Bank Capital Regulation: Theory, Empirics, and Policy[1]

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ABSTRACT

Minimum equity ratio requirements promote bank stability, but compliance must be measured credibly and requirements must be commensurate with risk. A mix of higher book equity requirements, a carefully designed CoCos requirement, cash reserve requirements, and other measures, would address prudential objectives better than book equity requirements alone. Basel III's ill-defined liquidity ratios, book capital ratios and internal models of risk must be replaced by a system of credible, incentive-robust rules that combine valid concepts with objective, market-based information into a simplified and credible regulatory process. Raising minimum capital requirements will not be socially costless; bank profitability, share prices, and loan supply are likely to suffer. But avoiding the dramatic consequences of banking crises would more than repay those costs.

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I. Introduction

The global banking crisis of 2007-2009 revealed that many of the largest financial institutions in the world had been financing extremely risky mortgage lending and other activities. When losses arose the amount of equity finance used by those institutions – a buffer that is supposed to prevent bank loan losses from producing defaults on banks' debts – proved inadequate. Some banks were unable to roll over their maturing short-term debts, which provoked a scramble for liquid assets, declines in the prices of risky assets, and a contraction in the available supply of bank credit. Was this just bad luck or did the crisis reveal deep flaws in the prudential regulation of banks? How can regulatory reform best ensure that such crises are unlikely to recur?

This paper addresses questions about prudential capital regulation that are critical to regulatory policy. The discussion is organized as a set of nine specific questions, which build in logical sequence. We divide the discussion of these key questions into six broad sections: Section II summarizes theoretical perspectives on the need for capital in banking, the need for equity capital ratio regulation, and the costs and benefits of raising minimum equity capital ratio requirements (questions 1-3). Section III discusses some empirical evidence about those costs and benefits (question 4). Section IV assesses the adequacy of current capital requirements in light of these considerations (question 5). Section V identifies the pitfalls of relying on book equity requirements as a regulatory tool (question 6). Section VI considers how to mitigate those pitfalls by combining minimum book equity ratio requirements with other prudential tools (questions 7-8). Section VII connects the prior discussion of "micro-prudential" issues in capital regulation (related to the safety and solvency of regulated banks) to the recent advocacy of using capital regulation for "macro-prudential purposes" – namely, to stabilize aggregate lending, to contain

asset price bubbles, or to have other macroeconomic influence on the financial system or the economy (question 9). Section VIII concludes.

Organizing the discussion in this way allows us to build a case for a particular approach to prudential capital regulation. We show that the effectiveness of book equity capital requirements would be enhanced if they were combined with a carefully designed contingent capital (CoCos) requirement, a cash reserve requirement, and other measures. The focus of the Basel III system on ill-defined concepts of liquidity ratios and book capital ratios and internal models of risk does not provide a credible basis for faith in capital adequacy. This approach must be replaced by a system of credible, incentive-robust rules that revolve around objective, market-based information. Raising minimum capital requirements will not be socially costless; bank profitability, share prices, and loan supply are likely to suffer. But avoiding the dramatic consequences of banking crises – and their significant costs in the form of fiscal strains on taxpayers and lost GDP – would more than repay those costs.

The paper should not be mistaken for a thorough review of the literature. We do not attempt to include all relevant issues or all points of view, nor do we present theoretical and empirical evidence in great detail.[2] Rather, we summarize what we regard as some of the most important theoretical and empirical perspectives, and integrate them within a coherent framework, in order to derive implications for desirable reforms. For the sake of brevity, and to maintain a clear expositional focus, we do not explain here the relative shortcomings of all

[2] For example, our discussion of macro-prudential regulation does not discuss the potential tradeoffs involved between the use of capital requirements or loan-to-value ratios as regulatory tools, nor do we provide a detailed analysis of the history of capital requirements in banking, the evolution of the Basel capital standards and their deficiencies, or a discussion of the many alternative approaches to capital standards undertaken in other contexts (e.g., innovative approaches to risk-based capital regulation undertaken in Chile in the 1980s or in Argentina in the 1990s).

alternative points of view about regulatory policy (e.g., the Basel III system). For the same reasons, we do not address every relevant question about capital standards.

II. Theory

1. What is the role of equity in a bank's financing structure?

Equity serves two crucial functions. Ex post facto of a bank's investment realizations, equity is a first absorber of losses, which thereby reduces the risk of default on senior (debt) financing, which also reduces the exposure of the insurers of those debts in the presence of a public safety net. Ex ante facto, higher equity incentivizes good risk management; so long as there is a sufficient amount of equity relative to assets, and so long as the bank manager's incentives are aligned with equity owners, managers will face strong incentives to exert the appropriate effort to manage risk properly.[3]

2. What is the role of setting minimum equity-to-asset ratio *requirements* as part of prudential bank regulation?

Left to their own devices, bank managers who control banks' capital structure decisions may not face incentives to raise sufficient equity relative to debt. This can occur for three reasons: (1) Bank failure may have social costs (externalities) – such as those related to contractions of credit supply or disruptions of the payment system – that are not internalized by the providers of bank funding. (2) The presence of safety nets that protect bank creditors create potential subsidies for risk

[3] Frequently, in theoretical models of banking, equity's role in incentivizing good behaviour is confined to "inside"equity, owned by the manager/owner of the bank, which is combined with outside debt to finance the bank, as in Calomiris and Kahn (1991); Holmstrom and Tirole (1997, 1998); Calomiris, Heider and Hoerova (2014). The latter article conjectures that a combination of outside equity, inside equity and outside debt works similarly in environments where corporate governance of outside equity holders provides them with adequate discipline over management.

taking which can, and have, led bank stockholders to encourage bank managers to game the safety net by increasing cash flow risk and maintaining the minimum amount of capital.[4] (3) Bank managers may face incentives to increase risk at the expense of shareholders if managers obtain private benefits from maintaining high default risk and if the prudent management of risk in the interest of shareholders is not contractible.

Minimum equity-to-asset ratio requirements will only have a binding effect on banks' behaviour if they are set above the level that banks would otherwise choose voluntarily, based on managerial reactions to market discipline. Even when equity requirements are binding, banks will still set their actual ratios above the minimum requirement. Buffers are a way to insure against a violation in regulation that may occur due to a sudden loss. Buffers also can insure against changes in requirements – if the requirement is increased, banks can draw on their buffers to satisfy part of the increased requirement. In the UK, where it has been possible to observe banks' responses to numerous changes in bank-specific minimum equity ratio requirements, banks do indeed draw down their buffers temporarily when adjusting to higher requirements.[5]

3. What are the social benefits, and what are the social costs, of raising minimum bank equity-to-asset ratios?

The main benefit of higher equity-to-asset requirements is reducing bank default risk. Increased stability, as already noted, may reflect better risk management and greater allocative efficiency because of the incentive benefits for risk management of maintaining higher equity capital.

[4] For a brief list of the relevant literature, see Calomiris and Haber (2014), pp.461-462.
[5] Aiyar, Calomiris, Hooley, Korniyenko, and Wieladek (2014).

The social costs of raising minimum equity ratio requirements consist of two types: (1) those borne within the financial system, including inefficiencies in the operation of banks, and diminished wealth of bank stockholders when equity capital ratios are required to be either too low or too high, and (2) costs borne by the non-financial sectors – especially by would-be bank borrowers – if excessive equity requirements result in reduced lending. The latter category are only social costs if those borrowers' projects are worth funding (have positive net present value) and if they would not be funded in the absence of bank credit (that is, if these beneficial projects are dependent on bank lenders, as opposed to other sources of funding).

Optimal Capital Structure Models and Their Implications

If minimum equity ratio requirements lead banks to raise equity in the market, one cost of issuing equity rather than debt to fund bank assets has to do with "signalling." As Myers and Majluf (1984) show, there can be large adverse selection costs associated with raising external equity that result from information asymmetries—that is, the possibility for significant differences between management's and other insiders' view of a company's future earnings prospects, and what outside investors believe, and hence the market price reflects. Such adverse selection costs are reflected, first and foremost, in the negative average market reactions to the announcement of equity offerings.[6] To the extent that such price drops force issuers to raise equity at prices that are well below fair value, such offerings end up "diluting" the value of existing shareholders. This cost leads banks to avoid equity offerings more than they otherwise would. As we discuss further below, adverse-selection costs associated with meeting an increased minimum equity ratio requirement

[6] Adverse-selection problems are also reflected in the much higher underwriting costs paid by companies to issue equity rather than debt, which reflect attempts by issuers to overcome asymmetric information problems during "road shows" in which their investment bankers meet with institutional investors to explain the issuers' motives for raising capital and attempt to allay any concerns they may have about the prospects of the issuer. See Calomiris and Tsoutsoura (2010).

do not just imply a one-time cost of adjusting to a new steady state equilibrium; rather, the costs of maintaining a higher capital ratio are ongoing in the future because the higher required ratio implies the need for greater future offering of equity as well.[7]

Another class of models focuses on the positive disciplinary and incentive consequences of debt contracts. Equity offerings do not confer on equity holders the same control rights that debt holders enjoy in low-return states of the world. This implies control advantages of debt. In some of these models, choosing the right combination of debt and equity (and a sufficiently high proportion of debt relative to equity) can lead to efficient future transfers of the control of the bank to creditors under certain states of the world, which can also encourage diversification of a bank's lending portfolio and truthful revelation of investment outcomes by bankers, all of which reduce bank funding cost.[8] In other models, the right combination of equity and debt can provide bankers with incentives to perform their jobs better or to manage risk more efficiently, which also reduces banks' overall funding costs. Setting required equity ratios either too low *or too high* can reduce managerial incentives to manage risks properly. When incentives of managers and stockholders are aligned, the main risk comes from setting equity requirements too low, which reduces managerial incentives to manage risk, particularly in the presence of a safety net. When incentives of managers and stockholders are not aligned (for example, in very large banking organizations, with highly fragmented ownership structures), too much equity can promote inefficiency by removing an

[7] Recognizing their own informational disadvantage and managers' incentives to issue overpriced securities (or at least to avoid issuing undervalued ones), investors usually respond to announcements of new equity offerings by reducing the value of the shares. As a general rule, the larger an issuer's growth opportunities as a percentage of total value (as represented by its price to book ratio), the less negative the market reaction to the announcement of an equity offering (Jung, Kim and Stulz 1996). But in cases where mature companies with limited (if any) profitable opportunities announce they are raising equity, the market reaction is likely to be severely negative.

[8] Diamond (1984); Ramakrishnan and Thakor (1984); Calomiris and Kahn (1991).

important source of discipline over managers that results from heightened risk (which can lead to the loss of managerial control).[9]

Still other models show that issuing low-risk, short-term debt in combination with equity can provide non-pecuniary liquidity benefits to the holders of the debt (especially depositors), which increases demand for the debt and allows bankers to save on funding costs.[10]

In summary, apart from the distortions introduced by tax treatment of debt and safety net subsidies, there are many good theoretical reasons to believe that efficient banking arrangements naturally lead banks to target an optimal ratio of debt to assets that is heavily weighted toward debt. Forcing banks to maintain equity ratios higher or lower than the amount implied by models of efficient contract choice will, therefore, negatively affect bank performance.

The social costs of imposing inefficiently high equity financing requirements on banks are not limited to their effects on bank profits. One implication of the various models of optimal capital structure is that an excessively high equity-to-asset ratio requirement will reduce banks' willingness to lend. When a bank is forced either by sudden equity losses or by increased regulatory requirements to raise its ratio of equity to assets, it may decide to reduce lending rather than raise equity. A significant contraction of credit can adversely affect economic growth.

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[9] Holmstrom and Tirole (1997) and Calomiris, Heider, and Hoerova (2014) discuss the incentive consequences of inadequate capital in banks where managers and ownership are aligned. Kashyap, Rajan and Stein (2008) consider the case of misaligned incentives. The recognition that there may be significant conflicts of interest between managers and shareholders at large banks, and thus significant costs from requiring excessive equity ratios, does not imply that managers always act contrary to the interests of shareholders, or that shareholders are unable to exert any influence over managerial decisions. Laeven and Levine (2009) and Cheng, Hong and Scheinkman (2013) find evidence suggesting that blockholders in large banks are sometimes able to encourage risk taking. See also Claessens, Djankov, Fan and Lang (2002). Firms may be able to reduce the cost of raising outside equity by adopting corporate governance reforms, but doing so is not costless (see Calomiris and Carlson 2014, who analyse the corporate governance practices of national banks in the 1890s).

[10] Gorton and Pennacchi (1990); DeAngelo and Stulz (2013); Gorton and Ordonez (2014).

Moreover, it is worth emphasizing that the reduction in loan supply that comes from raising equity ratios is not just a one-time cost. A higher required equity ratio will mean that, as the banking system grows, a larger percentage of bank equity will have to be raised externally rather than through the retention of earnings. Because it is costly to raise outside equity (in large part because of the signalling and agency costs mentioned earlier), banks will face permanently higher funding costs, which in turn will permanently reduce the supply of lending relative to a world with lower equity ratio requirements.[11]

This is not to say that all of the reduced lending that results from higher equity ratio requirements is socially undesirable; to the extent that safety-net distortions that remove market discipline over bank risk management encourage banks to engage in excessive lending relative to the social optimum, forcing banks to curtail lending may be beneficial. Or, even if safety nets are non-existent, if banks do not properly internalize the social costs of taking risks, forcing them to maintain equity ratios in excess of what they would choose in the absence of requirements may be socially beneficial even if it results in lower bank lending and lower economic growth.

Imposing equity ratio requirements that force banks to maintain higher ratios than they otherwise would does not always result in reduced credit supply. If banks have suffered adverse

[11] A simple example illustrates why this is so. Assume that a banking system with initial size of 100 grows at the rate of 3% per year. Assume that banks earn 1.2% of assets per year in interest and fees net of non-interest expenses, and pay 1% to insured depositors. If banks were required to maintain a 10% equity ratio, after their first year of operation they would be able to pay interest of 90 cents and retain 30 cents to meet the 3% growth in required equity. Abstracting from any future loan losses, the banks in this system would never have to go to the public market to raise new equity. If this same banking system were required to meet a 15% equity requirement, it would pay 85 cents in interest in the first year, and not have enough in retained earnings (35 cents) to grow its equity in the first year by the required 45 cents (3% of 15). Thus, in the system with a 15% equity requirement banks need to raise external equity of 10 cents in the first year, and higher amounts in every following year. We note, however, that while the cost of raising new equity is ongoing under the higher capital ratio requirement, as the minimum required ratio becomes higher the dilution cost per dollar of capital raised in the market likely declines. Signalling costs should be increasing in risk, and so, if higher equity ratios reduce the riskiness of equity, signalling costs of new offerings will also be reduced.

shocks, they may find themselves operating in a situation of "debt overhang" (Myers 1977), where their equity ratios are below the efficient level but they face incentives not to raise equity because doing so does not increase the value of existing equity shares (i.e., much of the advantage of raising the new equity accrues to existing creditors of the bank). In that circumstance, banks may also refuse to undertake socially beneficial low-risk lending and prefer instead to undertake excessively risky alternative investments (although this may affect the composition of lending more than its amount). In that case, it is possible that increasing equity requirements can make banks operate more efficiently and encourage them to lend more.[12]

The Admati-Hellwig Claim That Higher Capital Requirements Are Socially Costless

We emphasize that the social costs associated with raising banks' minimum capital ratio requirements discussed above are not the result of tax deductions on banks' interest payments on debt (Modigliani and Miller 1963), or of the existence of safety net subsidies that encourage banks' excessive use of debt. As Admati and Hellwig (2013) correctly point out, if these government distortions were the only reasons that higher bank capital requirements resulted in less lending, those reasons would not imply a social cost of higher capital requirements. The deductibility of interest payments influences the optimal combination of debt and equity, but this distortion can be eliminated by abolishing the tax-advantaged status of debt. Similarly, government protection of banks that encourages banks to increase their subsidized default risk (in order to extract the

[12] Of course, this conclusion is model-dependent; it is possible to envisage a set of circumstances in which a rise in minimum capital requirements causes banks with debt overhang to become more constrained and lend less. If the regulator were able to require banks to raise more equity, low-risk loans that otherwise would not have been made would now be undertaken. At the same time, high-risk loans that were made before might be reduced, so the effect on total loan supply is unclear. Furthermore, an increase in lending is especially likely if a bank suffering from a debt overhang is required to meet an increased equity ratio at least in part through an increase in the required amount of equity. Otherwise, a higher required equity ratio might lead to the opposite behaviour (a reduction in low-risk lending) by a bank with a debt overhang problem.

subsidy, as described by Merton 1977, and as documented in numerous empirical studies) is a socially costly distortion that higher capital requirements would help eliminate.[13] For higher equity requirements to result in social costs, there must be additional, fundamental economic influences on banks' capital structure decisions (such as the signalling costs discussed above) that are unrelated to government safety net and tax policies. Those fundamental influences can explain why banks have chosen for centuries to operate with capital structures that entail greater leverage and greater reliance on short-term debt than non-bank corporations have employed—often in environments where debt conferred no tax advantage or safety net subsidy on banks.

In a recent book that has received a great deal of attention, Admati and Hellwig (2013) ignore the fundamental influences on bank capital structure that are unrelated to interest deductibility or safety net subsidies, and incorrectly argue that leverage choice is irrelevant in banking, except for its effects on bank value that are consequences either of tax deductions or safety net subsidies. A key error made by the authors, which is the basis for that assessment, is their assertion that the returns expected by investors equals the risk-adjusted costs to banks of their capital structure choices: "The cost of equity essentially corresponds to the returns that corporations must provide to shareholders to justify the money it has received from them."[14]

This assertion neglects the fact that, for issuers of equity, there are other important costs (and benefits) associated with capital structure choices that are only indirectly related to the returns expected by investors. For that reason, contrary to the assertion of Admati and Hellwig

[13] The literature is vast. Two particularly influential studies are Demirguc-Kunt and Detragiache (2002), and Barth, Caprio, and Levine (2006).

[14] For a detailed discussion of Admati and Hellwig (2013) see Calomiris (2014). For a similarly mistaken view of the neutrality of bank capital structure choices, see the bold proposal for 100% equity banking by Kotlikoff (2011).

(2013), the costs to a bank of issuing equity and the expected return received by equity investors who buy the new offering are not generally the same.

Indeed, one might describe the main subject of the entire literature on capital structure choice in banking, and in corporate finance more generally, as the *difference* between the expected costs a firm experiences from the decision to issue a given security (both when announcing it and later as a result of having issued it) and the expected return to investors who purchase it. The various expected consequences of different capital structure choices have the potential to make the cost of issuing equity considerably greater than the expected return earned by equity investors. And, indeed, recognizing the consequences of its financing choices for the overall value of a bank has been the unifying theme of the theory of optimal capital structure in banking.[15] In other words, there is an optimal funding choice that maximizes bank value—and deviations from that optimum reduce value.[16]

III. Empirics

4. What sorts of evidence exist regarding these benefits and costs?

Evidence of Benefits from Higher Equity Capital Ratios

[15] Although much of the discussion about bank funding focuses on debt vs. equity, it is important to note that, both theoretically and empirically, there are important aspects to the structure of debt finance in banking, especially deposit vs. non-deposit funding. A greater reliance on core deposits relative to other debts tends to be associated with lower default risk of the bank, either because core deposits entail less liquidity risk than other short-term debts (such as brokered deposits), or because a bank's ability to attract core deposits is itself an indication of lower default risk. For empirical evidence, see Ratnovski and Huang (2009), Calomiris and Mason (2003a), and Calomiris and Carlson (2014).

[16] For a review of capital structure theory in banking, see Thakor (2014). For a recent example of a theory of optimal bank capital structure in which different banks choose different interior optima as their capital structures, see Mehran and Thakor (2011).

Evidence of the stabilizing effects of capital ratio regulation has been mixed. Barth, Caprio and Levine (2006) study a cross-section of many countries and find no relationship between the strictness of capital ratio requirements and bank stability. Berger and Bouwman (2013) find that capital ratios are always stabilizing for small U.S. banks, and are stabilizing for larger banks during crises. That is not to say that they are always effective during crises for large banks; Citigroup's 11.8% risk-weighted capital ratio in December 2008 coincided with a roughly 2% market capital ratio, which is generally regarded as indicating possible insolvency.[17]

The mixed evidence with respect to the stabilizing effects of higher capital, or higher capital requirements, reflects some combination of (a) errors in measuring true capital due to underestimation of tangible asset losses (Huizinga and Laeven 2012), (b) errors in measuring true capital that reflect deficiencies in the reliance on book capital ratios, which do not incorporate the effects of cash flows not captured by accounting for tangible assets (Calomiris and Nissim 2014), and (c) differences in asset risk that may adjust endogenously to offset or magnify the otherwise stabilizing effects of higher capital. Banks may choose to offset the stabilizing effects of higher capital requirements in order to increase the value of their access to safety net subsidies. (We return to these potential deficiencies below in our analysis of policy tools for improving the efficacy of minimum equity ratio requirements.)

The potential for banks to offset increases in required equity by increasing risk, in theory, should vary with the size and effectiveness of the minimum equity ratio requirement being imposed. For sufficiently high and meaningfully enforced minimum equity capital ratios, banks should react by *reducing* rather than increasing risk—because equity holders bear a sufficiently large amount of initial losses from taking risk. Berger and Bouwman (2013) find that this is one of

[17] Calomiris and Herring (2013).

the most important channels through which capital requirements stabilize banks; higher capital induces banks to improve their efficiency. Importantly, they find that higher capital is associated with both lower asset risk and greater profitability. That evidence is consistent with some of the above-referenced models that emphasize the role of optimal capital structure in incentivizing management effort to manage risk (e.g., Holmstrom and Tirole 1997).

Various studies of UK capital requirement policies during the period 1998-2007 take advantage of a unique environment for studying the effects of equity capital *requirements* – as opposed to the effects of equity capital ratios – on bank behaviour, including their effects on stability. Equity ratio requirements (set under Basel I rules for measuring loan default risk until the first quarter of 2007) were set on a bank-specific basis and varied greatly across banks. Basel I defined the amount of default risk weights on loans, but the UK regulators added bank-specific capital surcharges to take into account operational risk and market risk. This allows sufficient variation to perform statistical analysis of the effects of differences in capital requirements on bank stability. For example, one can inquire whether higher capital requirements, holding constant bank risk, resulted in a lower probability of financial distress.

If all bank risk were measured by "risk-weighted assets" then cross-sectional variation in the minimum "trigger" ratio set by the UK authorities (the minimum required ratio of capital to risk-weighted assets) would capture risk-adjusted differences in minimum capital requirements across banks. Of course, the fact that regulators chose to set different capital requirements for different banks indicates that they believed the risk weights were an inadequate measure of bank risk. Thus, additional risk controls are needed in any analysis of the correlation between cross-sectional variation in capital requirements and bank stability outcomes.

In empirical results not reported here, we estimated probit models to gauge the effects of higher capital ratio requirements on the probability of a UK bank's experiencing "financial distress," measured alternatively by the bank's participation in a government liquidity insurance scheme during the crisis or the bank's having received a public capital injection.[18] We considered specifications with two independent variables of interest, the required level of capital relative to risk-weighted assets (which was the regulatory bank-specific trigger ratio used by the UK prudential authority), and the ratio of required nominal capital relative to total assets. This latter construct was *not* a regulatory ceiling explicitly imposed by the UK authorities; rather it is calculated by us as the implicit regulatory leverage ceiling at each point in time given the risk-based capital requirement (which can be used to calculate required nominal capital) and the bank's total assets.[19]

We find that "risk-adjusted" minimum capital ratio requirements appear to have been somewhat effective as a regulatory tool. Higher minimum requirements were associated with a lower risk of financial distress, using either definition of financial distress. Our analysis includes various controls that should capture risk differences not already captured by risk-weighted assets (loan growth, liquidity, write-offs, size, mortgage exposure, proportion of core deposit funding, and proportion of lending which is to the financial sector). Ideally, controls in these regressions would only capture risks that were realized during the crisis; ex ante risks that caused regulators to increase banks' capital ratios, but which were not important during the crisis, should have contributed to bank stability. In that sense, it is possible that adding all conceivable ex ante risk

[18] These data were taken from Rose and Wieladek (2014), which provide a more detailed description of the dependent variables.
[19] Note that by construction, a bank would only be in breach of the implied leverage requirement if it were in breach of the risk based capital requirement ratio.

control variables may over-control for risk in regressions that attempt to assess the stabilizing effects of higher capital ratios during the recent crisis.

In further regressions, when we consider the predictive power of actual ratios of capital (rather than minimum required ratios), we find that the leverage ratio (defined as total assets/ capital) enters with a positive sign and is statistically significant. This is supportive of the idea that bank-specific leverage is a useful predictor of individual bank distress. Finally, the log of bank size always enters statistically significantly with a positive sign, suggesting that larger banks are more likely to receive government help, a finding consistent with that in Rose and Wieladek (2012).[20]

Evidence of Costly Equity Requirements: Signalling

Consistent with the signalling costs of issuing equity, there is a large literature in financial economics documenting the adverse effects on stock returns of announcing new equity offerings. The total costs related to adverse selection are the sum of those adverse price effects and the costs paid to underwriters to mitigate adverse selection through road shows and other marketing costs that help to reduce the extent of asymmetric information. Such costs can be large.[21]

[20] Note that our sample of Banks consists of both UK-owned banks and foreign subsidiaries. As documented in Aiyar, Calomiris and Wieladek (2014a), foreign subsidiaries were subject to, on average, a higher capital requirement that UK-owned banks. This raises a question whether our findings might be due to the inclusion of this second group of banks. The results on the regulatory and actual capital ratio are robust to estimating our regressions for the sample of UK-owned banks only. But in regressions reported only for this subsample of banks these variables lose statistical significance when bank size is included as an additional variable. This should not be surprising, as the two variables are correlated in the cross-section because larger banks were likely to have been perceived as better diversified and hence safer, which allowed regulators to justify a smaller capital requirement.

[21] For a review of the determinants of underwriting costs, see Calomiris and Raff (1995), Calomiris (2002), and Calomiris and Tsoutsoura (2010).

Would adverse-selection costs related to signalling also arise if equity were raised as a consequence of regulatory equity requirements? It is important to bear in mind that raising a minimum equity ratio requirement does not require banks to raise equity; banks can satisfy the higher requirement by choosing to shrink assets instead. To the extent that adverse selection is important, "good" banks (those with relatively favourable financial condition that are being pooled with other banks) will face an incentive to avoid dilutive equity offerings and instead reduce their asset size until asymmetric information problems have been resolved. Thus, equity offerings in response to equity ratio requirement hikes will not generally avoid signalling costs. Indeed, a study of bank equity issues following the U.S. bank distress of the 1980s found that equity issues in response to a regulatory requirement resulted in only slightly less of a negative reaction in market prices.[22] Moreover, while this study suggests that signalling effects can be smaller when issues are made in reaction to regulatory action, the authors find that this smaller price effect only holds for sufficiently small equity offerings.

We conclude that raising minimum equity ratio requirements is likely to result in many banks' choosing to reduce leverage and risky assets (such as loans) rather than raising new equity capital in the market. A regulatory mandate to raise a given *amount* of equity (not just the equity ratio) could substantially mitigate the signalling effects of a higher equity requirement, but this sort of micro-management of bank balance sheet scale has not been the approach generally employed in setting regulatory capital requirements. Moreover, in theory, even that would not eliminate the signalling problem, particularly if the public inferred that the new policy of requiring higher nominal equity, not just a higher equity ratio, reflected regulators' concerns about publicly unobservable weaknesses in banks.

[22] See Table 6 of Cornett and Tehranian (1994).

Evidence of Costly Equity Requirements: Loan Supply

A large number of studies have shown that, when banks need to raise their equity-to-asset ratios, they often choose to do so by cutting back on new loans, which avoids the need to raise new equity and the high costs associated with it. These studies divide into two groups: some document cutbacks in bank lending in response to losses in equity that result from loan losses; other studies examine responses to increases in equity ratio requirements.[23]

Studies examining credit-supply effects of lost equity include Peek and Rosengren (2000), Calomiris and Mason (2003b), and Calomiris and Wilson (2004). Peek and Rosengren (2000) find that Japanese banks' loan losses in Japan reduced their lending in the United States. Calomiris and Mason (2003b) and Calomiris and Wilson (2004) document large contractions in credit supply resulting from bank losses during the Depression. Calomiris and Wilson (2004) also document that New York City banks engaged in frequent equity offerings during the boom years of the 1920s, but avoided capital offerings entirely after 1930 (a cyclical pattern observed more generally for other industries and other time periods). Banks also cut dividends to preserve capital, in their attempt to limit contractions of loan supply. Rising bid ask spreads for bank equity during the 1930s are also consistent with a dramatic increase in adverse-selection costs, which made equity offerings prohibitively expensive. In general, this literature identifies large contractions in bank credit associated with losses of bank capital and high costs of replacing bank capital during recessions (giving rise to the term "capital crunch" to denote large credit-supply reductions induced by a loss of bank capital).

[23] For reviews of the literature, see VanHoose (2008) and Aiyar, Calomiris and Wieladek (2014a).

Studies of the credit supply effects of changes in capital requirements include Aiyar, Calomiris and Wieladek (2014a, 2014b, 2015), Aiyar, Calomiris, Hooley, Korniyenko and Wieladek (2014), Jimenez, Saurina, and Peydro (2011), and Brun, Fraisse and Thesmar (2014). The four papers by Aiyar et al. study the UK's bank-specific capital requirement changes. The Jimenez et al. paper analyses bank-specific provisioning requirements (a temporary, front-loaded increase in the effective capital requirement). The Brun et al. paper analyses the heterogeneous effects on French banks of the transition in France from Basel I to Basel II, which effectively created cross-sectional heterogeneity in the effective capital requirements for lending.

All of these studies find very large short-term effects on the supply of lending from changes in required capital ratios, and the magnitudes of the effects are fairly consistent across these three different countries (once one takes account of the differences between provisioning requirements and capital requirements). The estimated elasticities of loan supply are much larger than those that were assumed by the Bank for International Settlements (2011), which was the basis for establishing its guidelines for cyclical variation in capital requirements.

With respect to the short-term loan supply response to increases in required equity ratios in the UK, a one percentage point increase in required equity ratios reduces loan supply to domestic nonfinancial borrowers over the next year by about six or seven percent (implying an elasticity of loan supply of roughly negative 0.6 or 0.7), and leads to a reduction in cross-border interbank lending of about five percent (implying an elasticity of roughly negative 0.5), which tends to be disproportionately concentrated in borrowing countries that are not part of the bank's core customer base. The responses of French banks' lending to capital requirement changes are similar in magnitude. The loan-supply response to provisioning requirements for Spanish banks implies an

elasticity of roughly 0.3. Assuming that a dollar of provisioning (a temporary increase in capital) equates in present value to about half a dollar of capital, the estimated elasticities are comparable.

In response to a capital requirement increase, alongside the contraction in loan supply, UK banks temporarily draw down their capital "buffers" (the amount of capital they hold over and above the regulatory requirement). They subsequently rebuild their buffers over the ensuing quarters. Larger buffers are not indicative of slackness of the regulatory constraint, but rather indicate a greater need for self-insurance against shocks; banks with higher buffers display a higher response elasticity of loan supply to increases in capital requirements.

Although these findings provide strong evidence of high costs of raising equity capital, the magnitude of these elasticities do not provide a reliable generally applicable guide to the magnitude of bank loan-supply reactions to changes in minimum capital requirements. First, the estimated magnitudes cannot be extrapolated linearly to gauge the loan-supply responses to very large capital requirement changes. For the UK sample, few capital requirement changes exceed one and a half percentage points. An out-of-sample, very large regulatory change, such as a doubling of the average capital ratio requirement from 11% to 22%, surely would not result in a 77% decline in lending; banks would be more likely to face such an increase, at least in part, with large equity offerings and a much smaller percentage change in loan supply. Because such capital requirement changes are not present in the data, one cannot gauge accurately the extent to which the percentage loan-supply response changes with the size of the capital requirement increase. Second, the magnitudes of banks' loan-supply reactions should vary according to banks' costs of accessing public equity markets. Third, banks' loan-supply reactions will depend on competitive

pressures; the reactions of banks to equity requirement increases that apply to all banks may differ from those that apply to a subset of banks.[24]

We also note that short-term estimated elasticities cannot tell us much about long-run loan-supply responses to capital requirement changes. It is difficult, amidst the noise of many other influences, to gauge the long-term responses of loan supply growth to capital requirement change, but surely the responses are diminished over time relative to their short-term magnitudes as banks are able to adjust on other margins (e.g., retained earnings).

Finally, as noted in our theoretical review, for banks with very low capital ratios that are suffering debt overhang problems, increases in required capital ratios may actually increase lending. As far as we can observe based on accounting data, such banks are not present in the UK sample during the period 1998-2007. Thus, we are unable to explore the possible reversal of loan supply responses to capital requirement changes that may occur at very low levels of capital.

In summary, estimated loan-supply reductions in response to capital requirement increases provide consistent evidence of a significant social cost to raising equity capital requirements. But there is still much that we do not know about the precise size of those costs when considering large changes in capital requirements, long-term responses, and responses of banks that are already in or near a position of financial distress.

IV. Assessing the Adequacy of Bank Equity Ratios Today

5. Are bank equity ratios too low for global US and European banks?

[24] Interestingly, however, the average magnitudes of loan-supply responses in Brun et al. (2014) – which studies the the French case of an across-the-board change – is similar to the loan-supply responses found in the UK studies of bank-specific capital requirement changes.

Figure 1 uses the Black-Scholes model to plot deposit isorisk curves as a function of equity ratios (E/A) and the riskiness of assets, measured by the standard deviation of asset returns (s_A). The isorisk lines define combinations of E/A and s_A that are consistent with a particular actuarially fair default risk premium, expressed in basis points of debt spread. Consistent with many models of banking, and much observation of banking outcomes, in the absence of safety nets market discipline operates on banks via depositors' choices of an isorisk line for deposit risk. Uninsured depositors typically are risk-intolerant (as modelled in Gorton and Pennacchi 1990; Calomiris and Kahn 1991), and require banks to operate at very low p-values of depositor risk.[25]

In the presence of bank safety nets, banks may face incentives to extract subsidies by reducing their E/A and/or increasing their s_A. One of the primary purposes of a minimum capital ratio requirement is to prevent banks from free-riding on the safety net by forcing them to target a p-value of default risk that is commensurate with the fees they pay on deposit insurance. In choosing that p-value, regulators may want to target a lower p-value than banks would target in the absence of safety nets and prudential regulation, if for example, regulators wish to internalize social costs of bank failure beyond those experienced by banks' funding sources (e.g., the effect of credit contraction on economic growth, or the possibility that a bank failure may impose negative externalities on other banks).

[25] There is substantial evidence from numerous academic studies of many countries that a reliance on uninsured short-term debt enhances risk management and reduces the probability of banking crises, including Martinez-Peria and Schmukler (2001); Calomiris and Powell (2001); Calomiris and Wilson (2004); Barth, Caprio, and Levine (2006); Demirguc-Kunt and Huizinga (2014); Calomiris and Carlson (2014). Debt discipline operated to some extent even in the recent crisis, despite the insurance of many bank debts. Had it not been for the contractions of uninsured short-term bank debts in 2007-2009—that is, the dramatic declines in interbank loans, asset-backed commercial paper, and repos—regulators would not have acted as quickly to force banks to shore up their positions. That example illustrates that debt market discipline is not just about crisis prevention; it is also about crisis resolution.

As this framework illustrates, regulators should choose E/A relative to risk in order to target a given level of default risk on bank debt. Thus, there is no "magic number" for the correct E/A in the banking system. The goal of regulation is to successfully target the desired p-value of debt (say, p = 1 basis points) by establishing an effective means of requiring banks to maintain appropriate *combinations* of E/A and s_A.

Some of the most stable banking systems—Canada's, for example, which has never suffered a major banking crisis during its nearly two centuries of operation—were able to achieve stability with lower equity ratios historically than U.S. banks despite the higher loan-to-asset ratios of Canadian banks.[26] The low equity ratios and high loan ratios of Canadian nationwide branching banks reflected their greater portfolio diversification and other risk-lowering attributes in contrast to the much riskier single-office (unit) banks in the United States. For example, around the turn of the 20th century, national banks in the United States operating in the South and West maintained average book equity-to-asset ratios of 33%, which were higher than other U.S. banks, and much higher than either Canadian banks operating around the same time (Calomiris and Carlson 2014; Calomiris 2006, p. 41). The equity ratios of U.S. banks have varied dramatically over time, and in ways that have clearly reflected changes in their asset risk. The decline in the market equity-to-asset ratios of New York City banks during the 1930s—from about 30% of assets in 1929 to about 15% by 1939—reflected the substantial reduction in the asset risk of such banks that was accomplished through the very large increase in their holdings of cash assets, and comparable p-values for debt in the two years (Calomiris and Wilson 2004). Clearly, there is no magic equity ratio that delivers stability; equity ratios should vary with the riskiness of bank cash flows.

[26] Calomiris (2006), Chapter 1; Calomiris and Haber (2014), Chapter 9.

Although these examples illustrate the pitfalls of assuming that higher capital ratios always translate into safer banking systems, it is also clear that the protection of banks (deposit insurance and bailout policies), combined with permissive risk-based capital regulations, have removed the discipline of withdrawal threats that used to encourage banks to maintain higher (non-risk weighted) capital ratios. The protection of banks debts has permitted banks' capital-to-asset ratios to decline significantly over time. That decline has given rise to political movements around the world – most notably, the Brown-Vitter Bill in the United States – calling for substantial increases in banks' minimum capital-to-asset ratios.

The simplest way to address the question of whether current bank equity capital ratios (appropriately defined relative to their riskiness) are too low is to ask whether their default risk is too high. One gauge is the propensity for crises. The financial crisis of 2007-2009 wasn't the first to illustrate that protected banking systems tend to blow up, imposing huge losses on taxpayers who are left to foot the bill. In the past three decades alone, there have been over a hundred major banking crises worldwide (Laeven and Valencia 2013). Many years of academic research on this unprecedented pandemic of banking crises have consistently identified the protection of banks as one of the primary causes. Indeed, one could even say that there is no topic in financial economics that has achieved such a clear consensus among researchers as the proposition that government protection of banks has been a major contributor to the recent wave of costly bank failures around the world—failures on a scale that has never been witnessed before.[27]

It is also possible to use models of bank fragility, which employ market-based information about bank risk and market equity capital values, to assess the fragility of banks. For example, Acharya, Engel and Pierret (2013) and Acharya and Steffen (2013) apply their "SRISK" model to

[27] For reviews of that literature, see Calomiris (2011a) and Calomiris and Haber (2014), Chapter 14.

evaluate the adequacy of prudential regulatory requirements of U.S. and European banks. They find that banks remain quite risky, especially in Europe.

Applying yet another methodology, Ignatowski and Korte (2014) find that U.S. megabanks have not perceptibly changed their risk taking behaviour since the introduction of the Dodd-Frank Act, implying that the Orderly Liquidation Authority (OLA) and the living wills requirements established under Dodd-Frank did not have the desired regulatory impact on megabanks. Critics of the OLA long have argued that it has actually institutionalized too-big-to-fail by creating a formal bailout procedure and earmarking a new source of tax revenue to fund bailouts. This research seems to confirm that fear.

V. Pitfalls of Relying on the Book Equity Ratio as a Prudential Tool

6. What are the shortcomings of using book equity ratios as prudential tools?

Regulating banks' equity ratios credibly and effectively to achieve prudential goals is easier said than done, even if one were able to identify the right amount of equity that is needed relative to any given level of bank risk. First, effective book value equity requirements depend upon honest accounting of the value of tangible assets. But bankers, regulators, and politicians have reasons not be honest; understating losses in downturns avoids politically and financially undesirable contractions in credit that result from loss recognition.[28]

Second, banks' true equity values are not well measured even by accurate book equity ratios. As Calomiris and Nissim (2014) show, the persistently low market values of U.S. banks after

[28] Regulators may also be concerned about contagion effects from loss recognition. That concern, however, presumes that markets are unaware of unrecognized losses. Data on market valuation of banks during the recent crisis (Calomiris and Herring 2013) suggest that market values of equity ratios reflected bank condition better than regulatory values.

the subprime crisis primarily reflects reductions in banks' cash flows that are unrelated to the values of tangible assets or liabilities. Book values of equity simply do not accurately capture its true economic value, and the differences can be dramatic.

Balance sheet fetishism – the belief that book equity ratios meaningfully reflect true equity ratios – is a major source of systemic risk. U.S. banks' market values of equity relative to assets fell dramatically from 2006 to September 2008, and regulators did not force banks to maintain those ratios. Ultimately, as market value ratios for some banks declined to roughly 2% for many banks, creditors became unwilling to roll over bank debt obligations. From this perspective, Lehman's failure is best seen as a signalling match in a tinder box of declining market perceptions of banks' counterparty risks. The key to a stable banking system is ensuring that banks are not allowed to permit their true, as opposed to book, equity ratios to decline to unsafe levels. Prudential capital regulation based on book values is an imperfect tool to prevent such a decline.

Third, given our prior discussion of the need to set equity relative to risk, riskier banks should be required to maintain higher minimum ratios. But risk measures are prone to manipulation by banks and measurement errors by regulators (Haldane 2013). How can book equity ratios constrain failure risk if banks window-dress risks with impunity?

One solution proposed to deal with the problem of risk measurement manipulation is to rely on simple leverage limits (a regulatory minimum capital-to-asset ratio that treat all assets as having the same unitary risk weight). While such an approach avoids the manipulation of risk weights it does not necessarily limit the difference between an asset's risk and its (unitary) risk weight; if banks increase asset risk in reaction to the imposition of simple leverage limits, they can still end up with an inadequate amount of capital relative to asset risk.

In Argentina in the 1990s, regulators imposed risk weights that varied with the interest rate spreads on bank loans (Calomiris and Powell 2001). Because loan spreads forecast losses accurately (they are the market-determined compensation banks receive for anticipated risk), they are a robust means of avoiding the manipulation of risk weights. This approach, however, is not so easily applied to other classes of bank assets, where it may be harder to infer market-based risk estimates from bank transactions.[29]

VI. Integrating Capital Regulation with Other Prudential Tools

7. What combination of additional policies should accompany a rise in minimum equity ratio requirements?

Calomiris (2011b) reviews a wide range of policies geared toward the measurement and management of risk and equity capital that would help to make equity requirements more effective. One of those – a recent policy proposal by Calomiris and Herring (2013), which is the latest in a long series of similar proposals by many other authors (reviewed in detail in their appendix) – suggests that all three of these problems with book capital regulation can be addressed by requiring, alongside higher book equity-to-assets, another funding requirement known as contingent capital (CoCos), which is debt convertible into equity on the basis of a market value trigger.

How would market-triggered CoCos be constructed? Alongside (say) a 10% book equity-to-asset requirement, banks would be required to issue 10% of assets in CoCos that convert from debt into equity if the market value of equity relative to assets falls below a critical ratio (say, 10%)

[29] Calomiris (2011b) advocates reforms to the use of securities ratings in bank risk measurement that would improve the accuracy of ratings by giving rating agencies an incentive to avoid understatements of security risk.

on average for a period of (say) 120 days. If conversion does occur, CoCos convert at a premium of, say, 5% (CoCo holders end up with shares worth more than the face value of their debt holdings).

How would this CoCos requirement solve the three problems that plague book equity requirements? Using the market value of equity as a conversion trigger incentivizes banks to maintain sufficient true capital. To avoid triggering a dilutive CoCos conversion, managers would choose to issue new equity to offset declines in their market valuation. Managers would make that choice because dilutive conversion is costly to existing stockholders; both the holders of newly converted shares and pre-existing shareholders would likely agree to sack management incompetent enough to permit such a conversion. Using a 120-day moving average insures that banks have plenty of time to arrange an offering in response to market perceptions of losses. And setting the trigger at 10% – far above the insolvency point of the bank – ensures that the bank will have access to the market (insolvent banks may lose such access) so that they can make voluntary equity offerings to avoid CoCos conversion.

The purpose of the CoCos requirement is to overcome the reluctance of bankers to issue equity during a downturn – that is, after prices of their shares have fallen, and at a time when an announced share offering will generally have a pronounced adverse signalling effect on their share prices. Bankers generally will want to wait for markets to recover and for confidence in their investments to be restored before issuing shares. But, to be effective in promoting systemic stability, capital regulation must not tolerate such delays: rather than gambling and hoping for a restoration of market confidence, requiring that banks replace lost equity in a timely manner insures that confidence will be restored.

Relying on market values to trigger CoCos conversion encourages bank equity issuance when the market believes banks have suffered a sufficiently large loss. This link to market

perceptions solves all three of the problems that plague book equity requirements. First, market values reflect loan losses that bankers and regulators may choose to understate. Second, market expectations about cash flows determine the market value of equity, which avoids unwarranted emphasis on balance sheets to gauge bank health. Third, the higher the riskiness of a bank's cash flows, the higher the market equity-to-assets ratio the bank will target. For example, if the trigger ratio for market equity relative to market assets (where market assets is the sum of the face value of bank debt plus market equity) were 10%, a bank with little risk might target an 11% ratio, while a bank with much higher risk might target a 13% ratio. That connection between risk and the targeted equity ratio also encourages banks to improve risk management and eliminate unwarranted risk.

Most importantly, a market-based requirement is uniquely useful for preventing liquidity crises. The failure of Lehman caused a crisis because it led the market to suddenly revise downward its assessment of the value of many financial institutions about which it already had grave doubts. Those doubts were reflected in the deterioration of banks' market equity ratios since 2006. The primary purpose of capital requirements is to insure that banks are able to maintain market confidence, whether or not that confidence is "accurate." What better way to prevent a crisis than to actually use market values when gauging bank creditworthiness?

Why not just replace the book equity requirement with a market equity requirement? The history of regulatory "forbearance" is replete with examples of politically motivated relaxation of requirements. Requiring banks to enter into CoCos with other market participants, with pre-specified market-based triggers, uses bank contracts with investors – which cannot be altered by regulatory forbearance – to prevent regulators and politicians from relaxing the discipline of market opinions.

What new risks might attend the regulatory use of CoCos? Is the possibility of short-sellers forcing banks to make offerings at depressed prices a concern? By relying on a 120-day moving average, short-sellers would have to maintain their pressure on undeserving bank stocks for four months, which is a far-fetched possibility. And banks will factor in short-selling risk when targeting their market equity ratio. A bank concerned about shorting could raise its target to 13%, meaning that short sellers would have to depress that bank's stock by more than 30% for four consecutive months to force an unnecessary stock offering.[30]

If an unlikely event, such as accounting fraud, produced a sudden loss of equity and prevented equity issuance, then conversion would occur. The resulting equity increase would provide a massive stabilizing cushion, which would itself likely avoid the need for liquidation.

No solution, including CoCos, is perfect and there are many additional reforms worth considering. In judging CoCos or other proposals, however, perfection should not be the standard that proposed reforms must meet, given that the status quo is so far from it.

8. How should cash or liquidity requirements be integrated with equity requirements?

Calomiris (2011b, 2012a, 2012b) and Calomiris, Heider and Hoerova (2014) argue in favor of introducing a cash reserve requirement for banks – held in the form of remunerative deposits by banks at the central bank – to exist alongside capital requirements and to serve as a substitute for the two Basel III liquidity ratios that have been introduced. Unlike the Basel liquidity requirements, the proposed reserve requirement is conceived from the perspective of dealing both with liquidity risk and solvency risk, in recognition of the fact that all "liquidity shocks" in

[30] Just to be doubly sure, regulation could limit CoCo holders to qualified institutional investors (insurance companies, hedge funds, pension funds, and mutual funds) and prohibit institutional investors from shorting the stocks of the megabanks that are required to issue CoCos.

real-world banking crises result from heightened insolvency risk. Calomiris, Heider and Hoerova (2014) show that cash reserve requirements, *when used in combination with effective equity capital requirements*, have unique advantages as prudential tools for reducing default risk and incentivizing efficient risk management that make them more desirable than "liquidity regulation." Cash requirements focus on the amount of *gross cash reserves* held by the bank (effectively requiring that a minimum proportion of assets be held in the form of Treasury securities deposited at the central bank[31]), not the amount of *net liquid assets* (broadly defined) net of debts deemed to be relatively subject to liquidity risk.

Any simple model of default risk implies a substitutability between the equity-to-asset ratio and the cash-to-asset ratio as means of reducing the default risk on bank debt (in Figure 1, raising the cash-to-asset ratio lowers σ_A for any given riskiness of the loan portfolio). The main advantages of cash in reducing default risk are two: (a) that unlike book equity, cash at the central bank is a real asset, not an accounting entry, and its value is known; (b) cash held at the central bank is riskless and its risk cannot be increased by any action taken by the bank. Calomiris, Heider and Hoerova (2014) show that these aspects of cash have important consequences for risk management incentives, and can make cash requirements more effective than book equity requirements as credible prudential regulations limiting bank default risk: by raising the lower bound of the bank's liquidation value, cash reduces incentives for risk shifting of loans, and thus, encourages good risk management.[32] Calomiris (2012b), for example, proposes a "20-20" solution that combines loss-absorbing capital (equity plus CoCos) of 20% alongside a 20% cash assets reserve requirement. It is worth noting that, for U.S. banks historically, it would have been

[31] Depositing the assets at the central bank prevents window dressing by banks, who might otherwise hold cash only once per quarter on accounting report dates.
[32] For a somewhat similar argument about the advantages of combining cash asset requirements alongside capital requirements to encourage better risk management, see Acharya, Mehran and Thakor (2010).

considered normal for them to maintain total cash assets (cash reserves plus Treasury securities) far in excess of 20% and capital ratios that also generally exceeded 20%.

More generally, both cash and equity are prudential tools whose marginal costs (the cost of raising equity capital, and the foregone quasi rents from lending, respectively) are increasing in the amount banks make use of each. That implies that an interior solution that combines some cash and some equity is likely to be cost-minimizing relative to a solution that requires either in isolation.

VII. Macro-Prudential Use of Capital Requirements

9. What are the objectives and pitfalls of using capital requirements as a macro-prudential tool?

Many observers argue that the recent global financial crisis shows that the aggressive pursuit of macro-prudential policies – policies that vary bank capital requirements, mortgage leverage constraints, and other instruments on a cyclical basis to cool down or heat up the financial system as needed – are necessary to combat the cycles of financial boom and bust that have characterized developed and developing economies over the past three decades. The evidence on the large responsiveness of loan supply to capital requirement changes, summarized above, shows that capital requirements could be a powerful tool in the macro-prudential arsenal.

Sceptics, in contrast, believe that the pursuit of macro-prudential policies could produce more distortions, uncertainty and macroeconomic volatility.[33] First, sceptics see excessive risk

[33] Our discussion focuses on the use of capital requirement changes as a macro-prudential tool. Other macro-prudential tools – such as changes in maximum permissible loan-to-value ratios – provide an alternative means of influencing loan supply, and one that may not suffer from the same degree of imprecision in the estimation of its effects.

taking as primarily a symptom of ineffective or unwise monetary policies and micro-prudential policies, which if corrected, would remove much of the incentive to undertake excessive risks during booms. Excessive risk taking during booms, according to this view, is primarily the result of the combination of loose monetary policy, generous government safety nets for banks, and borrowing subsidies for consumers (especially in housing credit). Thus, the need for macro-prudential regulation to lean against the wind during booms would be substantially reduced if monetary policy followed a clear, time-tested rule, if micro-prudential regulation were reformed to be made effective, and if government subsidies for risk taking were absent. According to this view, a focus on macro-prudential regulation distracts from these more important policy reforms.

Furthermore, during recessions, relaxing prudential regulation on macro-prudential grounds (to stimulate lending and encourage investment) is likely to be destabilizing. The tolerance for inadequate capital ratios of troubled lenders is already the all-too-common discretionary reality known as "forbearance," which is usually accomplished through lax recognition of loan losses (Huizinga and Laeven 2012). The unprecedented severity of many recent banking system disasters of the past three decades (documented in Laeven and Valencia 2013) can be traced to relaxing regulatory standards in the name of preserving bank lending during contractions (Calomiris and Haber 2014, Chapter 14).[34]

Problems of implementation also abound. The Basel III standards envision a 2.5 percentage point cyclical variation in minimum capital ratio requirements for banks. At the time that policy was announced, there had been no microeconomic studies of the effects of capital

[34] On the other hand, some might argue that having an explicit framework for reducing capital requirements during recessions, which makes a form of "forbearance" explicit might make the relaxation of capital requirements more accountable and controllable, and thus make excessive and destabilizing forbearance less likely. This is a difficult question for economic theory to address as it revolves around practical questions relating to the political economy of prudential regulation and supervision.

requirement changes on the supply of credit. The aggressive cyclical variation in capital requirements under Basel III was based on unreliable back-of-the-envelope estimates that suggested small loan-supply reactions to changes in capital requirements. The studies reviewed above, using microeconomic data on bank reactions to capital requirement changes in the UK and France, and provisioning requirement changes in Spain, suggest very large reactions.

But this powerful capital requirement tool cannot be wielded with precision (Borio 2014). First, as noted by Aiyar (2011, 2012) and Aiyar, Calomiris and Wieladek (2014a, 2014b), there is the problem of uncertain "leakages" due to substitutes for regulated credit. Intermediaries and credit instruments that are not subject to capital regulation can offset credit supply reductions by regulated entities. Aiyar, Calomiris and Wieladek (2014b) found that potential leakages from bank branches operating in the UK that were not subject to UK capital regulations were quite large (offsetting roughly 40% of the total loan-supply effect). The extent of leakage in the future from shadow banking, including securitizations, finance company loans, insurance company loans, etc., are hard to predict but potentially large.

Estimates of banks' reactions to capital requirement changes, and their reactions to each other's capital requirement changes, are not always precisely estimated, but there are reasons to believe that such reactions should vary depending on a variety of circumstances. For example, responses analyzed in Aiyar, Calomiris and Wieladek (2014b) reflect differences in the extent to which banks operate internal capital markets, and in theory, such effects should also vary over the business cycle, although available data are not sufficiently rich to explore such differences. Differences in the value of preserving lending relationships are also likely to matter, as indicated by the lack of responsiveness of cross-border non-financial lending documented by Aiyar, Calomiris, Hooley, Korniyenko and Wieladek (2014). Even the seemingly robust estimates of

average effects from the UK, France, and Spain do not provide a reliable indicator of the magnitude of that variation for other banks operating in other countries. Policy makers, therefore, are in the awkward position of knowing that existing estimates of elasticities of loan-supply are not reliable as precise guides of aggregate effects going forward. In short, macro-prudential policy tools are a bazooka, not a pea shooter, and using them as a cyclical tool, given the existing scant empirical knowledge about their effects, amounts to firing a bazooka without the benefit of a sight.

Finally, an aggressive approach to macro-prudential policy can be destabilizing through its unintended consequences for other policy instruments, especially monetary policy. Pro-cyclical monetary policy (policy that cuts interest rates and expands money and credit during expansions) has been a major contributor to risk taking during booms.[35] Monetary policy over the past century of U.S. history generally has been pro-cyclical, either because of flawed conceptual frameworks that have guided monetary targeting, or because of political pressures associated with the financing of government deficits.[36]

A major part of the cure for the destabilizing pro-cyclical tendency of monetary policy is the establishment of a policy rule to constrain and guide policy makers. An observable rule that has a reliable track record for producing countercyclical policy and price stability insulates central

[35] Bernanke and Gertler (1995); Kashyap and Stein (1995, 2000); Gourinchas, Valdes and Landerretche (2001); Dell'Ariccia and Marquez (2006); Dell'Ariccia, Igan, and Laeven (2008); Mendoza and Terrones (2008); DeNicolo, Dell'Ariccia, Laeven, and Valencia (2010); Bekaert, Hoerova, and Lo Duca (2013); Dell'Ariccia, Laeven and Suarez (2014); Jiménez, Ongena, Peydró, and Saurina (2014); Aiyar, Calomiris, and Wieladek (2015). These papers show that there are various channels through which monetary policy operates, and various indicators of the effects of monetary policy, including the tolerance for greater risk in equity, bond, and banking markets, the reduced pricing of risk, and the expanded supply of credit, especially by smaller banks who are more dependent on depository debt funding.

[36] Bordo and Wheelock (2007a, 2007b); Meltzer (2003, 2010).

bankers from the political pressure to use discretion to monetize deficits, and protects the public from discretionary policies that are based on faddish models.

Macro-prudential policy can undermine this sort of desirable monetary policy rule. First, in the presence of a new and powerful set of tools that affect the supply of credit in the financial system, it is quite likely that the responses of inflation and unemployment to changes in the policy instrument (e.g., the federal funds rate) will differ from what they were before, which makes the existing empirical basis for a reliable monetary rule obsolete. Second, adding numerous new tools and objectives risks undermining the central bank's accountability for following its monetary policy rule. If a central bank employs the multiple tools at its disposal (the federal funds rate, time-varying capital ratio requirements, time-varying loan-to-value ratios on mortgages, etc.) for achieving countercyclical objectives, it may be very hard - perhaps virtually impossible - for it to articulate any rule that will guide its actions, especially given the lack of knowledge of the impact on the economy of these various policy levers.

These criticisms do not imply that macro-prudential policy is always a bad idea. The financial histories of many countries contain episodes in which extremely rapid growth of bank credit is followed by a severe recession. Monetary policy can be a weak tool to cool down excessive bank credit growth in such extreme circumstances. The recent experience of Colombia provides an interesting example. In 2006-2007, rapid acceleration in credit growth, the high current account deficit, and rising inflation led the central bank to raise interest rates dramatically, but this did not slow down credit growth. Only the combination of a substantial increase in capital requirements, provisioning requirements, cash requirements, and capital controls was able to cool credit growth, which led to a soft landing with no recession in 2008-2009. This is not an isolated example, but neither is it a constant occurrence.

What, then, is the appropriate rule to follow with respect to macro-prudential policy? Given the four problems mentioned above, we suggest that policy makers continue to rely on traditional monetary policy in almost all circumstances, and not employ macro-prudential policies except during extreme circumstances associated with the most severe credit booms. For example, one could set a threshold of, say, a 20% annualized growth rate of banking system credit over a minimum length of time (say, eighteen months). If credit growth exceeds that threshold over that length of time, a pre-specified increase in capital ratio requirements per quarter would be imposed (say, 50 basis points per quarter) until credit growth slowed to an acceptable level; or else the regulator would have to explain why the increase in capital requirements should not be imposed. Once credit growth slowed, and following some pre-announced formula, requirements would return to their normal levels.[37]

This approach would achieve much of what macro-prudential policy advocates have in mind, while minimizing potential costs. It would avoid making macro-prudential policy a constant source of uncertainty. It also would avoid undermining micro-prudential policies during recessions through forbearance. Because the macro-prudential policy tool would be used so rarely, it would not undermine the effectiveness of the monetary policy rule established by the central bank. This approach, however, will only work to promote economic stability if it is combined with two other crucial long-term policies: a credible monetary policy rule, and an effective reform of micro-prudential policies to avoid the subsidization of risk taking. Much of the impetus for macro-prudential policy action is the result of the failure to do either.

[37] This is, of course, not the only potential rule one could follow. For example, a rule that would impose bank-specific limits in high-credit growth states might be superior because it would be able to reward banks that behave prudently by assuring them that they would not be punished with higher capital requirements as the result of the behaviour of other banks.

VIII. Conclusion

Prudential capital regulation targets the default risk of banks by establishing a relationship between asset risk and minimum capital ratio requirements. The primary objective of such a framework is to insure the safety and soundness of the banking system. The recent unprecedented worldwide pandemic of banking crises shows that the combination of generous safety net protection and prudential capital regulation (intended in part to limit the abuse of safety nets) has not accomplished that objective for the most part.

Higher minimum book equity-to-asset requirements are a necessary step to achieve appropriate banking system stability, but these requirements must be measured credibly and established relative to effective restraints that insure that the level of capital is commensurate with the level of asset risk. A mix of higher book equity requirements, a carefully designed CoCos requirement, cash reserve requirements, and other measures, will be much better able to meet prudential objectives than book equity requirements alone. The focus of the Basel III system on ill-defined concepts of liquidity ratios and book capital ratios and internal models of risk must be replaced by a system of credible, incentive-robust rules that combine valid concepts with objective, market-based information into a simplified and credible regulatory process.

Raising minimum capital requirements will not be socially costless. Bank profitability and share prices are likely to suffer, and loan supply will likely be constrained significantly compared to the free-wheeling world of safety net protection and paper-thin capital buffers. But credible reform would be worth it: the dramatic consequences of banking crises, both in the form of huge burdens on taxpayers, and in the form of lost GDP (Laeven and Valencia 2013) would more than repay the costs of somewhat lower credit supply.

Ironically, just as the deficiencies of micro-prudential regulation have become most apparent, policy makers have also added to the challenge of prudential regulation by prescribing cyclical regulatory tools – including bank capital requirements – to achieve macro-prudential objectives. There are circumstances (extreme credit booms that distort asset prices and promote excessive leverage) that warrant macro-prudential intervention, but given the uncertainties associated with macro-prudential interventions, and their many potential costs, such interventions should be reserved for exceptional circumstances.

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Figure 1 Equity-to-Assets, Asset Risk, and Deposit Isorisk Curves