Rethinking Capital Regulation*

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Final Version September 2008

* Paper prepared for Federal Reserve Bank of Kansas City symposium on "Maintaining Stability in a Changing Financial System", Jackson Hole, Wyoming, August 21-23, 2008. We thank Alan Boyce, Chris Culp, Doug Diamond, Martin Feldstein, Benjamin Friedman, Kiyohiko Nishimura, Eric Rosengren, Hyun Shin, Andrei Shleifer and Tom Skwarek for helpful conversations. We also thank Olivier Blanchard, Steve Cecchetti, Darrell Duffie, Bill English, Jean-Charles Rochet, Larry Summers, Paul Tucker and seminar participants at the Bank of Canada, NBER Summer Institute, the Chicago GSB Micro Lunch, the University of Michigan, the Reserve Bank of Australia, and the Australian Prudential Regulatory Authority for valuable comments. Yian Liu provided expert research assistance. Kashyap and Rajan thank the Center for Research on Security Prices and the Initiative on Global Markets for research support. Rajan also acknowledges support from the NSF. All mistakes are our own.

I. Introduction

Recent estimates suggest that U.S. banks and investment banks may lose up to $250 billion from their exposure to residential mortgages securities.[1] The resulting depletion of capital has led to unprecedented disruptions in the market for interbank funds and to sharp contractions in credit supply, with adverse consequences for the larger economy. A number of questions arise immediately. Why were banks so vulnerable to problems in the mortgage market? What does this vulnerability say about the effectiveness of current regulation? How should regulatory objectives and actual regulation change to minimize the risks of future crises? These are the questions we focus on in this paper.

Our brief answers are as follows. The proximate cause of the credit crisis (as distinct from the housing crisis) was the interplay between two choices made by banks. First, substantial amounts of mortgage-backed securities with exposure to subprime risk were kept on bank balance sheets even though the "originate and distribute" model of securitization that many banks ostensibly followed was supposed to transfer risk to those institutions better able to bear it, such as unleveraged pension funds.[2] Second, across the board, banks financed these and other risky assets with short-term market borrowing.

This combination proved problematic for the system. As the housing market deteriorated, the perceived risk of mortgage-backed securities increased, and it became difficult to roll over short-term loans against these securities. Banks were thus forced to sell the assets they could no longer finance, and the value of these assets plummeted, perhaps even below

[1] See Bank for International Settlements (2008, chapter 6), Bank of England (2008), Bernanke (2008), Borio (2008), Brunnermeier (2008), Dudley (2007, 2008), Greenlaw et al (2008), IMF (2008), and Knight (2008) for comprehensive descriptions of the crisis.

[2] Throughout this paper, we use the word "bank" to refer to both commercial and investment banks. We say "commercial bank" when we refer to only the former

their fundamental values—i.e., funding problems led to fire sales and depressed prices. And as valuation losses eroded bank capital, banks found it even harder to obtain the necessary short-term financing—i.e., fire sales created further funding problems, a feedback loop that spawned a downward spiral.[3] Bank funding difficulties spilled over to bank borrowers, as banks cut back on loans to conserve liquidity, thereby slowing the whole economy.

The natural regulatory reaction to prevent a future recurrence of these spillovers might be to mandate higher bank capital standards, so as to buffer the economy from financial-sector problems. But this would overlook a more fundamental set of problems relating to corporate governance and internal managerial conflicts in banks—broadly termed agency problems in the finance literature. The failure to offload subprime risk may have been the leading symptom of these problems during the current episode, but they are a much more chronic and pervasive issue for banks—one need only to think back to previous banking troubles involving developing country loans, highly-leveraged transactions, and commercial real estate to reinforce this point. In other words, while the specific manifestations may change, the basic challenges of devising appropriate incentive structures and internal controls for bank management have long been present.

These agency problems play an important role in shaping banks' capital structures. Banks perceive equity to be an expensive form of financing, and take steps to use as little of it as possible; indeed a primary challenge for capital regulation is that it amounts to forcing banks to hold more equity than they would like. One reason for this cost-of-capital premium is the high level of discretion that an equity-rich balance sheet grants to bank management. Equity

[3] See Brunnermeier and Pedersen (2008) for a detailed analysis of these kinds of spirals and Adrian and Shin (2008b) for empirical evidence on the spillovers.

investors in a bank must constantly worry that bad decisions by management will dissipate the value of their shareholdings. By contrast, secured short-term creditors are better protected against the actions of wayward bank management. Thus the tendency for banks to finance themselves largely with short-term debt may reflect a privately optimal response to governance problems.

This observation suggests a fundamental dilemma for regulators as they seek to prevent banking problems from spilling over onto the wider economy. More leverage, especially short-term leverage, may be the market's way of containing governance problems at banks; this is reflected in the large spread between the costs to banks of equity and of short-term debt. But when governance problems actually emerge, as they invariably do, bank leverage becomes the mechanism for propagating bank-specific problems onto the economy as a whole. A regulator focused on the proximate causes of the crisis would prefer lower bank leverage, imposed for example through a higher capital requirement. This will reduce the risk of bank defaults. However, the higher capital ratio will also increase the overall cost of funding for banks, especially if higher capital ratios in good times exacerbate agency problems.

Moreover, given that the higher requirement holds in both good times and bad, a bank faced with large losses will still face an equally unyielding tradeoff—either liquidate assets or raise fresh capital. As we have seen during the current crisis, and as we document in more detail below, capital-raising tends to be sluggish. Not only is capital a relatively costly mode of funding at all times, it is particularly costly for a bank to raise new capital during times of great uncertainty. Moreover, at such times many of the benefits of building a stronger balance sheet accrue to other banks and to the broader economy, and thus are not properly internalized by the capital-raising bank.

Here is another way of seeing our point. Time-invariant capital requirements are analogous to forcing a homeowner to hold a fixed fraction of his house's value in savings, as a hedge against storm damage—and then not letting him spend down these savings when a storm hits. Given this restriction, the homeowner will have no choice but to sell the damaged house and move to a smaller place—i.e., to suffer an economic contraction.

This analogy suggests one possible avenue for improvement. One might raise the capital requirement to, say, 10% of risk-weighted assets in normal times, but with the understanding that it will be relaxed back to 8% in a crisis-like scenario. This amounts to allowing some of the rainy-day fund to be spent when it rains, which clearly makes sense—it will reduce the pressure on banks to liquidate assets, and the associated negative spillovers for the rest of the economy. Thus time-varying capital requirements represent a potentially important improvement over the current time-invariant approach in Basel II.

Still, even time-varying capital requirements continue to be problematic on the cost dimension. If banks are asked to hold significantly more capital during normal times—which, by definition, is most of the time—their expected cost of funds will increase, with adverse consequences for economic activity. This is because the fundamental agency problem described above remains unresolved. Investors will continue to charge a premium for supplying banks with large amounts of equity financing during normal times, because they fear that this will leave them vulnerable to the consequences of poor governance and mismanagement.

Pushing our storm analogy a little further, a natural alternative suggests itself, namely disaster insurance. In the case of a homeowner who faces a small probability of a storm that can cause $500,000 of damage, the most efficient solution is not for the homeowner to keep

$500,000 in a cookie jar as an unconditional buffer stock—especially if, in a crude form of internal agency, the cookie jar is sometimes raided by the homeowner's out-of-control children. Rather, a better approach is for the homeowner to buy an insurance policy that pays off only in the contingency when it is needed, i.e. when the storm hits. Similarly, for a bank, it may be more efficient to arrange for a contingent capital infusion in the event of a crisis, rather than keeping permanent idle (and hence agency-prone) capital sitting on the balance sheet.[4]

To increase flexibility, the choice could be left to the individual banks themselves. A bank with $500 billion in risk-weighted assets could be given the following option by regulators: it could either accept a capital requirement that is 2% higher, meaning that the bank would have to raise $10 billion in new equity. Or it could acquire an insurance policy that pays off $10 billion upon the occurrence of a systemic "event"—defined perhaps as a situation in which the aggregate write-offs of major financial institutions in a given period exceed some trigger level. In terms of cushioning the impact of a systemic event on the economy, the insurance option is just as effective as higher capital requirements.

To make the policy default-proof, the insurer (say a sovereign wealth fund, a pension fund, or even market investors) would, at inception, put $10 billion in Treasuries into a "lock box". If there is no event over the life of the policy, the $10 billion would be returned to the insurer, who would also receive the insurance premium from the bank as well as the interest paid by the Treasuries. If there is an event, the $10 billion would transfer to the balance sheet of the insured bank.

[4] The state-contingent nature of such an insurance scheme makes it similar in some ways to Flannery's (2005) proposal for the use of reverse convertible securities in banks' capital structures. We discuss the relationship between the two ideas in more detail below.

From the bank's perspective, the premium paid in insuring a systemic event triggered by aggregate bank losses may be substantially smaller than the high cost it has to pay for additional unconditional capital on balance sheet. This reduced cost of additional capital would in turn dampen the bank's incentive to engage in regulatory arbitrage.

Note that the insurance approach does not strain the aggregate capacity of the market any more than the alternative approach of simply raising capital requirements. In either case, we must come up with $10 billion when the new regulation goes into effect. Nevertheless, there may be some concern about whether a clientele will emerge to supply the required insurance on reasonable terms. In this regard, it is reassuring to observe that the return characteristics associated with writing such insurance have been much sought after by investors around the world—a higher-than-risk free return most of the time, in exchange for a small probability of a serious loss. Also, given the opt-in feature, if the market is slow to develop or proves to be too expensive, banks will always have the choice of raising more equity instead of relying on insurance.

To be clear, capital insurance is not intended to solve all the problems associated with regulating banks. For example, to the extent that the trigger is only breached when a number of large institutions experience losses at the same time, the issue of dealing with a single failing firm that is very inter-connected to the financial system would remain. The opt-in aspect of our proposal also underscores the fact that one should not view capital insurance as a replacement for traditional capital regulation, but rather, as one additional element of the capital-regulation toolkit. What makes this one particular tool potentially valuable is that it is designed with an eye towards mitigating the underlying frictions that make bank equity expensive—namely the governance and internal agency problems that are pervasive in this

industry. The added flexibility associated with the insurance option may therefore help to reduce the externalities associated with bank distress, while at the same time minimizing the potential costs of public bailouts during crises, as well as the drag on intermediation in normal times.

More generally, our proposal reflects some pessimism that regulators can ever make the financial system fail-safe. Rather than placing the bulk of the emphasis on preventative measures, more attention should be paid to reducing the costs of a crisis. Or, using an analogy from Hoenig (2008), instead of attempting to write the most comprehensive fire code possible, we should give some thought to installing more sprinklers.

The rest of the paper is organized as follows. In Section II., we describe the causes of the current financial crisis, and its spillover effects onto the real economy. In section III. we discuss capital regulation, with a particular focus on the limitations of the current system. In section IV. we use our analysis to draw out some general principles for reform. In Section V., we develop our specific capital-insurance proposal. Section VI. concludes.

II. The Credit-Market Crisis: Causes and Consequences

We begin our analysis by asking why so many mortgage-related securities ended up on bank balance sheets, and why banks funded these assets with so much short-term borrowing.

II.A. Agency problems and the demand for low-quality assets

Our preferred explanation for why bank balance sheets contained problematic assets, ranging from exotic mortgage-backed securities to covenant-light loans, is that there was a breakdown of incentives and risk control systems within banks.[5] A key factor contributing to

[5] See Hoenig (2008) and Rajan (2005) for a similar diagnosis.

this breakdown is that, over short periods of time, it is very hard, especially in the case of new products, to tell whether a financial manager is generating true excess returns adjusting for risk, or whether the current returns are simply compensation for a risk that has not yet shown itself but that will eventually materialize. Consider the following specific manifestations of the problem.

Incentives at the top

The performance of CEOs is evaluated based in part on the earnings they generate relative to their peers. To the extent that some leading banks can generate legitimately high returns, this puts pressure on other banks to keep up. Follower-bank bosses may end up taking excessive risks in order to boost various observable measures of performance. Indeed, even if managers recognize that this type of strategy is not truly value-creating, a desire to pump up their stock prices and their personal reputations may nevertheless make it the most attractive option for them (Stein (1989), Rajan (1994)).

There is anecdotal evidence of such pressure on top management. Perhaps most famously, Citigroup Chairman Chuck Prince, describing why his bank continued financing buyouts despite mounting risks, said:

"When the music stops, in terms of liquidity, things will be complicated. But as long as the music is playing, you've got to get up and dance. We're still dancing."[6]

Flawed internal compensation and control

Even if top management wants to maximize long-term bank value, it may find it difficult to create incentives and control systems that steer subordinates in this direction. Retaining top traders, given the competition for talent, requires that they be paid generously based on performance. But high-powered pay-for-performance schemes create an incentive to

[6] Financial Times, July 9, 2007.

exploit deficiencies in internal measurement systems. For instance, at UBS, AAA-rated mortgage-backed securities were apparently charged a very low internal cost of capital. Traders holding these securities were allowed to count any spread in excess of this low hurdle rate as income, which then presumably fed into their bonuses.[7] No wonder that UBS loaded up on mortgage-backed securities.

More generally, traders have an incentive to take risks that are not recognized by the system, so they can generate income that appears to stem from their superior abilities, even though it is in fact only a market risk premium.[8] The classic case of such behavior is to write insurance on infrequent events, taking on what is termed "tail" risk. If a trader is allowed to boost her bonus by treating the entire insurance premium as income, instead of setting aside a significant fraction as a reserve for an eventual payout, she will have an excessive incentive to engage in this sort of trade.

This is not to say that risk managers in a bank are unaware of such incentives. However, they may be unable to fully control them, because tail risks are by their nature rare, and therefore hard to quantify with precision before they occur. Absent an agreed-on model of the underlying probability distribution, risk managers will be forced to impose crude and subjective-looking limits on the activities of those traders who are seemingly the bank's most profitable employees. This is something that is unlikely to sit well with a top management that

[7] *Shareholder Report on UBS Writedowns*, April 18th 2008, http://www.ubs.com/1/e/investors/agm.html.

[8] Another example of the effects of uncharged risk is described in the *Shareholder Report on UBS Writedowns* on page 13: "The CDO desk received structuring fees on the notional value of the deal, and focused on Mezzanine ("Mezz") CDOs, which generated fees of approximately 125 to 150 bp (compared with high-grade CDOs, which generated fees of approximately 30 to 50 bp)." The greater fee income from originating riskier, lower quality mortgages fed directly to the originating unit's bottom line, even though this fee income was, in part, compensation for the greater risk that UBS would be stuck with unsold securities in the event that market conditions turned.

is being pressured for profits.[9] As a run of good luck continues, risk managers are likely to become increasingly powerless, and indeed may wind up being most ineffective at the point of maximum danger to the bank.

II.B. Agency problems and the (private) appeal of short-term borrowing

We have described specific manifestations of what are broadly known in the finance literature as managerial agency problems. The poor investment decisions that result from these agency problems would not be so systemically threatening if banks were not also highly levered, and if such a large fraction of their borrowing was not short-term in nature.

Why is short-term debt such an important source of finance for banks? One answer is that short-term debt is an equilibrium response to the agency problems described above.[10] If instead banks were largely equity financed, this would leave management with a great deal of unchecked discretion, and shareholders with little ability to either restrain value-destroying behavior, or to ensure a return on their investment. Thus banks find it expensive to raise equity financing, while debt is generally seen as cheaper.[11] This is particularly true if the debt can be

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[9] As the Wall Street Journal (April 16, 2008) reports, "Risk controls at [Merrill Lynch], then run by CEO Stan O'Neal, were beginning to loosen. A senior risk manager, John Breit, was ignored when he objected to certain risks…Merrill lowered the status of Mr. Breit's job...Some managers seen as impediments to the mortgage-securities strategy were pushed out. An example, some former Merrill executives say, is Jeffrey Kronthal, who had imposed informal limits on the amount of CDO exposure the firm could keep on its books ($3 billion to $4 billion) and on its risk of possible CDO losses (about $75 million a day). Merrill dismissed him and two other bond managers in mid-2006, a time when housing was still strong but was peaking. To oversee the job of taking CDOs onto Merrill's own books, the firm tapped …a senior trader but one without much experience in mortgage securities. CDO holdings on Merrill's books were soon piling up at a rate of $5 billion to $6 billion per quarter." Bloomberg (July 22, 2008, "Lehman Fault-Finding Points to Last Man Fuld as Shares Languish") reports a similar pattern at Lehman Brothers whereby "at least two executives who urged caution were pushed aside." The story quotes Walter Gerasimowicz, who worked at Lehman from 1995 to 2003, as saying "Lehman at one time had very good risk management in place. They strayed in search of incremental profit and market share."

[10] The insight that agency problems lead banks to be highly levered goes back to Diamond's (1984) classic paper.

[11] By analogy, it appears that the equity market penalizes too much financial slack in operating firms with poor governance. For example, Dittmar and Mahrt-Smith (2007) estimate that $1.00 of cash holdings in a poorly-governed firm is only valued by the market at between $0.42 and $0.88.

collateralized against a specific asset, since collateral gives the investor powerful protection against managerial misbehavior.

The idea that collateralized borrowing is a response to agency problems is a common theme in corporate finance (see, e.g., Hart and Moore (1998)), and of course this is how many assets—from real estate to plant and equipment—are financed in operating firms. What distinguishes collateralized borrowing in the banking context is that it tends to be very short-term in nature. This is likely due to the highly liquid and transformable nature of banking firms' assets, a characteristic emphasized by Myers and Rajan (1998). For example, unlike with a plot of land, it would not give a lender much comfort to have a long-term secured interest in a bank's overall trading book, given that the assets making up this book can be completely reshuffled overnight. Rather, any secured interest will have to be in the individual components of the trading book, and given the easy resale of these securities, will tend to short-term in nature.

This line of argument helps to explain why short-term, often secured, borrowing is seen as significantly cheaper by banks than either equity or longer-term (generally unsecured) debt. Of course, short-term borrowing has the potential to create more fragility as well, so there is a tradeoff. However, the costs of this fragility may in large part be borne systemically, during crisis episodes, and hence not fully internalized by individual banks when they pick an optimal capital structure.[12] It is to these externalities that we turn next.

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[12] A more subtle argument is that the fragile nature of short-term debt financing is actually part of its appeal to banks: precisely because it amplifies the negative consequences of mismanagement, short-term debt acts as a valuable ex ante commitment mechanism for banks. See Calomiris and Kahn (1991). However, when thinking about capital regulation, the critical issue is whether short-term debt has some social costs that are not fully internalized by individual banks.

II.C. Externalities during a crisis episode

When banks suffer large losses, they are faced with a basic choice: either they can shrink their (risk-weighted) asset holdings, so that they continue to satisfy their capital requirements with their now-depleted equity bases, or they can raise fresh equity. For a couple of reasons, equity-raising is likely to be sluggish, leaving a considerable fraction of the near-term adjustment to be taken up by asset liquidations. One friction comes from what is known as the debt overhang problem (Myers (1977)): by bolstering the value of existing risky debt, a new equity issue results in a transfer of value from existing shareholders. A second difficulty is that equity issuance may send a negative signal, suggesting to the market that there are more losses to come (Myers and Majluf (1984)). Thus banks may be reluctant to raise new equity when under stress. It may also be difficult for them to cut dividends to stem the outflow of capital, for such cuts may signal management's lack of confidence in the firm's future. And a loss of confidence is the last thing a bank needs in the midst of a crisis.

Figure 1 plots both cumulative disclosed losses and new capital raised by global financial institutions (these include banks and brokerage firms) over the last four quarters. As can be seen, while there has been substantial capital raising, it has trailed far behind aggregate losses. The gap was most pronounced in the fourth quarter of 2007 and the first quarter of 2008, when cumulative capital raised was only a fraction of cumulative losses. For example, through 2008Q1, cumulative losses stood at $394.7 billion, while cumulative capital raised was only $149.1 billion, leaving a gap of $245.6 billion. The situation improved in the second quarter of 2008, when reported losses declined, while the pace of capital raising accelerated.

While banks may have good reasons to move slowly on the capital-raising front, this gradual recapitalization process imposes externalities on the rest of the economy.

The fire sale externality

If a bank does not want to raise capital, the obvious alternative will be to sell assets, particularly those that have become hard to finance on a short-term basis.[13] This creates what might be termed a fire-sale externality. Elements of this mechanism have been described in theoretical work by Allen and Gale (2005), Brunnermeier and Pedersen (2008), Kyle and Xiong (2001), Gromb and Vayanos (2002), Morris and Shin (2004), and Shleifer and Vishny (1992, 1997) among others, and it has occupied a central place in accounts of the demise of Long-Term Capital Management in 1998.

When bank A adjusts by liquidating assets—e.g., it may sell off some of its mortgage-backed securities—it imposes a cost on another bank B who holds the same assets: the mark-to-market price of B's assets will be pushed down, putting pressure on B's capital position and in turn forcing it to liquidate some of its positions. Thus selling by one bank begets selling by others, and so on, creating a vicious circle.

This fire-sale problem is further exacerbated when, on top of capital constraints, banks also face short-term funding constraints. In the example above, even if bank B is relatively well-capitalized, it may be funding its mortgage-backed securities portfolio with short-term secured borrowing. When the mark-to-market value of the portfolio falls, bank B will effectively face a margin call, and may be unable to roll over its loans. This too can force B to unwind some of its holdings. Either way, the end result is that bank A's initial liquidation—

[13]In a Basel II regime, the pressure to liquidate assets is intensified in crisis periods because measured risk levels—and hence risk-weighted capital requirements—go up. One can get a sense of magnitudes from investment banks, who disclose firm-wide "value at risk" (VaR) numbers. Greenlaw et al (2008) calculate a simple average of the reported VaR for Morgan Stanley, Goldman Sachs, Lehman Brothers and Bear Stearns, and find that it rose 34% between August 2007 and February 2008.

through its effect on market prices and hence its impact on bank B's price-dependent financing constraints—forces bank B to engage in a second round of forced selling, and so on.

The credit crunch externality

What else can banks do to adjust to a capital shortage? Clearly, other more liquid assets (e.g. Treasuries) can be sold, but this will not do much to ease the crunch since these assets do not require much capital in the first place. The weight of the residual adjustment will fall on other assets that use more capital, even those far from the source of the crisis. For instance, banks may cut back on new lending to small businesses. The externality here stems from the fact that a constrained bank does not internalize the lost profits from projects the small businesses terminate or forego, and the bank-dependent enterprises cannot obtain finance elsewhere (see, e.g., Diamond and Rajan (2005)). Adrian and Shin (2008b) provide direct evidence that these balance sheet fluctuations affect various measures of aggregate activity, even controlling for short-term interest rates and other financial market variables.

Recapitalization as a public good

From a social planner's perspective, what is going wrong in both the fire-sale and credit-crunch cases is that bank A should be doing more of the adjustment to its initial shock by trying to replenish its capital base, and less by liquidating assets or curtailing lending. When bank A makes its privately-optimal decision to shrink, it fails to take into account the fact that were it to recapitalize instead, this would spare others in the chain the associated costs. It is presumably for this reason that Federal Reserve officials, among others, have been urging

banks to take steps to boost their capital bases, either by issuing new equity or by cutting dividends.[14]

A similar market failure occurs when bank A chooses its initial capital structure up front and must decide how much, if any, "dry powder" to keep. In particular, one might hope that bank A would choose to hold excess capital well above the regulatory minimum, and not to have too much of its borrowing be short-term, so that when losses hit, it would not be forced to impose costs on others. Unfortunately, to the extent that a substantial portion of the costs are social, not private costs, any individual bank's incentives to keep dry powder may be too weak.

II.D. Alternatives for regulatory reform

Since the banking crisis (as distinct from the housing crisis) has roots in both bank governance and capital structure, reforms could be considered in both areas. Start first with governance. Regulators could play a coordinating role in cases where action by individual banks is difficult for competitive reasons—for example, in encouraging the restructuring of employee compensation so that some performance pay is held back until the full consequences of an investment strategy play out, thus reducing incentives to take on tail risk. More difficult, though equally worthwhile, would be to find ways to present a risk-adjusted picture of bank profits, so that CEOs do not have an undue incentive to take risk to boost reported profits.

But many of these problems are primarily for corporate governance, not regulation, to deal with, and given the nature of the modern financial system, impossible to fully resolve. For example, reducing high-powered incentives may curb excessive risk taking, but will also

[14] For instance, Bernanke (2008) says: "I strongly urge financial institutions to remain proactive in their capital-raising efforts. Doing so not only helps the broader economy but positions firms to take advantage of new profit opportunities as conditions in the financial markets and the economy improve."

diminish the constant search for performance that allows the financial sector to allocate resources and risk. Difficult decisions on tradeoffs are involved, and these are best left to individual bank boards rather than centralized through regulation. At best, supervisors should have a role in monitoring the effectiveness of the decision-making process. This means that the bulk of regulatory efforts to reduce the probability and cost of a recurrence might have to be focused on modifying capital regulation.

III. The Role of Capital Regulation

To address this issue, we begin by describing the "traditional view" of capital regulation—the mindset that appears to inform the current regulatory approach, as in the Basel I and II frameworks. We then discuss what we see to be the main flaws in the traditional view. For reasons of space, our treatment has elements of caricature: it is admittedly simplistic, and probably somewhat unfair. Nevertheless, it serves to highlight what we believe to be the key limitations of the standard paradigm.

III.A. The traditional view

In our reading, the traditional view of capital regulation rests largely on the following four premises.

Protect the deposit insurer (and society) from losses due to bank failures

Given the existence of deposit insurance, when a bank defaults on its obligations, losses are incurred that are not borne by either the bank's shareholders or any of its other financial claimholders. Thus bank management has no reason to internalize these losses. This observation yields a simple and powerful rationale for capital regulation: a bank should be

made to hold a sufficient capital buffer such that, given realistic lags in supervisory intervention, etc., expected losses to the government insurer are minimized.

One can generalize this argument by noting that, beyond just losses imposed on the deposit insurer, there are other social costs that arise when a bank defaults—particularly when the bank in question is large in a systemic sense. For example, a default by a large bank can raise questions about the solvency of its counterparties, which in turn can lead to various forms of gridlock.

In either case, however, the reduced-form principle is this: bank failures are bad for society, and the overarching goal of capital regulation—and the associated principle of prompt corrective action—is to ensure that such failures are avoided.

Align incentives

A second and related principle is that of incentive alignment. Simply put, by increasing the economic exposure of bank shareholders, capital regulation boosts their incentives to monitor management, and to ensure that the bank is not taking excessively risky or otherwise value-destroying actions. A corollary is that any policy action that reduces the losses of shareholders in a bad state is undesirable from an ex ante incentive perspective—this is the usual moral hazard problem.

Higher capital charges for riskier assets

To the extent that banks view equity capital as more expensive than other forms of financing, a regime with "flat" (non-risk-based) capital regulation inevitably brings with it the potential for distortion, because it imposes the same cost-of-capital markup on all types of assets. For example, relatively safe borrowers may be driven out of the banking sector and

forced into the bond market, even in cases where a bank would be the economically more efficient provider of finance.

The response to this problem is to tie the capital requirement to some observable proxy for an asset's risk. Under the so-called IRB (internal-ratings-based) approach of the Basel II accord, the amount of capital that a bank must hold against a given exposure is based in part on an estimated probability of default, with the estimate coming from the bank's own internal models. These internal models are sometimes tied to those of the rating agencies. In such a case, risk-based capital regulation amounts to giving a bank with a given dollar amount of capital a "risk budget" that can be spent on either AAA-rated assets (at a low price), on A-rated assets (at a higher price), or on B-rated assets (at an even higher price).

Clearly, a system of risk-based capital works well only insofar as the model used by the bank (or its surrogate, the rating agency) yields an accurate and not-easily-manipulated estimate of the underlying economic risks. Conversely, problems are more likely to arise when dealing with innovative new instruments for which there exists little reliable historical data. Here the potential for mis-characterizing risks—either by accident, or on purpose, in a deliberate effort to subvert the capital regulations—is bound to be greater.

License to do business

A final premise behind the traditional view of capital regulation is that it forces troubled banks to seek re-authorization from the capital market in order to continue operating. In other words, if a bank suffers an adverse shock to its capital, and it cannot convince the equity market to contribute new financing, a binding capital requirement will necessarily compel it to shrink. Thus capital requirements can be said to impose a type of market discipline on banks.

III.B. Problems with the traditional mindset

The limits of incentive alignment

Bear Stearns' CEO Jim Cayne sold his 5,612,992 shares in the company on March 25, 2008 at price of $10.84, meaning that the value of his personal equity stake fell by over $425 million during the prior month. Whatever the reasons for Bear's demise, it is hard to imagine that the story would have had a happier ending if only Cayne had had an *even bigger* stake in the firm, and hence higher-powered incentives to get things right. In other words, ex ante incentive alignment, while surely of some value, is far from a panacea—no matter how well incentives are aligned, disasters can still happen.

Our previous discussion highlights a couple of specific reasons why even very high-powered incentives at the top of a hierarchy may not solve all problems. First, in a complex environment with rapid innovation and short histories on some of the fastest-growing products, even the best-intentioned people are sometimes going to make major mistakes. And second, the entire hierarchy is riddled with agency conflicts that may be difficult for a CEO with limited information to control. A huge bet on a particular product that looks, in retrospect, like a mistake from the perspective of Jim Cayne may have represented a perfectly rational strategy from the perspective of the individual who actually put the bet on—perhaps he had a bonus plan that encouraged risk taking, or his prospects for advancement within the firm were dependent on a high volume of activity in that product.

Fire sales and large social costs outside of default

Perhaps the biggest problem with the traditional capital-regulation mindset is that it places too much emphasis on the narrow objective of averting defaults by individual banks, while paying too little attention to the fire-sale and credit-crunch externalities discussed

earlier.[15] Consider a financial institution, which, when faced with large losses, immediately takes action to brings its capital ratio back into line, by liquidating a substantial fraction of its asset holdings.[16] On the one hand, this liquidation-based adjustment process can be seen as precisely the kind of "prompt corrective action" envisioned by fans of capital regulation with a traditional mindset. And there is no doubt that from the perspective of avoiding individual-bank defaults, it does the trick.

Unfortunately, as we have described above, it also generates negative spillovers for the economy: not only is there a reduction in credit to customers of the troubled bank, there is also a fire-sale effect that depresses the value of other institutions' assets, thereby forcing them into a similarly contractionary adjustment. Thus liquidation-based adjustment may spare individual institutions from violating their capital requirements or going into default, but it creates a suboptimal outcome for the system as a whole.

Regulatory arbitrage and the viral nature of innovation

Any command-and-control regime of regulation creates incentives for getting around the rules, i.e., for regulatory arbitrage. Compared to the first Basel accord, Basel II attempts to be more sophisticated in terms of making capital requirements contingent on fine measures of risk; this is an attempt to cut down on such regulatory arbitrage. Nevertheless, as recent experience suggests, this is a difficult task, no matter how elaborate a risk-measurement system one builds into the regulatory structure.

One complicating factor is the viral nature of financial innovation. For example, one might argue that AAA-rated CDOs were a successful product precisely because they filled a

[15] Kashyap and Stein (2004) point out that the Basel II approach can be thought of as reflecting the preferences of a social planner who cares only about avoiding bank defaults, and who attaches no weight to other considerations, such as the volume of credit creation.

[16] See Adrian and Shin (2008a) for systematic evidence on this phenomenon.

demand on the part of institutions for assets that yielded unusually high returns given their low regulatory capital requirements.[17] In other words, financial innovation created a set of securities that were highly effective at exploiting skewed incentives and regulatory loopholes. (See, e.g., Coval, Jurek and Stafford (2008a b), and Benmelech and Dlugosz (2008).)

Insufficient attention paid to cost of equity

A final limitation of the traditional capital-regulation mindset is that it simply takes as given that equity capital is more expensive than debt, but does not seek to understand the root causes of this wedge. However, if we had a better sense of *why* banks viewed equity capital as particularly costly, we might have more success in designing policies that moderated these costs. This is turn would reduce the drag on economic growth associated with capital regulation, as well as lower the incentives for regulatory arbitrage.

Our discussion above has emphasized the greater potential for governance problems in banks relative to non-financial firms. This logic suggests that equity or long-term debt financing may be much more expensive than short-term debt, not only because long-term debt or equity has little control over governance problems, it is also more exposed to the adverse consequences. If this diagnosis is correct, it suggests that rather than asking banks to carry expensive additional capital all the time, perhaps we should consider a *conditional capital arrangement* that only channels funds to the bank in those bad states of the world where capital is particularly scarce, where the market monitors bank management carefully, and hence where excess capital is least likely to be a concern. We will elaborate on one such idea shortly.

[17] Sub-prime mortgage originations seemed to take off to supply this market. For instance, Greenlaw et al show that subprime plus Alt-A loans combine represented fewer than 10% of all mortgage originations in 2001, 2002 and 2003, but then jumped to 24% in 2004 and further to 33% in 2005 and 2006; by the end of 2007 they were back to 9%. As Mian and Sufi (2008) and Keys et al. (2008) suggest, the quality of underlying mortgages deteriorated considerably with increased demand for mortgaged-backed securities. See European Central Bank (2008) for a detailed description of the role of structured finance products in propagating the initial sub-prime shock.

IV. Principles for Reform

Having discussed what we see to be the limitations of the current regulatory framework for capital, we now move on to consider potential reforms. We do so in two parts. First, in this section, we articulate several broad principles for reform. Then, in SectionV, we offer one specific, fleshed-out recommendation.

IV.A. Don't just fight the last war

In recent months, a variety of policy measures have been proposed that are motivated by specific aspects of the current crisis. For example, there have been calls to impose new regulations on the rating agencies, given the large role generally attributed to their perceived failures. Much scrutiny has also been given to the questionable incentives underlying the "originate to distribute" model of mortgage securitization (Keys et al. (2008)). And there have been suggestions for modifying aspects of the Basel II risk-weighting formulas, e.g., to increase the capital charges for highly-rated structured securities.

While there may well be important benefits to addressing these sorts of issues, such an approach is inherently limited in terms of its ability to prevent future crises. Even without any new regulation, the one thing we can be almost certain of is that when the next crisis comes, it won't involve AAA-rated subprime mortgage CDOs. Rather, it will most likely involve the interplay of some new investment vehicles and institutional arrangements that cannot be fully envisioned at this time. This is the most fundamental message that emerges from taking a viral view of the process of financial innovation—the problem one is trying to fight is always mutating. Indeed, a somewhat more ominous implication of this view is that the seeds of the next crisis may be unwittingly planted by the regulatory responses to the current one: whatever

new rules are written in the coming months will spawn a new set of mutations whose properties are hard to anticipate.

IV.B. Recognize the costs of excessive reliance on ex ante capital

Another widely-discussed approach to reform is to simply raise the level of capital requirements. We see several possible limitations to this strategy. In addition to the fact that it would chill intermediation activity generally by increasing banks' cost of funding, it would also increase the incentives for regulatory arbitrage.

While any system of capital regulation inevitably creates some tendency towards regulatory arbitrage, basic economics suggests that the *volume* of this activity is likely to be responsive to incentives—the higher the payoff to getting around the rules, the more creative energy will be devoted to doing so. In the case of capital regulation, the payoff to getting around the rules is a function of two things: i) the level of the capital requirement; and ii) the wedge between the cost of equity capital (or whatever else is used to satisfy the requirement) and banks' otherwise preferred form of financing. Simply put, given the wedge, capital regulation will be seen as more cumbersome and will elicit a more intense evasive response when the required level of capital is raised.

A higher capital requirement also does not eliminate the fire-sale and credit-crunch externalities identified above. If a bank faces a binding capital requirement—with its assets being a fixed multiple of its capital base—then when a crisis depletes a large chunk of its capital, it must either liquidate a corresponding fraction of its assets, or raise new capital. This is true whether the initial capital requirement is 8% or 10%.[18]

[18] It should be noted, however, that higher ex ante capital requirements do have one potentially important benefit. If a bank starts out with a high level of capital, it will find it easier to recapitalize once a shock hits, because the lower is its post-shock leverage ratio, the less of a debt overhang problem it faces, and hence the easier it is issue more equity. Hence the bank will do more recapitalization, and less liquidation, which is a good thing.

A more sophisticated variant involves raising the ex-ante capital requirement, but at the same time pre-committing to relax it in a bad state of the world.[19] For example, the capital requirement might be raised to 10%, with a provision that it would be reduced to 8% conditional on some publicly observable crisis indicator.[20] Leaving aside details of implementation, this design has the appeal that it helps to mitigate the fire-sale and credit-crunch effects: because banks face a lower capital requirement in bad times, there is less pressure on them to shrink their balance sheets at such times (provided, of course, that the market does not hold them to a higher standard than regulators). In light of our analysis above, this is clearly a helpful feature.

At the same time, since crises are by definition rare, this approach has roughly the same impact on the expected cost of funding to banks as one of simply raising capital requirements in an un-contingent fashion. In particular, if a crisis only occurs once every ten years, then in the other nine years this looks indistinguishable from a regime with higher un-contingent capital requirements. Consequently, any adverse effects on the general level of intermediation activity, or on incentives for regulatory arbitrage, are likely to be similar.

Thus if one is interested in striking a balance between: i) improving outcomes in crisis states, and ii) fostering a vibrant and non-distortionary financial sector in normal times, then even time-varying capital requirements are an imperfect tool. If one raises the requirement in

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[19] See Tucker (2008) for further thoughts on this. For instance, capital standards could also be progressively increased during a boom to discourage risk-taking.

[20] Starting in 2000 Spain has run a system based on "dynamic provisioning" whereby provisions are built up during times of low reported losses that are to be applied when losses rise. According to Fernández-Ordóñez (2008), Spanish banks "had sound loan loss provisions (1.3% of total assets at the end of 2007, and this despite bad loans being at historically low levels.)" In 2008 the Spanish economy has slowed, and loan losses are expected to rise, so time will tell whether this policy changes credit dynamics.

good times high enough, this will lead to progress on the first objective, but only at the cost of doing worse on the second.

IV.C. Anticipate ex post cleanups; encourage private-sector recapitalization

Many of the considerations that we have been discussing throughout this paper lead to one fundamental conclusion: it is very difficult—probably impossible—to design a regulatory approach that reduces the probability of financial crises to zero without imposing intolerably large costs on the process of intermediation in normal times. First of all, the viral nature of financial innovation will tend to frustrate attempts to simply ban whatever "bad" activity was the proximate cause of the previous crisis. Second, given the complexity of both the instruments and the organizations involved, it is probably naïve to hope that governance reforms will be fully effective. And finally, while one could in principle force banks to hold very large buffer stocks of capital in good times, this has the potential to sharply curtail intermediation activity, as well as to lead to increased distortions in the form of regulatory arbitrage.

It follows that an optimal regulatory system will necessarily allow for some non-zero probability of major adverse events, and focus on reducing the costs of these events. At some level this is an obvious point. The more difficult question is what the policy response should then be, once an event hits. On the one hand, the presence of systemic externalities suggests a role for government intervention in crisis states. We have noted that, in a crisis, private actors do too much liquidation, and too little recapitalization, relative to what is socially desirable. Based on this observation, one might be tempted to argue that the government ought to help engineer a recapitalization of the banking system, or of individual large players. This could be

done directly, through fiscal means, or more indirectly, e.g., via extremely accommodative monetary policy that effectively subsidizes the profits of the banking industry.

Of course, ad hoc government intervention of this sort is likely to leave many profoundly uncomfortable, and for good reason, even in the presence of a well-defined externality. Beyond the usual moral hazard objections, there are a variety of political-economy concerns. If, for example, there are to be meaningful fiscal transfers in an effort to recapitalize a banking system in crisis, there will inevitably be some level of discretion in the hands of government officials regarding how to allocate these transfers. And such discretion is, at a minimum, potentially problematic.

In our view, a better approach is to recognize up front that there will be a need for recapitalization during certain crisis states, and to "pre-wire" things so that the private sector—rather than the government—is forced to do the recapitalization. In other words, if the fundamental market failure is insufficiently aggressive recapitalization during crises, then regulation should seek to speed up the process of private-sector recapitalization. This is distinct from both: i) the government being directly involved in recapitalization via transfers; ii) requiring private firms to hold more capital ex ante.

V. A Specific Proposal: Capital Insurance

V.A. The basic idea

As an illustration of some of our general principles, and building on the logic we have developed throughout the paper, we now offer a specific proposal. The basic idea is to have banks buy capital insurance policies that would pay off in states of the world when the overall

banking sector is in sufficiently bad shape.[21] In other words, these policies would be set up so as to transfer more capital onto the balance sheets of banking firms in those states when aggregate bank capital is, from a social point of view, particularly scarce.

Before saying anything further about this proposal, we want to make it clear that it is only meant to be one element in what we anticipate will be a broader reform of capital regulation in the coming years. For example, the scope of capital regulation is likely to be expanded to include investment banks. And it may well make sense to control liquidity ratios more carefully going forward—i.e., to require, for example, banks' ratio of short-term borrowings to total liabilities not to exceed some target level (though clearly, any new rules of this sort will be subject to the kind of concerns we have raised about higher capital requirements). Our insurance proposal is in no way intended to be a substitute for these other reforms. Instead, we see it as a complement—as a way to give an extra degree of flexibility to the system, so that the overall costs of capital regulation are less burdensome.

More specifically, we envision that capital insurance would be implemented on an opt-in basis, in conjunction with other reforms, as follows. A bank with $500 billion in risk-weighted assets could be given the following choice by regulators: it could either accept an upfront capital requirement that is, say, 2% higher, meaning that the bank would have to raise $10 billion in new equity. Or it could acquire an insurance policy that pays off $10 billion upon the occurrence of a systemic "event"—defined perhaps as a situation in which the aggregate write-offs of major financial institutions in a given period exceed some trigger level.

To make the policy default-proof, the insurer (we have in mind a pension fund, or a sovereign wealth fund) would at inception put $10 billion in Treasuries into a custodial

[21] Our proposal is similar in the spirit to Caballero's (2001) contingent insurance plan for emerging market economies.

account, i.e., a "lock box". If there is no event over the life of the policy, the $10 billion would be returned to the insurer, who would also receive the insurance premium from the bank as well as the interest paid by the Treasuries. If there is an event, the $10 billion would transfer to the balance sheet of the insured bank. Thus from the perspective of the insurer, the policy would resemble an investment in a defaultable "catastrophe" bond.

V.B. The economic logic

This proposal obviously raises a number of issues of design and implementation, and we will attempt to address some of these momentarily. Before doing so, however, let us describe the underlying economic logic.

One way to motivate our insurance idea is as a form of "recapitalization requirement". As discussed above, the central market failure is that, in a crisis, individual financial institutions are prone to do too much liquidation, and too little new capital raising, relative to the social optimum. In principle, this externality could be addressed by having the government inject capital into the banking sector, but this is clearly problematic along a number of dimensions. The insurance approach that we advocate can be thought of as a mechanism for committing the private sector to come up with the fresh capital injection on its own, without resorting to government transfers.

An important question is how this differs from simply imposing a higher capital requirement ex ante—albeit one that might be relaxed at the time of a crisis. In the context of the example above, one might ask: what is the difference between asking a pension fund to invest $10 billion in what amounts to a catastrophe bond, versus asking it to invest $10 billion in the bank's equity, so that the bank can satisfy an increased regulatory capital requirement? Either way, the pension fund has put $10 billion of its money at risk, and either way, the bank

will have access to $10 billion more in the event of an adverse shock that triggers the insurance policy.

The key distinction has to do with the *state-contingent nature* of the insurance policy. In the case of the straight equity issue, the $10 billion goes directly onto the bank's balance sheet right away, giving the bank full access to these funds immediately, independent of how the financial sector subsequently performs. In a world where banks are prone to governance problems, the bank will have to pay a cost-of-capital premium for the unconditional discretion that additional capital brings.[22]

By contrast, with the insurance policy, the $10 billion goes into a custodial account. It is only taken out of the account, and made available to the bank, in a crisis state. And crucially, in such states, the bank's marginal investments are much more likely to be value-creating, especially when evaluated from a social perspective. In particular, a bank that has an extra $10 billion available in a crisis will be able to get by with less in the way of socially-costly asset liquidations.[23]

This line of argument is an application of a general principle of corporate risk management, developed in Froot, Scharfstein and Stein (1993). A firm can in principle always

[22] There may be a related cosmetic benefit of the insurance policy. Since the bank takes less equity onto its balance sheet, it has fewer shares outstanding, and various measures of performance, such as earnings per share, and return on equity, may be less adversely impacted than by an increase in the ex ante capital requirement. Of course, this will also depend on how the bank is allowed to amortize the cost of the policy.

[23] To illustrate, suppose a bank has 100 in book value of loans today; these will yield a payoff of either 90 or 110 next period, with a probability ½ of either outcome. One way for the bank to insure against default would be to finance itself with 90 of debt, and 10 of equity. But this approach leaves the bank with 20 of free cash in the good state. If investors worry that this cash in good times will lead to mismanagement and waste, they will discount the bank's stock. Now suppose instead that the bank seeks contingent capital. It could raise 105, with 100 of this in debt, and 5 in equity, and use the extra 5 to finance, in addition to the 100 of loans, the purchase of an insurance policy that pays off 10 only in the bad state. From a regulator's perspective, the bank should be viewed as just as well-capitalized as before, since it is still guaranteed not to default in either state. At the same time, the agency problem is attenuated, because after paying off its debt, the bank now has less cash to be squandered in the good state (10, rather than 20).

manage risk via a simple non-contingent "war chest" strategy of having a less leveraged capital structure and more cash on hand. But this is typically not as efficient as a state-contingent strategy that also uses insurance and/or derivatives to more precisely align resources with investment opportunities on a state-by-state basis, so that, to the extent possible, the firm never has "excess" capital at any point in time.

In emphasizing the importance of a state-contingent mechanism, we share a key common element with Flannery's (2005) proposal for banks to use reverse-convertible securities in their capital structure.[24] However, we differ substantially from Flannery on a number of specific design issues. We sketch some of the salient features of our proposal below, acknowledging that many details will have to be filled in after more analysis.

V.C. Design

We first review some basic logistical issues and then offer an example to illustrate how capital insurance might work.

Who participates?

Capital insurance is primarily intended for entities that are big enough to inflict systemic externalities during a crisis. It may, however, be unwise for regulatory authorities to identify ahead of time those whom they deem to be of systemic importance. Moreover, even smaller banks could contribute to the credit crunch and the fire-sale externalities. Thus we recommend that any entity facing capital requirements be given the option to satisfy some fraction of the requirement using insurance.

[24] See also Stein (2004) for a discussion of state-contingent securities in a banking context.

Suppliers

Although the natural providers of capital insurance may include institutions such as pension funds and sovereign wealth funds, the securitized design we propose means that policies can be supplied by any investor who is willing to receive a higher than risk-free return in exchange for a small probability of a large loss.[25] The experience of the last several years suggests that such a risk profile can be attractive to a range of investors.

While the market should be allowed to develop freely, one category of investor should be excluded, namely those that are themselves subject to capital requirements. It makes no sense for banks to simultaneously purchase protection with capital insurance, only to suffer losses from writing similar policies. Of course, banks should be allowed to design and broker such insurance so long as they do not take positions.

Trigger

The trigger for capital insurance to start paying out should be based on losses that affect aggregate bank capital (where the term "bank" should be understood to mean any institution facing capital requirements). In this regard, a key question is the level of geographic aggregation. There are two concerns here. First, banks could suffer losses in one country and

[25] There may be some benefit to having the insurance provided by passive investors. Not only do they have pools of assets that are idle, and can profitably serve as collateral (in contrast to an insurance company that might be reluctant to see its assets tied up in a lock box), they also have the capacity to bear losses without attempting to hedge them (again, unlike a more active financial institution). Individual investors, pension funds, and sovereign wealth funds would be important providers. See Organization for Economic Cooperation and Development (2008) for a list of major investments, totaling over $40 billion, made by sovereign wealth funds in the financial sector from 2007 through early 2008.

withdraw from another.[26] Second, international banks may have some leeway in transferring operations to unregulated territories.[27]

These considerations suggest two design features: First, each major country or region should have its own contingent capital regime, meeting uniform international standards, so that if, say, losses in the U.S. are severe, multinational banks with significant operations in the U.S. do not spread the pain to other countries. Second, multinational banks should satisfy their primary regulator that a significant proportion of their global operations (say 90 percent) are covered by capital insurance.

With these provisos, the trigger for capital insurance could be that the sum of losses of covered entities in the domestic economy (which would include domestic banks and local operations of foreign banks) exceeds some significant amount. To avoid concerns of manipulation, especially in the case of large banks, the insurance trigger for a specific bank should be based on losses of all other banks *except* the covered bank.

The trigger should be based on aggregate bank losses over a certain number of quarters.[28] This horizon needs to be long enough for substantial losses to emerge, but short enough to reflect a relatively sudden deterioration in performance, rather than a long, slow downturn. In our example below we consider a four-quarter benchmark, which means that if

[26] Indeed, Peek and Rosengren (2000) document the withdrawal of Japanese banks from lending in California in response to severe losses in Japan.

[27] The trigger might also be stated in terms of the size of the domestic market so that firms entering a market do not mechanically change the likelihood of a payment.

[28] Because this insurance pays off only in systemically bad states of nature, it will be expensive, but not relative to pure equity financing. For example, suppose that there are 100 different future states of the world for each bank, and that the trigger is breached only in 1 of the 100 scenarios. Because equity returns are low both in the trigger state and in many others (with either poor bank specific outcomes or bad but not disastrous aggregate outcomes), the cost of equity must be higher than the cost of the insurance.

there were two periods of large losses that were separated by more than a year the insurance might not be triggered.

An alternative to basing the trigger on aggregate bank losses would be to base it on an index of bank stock prices, in which case the insurance policy would be no more than a put option on a basket of banking stocks. However, this alternative raises a number of further complications. For example, with so many global institutions, creating the appropriate country-level options would be difficult, since there are no share prices for many of their local subsidiaries. Perhaps more importantly, the endogenous nature of stock prices—the fact that stock prices would depend on insurance payouts and vice-versa—could create various problems with indeterminacy or multiple equilibria. For these reasons, it is better to link insurance payouts to a more exogenous measure of aggregate bank health.

Payout profile

A structure that offers large discrete payouts when a threshold level of losses is hit might create incentives for insured banks to artificially inflate their reported losses when they find themselves near the threshold. To deter such behavior, the payout on a policy should increase continuously in aggregate losses once the threshold is reached. Below, we give a concrete example of a policy with this kind of payout profile.

Staggered maturities

An important question is how long a term the insurance policies would run for. Clearly, the longer the term, the harder it would be to price a policy, and the more unanticipated risk the insurer would be subject to, while the shorter the term the higher the transactions costs of repeated renewal. Perhaps a five-year term might be a reasonable compromise.

However, with any finite term length, there is the issue of renewal under stress: what if a policy is expiring at a time when large losses are anticipated, but have not yet been realized? In this case, the bank will find it difficult to renew the policy on attractive terms. To partially mitigate this problem, it may be helpful for each bank to have in place a set of policies with staggered maturities, so that each year only a fraction of the insurance needs to be replaced. Another point to note is that if renewal ever becomes prohibitively expensive, there is always the option to switch back to raising capital in a conventional manner, i.e., via equity issues.

An example

To illustrate these ideas, Figure 2 provides a detailed example of how the proposal might work for a bank seeking $10 billion in capital insurance. We assume that protection is purchased via five policies of $2 billion each that expire at year end for each of the next five years. There are three factors that shape the payouts on the policies: the trigger points for both the initiation of payouts and the capping of payouts, the pattern of bank losses, and the function that governs how losses are translated into payouts.

In the example, the trigger for initiating payouts is hit once cumulative bank losses over the last four quarters reach $100 billion. And payouts are capped once cumulative losses reach $200 billion. In between, payouts are linear in cumulative losses. This helps to ensure that, aside from the time value of earlier payments, banks have no collective benefit to pulling forward large loss announcements.

The payout function also embeds a "high-water" test, so that—given the four-quarter rolling window for computing losses—only incremental losses in a given quarter lead to further payouts. In the example, this feature comes into play in the 3rd quarter of 2009, when current losses are zero. Because of the high-water feature, payouts in this quarter are zero also,

even though cumulative losses over the prior four quarters continue to be high. Put simply, the high-water feature allows us to base payouts on a four-quarter window, while at the same time avoiding double-counting of losses.

These and other details of contract design are important, and we offer the example simply as a starting point for further discussion. However, given that the purpose of the insurance is to guarantee relatively rapid recapitalization of the banking sector, one property of the example that we believe should carry over to any real-world structure is that it be made to pay off promptly.

V.D. Comparisons with alternatives

An important precursor to our proposal, and indeed the starting point for our thinking on this, is Flannery (2005). Flannery proposes that banks issue reverse convertible debentures, which convert to equity when a bank's share price falls below a threshold. Such an instrument can be thought of as a type of firm-specific capital insurance.

One benefit of a firm-specific trigger is that it provides the bank with additional capital in *any* state of the world when it is in trouble—unlike our proposal where a bank gets an insurance payout only when the system as a whole is severely stressed. In the spirit of the traditional approach to capital regulation, the firm-specific approach does a more complete job of reducing the probability of distress for each individual institution. The firm-specific trigger also should create monitoring incentives for the bond holders which could be useful. Finally,, to the extent that one firm's failure could be systemically relevant, this proposal resolves that problem whereas ours does not.

However, a firm-specific trigger also has disadvantages. First, given that a reverse convertible effectively provides a bank with debt forgiveness if it performs poorly enough, it

could exacerbate problems of governance and moral hazard. Moreover, the fact that the trigger is based on the bank's stock price may be particularly problematic here. One can imagine that once a bank begins to get into trouble, there may be the ingredients in place for a self-fulfilling downwards spiral: as existing shareholders anticipate having their stakes diluted via the conversion of the debentures, stock prices decline further, making the prospect of conversion even more likely, and so on.[29]

Our capital insurance structure arguably does better than reverse convertibles on bank-specific moral hazard, given that payouts are triggered by aggregate losses rather by poor individual performance. With capital insurance, not only is a bank not rewarded for doing badly, it gets a payout in precisely those states of the world when access to capital is most valuable—i.e., when assets are cheap and profitable lending opportunities abound. Therefore, banks' incentives to preserve their own profits are unlikely to diminished by capital insurance.

Finally, ownership of the banking system brings with it important political-economy considerations. Regulators may be unwilling to allow certain investors to accumulate large control stakes in a banking firm. To the extent that holders of reverse convertibles get a significant equity stake upon conversion, regulators may want to restrict investment in these securities to those who are "fit and proper", or alternatively, remove their voting rights. Either choice would further limit the attractiveness of the reverse convertible. By contrast, our proposal does not raise any knotty ownership issues: when the trigger is hit, the insured bank simply gets a cash payout with no change in the existing structure of shareholdings.

[29] Relatedly, such structures can create incentives for speculators to manipulate bank stock prices. For example, it may pay for a large trader to take a long position in reverse convertibles, then try to push down the price of the stock via short-selling, in order to force conversion and thereby acquire an equity stake on favorable terms.

The important common element of the Flannery (2005) proposal and ours is the contingent nature of the financing. There are other contingent schemes that could also be considered; Culp (2002) offers an introductory overview of these types of securities and a description of some that have been issued.

Security design could take care of a variety of concerns. For example, if investors do not like the possibility of losing everything on rare occasions, the insurance policies could be over-collateralized: the insurer would put $10 billion into the lock box, but only a maximum of $5 billion could be transferred to the insured policy in the event the trigger is breached. This is a transparent change that might get around problems arising because some buyers (such as pension funds or insurance companies) face restrictions on buying securities with low ratings.

A security that has some features of Flannery's proposal (it is tied to firm- specific events) and some of ours (it is tied to losses, not stock prices) is the hybrid security issued in 2000 by the Royal Bank of Canada (RBC). RBC sold a privately placed bond to Swiss RE that, upon a trigger event, converted into preferred shares with a given dividend yield. The conversion price was negotiated at date of the bond issue and the trigger for conversion was tied to a large drop in RBC's general reserves. The size of the issue (C$200 million) was set to deliver an equity infusion of roughly one percent of RBC's Tier capital requirement.

Of particular interest is the rationale RBC had for this transaction. Culp (2002, p. 51) quotes RBC executive David McKay as follows: "It costs the same to fund your reserves whether they're geared for the first amount of credit loss or the last amount of loss…What is different is the probability of using the first loss amounts versus the last loss amounts. Keeping capital on the balance sheet for a last loss amount is not very efficient."

The fact that this firm-specific security could be priced and sold suggests the industry-linked one that we are proposing need not present insurmountable practical difficulties.

Before concluding, let us turn to a final concern about our insurance proposal—that it might create the potential for a different kind of moral hazard. Even though banks do not get reimbursed for their own losses, the fact that they get a cash infusion in a crisis might reduce their incentives to hedge against the crisis, to the extent that they are concerned about not only expected returns, but also the overall variance of their portfolios. In other words, banks might negate some of the benefits of the insurance by taking on more systematic risk. To see the logic most transparently, consider a simple case where a bank sets a fixed target on the net amount of money it is willing to lose in the bad state (i.e., it implements a value-at-risk criterion). If it knows that it will receive a $10B payoff from an insurance policy in the crisis, it may be willing to tolerate $10B more of pre-insurance losses in the crisis. If all banks behave in this way, they may wind up with more highly correlated portfolios than they would absent capital insurance.

This concern is clearly an important one. However, there are a couple of potentially mitigating factors. First, what is relevant is not whether our insurance proposal creates any moral hazard, but whether it creates more or less than the alternative of raising capital requirements. One could equally well argue that, in an effort to attain a desired level of return on equity, banks target the amount of systematic risk borne by their stockholders, i.e. their equity betas. If so, when the capital requirement is raised, banks would offset this by simply raising the systematic risk of their asset portfolios, so as to keep constant the amount of systematic risk borne per unit of equity capital. In this sense, any form of capital regulation faces a similar problem.

Second, the magnitude of the moral hazard problem associated with capital insurance is likely to depend on how the trigger is set, i.e. on the likelihood that the policy will pay off. Suppose that the policy only pays off in an extremely bad state which occurs with very low probability—a true financial crisis. Then a bank that sets out to take advantage of the system by holding more highly correlated assets faces a tradeoff: this strategy makes sense to the extent that the crisis state occurs and the insurance is triggered, but will be regretted in the much more likely scenario that things go badly, but not sufficiently badly to trigger a payout. This logic suggests that with an intelligently designed trigger, the magnitude of the moral hazard problem need not be prohibitively large.

This latter point is reinforced by the observation that, because of the agency and performance-measurement problems described above, bank managers likely underweight very low probability tail events when making portfolio decisions. On the one hand, this means that they do not take sufficient care to avoid assets that have disastrous returns with very low probability—hence the current crisis. At the same time, it also means that they do not go out of their way to target any specific pattern of cashflows in such crisis states. Rather, they effectively just ignore the potential for such states ex ante, and focus on optimizing their portfolios over the more "normal" parts of the distribution. If this is the case, insurance with a sufficiently low-probability trigger will not have as much of an adverse effect on behavior.

VI. Conclusions

Our analysis of the current crisis suggests that governance problems in banks and excessive short-term leverage were at its core. These two causes are related. Any attempt at preventing a recurrence should recognize that it is difficult to resolve governance problems,

and, consequently, to wean banks from leverage. Direct regulatory interventions, such as mandating more capital, could simply exacerbate private sector attempts to get around them, as well as chill intermediation and economic growth. At the same time, it is extremely costly for society to either continue rescuing the banking system, or to leave the economy to be dragged into the messes that banking crises create.

If despite their best efforts, regulators cannot prevent systemic problems, they should focus on minimizing their costs to society, without dampening financial intermediation in the process. We have offered one specific proposal, capital insurance, which aims to reduce the adverse consequences of a crisis, while making sure the private sector picks up the bill. While we have sketched the broad outlines of how a capital insurance scheme might work, there is undoubtedly much more work to be done before it can be implemented. We hope that other academics, policymakers and practitioners will take up this challenge.

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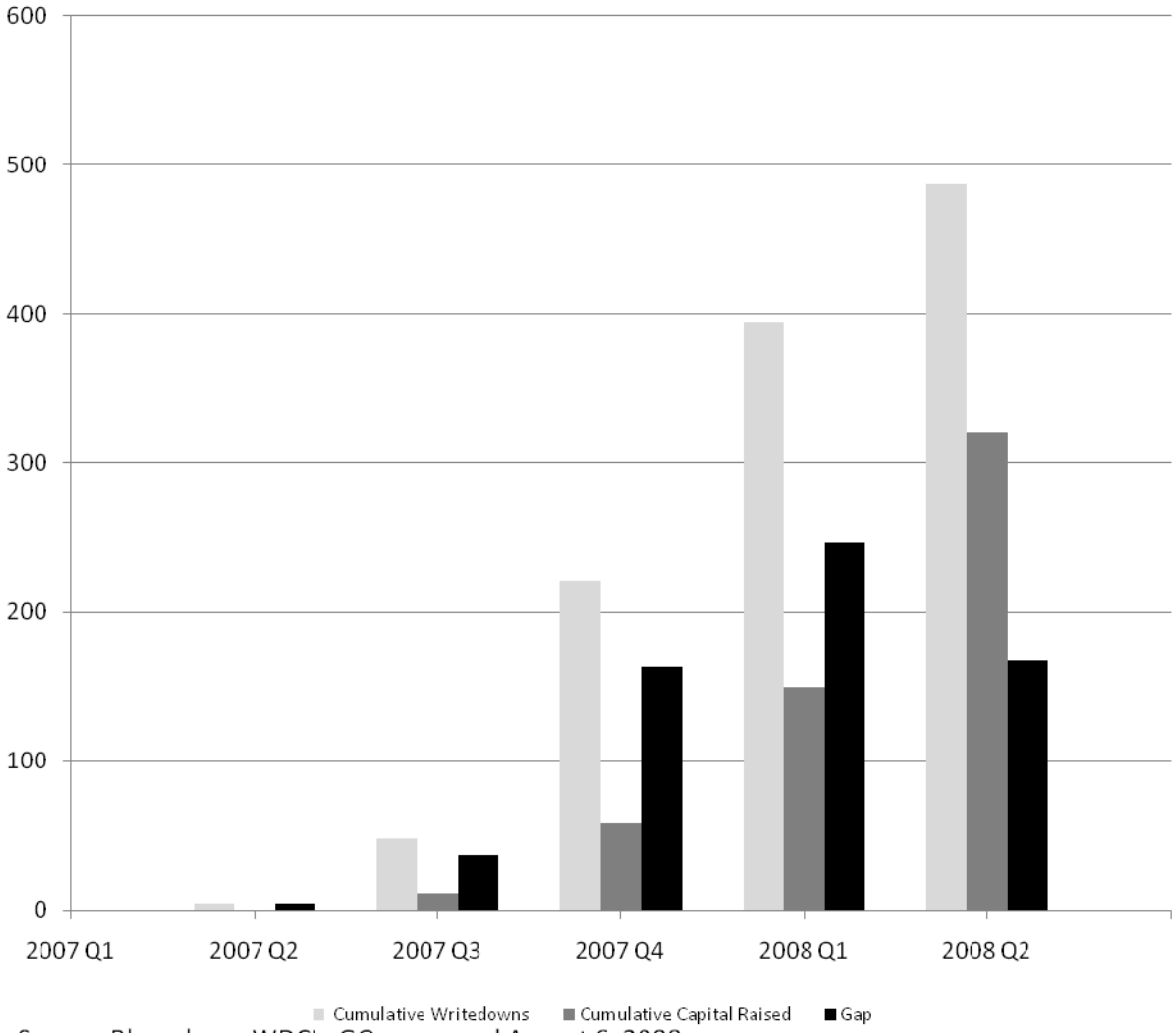
Figure 1: Progress Towards Recapitalization by Global Financial Firms



Source: Bloomberg, WDCI <GO> accessed August 6, 2008

Figure 2: Hypothetical Capital Insurance Payout Structure

In this example, Bank X purchases $10 billion in total coverage. It does so by buying five policies of $2 billion each, with expiration dates of 12/31/2009, 12/31/2010, 12/31 2011, 12/31/2012, and 12/31/2013. The payout on each policy is given by:

$$\text{Payout} = \frac{\text{4 quarter loss - max(high water}_{t-1}\text{,trigger)}}{\text{Full payout - trigger}} * \text{(Policy face)} \quad \text{if 4 quarter loss} > \text{high water loss}_{t-1}$$

$$= 0 \quad \text{otherwise}$$

The trigger on each policy is $100 billion in aggregate losses for all banks other than X, and full payout is reached when losses by all banks other than X reach $200 billion.

	Dollars (billions)				
	2008Q4	2009Q1	2009Q2	2009Q3	2009Q4
Current quarter loss	50	40	20	0	140
Cumulative 4 quarter loss	80	120	140	110	200
High water mark on losses	80	120	140	140	200
Payout per policy	0	0.4	0.4	0	1.2
Payout total	0	2	2	0	6
Cumulative payout	0	2	4	4	10