:

$$F \in [\hat{F}, \tilde{F}] \quad (15)$$

where \hat{F} is defined in (12) and \tilde{F} is defined in (14). We also need to verify that $\tilde{F} > \hat{F}$. The restriction that guarantees this is:

$$y > \frac{[c+L][p_G - p_A]}{p_G[p_G H_G - p_A H_A]} \quad (16)$$

It will be assumed for now that (16) holds. We will later examine the consequences of assuming (16) does not hold. Thus, so far we have:

Proposition 1: *Suppose (16) holds. Then, to ensure that in equilibrium at $t=1$ the manager will choose the good project G in preference to both the private benefit project B and the asset-substitution project A requires that the $t=2$ repayment obligation on the new debt financing raised at $t=0$ be at least as great as \hat{F} but no greater than \tilde{F} .*

The intuition is as follows. The bank needs enough debt financing to ensure that creditors have sufficient “skin in the game” so that they will monitor the bank manager and prevent him from choosing project B at $t=1$, rather than unconditionally liquidating the bank when there is a date-1 repayment violation. This leads to $F \geq \hat{F}$ as the condition necessary to prevent managerial rent-seeking. However, there also needs to be sufficient equity capital to ensure that, conditional upon the manager not opting for B , he will not gamble at expense of bank creditors, that is, he will prefer A over G . This implies that the amount of debt financing can be no greater than \tilde{F} .

Events at $t=0$:

Now we examine the bank’s decisions at $t=0$ about how much debt to issue, the pricing of this debt, and the choice of project. Note that if creditors assume G will be chosen, the amount of debt financing the bank can raise at $t=0$ with a debt face value of F is:

$$D = \theta x + [1 - \theta]y + p_G F. \quad (17)$$

We now note a straightforward result.

Lemma 2: *The shareholders of the bank will choose the amount of debt to raise at $t=0$ as well as the associated contract terms so as to maximize the total value of the bank by ensuring an equilibrium choice of project G at $t=0$ (i.e. debt repayment obligation $F \in [\hat{F}, \tilde{F}]$ assuming (16) holds) and ensuring that*

any cash raised at $t=0$ in excess of that needed to roll over legacy debt is paid out to the shareholders at $t=0$.

Put simply, since debt is fairly priced and the entire surplus from operating the bank goes to the shareholders, they wish to have the value of the bank maximized at $t = 0$. This involves both the initial choice of the value-maximizing project G at $t = 0$ and making sure that no surplus cash is left over in the bank for the manager to consume as perquisites.

Given the costs of raising external debt financing (recall the transaction cost of external financing T even if arbitrarily small), it follows that the debt financing needed to be issued by shareholders to pay off legacy debt D_0 at $t = 0$ is *after* they have used retained earnings or internal liquidity to roll over existing debt:

$$D = D_0 - E. \quad (18)$$

We can now solve for how much debt the bank can issue at $t = 0$. Since the value of the bank is maximized with the choice of project G , the face value of the debt F must be in the interval $[\hat{F}, \tilde{F}]$.

Using (17), let \hat{D} and \tilde{D} be the corresponding amounts of debt raised at $t = 0$.

Clearly, $D \in [\hat{D}, \tilde{D}]$ is necessary to maximize bank value. We thus have the following result:

Proposition 2: *In equilibrium, the amount of privately optimal debt financing raised by a bank, D^* , is as follows. If the D that satisfies (18):*

- (i) *is less than \hat{D} , the bank borrows $D^* = \hat{D}$ and pays out $\hat{D} - [D_0 - E]$ as a dividend to the shareholders at $t = 0$.*
- (ii) *exceeds \hat{D} , but is less than \tilde{D} , then the bank is indifferent across different values of borrowing as long as $D \in [\hat{D}, \tilde{D}]$*
- (iii) *exceeds \tilde{D} , then the bank cannot meet its debt repayment using debt financing.*

The intuition is clear. The bank cannot raise more debt than that at which asset-substitution moral hazard is triggered. Interestingly, if the bank needs to raise less debt than the level at which the creditors have no incentive to monitor the manager to prevent choice of the private-benefit project—the bank has so much equity E that the amount of new debt raised falls below that needed for incentive compatibility for private-benefit moral hazard—then some of the equity is paid out as a dividend to ensure that at least \hat{D} in new debt is raised. *Figure 2* depicts pictorially this situation of being “caught between Scylla and Charybdis,” i.e., the tension between needing sufficient debt to impose market discipline on the manager and not raising so much debt that shareholders will be induced to invest in projects with socially-inefficient risks.

Figure 2 here

Thus far we have assumed that (16) holds, so that $\hat{D} < \tilde{D}$. This yields the convenient result that a leverage level can be found that exceeds the minimum level \hat{D} needed to ensure creditor discipline and is less than the maximum level \tilde{D} above which asset-substitution moral hazard is triggered. But what if the inequality in (16) is reversed, say because project A becomes more attractive due to a shock that increases H_A ? Now $\hat{D} > \tilde{D}$, so the amount of leverage, D , that the bank needs to ensure the choice of project G should be such that $D < \hat{D}$ and $D < \tilde{D}$. It is clear that it is impossible for both these inequalities to hold simultaneously. The bank will have to choose to either forgo creditor monitoring or the ability to pre-commit to eschew project A , so some inefficiency with private contracting will have to be tolerated.

Which of the two inefficiencies will be tolerated in the second-best outcome will depend on specific parameter values. If the bank chooses $D > \hat{D} > \tilde{D}$, then it will end up with the asset-substitution project A as creditor monitoring will preclude the choice of project B . On the other hand, if the bank chooses $D > \tilde{D} > \hat{D}$, then creditor monitoring is lost and leverage loses all its benefit. The bank will end up with the rent-seeking project B . However, this inefficiency in the second-best solution does not justify

regulatory intervention. The conditions under which such intervention may be justified appear in the next section.

IV. CORRELATED DEFAULTS AND EXTERNALITIES

In the analysis up to this point, if (16) holds, then private contracting results in optimal leverage decisions that eliminate the problems created by managerial rent seeking and risk shifting so that there is no need for any sort of prudential regulation. If (16) does not hold, then private contracting does not lead to the first-best outcome, as discussed above. This, however, is nothing more than another example of a second-best that deviates from the first-best because not all frictions can be costlessly resolved, and again is not a prescription for regulatory intervention. But even if (16) holds, in practice an efficient outcome is unlikely to arise due to limits on contracting and monitoring. We have, however, set up the benchmark model this way precisely to examine why even when such limits are not present, government forbearance can distort the private outcomes toward socially inefficient ones and how to address this distortion.

We now extend the model by assuming that there are two failure states for the asset-substitution project A , an idiosyncratic state, say θ_i and a systematic state, say θ_s . The probabilities of these states are q_i and q_s , respectively, such that $q_i + q_s = 1 - p_A$. Moreover, for simplicity, assume that:

$$1 - p_A - q_s = 1 - p_G \quad (19)$$

Or in other words, $q_i = 1 - p_G$. This condition implies that the probability of idiosyncratic state θ_i is the same as the failure probability of the good project G . We assume that in state θ_i bank failures are uncorrelated in the cross-section of banks and that there are arbitrarily many banks, so that by the law of large numbers, in state θ_i , the probability that *all* banks will fail is zero in the limit. In state θ_s however, these failures are perfectly correlated. Assumptions weaker than (19) would suffice for our purposes, but (19) effectively implies that the entire asset-substitution component of project A relative to project G is due to its systematic risk. Also note that having arbitrarily many banks and *i.i.d.* project cash flows for project G also guarantees that the probability that all banks will fail together if they choose project G is

asymptotically zero. We will consider both the case in which (16) holds and the case in which (16) does not hold.

Rationale for Lender of Last Resort and “Looting” in the End Game

Assume further that there is a sufficiently large social cost, Ψ , associated with *all* banks failing together and their creditors making losses but a negligibly small cost associated with failure of any individual bank¹³. Then, in the case where all banks fail together, and only in this case, the regulator such as a LOLR or resolution authority will find it *ex post* efficient to intervene and bail out some or all banks. We assume that in a bail out, the forbearing regulator only needs to pay off creditors fully (but can wipe out shareholders), and thereby avoids the cost Ψ . Indeed, if shareholders are bailed out too, then the distortions induced by regulatory forbearance would in fact be even stronger. Consider for sake of argument that *all* banks are bailed out if they fail together, e.g. due to “fairness” reasons. Consider first the case of Proposition 2 where the banks are able to roll over their existing debt by issuing new debt, i.e. (16) holds and the D that satisfies (18) does not exceed \tilde{D} .

Before proceeding further, let us specify the *regulatory objective function*. The regulator’s objective is to avoid the social cost Ψ (since it is assumed to be sufficiently large), and among different regulatory policies that achieve this, choose the one that maximizes the value of the bank. The regulator faces the same informational constraints that the bank’s shareholders face and must respect the contractual features of debt and equity claims that the bank uses (e.g. limited liability of equity, priority of debt over equity, etc.), but has the ability to restrict the bank’s capital structure and its asset choices (only the observable or verifiable ones as we will explain below), and potentially create ex ante “super-priority” claims on the bank’s assets.¹⁴

¹³ Recall that we have assumed there is an arbitrarily large number of banks, so even a negligible social cost associated with an individual bank failing can add up to a significant social cost associated with all banks failing. But more likely, there are externalities from failures of many banks at the same time.

¹⁴ An analogy can be made with respect to the objective function of the Federal Deposit Insurance Corporation (FDIC) in the United States. Its explicit mandate is to provide deposit insurance, charge the insured depositories an ex ante risk-based premium for the insurance, upon their failure pay off insured claims and resolve (merge or liquidate) the failed institutions directing proceeds to its reserve fund, and intervene in an early fashion (“prompt

We can then show that there are two Nash equilibria in the game in which banks are choosing their optimal capital structures. In one Nash equilibrium, all banks continue to raise an amount of debt that is moderate and allows them to pay off their legacy debt but does not trigger the asset-substitution incentives: $D \in [\hat{D}, \tilde{D}]$. This is a Nash equilibrium because, conditional on all other banks choosing such a D , an individual bank knows that if it deviates and fails, it will not be bailed out since all the other banks will not fail at the same time. Our previous analysis of Proposition 2 stands in this case, and it is privately optimal for each bank to raise $D \in [\hat{D}, \tilde{D}]$.

But there is also another Nash equilibrium in which all banks asset-substitute in favor of project A (even though condition (18) can be met by a level of debt that would not trigger asset-substitution) and raise the maximum possible leverage by setting $F = F_A \equiv yH_A$ ¹⁵. We call this the “looting” equilibrium as in Akerlof and Romer (1993). To see this, note that if the bank sets the face value of the debt it raises at $t = 0$ at $F = H_A$ and creditors believe the bank will choose project A and be bailed out by the central bank or the government in state θ_s , then the amount of debt the bank can raise at $t = 0$ is:

$$\begin{aligned} D_A &= \{p_A + [1 - p_A - q_i]\} yH_A + \theta x + [1 - \theta] y \\ &= [1 - q_i] yH_A + \theta x + [1 - \theta] y \\ &= yp_G H_A + \theta x + [1 - \theta] y. \end{aligned} \tag{20}$$

This expression recognizes that if creditors believe they will be bailed out contingent upon project failure, then they view their claim on the cash flow of project A as being of the same risk as their claim on the cash flow of project G. We shall assume that $D_0 - D_A < H_A$. We will allow for the possibility that $D_A > D_0 - E$, that is, asset-substitution in presence of forbearance reduces the risk of debt enough and

corrective action”) with a variety of restrictions on activities in case capitalization of depositories falls below a pre-determined level.

¹⁵ One could argue that the bank could even set F_A at $xH_A > yH_A$. Examining this case makes the algebra more cumbersome but does not yield additional insights.

raises debt capacity to the point that banks can not only meet their legacy claims but in fact have surplus funds at date 0. We define:

$$S \equiv \{D_A - (D_O - E)\}^+ \quad (21)$$

as the “surplus debt” that is raised by the bank at $t=0$. This surplus debt may simply be paid out to bank shareholders as a dividend.

Finally, if the D that satisfies (18) exceeds \tilde{D} , then it can be shown that the looting equilibrium is in fact the unique equilibrium, and if D exceeds D_A , then banks cannot meet their legacy debt payments even by choosing the asset-substitution project, A.

Proposition 3 (Looting Equilibrium): *Suppose (16) holds and let the minimum debt financing necessary to meet legacy debt payments D satisfy (18). In the extended model with multiple banks and correlated risk in the asset-substitution project A, assuming that the regulator bails out all banks (creditors take no haircuts but shareholders are wiped out) when they fail together and none otherwise, the following is true:*

- (i) *If D is less than \tilde{D} , then two Nash equilibria arise. In one (socially efficient) Nash equilibrium, all banks raise debt $D^* \in [D, \tilde{D}]$ and also choose the good project G. In another (socially inefficient) Nash equilibrium, all banks set the face value of debt at the highest possible level H_A , raise D_A of debt (given by equation (20)), and choose the asset-substitution project A. In the inefficient Nash equilibrium, the bank’s shareholders require that the surplus debt, S , raised by the bank (given by equation (21)) be paid out as a dividend at $t = 0$.*
- (ii) *If D is greater than \tilde{D} but less than D_A , then the inefficient Nash equilibrium stated in (i) arises as a unique equilibrium.*
- (iii) *If D exceeds D_A , then banks cannot meet their legacy debt repayment.*

In essence, the regulator's intervention in state θ_s "socializes" the bank's incremental risk in choosing project A relative to project G . This induces all banks to choose project A and also employ excessive leverage. Somewhat perversely, the riskier is the asset-substitution project (the higher the H_A holding constant its expected payoff $(1 - p_A)H_A$), the worse is the regulator's problem: banks can pledge the highest possible cash flow to creditors but their downside in the systematic risk state is socialized, so that their ability to raise debt does not erode due to asset-substitution but rather perversely it expands. Hence, maximizing bank shareholder value amounts to behavior where the bank shareholders "loot" the regulator or effectively the taxpayer as much as possible by passing on risks to them and paying out to themselves the proceeds from the extra debt issued. The reason why the shareholders insist on the surplus debt issuance S being paid out as a dividend is that they rationally anticipate that otherwise the manager will inefficiently consume it as perquisites. And all market discipline on project choice or dividend payouts – that would otherwise be provided by uninsured creditors – is lost because creditors are now effectively insured and the relevant agency problem is the conflict of interest between bank shareholders and taxpayers. That is, the only economic creditor of the banking sector is the taxpayer and the formal creditors are in fact equivalent to shareholders too (from a cash flow perspective, even though not from a control rights perspective).

Equally importantly, note from Proposition 2 that in the absence of regulatory intervention, when banks are "insolvent," (i.e. the D that satisfies (18) is greater than \tilde{D}), they cannot meet their debt rollover needs at $t = 0$. However, with correlated asset-substitution, the prospect of regulatory intervention enables banks to roll over existing debt even in this insolvency region. Somewhat perversely, bank debt now only serves the purpose of curbing managerial rent-seeking, but loses all of its bite as far as addressing the risk-shifting problem is concerned. In fact, bank creditors are the channel through which regulatory forbearance is transferred in value terms to bank shareholders.¹⁶

¹⁶ Acharya, Gujral, Kulkarni and Shin (2009) show that while distressed depositories (such as Wachovia and Washington Mutual) subject to prompt corrective action of the FDIC cut their dividends a few quarters prior to their

Incentive Compatible Regulatory Policy

From the standpoint of the regulator, the inefficient equilibrium with high leverage is problematic because banks are encouraged to engage in excessive and correlated risk taking, an incentive engendered by the very presence of the regulator (LOLR, resolution authority, government guarantees, etc.). How can the regulator design an ex-ante policy in order to eliminate the high-leverage Nash equilibrium and prevent the choice of the socially inefficient project? One way to do it would be to make a pre-commitment not to bail out banks ex post. However, such a pre-commitment is not time-consistent when the cost of a full-blown banking crisis is sufficiently high (see related literature that has underscored this point in footnote 6) and hence a more attractive approach is to impose *ex ante* regulation, for example, in the form of a capital requirement.

In fact if (16) holds, then all that the regulator needs to do is to impose a capital requirement that limits the bank's debt to be no more than \tilde{D} . Given that leverage, it becomes privately optimal for the bank to select project G since the incentive compatibility constraint for the choice of G holds. So a simple capital requirement takes care of the problem of looting. Indeed, this reaffirms the well-known role of capital requirements in ameliorating asset-substitution moral hazard. However, this is predicated on the assumption that (16) holds. Now suppose (16) does not hold, so that $\hat{F} > \tilde{F}$ or $\hat{D} > \tilde{D}$. In this setting, the regulatory capital requirement such that $D \leq \tilde{D}$ continues to dissuade banks from investing in project A and hence eliminates the social cost Ψ . In that sense, this is a feasible regulatory policy. However, with this policy, creditors will have no incentive to monitor the bank and prevent the choice of the private-benefit project, B . This is the very problem with capital requirements that the papers that focus on the market discipline of risky (or uninsured demandable) debt have articulated (e.g. Calomiris and Kahn (1991), and Diamond and Rajan (2001)). Thus, the feasible capital requirement outlined above can be improved upon if there exists a policy that eliminates the social cost Ψ and also ensures selection of

failure, similarly distressed investment banks (Lehman Brothers and Merrill Lynch) in fact raised their dividends in quarters prior to failure even as their leverage was rising. The latter evidence is consistent with anticipation of regulatory forbearance, especially following the rescue of Bear Stearns, providing incentives to these banks to not cut back on leverage and dividends even as their insolvency became imminent.

project G , because such a policy would also maximize the value of the bank (recall that the regulator wishes to eliminate the social cost of correlated failures and also choose the value-maximizing policy from among policies that eliminate this cost).

It turns out that there exists a regulatory policy that attains such an outcome. Under this regulatory policy, the regulator demands that, in addition to the equity input E that permitted the bank to roll over its legacy debt D_0 when combined with new borrowing D , the bank must raise an additional ΔE in equity. This ΔE is kept in a “special capital account” and is invested in liquid and riskless security like Treasuries. In this sense, this special capital account is in the spirit of cash-asset reserve requirements. However, this special capital account goes well beyond reserve requirements in that a key feature of this account is that while it is available to enhance the bank’s shareholders’ payoff in the solvency state, it is not available to the bank’s creditors in the event of insolvency¹⁷. Assuming that the contractual constraint that shareholders cannot be paid anything if creditors are not paid in full is binding, the only resolution is for the capital account to go to the regulator in the event of insolvency. The regulator, can in turn, utilize the proceeds from the account to fund its administrative costs and potentially even transfer them to surviving banks and firms in the economy (e.g., by lowering taxes).

The intuition for why this works is as follows. When (16) is violated, $\hat{F} > \tilde{F}$. So it is essential to choose $F = \hat{F}$ to ensure that creditors will monitor the bank. Because this violates the IC constraint for the bank to prefer project G to A , we need to find a way to increase \tilde{F} without affecting \hat{F} such that $\tilde{F} > \hat{F}$ and (16) is honored once again. Providing an additional equity input – via the special capital account – helps raise \tilde{F} since this amount is invested in the riskless asset. This increases the bank shareholders’ payoff in the solvency state and thus reduces asset-substitution moral hazard. But it does not affect \hat{F} since it is not available to bank creditors in the event of insolvency; note that creditors do

¹⁷ Another key difference is that a reserve requirement simply locks up a fraction of deposits in the form of cash or deposits at the Federal Reserve. By contrast, the special capital account can be “leveraged” by the bank to add assets, just like regular Tier-1 capital. That is, with a 4% special capital requirement, every dollar of capital in this account allows the bank to put another \$25 of assets on its books.

not care about this account in the state of solvency since they get paid in full with or without this account. Consequently, the special capital account is “invisible” to the creditors. Once \tilde{F} is raised sufficiently, it will eventually exceed \hat{F} and (16) will hold. All of our previous results will therefore apply.

One may object to this on the grounds that additional equity to be injected beyond the amount E incurs potentially significant costs that we have not taken into account. In essence, we had assumed in our analysis of Section III that raising equity from the shareholders by issuing shares was expensive due to a transaction cost but the cost was small ($T > 0$). What if the cost is large? First, such a transaction cost may only be a private cost of issuing outside bank equity rather than a social cost. Second, even if this transaction cost were a social cost, in general bank shareholders may find it privately suboptimal to incur it since its benefit is primarily to avoid the systemic externality associated with *en masse* bank failures. That is, banks incurring some cost for the provision of additional equity may be desirable from a societal standpoint, even though it might limit the optimal size of the capital account. Finally, in practice, the regulator could simply impose a dividend restriction on the bank and ask for the special capital account to be filled via earnings retentions. This would avoid any dissipative private (or social) costs of issuing new equity. Banks will not impose such dividend restrictions on their own due to the externality argument outlined above. The anticipation of dividend restrictions will provide the same incentives to bank shareholders as would issuing equity (backed by the dividends) and placing the proceeds in a special capital account.

Thus, we have established the following result.

Proposition 4: *In the extended model with multiple banks and correlated risk in the asset-substitution project, assuming that ex post the regulator bails out all banks (creditors take no haircuts but shareholders are wiped out) when they fail together and none otherwise, we obtain the following ex-ante ($t = 0$) optimal regulatory policy:*

(iv) Suppose (16) holds. Let D be such that it satisfies (18). Then, if $D \in [\hat{D}, \tilde{D}]$, the regulator

permits the bank to raise D in leverage and no restrictions are imposed. If $D < \hat{D}$, then the regulator permits the bank to raise \hat{D} in new debt and pay out $\hat{D} - D$ as a dividend to the shareholders, both of which are privately optimal for the bank. If $D > \tilde{D}$, the bank is limited to raising only \tilde{D} in leverage and providing equity for the remaining amount needed to roll over its legacy debt. If the bank finds it prohibitively expensive to raise new equity, it will be asked to seek forbearance from the creditors until the necessary equity can be raised through earnings retentions to permit legacy debt to be completely paid off. If such forbearance is unavailable, the bank is shut down and liquidated.

(v) Suppose (16) does not hold. Then the bank is allowed to raise \hat{D} in leverage and is asked to provide additional equity (special capital account) that is invested in a risk-free and liquid security, whose payoff is available to the bank's shareholders in the solvency state, such that \tilde{F} increases enough to exceed \hat{F} and ensure (16) holds. The special capital account is not available to the bank's creditors in the insolvency state, but instead belongs to the regulator. If the bank finds it prohibitively expensive to raise new equity, then this additional equity must be provided through earnings retentions made possible by dividend restrictions on the bank.

In both cases, when banks are bailed out, the claims of the creditors are fully covered by the regulator, and when the banks fail but are not bailed out, the special capital account belongs to the regulator rather than the creditors.

An interesting aspect of Proposition 4 is that the special capital account can be arbitrarily large (of course, it is constrained by future cash flows available for backing the issued equity). Once $\tilde{F} > \hat{F}$, it does not matter by how much \tilde{F} exceeds \hat{F} . The bigger is ΔE , the higher will be \tilde{F} , but increases in

\tilde{F} leave \hat{F} unaffected. This reduces the calibration burden on the regulator, who can choose the minimum level of the special capital account to be quite large without worrying about diluting the monitoring incentives of creditors.

An important point to note is what it means for the creditors to *not* have access to the special capital account in the event of bankruptcy when we admit the possibility of a bailout by the regulator. If all banks fail together (i.e., project *A* is chosen and the correlated-failure state is realized), then the regulator bails them all out and creditors take *no* haircut, so the treatment of the special capital account is a moot point in this state. That is, it does effectively pay off the creditors. However, in the state in which a particular bank fails when some other banks succeed – the bank’s failure is an idiosyncratic event rather than part of a system-wide collapse – the special capital account of the failing bank goes to the regulator rather than the failing bank’s creditors. Thus, it is the combination of what happens in the project-success state (the special capital account is an additional equity input that belongs to the bank’s shareholders) and the *non-systemic* failure state (the special capital account belongs to the regulator rather than the creditors) that allows asset-substitution moral hazard to be deterred without diluting creditors’ monitoring incentives.

One may argue that we have given the regulator contracting possibilities that were unavailable to the bank and its financiers in the absence of the regulator. In particular, the special capital account represents a kind of security that differs from debt and equity. It clarifies that what is required for efficiency is a way to break the “budget balancing constraint” that the sum of the claims of the shareholders and bondholders must be equal to the total claims on the bank.¹⁸ The reason why such a security was not permitted in the absence of the regulator is that we limited the set of securities available for contracting to debt and equity and did not address the problem of optimal security design in this

¹⁸ This is reminiscent of the resolution provided by relaxing the budget balancing constraint in the model of moral hazard in teams in Holmstrom (1982).

setting. We do not know of any existing securities that correspond exactly to the special capital account.¹⁹ But if such a security were to be designed, then the inefficiency associated with the second best (when (16) does not hold) may be eliminated, and the regulator may be able to rely on this security instead of the special capital account. However, such a security would be at best allocationally equivalent to the special account in that the best outcome it could achieve would be to induce choice of the G project, which is what our scheme with the special capital account achieves.

Another issue is why we need a regulator rather than a private insurer that provides banks with ex post liquidity in exchange for a premium. The main reason is that in the systemic failure state, it is important to avoid the failure costs and to ensure that there be *no* counterparty risk, i.e., no doubt about the ability of the insurer to bail out all banks. But it appears difficult (almost impossible) to achieve this with a private insurer. In essence, there would need to be a regulator of the private insurer with similar problems as we have analyzed for banks (see Kashyap, Rajan and Stein, 2008, and Acharya, Pedersen, Philippon and Richardson, 2010a, for a discussion of such private insurance).

Finally, we have assumed that when banks fail *en masse*, the regulator bails out *all* the banks. If the regulator were to bail out only a subset of banks, say the largest banks in the spirit of Too Big to Fail (TBTF), then the looting problem that we have discussed will be confined to that subset.

V. REGULATORY IMPLICATIONS

Our analysis has several important implications for regulatory capital requirements. We discuss below how the prescription in Proposition 4 for a two-tiered capital requirement (when (16) does not hold) can be implemented.

¹⁹ In this sense, the special capital account is also different from deposit insurance premium. One, creditors are not guaranteed in all instances of bank failures, but only in case of systemic failures. Due to this feature, contribution to the special capital account are not available to pay off creditors in idiosyncratic bank failures, unlike a reserve fund which is in principle always available to pay off insured creditors, regardless of whether bank failures are idiosyncratic or systemic. And second, contributions to the special capital account belong to bank shareholders in success states, and hence, are not like once-and-for-all payments to the deposit insurance fund. That is, the contributions are more like a “deductible” than a “premium”.

Suppose to start with, that banks are at their “regular” tier-1 capital requirement. The regulator could ask each bank to retain all earnings and not pay any dividends, putting the retained earnings in a “special” capital account, and requiring a separate minimum capital ratio for this kind of capital.²⁰ Once the special capital ratio exceeds that particular level, the bank can resume dividend payments. The retained earnings can only be invested in pre-determined securities like Treasuries. When a negative shock hits (either bank-specific or systemic) and bank’s tier-1 capital diminishes, banks would be allowed to sell these securities and transfer cash from the special capital account to the regular capital account (and required to do so if banks do not replenish tier-1 capital through other means such as equity issuances), but the dividends would be frozen until special capital is built back up to its required ratio. Note that this can deal not only with the challenge of refurbishing capital but also potential liquidity shortages (selling Treasuries provides liquidity). Also we stress that the special capital account is unavailable to creditors should they choose to liquidate the bank (unless, of course, the regulator intervenes with a bailout of all banks). The special capital account belongs to the regulator in the states in which the bank is insolvent, as we have stressed.

This proposal to preserve capital (or in other words, prevent capital erosion), depicted pictorially in Figure 3, has numerous advantages.

Figure 3 here

First, the two-tiered capital proposal deals simultaneously with the three forms of moral hazard most commonly studied in banking—managerial rent seeking, managerial perquisites consumption, and shareholders’ risk shifting—in an integrated way, and incorporates both the market discipline of debt as well as the risk-attenuation benefit of equity. For instance, the proposal gets around the criticism that more capital makes bank managers lazy or reduces creditor-induced market discipline. This is because special capital account is *additional* capital that would not exist otherwise (money would have been paid out as dividends otherwise)—so that it does *not* replace the debt that provides discipline or liquidity

²⁰ The idea of building up equity via dividend retentions invokes dynamic contracting issues. A dynamic agency model of financial contracting appears in DeMarzo and Fishman (2007) and is beyond the scope of our paper.

creation. At the cost of reiterating, the key point is that the bank *cannot* invest the retentions as it wishes—the investments have to be in Treasuries.

Second, the proposal has the advantage of *not* requiring shareholders to infuse additional capital (cash) at a time when confidence in bank management is the lowest and liquidity is very low. Dividends can be retained at a time when the bank is doing well (or at least, before it becomes distressed).

Third, the high capital during normal times also leads to a reduction of asset-substitution during these times. The fact that the shareholders/manager will lose this special capital in a bad state means the positive aspect of high capital is maintained. Thus, we avoid the gradual (pre-crisis) erosion of bank capital during the good times through dividend and cash distributions to shareholders and bank managers that converts an adverse asset-side shock into a crisis. More importantly, our scheme eliminates bank behavior that makes adverse asset shocks endogenously more likely due to correlated choices of poor investments with other banks.

Fourth, the idea of building and preserving capital through retained earnings and dividend restrictions is relatively simple. In particular, since capital is transferred from the special capital account into the regular capital account on a continuous and mechanical basis, the issue of designing “crisis triggers” does *not* arise, and the bank’s regular capital never gets depleted (absent unexpected shocks), nor is the bank required to raise additional equity by issuing stock.

Fifth, there is *no* adverse information communicated by dividend restrictions kicking in when capital has to be moved from the special capital account into the regular capital account because a negative shock to earnings has depleted the regular capital account. This is because the “automatic” nature of the transfer involves *no* management/regulatory discretion and hence communicates no information beyond that already contained in the negative earnings shock.

Finally, the scheme is relatively easy to harmonize internationally, or at least as easy as the current tier-1 capital requirements.

In the Fall of 2009, regulators raised the issue of the need for banks to have additional liquid capital in difficult financial times and recommended the idea of “Capital Conservation.” Later in the

year, the Bank for International Settlements (BIS) proposed “a framework to promote the conservation of capital and the build-up of adequate buffers above the minimum that can be drawn down in periods of distress.” The BIS Task Force also questioned the prudence of the continuation of dividend payments by banks in 2008-2009, a period when they were supposed to cut their dividends (see Acharya, Gujral, Kulkarni and Shin, 2009). The model we presented generates a formal rationale for the BIS “Capital Conservation” proposal and furthermore provides a channel through which dividend restrictions can be judiciously deployed to gradually replenish bank capital levels to dissolve risk-shifting incentives without diminishing the market discipline provided by subordinated debt. As we stated, dividend cuts become mechanical when banks access their special capital account as they cannot resume dividend payouts unless the special capital account is replenished to meet the regulatory requirement (e.g. some percentage of risk-weighted assets).²¹

VI. DISCUSSION – CONTROL RIGHTS OF CREDITORS AND SHAREHOLDERS

Throughout our analysis, we assumed that creditors can discipline the manager, but shareholders cannot. We show here that even if shareholders had the monitoring technology that the creditors possess, the shareholders—due to their differential cash flow rights—may lack the *incentive* to discipline the manager’s choice of the private-benefits project B .

To show this, let us simplify the base model of Sections II and III by assuming that the manager makes his project choice at $t=0$, but that he cannot change this choice at $t=1$, i.e. once a project is chosen at $t=0$, the bank must continue with it until $t=2$, and that the only way to avoid continuation of the project chosen earlier beyond the interim date is to liquidate the bank for a value of L at $t=1$. In this case, to show that conditional on project B being discovered at $t=1$ (which also means that the date-1 cash flow was y), creditors will have the incentive to liquidate the bank at $t=1$ but shareholders will not, we need the following conditions to hold simultaneously:

²¹ The calibration issue of what this percentage should be is outside the scope of our model. By all accounts, however, current Basel risk weights might need to be revisited to take account of systematic or correlated risk of assets rather than their total or absolute risk (see Acharya (2009), and Acharya, Pedersen, Philippon and Richardson (2010a, b)).

- (1) *Even if the shareholders discover at $t=1$ that B was chosen at $t=0$, they will wish to continue.* Since $F > L$, we know that the shareholders' payoff is 0 if they liquidate, whereas it is $p_B[yH_B - F]$ if they continue, so the condition that is needed is:

$$F < yH_b \tag{22}$$

- (2) *Creditors will wish to liquidate if they discover B .* This requires:

$$F < L / p_B \tag{23}$$

- (3) *Creditors will continue and not liquidate the bank if they discover the good project G .* This has already been accounted for in the IC constraints in our earlier analysis.

If we additionally assume that, $\min\{yH_B, L / P_B\} > \tilde{F}$ then neither (22) nor (23) will be binding constraints, and $F < \tilde{F}$ will also satisfy (22) and (23). Thus, we see that a simple perturbation of our model leads to a robust set of situations in which the shareholders do not have the incentives to discipline the manager, but creditors do.

The intuition is as follows. At $t=1$, if shareholders discover the project B , they know that forcing liquidation will produce a cash flow that is not even sufficient to fully pay off the creditors. Indeed, the amount of debt financing is deliberately chosen to be so high that this will be the case; otherwise, the creditors liquidate unconditionally and excessively. This means that liquidation at $t = 1$ leaves the shareholders with nothing, whereas continuation with B gives them a positive expected payoff as long as B eventually produces a cash flow in the successful state that is more than enough to cover the creditors' claims. On the other hand, creditors will wish to liquidate project B because the liquidation value of the bank, L , exceeds the expected payoff for the creditors if they continue with project B . Hence, it is the very nature of the cash flows of debt and equity contracts (concavity and convexity in project risk, respectively) that ensures that the creditors can *credibly* threaten to liquidate the bank at $t = 1$ if project B

was chosen at $t = 0$, but shareholders may not be able to do so. Given this credible threat, the manager will avoid the private-benefits project B at $t = 0$ if the amount of bank debt is in the appropriate range.

VII. CONCLUSION

In this paper we developed a theoretical model to examine the tension between the role of leverage in disciplining bank managers—preventing the diversion of free cash flows in perks and dissuading rent-seeking or the choice of inefficient “pet” projects—and the role of bank capital in diminishing the risk-shifting incentives of bank shareholders. These agency problems are at least as old as Jensen and Meckling (1976). Recently however, Hellwig (2010) has pointed out the “asymmetry” in Jensen and Meckling’s (1976) modeling of the agency costs of debt (asset-substitution) and equity (managerial pursuit of private benefits), explaining that in typical models, managerial pursuit of private benefits does not alter project risk, whereas asset-substitution does. This asymmetry prevents an analysis of optimal capital structure along a common continuum of project choices. Our paper addresses exactly this issue in the context of bank leverage choices. We show that the tension between private-benefits and asset-substitution moral hazard problems requires that bank leverage not be too low or too high. The key to the result that leverage not be too low is the need to create strong enough incentives for creditors to monitor and deter managerial rent-seeking. And the key to the result that leverage not be too high is based on the need to have enough capital in the bank to eliminate the shareholders’ propensity to take excessive risk at the creditors’ expense. This leads to a theory of optimal bank capital structure with private contracting.²²

When we introduce correlated default risk, bank failures generate negative social externalities. This creates a potential case for ex post regulatory intervention to bail out banks when they fail *en masse*. Such discretionary regulatory forbearance itself becomes a source of systemic risk. It leads to multiple Nash equilibria for ex-ante bank capital structures, one of which involves banks over-levering themselves, selecting socially inefficient, excessively risky and cross-sectionally correlated projects, and paying out

²² Recently, Mehran and Thakor (2010) provide a theory of bank capital structure that focuses on the monitoring benefits of bank capital and predicts that higher capital is correlated with higher bank values in the cross-section. They also provide empirical evidence in support. By contrast, our theory focuses on the role of bank capital in dealing with three forms of moral hazard and optimal capital-replenishment regulatory policy.

surplus debt as dividends or other forms of cash distributions. Under some conditions, a simple minimum equity (e.g., tier-1) capital requirement solves the problem and eliminates the bad Nash equilibrium. But in general, this can make bank debt too safe and erode market discipline. This necessitates an additional tier to capital requirement – a special capital account – that involves dividend payment restrictions as well as restrictions on how the special capital may be invested in good times and distributed in case of bank failures. The capital regulation we propose prevents erosion of capital in good times, avoids costly issuance of capital in bad times, and also stays away from adverse-signaling issues by virtue of being mechanical in its transfers from the special account to a depleted tier-1 account.

FIGURE 1: SEQUENCE OF EVENTS

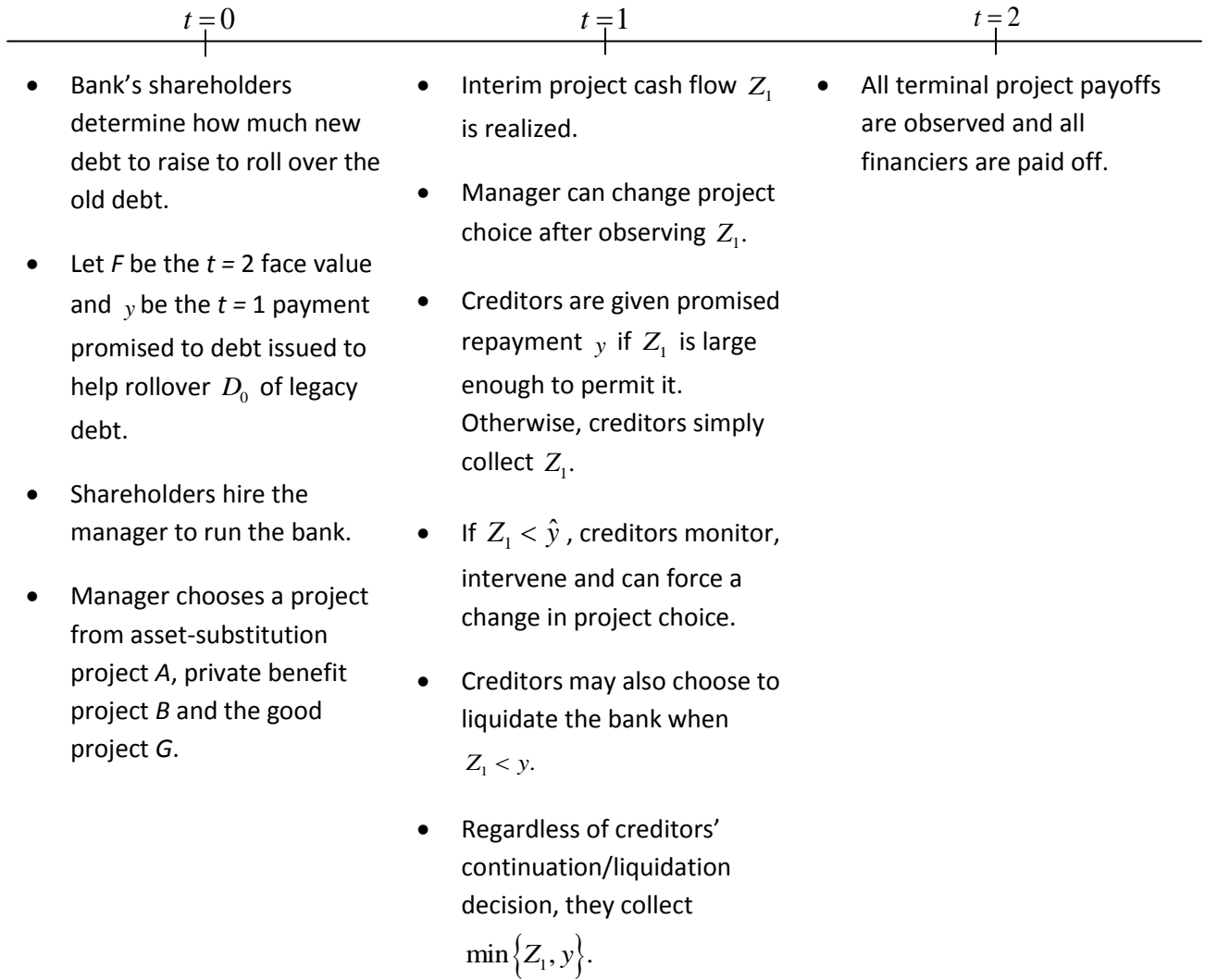


FIGURE 2: OPTIMAL AMOUNT OF DEBT RAISED BY THE BANK AT $t = 0$

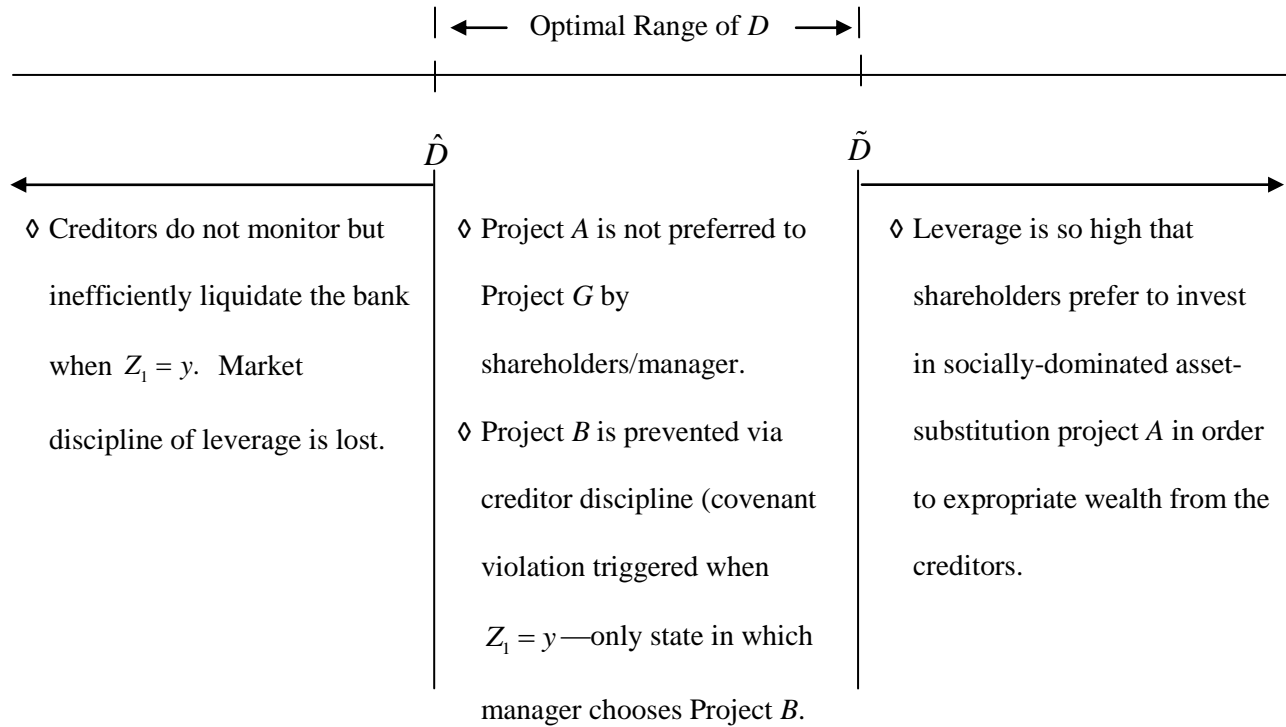
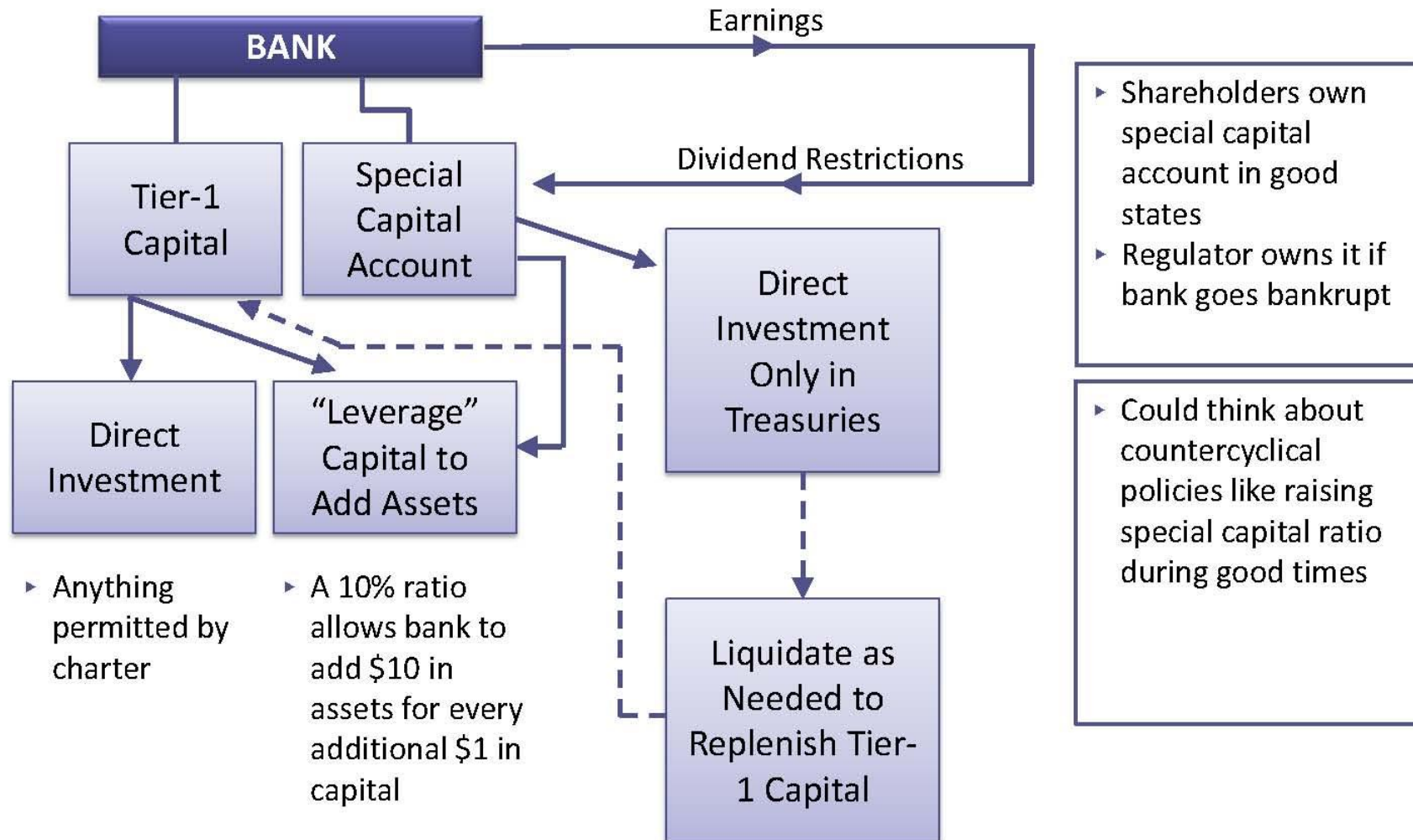


FIGURE 3: IMPLEMENTATION DETAILS



APPENDIX

Proof of Lemma 1: Since intervention is costly and the creditors can only intervene when a promised repayment is missed, they will design intervention in such a way that they can intervene if B is chosen and avoid intervention otherwise. By setting the date-1 promised repayment at $\hat{y} > y$, they avoid intervention when $Z_1 > \hat{y}$ which is exactly when the project choice is either A or G and cannot possibly be B .¹ Moreover, given (4) and (5), creditors realize that the manager prefers B when $Z_1 = y < \hat{y}$. Thus, in this case it pays for the creditors to intervene as long as c is not too large. Thus, setting the intervention trigger at $\hat{y} \in (y, x]$ is optimal for the creditors, regardless of whether they actually choose to intervene at $t=1$ (which depends on c). The reason why $\hat{y} = x$ is that for any amount of debt financing raised at $t=0$, the face value (promised repayment) on the debt can be reduced, making it possible to satisfy the incentive compatibility condition for the manager to choose G over A . ■

Proof of Proposition 1: Follows from the analysis. ■

Proof of Lemma 2: Since the external providers of capital simply earn their reservation return of zero, all remaining surplus goes to the initial owners of the bank, and this surplus is maximized by choosing project G . This means that the amount of debt issued at $t=0$ by the bank will have face value $F \in [\hat{F}, \tilde{F}]$. Note that Proposition 1 guarantees that, with this debt level, the bank will choose G at $t=1$ in every state. Given this, it is incentive compatible for the manager to choose project G at $t=0$. Finally, the reason for ensuring that no surplus cash is left in the bank is to prevent inefficient perquisites consumption. ■

Proof of Proposition 2: The proof is straightforward. To satisfy the IC constraints that $D \geq \hat{D}$, the bank needs to increase its borrowing until $D = \hat{D}$. Since $\hat{D} - [D_0 - E]$ is left over after rolling over its legacy debt, this excess should be paid out as a dividend to prevent its diversion for inefficient managerial

¹ The creditors know that they cannot distinguish between A and G , so intervening in the $Z_1 > y$ state is inefficient and to be avoided

perquisites consumption. If, on the other hand, $D_0 - E > \tilde{D}$ then satisfying the IC constraint requires that $D = \tilde{D}$ and the bank's shareholders need to infuse equity to make up for the shortfall.

Proof of Proposition 3: We have already established that $D = \tilde{D}$ is a Nash equilibrium. Our previous analysis also shows that as long as $D \leq \tilde{D}$ the bank will choose project G . As for the second Nash equilibrium, note that if all other banks are choosing $D = D_A > \tilde{D}$ then from our previous analysis it follows that the IC constraint for the bank to choose project G is violated and the bank will consequently choose project A . If all other banks are raising $D = D_A$ and choosing project A , then it is privately optimal for a particular bank to also raise $D = D_A$ and choose project A . The reason is that in state θ_s , all banks choosing project A will fail together, causing the regulator to bail out all the banks by paying off creditors, and thereby avoiding the social cost Ψ . This means that creditors will price the debt *ex ante* (at $t=0$) to satisfy (20)—which assumes the probability of full repayment of debt is p_G —even though they know that the bank will choose project A . That is, even though the IC constraint $\left(D \in [\hat{D}, \tilde{D}]\right)$ is violated and banks are choosing project A , the pricing of debt is as if banks are choosing project G . And since the value of equity *ex post* is higher with project A than with project G , the shareholders prefer that the manager choose project A at $t=1$. The shareholders insist on the surplus cash raised being paid out as a dividend because the manager would otherwise engage in inefficient perks consumption with it. This proves part (i). Part (ii) follows immediately from the above arguments. Part (iii) follows from the fact that when $D > D_A$, the amount of debt needed to roll over the legacy debt exceeds the maximum pledgeable debt. ■

Proof of Lemma 3: We will first show that when $F = F_A$ and $D = D_A$, the manager will prefer to consume all of S as perquisites at $t=0$ if the shareholders do not require that it be paid out as a dividend.

The manager's expected utility if he chooses to consume all of S as perquisites is bS , regardless of whether he invests in A or G . If the manager keeps S in the bank, then his expected utility is:

$$\begin{array}{ll} \alpha_1 p_G [S + H_G - H_A] & \text{with project } G \\ \alpha_1 p_A S & \text{with project } A \end{array}$$

Since $b > \alpha_1$, it follows that the manager's expected utility is higher if he consumes the cash than if he keeps the cash in the bank and invests it in either project A or project G . Knowing this, the bank's shareholders will insist that all of S be paid out as a dividend. ■

Proof of Proposition 4: Proving (i) is straightforward, as the proof follows directly from arguments

made earlier in the analysis. So consider (ii). Set $F = \hat{F} = \frac{c+L}{p_G}$, thereby satisfying (12). Note that (12)

treats the project success probability as p_G , so the assumption is that if banks select project A , the regulator will bail out all banks if they fail together and none otherwise (which makes the probability of success from the creditors' standpoint exactly equal to p_G). By assumption, the \tilde{F} that satisfies (8) is such that $\tilde{F} < \hat{F}$. So introduce an equity input ΔE that is invested in a riskless asset like Treasuries. The requirement to invest in Treasuries comes from the fact that otherwise the manager would inefficiently consume the cash as perquisites. Given the zero riskless-rate assumption that we have made, this investment will pay off ΔE . If ΔE is unavailable to creditors upon insolvency, then satisfaction of (12) is unaffected by ΔE . However, the IC constraint (7) now becomes

$$\alpha_1 p_G \{yH_G + \Delta E - F\} \geq \alpha_1 p_A \{yH_A + \Delta E - F\}$$

and this means the constraint is:

$$F \leq \tilde{F} \equiv \frac{\{y[p_G H_G - p_A H_A] + [p_G - p_A] \Delta E\}}{[p_G - p_A]} \quad (\text{A-1})$$

Comparing (A-1) to (8), we see that the \tilde{F} in (A-1) is bigger than the \tilde{F} in (8). Moreover, in (A-1), $\frac{\partial \hat{F}}{\partial \Delta E} > 0$. Thus, $\exists \Delta E$ large enough that $\tilde{F} > \hat{F}$. Once this is achieved, both the IC constraints will be satisfied and project G will be chosen. To the extent that issuing equity is costly (say at a minimum involving a positive transaction cost T per dollar of equity raised), allowing the bank to raise ΔE through earnings retentions will be value maximizing. ■

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