

# The “Surprising” Origin and Nature of Financial Crises: A Macroeconomic Policy Proposal

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## *I. Introduction*

The recent financial crisis has caused previously unimaginable wealth losses, the demise of elite financial institutions, and a global recession. What is behind severe financial crises, and what can we do to prevent a relapse or at least to reduce the economic costs of the next one?

Most professional (and amateur) economists and policymakers are currently seeking answers to these questions, and we are no exception. However, we argue that the conventional wisdom is rushing into conclusions and is converging too quickly on the standard post-crises themes of insufficient regulation, real estate bubbles, excessive leverage and capital flows, lax monetary policy, and so on. We do not disagree with the importance of some of these themes, but stopping there is bound to lead either to fairly conventional policy recommendations which have already proved to be insufficient to prevent severe crises from recurring, or to asphyxiate the development of the financial system through excessive capital requirements and deleveraging.

It is important to avoid falling into this intellectual and policy trap. For this reason we focus our analysis on factors that are not part of the core of the conventional wisdom. In particular, we highlight the importance of three key ingredients for severe financial crises in developed financial markets. The first and most central ingredient is a significant negative *surprise*. By this we mean not a large negative shock of the kind economic agents can foresee, but something that is new and confusing, a (perhaps temporary) change in the paradigm. In the context of the current crisis the surprise was **not** the decline in real estate prices or the fact that subprime mortgages were the first to be affected by this decline. Rather, the surprise was in the distress of many parts of the financial system, even those very distant from the subprime market itself, including all structured products, commercial paper, and interbank lending. At a moment's

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notice, linkages became too complex and hard to understand, prime counterparties were no longer perceived as such, and panic ensued.

In many of these instances, the data was available to recognize the problem, but this is mostly wisdom-after-the-facts.<sup>2</sup> Reality is immensely more complex than models, with millions of potential weak links. Ex-post, it is easy to highlight the one that blew up, but ex-ante is a different matter. Each market participant and policymaker knows their own local world, but understanding all the possible linkages across these different worlds (which are mostly irrelevant except during a severe crisis when they turn critical) is too complex. This change in paradigm, from irrelevant to critical linkages, triggers massive uncertainty, indeed Knightian uncertainty (when the unknowns shift from known to unknown), and unleashes destructive flights to quality.<sup>3</sup>

The second ingredient for severe financial crises is the excessive *concentration of aggregate risk* in highly leveraged (systemically important) financial institutions. Note that our emphasis here is on the concentration of aggregate risk rather than on the much hyped leverage. In our view, the problem in the current crisis was not leverage *per se*, which was high but not much higher than in past recessions that did not turn into financial catastrophes, but the fact that banks had held on to AAA tranches of structured asset backed securities which were more exposed to *aggregate* surprise shocks than their rating, when misinterpreted, would suggest. Thus, when systemic confusion emerged, these complex financial instruments quickly soured, compromised the balance sheets of their leveraged holders, and triggered asset fire sales that ravaged balance sheets across financial institutions. The result was a vicious feedback loop between assets exposed to aggregate conditions and leveraged balance sheets.

The third and last ingredient we highlight is a policy response that is too slow in addressing the consequences of the previous ingredients. Almost every severe crisis has an early bifurcation phase, where it can be contained by a decisive and systemic policy intervention supporting the financial system or exacerbated by policy timidity. The reasons for the latter are many, not least because policymakers are often shell-shocked as well, but also because the political tempo for unorthodox interventions is simply too slow to catch up with a financial system in free fall. In the current crisis, policies only turned systemic and aggressive enough after the Lehman debacle. Only then did politicians and policymakers (and most academic economists and journalists) seem to have gotten the evidence they needed to pick up the pace and move away from ill-timed moral hazard and distributional considerations. Unfortunately, by this time the

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<sup>2</sup> See, e.g., Caplin and Leahy (1994).

<sup>3</sup> See Caballero and Simsek (2009a,b) for a model of endogenous complexity during crises, and Caballero and Krishnamurthy (2008) for a model of Knightian uncertainty during crises. Other paradigms besides Knightian uncertainty have similar implications; for instance hot/cold decision-making (Bernheim and Rangel, 2005).

task had already grown to enormous proportions, and soon enough the political pressures and constraints built back again when faced with the exorbitant costs of an effective policy-package implemented in late stage.

For normal contractions, the institutional solution to the rigidity and biases inherent to the political process is to remove monetary policy from this process. Modern central banks are given the flexibility to react with adequate speed to regular business cycles. Unfortunately, there is no equivalent flexibility to deal with severe financial crises, which is precisely when a rapid response is most needed. Our goal in this paper is to propose a policy that is a close analogue to monetary policy (and conventional capital-adequacy requirements) in terms of its management, but that is targeted to systemic crises prevention and control.

In addition to being flexible, the policy must be useful in responding to surprises stemming from complexity and in reducing the exposure of the leveraged financial institutions to these surprises. The centrality of surprises, defined as an (often temporary) change in the perceived paradigm and working of the system, is discouraging at first, since it would seem that it is difficult to fight something that keeps changing and is not understood until after it happens. However, there is a certain order in this chaos. In particular, a common pattern across all these episodes is that the confusion triggers panics, and panics trigger spikes in the demand for explicit and implicit insurance. This observation immediately hints at the core of the required policy response: *public insurance provision*. When a systemic crisis of uncertainty strikes, *the government must quickly provide access to reasonably priced balance-sheet insurance to financial institutions*.<sup>4</sup>

Drawing an analogy with cardiac arrest treatment, we view our policy proposal as the equivalent to the strategic placement of *defibrillators*. We all know that a low-fat diet and plenty of exercise and rest are important preventive factors, but two-thirds of the sudden deaths from cardiac arrest still take place without any prior evidence of disease, and most of these deaths could have been prevented with adequate treatment within the first four critical minutes of the cardiac arrest.

Under our proposal, the central bank (CB) would issue *tradable insurance credits* (TICs). Each TIC would entitle its holder to attach a central bank guarantee to assets on its balance sheet *during* a systemic crisis. The amount of TICs required to insure a given type of security would be set by the CB to adjust for differing fundamental riskiness. All regulated financial institutions would be allowed to hold and use TICs, and possibly hedge funds; private equity funds and

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<sup>4</sup> See Caballero and Krishnamurthy (2008) for a model of crises triggered by spikes in Knightian uncertainty and the optimal response of the central bank in terms of insurance provision. To a large extent, that paper provides the formal perspective underpinning the current paper and proposal.

corporations would be allowed to as well (especially under the extended reach of the new regulatory proposal). Prudential regulations, however, would require that during normal times, regulated financial institutions hold a minimum amount of TICs as a proportion of risk-weighted assets and systemic importance.

At a minimum, the TIC-policy would have the following key components:

*A convertibility rule.* The CB determines a (necessarily noisy) convertibility-threshold level for systemic panic, above which TICs can be attached to a bond or portfolio. An attached TIC is simply a central bank backed CDS.

*Open market operations.* During normal times, when TICs are not convertible, the CB can buy or sell TICs at a market price.

*Minimum holding requirements.* During normal times, highly leveraged and systemically important institutions must preserve a minimum TIC/Assets ratio.

How would TICs have worked during the current crisis? Suppose U.S. banks had held approximately \$1 trillion (notional) worth of TICs. The Fed could have responded first by hinting that it might declare TICs convertible and then by making an increasing proportion of the outstanding TICs convertible. Arguably, this would have required converting approximately the amount of ad-hoc insurance for specific institutions that was actually offered during the crisis, about \$500 billion.

It is important to notice that the TIC-policy is not a conventional insurance policy in the sense that an insurance policy exchanges a fee during normal times for a cash injection during crises. Rather, the TIC-policy is an “insurance-squared” policy: For a fee, it ensures that financial institutions will have *access* to insurance for their assets during systemic crises. This aspect of the policy is central, as a core feature of panics caused by Knightian uncertainty is that economic agents behave as if the likelihood of a catastrophe were much higher than it actually is (at least in the absence of the panic itself). By providing insurance against these catastrophes, economic agents are able to go back to their normal activities while the government is unlikely to ever have to deliver on this insurance (or is at least much less likely than panicked investors estimate).<sup>5</sup>

Note also that TICs are equivalent to CDS during systemic crises but *not* during normal times. That is, TICs are *contingent*-CDS. They become activated only when a systemic crisis arises. By

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<sup>5</sup> Caballero and Krishnamurthy (2008) provide an example where in the presence of Knightian uncertainty the event agents worry about is individually plausible but collectively impossible (not everyone can do worse than the average). The central bank cannot fall into this fallacy of composition, and hence solves the problem by providing a very low cost insurance.

targeting the event that needs protection, this contingent feature significantly lowers the cost of insurance for financial institutions. This is an important advantage of this approach over the calls for higher capital adequacy ratios and deleveraging.

In summary, the TIC-policy framework can significantly stabilize the value of banks' assets and equity during systemic events and hence limit the panic-driven fire sales and market freezes that characterize severe financial crises. Through open market operations and announcements on the convertibility threshold, not too different from the way central banks conduct monetary policy, they can manage the devastating consequences of rises in perceived uncertainty on the financial sector without massive contemporaneous injections of public resources, and at a much lower cost to the private sector than large capital requirements.

The rest of the paper is divided into two main parts and a conclusion. In the first part we describe the three ingredients behind severe crises in more detail. In the second part we describe the TIC-policy and how it compares with some of the alternatives.

## *II. What Causes Severe Financial Crises in Developed Economies?*

The silver lining to financial crises is that they reveal severe weaknesses of the financial infrastructure which we can then fix to improve the resilience of the economy to similar events in the future. The current financial crisis is no exception, and we have seen a large number of symposiums and proposals devoted to these new fixes. These proposals range from new monetary policy mandates to complete overhauls of financial regulation, at both domestic and global levels.

To cite just two examples, the first two items of the Executive Summary of the 2009 London Summit on Reshaping the Global Financial System state:

“... world leaders will consider how government and regulators can work together internationally to agree what further steps are needed to enhance corporate governance and risk management by financial institutions; agree on steps to strengthen prudential regulation, including requiring banks to build buffers of resources in good times....”

and the Administration's recent reform plan includes:

“raising capital and liquidity requirements, with more stringent requirements for the largest and most interconnected firms, [...] impos[ing] robust reporting requirements on the issuers of asset-backed securities [and] harmonizing the regulation of futures and securities”

While the proposals that emerge from such meetings and policy committees are mostly good and sound advice, they are hardly new, and more importantly, they run the serious risk of trivializing the nature of severe crises. Almost every crisis is followed by similar proposals, and

progress is made, but just as one hole is plugged, new ones arise (and sometimes the policies themselves create new ones). This inability to make the system completely crisis-proof stems from the very nature of the dynamic process of financial development. Unfortunately, the importance of the “newness” factor, while often mentioned, is minimized at the time of proposing concrete policy solutions.

In the remainder of this section we describe the three features of crises that motivate our policy proposal put forth in Section III.

## *II.A. Surprises*

There is extensive experimental evidence that human beings crave patterns – sunbathers see animals and faces in clouds, etc. (pareidolia and cluster illusion).<sup>6</sup> This tendency is also prevalent in the analysis of economic and financial crises. Surely there are common patterns across the preludes of crises, but these cannot be the core of the problem or we would have solved it a long time ago. If all crises were caused by underestimates of the potential for real estate values to drop, we would already have found a way to mitigate this particular risk.

Policy conclusions often derive from formal or informal case studies. Caprio and Honohan (2008) examine the factors that contributed to each of the many crises of the post-Bretton Woods era. While each crisis is different, they argue that the contributing factors usually involve some combination of: fraud, lax internal controls, mismanagement, excessive risk taking, financial liberalization, government-directed credit decisions, taxes or tax-like policies, over-optimism, and herd effects. But case studies, by construction, suffer from selection bias: The explanations and culprits appear too certain, as they ignore the many instances when similar factors were present but nothing happened (as these are not the subject of the case study). More generally, the certainty in researchers’ and policymakers’ authoritative conclusions on the causes of crises contrasts sharply with the very limited predictive power that models have in anticipating crises, even when they include the very same factors that are ex-post considered as obvious parts of the explanation.

For example, so-called Early Warning System models, following Kaminsky, Lizondo and Reinhart (1998), and Kaminsky and Reinhart (1999), attempt to predict banking and/or capital account crises. They do so by tracking the behavior of several macroeconomic and financial indicators and by issuing a warning signal when the estimated probability of an upcoming crisis crosses a threshold. The KLR model issues warnings on a variable-by-variable basis and then combines these individual warnings in an index; other specifications use a probit model. Berg et. al. (2004) survey the predictive power of several variants of these models and conclude that the

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<sup>6</sup> See Gilovich, T. et. al. (2002).

warnings are statistically significant, both in-sample and out-of-sample. Financial-sector variables, such as domestic credit growth and real interest rates, account for a large fraction of their predictive power. The magnitudes of the coefficients, however, are not very large. On the basis of the KLR model, the conditional probability of a crisis being given a warning is 29%, compared to 9% without a warning. It is certainly possible that a different specification or including more variables (real estate values, for instance, are not included in the KLR model) would improve the models' predictive power. To a first approximation, however, the macroeconomic factors that are often cited as the causes of crises explain about 20 percentage points of increased likelihood. Residual uncertainty, including surprises and factors other than commonly analyzed macroeconomic variables, account for the remaining 80 percentage points.<sup>7</sup> If nothing else, this evidence suggests we should be humble about claiming to have a full understanding of what triggers financial crises and, consequently, about having policy recommendations that we claim will prevent them.

More recently, using an extended database, Reinhart and Rogoff (2008) study the incidence of banking crises. They find that crises are quite frequent, taking place on average every 14 years in advanced economies and every nine years in emerging economies. Capital account “bonanzas”, which are often mentioned as sources of unsustainable imbalances, do indeed increase the likelihood of crises: The probability of a banking crisis within a three year window before and after the bonanza is 18%, whereas the unconditional probability is 13%. Again, a statistically significant and informative difference but **not** a decisive indication of when a crisis is going to occur or what its causes are. Furthermore, these figures come from a sample that includes both developed and emerging economies. Financial crises associated with a sharp change in the capital account (a “sudden stop”) tend to be more common in emerging than in advanced economies (Mendoza and Terrones, 2008). Indeed in the U.S., capital flows have usually had a stabilizing role in times of crisis, as investors seek a safe haven in the perceived security of US government bonds. In the current crisis, the U.S. has not had to rapidly reduce its current account deficit, which has gone from 6.1% of GDP in 2006, to 5.3% in 2007, to 4.9% in 2008. In fact, the value of the dollar increased approximately 6.3% against a broad trade-weighted basket of currencies between the second quarter of 2007 and the first quarter to

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<sup>7</sup> The values for the KLR model follow from the following table which includes both in-sample and out-of-sample observations

	Warning	No warning
Crisis	333	232
No crisis	803	2229

False alarms are issued in 26% of non-crises compared to accurate alarms in 59% of crises. The table cannot be used directly to compute standard errors around the estimates of conditional probabilities because there is substantial serial correlation in the observations (Berg et. al. 2004).

2009. So-called global imbalances are certainly part of the background of the current crisis, but it is not the rapid unwinding of these imbalances which has caused it, as some had feared.

It is not our goal here to discredit standard policy analysis and conclusions. It would be unwise not to learn and incorporate the most obvious lessons of the past, such as the importance of trying to prevent the ills listed by Caprio and Honohan, into economic analysis and policy. Our point is simply that these lessons are only a small part of what is needed to prevent and soften the impact of severe financial crises. Placing too much weight on them may be counterproductive if it translates into excessive straightjackets, a false sense of security, or simply an outdated and hence wasteful precautionary measure. These concerns are all the more relevant given the rapidly integrating global economy that will undoubtedly bring back many of the elements that, according to many policymakers and commentators, “trigger” crises, such as global imbalances and high asset valuations. Whether we embrace them or not, these are part of the structure of the new global economy.<sup>8</sup> In this context, unexpected accidents will continue to happen, and it is important to build a system that is resilient to these accidents.

To some extent, the claim that surprises are a necessary condition for financial crises is tautological since absent a surprise (in most instances) economic agents and the government would be prepared for the negative event. However, our claim is more subtle than this. The surprises that have the potential to trigger severe crises are not simply bad realizations within a known probabilistic environment. Rather, they are changes in the environment itself. It is this “rare event” feature that holds the key as it has the potential to trigger sharp rises in perceived uncertainty and flight to quality. Surprises of this kind destroy an enormous amount of intangible capital built from an understanding of how the (previous) financial world works. Risk management paradigms have to be replaced for uncertainty-management ones, but the latter is not something human beings, let alone highly leveraged financial institutions, are particularly good at.

This perspective contains a more general message as well. The continuous potential for rules-of-the-game changing surprises stems from the process of financial development itself. New financial instruments and practices emerge continuously and, by their very essence, are untested with respect to major events and disruptions. Their first test invariably creates the potential for large dislocations and confusion. For example, the 1970 default by the Penn Central Railroad on \$82 million of prime-rated commercial paper, a relatively new product at the time, threw doubt onto the entire commercial paper market, causing investors to retreat. Similarly, the collapse of Long Term Capital Management (LTCM), a giant hedge fund that used

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<sup>8</sup> For a characterization of the macroeconomics of asset shortages, see (Caballero 2006, and Caballero et al 2008a,b).

a complex strategy to profit from small movements in security prices was the first of its kind, and caused an immediate global financial panic. In contrast, the 1997 Mercury Financing commercial paper default, and the 2006 collapse of the Amaranth hedge fund caused little liquidity disruption.<sup>9</sup>

In the current financial crisis, several turns of events, over and beyond the large decline in real estate values, took market participants by surprise. A comparatively slowly evolving surprise was the crisis of monoline insurers. Many banks had large holdings of AAA tranches of CDOs, insured by monolines, themselves also rated AAA. The insurance helped lower banks' capital requirements and, in theory (and in financial reporting), lowered their exposure to subprime assets. However, monolines were themselves highly exposed to subprime assets, more so than was realized. In late 2007, it started to become clear that subprime mortgages would indirectly lead to huge losses for monolines, raising questions about their solvency.<sup>10</sup> When they were finally downgraded in 2008, this cascaded onto the over \$2 trillion worth of assets they insured, including but not limited to subprime CDOs.<sup>11</sup> This triggered selloffs by ratings-constrained investors and forced banks to write down and hold capital against large positions in the insured assets. In retrospect it seems clear that monolines' insurance on CDOs did not really decrease banks' exposures, since the counterparty risk was almost perfectly correlated with the assets themselves. But this was not obvious at the time, since most of the instruments involved were untested with respect to major market disruptions. When it was realized that the monolines were not as reliable as had been thought, this contributed to the overall uncertainty (aside from spreading the crisis into the municipal bond market, yet another indirect linkage).

A more sudden surprise took place when the Reserve Primary Fund, a leading money market fund, "broke the buck" after Lehman declared bankruptcy. In testimony to Congress on September 23, 2008, Chairman Bernanke stated that

"The troubles at Lehman had been well known for some time, and investors clearly recognized - as evidenced, for example, by the high cost of insuring Lehman's debt in the market for credit default swaps - that the failure of the firm was a significant possibility. Thus, we judged that investors and counterparties had had time to take precautionary measures."

Chairman Bernanke was certainly right that Lehman's failure (and arguably the government's decision to let it fail) was not entirely unpredicted. Yet its ramifications still caught many market participants and policymakers by surprise.

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<sup>9</sup> For a more detailed discussion of these and other examples, see (Caballero and Krishnamurthy, 2008).

<sup>10</sup> At the time, it was estimated that MBIA would require about \$4 billion in additional capital to retain its AAA rating; if it lost it, the loss of market value of the assets it insured was estimated at around \$200 billion (Bloomberg, December 5, 2007).

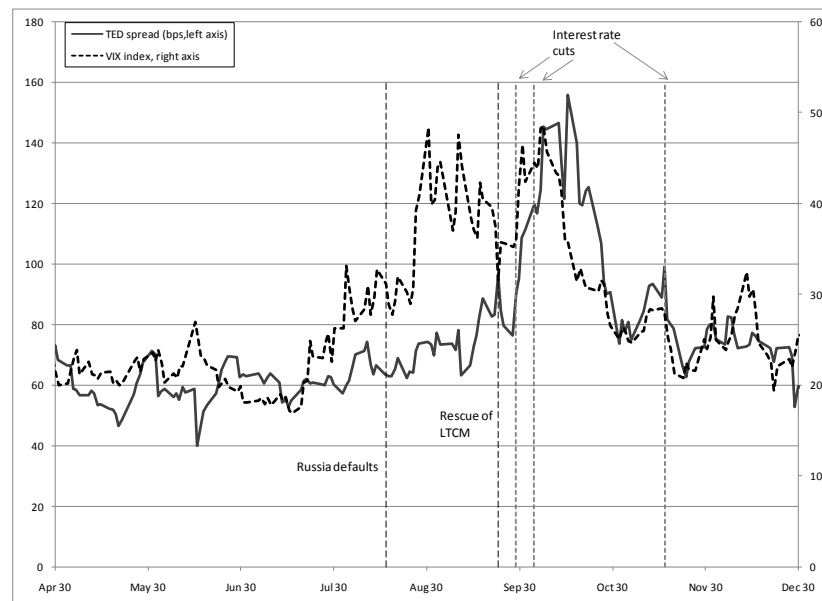
<sup>11</sup> Ambac was first downgraded by Fitch on January 18; MBIA was first downgraded on April 4, also by Fitch.

One of those ramifications was that the Reserve Primary Fund saw its Net Asset Value (NAV) drop below one dollar. The fund had invested \$785 million in Lehman debt, which constituted about 1.2% of its assets. Immediately after Lehman filed for bankruptcy, the fund suffered a massive run, with over \$30 billion in redemption requests (about half of its total assets) before it stopped accepting redemption requests at \$1 at 11 a.m. the following day. Money market funds had been considered extremely safe, and had indeed benefited from the flight to quality during the previous year, growing by about \$850 billion (34%) since mid 2007. The drop in the Reserve Primary Fund's NAV caused investors to question the safety of the entire industry. There were net redemptions for about \$170 billion during that week, as well as a large shift from prime funds towards funds investing exclusively in government debt. In order to stem the panic, on September 19 the U.S. Treasury announced a guarantee program that would compensate investors if the NAV of participating funds fell below \$1.

In retrospect, the consequences of Lehman's demise on the Primary Fund could have been predicted. Public filings showed large investments in Lehman as early as November 2007, part of a generally less conservative investment strategy (Investment Company Institute, 2009). Anyone who took the trouble to connect the dots could, in principle, have foreseen what might happen. However, money market funds had a track record of stability that had always made it unnecessary to inspect their holdings. Moreover, in a complexly interconnected financial system, it is inevitable that some dots will remain unconnected. The realization that there might be further losses in previously unexamined places led investors to intensify their flight to quality. In the terminology of Gorton and Pennacchi (1990) and Holmstrom (2008), the losses at the Primary Fund suddenly transformed money market funds from information-insensitive assets to information-sensitive ones. Investors fled toward the few assets that were still perceived as not requiring acquisition of information.

Surprises also played a large role in previous crises, or near-crises. When Russia defaulted on its debts in August 1998 this was certainly not a completely unexpected event. Spread on Russian bonds had been rising for months and had reached 1200 basis points by the end of July. What surprised the markets was the degree to which some key institutions, notably LTCM, were exposed not just to Russia itself but to the reappraisal of risk that followed. As the troubles at LTCM became known and investors fled towards the safest and most liquid assets, prices of risk, including counterparty risk, began to rise, as illustrated in Figure 1. This soon became self-reinforcing since LTCM was highly exposed to the surprise, for instance making huge losses on on-the-run/off-the-run arbitrage when spreads widened. The Fed-sponsored rescue of LTCM by its creditors plus an unscheduled interest rate cut in October 1998 persuaded investors that the

worst scenarios would not be reached and calm returned to (developed) financial markets relatively quickly.<sup>12</sup>



**Figure 1. Surprises during the 1998 flight to quality**

The focus on surprises does not mean that in the current crisis there were no excesses of the conventional kind, especially in the subprime market. Warren Buffett publicly scolded bankers at his famous yearly meeting (Omaha 2009) for not anticipating the impact of the impending decline in the real estate market, as did many others.<sup>13</sup> However, if one looks at the direct impact of the subprime shock, it is difficult to support these claims. The bankers' main mistake was not to miss it, since this was (relatively) "small change," but rather their failure to understand the impact of all the confusion that followed when the entire securitization markets began to be questioned. This is a far more subtle and likely kind of mistake – as it stems from complexity itself.

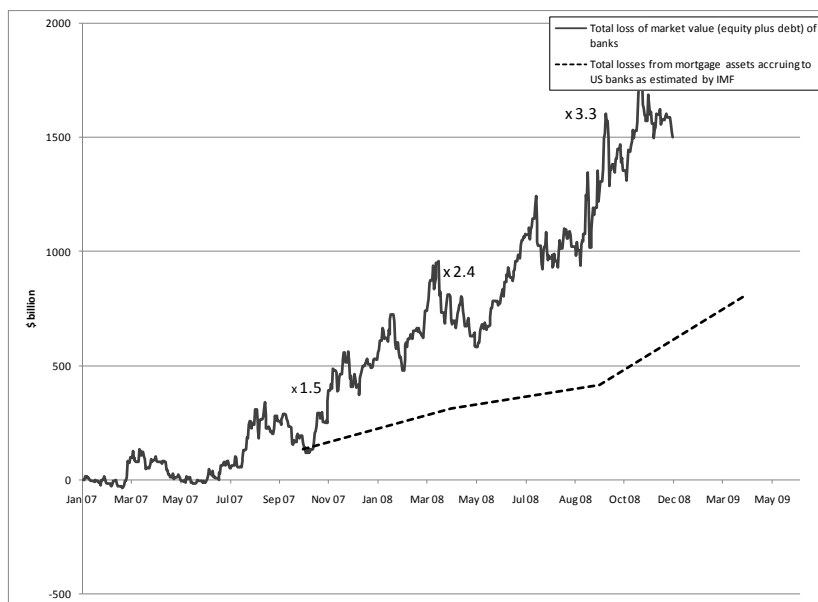
The following calculation illustrates the difference in the orders of magnitude of the shock itself and the losses derived from it. We computed the evolution of the market value (equity plus long term debt) of the 20 largest U.S. banks since January 2007.<sup>14</sup> From this we obtained an

<sup>12</sup> Emerging markets and high yields did experience a crisis but this did not compromise the core of the global financial system.

<sup>13</sup> May 4 (Bloomberg) – [Berkshire Hathaway Inc.](#) Chairman [Warren Buffett](#) lambasted bankers, insurers and regulators for being blind to the possibility home prices could fall, and said their shortcomings caused the worst recession in half a century.

<sup>14</sup> The procedure for estimating this was as follows: For equity, we simply tracked the evolution of each bank's market capitalization, excluding increases in the market cap due to issues of new shares. For debt, we estimated the duration of each bank's long term debt (including any preferred shares) from the maturity profiles

estimate of total losses on the right hand side of these banks' balance sheets. Absent any feedback effects, this should be equal to the losses suffered by the assets on the left hand side of the balance sheet. However, as illustrated in Figure 2, we find that losses on the right hand side are on the order of three times the IMF's (evolving) estimates of losses related to mortgage assets accruing to U.S. banks.<sup>15</sup> Beginning in 2008 and increasingly after the fall of Bear Stearns, the overall loss in market value becomes larger than the losses from subprime assets. The market began to price in losses from the overall disruption of financial markets, the severe recession and losses on other types of assets which far exceeded the estimated losses from the mortgage market itself.



**Figure 2. Losses from mortgage assets, total loss of market value and multiplier. Sources: IMF Global Financial Stability Reports, banks' financial statements and JPMorgan.**

The losses for the overall economy are, of course, an order of magnitude larger than simply the loss of market value of the banks. The cumulative loss of output from the recession over the next five years, using projections from the Congressional Budget Office, will be of the order of \$5 trillion. The stock market lost approximately \$9 trillion between its peak in October 2007 and March 2009, approximately six times the estimated losses of the banking sector alone. It

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described in the 10-K statements as of December 2007, assuming the interest rate was equal to the rate on 10-year Treasuries plus the spread on 5-year CDS for each bank, obtained from JPMorgan. Assuming an unchanged maturity profile, we then tracked the changes in the implied market value of each bank's long term debt on the basis of the evolution of the CDS spread. The banks included in the calculation are the 19 banks that underwent the "stress tests" plus Lehman, Bear Stearns, Merrill Lynch, Wachovia, and Washington Mutual.

<sup>15</sup> The IMF uses a projection of macroeconomic variables and default rates to estimate losses on loans and market values to estimate losses on subprime-related securities. To the extent that market prices of securities overreacted due to fire sales, this would tend to understate the multiplier.

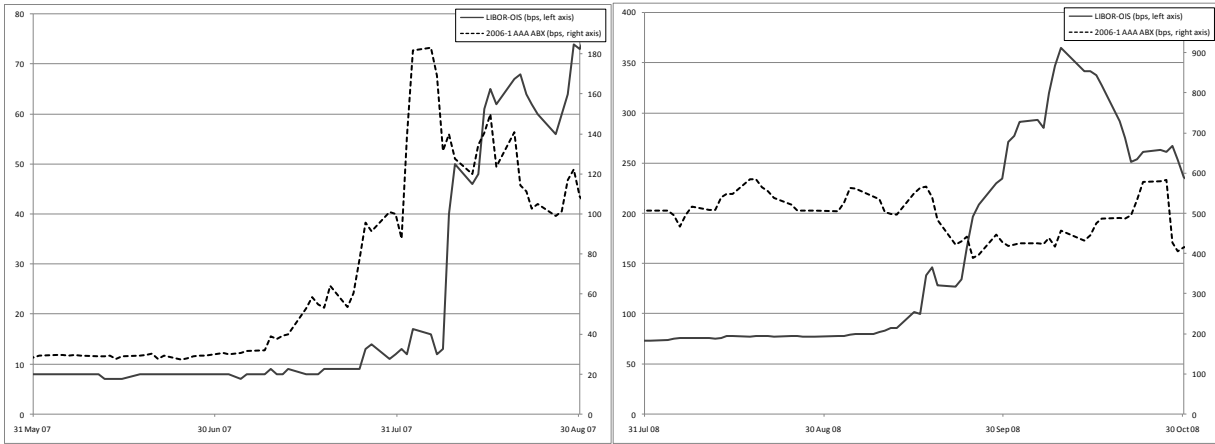
has since recovered about \$3 trillion of the losses, partly due to increased confidence in the stability of the financial system. This size of the recovery is again far larger than what can be attributed to the direct effect of market support policies.

The transmission mechanisms by which the initial losses become amplified are many, but a large part has to do with how negative surprises disrupted financial markets. The two panels in Figure 3 show the evolution, during the summer of 2007 and the fall of 2008 respectively, of the LIBOR-OIS spread and the implied spread on the 2006-1 AAA ABX, which measures the cost of insuring against default by AAA tranches of subprime mortgage-backed securities of the first-half-of-2006 vintage.<sup>16</sup> At the beginning of 2007, AAA tranches of subprime MBS were perceived as very safe, with spreads around 25 basis points; the LIBOR-OIS spread was around 10 basis points. As bad news from the housing market continued to accumulate during the first half of the year, the ABX started to climb, reaching around 100 basis points by the end of July. It was well understood that a decline in housing prices would be bad news for subprime mortgage assets, although the magnitude of the losses, and the extent to which they might trickle up the capital structure to affect AAA tranches of structured products, was realized only gradually. The contrast with the path of the LIBOR-OIS spread is instructive. Even as investors realized the possibility that losses might reach AAA securities during the second trimester of 2007, they remained unaware of the ramifications that this might have for interbank markets in particular, and financial markets more generally. The LIBOR-OIS spread remained low until August 9, when it shot up by 27 basis points after BNP Paribas announced it would freeze withdrawals from three investment funds that were heavily invested in subprime mortgages and the European Central Bank provided €95 billion emergency liquidity to banks. Suddenly and unexpectedly, the soundness of the financial system became questioned.

A qualitatively similar but more extreme pattern was repeated in September 2008. At a time without any particularly bad news from the housing market, as evidenced by the high but stable ABX, the bankruptcy of Lehman Brothers and the run against money markets were followed by a new jump of the LIBOR-OIS spread, which reached peaks of over 300 basis points. The different paths of these two variables illustrate the distinction between large-yet-unsurprising shocks and what we call “surprises”. The magnitude of the shock to housing-related assets was considered an unlikely possibility, as evidenced by low spreads on AAA tranches. However, the disruption of financial markets that resulted from this shock was a true surprise, unexpected even after large losses from housing assets had become a concrete possibility and involving a change in the understanding of the financial environment.

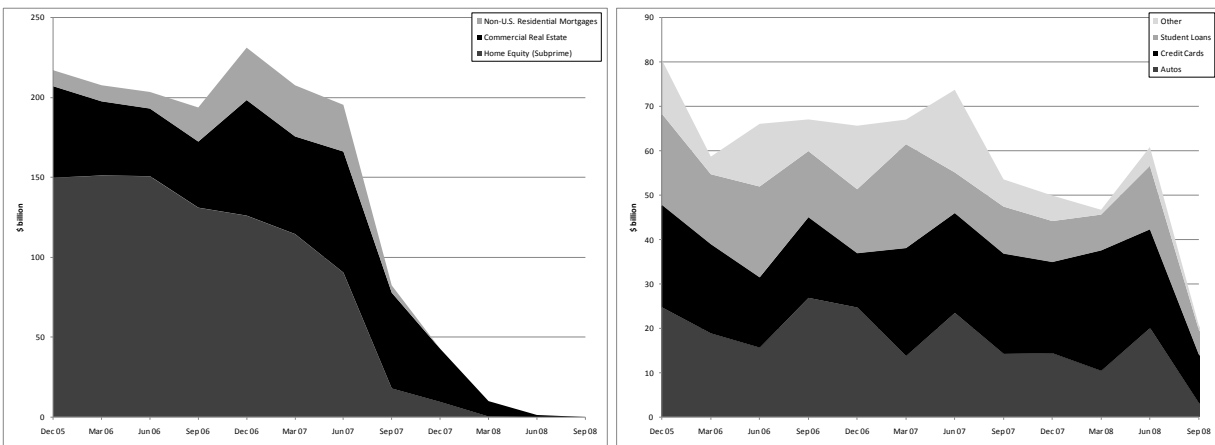
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<sup>16</sup> A similar comparison is made by Gorton and Metrick (2009).



**Figure 3. Evolution of LIBOR-OIS spreads and ABX.**

Surprises quickly trigger a chain of unexpected events following from the panic they engender. One consequence of the surprise was the almost complete collapse of the market for new issues of asset-backed securities, as illustrated in Figure 4.<sup>17</sup> The left panel shows the evolution of new issues of real-estate-related ABS, which collapsed from about \$200 billion per quarter during 2006 to virtually zero in the second half of 2008. The right panel shows new issues of ABS whose underlying loans are not directly related to real estate: auto loans, credit cards, student loans, etc. These fell less than mortgage ABS during 2007 but collapsed by more than two thirds in the third quarter of 2008. Securitization markets became questioned in their entirety, depriving issuers of a previously reliable source of funding and feeding back into the generalized scramble for liquidity.



**Figure 4. New Issuance of asset backed securities in previous three months. Source: JP Morgan Chase**

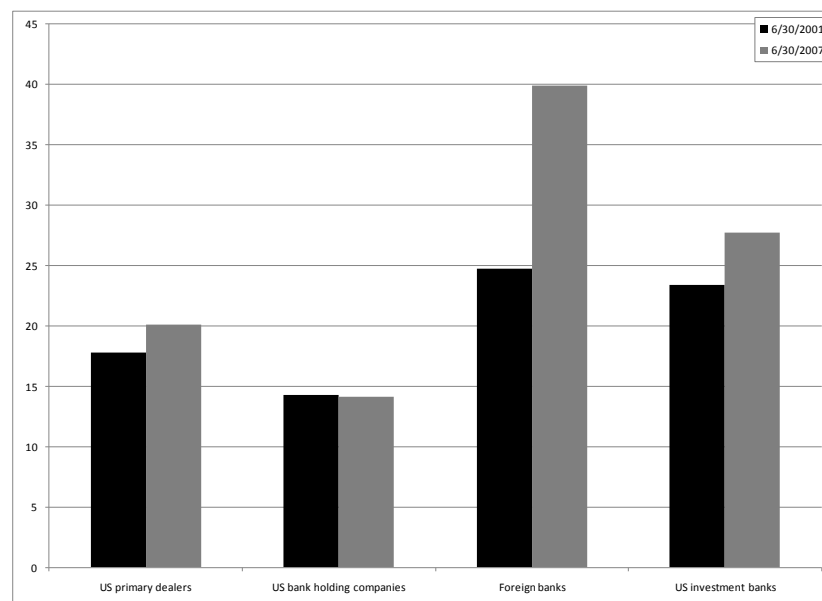
<sup>17</sup>

We thank Tobias Adrian for sharing this data, also analyzed in Adrian and Shin (2009).

## II.B. Aggregate Risk Concentration in Leveraged Financial Institutions

The second important condition for a severe crisis to develop is that the highly leveraged and interconnected sector of the economy, typically the financial sector, be significantly exposed (directly or indirectly) to a surprise of the kind discussed earlier.

In general, the combination of leverage and exposure to aggregate risk is a bad one, as it has the potential to create severe downward feedback-loops. Moreover, there is an extensive literature describing different pecuniary externalities that lead private financial institutions to take on too much aggregate risk relative to the social optimum.<sup>18</sup> However, this concern is magnified many times when the aggregate exposure comes through new financial instruments which have not been tested through crises, since these are susceptible to severe panic-driven runs (effectively, much larger aggregate shocks), as illustrated by the collapse in both the values of existing ABS (Figure 3) and the market for new issues (Figure 4). Note that leverage *per se* is not the cause of concern. Indeed, as illustrated in Figure 5, leverage ratios, except for foreign banks, were only slightly higher at the outset of the current crisis than at the beginning of the 2001 recession.<sup>19</sup> However, investments in structured products exposed financial institutions to more aggregate risk and surprises than in the past.



**Figure 5. Aggregate leverage ratios for commercial banks and broker/dealers. Source: Adrian and Shin (2009)**

<sup>18</sup> See, e.g., (Geanakoplos and Polemacharkis, 1986; Caballero and Krishnamurthy (2001, 2006), and Lorenzoni, 2008).

<sup>19</sup> They subsequently increased as losses decreased the *denominator*.

In the current U.S. crisis, banks were holding mostly AAA-tranches of a large variety of new ABS, as shown in Table 1:

	Whole mortgages	HELOC & 2nd mortgages	Agency MBS	Non-agency AAA	CDOs	Non-agency non AAA	Total
US banks & thrifts	2020	869	852	383	90	0	4212
Broker Dealers	0	0	49	100	130	24	303
Total	2020	869	901	483	220	24	4515

**Table 1. Exposure to mortgage assets as of April 2008. Figures in \$ billion. Source: Lehman Brothers**

AAA or agency-backed securities accounted for 85% of assets held in securitized (as opposed to whole-loan) form. Giving rating agencies the benefit of the doubt, these may have been unconditionally AAA in the sense that the unconditional probability of default was very low. However, they were not AAA conditional on large aggregate shocks. They relied on protection by the junior tranches and the law of large numbers in order to reduce the unconditional risk of default enough to achieve AAA rating. The law of large numbers implies that losses on a pool with a sufficient number of underlying assets, as was the case with most ABS, can only occur when an aggregate shock takes place. Furthermore, the higher up the capital structure a given security is situated, the larger the aggregate shock must be for it to pierce the protection offered by the junior tranches. Losses large enough to affect the AAA tranche only occur in states of severe aggregate shocks, but this is exactly what large surprises do (i.e., transform manageable aggregate shocks into potentially devastating ones). Therefore holdings of AAA tranches of structured products exposed financial institutions to more systemic risk than their rating, when misinterpreted, would suggest, and certainly more than similarly rated “single name” corporate bonds. The latter are still affected by aggregate macroeconomic conditions but idiosyncratic factors play a larger role. Downgraded structured finance securities in the 2007/2008 period on average lost between 5 and 6 notches.<sup>20</sup> In comparison, during the great corporate bond downgrade of 2001/2002 (30% of corporate bonds were downgraded in that period), the average notch-loss was only 1.8 (Benmelech and Dlugosz, 2009).

Coval et. al. (2008) argue that the correlation between economic catastrophe and default by highly rated structured products went largely unappreciated by investors, who seemed to treat ratings as a sufficient statistic for pricing. Highly rated single-name CDSs and structured product tranches traded at very similar spreads (their data is for September 2004 to September

<sup>20</sup> In most cases this downgrade implied that regulatory capital requirements for the banks that held the assets increased from 1.6% to either 4% or 8%.

2007), despite the fact that on average the structured product tranche would likely default in a much worse macroeconomic state.

Regardless of whether this correlation was underappreciated or not, the systemic consequence of this risk was that highly leveraged institutions were bearing more *aggregate* risk than would have been thought from simply observing the ratings of their assets. Having the highly leveraged financial sector of the economy holding the risk with respect to an *aggregate* surprise proved to be a recipe for disaster.

### *II.C. Behind-the-Curve Policy Response*

The third ingredient for a severe crisis to develop is a policy response which does not recognize the nature of the rules-of-the-game changing surprise and is behind the curve.<sup>21</sup> A critical aspect of a policy response to prevent severe crises is the **reaction** to the initial surprise. Most of the policy debate is divided between ex-ante and ex-post policies. We argue, however, that much of the action happens **in between the two**. Once a significant surprise takes place, there is almost always a window of time when the crisis can either be contained or exacerbated by the policy response. That is, many of the ex-ante aspects of a severe financial crisis happen during the **early stages** of the crisis rather than years earlier (as with cardiac arrests).

There are many reasons why policy responses can be too slow, but there are two main retardants: *moral hazard concerns* and *political constraints*.

Invariably, policies of supporting the financial system come together with lengthy debates of whether such intervention will so weaken incentives as to essentially cause the next crisis. A problem with the standard moral hazard view is that it is typically rudimentary, in that it disregards the incentive problems it generates *within* crises. In real life, unlike in many of our models, crises are not an instant but a time-period. This time dimension creates ample opportunity for all types of strategic decisions within a crisis. Distressed agents have to decide when and if to let go of their assets, knowing that a miscalculation on the right timing can be very costly. Speculators and strategic players have to decide when to reinforce a downward spiral, and when to stabilize it. Governments have to decide how long to wait before intervening, fully aware that delaying can be counterproductive, but that the political tempo may require that a full blown crisis becomes observable for bickering to be put aside. Former Assistant Secretary for Economic Policy Phillip Swagel put it succinctly (Swagel 2009):

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<sup>21</sup> Of course the role of this factor, as a necessary condition, depends on the resources available to the government. For example, emerging markets embroiled in crises often experience large capital flow reversals that severely limit the government's options.

"[...] massive intervention in financial markets could only be proposed if Secretary Paulson and Chairman Bernanke went up to Congress and told them that the financial system and economy were on the verge of collapse. By then it could well be too late."

Each of these agents is in the game of predicting what others are likely to do. In particular, the likelihood of a bailout and the form it is expected to take change the incentives for both distressed firms and speculators within the crisis. These incentives are central, both to the resolution of the ongoing crisis and to the severity of the *next* crisis.

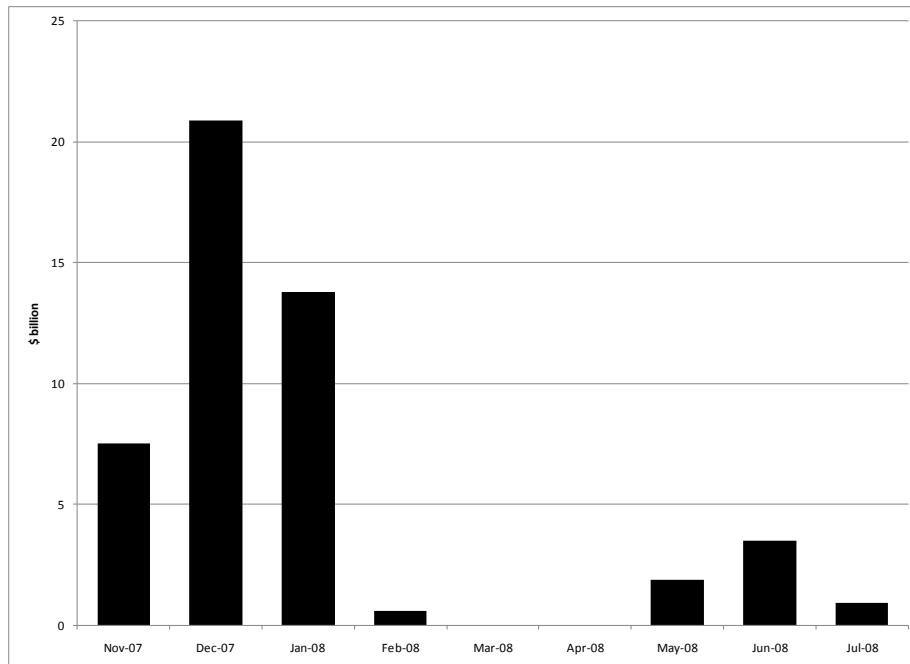
A standard advice stemming from the moral hazard camp is to subject shareholders to *exemplary punishment* (the words used by Secretary Paulson during the Bear Stearns intervention). This is sound advice in the absence of a time dimension within crises. With no time dimension, all shareholders were part of the boom that preceded the crisis and as soon as the bailout takes place the crisis is over; the next concern is not to repeat the excesses that led to the crisis. Punishing shareholders means punishing those that led to the current crisis, and it is better that they learn the lesson sooner rather than later, the righteous speech goes.

However, this advice can backfire when we add back the time dimension. Now, the expectation that shareholders will be exemplarily punished if the crisis worsens delays investors' decision to inject much needed capital. As a concrete example, sovereign wealth funds were much less eager to inject equity into the U.S. financial system after the Bear Stearns exemplary punishment policy (March 2008) than they were before the policy, as illustrated in Figure 6. Some of the capital injections that did take place after this, such as UFJ Mitsubishi's \$9 billion investment in Morgan Stanley in October 2008, only took place after the U.S. Treasury assured them that the investment would not be wiped out in a future government intervention.<sup>22</sup> Conversely, destabilizing speculators and shortsellers saw the value of their strategy reinforced by the policy of exemplary punishment.<sup>23</sup> Moreover, from the point of view of future crises, memories of this intervention may also hamper any chance of a private sector resolution as new equity will be less likely to attempt to arbitrage the initial fire sales. In other words, once the within-crisis time dimension is considered, the anti-moral hazard strategy may morph into a *current and future* crisis enzyme.

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<sup>22</sup> <http://dealbook.blogs.nytimes.com/2008/10/13/treasury-said-to-offer-mitsubishi-protection-on-morgan-deal/>

<sup>23</sup> On June 8th, 2009, Senator Kaufman, arguing the case for imposing new constraints on naked short-selling, warned that: "... there are legions of hedge funds with capital ready to take action should another concentrated downturn take place.... If someone has made a lot of money in a particular endeavor, he will take that opportunity to do it again in the future." <http://www.marketwatch.com/story/senators-push-sec-to-reign-in-naked-short-selling>



**Figure 6: Injections of capital into U.S. financial system by Sovereign Wealth Funds. Excludes injections to prevent dilution. Source: RGE Global Monitor.**

However, the biggest policy miscalculation during the current crisis was not so much a result of moral hazard concerns as one of political constraints. The failure to anticipate the consequences of letting Lehman collapse was a first order mistake during the management of the current U.S. financial crisis and it marked a clear turning point for the worse.

Former Secretary Paulson has stated on multiple occasions that the main reason to not provide support to Lehman was the lack of legal authority to do so. The obvious question of course is why did he not seek such authority, but it is not unreasonable to conjecture that the answer to that question is that he faced a political climate that would have made it difficult to obtain Congressional authorization to bail out the firm, especially with the speed that would have been required. For instance, only days before the final demise of Lehman, the WSJ reported that: “Speaker of the House Nancy Pelosi (D., Calif.) said Thursday that Lehman’s impact on the credit markets would have to be evaluated before the federal government moved to pull together a rescue package for the troubled investment bank.”<sup>24</sup> The noncommittal nature of her statement contrasts sharply with the urgency of the situation, which led to the bankruptcy of Lehman only a few days later.

<sup>24</sup> [http://online.wsj.com/article/SB122116292232524671.html?mod=hpp\\_us\\_whats\\_news](http://online.wsj.com/article/SB122116292232524671.html?mod=hpp_us_whats_news)

On the other side of the spectrum, the fast intervention during the LTCM crisis, played a very significant role in containing what could have been a major panic trigger in U.S. financial markets.<sup>25</sup>

#### *II.D. Setting the Stage for the Policy Discussion*

When thinking about the future, there are two types of policy-paradigms that typically emerge after a crisis, and the current one is no exception. The first, and most dangerous, is simply to behave as if the probabilistic statements of the early warning systems are more accurate than they really are, and come up with a long list of macro-policy recommendations and prudential regulations which, as we argued earlier, can be both an excessive straightjacket and give the system an unwarranted sense of security.

The second type of policy response is to acknowledge the extreme unpredictability of crises and simply forbid leverage, in which case it doesn't much matter what the shock may be since the financial multipliers are kept at bay. For example, Kotlikoff and Goodman (2009) have proposed converting all banks into mutual funds, implying that the only way to issue something equivalent to demand deposits would be with 100% reserves. Any other intermediation activity would be financed 100% by equity investors rather than depositors, an extreme form of narrow banking. A serious problem with recommendations of this type is that they do not distinguish between micro- and macro-risk. The core of business for financial institutions is (and should be even more so) the management and redistribution of microeconomic risk. This activity, however, requires much less capital than does managing aggregate risk. Therefore, basing capital requirement on aggregate risk management considerations could be enormously wasteful.<sup>26</sup>

We argue that a more effective response is to acknowledge our inability to predict crises (unlike the first response) and to design policies that have uncertainty spikes as a central concern, without throwing away the baby with the bath water (unlike the second response). This is the starting point of the second part of the paper, which contains our policy proposal.

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<sup>25</sup> The argument of "moral hazard" arises in most cases of successful interventions (and is used as an excuse for failing to intervene when needed). Both the successful Mexican intervention during the mid 1990s and the LTCM intervention during the late 1990s have been blamed for subsequent crises. However, "bailed out" investors often experience enormous losses in these scenarios. It seems farfetched to argue that adding a bit to these losses will change future actions very much (beyond the impact of the crisis itself).

<sup>26</sup> Of course under the conditions of the Modigliani-Miller theorem, there would be no cost to increasing capital requirements, but this is not a realistic assumption for financial institutions. See Kashyap et. al. (2008) for a discussion of the economic costs of bank capital based on agency theory.

### *III. Economic Policy Proposal: Tradable Insurance Credits (TICs)*

Given the three ingredients we have highlighted -surprises, concentration of surprise-risk on the leveraged financial sector of the economy, and a political tempo which is not fast enough to deal with crises while they are still manageable - the policy must be flexible to react quickly to a truly unexpected event and focus on minimizing the impact of this surprise on the highly leveraged sector of the economy.

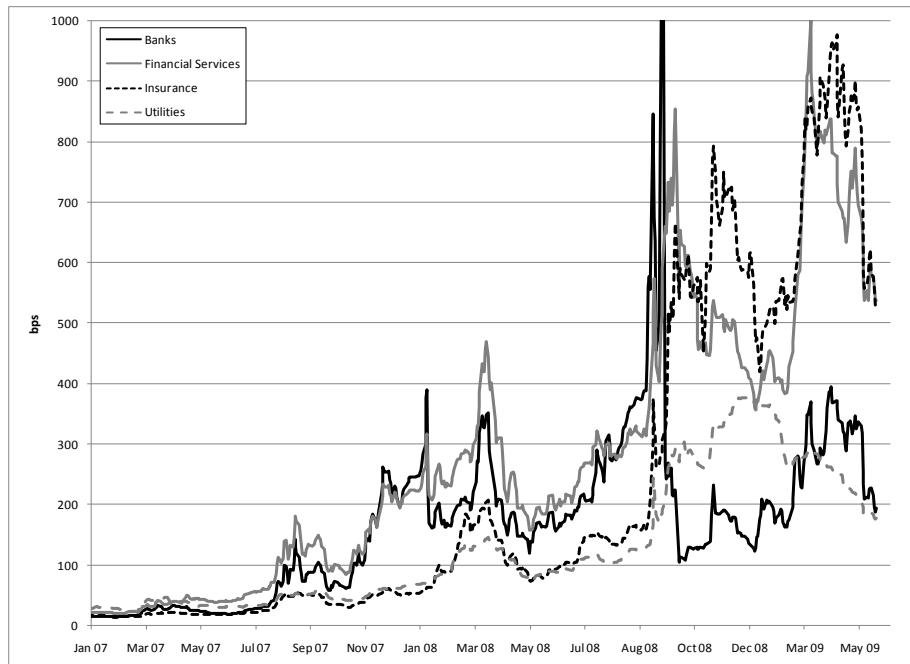
Note that what we seek is not to deal with the truly unexpected itself, for this is something that by its nature can only be dealt with ex-post. Instead our goal is to address one of the main and most devastating systemic consequences of such events: the widespread panic and associated flight to quality. As Knightian uncertainty takes over and agents fear that exposures may emerge in unexpected places, prices of credit risk insurance spike, ravaging credit and financial markets.

Our policy proposal begins with the simple observation that any debt involves a pure interest component and a credit risk component. These two components are conceptually separate and, either implicitly or explicitly, there is a price for each of them. If the discounted value of the promises on a debt contract (a bond) is one dollar and the bond is worth **B**, then we must have

$$\mathbf{B} + \mathbf{P} = 1 \quad (1)$$

where **P** is the price of insurance on the corresponding credit risk.

Thanks to the growing market for credit default swaps, it is increasingly simple to keep track of their separate prices. Figure 7 shows the evolution of CDS spreads for selected industries. Insurance prices increased sharply in March 2008 around the time of the fall of Bear Sterns, and again in September 2008 around the fall of Lehman Brothers and AIG. The increase was greatest for directly-affected financial services and insurance companies but extended to all sectors of the economy.



**Figure 7. Industry CDS indices for selected industries. Source: JPMorgan.**

This point was not lost on central bankers during the current crisis where many saw the need to provide public insurance to substitute for the disappearing private insurance.<sup>27</sup> The U.K., for instance, offered banks an Asset Protection Scheme. In exchange for a fee, the UK treasury offered banks insurance against credit losses on assets affected by the crisis, after a first-loss borne by the banks. The U.S. reached similar deals with Citigroup in November 2008 and Bank of America in January 2009. The Public-Private Investment Program in the U.S. contains some similar elements as well. Banks can sell assets to newly-created investment funds, offloading the entire risk (instead of just the extreme downside, as in the UK case). The Treasury provides half of the equity for the Funds and the FDIC insures their liabilities (there is a cap on leverage). First losses (relative to the purchase price, not the original contractual terms) are borne equally by the government and private equity co-investors, and any subsequent losses are borne by the FDIC.

These initiatives contributed to an easing of tensions in financial markets. The CDS spread on the banking sector dropped by about 50 basis points during the week asset insurance for Citibank was announced. Citigroup's market value (equity plus long-term debt) increased by around \$50 billion, 20% of the amount of the guarantee and the market value of the main 20 banks increased by \$220 billion, 90% of the amount of the guarantee. Some of this increase is of course due to the fair actuarial value of the insurance provided by the government, some of

<sup>27</sup> In his January 20, 2009 speech at the CBI Dinner, the Governor of the Bank of England, Mervyn King, described some of these policies as "unconventional unconventional measures"...

it may reflect an increase in the perceived probability of future bailouts, while some may just reflect other news in a market that fluctuated widely. However, the effects are greater than would seem justified by the expected net transfer (using non-panic distorted catastrophe probabilities) and it seems likely that the reassurance they brought had multiplier effects that greatly exceed its expected cost.

Moreover, several recent developments support the view that insurance is an effective and cheap tool during panics. First, the PPIP has been scaled down significantly, mostly because after a sharp recovery in financial markets, it is considered less urgent than it once was. Second, it turns out that the Treasury and Bank of America never formalized the asset insurance contract. The mere prospect of such a contract helped provide Bank of America with the stability it needed to ride that panic wave. After the panic subsided, Bank of America reportedly tried to renege on the agreement, since losses seemed likely to be even less than the insurance fee.

These approaches were needed given the depth of the crisis and the limited instruments available at the time, but they were necessarily reactive and ad-hoc. In both the U.K. and the U.S., Treasury officials had to bargain with banks on a case-by-case basis over what assets were eligible for insurance, what fee was payable, the amount of the first-loss, etc. Without a clear guideline of how to intervene, there is always a danger that political considerations emerging during the crisis will delay or prevent intervention, exacerbating uncertainty and possibly missing the early window of opportunity to contain the crisis.<sup>28</sup> Our proposal is to design a tool whereby central banks can manage the effective availability of insurance at a systemic level, analogous to the way they manage monetary policy, with the aim of preventing the devastating consequences of spikes in risk-uncertainty premium on financial institutions' balance sheets.

### *III.A. TICs, the Essence*

Under our proposal, the central bank would issue *tradable insurance credits* (TICs). During a systemic crisis, each TIC would entitle its holder to attach a central bank guarantee to newly-issued and legacy securities. All regulated financial institutions would be allowed to hold and use TICs, and possibly hedge funds, private equity funds, and corporations as well. In principle, TICs could be used as a flexible and readily available substitute for many of the facilities that were created during the crisis. The basic mechanism would consist of attaching them to assets, but variants could include attaching them to liabilities and even equity, depending on the

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<sup>28</sup> Moreover, the effectiveness of intervention is also affected by these ex-post political considerations. For example, the U.K.'s Asset Protection Scheme had less subscription than seemed optimal at the time because it required very high insurance fees, probably set to optimize political appeal rather than financial stability. (Or, more precisely, to optimize financial stability subject to a tight political constraint.)

particular needs of the distressed institutions and markets, and they could also operate as collateral-enhancers for discount window borrowing. To state the obvious, we view this as a starting point for a potentially useful proposal, rather than as a complete one. Many implementation issues need to be addressed before this proposal can be transformed into policy.

In the current crisis, much of the uncertainty derived from the possibility of larger than expected losses from loans and securities related to residential real estate. Accordingly, the ad-hoc asset insurance programs that were undertaken concentrated on those kinds of assets. TICs would have provided a systematic way of doing the same thing, by simply declaring them convertible into insurance for that type of security.

Let us start from an extremely stylized formulation which illustrates the core idea. For this, assume that there is only one risky bond and that  $\theta$  captures the degree of systemic “fear” prevalent in the economy. In the absence of a TIC-policy, the CDS price associated to this bond,  $P$ , rises as  $\theta$  increases, and, correspondingly, the price of the bond,  $B$ , falls one for one (see equation 1). The concern of the Central Bank (CB in what follows) is to limit the impact of extreme rises in  $\theta$  on banks’ balance sheets.

The TIC-policy has the following three key components:

***A convertibility rule.*** The CB determines a threshold level for  $\theta$ , above which TICs can be attached to the bond. An *attached* TIC is simply a CB-backed CDS that makes a bond whole, similar to the way the public insurance wrapping GNMA’s do. In practice,  $\theta$  is not observed with perfect precision and hence the reaction of the CB is a probabilistic rather than a deterministic function. But the point that is important to us is that the probability of declaring the TICs convertibility is increasing with respect to the degree of panic in the system.

***Open market operations.*** During normal times, when TICs are not convertible, the CB can buy or sell TICs at market price  $Q$ . This price is necessarily below the price of the corresponding CDS since the value of a TIC derives entirely from its option to be converted into a CDS in the near future.

***Minimum holding requirements.*** During normal times, highly leveraged and systemically important institutions must preserve a minimum amount of TICs as a proportion of risk-weighted assets and systemic importance, analogous to, and complementary with, conventional capital-adequacy ratios.

The TIC-policy can achieve its balance-sheet stabilization goal by reducing  $\theta$  itself, as well as by limiting the consequences of  $\theta$  on banks. We will focus on the conservative scenario where, despite having an effective policy framework, the CB is unable to influence  $\theta$  directly. Thus, all

the effects we highlight below derive from changing the impact of uncertainty spikes on the economy, but it goes without saying that the indirect benefits from reducing  $\theta$  only reinforce the virtues of the TIC-policy framework.

How does the TIC-policy work? Let **A** denote the value of a bank's assets, which for this example is composed of one risky bond with value **B**, a TIC that can be attached to that bond with market value **Q**, and some cash **C**. Thus:

$$\mathbf{A} = \mathbf{B} + \mathbf{Q} + \mathbf{C} \quad (2)$$

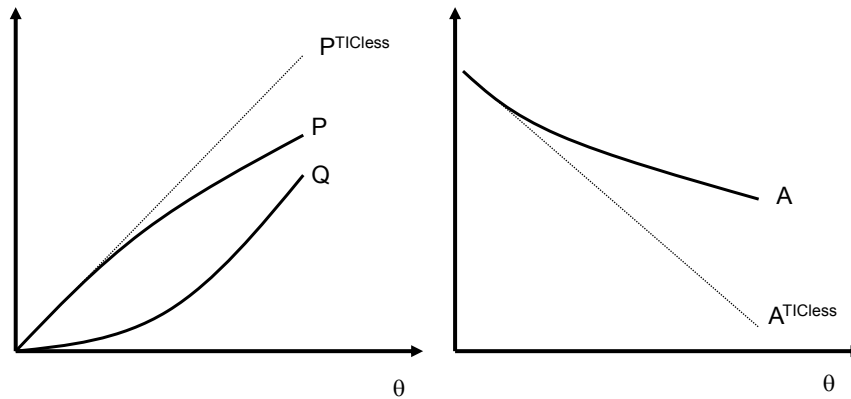
Using equation (1) to solve out **B** from this expression, we can write the assets of the bank as:

$$\mathbf{A} = \mathbf{1} - \mathbf{P} + \mathbf{Q} + \mathbf{C} \quad (3)$$

In the absence of a TIC-policy, **P** rises with an increase in systemic fear  $\theta$ , and **A** falls one for one. These patterns are illustrated by the thin-dotted lines in the two panels of Figure 8. The TIC-policy improves over this outcome through two channels: The first and most direct channel is the addition of **Q** to the balance sheet, which is sharply increasing with respect to  $\theta$  once fear is sufficiently high. The reason for this "convex" pattern is that there are two forces compounding each other: **Q** rises in response to the increase in the price of the underlying CDS that it may eventually be converted to, and because the probability of this conversion rises with systemic fear.<sup>29</sup> The second channel is that the policy reduces the sensitivity of the CDS price to increases in  $\theta$ . The reason for this effect is that as fear rises, the probability of having the TICs converted into CDS rises, and hence the likelihood of a significant expansion in the effective supply of CDS also increases. The strength of this channel depends on the degree of illiquidity of the CDS market. The solid lines in Figure 8 illustrate the TIC-world.

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<sup>29</sup> Note that in the comparison the bank with the TIC will have less **c** since it used cash to buy the TIC, but the whole point is that these TICs are purchased during normal times, when  $\theta$ , and hence **Q**, are very low.



**Figure 8. Effect of systemic fear on bank asset values and TIC prices**

Consider now a TIC-OMO in which the CB decides to add TICs to the system in exchange for cash at a point in which systemic risk is rising but still relatively low (point  $\theta_0$  in Figure 9). The result of such an operation is illustrated in the figure. Again, there are two effects of this policy: The first and most direct is an increase in banks' protection since the representative balance sheet is now (where the subindex 0 denotes the value at  $\theta_0$  and  $n$  is the number of new TICs sold to the representative bank) :

$$A = 1 - P + (1+n)Q + (C - nQ_0) \quad (4)$$

The effect of this portfolio shift is to rotate the  $A$  curve in the figure, reducing the exposure of the bank's assets to further rises in systemic fear.

The second effect of the TIC-OMO is a market effect by which it reduces the price of the CDS and of TICs. The reason is that the expansion in the supply of TICs raises the expected expansion of the supply of CDS if TIC's become convertible. The change in these two prices work in the opposite direction on the value of the bank's assets, but it is easy to see that, on net, these changes are positive for the bank since  $Q$  is just an option value on future  $P$ , and the direct effect of the policy on  $P$  must be larger than that on its option.

The total effect of the TIC-OMO is illustrated by the thick lines in Figure 9. It is apparent that a TIC-OMO improves the contemporaneous balance sheet of the banks and, more importantly, it

ensures that the system becomes more resilient to further deterioration in systemic confidence.<sup>30</sup>

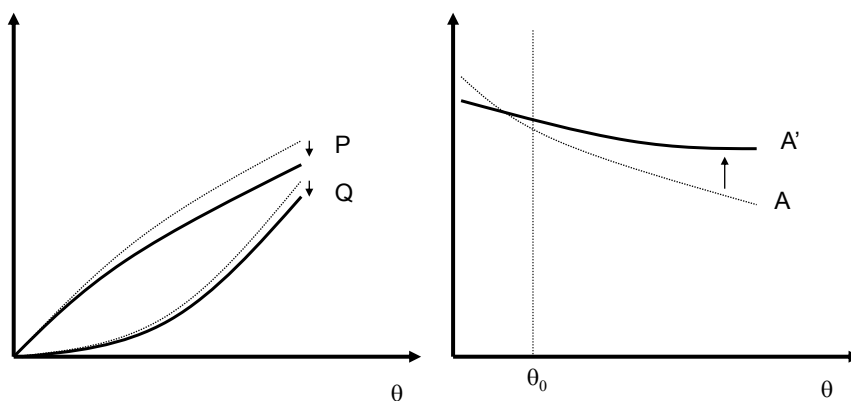


Figure 9. Open market operations with TICs

### III.B. Heterogeneity and Adverse Selection

The above example is concerned with a single bond, whereas in practice there are many heterogeneous assets and the rules of TICs must specify how (and whether) they can be attached to different kinds of assets. A large part of this heterogeneity can be addressed with differential conversion factors, very much as the Fed currently does in its haircut tables for TALF and other liquidity facilities. For instance: 1 TIC per dollar of AAA-rated bonds, 1.7 TICs per dollar of AA, etc. The ratings should be recent to avoid the use of TICs for already-troubled assets and, obviously, the ratings should be set on the basis of the TIC-less bond. Moreover, these relative conversion factors could be gauged from the pre-crisis CDS prices. A similar principle can be used to avoid distorting the allocation of TICs towards long-duration assets

<sup>30</sup> It follows from the discussion above that the maximum contemporaneous power of a TIC-OMO takes place at intermediate levels of fear. If done at low levels of  $\theta$ , the policy has little effect on current prices but it still has the benefit of improving the resilience of the banks' portfolios to systemic spikes in fear. In fact, this is the right (inexpensive) time for banks to stock up on TICs. If done when  $\theta$  is already very high, then a TIC is almost like a CDS (since the probability of convertibility is close to one), and the policy cannot affect the spread (**P-Q**) by any significant amount, so again all the benefit comes from the direct effect.

(where, other things being equal, they would be more valuable). The conversion rule could require  $x$  TICs per dollar of assets of a given rating per year of duration.

Still, it is quite likely that there will be heterogeneity among assets within a given rating and duration; it is to be expected that TIC holders will attempt to make the most of the insurance by attaching TICs to assets that they know to be the worst within a given rating. This could bring two separate problems. The first is simply a question of costs for the taxpayer, who might end up insuring an adversely selected pool of assets. In principle, this need not be a great concern, since the opportunity to engage in this kind of selection will be anticipated by TIC buyers and will be incorporated into the price that TICs fetch when the Central Bank issues them.

The second concern is potentially more serious. The objective of TICs is to provide a way for financial institutions to remove uncertainty from their balance sheets at times when the private sector makes uncertainty-insurance too expensive. For this to work, TIC holders must attach TICs to assets that are greatly affected by market uncertainty. If gaming the system by using TICs for mis-rated assets is too attractive, this might draw TICs away from the uncertainty-affected assets where, from a social point of view, they would be most needed. This matters most if mis-rated and uncertainty-affected assets are very different. However, debt contracts, which TICs would be used for most, are characterized by having more risk on the downside than on the upside (Dang et al 2009). This means that a bond whose holder deems to be over-rated is also likely to be one whose true value is uncertain and where a TIC would be well allocated.

### *III.C. Discontinuity and Smooth Interventions*

The above analysis assumes that convertibility of TICs is a binary decision, which takes place at an exact pre-specified value of  $\theta$ . In practice, it might be worthwhile to make the policy smoother. One way to do this is that instead of declaring all TICs convertible when the threshold is reached, convertibility can be declared for just  $x\%$  of the outstanding TICs.<sup>31</sup> If  $\theta$  continues to increase during a crisis, the percentage can be gradually increased until it reaches 100%. This would give the CB a way of dynamically fine-tuning the policy and it would moderate the extremely high stakes and consequent political pressures that would accompany an all-or nothing convertibility decision.

### *III.D. Rules, Discretion and Central Bank Independence*

One of the longstanding debates regarding the conduct of monetary policy has been who must be in charge of deciding it and what degree of discretion they should have. Tradeoffs involve

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<sup>31</sup> This can be implemented in several ways. For instance, TICs could have serial numbers and convertibility could extend to just those with serial numbers between 0 and  $x$  (prudential regulations could require that holders have TICs with diversified serial numbers).

the vagaries (and possible time-inconsistency) of the political process, democratic control over policy decisions, policy stability and the flexibility to react to circumstances. Modern arrangements in advanced economies have favored independent Central Banks, with discretion over day-to-day decisions but bound by a reasonably clear mandate and principles.

The current crisis has shown that, unlike the case of monetary policy, the institutional balance of authority to deal with financial crises is far from settled, a fact that contributed to costly policy delays. A necessary condition of a successful TIC program must be the clarification of the boundaries of the Central Bank's authority in carrying it out, especially given that it would be explicitly committing public resources. This mandate should be subject to proper political debate ex-ante and some agreed-upon level of independence and discretion ex-post. For instance, the Central Bank might be given authority to declare TICs convertible with respect to certain types of securities or up to a certain maximum amount; conversions beyond that limit may require notification and/or authorization from an oversight committee. Given that TICs are designed to address surprising and confusing situations, it is unlikely that one would want the Central Bank to be bound by very tight rules.

### *III.E. TICs for Equity, Liabilities, and Debt-Equity Swaps*

Invariably, during crises the leveraged sector's capital shrinks rapidly and the need arises to quickly recapitalize financial institutions to prevent runs and sharp loan contractions. The TIC-policy for these institutions' assets should reduce the need for rushed recapitalizations, however, it may be useful to have a more direct policy to deal with capital shortage problems in case asset-insurance is insufficient.<sup>32</sup>

This policy can be implemented by extending the TIC program to new equity issued by financial institutions. In this case TICs would operate as CB (or Treasury) minimum share-price guarantees a few years hence. During times of systemic crises, financial institutions could attach TICs to any new private capital raised; the (price) level of the guarantee could be determined from the result of a stress test along the lines of those recently performed by the U.S. government on the largest domestic financial institutions.

TICs also could be used more narrowly to facilitate debt-for-equity swaps during crises. That is, TICs could be attached to the new equity issued to the debt holders that are willing to participate in the exchange.

In other circumstances, TICs might be more usefully attached to liabilities rather than assets. If a panic is affecting the funding side of financial sector balance sheets (as was for instance the

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<sup>32</sup> For an equity guarantee proposal during the current crisis, see (Caballero, 2009a; and Caballero and Kurlat 2009).

case during the run on money markets), the Central Bank could allow banks to attach TICs to their liabilities (at some conversion rate). This would in effect allow them to issue debt guaranteed by the Central Bank, a measure that was also tried during the current crisis (with FDIC guarantees).

### *III.F. Fees*

The simplest TIC setup involves no payments by the holder during the life of the TIC; all the value of insurance is paid at the time the TIC is issued. A variant may involve periodic fees (perhaps measured in basis points), possibly different for attached and unattached TICs. These fees could be set so that holders of TIC guaranteed securities be willing to un-attach the TICs if the panic subsides and private insurance prices return to normal. Allowing the possibility of un-attaching TICs and providing incentives to un-attach TICs can be a way to ensure that public involvement does not last more than necessary.

These and other variants provide many degrees of freedom in designing a TIC program; actual implementation requires deciding which of these are worth taking advantage of.

### *III.G. TICs and the Discount Window*

TICs could also be used to enhance the collateral value for discount window borrowing. Eligible financial institutions could choose to pledge TIC guaranteed securities rather than naked collateral, which would be subject to lower haircuts, perhaps comparable to that of Treasuries.<sup>33</sup>

During the current crisis the Collateral Management System (CMS) has shown to be able to handle large volumes of collateral tracking and is engaged in an effort to improve the precision and frequency of collateral valuation. By the end of 2008, the CMS was tracking assets with more than \$5 trillion in original par value and a collateral value of \$2.5 trillion. The CMS expects to be able to provide real time valuations within the next two years. (See the 2008 Annual Report by the Federal Reserve Bank of Philadelphia). It would seem that the CMS should play a central role, perhaps both in determining the TIC-conversion factors for different securities and the haircuts for TIC guaranteed assets.

### *III.H. Orders of Magnitude*

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<sup>33</sup> Geanakoplos (2009) argues that the FED should find a mechanism to control the haircuts on collateral during crises. Our integration of TICs with the discount window could be a first step in achieving that goal.

Some indication of the order of magnitude the TIC program should have can be gained from the ad-hoc insurance programs that were undertaken during the crisis. The government-provided insurance for JPMorgan/Bear Stearns, Citigroup, and Bank of America/Merrill Lynch totaled about \$400 billion, approximately 6% of the respective institutions' assets

	Maximum total assets	First loss borne by insured party	% Exposure of remainder	Net maximum exposure
Maiden Lane (Bear Stearns)	30	1	100%	29
Maiden Lane II (AIG)	20	0	100%	20
Maiden Lane III (AIG)	30	5	100%	25
Citigroup	306	29	90%	249
Bank of America	118	10	90%	97
Total	504			421

**Table 2 . TIC-like guarantees for specific institution. \$ billion**

If this order or magnitude is roughly the right size to insure the financial system against extreme macroeconomic risks, required holdings of TICs should be more or less on par with regulatory capital requirements. The total supply of TICs for the US financial system should be of the order of \$1-2 trillion. It is worth recalling the \$1-2 trillion is a notional amount. Actual outlays would only take place if there is a crisis in which TICs are converted *and* the underlying assets default. Importantly, one of the distinctive features of spikes in Knightian uncertainty is that private agents greatly exaggerate the likelihood of the default event. In the mean time, the government would obtain revenues from the sales of TICs.

An amount higher than \$1-2 trillion might be required if wider uses for TICs are envisioned. As discussed above, TICs may provide a ready-made instrument to undertake different types of insurance-like interventions, which could encompass many of the myriad programs in support of the financial system that were undertaken during the crisis. The outstanding balance of these programs as of June 2009 was of \$3 trillion (SIGTARP, 2009).

We believe that TICs would have been an effective policy tool to address the current crisis. Predicting exactly how TICs would have been used and how the economy would have reacted inevitably involves some degree of counterfactual speculation, but it may serve as an illustration of how a TIC program would be used. Suppose U.S. banks had held approximately \$2 trillion worth of TICs. When the first surprises hit financial markets in the summer of 2007, the Fed might initially have merely hinted that it was considering making TICs convertible. This would have raised the perceived probability of convertibility and thus raised the price of TICs. TIC holders that were not against prudential constraints and who believed their asset portfolios were sound could have taken the opportunity to sell TICs at a profit to banks that believed they

were more vulnerable. The Fed might also have engaged in open market operations to provide more TICs to the market, increasing the (contingent) supply of insurance.

If fear nevertheless began to take over the markets (for instance, as the weakness of mortgage lender and monolines began to surface in late 2007 and early 2008), the Fed could have declared convertibility, perhaps of around \$50 to \$100 billion TICs, declaring them convertible into insurance on AAA asset-backed securities.<sup>34</sup> This probably would have required a more detailed schedule of convertibility factors as it was becoming clear by then that not all AAAs were created equal. It could also extend to non-AAA securities, at some higher conversion factor.

Presumably, troubled firms such as Bear Stearns would have been hoarding TICs in anticipation of this possibility and could now attach them to the assets on their balance sheet, reducing their vulnerability and enabling them to obtain repo financing against the TIC guaranteed assets on much better terms. Note that banks that were not so exposed to aggregate surprises would have been able to realize a significant profit by selling TICs, a reward for prudence that most ad-hoc insurance schemes did not provide.

The Fed's next steps would have depended on the market's reaction, especially on the degree to which the increased supply of insurance helped to ease Knightian fears in the market. If necessary, convertibility could have extended to all the outstanding TICs. Banks like Citibank or Merrill Lynch/Bank of America would probably have been among the first to avail themselves of the possibility of attaching them to their assets to dispel doubts about their solvency.

How far the Fed would have needed to go is certainly a matter of speculation. Depending on what other conventional measures such as discount window lending were also used, it is conceivable that not much more than the \$500 billion that was in fact committed in asset insurance for specific institutions would have been needed.

### *III.I. Complementary Insurance Proposals*

*Private markets and indexing to observable variables.* In some instances, there are elements of the surprise that are predictable. For example, commodity producing economies are more likely to experience unexpected financial events when their terms of trade have declined sharply. Also, large capital flow reversals to emerging markets more broadly, are negatively correlated

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<sup>34</sup> Recall that the original Maiden Lane program for Bear Stearns involved \$29 billion, a figure that seemed huge at the time but pales in comparison to what happened later.

with spikes in the VIX. In such cases, it may be feasible to implement insurance contracts through the private sector.<sup>35</sup>

Kashyap et. al. (2008) have proposed a policy for dealing with negative shocks that is based on such private-sector insurance. Banks would be required to buy insurance policies that pay out in the event of a negative shock to the banking sector. A TIC framework is somewhat similar in spirit in that it emphasizes insurance rather than higher capital requirements. There are, however, some key differences. First, TICs involve one more layer of state-contingency (“insurance-squared”): Crises involve not just realized losses that necessitate increased capital but also (due to Knightian uncertainty) an exaggerated fear of potential future losses, which is dealt with less expensively through insurance. Second, TICs do not require the private sector to freeze capital to back up insurance promises, which would require huge amounts of resources. The monolines and AIG were partially in the business of providing such insurance and they proved undercapitalized to withstand extreme events. Third, TICs do not require an ex-ante definition of what the extreme event is. Contracts between private parties are necessarily incomplete and might prove useless if the negative shock materializes in a way that is not covered by the terms of the contract. The government can afford to be vaguer in its announcement of what kinds of adverse shocks it would respond to.

*Government insurance contracts and guarantees.* There have been multiple proposals of this kind that vary on the type of asset or liability guaranteed, and during the crisis we have seen several of them implemented mostly on an ad-hoc rather than systemic basis.<sup>36</sup> In the U.S., Citibank and Bank of America were offered guarantees on a share of their assets, and the U.K. implemented a similar plan more broadly (although the political constraint in the latter case manifested itself in a very high premium which discouraged many banks from participating when it would have been socially optimal for them to be part of the arrangement). This approach is useful to deal with a few institutions but is more cumbersome to implement than the TICs system for the system as a whole, with new entrants, etc., and is subject to strong political frictions and backlash. Presumably, the TIC-policy could be used as the main systemic policy, which could be supplemented by customized insurance for specific new circumstances that may arise.

*Expanded discount window.* A mechanism that was very important during the current crisis was the expansion on the eligibility of both institutions and assets to access the discount window. This is certainly a policy that ought to be preserved in a contingent basis. Similarly to the TIC-

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<sup>35</sup> For private markets based proposals to insure macroeconomic risk in emerging markets, see, e.g., Caballero 2003; Caballero and Panageas 2007 and 2008; and Borensztein and Mauro (2004).

<sup>36</sup> See, e.g., Caballero (2009a,b); Caballero and Kurlat (2009); and Mehrling and Milne (2008).

policy, the Fed could determine states of the world considered of systemic risk that triggers the expansion of the discount window access.

This is a complementary policy to the TIC-policy but not a substitute for it, especially in economies such as the U.S. or U.K. that have large “shadow” financial systems.<sup>37</sup> Moreover, discount window access deals with liability problems (it is a substitute for new borrowing in private markets), but it does not help directly with perceived asset, and hence capital, losses in the short run. These losses trigger problems beyond lack of access to debt markets, which is what the discount window helps to alleviate.

*A dual currency economy.* Brunnermeir et al (2009) are currently working on a proposal in which the Fed controls two units of accounts, one for regular currency (dollars) and one for debt. During normal times, the exchange rate between these two units of accounts is one, while the debt-unit is devalued during crises, diluting debt-holders and lightening the debt burden of leveraged institutions. This is an interesting proposition but it could backfire if debt-holders decide to run against debt anticipating a devaluation. Still, it probably does make sense to add this second type of debt into the system as a mechanism to substitute for out-of-bankruptcy debt-for-equity swaps.

Overall, and aside from the expanded-discount-window policy, a clear advantage of the TIC-policy over the many alternatives is its operational similarity with conventional monetary policy and capital-requirements. It is up to practitioners to push this analogy even further.

#### *IV. Final Remarks*

While there are many similarities across financial crises, the core of the problem is often a significant surprise, which suddenly changes, at least temporarily, the perceived rules of the game. The original shock may come from partially anticipated factors, such as the burst of a real estate bubble or trouble in a rapidly growing derivatives market, but the real crisis arises when the filtering of such shocks through the complex financial (and political, and social) network produces an outcome that is highly unexpected. All of a sudden, it is no longer enough for economic agents and financial institutions to understand their local environment since, as we have seen in the current crises, systemic events can seep through unexpected and distant linkages.

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<sup>37</sup> On July 14, 2009, Trichet argued that the main reason why the ECB had not expanded its facilities to purchase new and legacy securities nearly as much as the Fed and BoE, is that the Euro zone is much more bank centric than the U.S. and the U.K.

When that happens, the fundamental shock is compounded many times by panic. The surprise turns risk into uncertainty, and the natural response of human beings, and leveraged financial institutions in particular, is to withdraw into safe assets. This panic triggers asset fire sales and activates financial multipliers that cause enormous damage to balance sheets and credit markets. This is the way a few hundred billions of real subprime losses in the U.S. translated into many trillions of output and wealth losses around the world.

The main antidote to fear is prime, government backed, insurance against what investors fear. The silver lining of this diagnosis is that providing such insurance is inexpensive for the government, as once panic subsides the real losses are much smaller than those initially feared by investors.

The TIC-policy we propose is an “insurance-squared” policy: For a fee, it gives the right to a variety of financial institutions to issue government-backed insurance to protect some of their assets and liabilities when systemic panic destroys the value of otherwise worthy securities. Note that the government does not inject resources during the crisis, as it would with an asset purchase or capital injection program, but rather, it only provides insurance against vastly exaggerated (by panic) extreme outcomes. If correctly designed, this insurance is not only less costly but also more efficient than capital injections in breaking the downward feedback loop between the financial and the real sector that typically develops when banks are left to absorb losses due to macroeconomic shocks (as the capital injection approach does).

As with our cardiac-arrest analogy in the introduction, during severe financial crises it is critically important to intervene early on. The TIC-policy has the virtue of offering a very expedient and flexible policy-tool to the central bank. It is the analog of conventional monetary policy, but directly targeted at offsetting the damaging effect of uncertainty-spikes on balance sheets and credit markets.

Having said this, the benefit of a TIC-framework extends beyond the pure uncertainty-spike antidote, as it provides an expedient channel to inject resources into a financial system in distress. Although in such extended use of the system, the decision may belong to the Treasury rather than to the Fed.

Another advantage is that the TIC-policy also has a natural and contingent exit strategy built in. On one hand, if the crisis goes on, TICs eventually translate into an injection of public resources into distressed financial institutions. On the other hand, if the crisis subsides and new conversions of TICs are suspended, then most of the attached TICs expire worthless as the underlying securities mature. This strategy can be reinforced by a fee structure similar to that of a conventional lender of last resort facility (expensive while TICs are attached to securities).

Of course the TIC-policy is not a substitute for supervision. In fact, as with any insurance arrangement, supervision becomes all the more important. However, the TIC-policy is a (partial) substitute for deleveraging and increased capital requirements, which is clearly a virtue from the point of view of efficient use of scarce intermediation capital.

Finally, we have embedded the TIC-program in central banks because the infrastructure required for its management and decision-making is very much what most central banks already have in-house. But this is not a requirement, and in many instances it will depend on being able to overcome specific institutional constraints. In the U.S., for example, the Federal Reserves Act limits the Fed's ability to "take risks." One possibility in this case is to build on the multiagency infrastructure created during the current crisis to implement the insurance and guarantee programs that were so central in preventing a repeat of the Great Depression of the 1930s.

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