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BANK CAPITAL AND FINANCIAL STABILITY:

AN ECONOMIC TRADEOFF OR A FAUSTIAN BARGAIN?

by

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ABSTRACT

Financial crises impose large and persistent social costs, making banking stability important. This paper reviews the central issues surrounding the role bank capital plays in financial stability. Because the socially efficient capital level may exceed banks' privately-optimal capital levels, regulatory capital requirements become germane. But such requirements may entail various bank-level and social costs. Thus, while there is agreement that higher capital would enhance banking stability, recognition of these costs has generated theoretical disagreement over whether capital requirements should be higher. The empirical evidence reveals that, in the cross-section of banks, higher capital is associated with higher lending, higher liquidity creation, higher bank values, and higher probabilities of surviving crises. Moreover, increases in capital requirements are met with modest declines in lending. The overarching message from the research is that lower capital in banking leads to higher systemic risk and a higher probability of a government-funded bailout that may elevate government debt and trigger a sovereign debt crisis. Thus, capital regulation reform, as well as tax policy, should seek to increase bank capital. The paper discusses the contemporary thinking on these issues, and concludes with open research questions.

I. INTRODUCTION

The economist's view of bank capital is that it is the amount of equity the bank chooses to finance itself with. The regulatory view is similar but broader in that what qualifies as regulatory capital typically includes other sources of financing such as preferred stock.[1] Because the rich variety of regulatory definitions of capital all assign a central role to equity, I will refer to bank capital simply as common equity (paid-in capital plus retained earnings) in the bank.

Bank capital is arguably one of the most important targets of micro-prudential and macro-prudential regulation in banking all over the world, and also occupies center stage in global regulatory capital accords ─ such as the *Bank for International Settlements* (BIS) or "Basel" accords for short ─ that seek to constrain and provide common guidelines for capital requirements set by national regulators. The reason is simple. How much capital a bank has affects its risk-management incentives and determines its ability to withstand economic shocks. Banks are especially vulnerable to such shocks because in providing valuable economic services through "qualitative asset transformation (QAT)" ─ a process whereby the nature of the bank's assets is typically different in many dimensions from the nature of its liabilities ─ banks take on many risks.[2] For example, banks provide maturity transformation by financing loans of longer maturities than the bank's deposits.[3] They provide liquidity transformation by financing

[1] Regulators define different "types" of capital such as "tier one" and so on, as well as a host of capital ratios. In the past, even intangibles like goodwill have been included in some forms of regulatory capital. Most of the theories of capital covered in this survey deal with equity as capital, and capital requirements that correspond most closely to the "leverage ratios" used by regulators.

[2] See Bhattacharya and Thakor (1993). QAT is an essential part of relationship banking (e.g. Boot and Thakor (2000)).

[3] Hellwig (1994) studies maturity transformation and the link between interest rate risk and credit risk.

relatively illiquid loans with liquid (withd`rawable-on-demand) deposits.[4] They specialize in credit screening[5] and fund risky borrowers, while providing their depositors less risky claims on the bank, and achieve this through a combination of credit analysis, monitoring and diversification. These activities spawn risks that not only make banks vulnerable to shocks to economic fundamentals, but also shocks to perceptions about their soundness that may even be unrelated to economic fundamentals. These shocks can jeopardize the bank's continued access to funding and trigger a collapse, which can be socially very costly. Kupiec and Ramirez (2013) estimate that during 1900-1930, a bank failure shock involving one percent of system liabilities led to a 15% points decline in industrial production and a 6.5% points reduction in GNP growth within three quarters; in the absence of intervention, the macroeconomic effects are protracted. Luttrell, Atkinson, and Rosenblum (2013) estimate that the subprime crisis of 2007-09 resulted in an output loss of $6 trillion to $14 trillion, with the wide range due to the uncertainty about how long it will take the economy to return to pre-crisis output levels. Capital helps the bank to cope with the shocks that may precipitate crises. Bank capital is akin to "braking distance" ─ the more capital the bank has, the longer the distance between it and economic failure, and thus the

[4] Calomiris and Kahn (1991) develop a model of liquidity transformation by banks in which the optimal deposit contract can lead to bank runs.

[5] Ramakrishnan and Thakor (1984) provide a formal theory of financial intermediation based on the role of banks as specialists in credit screening. Millon and Thakor (1985) point out that this role of banks is consistent with the growth of loan sales and syndicated loan markets in which originating banks provide credit screening and then sell these loans so as to avoid funding them. This is similar to banks avoiding deposit funding by securitizing loans. Eschewing funding does not lead to incentive problems in Ramakrishnan and Thakor (1984) and Millon and Thakor (1985) because the default/repayment outcome on each loan is assumed to be observable, and the intermediary's compensation can be made contingent on it.

greater is the amount of time the bank's managers have to sight impending danger and make decisions that increase the bank's odds of survival.[6]

Not only does higher capital lower the probability of bank failures and crises, but it can also speed up the post-crisis recovery of the economy. The reason is that better-capitalized banks have stronger screening incentives (e.g., Coval and Thakor (2005)) and monitoring incentives (e.g., Holmstrom, and Tirole (1997) and Mehran and Thakor (2011)), so they are in a stronger position to lend. Empirical evidence in support of this is provided by Cooke and Koch (2014) who document that the lending recovery after the subprime crisis was slowed down by large banks with relatively low capital ratios.

A noteworthy feature of banks is the possibility of contagion in bank failures. This means the failure of one bank can trigger the failures of other banks because an individual bank's failure is informative about potential problems at other banks. This happens in part because banks often hold assets whose risks are highly correlated across banks, and there is evidence that during 2000-06, the period leading right up to the crisis, this correlated risk-taking grew, with

[6] Based on a study of bank holding companies (BHCs) during 1992-2006, Berger et al (2008) document that banks set their target capital levels substantially above well-capitalized regulatory minima, and operated with more capital than required by regulation. This suggests that bankers recognize the benefits of capital and are not guided solely by regulatory requirements. I do not believe, however, that this necessarily indicates that there is sufficient capital in banking from a social efficiency standpoint, especially when one considers that US investment banks, which were at the epicenter of the subprime crisis, had much lower capital levels than BHCs. This may have been because they were guided by the Basel II capital requirements which left institutions with the discretion to use internal models to calculate required capital. Further, even for institutions that were not guided by Basel II, regulatory capital requirements may be too low to deal with systemic risk issues. Moreover, Berger and Bouwman (2013) provide empirical evidence that commercial banks with higher capital have a greater capability of surviving a financial crisis, and that small banks with higher capital are more likely to survive during normal times as well. Beltratti and Stulz (2009) investigate whether pre-crisis bank attributes explain performance during the crisis. They show that large banks with more Tier One capital at the end of 2006 had significantly higher returns during the subprime crisis. See Thakor (2014a) for a deeper discussion of these issues.

systematic risk in banking increasing substantially.[7] An immediate implication is that seemingly idiosyncratic failures of a handful of banks often raise financial stability issues for the whole economy, as these failures can spread and become a full-blown crisis through the endogenous generation of systemic risk.[8] This is a key reason why banks are the recipients of de jure ex ante guarantees like federal deposit insurance and de facto ex post bailout protection from the government. However, as shown by Merton (1977), the value of the deposit insurance put option to the bank is decreasing in bank capital, which engenders moral hazard associated with the proclivity of banks to be excessively highly leveraged. This means that a bank's privately-optimal capital structure may diverge from the social optimum, rationalizing capital requirements as an important tool of prudential regulation. Capital requirements are relied upon as a source of individual bank safety, and therefore ─ through the contagion argument ─ of financial system stability.

This summarizes the regulatory view of bank capital. An individual bank should have sufficiently high capital to give its shareholders and managers enough "skin in the game" to manage the bank prudently and limit the exposure of the deposit insurance fund. This is what

[7] Bhattacharyya and Purnanandam (2011) document that during this period, idiosyncratic risk in commercial banking was cut in half and systematic risk doubled. Acharya and Yorulmazer (2007) show that there is a "too-many-to-fail" problem in bank closure policy, and that this gives banks incentives to herd on asset portfolio choices, increasing systemic risk. Farhi and Tirole (2012) provide a theory in which the possibility of bailout assistance by regulators induces banks to make correlated asset choices and become highly levered. Acharya and Thakor (2013) develop a model in which the liquidation of one bank induces the creditors of other banks to also liquidate even though the creditors observe nothing suspicious about the bank, and this contagion is exacerbated by having lower capital in banks. Acharya and Yorulmazer (2008) show that the regulator may be better off providing liquidity assistance to solvent banks to buy out failed banks, rather than bailing out failed banks.

[8] It is useful to distinguish between "systemic risk" and the more familiar "systematic risk". A risk that is systematic is one that is correlated with the economy and hence not diversifiable. A systemic risk is a risk that threatens the whole system. While systemic risks are typically systematic, not all systematic risks are systemic.

microprudential regulation seeks. And because precluding failures of individual banks lowers the likelihood of contagion, the macroprudential goal of financial system safety and soundness is also served.[9]

However, bankers often get tetchy when higher capital requirements are proposed. A detailed discussion of why is deferred to a later section, but for now it suffices to note that bankers argue against higher capital requirements on the grounds that doing so would have a chilling effect on bank profitability and lending, as well as economic growth,[10] and also that, it would hurt the values of banks.[11] That is, they point to a variety of costs that would have to be borne in order to achieve greater stability. While the argument that higher capital in banking may involve significant costs has been endorsed by some in the literature (e.g. Diamond and Rajan (2001)), it has also led some to strongly disagree (e.g. Admati, DeMarzo, Hellwig, and Pfleiderer (2010), and Admati and Hellwig (2013))[12]. That is, there is theoretical disagreement about whether it is a good idea to increase capital requirements in banking. This raises three important questions:

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[9] Capital requirements are not the only tool of safety and soundness regulation. Tools like risk-based deposit insurance premia, portfolio restrictions, and risk management stipulations can also be used to control risk. However, the focus of this paper is on capital.

[10] Pfleiderer (2012) quotes Josef Ackermann, CEO of Deutsche Bank from a November 20, 2009 interview: "More equity might increase the stability of banks. At the same time, however, it would restrict their ability to provide loans to the rest of the economy. This reduces growth and has negative effects for all." Hanson, Kashyap and Stein (2011) review the literature on this issue and provide estimates of the potential effects of higher capital requirements on bank lending. This evidence will be discussed later in the paper.

[11] The decline in lending could come from either demand or supply effects, based on the commonly-used arguments. Banks may respond to higher capital requirements by shedding assets so that they are in compliance with the higher requirements without having to raise additional equity (a reduction in loan supply), or they could raise loan prices causing a decrease in loan demand. Later I will discuss some empirical studies that have disentangled supply and demand effects.

[12] Admati, DeMarzo, Hellwig, and Pfleiderer (2010) advocate substantially higher capital requirements in banking.

1) Will higher capital levels in banking lead to lower lending and liquidity creation by banks?
2) Will requiring banks to keep more capital increase funding costs for banks and diminish their values?
3) What are the systemic risk implications of higher capital in banking?

The first two questions are related, of course. Lower lending and liquidity creation may accompany higher capital levels in banking if higher capital is associated with a higher funding cost for the bank. In addressing these three questions, I review the theoretical literature, followed by a brief review of the empirical literature.

From a theoretical standpoint, there are two views that have focused on two different aspects of capital structure. One says that higher capital improves banks' incentives to make efficient asset portfolio choices and strengthens their incentives to monitor borrowers; see Holmstrom and Tirole (1997) for the monitoring channel.[13] From this standpoint, higher-capital banks are associated with more lending and liquidity creation, and higher bank values (see Mehran and Thakor (2011)).[14] The other says that higher capital may either directly reduce banks' liquidity and transaction services or lead to less efficient contracting resolutions and higher agency costs, thereby leading to lower liquidity creation by banks (see Diamond and Rajan (2001)). Where both viewpoints do seem to agree is that higher capital in banking would reduce bank fragility and systemic risk. I will examine these theories in more detail in the next section.

[13] Mehran and Thakor (2011) make a similar point in a dynamic model. Allen, Carletti and Marquez (2011) show that higher bank capital may enable banks to gain greater market share, a result for which Berger and Bouwman (2013) provide empirical support.

[14] This is a cross-sectional implication, i.e. in the cross-section of banks, what is the relationship between bank capital and outcome variables like lending and bank values?

The discussion that follows distinguishes between higher capital levels (or ratios) in banking and higher capital requirements. Empirical tests that examine the effects of capital levels primarily document *cross-sectional* relationships, whereas empirical tests of the effects of changes in capital requirements are essentially *intertemporal* in nature, focusing on how bank lending responds when there is say an increase in capital requirements. On the issue of capital levels, the empirical evidence suggests that banks with higher capital have a higher probability of surviving a financial crisis,[15] and also gain a competitive edge in deposit and loan markets.[16] Moreover, higher capital in banking is associated with higher liquidity creation by large banks that provide the vast majority of liquidity creation in the U.S. [17], but lower liquidity creation by small banks, and the relationship between total bank value and capital is positive in the cross-section.[18] On the issue of capital requirements, the evidence is that when there is a transition from one structure of capital requirements to another ─ as was the case in 1987 with the adoption of Basel I capital requirements that introduced measures of asset risk in the calculation of capital requirements – there may be non-trivial transitional effects in the form of lower bank lending.[19] The question not completely addressed by this research is whether the reduced lending due to

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[15] See Berger and Bouwman (2013).

[16] See, for example, Calomiris and Mason (2003), for empirical evidence. Mehran and Thakor (2011) develop a theory in which there is cross-sectional heterogeneity in the capital ratios of banks.

[17] See Berger and Bouwman (2009). This refers to both the dollar volume of liquidity creation as well as liquidity creation per dollar of capital. But this does not necessarily mean that all large banks should increase capital since banks are heterogeneous and each bank chooses its privately-optimal capital in equilibrium. It means that in the cross-section, banks with more capital create more liquidity.

[18] See Mehran and Thakor (2011). It should be noted, however, that all of these empirical studies measure cross-sectional equilibrium choices of banks, and hence do not address the issue of optimal capital requirements.

[19] Thakor (1996) develops a theoretical model and provides empirical evidence that the adoption of risk-based capital requirements under Basel I and the passage of FDICIA in 1991 caused banks to substitute risky lending with Treasury investments, and may have (procyclically) prolonged the economic downturn.

higher or more risk-sensitive capital requirements is a good or a bad thing for society, given the propensity of banks to herd and overlend to some sectors (see Acharya and Yorulmazer (2007) for a theory of banks herding in their asset choices).

Another issue of some import is the highly-publicized aversion of bankers to higher capital requirements. Socially-optimal capital levels may exceed privately-optimal capital levels, because individual banks do not internalize the social costs of large-scale bank failures induced by contagion effects, so one reason for the aversion of bankers may simply be that capital requirement may compel the bank to keep capital that it does not view as privately optimal. But we will see later that exploring more fully the reasons why banks resist higher capital requirements illuminates issues that are not exposed by the private-versus-social optimum divergence. An important reason for understanding the banker's viewpoint is that capital regulation in banking is largely, and appropriately, an exercise in political economy, with bankers, academics, regulators and politicians all providing input that shapes the final outcome. In this sense, banking may be no different from any regulated industry, but the political economy of banking is innately more complex than that of most other industries because of the role of large government safety nets in bank regulation.

Much of the discussion in this paper rests on the central premise that banking stability is desirable and financial crises are not. The view is based on the value typically associated with intertemporally smooth consumption for individuals and stable economic growth and employment levels. However, Reinhart and Rogoff's (2009) analysis of financial crises over the past eight centuries shows a recurring pattern of high leverage in financial institutions that facilitates rapid growth in bank lending and fuels asset price bubbles that precipitate financial crises when they burst. This raises an intriguing question about how one should think about the

costs and *benefits* of financial crises.[20] To the extent that the bull markets that precede financial crises have positive economic value—for example, the almost-unprecedented economic growth in the decade prior to the subprime crisis—perhaps we should take the benefits of the pre-crisis economic growth and high asset values into account in computing the *net cost* of a crisis. If high bank leverage facilitates the pre-crisis bull market and also increases the probability of a crisis, then both effects ought to figure in the cost-benefit calculation. I address this issue in Section V.

I then move on to briefly discuss capital regulation proposals. While the discussion is not exhaustive, I take a "helicopter" view of the research and try to piece together various seemingly disparate threads into a coherent story that permits a reasonable assessment of capital regulation proposals. Systemic risk is now the eight-hundred pound gorilla regulators have to wrestle with, and if this risk is not contained, it necessitates either government liquidity assistance or outright massive bailouts. As the Irish and Icelandic experiences have shown us, such intervention may call for resources that the affected sovereign governments do not have, i.e., we may have a "too big to save" problem that triggers a sovereign debt crisis as the government substantially spikes up its debt to finance the bailout. What our research tells us is that sufficiently high capital in banking may be, in combination with other remedies, an effective antidote to excessive systemic risk, and therefore also protection for sovereign governments. So my discussion focuses on the pros and cons of implementing higher capital requirements and the manner in which different capital adequacy proposals seek to infuse more capital into banking. Increasing capital in banking is unlikely to be costless because it may result in a loss of some of the private and social benefits associated with leverage that the literature has thoughtfully articulated, including a diminished likelihood of pre-crisis bull markets. Nonetheless, the reduction in systemic risk and

[20] I thank the editors for suggesting that this discussion be included in the paper.

the consequently lower probability of a sovereign debt crisis suggest an overall net benefit from raising capital levels. One can view this as augmenting "private deposit insurance", since it strengthens the protection of depositors both directly and through incentive effects. I argue that we should also seriously consider a change in the tax code to reduce the tax disadvantage of equity and facilitate a transition to higher capital levels. The scope of the paper is limited to bank capital as a source of stability, so that other tools of prudential regulation like liquidity requirements are not discussed. Nonetheless, I do discuss "narrow banking" as an alternative approach to enhancing banking stability. In this discussion I address briefly how capital regulation may adapt if the economy consisted of two types of banks—narrow banks with insured deposits that are limited to very safe investments, and banks with a broader lending mandate that do not have deposit insurance.

This paper is related to Dewatripont and Tirole (2012), who develop a model to examine how prudential regulation should respond to macroeconomic shocks. They distinguish between scarce "inside" equity—that provided by the manager or by some block shareholder with influence over management— and elastically-supplied "outside" equity (provided by unaffiliated investors), and argue that both debt and outside equity can be used to give efficient contingent control to discipline the bank manager. They show that after bad performance, control should shift from outside equity to debt, unless shareholders recapitalize the bank. They criticize the Basel capital regulation for not distinguishing between microeconomic and macroeconomic shocks, and thereby being too tough in recessions and too lenient in booms. However, unlike the focus of this paper, their paper is not about the link between the level of capital in banking and banking stability, nor is it about the level of optimal capital requirements. Rather, it is about how

capital requirements should change across the business cycle. In that sense, the paper neither argues for nor against higher capital requirements.

The rest of this paper is organized as follows. In Section II, I sketch a very simple model of a bank that provides QAT and chooses its capital structure. The idea is to present a model that captures many of the elements of banking models that endogenize the bank's capital structure choice. I use this highly reduced-form model to first explain the relationship between bank capital and stability. After this, the model is used to explain the various theories that have touched on the issue of bank capital structure, how contagion effects arise, and potential divergence between the privately-optimal and socially-optimal capital structures of banks. Section III then turns directly to the three central questions discussed earlier. Section IV takes up the issue of why bankers are typically averse to higher capital levels. Section V examines the net costs and benefits of crises and discusses capital regulation reform and narrow banking. Section VI concludes.

II. A SIMPLE MODEL OF A RISKY BANK AND ITS CAPITAL STRUCTURE

Think of a three-date model of a bank in a world without deposit insurance. At t=0, a bank has inside shareholders who provide $E(\text{inside})$ of their own equity and raise $\hat{E}_0$ of outside equity as well as debt (all deposits for simplicity) of D_0 that matures at t=1. Let $E_0 = E(\text{inside}) = E_0$. Then the bank invests the total amount $D_0 + E_0$ in: (i) cash and marketable securities equal to C_0 and (ii) loans equal to L_0. The balance sheet must balance, so

$$C_0 + L_0 = D_0 + E_0 \tag{1}$$

The bank's capital structure decision is denoted by $k \equiv \frac{E_0}{D_0 + E_0}$, which is referred to as the bank's "capital ratio" in book value terms. The loans mature at t=2 and are illiquid. If carried by the

bank on its books until t=2, the loans will be worth a random variable, L_2, with a probability distribution $F(\cdot|m,k,\theta)$, where *m* is the amount of screening, monitoring and advising done by the bank and θ is the bank's asset (or risk) choice. One can think of L_2 as the total loan cash flow at t=2. If liquidated at t=1, the loans will be worth a constant $\bar{L}_1 < L_0$.

It is standard to assume that cash and marketable securities are zero-NPV investments, but the bank may earn rents on its loans due to its expertise in credit screening and monitoring. Assume that all agents are risk neutral and the riskless interest rate is zero. Let r_D^0 be the interest rate the bank must promise its first-period depositors, and let $\alpha \in (0,1)$ be the share of ownership inside shareholders must sell at t=0 in order to raise $\hat{E}_0$. The capital market is competitive and when external financing is available, it can be raised to give the bank's financiers an expected return of zero. In the case of deposits, the bank may provide transaction and liquidity services (e.g. Song and Thakor (2007)), in which case the total value of the interest paid on deposits plus the value of these services must be at least as great as the depositors' reservation return of zero. Let $v_1(D_0)$ be the value of these services to the depositors if deposits stay in the bank one period and $v_2(D_0)$ if they stay two periods. The standard assumption is that $\partial v_i / \partial \mathrm{D}_0 > 0 \forall i \in \{1,2\}$.

Let $p \in (0,1)$ be the probability that the first-period depositors will renew funding at t=1 (or equivalently that new deposits can be procured to replace first-period deposits), and $1-p$ the probability that funding will not be renewed (at any price) and the bank will be forced to liquidate its loan portfolio. Let *B* be a bankruptcy cost associated with such a liquidation. For bank *i*, we can write p as a function $p(k_i, K_{-i}, \xi)$, where k_i is bank *i*'s capital structure, $K_{-i} = \{k_1, k_2 ..., k_{i-1}, k_{i+1}, ..., k_N\}$ is the vector of capital structures of all *N* banks in the economy except bank *i*, and ξ is the realization of some exogenous uncertainty at t=1. Although I will suppress

the arguments of r_D^0 to reduce notational clutter, one should think of r_D^0 as a function $r_D^0(k_i, K_{-i})$. If the bank's deposit funding is renewed at t=1, then let $r_D^1(k_i, K_{-i})$ be the deposit interest rate the bank must promise on its second-period deposits.

Suppressing the arguments of p, v_1, v_2, r_D^0 and r_D^1, as well as the superscript *i* on loan, deposits, and cash values for bank *i*, the total value of bank *i* to its shareholders at t=0 can then be written as

$$\begin{aligned} V_0^i = & \iint pMax\left\{0, L_2 + C_0 - D_0\left[1+r_D^0\right]\left[1+r_D^1\right]\right\} dQ(\xi)dF(L_2 \mid m_i, k_i, \theta_i) \\ & + \int [1-p] Max\left\{0, \bar{L}_1 + C_0 - D_0\left[1+r_D^0\right]\right\} dQ(\xi) - \int [1-p] B dQ(\xi) \\ & - W(m_i) \end{aligned} \tag{2}$$

where *W* is the cost of monitoring, recall that *B* is a bankruptcy cost,[21] and the first-period deposit rate, r_D^0 solves:

$$\begin{aligned} & \int p\left\{D_0\left[1+r_D^0\right]+v_1\right\} dQ(\xi) \\ & + \int [1-p]\left[Min\{\bar{L}_1 + C_0, D_0\left[1+r_D^0\right]\} + v_2\right] dQ(\xi) \\ & = D_0 \end{aligned} \tag{3}$$

The expression in (2) describes the expected payoff the bank's shareholders receive, given the deposit pricing expressed in (3). The first term on the right-hand side of (RHS) of (2) is the expected payoff to the bank's shareholders if the bank lasts two periods. The probability of this is *p,* and the shareholders receive the maximum of 0 and the difference between the asset portfolio payoff, $L_2 + C_0$, and the two-period repayment obligation to depositors, $D_0[1+r_D^0][1+r_D^1]$. The expected value of this is computed with respect to the exogenous uncertainty ξ and the

[21] *B* can also be thought of as the charter value the bank's shareholders would lose upon bankruptcy, i.e., it is available only for a solvent bank. In (2), the *B* term can be written as $-B + B(p)B,$ so the term has the same interpretation as the expectation of the bank's charter value if we ignore the constant *B* which does not affect the optimal choices of the decision variables to maximize V_0^i.

random loan payoff distribution *F*. The second term on the RHS of (2) is the bank's shareholders' expected payoff if the bank lasts only one period, and the third term is the expected bankruptcy cost. Both the second and third terms are multiplied with $1-p$. The last term in (2) is the non-stochastic monitoring cost.

To see (3), note that in the state in which the first-period depositors can be paid off and deposits replaced at t=1, depositors receive their full promised repayment amount $D_0\left[1+r_D^0\right]$. This state has probability *p*. With the complement of this probability, the bank is liquidated at t=1 and depositors are paid either their promised amount or $\bar{L}_1+\mathrm{C}_0$, whichever is smaller. Each of these terms includes the relevant value of liquidity and transaction services to depositors, ν_1 or ν_2, expressed as a function of the deposits raised, D_0. This describes the breakeven condition (3) that determines r_D^0.

The expected value of the loan proceeds at t=2, $\int L_2 dF(L_2|m_i,k_i,\theta_i)$, exceeds the promised repayment to second-period depositors,[22] $D_0\left[1+r_D^0\right]\left[1+r_D^1\right]$, at t=2, where the second-period deposit rate r_D^1, solves:

$$\begin{aligned}&\int Max\{L_2+C_0, D_0\left[1+r_D^0\right]\left[1+r_D^1\right]\}dF(L_2|m_i,k_i,\theta_i)\\&=D_0\left[1+r_D^0\right]\left[1+r_D^1\right]\end{aligned} \tag{4}$$

To raise outside equity $\hat{E}_0$, the bank's insiders sell ownership α_i in the bank, which is a solution to:

$$\alpha_i V_0^i\left[1+r_e\right]^{-1}=\hat{E}_0^i. \tag{5}$$

[22] The first-period depositors are repaid $D_0\left[1+r_D^0\right]$, so that the bank needs to raise that amount from second-period depositors and promise a repayment at t=2 equal to the right-hand side of (4).

where r_e is the two-period return on equity demanded by outside shareholders, with

$$[1+r_e] > [1+r_D^0][1+r_D^1]. \tag{6}$$

The bank chooses its screening investment m_i, its capital structure, k_i, and its asset-risk θ_i, taking as given the capital structure choices of all other banks (which will also pin down their choices of m and θ) in order to maximize the value of the initial shareholders' stake in the bank:

$$\begin{aligned} &Max \quad [1-\alpha_i]V_0^i \\ &m_i, k_i, \theta_i \end{aligned} \tag{7}$$

subject to (3), (4) and (5).

Remarks on the Model

The model presented above is quite general because it attempts to include as special cases many different models that have been developed in the literature. I will now discuss various features of the model.

Feature 1: Loan Monitoring: In many models, the bank's capital structure choice impacts its loan monitoring choice, which then affects the bank's loan payoff distribution. For example, higher monitoring may shift this distribution to the right in the sense of first-order stochastic dominance. The monitoring cost, *W*, is typically assumed to satisfy $W' > 0$, $W'' \geq 0$. See, for example, Holmstrom and Tirole (1997), Allen, Carletti and Marquez (2011), and Mehran and Thakor (2011).

Feature 2: Asset Portfolio Choice: The bank can choose which asset to invest in and this choice of θ too is affected by the bank's capital structure choice. Many papers have modeled this, in order to capture the bank's incentive to engage in risk-shifting. That is, the bank may

choose to invest in an excessively risky (possibly socially inefficient) asset either to exploit the deposit insurance put option (see Merton (1977)), or simply due to the usual shareholder-bondholder agency conflict (see Jensen and Meckling (1976)). These risk-shifting incentives get stronger as the bank becomes more highly leveraged, so a bank with higher equity capital is less prone to engage in risk-shifting.[23]

Feature 3: The Direct Effect of Capital Structure on the Bank's Cash Flows: While the bank's choice of k_i affects L_2 indirectly by influencing the bank's loan cash flows, as explained earlier, there can also be a direct effect if bank leverage produces debt-tax-shield benefits or induces its creditors to monitor the bank (as in Calomiris and Kahn (1991)) or solves a hold-up problem (as in Diamond and Rajan (2001)). This is consistent with the assumption in (6) that equity is costlier than debt. Another way that the bank's capital structure can directly impact the bank's cash flows is if core deposits produce rents for banks due to the provision of liquidity, as well as transactions and other services to depositors.[24] For models along these lines, see Song and Thakor (2007), and more recently Allen and Carletti (2013), and DeAngelo and Stulz (2013). This is captured by $\nu_1(D_0)$ and $\nu_2(D_0)$.

Feature 4: Probability of Non-Renewal of Bank Deposits at t=1 followed by Liquidation Depends on the Bank's Capital Structure Decision as Well as the Capital Structure Decisions of Other Banks: A more highly levered bank is more likely to be threatened with liquidation by its creditors, and this liquidation probability may also be increasing in the leverage

[23] There is a large literature that has examined the benefit of equity in attenuating asset-substitution moral hazard, e.g. Biais and Casamatta (1999), Edmans and Liu (2010), and Hellwig (2009).

[24] In many banking theories, the distinction between deposits and other forms of financing is made on the basis of the demandable and sequential-service-constrained nature of deposits. The formulation here recognizes the additional distinction that deposits are not just a way for the bank to raise financing, but also to provide financial intermediation services.

levels of other banks if creditors deduce information about one bank by observing what is happening at other banks. This form of "capital-structure contagion", with cross-sectional commonalities in asset holdings, has been modeled by Acharya and Thakor (2013). Farhi and Tirole (2012) develop a model in which the prospect of imperfectly-informed regulatory forbearance induces banks to become highly levered and make correlated asset choices.

Feature 5: Probability of Non-Renewal of Bank Deposits at t=1 followed by Liquidation Depends on an Exogenous Uncertainty Beyond the Bank's Control or on Insolvency Concerns: The assumption that the non-renewal probability, p, depends on an exogenous uncertainty, ξ, captures the idea that there may be runs on the bank due to panics, sunspots or other phenomena that are unrelated to the bank's fundamentals (e.g. Bryant (1980), and Diamond and Dybvig (1983)).

More in line with practice, we could also make p dependent on asset risk θ or a noisy but informative signal of θ. That is, it can be assumed that some depositors come to know θ at t=1 or are able to get an informative hint about what it will be at t=2. In this case, this signal may raise concerns about the possible insolvency of the bank and cause these depositors to withdraw funding, thereby causing others (who are uninformed) to infer sufficiently bad news that they may wish to follow suit. This then leads to the possibility of runs based on fundamentals, such as those in Chari and Jagannathan (1988). The empirical evidence suggests that such insolvency concerns are typically the reason for bank runs (e.g. Gorton (1988)).

Feature 6: Maturity Transformation−Deposits Mature Before Loans: A key element of the model is that the bank's first-period deposits mature at t=1, whereas its loans mature at t=2. This creates refinancing risk and is at the heart of how a bank could fail. Unlike non-financial corporations, it is possible for a bank's financial health to be in the "eyes of the beholder" in the

sense that the bank is healthy if depositors agree to renew financing, and it is not if they do not. Since their decision to not renew financing may be unrelated to fundamentals, a mere adverse shift in perceptions can lead to a bank's failure. But this problem arises only because banks engage in "maturity transformation", making loans of longer maturity than deposits.[25]

Feature 7: Cash Holdings of Banks and the Demandable Nature of Bank Deposits: In the model, the bank uses a part of its financing raised at t=0 to invest in cash. Banks typically keep far more cash on hand than non-financial corporations. The best way to understand why is to imagine a continuous time set-up in which all deposits are demand deposits, so that a depositor can withdraw his/her funds at any date *t* at a moment's notice. In order to meet these stochastic withdrawal needs, banks will keep cash on hand and typically far more than a non-financial firm. But a standard time-value-of-money argument indicates that holding cash is costly.[26] So the bank must trade off reducing liquidity risk against the cost of holding cash. In the model, it is assumed implicitly that the cash the bank keeps on hand is not enough to fully meet deposit withdrawals at t=1 if all depositors choose not to renew funding.

Feature 8: Bankruptcy Cost Associated with Premature Liquidation: There is a dissipative cost, *B*, associated with the bank being prematurely liquidated at t=1. This may be viewed as the cost associated with the bank losing a valuable charter (Keeley (1990)), or some other form of bankruptcy cost (e.g. Diamond and Rajan (2000)).

Most of the theories of bank capital structure are developed in a setting without deposit insurance, and other forms of government protection, in order to focus on the basic economics of

[25] Hellwig (1994) discusses maturity transformation in the context of the risks it creates for the bank. Bhattacharya and Thakor (1993) and Bhattacharya, Boot and Thakor (1998) explain why maturity transformation is a key financial intermediation service provided by banks and the regulatory issues it raises.

[26] There may be additional costs of holding cash as well, such as Jensen's (1986) free-cash-flow problem.

banking as the determinant of capital structure. The effect of these government guarantees is, not surprisingly, to encourage more leverage, as the discussion in Section IV will show.

III. USING THE MODEL TO UNDERSTAND BANK CAPITAL AND STABILITY: THEORIES AND EMPIRICAL EVIDENCE

The various theories of bank capital and stability can be understood within the context of the model in the previous section. These theories are now discussed, followed by a discussion of the empirical evidence.

A. The Theories

The theories I discuss are those that have addressed the issue of how bank capital is predicted to affect bank lending, liquidity creation and shareholder value in banking. The theories fall in three groups. These groups are for expositional convenience only, and should not be interpreted as competing theories. Rather, they focus on different aspects of the bank's capital structure choice.

Group 1 Theories: Higher Leverage Benefits the Bank Because of Deposit Rents

In the first group are theories in which deposits have rents associated with them, and this induces the bank to favor them as a source of financing.[27] Banks are different from non-financial corporations in the sense that a big chunk of their liabilities is in the form of deposits that are an essential part of the financial intermediation services that banks provide.[28] Different papers focus on different services and hence different sources of rents. For example, Greenbaum and Thakor (2007) go back to the origin of banks as entities where wealth was deposited for safeguarding, and economics of scale in providing this service can generate rents for banks that

[27] The rents can be private rents for the bank or some kind of social surplus or both.

[28] Based on an international sample of banks, Jayaraman and Thakor (2013) report that the average bank in the sample had 8% equity, 75% deposits, and the rest other forms of debt and preferred stock in its capital structure.

develop a special expertise in guarding deposits. Others, such as DeAngelo and Stulz (2013) and Song and Thakor (2007), have focused on the provision of liquidity and transaction services to depositors as a source of rents. In De Nicolo and Turk Ariss (2010), deposit rents arise from the market power enjoyed by the bank. So, just as steel is a factor of production in the making of a car, deposits are a factor of production in what a bank produces. But unlike steel for a car company, deposits are also a bank liability. That is, deposits are both a liability and a factor input for the bank. Neither the Greenbaum and Thakor (2007) nor the Song and Thakor (2007) analysis focuses on bank capital structure – the former is concerned with why banks exist and the latter with the optimal mix of purchased money and core deposit liabilities. However, De Nicolo and Turk Ariss (2010) focus on the capital structure implication of these rents, and DeAngelo and Stulz (2013) argue that these deposit rents are one reason why high leverage in banking is hard-wired by the bank's production process.

While it is true that deposits are a factor of production in banking, this fact alone is *not* sufficient to argue that banking must necessarily be characterized by higher leverage.[29] To see why, note first that the rents associated with the provision of valuable services to depositors represent an important reason why banks are willing to invest resources in building branch networks to gather deposits, and are willing to pay premia for core deposits or branches purchased from other banks, in order to consolidate and get larger (e.g., De Nicolo and Turk Ariss (2010)). But these deposits and associated rents are not inexhaustible. So imagine a bank that has harvested all of the core deposits as is cost-effective for the bank, and it now has a particular D_0 in equation (1). If one wants to impose a high capital requirement on the bank, all that one needs to ask the bank to do is to put as much equity, E_0, on its balance sheet as is

[29] See also Acharya, Mehran, Schuermann and Thakor (2012) for more on this.

necessary to achieve the desired capital ratio $k^* = E_0 / [D_0 + E_0]$. This equity would be *in* addition to all of the deposits that the bank has gathered and would not replace any deposits. Of course, the bank's lending opportunities may not be large enough to fully absorb $D_0 + E_0$, in which case the bank can invest the remainder, $D_0 + E_0 - L_0$, in marketable securities that have zero net present value (NPV).[30] Viewed this way, there appears to be no value loss associated with requiring the bank to finance with as much equity as is deemed efficient for prudential regulation because none of this equity need replace rent-generating deposits.[31]

The reasoning that higher capital requirements can be satisfied without replacing deposits is counter to the standard assumption in capital structure models that the size of the firm is held fixed as capital structure is varied. For example, Modigliani and Miller (1958) also did this in order to hold the firm's investment policy fixed and examine whether capital structure affects firm value. However, it is inappropriate to extend this logic to argue that banks should be highly levered, for reasons indicated in the discussion here ─ as a theoretical matter, the bank should be allowed to get bigger to accommodate higher equity capital after all rent-producing deposits have been gathered.[32] In other words, the result that banks should be highly levered due to the presence of rent-producing deposits should not arise simply because one assumes that the bank

[30] The assumption that unlimited zero-NPV investment opportunities are available is a pervasive assumption in Finance and lies at the heart of basic valuation ─ the NPV rule in capital budgeting. No-arbitrage equilibrium pricing of marketable securities would also imply that what the bank would pay for such securities should equal the present value of the future cash flows of the security ─ a zero-NPV investment.

[31] Note that since the bank is investing the additional equity in zero-NPV investments, outside shareholders' reservation rate return of zero is satisfied, so these shareholders have no reason to deny the bank funding.

[32] One may argue that bigger banks may create bigger "Too-big-to-fail" problems, but the idea of infusing more equity capital in banks is to reduce the probability of banks needing to be rescued in the first place.

has some arbitrary fixed size, thereby ruling out the possibility of having more equity in the bank by fiat.

There are three ways in which the argument above – that there is no value loss from requiring the bank to finance with as much equity as prudential regulators would like – can fail. One is to consider a general equilibrium setting in which there is an aggregate (socially) optimal level of bank deposits, and higher capital requirements can force banks to keep less than that level in deposits.[33] Gale (2010) makes this point in a model in which the socially-optimal deposit level achieves efficient risk sharing between investors with different levels of risk aversion.

A second way, which is a partial-equilibrium variant of the above, is to start with the assumption that banks provide some valuable liquidity service and that there is an optimal bank size, so asking the bank to hold equity can make it too big.[34] DeAngelo and Stulz (2013) have recently argued that asking banks of some optimal finite size to hold equity reduces the bank's liquidity creation, so it is both privately and socially optimal to let banks be highly levered.

The third way in which the argument may fail is if adding equity to the bank's capital structure adversely affects all of the bank's cash flows, not just the marginal cash flows generated by the investment of the additional equity (see Feature 3 of the banking model developed in Section II). In that case, adding equity on top of rent-earning deposits is no longer an innocuous exercise in expanding the bank's portfolio of zero-NPV investments since adding

[33] The idea that the safety and liquidity associated with bank deposits (and similar instruments like Treasuries) has social value is empirically supported by Krishnamurthy and Vissing-Jorgensen (2010), who document that investors are willing to give up yield for safety. Their evidence also suggests, however, that bank deposits are not unique in this regard.

[34] For a formal model of optimal bank size, see Millon and Thakor (1985) where the diversification benefits from getting bigger are traded off against the intrafirm incentive problems that increase with size.

equity changes the bank's capital structure and therefore its cash flows from all its loans. This is the central argument in the group of theories discussed next.

Group 2 Theories: Higher Leverage Benefits the Bank Because It Leads to More Discipline and Hence More Lending and Liquidity Creation by Banks: There are theories that conclude that leverage disciplines banks and thereby elevates lending and liquidity creation. The basic idea is that as uninsured debt increases, there is less equity capital in the bank to absorb losses, so creditors are more exposed to risk. This gives them stronger incentives to monitor the activities of bank management and to raise the cost of the bank's debt to reflect their higher risk exposure.[35] The essence of these theories is that the nature of the debt contract reduces agency costs of various sorts, and that the nature of the equity contract does not lend itself to such agency-costs reduction.

This effect of debt exists in theory for all firms, not just banks. However, it is viewed as being stronger in the case of banks than for non-financial firms because of the demandable nature of bank deposits, and the short-term nature of debt funding in the case of non-depository financial intermediaries. This idea was first exploited by Calomiris and Kahn (1991) who noted that one benefit of the sequential service constraint (SSC) associated with demand deposits ─ depositors who withdraw first are allowed to withdraw all of their deposits and the bank responds sequentially until all its funds are exhausted ─ was that it gave early withdrawers a higher expected payoff than late withdrawers. This, in turn, makes information about the bank's financial condition valuable to depositors and generates incentives for some depositors to engage in costly auditing of the bank. These informed depositors will withdraw their funds if they suspect problems at the bank. Their withdrawals may induce others to withdraw as well,

[35] One should think of this monitoring as being provided by block creditors. See Mehran and Mollineaux (2012).

triggering a run on the bank. The fear of a run can keep the bank honest. The Calomiris and Kahn (1991) argument is that equity lacks this premature-withdrawal threat and is therefore not endowed with the same disciplining potential. The implication is that, absent sufficient demand deposits, the bank will simply be unable to raise the financing needed to make loans.[36]

In similar vein, Diamond and Rajan (2001) proposed that the fragility associated with high bank leverage is necessary for banks to create liquidity. Their argument is that there is a holdup problem in banks. The bank's insider may refuse to collect repayments from borrowers unless the bank's financiers are willing to give the insider a greater share of the surplus. This makes loans illiquid. But if the funding comes in the form of deposits, then depositors can resolve the hold-up problem by threatening to prematurely withdraw their funds. Equity cannot do this. Thus, Diamond and Rajan (2001) reason that high leverage is needed to solve contracting problems in banking in the form of a priori illiquid banks being funded with liquid demand deposits.

The notion that there is potentially some "market discipline" provided by uninsured subordinated debt-holders of banks was codified in the Basel II Capital Accord, which identified three pillars of bank regulation: capital requirements, regulatory monitoring and market discipline.[37]

In practice, there are some who question how effective debt monitoring has been as a source of discipline that impacts the portfolio choices of banks and enhances stability. Deposit insurance eliminates much of the monitoring incentive of retail depositors. Wholesale creditors

[36] Note that the paper only predicts that a *sufficient* amount of demandable debt is needed to discipline the bank and ensure prudent choices; these choices include not only good loans but also adequate capital levels. So, the Calomiris and Kahn (1991) paper is not necessarily a maximum-leverage prescription.

[37] See DeCamps, Rochet, and Benoit (2004).

are not similarly protected. These creditors, especially in the shadow banking sector, seem to have responded to perceived insolvency problems at the institutions they fund by shortening the maturity of the debt they supply. As with Lehman Brothers and Bear Stearns, this maturity eventually shrinks to overnight funding and market discipline is typically manifested in funding being eventually cut off. By the time this happens, however, it is often too late for the institution, which is already insolvent. The shortness of the debt maturity, which may even substitute for debt monitoring that seeks to influence the bank's asset choice, provides creditors a greater measure of protection than longer-maturity debt would, but it also threatens banking stability. The principal value of this form of market discipline must lie in its *ex ante* incentive effect on the bank. But the paradox is that the time that it is observationally most salient that this discipline is working is when creditors actually refuse to renew funding, which means a high posterior probability that the incentive effect failed. Indeed, the strongest incentive effect of debt discipline based on the threat of funding nonrenewal may be to encourage banks to keep more capital, so as to make it less likely that creditors will pull the plug.

Group 3 Theories: Higher Capital Leads to Better Asset Choices and More Monitoring of Borrowers by Banks: There are also theories that have highlighted the positive aspects of bank capital. These theories fall into three subgroups. In the first subgroup are older theories that build on Jensen and Meckling's (1976) insight that there is an asset-substitution moral hazard problem in banking in that equity represents a call option on the bank's total assets, and whose value can be increased by investing in riskier assets (Merton (1977)). Bank capital attenuates this moral hazard.[38] Numerous models have used this argument as their centerpiece. See, for

[38] There are also some papers that argue that excessive equity may perversely induce greater risk-taking by banks, e.g., Besanko and Kanatas (1996), Calem and Rob (1999), and Hellmann, Murdock and Stiglitz (2000).

example, Coval and Thakor (2005), Furlong and Keeley (1989) and Merton (1977), as well as the review by Bhattacharya, Boot and Thakor (1998).[39]

The view that more tangible equity capital is needed in banking to suppress the risk-taking appetites of thinly-capitalized banks is an idea that was in vogue in the 1980s, especially in the aftermath of the S&L crisis in the U.S. This idea was at the heart of many landmark regulatory reforms, such as the Basel I Capital Accord in 1987, FIRREA in 1989, and the FDICIA in 1991.[40] It is also one of the factors that underlies the strong endorsement of significantly higher capital requirements in banking by Admati, DeMarzo, Hellwig, and Pfleiderer (2010).

The second subgroup of theories argues that higher capital improves banks' ability to absorb risk, QAT exposes banks to risks, and these risks go up with the amount of QAT provided by the bank. For example, the greater the liquidity created, the greater are the likelihood and severity of losses associated with having to sell illiquid assets to meet customers' liquidity demands (e.g. Allen and Santomero (1998), Allen and Gale (2004), and Berger and Bouwman (2009)). Capital absorbs risk and expands banks' risk-bearing capacity (e.g. Bhattacharya and Thakor (1993), Coval and Thakor (2005), and Repullo (2004)).

[39] The argument in Coval and Thakor (2005), which contains a theory of financial intermediation based on the idea that intermediaries can provide a "beliefs bridge" between optimistic entrepreneurs and pessimistic investors, is not one of asset-substitution moral hazard. Rather, a bank needs enough capital to be viable in the sense that the capital incents the bank to screen loan applicants and assure investors that only creditworthy entrepreneurs will be funded.

[40] The Basel I Capital Accord was an agreement among banking regulators in countries that were signatories to the Basel Accord to adopt a common set of minimum capital standards that accounted for the (credit) risks in the bank's assets and also off-balance-sheet items like loan commitments. FIRREA stands for the Financial Institutions Reform, Recovery and Enforcement Act. FDICIA stands for the FDIC Improvement Act.

The third subgroup of theories that emphasize the positive role of bank capital relies on the idea that the shareholders of better-capitalized banks have more to lose from bank failure and are therefore more likely to engage in costly borrower monitoring. This idea was given legs by Holmstrom and Tirole (1997) who developed a model in which higher capital provides stronger incentives for banks to monitor their borrowers, and there is an interaction between bank capital and borrower capital. Enhanced bank monitoring not only improves the terms of financing and access to bank credit for borrowers, but also improves their access to non-bank sources of finance because those financiers benefit as well from the improvement in borrower credit quality due to the bank's monitoring. While the Holmstrom and Tirole (1997) model is static, Mehran and Thakor (2011) develop a dynamic variant of it in which bank equity capital serves not only to strengthen the bank's monitoring incentives, but it also enhances its survival probability, and this increases the value of its relationship loans, creating a positive feedback effect that further strengthens the bank's incentive to monitor.[41] Allen, Carletti and Marquez (2011) show that higher bank capital can help the bank increase its market share.[42] These monitoring-based theories of bank capital structure reinforce the idea of the beneficial impact of bank capital in

[41] In a dynamic analysis of the evolution of financial system architecture, Song and Thakor (2010) highlight another role of bank capital. They show that banks and capital markets exhibit three forms of co-evolution. As banks evolve due to improvements in credit screening, they securitize credits of higher qualities. This encourages greater investor participation and stimulates capital market evolution, which makes it cheaper for banks to raise equity capital. This permits the bank to meet the endogenously-generated risk-sensitive capital requirements associated with lending to previously-excluded high-risk borrowers. Thus, greater capital in banking allows the banking sector to serve a larger set of borrowers, and capital market development facilitates this.

[42] This literature takes the existence of valuable bank-borrower relationships as a given and asks how bank capital affects the value of these relationships. Boot and Thakor (1994) develop a theory of how intertemporal loan contracting can foster the development of enduring relationships.

diminishing bank risk and hence enhancing financial system stability that the earlier asset-substitution-moral-hazard theories had highlighted.[43]

Putting the Theories Together: What Do We Learn? At first blush, it appears that these three groups of theories are incompatible with each other, and to some extent, it is difficult to extract a single coherent message from them. Nonetheless, it is useful to begin by first establishing common ground between them.

Consider the Group 1 theories in which deposit rents arise due to liquidity provision. They rely on earlier theories that provide the microfoundations for deposits to provide liquidity services, such as Diamond and Dybvig's (1983) model in which deposits facilitate (across-states) consumption smoothing for depositors or Gorton and Pennacchi's (1990) model in which deposits represent an information-insensitive claim that protects the uninformed against wealth expropriation[44] or Greenbaum and Thakor's (2007) wealth-safeguarding model of deposits. In all of these theories, the value of the bank's services is decreasing in the probability of the bank's failure. That is, safer banks provide more valuable liquidity services. Consequently, higher levels of capital in banks and deposit insurance help to enhance the provision of liquidity services.[45]

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[43] There is another way in which an increase in information-sensitive equity can reduce adverse selection and increase the force of equity-based governance in banking. Boot and Thakor (1993) show that splitting a firm's total cash flows into debt and equity creates a more information-sensitive claim (equity) and stimulates greater information acquisition by investors, lessening the impact of adverse selection on the stock price. This suggests that by increasing equity capital, whose value is not distorted by government guarantees, we can have greater information acquisition about the bank by investors, thereby improving transparency and governance.

[44] Boot and Thakor (1993) show that an optimal security design approach yields the same role for the debt issued by any firm, so riskless debt issued by banks and non-banks provides the same service as an information-insensitive bank deposit.

[45] DeAngelo and Stulz (2013) reach a different conclusion about the relationship between bank capital and liquidity services. A key reason is that the bank's equilibrium asset portfolio in

The Group 2 theories introduce agency problems (absent in Group 1 theories) in risk management and the creation of liquidity services and reach the opposite conclusion – high bank leverage is needed to provide the right incentives and create liquidity. The Group 3 theories also recognize agency problems within banks, but focus on the role of these problems in the bank's relationship with its borrowers. They conclude that higher bank capital leads to more stable banks that create more relationship-lending surplus.

The common ground between the theories in which the role of bank debt in providing liquidity and transaction services is microfounded (that the Group 1 theories rely on to rationalize deposit rents), the Group 2 theories and the Group 3 theories is that higher bank leverage makes individual banks more failure-prone,[46] and may even increase systemic risk (e.g. Acharya and Thakor (2013) and Farhi and Tirole (2012)). Where these theories disagree is on the economic benefit of leverage. The Group 2 theories say that bank leverage provides discipline, whereas the Group 3 theories say the opposite ─ it is equity that provides the

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their model is riskless, so equity capital has no benefit in terms of reducing bank failure costs (as in Diamond and Rajan (2000)) and enhancing bank stability. That is, to provide an economic rationale for high bank leverage in response to a liquidity premium, their model relies on banks endogenously controlling asset risks so that high leverage is consistent with safe debt. But when banks cannot eliminate all asset risks, then liquidity provision may be jeopardized by high leverage, as pointed out by Boot and Greenbaum (1993): "Another possible reason for capital requirements is the risk of bank runs deriving from the liquidity role of banks (see Diamond and Dybvig, (1983)). Since the bank run argument is based on costs associated with the liquidation of the bank's assets, higher capital requirements may convince the public that the value of assets net of liquidation costs will not fall below the value of deposits." Thus, when banks have risky asset portfolios, capital has a potential role to play in enhancing liquidity creation. This point is also recognized by DeAngelo and Stulz (2013) who state: "…in capital structure models that relax our idealized conditions, there can be legitimate, and potentially substantial benefits to regulations that limit bank leverage."

[46] In discussing the disciplining role of bank leverage in fostering liquidity creation, Rajan (1998) notes: "Unfortunately, absent much better financial markets than those that currently exist, the theory suggests we cannot get many of the good things banks do, such as liquidity creation, credit origination, and financial innovation, without banks issuing claims susceptible to runs and thus being financially fragile."

appropriate incentives. But by construction, equity has no governance role in the Group 2 theories and debt has no governance role in the group 3 theories, so juxtaposition of the two viewpoints is difficult. Such juxtaposition is precisely what Acharya, Mehran and Thakor (2013) attempt. That paper recognizes the tension that is suggested between the need for higher leverage to ensure greater market discipline and the need for higher equity to attenuate asset-substitution moral hazard. It proceeds to characterize the bank's optimal capital structure when both market discipline and attenuation of asset-substitution moral hazard are present.

The theories discussed above are concerned with on-balance-sheet lending by banks. But a large portion of bank lending is done via loan commitments, an off-balance-sheet claims. Huang (2010) reports that 77% of new commercial loans in an average U.S. bank's portfolio are under loan commitments, with only 23% being spot loans. Moreover, 46% of banks make no spot loans at all. What is interesting about bank loan commitments is that they are "illusory promises" and the bank need not honor them if it believes that the borrower's financial condition has deteriorated significantly between the date the commitment was sold to the borrower and the date the borrower wishes to exercise it.[47] The flexibility afforded to the bank is not trivial. Huang (2010) documents that many banks did not honor their loan commitments during the financial crisis, especially to relatively risky borrowers. The evidence supports the predictions of the theory developed by Boot, Greenbaum and Thakor (1993) who analyzed the reputational and financial incentives that banks have to honor their loan commitments. One of the implications of their analysis is that banks that are in a stronger position financially will have stronger incentives to not attempt to "liquefy" their reputational capital by reneging on their commitment promises.

[47] Bank loan commitments typically have a Material Adverse Change (MAC) clause that enables the bank to not keep its illusory promise. See Boot, Greenbaum and Thakor (1993), and Thakor (2005).

This means that risky borrowers are less likely to be denied access to funding under loan commitments during an economic downturn if banks are more highly capitalized. This assured access to funding can shorten the economic downturn, so bank capital can serve a countercyclical role.[48]

C. The Empirical Evidence

The central questions posed in the Introduction of this paper ─ whether higher bank capital levels adversely affect bank lending, liquidity creation and the values of banks ─ can only be settled empirically, given the divergent predictions from the theories. I now briefly review the empirical evidence, with the goal of arriving at some broad conclusions rather than providing an exhaustive review.

Let us begin with how capital affects bank screening. The empirical evidence indicates that higher capital leads to stronger incentives for banks to screen borrowers before extending them loans. Purnanandam (2011) documents that banks with higher involvement in the originate-to-distribute mortgage market originated mortgages of poorer credit quality, and that this effect was stronger for banks with lower capital. This is consistent with prediction of the credit-screening theory developed in Thakor (1996). Additional evidence of the effect of bank capital on bank monitoring is provided by Jayaraman and Thakor (2013), who exploit international data on heterogeneous creditor rights to show that it is bank equity, rather than bank debt, that seems to provide stronger monitoring incentives for banks. I now discuss the empirical evidence on the link between bank capital and lending, with the observation that calibrating the (potential) effects is challenging.

[48] In an economic upturn, however, the reputational incentives of banks may lead to overlending under commitments, as shown by Thakor (2005).

When it comes to the effect of bank capital on lending, there are two issues: (i) what happens to bank lending when bank capital levels increase?, and (ii) what happens to bank lending when regulatory capital requirements are increased? These two issues are quite distinct in that, broadly speaking, the empirical evidence suggests that the relationship between the level of bank capital and bank lending is positive in the cross-section and positive intertemporally for a given bank, whereas lending tends to decline (albeit modestly) in response to an increase in capital requirements. Having said this, it is worth noting that separating the effect of capital levels from capital requirements is difficult because changes in level can influence whether the bank is in compliance with requirements.

Consider now the effect of the level of bank capital on lending. In general, establishing a causal link between these variables is a daunting task due to the difficulty in achieving a meaningful segregation of demand and supply effects, and also because the theory predicts that borrower capital is a mediating variable in this relationship (see Holmstrom and Tirole (1997)). However, there are a few papers that have employed clever identification strategies to establish causal linkages. Peek and Rosengren (1997), for example, examine how the depleted capital levels of Japanese banks due to the sharp decline in the Japanese stock market during 1989-92 affected lending by the U.S. branches of these banks. They document that these U.S. branches displayed significantly lower lending in response to the lower capital levels of the parent banks. That is, this was a credit supply shock induced by an exogenous hit to the capital levels of banks.[49] Based on this and other studies (e.g. see the review by Hanson, Kashyap and Stein

[49] Clearly, some of the reduced lending was because the negative shock to capital caused some banks to be out of compliance with capital requirements, but some was also possibly due to the amount of capital being too low to be consistent with the level of lending these banks considered as being prudent given that capital.

(2011)), it appears that when banks experience negative exogenous shocks to their capital, they reduce their lending.

Bank capital can decline not just due to exogenous shocks but also due to the endogenous pursuit of additional rents. De Nicolo and Turk Ariss (2010) follow up their theory with empirical evidence that bank loan and bank deposit rents are highly positively correlated, and larger loan and deposit rents are associated with lower levels of bank capital and higher probabilities of bank failures. They argue that the pursuit of these rents is an important driver of bank consolidation and systemic risk. This indicates that greater bank size can impose bigger social costs, and it appears to be because these banks tend to have lower capital ratios and are systemically more risky.

What about the effect of bank capital on liquidity creation by banks? Using a comprehensive measure of bank liquidity creation that includes both on-balance-sheet and off-balance-sheet items, Berger and Bouwman (2009) document that, for most of the dollar volume of liquidity creation in their sample, higher capital leads to greater liquidity creation. That is, the relationship between capital and liquidity creation is positive for large banks, which create most of the liquidity (81%) in the U.S. economy. The exception is the "small bank" subset in their sample, for which higher capital connotes lower liquidity creation. It should be remembered that what studies like this document are cross-sectional equilibrium relationships, involving each bank being at its privately optimal capital level, with (unobserved) heterogeneity across banks driving different optima.

There is also empirical evidence that having higher capital strengthens the bank's competitive position, and allows it to grow faster by gaining an edge over its lower-capital counterparts in both its deposit and loan markets. Calomiris and Powell (2001) find that capital

enhanced banks' ability to acquire deposits in Argentina in the 1990s. Calomiris and Mason (2003) encountered a similar result for U.S. banks during the Great Depression. And in a study of New York banks in the 1920s and 1930s, Calomiris and Wilson (2004) found that higher-capital banks had a competitive advantage in the market for risky loans.[50] Berger and Bouwman (2013) find that higher bank capital is associated with greater (asset) market share.

Moving to capital requirements, one should be careful to distinguish between an increase in capital requirements and a change in the capital-requirements regime that includes not only a change in levels, but also in structure. For example, the adoption of the Basel I Capital accord and the subsequent passage of FDICIA in the U.S. led to a variety of changes in the structure of capital requirements. Specifically, banks were required to keep capital against off-balance-sheet items for the first time, and capital requirements differed across assets with different degrees of risk. Moreover, intangible items like goodwill were phased out from being considered as capital for regulatory purposes. Thakor (1996) documents that this transition to risk-based capital requirements caused U.S. banks to shift some portion of their asset portfolios away from loans and into government securities with zero capital requirements. This appears, however, to be a *transitional* issue, and one should be cautious not to extrapolate the results to permanent effects.[51]

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[50] Joining together the insights of the group 2 and group 3 theories, one might argue that part of the reason for banks to maintain adequate capital is the refinancing pressure created by short-maturity depositors where willingness to renew funding is predicated on the bank having sufficient equity capital.

[51] Recently, Brun, Fraisse and Thesmar (2013) have used the transition of French banks from the Basel I to the Basel II capital-requirements regime to examine the sensitivity of bank lending to changes in capital requirements. Like Thakor's (1996) analysis, this is a regime shift that involves a change in the structure of capital requirements. They document fairly large effects, but do note that the effects fade over time. Moreover, the transition occurred during 2008, when the global financial crisis was raging and many banks were constrained in terms of capital and liquidity. These considerations, and the fact that U.S. depository

On the issue of higher capital requirements, a relevant question is how quickly banks would be required to operate with higher capital ratios. There is a distinct advantage in asking banks to bring their capital ratios up gradually over time, with a phase-in period of say three to five years.[52] The advantage is that banks can cut back on dividends and build up capital via retained earnings, thereby avoiding adverse-selection costs a la Myers and Majluf (1984) or any perceived ownership-dilution costs.[53]

Phasing in higher capital requirements gradually may also have implications for the competitive reshuffling across regulated banks and unregulated institutions when the former are subjected to higher capital requirements. Aiyar, Calomiris and Wieladek (2012) examine banks in the UK, where regulators have deployed time-varying, bank-specific minimum capital requirements. They document that regulated (UK-owned) banks reduce lending in response to higher capital requirements, whereas unregulated banks (resident foreign branches) increase lending, and that this effect is significant.

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institutions never implemented Basel II, makes generalizations based on their analysis somewhat difficult, but it reinforces Thakor's (1996) finding that the transitional effects may be non-trivial.

[52] For example, when FDICIA was implemented in 1991, banks had a similar time period over which certain intangible components of what qualified as regulatory capital were phased out and had to be replaced by tangible capital.

[53] There may be other benefits as well. Recently, Baker and Wurgler (2013) have highlighted the "low-beta anomaly" in banking. They document that over the past 40 years, banks with higher capital had lower betas but higher realized stock returns, i.e., based on the Capital Asset Pricing Model (CAPM), these banks' shareholders enjoyed higher returns with lower risk. They interpret these higher realized returns as proxying for higher expected returns ex ante and conclude that shareholders in higher-capital banks require higher returns. This implies that higher capital requirements will raise the cost of capital for banks if banks are asked to raise equity to meet these requirements. One way to avoid this higher cost would be to ask the bank to build up capital by retaining earnings, since doing this generates a higher risk-adjusted return for the existing shareholders than paying out those earnings as dividends However, this is subject to the caveat that the evidence that lower-beta stocks earn higher returns is an anomaly in the context of the CAPM.

If one focuses primarily on levels, then the evidence reviewed by Hanson, Kashyap and Stein (2011) indicates that even a very large increase in capital requirements is likely to have a rather modest effect on loan interest rates via its impact on the bank's weighted average cost of capital. Their estimate is that if capital requirements go up by 10 percentage points, bank loan rates are likely to increase by 25 to 45 basis points. The effect of this on lending will depend on the price elasticity of loan demand. Kisin and Manela (2013) estimate that the effect of higher capital requirements on bank profits is likely to be modest.[54] These kinds of studies are useful because they are beginning to address calibration issues that the theories on bank capital structure are mostly silent on, but regulators are particularly interested in.

While much of the literature on this topic is concerned with whether lending declines in response to higher capital requirements, it is not clear whether such a decline, even if it were economically and statistically significant, is necessarily inimical to social welfare. After all, correlated lending choices by highly-levered banks often involve excessive lending, e.g. subprime lending in this crisis and real estate lending during the S&L crisis. So, if lending declines in response to an increase in capital requirements, it may be efficiency-enhancing. Whether it is or not is an important question for future research.

Let us now turn to the relationship between bank capital and bank value. There has been surprisingly little work done on this issue. An exception is Mehran and Thakor (2011). The theoretical predictions of their dynamic model are as follows: (i) total bank value and the bank's equity capital are positively correlated in the cross-section, and (ii) the various components of bank value in an acquisitions context are also positively related to bank capital. Their empirical

[54] Their estimate is that a ten percentage point increase in Tier-1 risk-based capital requirements would cost about $2 billion for all participating banks combined. On a per-bank basis, this is 4% of average annual profits for the average bank, a number dwarfed by the costs to banks of complying with various bank regulations.

tests support these predictions. The results of these tests are consistent with the monitoring-based view of the role of bank capital that features prominently in their theory, and are robust to a variety of alternative explanations for why acquirers pay more for higher-capital targets ─ growth prospects, desire to acquire toe-hold positions, the desire of capital-starved acquirers to buy capital-rich targets, market timing, pecking order, and the effect of banks with binding capital requirements. Because the theory provides a cross-sectional equilibrium relationship between bank capital and value, the paper is careful to note that it is not necessarily a prescription for higher capital requirements.

Thus, it appears that higher levels of bank capital are associated with greater bank lending, more liquidity creation by large banks, bigger market shares for banks, and higher bank values. Moreover, an increase in regulatory capital requirements may be associated with a possibly small effect in terms of reduced lending, although changes in the structure of capital requirements may have non-trivial (transitional) effects, and there may be a competitive reshuffling of lending from regulated to unregulated banks. Nonetheless, financial institutions seem resistant to keeping higher levels of capital, and engage in "regulatory arbitrage" that involves for example, searching for and shifting to activities with lower capital requirements.[55] So the question is: why are bankers so consistently opposed to higher capital requirements? I take this issue up in the next section.

[55] An example of this is provided by Becker and Opp (2013) who examine the effect of a recent change in the manner in which capital requirements are computed for the insurance holdings of mortgage-backed securities. The change replaced credit ratings with regulator-paid risk assessments by Pimco and Blackrock. They document that replacing ratings has led to significant reductions in aggregate capital requirements, and conclude that insurance industry interests in lowering capital requirements, rather than financial stability concerns, drove this regulatory change.

IV. WHY ARE BANKERS AVERSE TO HAVING MORE CAPITAL ON THEIR BALANCE SHEETS?

Banks may prefer high leverage for some of the theoretical reasons discussed earlier. But there may also be other reasons, including differences between the interests of banks and society and those of bank managers and bank shareholders. Without pretending to be exhaustive, I will propose and discuss a few of these additional explanations for bankers' preference for high leverage: (i) the political economy of banking; (ii) tax benefits of debt; (iii) deposit insurance put option effect; (iv) catering to ROE-obsessed investors; (v) funding cost advantage, and (vi) debt overhang.

(i) The Political Economy of Banking

Banking and politics are inseparable; see Calomiris (2010), for example. Because credit allocation by banks affects the relative allocation of resources across communities, it has far-reaching consequences, many of which matter to politicians.[56] Politicians can serve their own economic and social goals by enacting specific regulations that affect this allocation of credit,[57] and the nature of government intervention may depend on the stage of economic development, as argued by Song and Thakor (2012). Bank compliance with such regulations produces private benefits for politicians, in addition to having economic and other consequences for the community. When the cost of compliance is viewed by banks as being too onerous, they may negotiate with politicians and regulators to ease the burden. Since there are many different regulations that are negotiated in this manner, with varying marginal costs for banks and varying marginal benefits for politicians and broader society, there are opportunities for "trade". Banks

[56] For example, Moskowitz and Garmaise (2006) document the social effects of credit allocation, including effects on crime.

[57] For example, the Community Reinvestment Act.

may express a willingness to do more to serve political interests on one dimension in exchange for a lowering of the regulatory burden on another dimension.[58]

Objecting to higher capital requirements may be part of this negotiating game between banks, regulators and politicians. Even if banks do not view the cost of higher capital requirements as a crushing burden,[59] it may be an optimal strategy to represent this cost as high and the impact of higher capital requirements on the economy as being significantly adverse. If banks are sufficiently convincing in their arguments, they may prevail in defeating the push for higher requirements, thereby avoiding the perceived costs of compliance. Even if capital requirements cannot be prevented from going up, bankers' resistance to them may facilitate the negotiation of a reduced burden with respect to some other regulation. Thus, as long as banks perceive some incremental cost associated with higher capital requirements, the political economy of banking may provide the most straightforward explanation for why banks resist higher capital requirements.

(ii) Tax Benefit of Debt

Like other firms, banks too enjoy a tax advantage on debt interest payments relative to dividends on equity. As Modigliani and Miller (1963) showed, this makes high leverage attractive. However, there is nothing special about banks in this regard, so if taxes were the driving force, then why are all firms (that pay taxes) not as highly leveraged as banks? Perhaps the answer lies on the cost side, namely that higher leverage has a lower cost for banks than for non-financials, but outside of government bailout protection—through policies such as "too big to fail" and "too

[58] And I am not suggesting that banks do not view equity capital as costly. Indeed, the rest of this section discusses some of the perceived costs.

[59] Thakor and Beltz (1994) provide a model in which banks and politicians engage in "barter", with banks accepting regulatory burdens like the Community Reinvestment Act and the Bank Secrecy Act in exchange for regulatory benefits like deposit insurance.

interconnected to fail"— and deposit insurance, we need more research to understand why leverage should be less costly for banks than for other firms.

There may also be other reasons why the tax tradeoffs are different for banks from what they are for non-financials. There is growing empirical evidence that corporate income taxes affect banks in at least two ways: (i) If capital requirements are not binding, higher income taxes encourage banks to increase leverage. (ii) When capital requirements are binding, an increase in capital requirements or corporate income taxes leads to more non-bank funding of loans via securitization (see, for example, Hong, Park and Pennacchi (forthcoming)).

There is now direct evidence that the capital structures of banks respond to changes in taxes. Schepens (2013) documents that a 2006 change in the Belgian tax code that permitted tax deductibility of some return on book equity led to a significant increase in bank capital ratios. Schandlbauer (2013) documents than increase in local U.S. state corporate taxes induces well-capitalized banks to increase their leverage and under-capitalized banks to alter the asset side of their balance sheets.

An important difference between banks and non-banks when it comes to corporate taxes is that banks have several close competitors that are exempt from corporate taxes. Included in this list are credit unions, mutual funds, and securitization vehicles. For example, collateralized Loan Obligations (CLOs) participate in syndicated loans and fund them with debt and equity, but are exempt from corporate taxes. Similarly, mortgage-backed and asset-backed securitization vehicles hold real estate and consumer loans that are funded with debt and equity tranches, but are also exempt from corporate taxes. In recent years, mutual funds have been increasingly holding syndicated loans that are funded with 100% equity shares, but these funds pay no corporate taxes.

When banks face higher capital requirements (that force them to give up part of their debt tax shield) or higher income taxes, they become less competitive with respect to their tax-advantaged competitors. This induces banks to drive more loan funding to securitization vehicles, leading to not only a lesser reliance on deposits,[60] but also to less credit screening and monitoring of loans. Empirical evidence supporting this hypothesis appears in Han, Park and Pennacchi (forthcoming).

(iii) Deposit Insurance Put Option

Merton (1977), in a seminal contribution, showed that deposit insurance has an isomorphic correspondence to a common stock put option, and that its value declines as the bank's capital increases. So this would explain why the shareholders of insured banks would be loath to keep high levels of capital. However, empirical estimates (e.g., Ronn and Verma (1986)) have found that the put-option effect is significant primarily for banks with low levels of capital. This means that this effect was dominant for many thrifts ─ which operated like "zombies" with negative net worth ─ during the S&L crisis in the 1980s, but it is unlikely to be a major driver of the behavior of well-capitalized banks during normal times. Nonetheless, I suspect that both deposit insurance and other (less formal) forms of protection such as (no-precommitment) bailouts do play some role in the leverage choices of banks.

(iv) Catering to ROE-Obsessed Investors and Executive Compensation in Banking

It is a mathematical fact that increasing the bank's capital ratio (or reducing its leverage ratio) will reduce its return on equity (ROE) ceteris paribus. However, in a world without taxes, a reduction in ROE due to a reduction in leverage is of no consequence for the bank's shareholder value, if the change in leverage is not a distortion away from an optimal capital structure, and the

[60] Based on the earlier discussion, this may lead to a reduction in social efficiency based on risk sharing and the demand for riskless deposit-like claims.

bank's operating profit is unaffected. The reason is that the reduction in ROE is accompanied by a reduction in the shareholders' required rate of return on equity, since the risk to which equity is exposed declines as more equity is infused into the bank.[61] The only way that an increase in capital in this case can reduce the bank's shareholder value is if there are taxes and, holding the size of the bank fixed, equity replaces debt without affecting the bank's operating profit.[62] But this is the familiar debt-tax-shield argument of Modigliani and Miller (1963), and it is no different from the point that an all-debt capital structure is optimal in this case for all firms; there is nothing special about banks. The various arguments for why an all-debt capital structure is not optimal when various frictions – such as Jensen and Meckling's (1976) agency costs – are introduced are also well known, and apply to all firms.

There is, however, a "market segmentation" view which says that the equity investors of both depository and non-depository financial institutions care about the ROE of the institution, and they do not lower their ROE expectation when the bank increases its capital, either because they like the shield associated with debt or they prefer high leverage due to option effect of safety nets. If this is the case, then the managers of financial institutions may be compensated based on ROE[63] and will prefer high leverage to "cater" to these equity investors.[64] Goodhart

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[61] This argument is more fully developed in Mehran and Thakor (2011), who explain why the usual objections to higher capital requirements do not stand up to careful scrutiny.

[62] It turns out, however, that changes in capital may not leave the bank's operating profit unaffected. Berger (1995) showed that, at least for some periods, higher-capital banks earned higher profits. Mehran and Thakor (2011) document that higher-capital banks earn higher ROEs. More recently, Berger and Bouwman (2013) provide evidence that higher capital is generally associated with higher bank profitability in the cross-section – this is true for small banks at all times and for large banks during financial crises.

[63] Bhattacharyya and Purnanandam (2011) document that many banks had compensation plans tied to short-term earnings, and that these were the banks that substantially increased their systematic risk before the crisis.

[64] Stulz (2008) provides anecdotal evidence consistent with this.

(2013) has argued that compensation-based incentives for bank managers to maximize ROE play a major role in inducing high leverage.

(v) Funding Cost Advantage

Because rating agencies and the bank's creditors know that it enjoys both implicit and explicit government protection against failure, the credit ratings that banks receive on their (uninsured) debt are higher than what they would be in the absence of such protection. Pfleiderer (2012) notes that this ratings advantage may be two to three notches. This means that "protected" bank debt generates an implicit subsidy for the bank in the form of a lower cost of funding that is not available with equity. This creates a powerful incentive for banks to be highly levered and oppose higher capital requirements.

(vi) Debt Overhang

Another reason for banks to resist calls for higher capital may be due to the debt overhang problem described by Myers (1977). If banks are highly leveraged, possibly due to the reasons discussed earlier, and then they suffer negative shocks to their asset values, shareholders would view injecting additional equity into the bank as a negative-NPV project, even if it increases total value of the bank, since the gains from doing so would be shared with the bank's creditors. In the context of banking, debt overhang is a particularly interesting problem because of interconnectedness among banks. Thus, if one bank issues equity to increase capital, it not only benefits its own creditors, but may also benefit interconnected banks. This provides another perspective on capital requirements.

What do we conclude?

It is difficult to say which of these hypotheses has the most empirical validity, and perhaps all of them are at work to some extent. But it appears to me that the political economy of banking,

taxes, a debt-funding-cost advantage for financial institutions due to safety nets, and debt overhang in excessively-leveraged institutions offer plausible reasons for financial institutions to persist in their preference for high leverage. This would also explain why even non-depository institutions like investment banks had such high leverage ratios prior to the recent financial crisis. Having said this, in light of the empirical evidence that high-capital banks appear to enjoy competitive, survival and valuation advantages relative to their low-capital counterparts makes the persistence of high leverage in banks an interesting question to continue to study.

V. WHAT WE HAVE LEARNED AND RECENT CAPITAL ADEQUACY AND OTHER RISK-CONTAINMENT PROPOSALS

In this section, I first discuss whether financial crises are the inevitable cost of having high economic growth, and then attempt to extract an overarching message from the literature discussed earlier. Then I move on to discuss regulatory reform proposals that are responsive to this message.

A. Are Financial Crises the Inevitable Price We Must Pay for Economic Growth?

As mentioned in the Introduction, high leverage in financial institutions has facilitated expanded bank lending which, in turn, has helped ignite economic growth and asset price bubbles, and then led to financial crises when the bubbles collapsed (Reinhart and Rogoff (2009)). One might think that these boom-and-bust cycles suggest that we simply do not learn enough from past mistakes.

An alternative view is that we recognize that high bank leverage sacrifices stability, but we are willing to pay that price for the sake of the benefits we derive from high economic growth during the boom. If this viewpoint is correct, then there should be less hand-wringing over excessive bank leverage causing undesirable financial fragility.

There is some research that lends potential credibility to this alternative view of crises. Thakor (2012) develops a theory of financial innovation in which banks cannot make profits on standard products, so they create innovative financial products on which competition is limited because many potential competitors may disagree that these innovations are worth adopting. However, this disagreement also increases the probability that the bank's investors may choose not to refinance the bank. If sufficiently many banks are unable to refinance, a crisis ensues. The analysis shows that higher capital requirements can reduce this refinancing risk, but at the cost of diminishing financial innovation. Similarly, Brunnermeier and Sannikov (2014) develop a macroeconomic model with a financial sector and financial frictions, and show that securitization and derivative contracts that improve risk sharing may lead to higher leverage and more frequent crises.

While these factors should cause us to pause and rethink the net costs of financial crises, there are two key questions we need to address in this context. First, which way does the causality run—is it high bank leverage that leads to economic booms or it an economic boom that induces banks to become more highly levered? Second, is all of the additional bank lending encouraged by high bank leverage socially efficient or does it lead to negative-NPV investments by borrowers?

On the first question, the theoretical analysis presented in Goel, Song and Thakor (2014) indicates that a boom in real estate prices causes both borrower and bank leverage to *rationally* go up, even though it increases future financial risk. Their model shows that when there is positive fundamental shock to house prices, it requires home buyers to borrow more. Moreover, since higher current house prices rationally imply higher expected future house prices, banks assess that their loans have higher collateral values, which induces banks to increase their own

leverage. This asset-price-cum-leverage boom then makes banks more vulnerable to a negative house-price shock in the future and also increases house-price volatility. The model implies a lagged relationship between bank capital in period *t* and house-price volatility in period *t*+1, and the paper provides supporting empirical evidence for this prediction. This paper therefore suggests that the causality can run from high asset prices to high bank and borrower leverage.

Highly-levered borrowers are prone to be associated with asset-substitution moral hazard and high default risk. Carrasco and Salgado (2014) have developed a model in which there are correlated strategic defaults by borrowers. Some borrowers default because they expect other borrowers to default. Joining together their result with the insights from other papers exposes another dark side of bank leverage. If positive-asset price shocks induces banks to become more highly levered (Goel, Song and Thakor (2014)), then their monitoring incentives become weaker (e.g., Holmstrom and Tirole (1997)) and they make riskier loans (e.g., Mehran and Thakor (2011)). The higher resulting loan defaults for these borrowers may induce other borrowers to default (Carrasco and Salgado (2014)) and hence elevate systematic risk through correlated defaults that threaten many banks in the economy. Eventually, this risk may even become systemic. The second question—whether high bank leverage leads to good or bad additional lending—does not have a conclusive answer. Nonetheless, the empirical evidence does suggest that banks with lower capital invest less in screening borrowers, thereby making loans of poorer quality. See, for example, the paper by Purnanandam (2011) discussed earlier—it provides this evidence in the context of mortgages. This diluted screening expands bank lending as more

borrowers are (erroneously) found to be creditworthy,[65] but such credit expansion creates a fragile foundation for sustained economic growth.

To sum up, asset-price booms fueled by high bank leverage are often associated with diluted screening by banks and thus involve socially-inefficient loans, creating unsustainable economic growth with a high probability of a future crisis. Asking banks to keep higher capital during booms—as part of countercyclical capital regulation—will reduce the incidence of bad loans and diminish the likelihood of future crises. This will not be costless, as some financial innovation, and the economic growth that accompanies it, may have to be sacrificed due to the insistence on higher bank capital during booms. Nonetheless, the achievement of higher capital during booms will have to be through higher capital *requirements* for banks, as the incentives of banks during such periods will be to be more highly leveraged.

If high bank leverage is such a contributor to financial crises, with attendant negative economic consequences, why do we see a recurrence of leverage-induced boom-bust cycles? Thakor (2013) develops a model that provides a possible answer. If the abilities of banks to manage risks are unknown and being inferred over time and there is "model uncertainty" in the sense that economic agents are also learning whether outcomes are attributable to the skills of bankers or are just pure luck, then the longer the good times last, the higher is the (rational) posterior belief that bankers have high skills and that outcomes are skill-dependent. This leads to successively higher levels of risk-taking by banks and asset growth in the economy. Eventually there is a crisis if observed aggregate defaults cause a shift in investors' beliefs to the model

[65] Goel, Song and Thakor (2014) refer to the diluted screening incentive as "intermediation thinning". Screening incentives and lending standards may also be affected by other factors. For example, Sengupta (2014) develops a model in which greater heterogeneity in funding costs among lenders leads to a greater likelihood of screening.

being one of outcomes being luck-dependent and the level of risk-taking that banks are engaged in is considered excessive by investors in that model.

B. What is the Overarching Message?

The theories developed by Acharya and Yorulmazer (2007) and Farhi and Tirole (2012) show that the anticipation of regulatory assistance of some sort when sufficiently many banks fail can induce correlated asset choices among banks, leading to elevated systemic risk. Thakor's (2013) model, discussed earlier, highlights the fact that the elevation of systemic risk is more pronounced during the good times, when loan defaults are low and banks are doing well.

The theories that emphasize the market discipline of debt rely on the threat of creditors cutting off funding as the source of that discipline (e.g. Calomiris and Kahn (1991)). Recently, Acharya and Thakor (2013) have shown that in a setting in which banks make correlated asset choices and creditors are the random recipients of signals about the possible impairment in the values of these assets, there can be a "liquidation contagion" across banks that is induced by their leverage choices. That is, the liquidation of one bank – which can be because of either an idiosyncratic cash flow signal or a systematic asset-value impairment signal received by its creditors – can increase the odds of another bank being liquidated even if its creditors do not observe any adverse signal about their own bank. This contagion effect becomes stronger as banks become more highly levered. Thus, even when the market discipline of debt is effective, it induces contagion due to creditors' insolvency concerns and may cause an increase in systemic risk.

One way for the regulator to respond to this heightened systemic risk is with unconditional bailouts. But as Acharya, Mehran and Thakor (2013) show, this also destroys all market discipline on banks. Moreover, to the extent that bailouts minimize/eliminate haircuts

that creditors would otherwise experience but wipe out bank shareholders, the discussion in the precious section reveals that bank debt gains a funding advantage relative to equity, which further encourages leverage.

The more highly levered the banking system then, the greater the systemic risk – the more likely it is that banks will make correlated asset choices and that they will fail together. As Acharya, Dreschler and Schnabl (2013) have argued, such *en masse* failures require the sovereign government of the country in which these failing banks are domiciled to step up and rescue them, which increases its own indebtedness, generating taxpayer anticipation of higher future taxes to pay down the debt, with attendant adverse consequences for real-sector productivity and growth. In some cases, the borrowing capacity of the country may simply be exceeded by the size of the required bailout, or even if this "event horizon" is not reached, the size of the incremental indebtedness can trigger a sovereign debt crisis due to the negative economic consequences of high government debt that Acharya, Dreschler and Schnabl (2013) discuss.

A simple solution to this high systemic-cum-sovereign-debt-risk is to require banks to have higher levels of equity capital. Granted, some of the putative benefits of bank debt – market discipline, liquidity creation, risk sharing, the provision of a safe and liquid security, etc. – that have been discussed earlier may need to be sacrificed in order to have a more highly-capitalized banking sector. But this may be a cost well worth bearing in order to minimize the specter of catastrophic banking sector bailouts that may simply be unaffordable.[66] In a sense, requiring banks to keep more capital is a form of "private deposit insurance" that protects the government from prohibitively expensive future bailouts.

[66] Acharya, Engle and Richardson (2012) discuss some implementable schemes to regulate systemic risk.

Another simple solution is to have deposit insurance and other forms of government guarantees for depositors limited to "narrow banks". These are financial institutions that issue demandable liabilities and invest in assets that have little or no nominal interest rate and credit risk.[67] This moves the discussion away from capital requirements to redefining the boundaries of the bank in order to limit the safety-net provision exposure of taxpayers. I discuss the merits of this proposal in the context of the theories of why financial intermediaries exist.

Finally, although there has been little recent discussion of risk-based deposit insurance premia as a tool for moderating bank leverage and also curbing excessive risk-taking, the design of such premia deserves greater attention. The Chan, Greenbaum and Thakor (1992) model indicates that incentive-compatible schemes would be difficult to design in perfectly-competitive banking systems, but we are not at the perfect-competition stage in banking, so further research on this as a tool of prudential regulation seems warranted.

C. Reform Proposals to Increase Capital in Banking

The most direct way to inject more capital into banking in order to enhance banking stability would be to simply raise equity capital requirements as a percentage of total assets, including off-balance sheet items, and possibly link these requirements to the bank's (observable) risk. This was discussed by Bhattacharya, Boot and Thakor (1998) in their review of bank regulation in the context of theories of financial intermediary existence, and the importance of doing so has recently been emphasized by Admati, DeMarzo, Hellwig and Pfleiderer (2010), as well as Goodhart (2013). However, as discussed earlier, there are many who believe that increasing capital requirements beyond a certain point can entail costs, including more activities

[67] Prior to the early twentieth century, many U.S. banks functioned similarly to narrow banks, and banking failures were associated largely with banks that deviated from the narrow-banking model (See Pennacchi (2012)).

transitioning from the regulated banking sector to less regulated sectors that have lower capital requirements, such as the shadow banking system.

As an alternative to simply raising capital requirements, some have sought indirect ways to bring more capital into banking. One of these ways was originally proposed by Flannery (2005), who introduced the idea of contingent capital or contingent convertibles (CoCos). A CoCo is debt that is converted to equity in response to a triggering event, such as the bank's capital falling below a critical level. So the bank can operate with relatively high leverage (and avail of all of the perceived benefits of doing so) until things go sufficiently sour that the CoCo conversion transforms some debt into equity. In anticipation of this, the bank's shareholders would, in theory, have weaker ex ante incentive to engage in inefficient risk shifting at the bondholders' expense. Many variants of CoCos, have emerged in a variety of proposals on capital requirements, including French et. al. (2010).

CoCos have the advantage of dealing with some of the distortions caused by high leverage, while satisfying bankers' desire to operate most of the time with relatively high leverage,[68] but they are not without shortcomings. One of these is that it is unclear whether the IRS would allow them to be treated as debt for tax purposes, so the debt-tax-shield argument in favor of CoCos is tenuous.[69] Another potential drawback is the possibility of multiple equilibria. Sundaresan and Wang (forthcoming) show that a CoCo with a conversion trigger based on the

[68] As indicated earlier, one reason why one has to be cognizant of the potential objections of bankers is the political economy of bank regulation. Banks collectively represent a significant group that influences the kinds of regulations that are eventually imposed on banks, so academic views that seem insensitive to these concerns may have limited effect.

[69] As a matter of policy, the IRS does not opine on the tax treatment of hypothetical instruments/situations. Thus, unless an instrument is actually created and used, one cannot say for sure how it will be treated for tax purposes by the IRS. At a New York Federal Reserve conference in 2010, Wall Street analysts expressed skepticism that CoCos would be treated as tax-deductible.

market value of equity does not in general lead to a unique equilibrium for equity and CoCo-bond prices; one gets multiple equilibria or no equilibrium. Moreover, with CoCos, the bank's shareholders bear all of the losses up to a pre-specified amount, but they can shift some of these losses on CoCo bondholders once these losses exceed this amount. Berg and Kaserer (2011) focus on this aspect of CoCos and show that, as a consequence, the kinds of CoCo bonds issued by banks thus far can actually worsen asset-substitution moral hazard and debt-overhang problems. While alternative designs of CoCos may be able to overcome the problems of multiple-equilibria, market-based triggers, debt overhang, and perverse incentives to pursue tail risks (e.g. Berg and Kaserer (2011), and Calomiris and Herring (2011)), there are still many questions about CoCos, such as the appropriate choice of the conversion trigger and its potential manipulation (see Pennacchi, Vermaelen and Wolff (2013) for a design that deals with this) and the wisdom of introducing a new, potentially-difficult-to-value security with uncertain market and tax-treatment prospects.

Other alternatives have also been proposed. One of these is the Hart and Zingales (2009) proposal to require banks to maintain equity levels that are high enough to ensure that the prices of their credit default swaps (CDS) stay below a pre-specified level, and forcing banks to issue equity when CDS prices rise above this level, a proposal aimed at banks with traded CDS contracts. Duffie (2011) suggests that when the bank has unacceptably low capital, it should be required to make a pre-emptive rights offering at a relatively low price to existing shareholders in order to make it very costly for them to not exercise their rights. Exercise of the rights would inject more equity capital into the bank when most needed. Bulow and Klemperer (2013) propose that banks replace all non-deposit existing unsecured debt with "equity recourse notes" (ERNs), which are long-term bonds with the feature that any principal or interest payments

payable on a date when the stock price is lower than a pre-specified price would be paid in stock at that pre-specified price.[70]

One potential criticism of these proposals to get banks to operate with more equity capital is that banks would be forced to give up some debt-tax-shield benefits. Apart from the fact that this objection is of questionable relevance in a regulatory policy discussion of banking stability, it would be conceptually – although perhaps not politically – easy to deal with this by affording special tax treatment for at least some portion of bank dividends, something perhaps similar to the 2006 change in the Belgian tax code.[71] The lost revenue to the Treasury is likely to be significantly lower than the cost to taxpayers of bailing out inadequately-capitalized failing banks. In short, the lost-tax-benefit argument is specious when it is used as an objection to higher capital requirements, and the discussion should include possible changes in the tax code that lessen the tax disadvantage of equity for banks.

Recently, Acharya, Mehran and Thakor (2013) have proposed a new capital requirement design that is intended to inject more capital into banking without diluting any possible incentives that uninsured creditors might have to impose market discipline on banks. Their proposal is to have two kinds of capital requirements – a "regular" capital requirement that could be tier-one capital or just a leverage ratio that includes only common equity as a percentage of total assets (both on-balance-sheet and off-balance-sheet assets), and a requirement to keep

[70] In light of the Sudaresan and Wang (forthcoming) result, both ERNs and the Hart and Zingales (2009) proposal may also be subject to multiple equilibria/non-existence problems. Moreover, if one of the perceived benefits of bank debt is that it provides investors with access to information-insensitive debt claims (a benefit identified by Gorton and Pennacchi (1990)), then the debt involved in CoCos and ERNs is the wrong kind of debt because it is highly information-sensitive.

[71] See the earlier discussion of the Schepens (2013) paper.

additional capital in a "special" capital account.[72] The key innovation is that this special capital account belongs to the banks' shareholders as long as the bank is solvent, but if the bank has to be bailed out, this capital accrues to the regulator rather than the bank's creditors. Thus, as far as the bank's uninsured creditors are concerned, the special capital is invisible because they can never get it. This means the creditors' incentives to monitor/discipline the bank are unaffected by this special capital. However, the shareholders do risk losing it in the event of failure, so they have more skin in the game and their risk-shifting propensity is weakened. The scheme thus generates equity discipline by increasing the shareholders' exposure, while at the same time it does not make the creditors' claim any safer, thereby preserving debt discipline as well. This is particularly germane in their analysis when the possibility of a government bailout is introduced, because this destroys debt discipline. In the dynamic version of their model, a combination of keeping the bank's creditors from taking possession of the special capital account in the event of an idiosyncratic failure of the bank and regulators adopting a state-contingent bailout policy allows both debt and equity discipline to operate at the same time.

D. Narrow Banking

As Pennacchi (2012) notes, narrow banks have existed for hundreds of years and there are many kinds of narrow banks, ranging from a 100% Reserve Bank—a bank that keeps all of its deposits as cash or reserves with the central bank—to collateralized demand deposit banks that raise funds through demand deposits and invest them in money market instruments with low credit risk and interest-rate risk. Following financial crises, it is common for narrow-bank reform proposals to emerge as an organizational form that should be adopted broadly for all banks, with (insured)

[72] Acharya, Mehran and Thakor (2013) propose that this special capital account be built up via retained earnings, so as to avoid adverse-selection and transactions costs associated with issuing equity in the market. They also advocate requiring the bank to invest it in a relatively safe and liquid security like a U.S. Treasury bond.

demand deposits being essentially backed by an equal amount of relatively safe marketable assets as collateral. For example, Pollock (1992) proposes that only such deposits should be insured and all other non-demandable bank liabilities should be uninsured. Merton and Bodie (1993) offer a similar proposal but require that the collateral be restricted to U.S. Treasury bills or equivalent instruments. Given investments in such safe assets, they reckon that deposit insurance is unnecessary. Other variations have been proposed recently. Kotlikoff (2010) proposes having two kinds of mutual funds, one that operates like a Reserve Bank and offers payment services, and another that purchase risky loans via auctions and finances these loans with equity issues to investors. Ricks (2012) has made a proposal that combines narrow banking with capital requirements. In this proposal, banks have deposit insurance and pay risk-based insurance premia. Investments would initially be limited to safe assets like cash reserves and Treasury bills, with banks being allowed later to invest in loans, but being required to hold more capital and pay risk-based deposit insurance premia at that time.

While none of these proposals has been implemented, it is useful to consider their merits on theoretical grounds. I will discuss this from the vantage points of two sets of theories: those that emphasize the liquidity creation services banks provide to depositors (e.g., Diamond and Dybvig (1983)) and those that emphasize the screening and loan origination services banks provide to their borrowers (e.g., Coval and Thakor (2005) and Ramakrishnan and Thakor (1984)).

If the *raison d'etre* for a bank is to provide liquidity services, or consumption smoothing as in Diamond and Dybvig (1983), then a narrow bank that finances largely with demand deposits and invests mainly in Treasury securities of various maturities seems well equipped to provide these services. Because all of the bank's assets are invested in securities that are traded in a liquid market, the bank should be able to satisfy any interim withdrawal needs of its depositors by either selling these securities at a moment's notice or by offering them as collateral to obtain funds instantaneously

from the central bank or another bank. Such a bank can therefore provide some maturity transformation services without taking credit risk. Unlike the bank in Diamond and Dybvig (1983) that can be brought down by a bank run due to its illiquid asset investments, the narrow bank can provide depositors the necessary consumption smoothing (and more broadly liquidity and payments services) with minimal risk of a bank run.

Now consider the bank as a provider of screening and loan origination services. Clearly, a narrow bank would not provide these services for risky loans. However, banks that provide these services ought *not* to be financed with (insured) demand deposits. These loans can be financed with a combination of equity and long-maturity debt. Thus, the economy would have two kinds of banks—narrow banks that would have insured demand deposits and would provide payments and other services to depositors and uninsured banks that provide asset services but avoid demand deposit financing.

The main idea behind such a two-bank-types structure is that financial intermediary existence theories that focus on the bank's role in asset-side services (loan screening, origination, monitoring, etc.) do not require the bank to be funded with (sequentially-service-constrained) demand deposits.[73] And financial intermediary existence theories that rely on the provision of services to demand depositors do not rely on the screening/monitoring value generated by the bank for its borrowers. The narrow bank proposal essentially splits these asset and liability services, stipulating that deposit insurance be limited to the narrow bank that provides services on the liability side of the bank's balance sheet. The reason for providing deposit insurance for the narrow bank is that it is exposed to some interest-rate risk due to its maturity transformation. For the same reason it would be required to have some equity capital.

[73] In Diamond and Dybvig (1983), a bank run arises in part because demand deposits satisfy a first-come-first-served constraint called the "sequential service" constraint.

While the insured narrow bank can operate with relative low equity, the uninsured banks may be subject to higher capital requirements if there are social externalities associated with the disruption of relationship lending[74] due to bank failures that are not internalized by individual banks, and the government cannot credibly precommit to not bailing them out, as we saw during the crisis of 2007-09. However, one might also argue that this uninsured segment of the financial services industry ought to be left truly uninsured and the government should avoid bailouts as well as capital regulation, letting market forces dictate how much capital these banks keep.

There is nothing radical about having capital requirements and other forms of prudential regulation associated with financial intermediaries that do not have deposit insurance. Such requirements have existed for uninsured intermediaries (like brokerage houses, investment banks and the like) for quite some time. But clearly the nature of capital regulation will change in an economy with insured narrow banks and uninsured banks with a much broader lending mandate. In a sense, the sector of the economy we currently call "shadow banking" would expand, but these banks would be subject to higher capital requirements.

I should note that such a proposal, if implemented, would *not* be without potential economic costs. Besides making loans, banks also make loan commitments (see, for example, Boot, Greenbaum and Thakor (1993)). Kashyap, Rajan and Stein (2002) have shown that there are cost synergies for banks that have liquid assets on hand due to demand deposits and have a demand for access to that liquidity by borrowers who have purchased loan commitments. It therefore makes economic sense for the same intermediary to accept demand deposits and make risky loans via loan commitments. It would be interesting for future research to examine the cost-benefit tradeoffs of narrow banking in a model that is sufficiently general to capture the risk-mitigation benefits of

[74] See Boot and Thakor (2000) for an analysis of relationship lending.

narrow banking, the potential economic costs of functional separation in banking, and the optimal prudential regulation that would emerge in such a setting.

VI. CONCLUSION

In this paper, I have reviewed the literature on the relationship between bank capital and stability. Higher capital contributes positively to financial stability. On this issue, there seems to be little disagreement.

There is, however, disagreement in the literature on whether the high leverage in banking serves a socially-useful economic purpose, and whether regulators should permit banks to operate with such high leverage despite its pernicious effect on bank stability, and this disagreement seems at least as strong as that over the causes of the subprime crisis (see Lo (2012)). Some of the disagreement over higher capital requirements is between those who emphasize the potential benefits of this in terms of reducing systemic risk and those who believe that sufficiently high capital requirements will generate various costs (e.g. lower liquidity creation) and cause key financial intermediation services to migrate to the unregulated sector.

This disagreement is actually valuable because it raises the important issue of calibration: how high should capital requirements be before these costs exceed the stability benefits? We do not have a strong base of research to answer this question. Our theories are primarily qualitative in their characterizations, so definitive statements about the precise levels of optimal capital requirements are elusive. But more empirical research along the lines of Hanson, Kashyap and Stein (2011) and Kisin and Manela (2013) can yield useful insights on this. Theoretically, some progress may be made by settling the issue of whether capital requirements ought to be designed to protect against systematic tail risks, being cognizant of what we have learned about the

potentially endogenous dependence of these risks on the capital structures of systemically important institutions.[75]

I have also discussed a variety of possible reasons why banks themselves may oppose higher capital requirements, and that we would do well to not only understand the academic arguments on this issue but also the arguments of bankers and the political economy of capital regulation. A factor of some significance in this may be that bank managers often have compensation that rewards them for ROE, suggesting that regulatory concern with the level of executive compensation may be misplaced. What matters more are the conditioning variables for compensation.

One point of view about capital regulation appears to be that bank capital structures are optimally chosen in equilibrium, so capital requirements that distort leverage choices away from these (private) optima will generate costs that we should try to avoid, or at least balance against the benefits of enhanced stability that come with higher capital. Although these private optima may maximize bank equity value, the distorting effects of government safety nets can create a gap between what is privately optimal for banks and what is optimal for society, so the tradeoff is between the social benefits of higher bank capital and its costs as perceived by banks. The other point of view is that even though observed capital structures may be privately optimal, these may be the private optima of bank managers, and may diverge even from bank value maximization.[76] In this case, evidence on the positive cross-sectional relationship between bank capital on the one hand and lending, liquidity creation and bank value on the other would suggest

[75] If large and interconnected institutions—those considered to be important systemically—take on systematic tail risks, these tail risks can easily become *systemic* in that they threaten the whole system.

[76] The Bhattacharya and Purnanandam (2011) paper provides some evidence consistent with this. It shows that executive compensation may have induced bank managers to make risk choices that benefited managers but not shareholders.

potential benefits even to the shareholders of individual banks from capital regulation that elevates capital levels in banking.

Given the disagreement in the theoretical literature about the desirability of raising capital requirements to enhance banking stability, and the fact that the empirical evidence, while highlighting the benefits of higher capital in the cross-section of banks, does not conclusively settle the issue, we could research this topic for a long time without achieving consensus. In the meantime, policymakers must decide. And their decisions have profound consequences. To guide these decisions I believe the perspective in Section VB is useful. Higher capital in banking should be thought of as "private deposit insurance" that reduces the contingent liability of the government related to prohibitively expensive future bailouts. These bailouts are necessitated by the correlated failures of highly-leveraged banks making correlated asset choices that endogenously create systemic risk. Higher capital in banking can stanch this systemic risk by altering incentives at the individual bank level, and thereby diminish the threat of a sovereign debt crisis engendered by the need for a dramatic increase in government debt to finance a bailout of the banking industry. These benefits seem large enough to justify the possible loss of bank-level as well as social benefits associated with the replacement (in the aggregate) of some bank debt with equity. Changes in the tax code to reduce the tax disadvantage of equity would lessen the bank-level cost of reducing leverage and facilitate a transition to higher capital levels. Moreover, it would be best to achieve the transition in a phased-in manner, so that banks can build up higher capital levels via lower dividends and higher earnings retentions. This will avoid adverse selection and other costs associated with equity issues. Making more effective use of risk-based deposit insurance pricing may be a useful complement to capital regulation.

There are many important questions for future research. The first among these is: if banking stability is an important goal, how can regulators, anticipating the political economy of banking, come up with implementable approaches to adopting significantly higher capital requirements? Second, how do we deal with the shadow banking system and the inclination of regulated entities to circumvent capital requirements on regulated activities? As the recent crisis illustrated, the shadow banking system is large and can threaten financial stability. Third, banks that are "too big to fail" or "too interconnected to fail" can jeopardize financial stability by getting into financial distress. Should such banks be asked to keep more capital and if so, how much more? How useful will stress tests be in the calibration required to address this question? Fourth, what is the interaction between bank capital, interbank competition and financial crises?[77] Fifth, will making banks less opaque by requiring greater information disclosure make banks less fragile?[78] Sixth, what does an *integrated theory* of capital structure – one that characterizes the optimal capital structures of non-financial firms and financial intermediaries within the *same* model – look like?[79] Finally, what are all of the tradeoffs involved in the implementation of narrow banking?

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[77] Anginer, Demirguc-Kunt and Zhu (2014) document that greater competition causes banks to take on more diversified risks and reduces systemic risk.

[78] Surprisingly, the answer is no if the information is about bank strategy and subject to multiple interpretations. See Thakor (forthcoming), who shows theoretically that greater disclosure may lead to greater disagreement and elevate the bank's refinancing risk, even though its lowers its initial cost of capital.

[79] This is of potentially great theoretical significance because the current debate on bank capital seems to be hampered by a theoretical schism between those who argue that Modigliani and Miller (1958) and theories of capital structure for non-financial firms have no relevance for banking and those who argue that there are many lessons from these theories that carry over to banks (e.g. Miller (1995)). For recent papers that have developed integrated models of capital structure for banks and non-banks, see Gornall and Strebulaev (2013) and Thakor (2014b).

These are towering challenges for future research, but their exploration promises to significantly deepen our comprehension of the relationship between bank capital and stability. What may emerge is a more nuanced understanding of the manner in which higher capital requirements should be designed to dampen systemic risk, reduce the extent to which banks dip into the public till in providing their financial intermediation services, and overcome some of the political-economy impediments to implementing these requirements that have been discussed in this paper. The importance of such advances is hard to overstate, given how high the stakes are in increasing bank stability and diminishing the devastating and protracted real losses associated with financial crises.

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