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Abstract

We address the following questions concerning bank capital: why are banks so highly levered, what are the consequences of this leverage for the economy as a whole, and how can robust capital regulation be designed to restrict bank leverage to levels that do not generate excessive systemic risk? Bank leverage choices are a delicate balancing act: credit discipline argues for more leverage so that creditors have adequate skin in the game, while balance-sheet opacity and ease of asset substitution by bank managers and shareholders argue for less. Disturbing this balance are regulatory safety nets that promote *ex post* financial stability but also create perverse incentives for banks to engage in correlated asset choices *ex ante* and thus hold little equity capital. We discuss how a two-tier capital requirement can cope with these distortions: a core capital requirement like existing capital requirements, and a special capital account that must be invested in Treasuries, accrues to the bank's shareholders as long as the bank is solvent, and accrues to the regulators (rather than the creditors) if the bank fails. The special capital account requirement ensures creditors have skin in the game and also provides the second margin of safety in the calculation of capital adequacy—a buffer for the regulator's own "model risk" in calculations of needed capital buffers.

Key words: capital requirements, leverage, systemic risk, market discipline, model risk

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1. Introduction

In early 2009, the largest US bank holding companies (BHCs), including those 19 that would later be subjected to the bank stress test, were all adequately capitalized by regulatory capital standards. The market had a different view: most were trading at less than book value and all were at or near records for their credit default swap (CDS) spreads. It was difficult to penetrate their balance sheets, and it was difficult to assess who needed more capital, how much more, and at what cost. Although the bank stress test in 2009[1] provided some temporary clarity for at least the participating firms, we are today little wiser on the broader questions of capital adequacy and capital regulation. What can academic research offer to the debate on reforming capital regulation?

In this paper, we provide a fresh perspective on the forces that shape the privately-optimal capital structure choices of banks, the manner in which these choices are distorted by regulatory safety nets that tend to privatize banks' profits and socialize their losses, and how capital regulation ought to be redesigned in light of the induced distortions in bank incentives to take on excessive correlated risks and leverage. In particular, we discuss a novel approach to capital regulation that involves a two-tier capital requirement and discuss how such a capital requirement can cope with these distortions. The two tiers are: (i) a core capital requirement like existing capital requirements, and (ii) a special capital account requirement. The special capital account involves capital that must be invested in Treasuries or equivalents, accrues to the bank's shareholders as long as the bank is solvent, and accrues to the regulators (rather than the creditors) if the bank fails. The basic idea, formally provided in Acharya, Mehran, and Thakor (2010), is to exploit both the role of equity in reducing the risk-taking appetite of banks (by requiring more capital) and the role of uninsured debt in monitoring bank owner/managers (by

[1] The bank stress test is more formally known as the SCAP (Supervisory Capital Assessment Program).

ensuring that a part of the capital does not accrue to creditors so that they have enough "skin in the game" to monitor). In addition, we propose that the quantification of the capital requirement we suggest be not heavily dependent on a particular model for calibration of the bank's risks such as historical outcomes, but instead rely on several different approaches such as market-based signals of bank-level and systemic risk, as well as regulatory intelligence gathered through periodic stress tests of the financial sector. In addition to being "robust" in this calibration sense, our proposal is also robust in the sense that it is not heavily reliant on just bank equity to provide the right incentives, but also recognizes market discipline provided by uninsured creditors.

The remainder of the paper proceeds as follows. In Section 2, we discuss the bank's privately-optimal capital structure decision. Section 3 discusses the design of robust capital regulation. Section 4 concludes.

2. The Capital Structure Decision

How does any firm decide on its financing model – how much equity (capital) to use, how much debt? And why might the answer be different for a bank when compared with a non-financial firm? In particular, why do banks tend to be so highly levered? These are the questions we address in this section.

A typical non-financial firm has equity that exceeds 50% of its assets. By contrast, in mid 2010, the median capital ratio of commercial banks was about 8.5%. Figure 1 shows median equity to asset ratios, where equity is the residual of total (book) assets less total (book) liabilities for broad sectors using 6,662 firms in Compustat at year-end 2009. Credit

intermediation[2] has by far the lowest capital ratio at 9.8%, less than half the capital of the next sector, insurance, at 25.5%, which itself is less than half of the ratio for most non-financials.

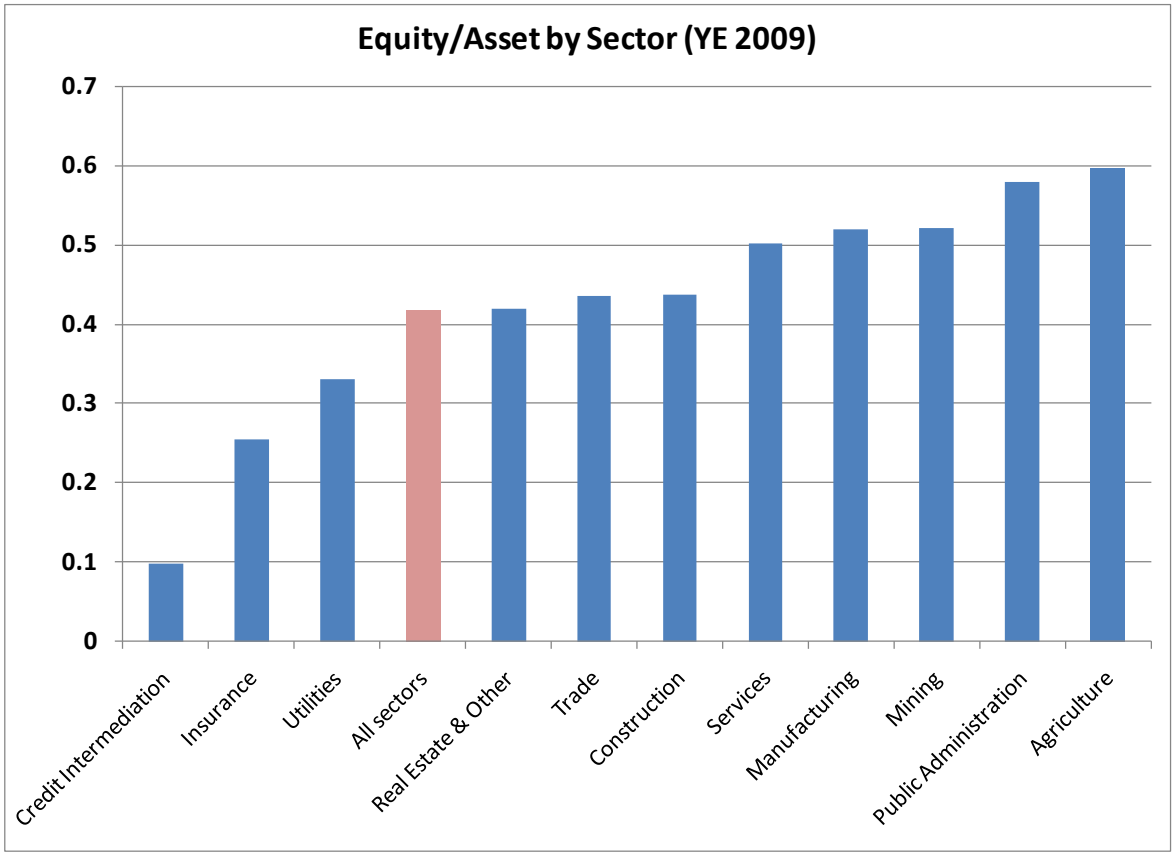

Figure 1: Capital ratios by sector. Equity is the residual of total (book) assets less total (book) liabilities. N = 6662 firms. Source: Compustat.

Academic corporate finance enters this debate with the famous Modigliani and Miller (M&M) (1958) leverage indifference theorem, and the debate has been made vigorous again today with contributions such as Mehran and Thakor (2011) and Admati, DeMarzo, Hellwig and Pfleiderer (2010). In a world without frictions (no taxes, no bankruptcy costs, no safety net like a lender of last resort or deposit insurer), M&M showed that the capital structure decision of how to finance the balance sheet, for a *given size of the firm* and *given asset portfolio composition*, matters only if this decision affects the value of the firm. Note that the M&M argument takes the

[2] Credit intermediaries are depository institutions + non-depository credit institutions + security and commodity brokers, dealers, exchangers, and services.

balance sheet, and thus the investment decisions that formed the balance sheet (projects, machines, buildings, or in the case of a bank, loans made or securities bought), as given, implying that the *financing-mix* decision is separable from the firm's *investment* decision.

The real world, of course, looks quite different from the M&M-world, particularly for banks. The fact that banks tend to be systematically highly levered must be, it is argued, because the M&M conditions do not apply to banks. A number of reasons have been put forth for why M&M may not apply to banks, which we briefly review below.

The standard argument against applying the M&M theorem is that deposits are a factor of production in banking – banks not only use deposits to make loans but also provide liquidity and transaction services to depositors – so we should expect banks to be highly levered since deposits are a form of debt. However, with finite (constrained) core deposit supply, it is not obvious why banks cannot add large amounts of equity to the deposits that they gather.

A second popular argument is that banks prefer high leverage because debt interest payments are tax deductible but shareholder dividends are not. This is true, but it cannot explain why banks are more levered than non-financial firms that enjoy the same debt tax shield.

A third argument, one that we overall favor, has appeared in theories that have emphasized the monitoring and disciplining role of leverage. As leverage increases, the loss absorption capacity provided by equity capital in the event of bankruptcy shrinks, inducing creditors to monitor more closely the activities of management, in addition to raising the price of debt to compensate for the increased risk. This effect is present for all firms, but bank funding appears unique, in the form of demand deposits. Calomiris and Kahn (1991) were the first to note that uninsured depositors who monitor the bank and observe/suspect managerial inefficiency/fraud can decide to withdraw those deposits. Observing their withdrawals may cause uninformed depositors to follow suit. This precipitates a full-scale bank run and may force

liquidation of the bank. Fear of such a run can induce the bank manager to stay straight and narrow. In this framework, leverage is needed for run-based market discipline to control agency problems.[3] The effect extends beyond deposits: as borrower (in this case, bank) risk increases, lenders tend to shorten maturity as the option not to renew the debt becomes more valuable. Such maturity shortening was in broad evidence throughout the crisis.

Since this line of reasoning is meant to justify the heavy use of *demandable* debt by banks, the potential discipline imposed by such debt is substantial (at least in theory) because the bank can be shut down at a moment's notice by creditors refusing to roll over debt. To explain why non-financial firms, which also stand to benefit from the disciplining role of leverage, do not use this form of debt and high levels of leverage in general, one must invoke the argument that the potential for agency problems, and hence the need for the market discipline of debt, is much greater in banking than in non-financial firms. The greater ease with which banks can expeditiously change their asset mix in a way that is not transparent to all but the most diligent and skilled monitors is likely an important reason. The recent financial crisis has in fact provided many examples of creative manufacturing of assets whose tail risks were far from transparent even to some insiders. As the riskiness of those assets became apparent to outsiders, the market reacted quickly by either shortening the maturity of credit or refusing to roll it over altogether.

While the disciplining role of debt can help reduce certain agency costs in banks, it can go too far. Jensen and Meckling (1976) argue that sufficiently high leverage creates asset-substitution or risk-shifting moral hazard that bank managers and shareholders prefer riskier gambles to safer ones simply to maximize the value of their equity option on bank assets. Coping with this moral hazard requires one to limit the use of leverage unless the discipline

[3] See also Diamond and Rajan (2000, 2001) who justify demandable bank debt given the inability of bankers to pledge their relationship-specific rents to depositors.

through liabilities has to be fast enough to keep pace with the asset substitution potential. So for banks the discipline has to be particularly harsh. "Run"-able demand deposits provide just that discipline, but in general the asset-substitution moral hazard can dominate the value of discipline at high levels of bank leverage.

This tension between the run-based disciplining role of leverage and the risk-inducing role of debt has been formally examined in a recent paper by Acharya, Mehran, and Thakor (2010, AMT henceforth).[4] AMT show theoretically that the bank is caught between a rock and a hard place when choosing its privately-optimal capital structure. If it does not choose a sufficiently high amount of leverage, then the bank's creditors do not have enough "skin in the game" to credibly threatenthe bank with liquidation for observed underperformance and impose thereby impose the necessary market discipline. However, if the leverage ratio is too high, asset-substitution moral hazard is triggered and the bank may be induced to take excessive risk at the creditors' expense, thereby expropriating wealth from the creditors/depositors to the benefit of the shareholders.[5] AMT show that the bank's privately optimal capital structure must navigate between these two forms of moral hazard. In particular, leverage must be high enough to induce creditor discipline but low enough to ensure that the bank's risk-taking is not excessive. However, since bank-level agency problems are adequately taken into account by bank-level capital structure problem, this does not provide a reasonable case for regulatory setting of capital requirements. AMT go on to show, however, that this argument for a privately-optimal capital

[4] Acharya and Thakor (2010) also point out that there is an inherent conflict between market discipline of an individual bank through fragile capital structure and financial stability of the system, when the fragility of an individual bank in the form of a depositor or creditor run can induce (potentially inefficient) information-based runs on other banks.

[5] In the context of financial firms, this asset-substitution moral hazard problem takes on particular importance as it is far easier to reallocate financing across different financial transactions and alter risks at a high frequency before creditors can discern, in contrast to say an auto firm that would face immediate risks of customer outrage were it to make riskier cars (a point referred to as the "paradox of liquidity" by Myers and Rajan, 1998).

structure can break down completely in the presence of regulatory distortions, which we consider next.

3. The Role of Regulatory Safety Nets and a Step Toward Robust Capital Regulation

So far, we deliberately excluded the role of regulatory safety nets in the bank's leverage choice. These safety nets have the feature that the bank's creditors do not have to take (all of) the "haircut" they would otherwise have to take on their claims when a bank fails. The bulk of a commercial bank's deposits are insured, whereas its equity is not. Deposit insurance, as well as other safety-net initiatives like *ex post* bailouts of some failing banks, turns *de jure* overnight debt financing, which would ordinarily be very risk sensitive, into *de facto* patient financing, more tolerant of changes in the riskiness of the bank. A similar argument applies to under-capitalized over-the-counter derivative exposures of large financial firms to each other.[6]

In addition, the financial safety net also has the central bank as the lender of last resort (LOLR) via the discount window. This enables otherwise solvent banks that face short-term liquidity constraints to pledge illiquid assets like loans or structured credit securities as collateral against cash or cash equivalent instruments such as Treasury securities.[7] The discount window complements deposit insurance: while deposit insurance allows the bank to obtain cheaper funding and subsidizes the right side of the balance sheet, the discount window gives the banks a liquidity put option in the form of an ability to "put" to the central bank otherwise illiquid assets and obtain short-term financing against these assets when the market is unwilling to do so.

[6] See Song and Thakor (2007) who show that deposit insurance adds to the "stickiness" of a bank's core deposits. That is, they show that deposit insurance can induce a sort of self-selection among investors, so that those more interested in the bank's transaction services but less able to or interested in monitoring the bank choose to become insured depositors, whereas the more active monitors become suppliers of uninsured (purchased) money. Consequently, core deposits (covered by deposit insurance) are less subject to withdrawal risk for the bank.

[7] Later we will discuss the implications of the practical difficulty of distinguishing between insolvency and illiquidity.

There are many ways of rationalizing these safety nets, but they primarily have to do with the desire of the central banks, other regulators, and governments to use them to prevent a wide-scale collapse of the intermediation services provided by the banking sector and avoid various forms of contagion with concomitant adverse economic effects (a severe recession or worse). That is, they are part and parcel of the desire for safety, soundness and stability of the banking system. Additionally, they facilitate the ability of banks to engage in effective maturity transformation: liabilities can be of shorter maturity in the presence of deposit insurance, and assets can be of longer maturity (and hence less liquid) in the presence of the discount window. In short, there are valid economic reasons to have regulatory safety nets in banking, when viewed purely from an *ex post* standpoint when in the midst of a crisis.

However, it is now becoming abundantly clear – both in theory and in practice – that these regulatory safety nets come at a fairly substantial cost, not just *ex post* in terms of fiscal outlays (Ireland's sovereign credit risk following bank bailouts by the government being a prime example),[8] but also *ex ante* in terms of moral hazard. The most obvious moral hazard is that banks are encouraged to become more highly levered. Because creditors do not face the same risk exposure as they would in the absence of the safety nets, the credit disciplining effect discussed earlier is dampened, and the pricing of bank debt becomes relatively insensitive to the amount of leverage. As a result, leverage appears "cheap" to banks even as they take on increasing amounts of leverage that make the bank riskier and riskier.[9]

[8] See, for example, the theoretical analysis of bank bailouts in a world of limited fiscal resources and supporting empirical evidence from the recent Eurozone sovereign credit woes in Acharya, Drechsler and Schnabl (2011).

[9] Merton (1977) showed that deposit insurance essentially provides the bank an option to put its assets to the deposit insurer in the event that its assets fall in value below its liabilities, and that the value of this option increases as the bank's leverage goes up. The discount window has a similar effect. The availability of discount-window financing significantly reduces the refinancing risk in maturity transformation. Moreover, as Farhi and Tirole (2009) have pointed out, the central bank may be unable to tell whether a bank is illiquid or insolvent. This means that insolvent banks may also be able to stay alive by tapping the discount window. This, in turn, encourages banks to become more highly levered.

The presence of the safety net – deposit insurance and LLR – upsets the balance of a finely tuned capital structure as described by AMT: enough equity capital to attenuate asset-substitution moral hazard, yet not so much to water down the market discipline provided by (uninsured) creditors. In addition to this bank-specific effect, they argue that bank risk-taking carries an important collective or systemic dimension. Banks can choose to take not only excessive idiosyncratic risk, but also risk that is highly correlated across banks, for example, by herding on similar asset classes for lending or investments.[10]

Now, if all banks choose excessive and highly correlated risks, they are likely to fail together. Faced with industry-wide failures, regulators are more likely to step in and bail out banks because such an industry collapse would be socially unacceptable, and it may also be *ex post* efficient to not have a crippled financial sector.[11] AMT show that the mere *anticipation* of this forbearance when banks fail *en masse* may cause banks to choose highly correlated, excessively risky projects. Creditors will not "punish" banks *ex ante* in the pricing of (uninsured) credit for the systemic risk in their portfolio choices because they anticipate being bailed out *ex post*. All market discipline of debt is lost and banks end up choosing much higher leverage *ex ante*. The channel of moral hazard is interesting. Ex post, it is the creditors of banks that get bailed out, typically not bank shareholders, but this means that *ex ante*, creditors do not price the correlated risk of bank projects adequately. This increases the attractiveness of riskier gambles on the macro-economy for bank shareholders and they pursue these until the bets (almost inevitably) go bad. When this happens, the LOLR bails out banks, taxpayer funds get transferred to bank creditors, and because these transfers are reflected in the ex ante pricing of

[10] Acharya (2009) models this collective agency problem and refers to it as "systemic risk-shifting". Schuermann and Stiroh (2006) show that, among firms that make up the S&P 500, the average equity return correlation banks have with each other is higher than that for firms in any other industry, with energy firms coming in second.

[11] See Acharya and Yorulmazer (2007) and Farhi and Tirole (2009) for a formal analysis of this time-inconsistency problem facing regulators when they have discretion over bailouts and expansionary monetary policy, respectively.

debt, it is effectively an *ex ante* wealth transfer from taxpayers to bank shareholders, managers and employees.

One avenue available for mitigating this correlation induced systemic risk is through appropriate pricing of deposit insurance. Specifically, DI premiums should cover not just the expected loss (to the DI fund) for a given bank, but more importantly it's contribution to overall banking system risk, which is a combination of size and correlation.[12] However, to the extent that some guarantees are implicit in nature, appropriate pricing of DI premiums may not suffice.

AMT argue that to prevent the "looting" of taxpayer funds (to borrow a term from Akerlof and Romer (1993)) through excess leverage and correlated risk-taking by banks, the regulator needs to impose a well-designed scheme of capital regulation that is robust in the following sense. The capital regulation must be such that the bank's leverage ratio stays below the upper bound beyond which the banks collectively wish to take excessively correlated risks in order to extract subsidies from the safety net. And at the same time, creditors should not perceive banks to be so safe that they do not discipline bank asset choices via monitoring and timely pricing of credit risks ("run"). In the AMT proposal, there are two important parts to deal with this tradeoff.

One is a regular core capital requirement that guarantees that the bank's leverage never exceeds the upper bound so as to keep risk-shifting incentives in check. The other – more innovative part – is a "special capital account" that is built up through earnings retentions made possible by dividend-payout restrictions on the bank. An important purpose of this special capital account is to provide the bank with a readily-available resource that can be tapped to refurbish the core capital account instantaneously, and automatically, when it is diminished due to an unexpected income shock. Anytime the bank suffers a negative income shock that depletes

[12] See, inter alia, Acharya, Santos and Yorulmazer (2010), and Kuritzkes, Schuermann and Weiner (2005).

the core capital account, there is an *automatic* and mechanical transfer from the special capital account into the core capital account to bring it up to the desired level. Dividend payout restrictions are then imposed on the bank to ensure that the special capital account is rebuilt back to its original level over time through earnings retentions.

This special account needs to have several noteworthy features. One is that the capital must be invested in pre-designated liquid securities like treasuries in order to remove managerial discretion over the use of that capital; this eliminates the potential moral hazard of bank managers being less efficient because they have excess cash not needed to run the bank. Although managers clearly have limited control rights over this capital account, it does have value which can be monetized, for instance, through sale of the bank.

Second, the capital account accrues to the shareholders as long as the bank is solvent, for instance, it can be used to meet special capital account requirement next period, but it accrues to the regulator—*rather than the bank's creditors*—in case the bank is insolvent and there is not an industry-wide rescue of banks by the LOLR. The idea is that in an industry-wide rescue, there is scarcity of bank capital and since the regulator is implicitly recapitalizing the system, the special capital account too indirectly accrues to creditors. However, in case of idiosyncratic failures, the bank assets can be acquired by well-capitalized players in the financial system. In this case, the creditors can be forced to take a haircut without substantial repercussions on the system. The fact that creditors do not benefit from the special capital account in the event the bank experiences an idiosyncratic failure means that this capital is "invisible" to creditors and ensures that they have enough "skin in the game" to discipline the banks, i.e., their incentives to credibly threaten withdrawal of financing and premature liquidation are not diluted by having this additional capital in the bank. Regulators would need to be explicitly directed, by the force of regulation and law, to take possession of the special capital account in the event of bank

insolvency, just as FDICIA (Federal Deposit Insurance Corporation Improvement Act, 1991) instructs regulators to shut down sufficiently undercapitalized banks. Thus, our overall proposal is a form of "capital preservation" whose goal is to ensure that the *probability* of the bank getting into a bad (insolvency) state is minimized *ex ante* but it also provides for "market discipline preservation" whose goal is to ensure that creditors have sufficient incentives to intervene in under-performing banks.[13] In this way the capital account acts as a deductible on explicit and implicit government insurance claims (pre-paid by the shareholders) and serves to reduce system-wide losses (given default), though not necessarily so for creditors of any given bank.

Third, since the special capital account is built up gradually through earnings retentions, the bank typically does not have to go out and raise equity in order to satisfy its capital requirement. Further, since such transfer is mechanically required by regulation that is based on market-observed performance variables, there is no new information released to the market. This is in contrast to a voluntary issuance of equity by the bank, which reveals private information, and will in general be perceived by the market as negative news. Thus, the information costs associated with issuing equity (as in Myers and Majluf (1984)), which often make bank managers and CEOs reluctant from issuing equity in the first place, are avoided. Thus, the bank is not put in a position of having to raise equity when it is in financial distress and raising equity might be difficult or costly. In this sense, AMT proposal has the natural interpretation of being a mechanism to enforce counter-cyclical capital requirements; these have been proposed as an important part of the regulatory toolkit for *macro-prudential* regulation of the financial sector.

[13] Note that our scheme focuses on reducing the likelihood of the bank getting into trouble rather than dealing with better resolution of bank distress, which is an important regulatory topic in itself.

Fourth, as explained in the previous paragraph, in the absence of a system-wide rescue, the transfer from the special capital account to the core capital account and the accompanying dividend restrictions are *mechanically triggered*, based on pre-specified rules (linked, e.g., to total market capitalization loss of financial sector in the last year), in other words with *no* regulatory discretion. This way, there is no bank-specific information conveyed by these actions, and the issue of the trigger somehow becoming a self-fulfilling prophecy of failure for an individual bank would not arise.[14] Also, because the special capital account is invested in Treasuries or other cash-like instruments, the bank always has a buyer of liquid assets that can be tapped in the event of a liquidity crunch.

Finally, because the special capital account restricts rent extractions from taxpayers, bank shareholders would in fact be discouraged from excess leverage and correlated risk-taking in the first place. Similarly, creditors would monitor because additional bank capital does not buffer them against losses in times when rescues are not system-wide. Thus, the purpose of the special capital account is to provide banks and their creditors the right incentives (through off-equilibrium "threats" in game-theoretic language) rather than (just) playing the statistical role of buffering against future losses (as is the current view of bank capital under Basel capital requirements).[15]

4. Will Higher Capital Requirements Not Hurt the Value of the Bank?

The capital regulation framework in AMT is intended to inject more capital into banking and provide banks incentives to reduce the likelihood of crises, without diluting the monitoring

[14] If the trigger is based on regulatory discretion, it will convey information to the market that the regulator knows that something is wrong. This will cause creditors to withdraw funding to the bank, precipitating the very crisis the regulator wished to avoid.

[15] Of course, in practice, regulatory design of required leverage ratios may not fluctuate on a frequent or perfect basis, resulting in actual contributions to the special capital account, an issue that would require a certain amount of regulatory calibration over time.

incentives of uninsured creditors. Opponents of higher capital requirements might object on two grounds, which we now discuss below.

First, they would argue that equity capital is really expensive for banks in the sense that bank shareholders demand a very high return on their investment. So asking banks to post more capital will force them to reduce the sizes of their balance sheets because they will be unable to locate investment opportunities with sufficiently high rates of return to cover the high expected rates of return demanded by shareholders on the additional equity. This, in turn, will lead to lower growth and hurt global GDP.

Wee can see the weakness in the above argument by discussing a corollary to it, which is that higher leverage is preferred because it leads to a higher return on equity (ROE). Some bankers put forth this reasoning to suggest that higher capital requirements will reduce shareholder value in banking, but of course it's not so simple. True, a bank's ROE will decrease with a decline in leverage, but so will its cost of equity capital (i.e., the minimum expected rate of return demanded by shareholders to compensate for the decline in risk), so changes in leverage would have no impact on bank value or on the sizes of bank balance sheets. Moreover, this decline in leverage increases the loss absorption buffer to debtholders who can afford to reduce their required yield, lowering the bank's cost of funds. Of course, with taxes, an increase in leverage causes ROE to rise faster than the bank's equity cost of capital, so shareholder value goes up, ignoring agency costs and other frictions associated with leverage. But this is nothing more than the debt-tax-shield argument, which should apply also to non-financial firms. The point is that if banks put more equity capital on their balance sheets, the rate of return their shareholders demand will be decreased, and equity then will not seem nearly as expensive.

The second argument is that banks will simply be worth less to their owners if the owners are forced to post more capital. After all, if deposits cost 3% and equity costs 20%, would the

owners of the bank not be worse off if they were forced to fund at the margin with equity rather than deposits? Mehran and Thakor (2011) expose the theoretical fallacy of this logic, but one may argue that this is ultimately an empirical question. The empirical evidence in Mehran and Thakor (2011) shows that bank capital and bank value are actually *positively correlated* in the cross-section of banks. That is, banks with more equity capital: (i) generate higher net present value for their shareholders (i.e., the value that is created for the shareholders over and above what they invested in the bank is higher when the shareholders invest more capital in the bank); (ii) are acquired at higher prices in mergers; (iii) are paid more in goodwill in the acquisition price; and (iv) experience higher *total* (enterprise) values (debt plus equity). The Mehran and Thakor (forthcoming) results suggest that higher bank capital is good not only for greater safety and soundness of the banking system, but also benefits the banks themselves. Higher bank capital improves the incentives of banks to monitor their own borrowers and develop stronger long-term relationships, and this, in turn, generates economic value.

5. Calibration of capital requirements

The answer to the question of how much capital banks should hold is invariably tied to the outcome or return distribution of the bank's assets, both on balance sheet (actual) as well as off (contingent): to figure out how much capital is needed, one needs to know how risky the assets are. Since bank balance sheets are relatively opaque (Morgan 2002), banks are especially susceptible to the "asset substitution" problem. Just how opaque and full of surprises bank balance sheets can be was highlighted in the recent financial crisis with the rather slow recognition of subprime risk hidden in the plethora of complex structured credit products. This opaqueness, combined with the structural incentives for banks to strategically benefit from the opaqueness, can make bank asset return distribution have more "tail" risk (see Rajan, 2006 and

Acharya, Cooley, Richardson and Walter, 2010), that is, both more complex (more non-normal) and also harder to estimate by outsiders making it more difficult for debt to conduct its monitoring and disciplining role. At any rate, banks are thinly capitalized when compared to other industries, so the margin of error around capital adequacy needs to be quite small. Given these considerations, which are only exacerbated by distortions introduced through access to the safety net (deposit insurance, lender of last resort), a sensible policy path is to put a premium on robustness along two dimensions.

First, one should develop and apply *several* different estimates of capital adequacy and develop appropriate loss-absorption mechanisms to help address the distortions. Capital adequacy assessments can be based on different ways of estimating asset quality and risk, such as a set of regulatory risk-weighting schemes along the lines of Basel 3, plus stress tests along the lines of the SCAP, as well as market measures of systemic risk based on CDS spreads, equity returns and volatility (for instance, as proposed by Acharya, Pedersen, Philippon and Richardson, 2010, and Brownlees and Engle, 2010).[16] This is the "belt and suspenders" approach which calls for some redundancy in the number of ways in which capital adequacy is assessed.

The special capital account requirement could provide the second margin of safety in the calculation of capital adequacy – a buffer for the regulator's own "model risk". This margin is necessary because opaque balance sheets, contingent exposures off-balance sheet and fat-tailed asset return distributions all make it likely that there will be imprecision in calculations of needed capital buffers. Moreover, the possibility of contagion and thin capital cushions of banks make this buffer more of an imperative.

[16] To be sure, only stress tests have the potential for taking systemic risks into account based on granular asset-level data. Current regulatory risk weights on assets and bank-internal risk weighting models do not account for systemic risk.

Capital ratios for banks have been increasing since recovering from the shock of the financial crisis. As Figure 2 below shows, prior to the introduction of deposit insurance, bank capital ratios were quite volatile and at times very high, fluctuating between 10% and more than 20% between the end of the 19th century and the Great Depression. The post-war period saw capital ratios hovering steadily around 6%, increasing after the introduction of FDICIA in 1993. As of this writing, it remains a live debate what the regulatory minimum capital ratio will be, but it would be surprising to find it settling in the single digits.

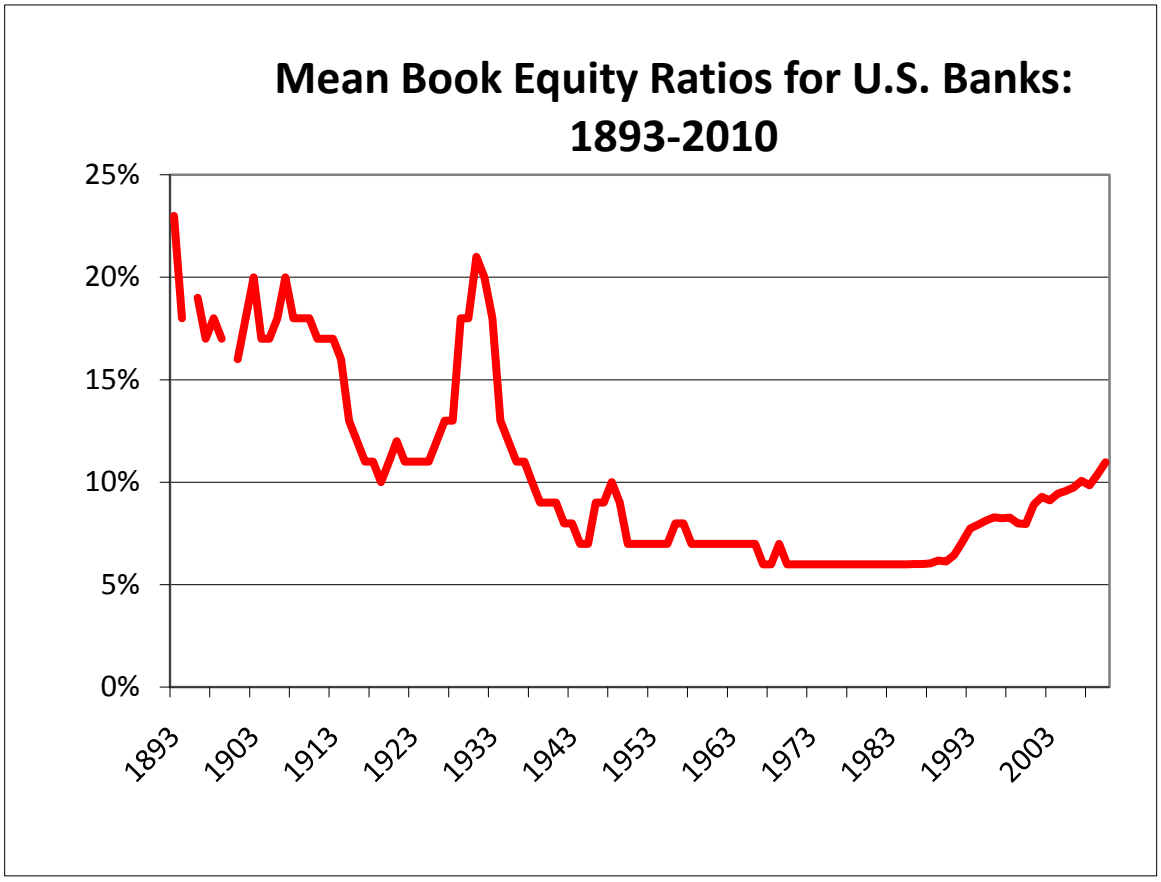

Figure 2: Book equity ratios for U.S. banks. Data through 2001 from Flannery and Rangan (2008); data since 2001: average quarterly capital ratios for largest 100 bank holding companies (Y-9C Reports).

6. Conclusion

In this paper, we have examined the important issue of the privately-optimal capital structure

decisions of banks, the circumstances under which it is not adequate from a prudential standpoint for regulators to rely on these privately-optimal choices, and the optimal design of capital regulation. Our proposed capital framework for banks, based on Acharya, Mehran and Thakor (2010), has two forms of capital requirements. One is a regular tier-one capital requirement that contributes to deterring excessive risk-taking incentives. The other is a special capital account that also limits risk-taking but also ensures creditor disciplining incentives are preserved. In particular, the special capital belongs to the bank's shareholders in solvency states, but belongs to the regulators – rather than the bank's creditors – in the event of a failure of the bank. The proposed capital requirement is robust in the sense that it can simultaneously accomplish four goals; the first goal is to bring more capital into banking – without necessarily requiring banking to issue new equity – and hence contribute to safety and soundness. The second goal is to improve bank incentives to reduce the probability of a crisis rather than focusing on what to do when a crisis occurs. The third goal is to do all this without diluting the market discipline provided by uninsured debt. And the fourth goal is to do this in the simplest possible manner, using well-known instruments (equity and retained earnings to build up equity) rather than new instruments whose pricing characteristics and market impact may be hard to gauge. Additional robustness can be lent to calibration of the two capital requirements by relying on multiple ways of assessing systemic risk of bank assets (historical data, market data, regulatory stress tests, systemic risk assessments, etc.) and keeping a buffer also for regulator's "model risk" in systemic risk assessments.

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