Sudden Financial Arrest

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Abstract

There are striking and terrifying similarities between the sudden failure of a heart and that of a financial system. In the medical literature, the former is referred to as a sudden cardiac arrest (SCA). By analogy, I refer to its financial counterpart as a *sudden financial arrest* (SFA). In this article I describe SFA and its treatment guided by its medical counterpart.

Keywords: Financial crisis, panic, defibrillation, complexity, Knightian uncertainty, moral hazard, financial network, capital requirements, contingent capital, contingent insurance, IMF

JEL Codes: E32, E44, E58, F30, G01, G20

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Introduction

> *"Sudden cardiac arrest (SCA) is a condition in which the heart suddenly and unexpectedly stops beating. When this happens, blood stops flowing to the brain and other vital organs…. SCA usually causes death if it's not treated within minutes…." (NHLBI/NIH)*

There are striking and terrifying similarities between the sudden failure of a heart and that of a financial system. In the medical literature, the former is referred to as a sudden cardiac arrest (SCA). By analogy, I refer to its financial counterpart as a *sudden financial arrest* (SFA).

When an economy enters an episode of SFA, panic takes over, trust breaks down, and investors and creditors withdraw from their normal financial transactions. These reactions trigger a chain of events and perverse feedback-loops that quickly disintegrate the balance sheets of financial institutions, eventually dragging down even those institutions that followed a relatively healthy financial lifestyle prior to the crisis. In this article I draw on the parallels between SCA and SFA to characterize the latter and to argue that a pragmatic policy framework to address SFA requires a much larger component of systemic insurance than most policymakers and politicians are currently willing to go along with.

An important risk factor behind SCA is coronary artery disease (CAD), and the front line prevention for CAD is a healthy lifestyle. However, the medical profession is keenly aware that people make poor choices regardless of warnings, and that even those who do adopt a healthy lifestyle and have no known risk conditions may still experience a fatal SCA episode. The pragmatic response to these facts of life is to complement preventive healthy lifestyle guidelines and advise with an effective protocol to prevent death once SCA takes place. The main (and perhaps only) option to treat SCA once triggered is the use of a defibrillator. Moreover, the window of time for this treatment

to be effective is very narrow, just a few minutes, making it crucial to have defibrillators readily available in as many places as is economically feasible.

Unfortunately, the pragmatic approach followed by the medical profession in reducing the risk of death associated with SCA contrasts sharply with the stubborn reluctance to supplement the financial equivalent of CAD-prevention type policies (mostly regulatory requirements) with an effective *financial defibrillator* mechanism. The main antidote to SFA is massive provision of credible public insurance and guarantees to financial transactions and balance sheets. In this analogy, these are the financial equivalent of a defibrillator.

The main dogma behind the great resistance in the policy world to institutionalize a public insurance provision is a fuzzy moral hazard argument: If the financial defibrillator were to be implanted in an economy, the argument goes, banks and their creditors would abandon all forms of healthy financial lifestyle and would thus dramatically increase the chances of an SFA episode.

This moral hazard perspective is the equivalent of discouraging the placement of defibrillators in public places because of the concern that, upon seeing them, people would have a sudden urge to consume cheeseburgers since they would realize that their chances of surviving an SCA had risen as a result of the ready access to defibrillators.

But actual behavior is less forward looking and rational than is implied by that logic. People indeed consume more cheeseburgers than they should, but this is more or less independent of whether defibrillators are visible or not. Surely, there is a need for advocating healthy habits, but no one in their right mind would propose doing so by making all available defibrillators inaccessible. Such policy would be both ineffective as an incentive mechanism, and a human tragedy when an episode of SCA occurs.

By the same token, and with very few exceptions (Fannie and Freddie?), financial institutions and investors in bullish mode make portfolio decisions which are driven by dreams of exorbitant returns, not by distant marginal subsidies built into financial

defibrillators. Nothing is further from these investors' minds than the possibility of (financial) death, and hence they could not ascribe meaningful value to an aid which, in their mind, is meant for someone else. This is simply the other side of the risk-compression and undervaluation during the boom phase. Logical coherence dictates that if one believes in this undervaluation, then one must also believe in the near-irrelevance of anticipated subsidies during distress for private actions during the boom.

Of course, once the crisis sets in, insurance acquires great value and leads to more risk-taking and speculative capital injections into the financial system, but by then this is mostly desirable since the main economy-wide problem during a financial panic is too little, not too much, risk-taking. The last thing we need at this time is for creditors to panic, and shortsellers to feast, as they suddenly realize that financial institutions can indeed fail from self-fulfilling runs, fires sales, and liquidity dry-ups, for which there is no counteracting policy framework in place aside from ill-timed "market discipline" or a high-fatality risk surgery. Indeed, attempting to "resolve" a large and interconnected institution in the middle of a panic, when asset prices are uninformative and hence "resolution" decisions are largely arbitrary, carries the serious risk of adding fuel to the fire (panic).[2]

In any event, when SFA does take place, it becomes immediately apparent to pragmatic policymakers that there is no other choice than to provide massive support to distressed

[2] One way to get a sense of how much the market values the "too big to fail" insurance provided by the government is to compare the cost of funding for small and large banks. Baker and McArthur (2009) compare the average costs of funding for banks with more than $100 billion in assets to the average costs for banks with less than $100 billion. They find that between the first quarter of 2000 and the fourth quarter of 2007, the large banks' costs were 0.29 percentage points lower than the small banks, averaging across time. Between fourth quarter 2008 and second quarter 2009, the spread increased to 0.78 percentage points. Clearly, there are many reasons why larger and smaller banks can have different costs of funding: different types of assets, different amounts of leverage, and so on. Baker and McArthur (2009) take the difference between these spreads, 0.78 minus 0.29, as a crude upper-bound on the subsidy associated with the solidification of the "too big to fail" policy after Lehman's collapse. I would suggest an alternative interpretation: During boom times, the "too big to fail" insurance was there but of little importance, while during the crisis, it became much more important and probably a source of stability.

institutions and markets, but since the channels to do so are not readily available, precious time and resources are wasted groping for a mid-crisis response (recall the many flip-flops during the early stages of the TARP implementation). If one is of the view (which I am not) that hubris plays only a small role during the boom and instead it is all about incentive problems due to anticipated subsidies during distress, then one must believe that savvy bankers and their creditors anticipate intervention anyway. Hence the incentive benefit of not having financial defibrillators readily available does not derive from the absence of a well designed ex-ante policy framework but from the real risk that improvised ex-post interventions may fail to be deployed in time to prevent death from SFA. This logic seems contrived at best as the foundation for a policy framework that does not include readily available financial defibrillators.

In summary, it is a fact of life, and of cognitive distortions, financial complexity, and innovation in particular, that SFA episodes will continue to happen regardless of how much regulatory creativity policymakers may muster. The absence of a financial defibrillator is a very weak incentive mechanism during the boom phase, and a potential economic tragedy during a financial crisis. We need a more pragmatic approach to SFA than the current monovision CAD-style, hope-for-the-best, approach. We need to endow the policy framework with powerful financial defibrillators.

Modern economies already count on one such device in the lender of last resort facility (LOLR) housed at the central bank, but this has clearly proven to be insufficient during the recent crisis. I discuss three supplements to this facility:

- *Self insurance*, which is where policymakers' instinct lies. In the current context this is reflected in a call for higher capital adequacy ratios, especially for systemically important financial institutions.

- *Contingent capital injections,* which is where most academics' instinct lies. The basic idea is to reduce the costs associated with holding capital when is not needed. Proposals primarily differ on whether the contingency depends on bank-

specific or systemic events, and on whether the source of capital is external to the distressed bank or internal (as in the debt-convertibility proposals).

- *Contingent insurance injections,* which is the most cost effective mechanism for the panic component of SFA. The basic idea is that the enormous distortion in perceived probabilities of a catastrophe during panics can be put to good use since economic agents greatly overvalue public insurance and guarantees. Providing these can be as effective as capital injections in dealing with the panic at a fraction of the expected cost (when assessed at reasonable rather than panic-driven probabilities of a catastrophe).

In practice, there are good reasons to have in place some of each of these types of mechanisms. For normal shocks, it is probably easiest to have banks self- and cross-insure. For large shocks, there is always a fundamental component, which is probably best addressed immediately with contingent capital (private at first and in extreme events, public). However, the large panic component of an SFA episode requires large amounts of guarantees, which would be too costly and potentially counterproductive (if they add to the fear of large dilutions) to achieve through capital injections. For this component, a contingent-insurance policy is the appropriate response.

One particularly flexible form of a contingent insurance program is the Tradable Insurance Credits (TICs) proposed in Caballero and Kurlat (2009a). These TICs act as contingent (on systemic events) CDS to protect banks' assets against spikes in uncertainty. They are a (nearly) automatic, pre-paid, and mandated mechanism to ring-fence assets whose price is severely affected by SFA, as it was done ex-post in the U.S. for some Citibank and Bank of America assets and was offered more broadly in the U.K.[3]

[3] It turns out that the Bank of America deal was never signed, but the perception that it had been was enough to contain the panic. The U.K. system was less successful in terms of the takers than it would have been socially optimal because it was voluntary and very expensive. Both aspects would be improved by the TICs framework.

The international dimension of SFA adds its own ingredients. I focus on the problem for emerging markets which has a close parallel with the issues faced by the financial sector within developed economies. For emerging markets, it is often the case that the sovereign itself becomes entangled in the crisis as the main shortage is one of international rather than (just) domestic liquidity. Most policymakers in emerging market economies are acutely aware of this danger, which is one of the main reasons they accumulate large amounts of international reserves. However, large accumulations of reserves are the equivalent to self-insurance for domestic banks, and as such are costly insurance facilities. For this reason, many of us have advocated the use of external insurance arrangements, and the IMF has spent a significant amount of time attempting to design the right contingent credit line facility. In this paper I propose creating a system akin to the TICs but aimed at supporting the value of emerging market new and legacy emerging debt during global SFA episodes. I refer to these instruments as E-TICs and envision them as being controlled by the IMF rather than by the U.S. or other developed economies' governments.[4]

In the rest of the paper I develop this line of argument in greater detail. Section II covers the analogy between SCA and SFA. Section III focuses on financial defibrillators. Section IV adds an international dimension to the analysis, and Section V concludes.

An Overview of SFA

In this section I characterize SFA, drawing a close financial-analogy with the health-equivalent issues in SCA. This sets up the case for a discussion of financial defibrillators in the next section.

[4] For developed economies, the international liquidity shortage problem is much less significant and it was appropriately dealt with the swap arrangements between major central banks. These should remain in place, at least on a contingent (to SFA) basis. A more delicate problem for these countries stems from the high degree of cross-borders interconnectedness of their financial institutions and the potential arbitrage and free riding issues that may emerge from differences in the type of financial defibrillators available. This raises international coordination issues which I don't develop in this paper but that obviously need to be addressed.

I.A. What is SFA and what are its immediate causes?

Sudden financial arrest (SFA) is a condition in which trust within and toward the financial system suddenly vanishes. When this happens, the financial system freezes and credit stops flowing within the financial system and to the real economy. SFA causes severe contractions and wealth destruction in the absence of an immediate systemic policy response.

The most immediate cause is a truly unexpected event that triggers enormous confusion (see Caballero and Kurlat 2009a). Often there is an observable shock (e.g., a real estate crash, a sovereign default, the uncovering of a significant fraud, or a sharp decline in terms of trade) but this shock is small relative to the observed response in some key financial institutions and markets. It is this apparent over-reaction that triggers a self-fulfilling confusion: Why such a large response? Are things worse than they seem? Who is compromised? Which instruments? What are the transmission channels? How will others react to this over-reaction? How will the government react?

These doubts by themselves bring about reluctance to engage in financial transactions and are triggers of good old-fashioned financial multipliers, which are often sufficient enough to cause a real contraction.

The now-classic contributions of Bernanke and Gertler (1989), Bernanke et al (1999), Kiyotaki and Moore (1997), and others illustrate the powerful feedback channels between asset markets and the macroeconomy. When the assets held by a leveraged firm decrease in value, the net worth of the firm is quickly eroded, forcing the firm to sell financial assets or decrease investment or hiring. These actions may in turn further decrease the value of the asset. Brunnermeier and Pedersen (2009a, 2009b) call this type of feedback a "loss spiral." Loss spirals may be aggravated by fire sales, in which market liquidity dries up because the natural holders of an asset are simultaneously trying to sell. Such fire sales have been extensively documented, e.g., in the equity markets (Coval and Stafford 2007), the market for airliners (Pulvino 1998), and the

convertible bond market (Mitchell, Pedersen and Pulvino 2007). Brunnermeier and Pedersen also emphasize "margin spirals," in which a reduction in firms' ability to borrow against an asset leads to sales. Increases in haircuts – the amount of equity needed to finance a given asset – have been dramatic in the present crisis, as Gorton and Metrick (2009) have documented. Geanakoplos (2003, 2009), and Fostel and Geanakoplos (2008) highlight the role of margins in a theory of "leverage cycles." In these models, the supply and demand for loans determines not only the interest rate, but also equilibrium leverage. News that causes increases in risk or disagreement can shift the equilibrium haircut, with large effects on asset prices.

However, there are two key additional and related ingredients which have the potential to leverage the consequences of these mechanisms to SFA level: *Complexity* and *Knightian uncertainty*.

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.

In Caballero and Simsek (2009a) we capture the idea of a sudden rise in complexity, followed by widespread panic in the financial sector. In our model, banks normally collect basic information about their direct trading partners which serves to assure them of the soundness of these relationships. However, when acute financial distress emerges in parts of the financial network, it is not enough to be informed about these direct trading partners, but it also becomes important for the banks to learn about the health of their trading partners, in order to assess the chances of an indirect hit. And as conditions continue to deteriorate, banks must learn about the health of the trading partners of the

trading partners, of their trading partners, and so on. At some point, the cost of information gathering becomes too large and banks, now facing enormous uncertainty, choose to withdraw from loan commitments and illiquid positions. A flight-to-quality ensues, and the financial crisis spreads. In Caballero and Simsek (2009b) we show how this complexity mechanism interacts and greatly amplifies the collateral and fire sales mechanisms.[5]

In Caballero and Krishnamurthy (2008a) we illustrate with a model and examples the amplification role of Knightian uncertainty (and the effectiveness of "financial defibrillation" in this context). We pointed out that most flight to quality episodes are triggered by unusual or unexpected events. The common aspects of investor behavior across these episodes —re-evaluation of models, conservatism, and disengagement from risky activities— indicate that these episodes involved Knightian uncertainty (i.e., immeasurable risk) and not merely an increase in risk exposure. The extreme emphasis on tail outcomes and worst-case scenarios in agents' decision rules suggests uncertainty aversion.

In Caballero and Krishnamurthy (2008b) we place the origins of the current crisis in this framework. We argue that financial instruments and derivative structures underpinning the recent growth in credit markets were complex. Indeed, perhaps the single largest change in the financial landscape over the last five years was in complex credit products: CDOs, CLOs, and the like. Because of the rapid proliferation of these instruments, market participants couldn't refer to a historical record to measure how these financial structures would behave during a time of stress. These two factors, complexity and lack of history, are the preconditions for rampant uncertainty. When defaults on subprime mortgages occurred, many market participants were taken by surprise at how their investments were reacting. Early on in the crisis, the most prominent example of this

[5] Haldane (2009) masterfully captures the essence of the counterparty uncertainty problem that can arise in a complex modern financial network: "…Knowing your ultimate counterparty's risk then becomes like solving a high-dimension Sudoku puzzle…."

was the losses experienced by AAA subprime tranches. It was at this point that investors became uncertain about their investments. Had the uncertainty remained confined to subprime mortgage investments, given the relatively small size of the subprime sector, the financial system could have absorbed the losses without too much dislocation. However, investors started to question the valuation of the myriad other credit products —not just mortgages— that had been structured in much the same way as subprime investments. The result was uncertainty and a freezing up across the entire credit market. The policy response to this initial freezing was timid, which kept the stress on the financial system alive until the latter eventually gave up and a full blown SFA episode developed (after Lehman's demise).

In summary, while fundamental factors are often the triggers, and hence there is good reason to try to manage them, their potential for real damage is often contained in the absence of SFA. Traditional financial multipliers can greatly increase the real impact of fundamental shocks, but it is only after they are themselves amplified by widespread panic and confusion that a deep crisis is likely to set in. Absent the panic, the financial heart may go through a few scary arrhythmias, but there are too many safety valves and resources in modern developed financial markets for it to come to a sustained halt.

I.B. Who is at risk?

Every economy with a reasonably modern financial system is at risk of SFA. It is a risk inextricably tied to the dynamic process of financial innovation and to the complexity of a rich financial network. As highlighted by Caballero and Krishnamurthy (2008a), it builds over time as untested financial innovations grow in relative importance, which is an unavoidable side effect of a period of prosperity.

Of course, there are factors that elevate SFA risk in addition to the mere passage of (innovation) time. There are the usual bad habit suspects, such as a high concentration of real estate loans in banks' balance sheets, currency and liquidity mismatches in financially leveraged institutions, lending and consumption booms, sharp asset appreciations, regulatory and supervisory negligence, weak corporate governance,

sustained appreciations and current account deficits, excessive exposure to terms of trade shocks, low levels of international reserves, and so on. But unfortunately these factors have very limited predictive power for SFA, especially in sophisticated financial markets (see Caballero and Kurlat 2009a).

The most visible of these factors, the macroeconomic ones, play a detectable role in emerging markets, since the strong pro-cyclicality of capital flows increases the likelihood that large macroeconomic shocks quickly translate into SFA episodes. These lessons have been largely learned, which explains why emerging markets did not implode during the recent global crisis.

However, this tight connection between macroeconomic events and SFA is weak in deep and developed financial markets. Reinhart and Reinhart (2008) find that, for low and middle income countries, the probability of a banking crisis is higher during episodes of "capital flow bonanza." (The probability conditional on a bonanza is 21 percent, versus a 14 percent unconditional probability.) For high income countries, this connection is absent in their sample.

Of course SFA is more likely to take place in the midst of a contractionary macroeconomic shock, in the same sense that an SCA episode is more likely to take place during a stressful situation, but this does not mean that the cause of SFA is a macroeconomic imbalance. Instead, the main SFA risks are more silent, building slowly over time and becoming deeply embedded in the financial network. These risks are very hard to detect in time to prevent an SFA. Going back to the analogy with SCA, I quote again from the NHLBI/NIH site:

> *"The major risk factor for SCA is undiagnosed coronary artery disease (CAD). Most people who have SCA are later found to have some degree of CAD. Most of these people don't know that they have CAD until SCA occurs. Their CAD is "silent"—that*

is, it has no signs or symptoms. Because of this, doctors and nurses have not detected it. Most cases of SCA happen in people who have silent CAD and who have no known heart disease prior to SCA."

Yes, we all knew that there could be a large correction in real estate markets and that this would complicate subprime mortgages and lenders first, and that a recession would surely follow a crash. But the hidden financial-CAD was not the price of real estate or the amount of subprime mortgages. Instead, it was in the particulars of the complex financial interconnections developed in the process of creating new financial instruments and products. There are, of course, ample anecdotes and media-created gurus, but these are mostly stories, where the crucial details were never part of them, which is long and conveniently forgotten. No one can (or should) claim to have understood before the crisis the precise channels through which complexity would turn out the way it did.

There is an economic parallel to the earlier hidden-CAD quote, found in the social learning literature. Like plaque in one's circulatory system, bad news can accumulate over time in the financial system without causing a catastrophe. Indeed, the financial system can continue in a state of "business as usual" even as increasing numbers of people receive bad news about fundamentals. As with plaque, it can take a critical mass of bad news before "business as usual" turns into crisis. For CAD, the reasons have to do with physics, but for financial-CAD, this can occur when bad news is not common knowledge. For example, as shown by Caplin and Leahy (1994), if private information is revealed through irreversible actions, agents will wait until their expectations cross a low threshold before acting upon them; this can allow bad information to accumulate over time without any visible signs. Similarly, bubbles may persist even as large numbers of agents learn that a bubble is occurring, if coordination is needed to burst the bubble and if the bubble's existence is not common knowledge, as in Abreu and Brunnermeier (2003). Such behavior is not inconsistent with rationality. As the then Citi

CEO Chuck Prince observed in July 2007, "When the music stops, in terms of liquidity, things will be complicated. But as long as the music is playing, you've got to get up and dance. We're still dancing." Even with the rough contours of the crisis clear in the CEO's mind, he kept dancing, because the timing and exact contours of the crisis were not clear.

I.C. Diagnosis

Diagnosis is the key element in deciding how and when to react. In health matters, while it is difficult to predict the occurrence of SCA its diagnosis is not hard, and in fact there are machines that do it nearly automatically (more specifically, defibrillators designed for the untrained check for severe arrhythmias before applying an electric shock to the heart).

In economic matters, diagnosis is a much trickier task, perhaps because even when violent, events are less abrupt than cardiac arrest. Usually SCA happens without a clear warning sign. In contrast, there is almost always a narrow window of opportunity to react to early warnings and prevent a full-blown SFA episode. Unfortunately, in practice much of this advantage is wasted as a conclusive diagnosis is delayed until the evidence is sufficiently clear to persuade reluctant politicians that emergency treatment for SFA is needed. By then, solving the problem often is an order of magnitude more expensive than in an early intervention. The following quote from Phillip L. Swagel (2009), then assistant secretary for economic policy, vividly captures this reality:

> *"Political constraints were an important factor in the reluctance at the Treasury to put forward proposals to address the credit crisis early in 2008. The options that later turned into the TARP were first written down at the Treasury in March 2008: buy assets, insure them, inject capital into financial institutions, or massively expand federally guaranteed mortgage refinance programs to improve asset performance from the bottom up. But we at the Treasury saw little prospect of getting legislative approval for any of these steps, including a*

massive program to avoid foreclosures. Legislative action would be possible only when Treasury Secretary Henry Paulson and Federal Reserve Chairman Ben Bernanke could go to Congress and attest that the crisis was at the doorstep, even though by then it could well be too late to head it off." (Swagel, p. 4)

The bickering early on is often Schumpeterian in nature. A boom accumulates many excesses in financial balance sheets and it is healthy that some of them are cleansed. The problem is that the ratio of inefficient panic-contagion-driven destruction to healthy cleansing can rise quickly. This is the policy conundrum, where to draw the line and, even more importantly, to muster the support to act quickly once the line is crossed. If intervention takes place too early, there is no healthy cleansing. If it takes place too late, there is great risk of an SFA episode.

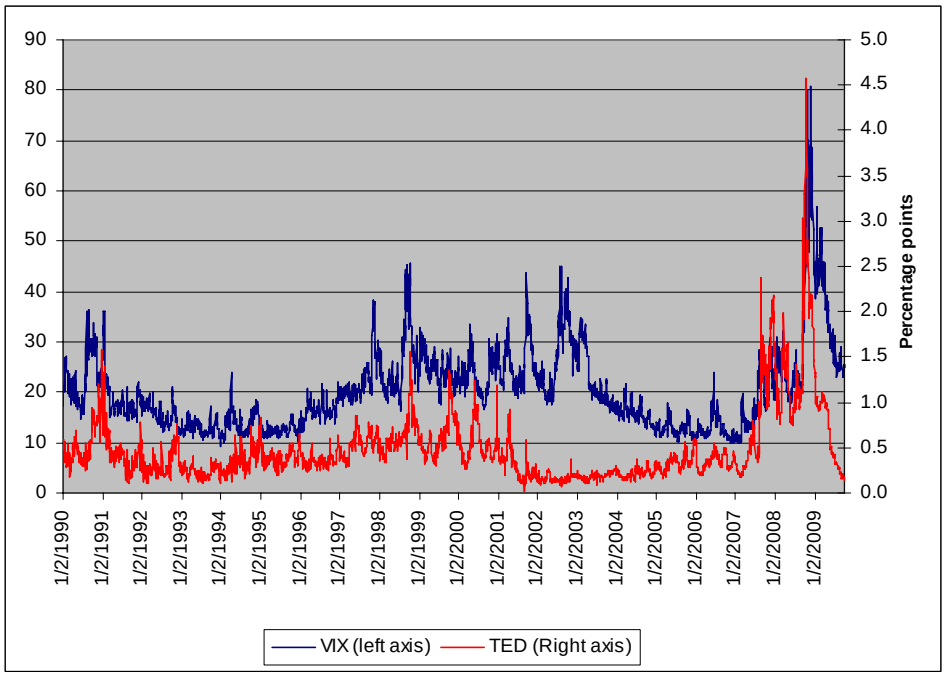
In practice, some objective measurement is needed. For SCA, electrocardiograms (EKGs) can be used to detect and locate the source of several heart problems. For SFA, there are many EKG-equivalents. Spreads of all sorts can be used to spot dysfunctional financial markets and institutions.

The blue line in Figure 1 is the VIX at market close, from the CBOE. The red line is the TED spread, the difference between 3-mo LIBOR and 3-mo constant maturity Treasury, both since the 1990s until the present. It is apparent that both capture well episodes of financial turmoil. The graph shows the unprecedented degree of financial-markets dislocation during the current crisis and that the level of unease was considerable well before Lehman's collapse. The TED spread in late 2007 and early 2008 exceeded levels associated with the Persian Gulf War, the LTCM/Russian default episode, and 9/11.

There is also a subtle but important difference between these two indicators. The VIX is probably a good *warning* for SFA proclivity but it is too sensitive to determine the occurrence of an SFA event by itself. This is not surprising since by construction the VIX

picks up distress in the riskiest segments of assets (equity). The TED, on the other hand, reflects trouble in the safest counterparties, and hence it is a more reliable indicator that financial chaos is in full force.

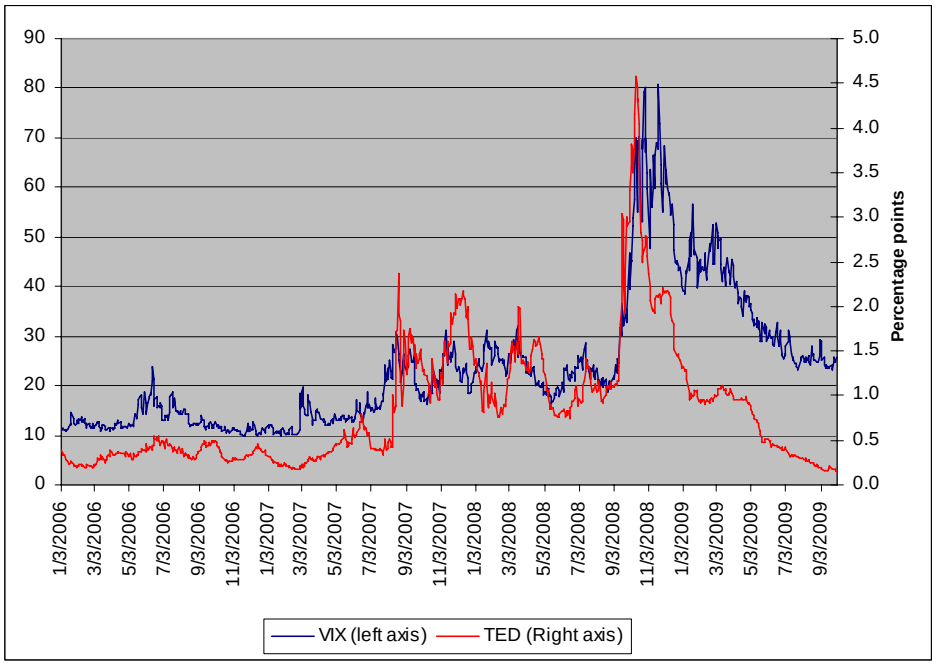
Figure 1. Indicators of Panic since 1990



Sources: CBOE, Datastream, Federal Reserve

Figure 2 offers a bird-eye view of the crisis from the perspective of the same two indicators of panic. Note that the TED spread soared the week of Lehman's collapse and retreated very sharply as the Capital Purchase Program (CPP) and Temporary Liquidity Guarantee Program (TLGP) were announced on October 14, 2008.

Figure 2. Indicators of Panic During the Crisis

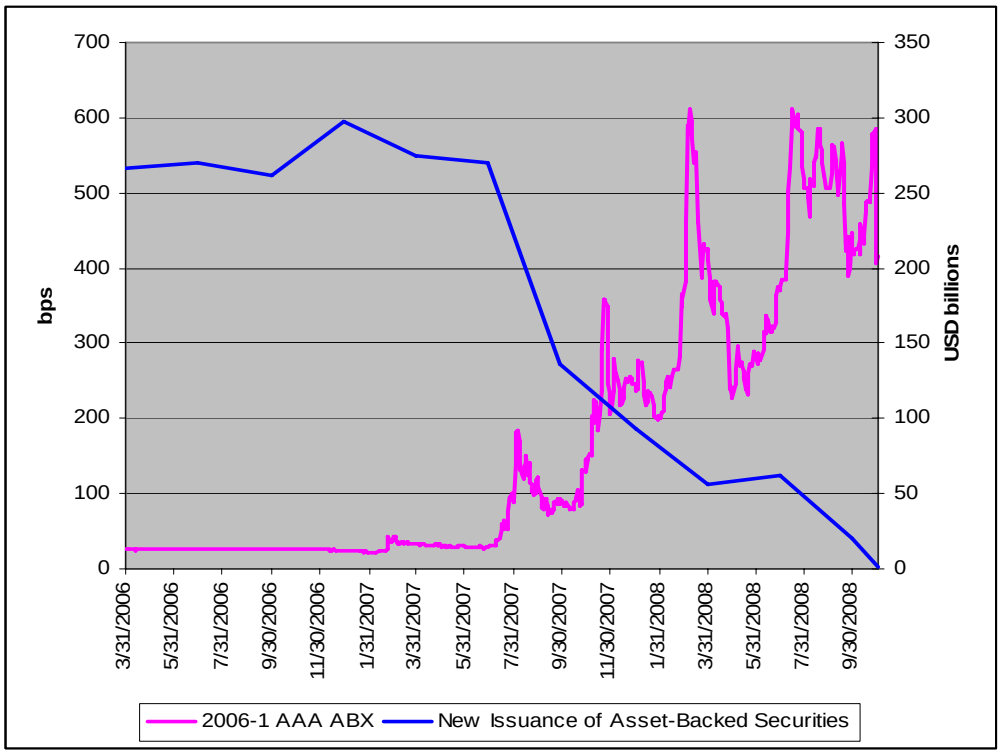


Sources: CBOE, Datastream, Federal Reserve

Quantity indicators are often harder to come by in real time, but they offer a clear indication of the extent of the damage being caused by the underlying crisis. The blue line in Figure 3 is "New Issuance of Asset-Backed Securities in Previous 3 Months," from Adrian and Shin (2009); the data originally come from JP Morgan Chase.[6] The crisis in this market is apparent from the disappearance of new issuances. The pink line is 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." The spread data are from JP Morgan Chase and not only corroborates the crisis impression from the quantity side but also makes it clear that the collapse in quantity is demand rather than supply driven.

[6]The new issuance series is the sum over the following categories of ABS: "home equity (subprime)"; commercial real estate; autos; credit cards; student loans; non-US residential mortgages; and other. The data were provided by Tobias Adrian.

Figure 3. SCA in the Asset-Backed Securities (ABS) Market



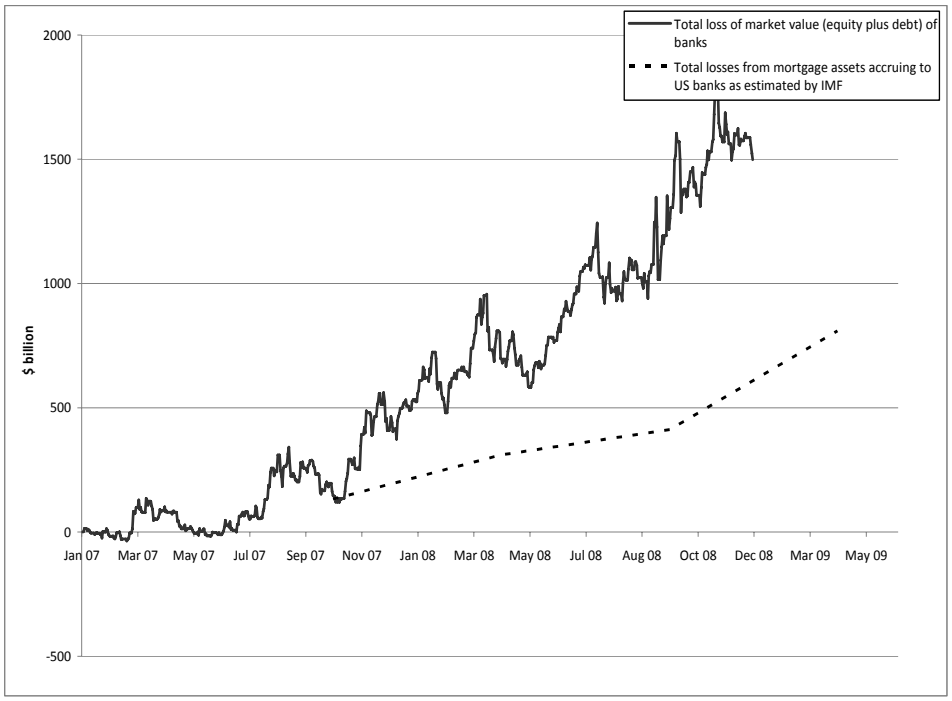
Sources: JP Morgan Chase, Adrian and Shin (2009)

To conclude, perhaps one of the best indicators of an imminent SFA episode is the large mismatch between the size of the shock that is "credited" for the contraction and the value-destruction that takes place in banks' balance sheets. Such mismatch is bound not only to cause, but also to reflect confusion and fear in financial markets. In Caballero and Kurlat (2009a) we constructed an estimate of this mismatch, which I reproduce in Figure 4. For this, we computed the evolution of the market value (equity plus long term debt) of the major U.S. banks since January 2007.[7] From this we obtained an estimate of total losses on the right hand side of these banks' balance sheets. Absent

[7] 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 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.

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 4, 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.[8]

Figure 4. Losses from Mortgage assets, Total Loss of Market Value and Multiplier.



Sources: IMF Global Financial Stability Reports, banks' financial statements and JPMorgan. From Caballero and Kurlat (2009a).

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.

[8] 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, our procedure understates the multiplier.

Most of these financial distress indicators were available in real time or shortly thereafter. By the end of the summer of 2007, they clearly reflected that the potential for SFA was high. They also showed by the end of the summer of 2008, that a severe SFA episode was taking place. Policymakers at the Fed and Treasury were acutely aware of these scenarios, but the treatment options at their disposal were limited by political constraints and lack of ex-ante preparation.[9]

I.D. Treatment

SCA requires immediate treatment with a defibrillator. That is, an electric shock to the heart, to restore normal rhythm. This must be done quickly as with every passing moment there is a steep decline in the chances of SCA survival.

Although less dramatic in its early stages, once SFA reaches full force, the analogy with SCA and the urgency of its treatment is accurate. This was clearly the case during the days that followed the Lehman and AIG events, when suddenly even Money Market funds became entangled and experienced panic-driven withdrawals that clearly had not been anticipated by policymakers and bankers. Swagel recounted to Bloomberg that on Monday, September 15, the day of Lehman's collapse, "The general feeling was things were working." And even as officials and market participants witnessed the run on money market funds and the drying up of the commercial-paper market –money-market redemption requests were $33.8 billion that Tuesday, compared to $4.9 billion the previous week– the full extent of the crisis was still hard to understand (Stewart 2009). In the same Bloomberg article, Mohamed El-Erian recounted "Monday and Tuesday, people didn't quite see what was happening…You had to be on the desk in the

[9] See Wessel (2009) for a fascinating account of some of the constraints faced by the Fed to act quickly during the crisis.

payments and settlements system, cash and collateral, to start seeing cascading market failures and a complete erosion of trust."[10]

Essentially, financial defibrillators are large public guarantees of different components of the financial system's balance sheet. There were many of these put in place in an ad-hoc basis during the recent crisis. For example, to staunch outflows from money market funds and stabilize the commercial-paper market, the Treasury created a temporary insurance program for money-market funds and the Fed created a backstop commercial-paper facility to purchase highly rated three-month commercial-paper directly from eligible issuers through a special-purpose vehicle. Through the Term Asset-Backed Securities Loan Facility (TALF) program, the Fed provides non-recourse funding –the non-recourse element is key– for purchases of asset-backed securities. Deposit insurance on bank accounts (FDIC) was extended (temporarily) from $100,000 to $250,000. The Fed created facilities for lending to investment banks. Later, Morgan Stanley and Goldman Sachs, the two remaining investment banks, were allowed to become bank-holding companies to reassure creditors and counterparties. Moreover, the FDIC, through the Temporary Liquidity Guarantee Program, provided guarantees of newly issued senior unsecured debt of financial institutions.

Europeans also implemented large public guarantees and interventions. The Asset Protection Scheme in the UK backed more than half a trillion pounds in post-haircut assets for RBS and Lloyds. The maturity of discount-window borrowing was extended in the U.S., the U.K., and the E.U. The UK asset purchase facility acquired commercial-paper and corporate bonds and the ECB purchased covered bonds. In addition, there were large capital injections by governments across the globe.

In the U.S., the initial response was ad-hoc, inconsistent and unpredictable. Eventually, but after much had gone wrong, there was convergence to a consistent policy that

[10] Ivry, Bob, Mark Pittman and Christine Harper. 2009. "Sleep-At-Night-Money Lost in Lehman Lesson Missing $63 Billion," Bloomberg.com, September 8.

placed panic and the systemic nature of the problem at the core. According to the IMF, between summer 2007 and June 2009, 49 front-page policy announcements were made in the U.S., 18 in the U.K., 49 in the Euro area, and 37 more in Japan, Sweden or Switzerland (IMF 2009). These measures included: interest rate changes; liquidity support measures such as changing reserve requirements or widening collateral rules; capital injections; debt guarantees; asset purchases; and asset guarantees. This was the right response and the steps that followed along the same direction eventually stopped the economy's free fall and made a recovery possible.

The unfortunate aspect of the process that got us to the right answer is its exasperating slow speed. For SCA, cardiopulmonary resuscitation (CPR) should be given to a person having SCA until defibrillation can be done. The equivalent to CPR in the context of SFA is the ad-hoc and idiosyncratic (as opposed to systemic) policy response to the early stages of SFA. For emerging market economies, sometimes the CPR-equivalent is all that is available until an external rescue is mounted. For developed economies the main obstacle is lack of political support for activating a financial defibrillator. Either way, it is apparent that in practice too much time is spent in financial-CPR-mode, delaying a much needed shock treatment.

Another important lesson from SCA treatment is that this is not the time to initiate long term treatment. The Lehman episode illustrates that similar patience is advisable for SFA. Once more quoting Swagel (2009), when the U.S. government allowed Lehman to fail, "The view at Treasury…was that Lehman's management had been given abundant time to resolve their situation by raising additional capital or selling off the firm, and market participants were aware of this and had time to prepare." However, it took "breaking the buck" at just one large money-market fund that was over-exposed to Lehman for panic to ensue among investors in money market mutual funds, in turn causing a drying up of short-term financing for banks and corporations. This episode

highlights the extreme fragility of a financial system on the verge of SFA and the unreasonable risk associated with attempting financial surgery during these episodes.[11]

I.E. Prevention

For low-risk populations, the main preventative prescription is a healthy lifestyle to address the main factors behind CAD. Economics has an analogous protocol. In particular, there are two main types of preventive policies often discussed in the context of financial crises: control of macroeconomic imbalances that can lead to large asset market crashes; and regulatory controls to limit excessive aggregate risk concentration in financial balance sheets.

For example, the Treasury department is currently seeking to control macroeconomic imbalances through its Framework for Sustainable and Balanced Growth, which calls for monitoring by the IMF. It also has proposed requiring banks to hold higher capital and liquidity buffers, and for imposing stricter requirements on the largest, most leveraged and most interconnected firms. It has also proposed a more unified regulatory approach that would merge the Comptroller of the Currency (OCC) and the Office of Thrift Supervision (OTS) into a new National Bank Supervisor and create a dedicated agency for consumer protection.

Continuous progress is being made along these dimensions; however, this is a never ending job, as the financial system adapts to new controls and regulations. Moreover, there is an aspect of SFA prevention that has received disproportionally little attention: *Hidden financial-CAD detection mechanisms.*

[11] The Lehman episode highlights the difficulty of predicting the fallout from the resolution of a major financial institution when the possibility of SFA is impending. There have been several proposals from academia and policymakers to create mechanisms for orderly resolutions, but resolving a major financial institution, especially during times of panic, inevitably involves an amount of uncertainty that can easily generate catastrophic consequences.

For SAC, there is substantial research effort in developing new tests to detect hidden-CAD. In the 1990s, doctors found that elevated levels of the C-reactive protein, or CRP, strongly predict future coronary events. CRP was discovered in 1930 and doctors had long known that CRP was an indicator to bear in mind, but when its measurement became more precise, the useful predictive features of CRP became clear. The medical profession believes a CRP reading in the upper-third versus lower-third of the distribution implies a relative risk of 2.0 for a future coronary event. However, some worry that the useful qualities of CRP testing has led doctors to over-emphasize CRP, when in fact it must be viewed as only one piece of a complex clinical puzzle, a situation we are quite familiar with in economics.

The financial equivalent of hidden-CAD derives from the particulars of the evolution of new connections within the financial network. Tracing and increasing the transparency of these connections should be a high priority in limiting the possibility of panics. We still have not found the financial equivalent of CRP testing, but early attempts are underway to expand our toolkit. As with CRP, making more precise measurements of financial and other variables we already know to be important, and integrating these better measurements into our models can help us find predictors of financial distress.[12]

One interesting first step is Adrian and Brunnermeier's (2009) CoVaR measure of the value-at-risk of the whole financial system conditional on a given financial institution being in distress. Adrian and Brunnermeier argue that capital requirements should be tighter for institutions that can be predicted to have a higher systemic risk contribution

[12] In an October 13, 2008 WSJ article (Summers Outlines Risks to Recovery) there is a quote to Alan Krueger, assistant Treasury secretary for economic policy, who pointed to a near-complete lack of information on such critical variables as hedge fund positions, the interconnections among financial institutions and mortgage-refinancing activity. He argued that "…the economic crisis has given an unintended stress test of our economic and financial indicators."

in the future; they find that higher leverage, more maturity mismatch, larger size and higher book-to-market predict future CoVaR. A related test is the "marginal expected shortfall" measure proposed by Acharya et al (2009a,b). A firm's marginal expected shortfall is a measure of losses experienced by the firm conditional on aggregate losses being large. Acharya and co-authors apply the method using stock prices; that is, calculating the mean stock return for a given firm conditional on a lower-tail market return. The "protein" that CoVar and marginal expected shortfall seek to measure is the conditional correlations between the returns on different firms' assets. CoVaR is a measure of the response of the firm-j or the system to a shock to firm-i. Marginal expected shortfall is a measure of the response of firm-i to a systemic shock.

Borio and Drehmann (2009) pursue a different type of early-warning system. They seek to test for the *joint* presence of two different proteins: aggregate balance-sheet imbalances and asset-price bubbles. They develop a binary indicator of risk based on deviations from trend of the quantity of private-sector credit and the prices of equity and property.

Acharya et al (2009a,b) find that the marginal expected shortfall of a firm measured during June 2006 to 2007, before the crisis, predicts the firm's return during the crisis. Borio and Drehmann (2009)'s binary indicator would have reflected heightened risk prior to the current crisis only for versions that sufficiently emphasize property prices. Their credit-to-GDP gap had exceeded a strict threshold since 2001, but their equity price gap was below even a weak threshold for almost a decade before the crisis. The search for the C-reactive protein of financial CAD is still in its early stages.[13]

On a cautionary note about hidden-financial-CAD, much of the current concern with large financial institutions (pejoratively referred to as too-big-to-fail or too-

[13] See Segoviano and Goodhart (2009) for another interesting attempt to measure banking interconnectedness and stability.

interconnected-to-fail) is the enormous complexity caused by their many linkages. This view presumes, however, that if these linkages instead were implemented by thousands of small institutions they would be much less complex and more transparent. I think this is a fallacy of composition. Indeed, each individual small bank would be simpler, but the whole network, which is what matters for macroeconomic and financial stability, would probably be more, not less complex, since it would take many linkages to perform some of the transactions that are internalized within and through larger institutions. Moreover, despite the many internal control problems that large institutions exhibit, at least there is some private-sector party that has some information and incentives to limit the risks embedded in these internal linkages. It is unlikely that an equivalent player would do so if all linkages become decentralized. In summary, detecting the gradual buildup of hidden-CAD probably would be harder rather than simpler in a financial network with no giant components and many more small nodes.

Finally, as a positive observation, since panic is at the core of SFA, the very existence of a powerful treatment is *preventative* in itself. I turn to a detailed discussion of this treatment in the next section.

Financial Defibrillators

Monetary policy is the first line of defense when distress arises in the financial system. It is systemic and quick, and it is an effective instrument for macroeconomic shocks that do not trigger significant panics. The next step in policy escalation is one of the oldest financial defibrillators: the lender of last resort facility (LOLR). It is an insurance mechanism whose primary role is to prevent depositors' runs from commercial banks. Bagehot advocated in 1873 that a LOLR should lend in a crisis to "solvent but illiquid" institutions with adequate collateral.[14]

[14] The solvency requirement is nice in theory but a real practical problem during an SFA episode. In such instance the distinction between a solvent and an illiquid institution is highly arbitrary as most asset prices become

The LOLR provides a channel and infrastructure that can be used even for situations that do not exactly match its original intent. In the current crisis, the Fed extended credit directly to primary dealers and investment banks through the Primary Dealer Credit Facility (PDCF) and the Term Securities Lending Facility (TSLF). The former facility lends against collateral, using haircuts to assure the safety of the loan and applying an interest rate above the rate prevailing under normal market conditions. This penalty rate has succeeded as a built-in exit mechanism for the program. The latter facility is the primary-dealer analog to the Term Auction Facility (TAF) that serves commercial banks. Under TSLF, the Fed determines an amount of funding to be provided and an auction determines the recipients and price of the funding. The Fed also established programs to serve as a lender of last resort, albeit indirectly, for money-market funds, but these programs were largely superseded by the Treasury's guarantee program.

Aside from the specific value of these extensions of the LOLR, the general principle that I wish to highlight is that having readily available channels to different segments of the financial system can save precious time in the midst of a crisis, and is one of the central arguments supporting the creation of a broader class of financial defibrillators.

Unfortunately, as starkly illustrated by the recent crisis, even with a flexible interpretation and use of the conventional LOLR, it can be insufficient when the panic extends beyond commercial banks and to assets and liabilities other than deposits. In particular, systemic panic temporarily destroys the value of assets on banks balance sheets and, more broadly, the collateral of most financial institutions. At distorted asset prices, capital-adequacy ratio constraints and margin calls trigger costly actions (e.g., fire sales) and feed back into panic itself. Absent a clear framework to support the financial system in such scenarios, speculations and misguided policy proposals of all ilk further

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uninformative, which turns the Bagehot principle (i.e., how regulators determine which firms are insolvent) in yet another source of uncertainty.

add to the uncertainty-fuel, and discourage any private sector participation in the solution to the crisis.

To address these extreme scenarios, not covered by the traditional LOLR, there have been several recent proposals to provide some form of protection to financial institutions and markets during systemic events (although many of the proposals do not distinguish between a systemic event and an individual bank problem, which is a key distinction from an SFA perspective). I review some of these in the following sub-sections.

Essentially, there are three broad categories of proposals to reduce crisis risk:

- Self-insurance through higher (and cyclical) capital-adequacy ratios,
- Pre-paid/arranged contingent capital injections,
- Pre-paid/arranged contingent asset and capital *insurance* injections.

I.F. Self-insurance

This is where policymakers' instinct lies. It essentially consists of requiring banks to increase their war chests. It is the analogue of requiring that every individual carries an ICD (implantable cardioverter defibrillator) to prevent SCA.

The Group of Central Bank Governors and Heads of Supervision, the oversight body of the Basel Committee on Banking Supervision, has agreed that banks should hold more capital (BIS 2009, Caruana 2009). This Basel group also favors a shift toward higher "quality" capital; for example, favoring equity over preferred shares. The new capital requirements would be set with respect to banks' leverage ratios; the coarseness of this metric is here seen as a virtue. The group also favors countercyclical capital buffers and liquidity standards for funding operations. The U.S. Treasury has offered similar recommendations, highlighting an interest in imposing, in the U.S., stricter and more conservative capital, liquidity and risk management standards on any financial firm

whose combination of size, leverage, and interconnectedness could pose a threat to financial stability were it to fail (U.S. Treasury 2009).

This category of proposals has the virtue of being the simplest to implement, but has the drawback of being the costliest. The reason for the latter is that in order to increase protection against extreme macroeconomic events, it forces banks to freeze capital which vastly exceeds what they need for their normal, mostly microeconomic risk management, operations.

Adding a procyclical capital clause, as well as increasing the capital-requirements for systemically fragile assets relative to idiosyncratically fragile assets, are sound improvements to the most basic self-insurance systems. However, at the end of the day, the costly nature of self-insurance caps how much insurance can be mandated through this mechanism.

I.G. Contingent capital injections

This is where most academics' instinct lies. The basic idea is to reduce the costs associated with holding capital when it is not needed. However, and centrally, these approaches recognize that access to capital during crises needs to be arranged in advance, since it is often hard to raise capital during a severe crisis. Proposals of this kind differ in the source of this contingent capital, in particular between the private sector and the government. Within the former, in some proposals the contingent funds come primarily from existing stakeholders and hence require no "new money" (e.g., through contingent debt/equity swaps) while in others the funds come from outsiders. However, outsiders' commitments problems limit the extent to which the private sector can serve as the source of this capital during extreme events, a point highlighted by Holmström and Tirole (1998) in theory and AIG (and the monolines) in practice.

Flannery's (2002) proposal made one of the first significant steps in this direction with his proposal for "reverse convertible debentures." Such debentures would convert to equity whenever the market value of a firm's equity falls below a certain threshold.

One problem of this early proposal from the point of view of the systemic problems addressed in this article is that it made no distinction between aggregate and idiosyncratic shocks. The Kashyap et al (2008) proposal deals with this distinction and calls for banks to buy capital insurance policies that pay off when the banking sector experiences a negative systemic shock. Private investors would underwrite the policies and place the amount insured into a "lock box" invested in Treasuries. Investors who are themselves subject to capital requirements would not be allowed to supply this insurance. The insurance would be triggered when aggregate bank losses over a certain number of quarters exceed some significant amount; losses at the covered bank would not be included in determining whether the insurance is triggered.

Combining both contributions, the Squam Lake Working Group on Financial Regulation has a proposal (2009) similar to Flannery's except that conversion from debt to equity is triggered only during systemic events and only for banks that violate certain capital-adequacy covenants.

Yet another variant on capital insurance is for the insurance policy to pay out to the regulator, instead of the firm. Under this proposal, by Acharya and others, the amount of insurance required would be proportional to an estimate of the systemic risk posed by the bank, in order to discourage firms ex-ante from taking on excessive systemic risk.

Hart and Zingales (2009) advocate an alternative approach; when spreads on a bank's CDS rise above a certain threshold, a regulator allows the bank a window of time to issue equity in order to bring the CDS spread back below the threshold. If the bank is unable to reduce its CDS spread, the regulator reviews the bank's books and determines whether or not the bank's debt is at risk. If the regulator determines the bank's debt is not at risk, the regulator invests in the bank by lending to the bank; otherwise, the regulator replaces the CEO with a trustee, who will liquidate the bank and pass the

proceeds to the bondholders. Although this approach does have a contingent capital-injection component, it also relies heavily on the resolution of financial firms, which can be a useful discipline device during normal times but can be highly counterproductive during an SFA episode (especially because CDS prices are severely affected by the panic itself).

More generally, the contingent capital approach is the right one when the crisis is mostly one of fundamentals. However, if the panic component is significant, a central feature of an SFA episode, then it is not the most cost-effective, and it may well trigger further panic as fear of dilution and forced conversion rises.

I.H. Contingent insurance injections

The pure panic component of SFA does not require a costly capital injection to subside. All that is needed is a broad guarantee that resources will be available should conditions worsen. Despite its high notional value, the expected cost of this policy is low because *it derives its power from the very same feature that underlies the panic*. That is, the enormous distortion in perceived probabilities of a catastrophe also means that economic agents greatly overvalue public insurance and guarantees. Providing these can be as effective as capital injections in dealing with the panic at a fraction of the expected cost (when assessed at reasonable rather than panic-driven probabilities of a catastrophe).

In Caballero and Krishnamurthy (2007) we showed that in an episode of Knightian uncertainty, a government or central bank concerned with the aggregate will want to provide insurance against extreme events even if it has no informational advantage over the private sector. The reason is that during a panic of this kind, each individual bank and investor fears to be in a situation worse than the average, an event that cannot be true for the collective. By providing a broad guarantee, the government gets the private sector to react more than one-for-one with this guarantee since it also closes the gap between the true average and the average of panic-driven expectations.

During the recent crisis, there were many asset-insurance injection proposals.[15] The argument for why it may be optimal to support assets rather than inject capital during panics is developed in Caballero and Krishnamurthy (2008b). In practice, financial institutions face a constraint such that value-at-risk must be less than some multiple of equity. In normal times, this structure speaks to the power of equity injections, since these are "multiplied" many times in relaxing the value-at-risk constraint. In contrast, insuring assets reduces value-at-risk by reducing risk directly, which typically does not involve a multiplier. However, when uncertainty is rampant, some illiquid and complex assets, such as CDOs and CDO-squared, can reverse this calculation. In such cases, insuring the uncertainty-creating assets reduces risk by multiples, and frees capital, more effectively than directly injecting equity capital.

Moreover, it turns out that the same principle of insurance-injection can be used to recapitalize banks when that's the chosen solution. Rather than directly injecting capital, the government can pledge a minimum future price guarantee for newly privately raised capital (Caballero 2009a). This mechanism is very powerful both because private investors overvalue the guarantee, and because the recapitalization itself makes the catastrophic event less likely. Caballero and Kurlat (2009b) quantified this mechanism and showed that once the equilibrium response of equity prices is taken into account, this mechanism significantly reduces the effective exposure of government resources relative to a public equity injection.

Many of the actual programs implemented during the crisis had elements of guarantees rather than being pure capital injections. Perhaps the clearest case of this approach is that followed by the UK. Their asset protection scheme, announced in January 2009, provided insurance against 90 percent of losses above a "first-loss" threshold on portfolios of corporate and leveraged loans, commercial and residential property loans, and structured credit assets such as RMBS, CMBS, CLO, and CDO obligations. The insurance is provided in exchange for a fee. The APS covered £552 billion portfolios of

[15] See, e.g., Caballero (2009a,b); Mehrling and Milne (2008) and Milne (2009) for real time proposals.

RBS and Lloyds Banking Group, with a first-loss amount of £19.5 billion and £25 billion, respectively. The main criticism to the U.K.'s approach is that they charged such a high fee for the insurance that most banks chose not to engage, leaving the overall economy more exposed to their failure than socially optimal.[16]

In Caballero and Kurlat (2009a) we proposed a policy framework which would not only guarantee access to insurance in the event of an SFA episode, but it would do so in a flexible manner that integrates the role of the government as an insurer of last resort with private sector information on the optimal allocation of contingent insurance.

Under our proposal, the government would issue *tradable insurance credits* (TICs) which would be purchased by financial institutions, some of which would have minimum holding requirements. During a systemic crisis, each TIC would entitle its holder to attach a government guarantee to some of its assets. 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.

There are five features of the TIC-framework which are worth highlighting at this point:

- *It is automatic*. While the precise threshold that defines the crisis is fuzzy, as in practice is that which determines the trigger for the Fed's unusual and exigent circumstances clause, once triggered the actions are well defined, broad, and easy to communicate to the public and financial institutions in advance.[17]

[16] This is a reminder that a taxpayers' "deal mentality" during an SFA episode can be highly counterproductive (Caballero 2009c). Also, it is important to note that each bank is more likely to know its own financial health and hence be less affected by Knightian uncertainty with respect to its own financial health than are their creditors. For this reason, a bank may reject an expensive insurance deal even when outsiders faced with the same option would accept it.

[17] If there is a concern that TICs will be activated too frequently without sufficient evidence of systemic risk, one could contemplate making activation subject to several "keys," as with the systemic risk exemption in FDICIA (i.e, the President has to sign off, 2/3 of the Fed board has to sign off, and 2/3 of the FDIC has to sign off). I owe this example to Morris Goldstein.

- *It addresses directly the multiple-effects of panic on asset values and financial balance sheets*. While the conventional LLOR is aimed at protecting the banks' ability to generate liabilities, the TIC framework protects assets and through it capital. For example, during the recent crisis the Fed relaxed the constraints on the type of assets it accepts in its discount window operations. This was extremely useful but it only addressed the effect of uncertainty on funding but not on capital constraints. Instead a TIC would have addressed both simultaneously.

- *It is contingent on a systemic crisis*. 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 targeting the event that needs protection, this contingent feature significantly lowers the cost of insurance for financial institutions.

- *It is flexible.* Which asset classes TICs are attached to depend on where the largest panic discounts take place on a specific crisis. This feature may raise concerns that banks will select their assets based on insider's knowledge of expected losses rather than on panic discounts, but this adverse selection problem can be limited with methods similar to those used by the Collateral Management System (CMS) for discount borrowing, supplemented with Representations and Warranties clauses.

- *TICs are tradable*. This feature allows private agents to use markets to reallocate the access to insurance toward financial institutions in most dire need. And if distressed institutions chose to not seek to stock up on TICs and risk their survival for a higher return (as Lehman probably did and failed), at the very least the rest of the financial system would be better protected against the turmoil that could arise if the misbehaving institutions fail as they would be holding the TICs.

Of course some of these basic properties can be modified depending on the specific circumstances and complementary measures available. Tradability clearly has pros and cons, and it could be done without it. Also, while the basic mechanism would consist of attaching TICs to assets, variants could include attaching them to liabilities and even equity, depending on the particular needs of the distressed institutions and markets, and they could also operate as collateral-enhancers for discount window borrowing. If the adverse selection effect is deemed to be overwhelming in a specific context, this can be controlled by narrowing the flexibility on the assets than can be protected by TICs.[18]

The International Dimension

The international dimension of SFA adds its own ingredients. I focus on the problem for emerging markets which has a close parallel with the issues faced by the financial sector within developed economies.

Financial crises in emerging markets are greatly amplified, indeed in many instances are caused, by a sudden stop and reversal of capital inflows (the so called "sudden stops"). This phenomenon enormously complicates the policy problem, since rather than providing the solution, the government itself often becomes entangled in the crisis. In Caballero and Krishnamurthy (2001, 2006), we refer to this as the dual-liquidity problem of emerging markets: The shortage is one of international rather than (just) domestic liquidity, which means that the local government may not have access to the right kind of financial-defibrillator when coping with large capital outflows.[19]

[18] In Caballero and Kurlat (2009a) we argued that TICs would have been an effective policy tool to address the recent crisis and provided an illustrative example of how these could have been used.

[19] While European banks also experienced a currency mismatch problem at some stage during the recent crisis, this was expediently solved by a swap mechanism between the Fed and the ECB. The Fed also established dollar liquidity swap lines with the central banks of Australia, Brazil, Canada, Denmark, the United Kingdom (BOE), Japan, Korea, Mexico, New Zealand, Norway, Singapore, Sweden, and Switzerland. The swap lines with the ECB and Swiss

Most policymakers in emerging market economies are acutely aware of this danger, which is one of the main reasons they accumulate large amounts of international reserves. Large accumulations of reserves are the equivalent to self-insurance for domestic banks, and as such are costly insurance facilities (although less so when they are the side effect of exchange rate intervention policies). For this reason, many of us have advocated the use of different external insurance arrangements, and the IMF has spent a significant amount of time attempting to design the right contingent credit line facility.

Since 1999 three different contingent lending facilities have been introduced by the IMF: the Contingent Credit Lines (CCL), the Short Term Liquidity Facility (SLF), and the Flexible Credit Lines (FCL). They all share the same basic premise: increase eligibility requirements ex-ante in order to provide reduced conditionality ex-post. The CCL was allowed to expire in 2003 and the SLF, introduced in October 2008, was replaced by the FCL in March 2009. Both the CCL and the SLF failed to attract a single borrower request.

The reluctance of the targeted emerging economies to join these facilities resulted in consecutive re-designs that provided more appealing terms. In November 2000, the CCL's conditions for activation were simplified to enhance automaticity; the rate of charge and the commitment fee were also reduced. Under the SLF ex-post

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National Bank were established on December 12, 2007, and the others were established subsequently. In addition, the Fed established foreign-currency liquidity swap lines with the BOE, the ECB, the BOJ, and the Swiss National Bank, should the Fed need to borrow foreign currency in the future. A far more problematic issue for these economies is the political concerns that arise from utilizing domestic financial-defibrillators when there is significant cross-border interconnectedness among their financial systems. In this context there is a free-rider problem which further delays an already slow policy response during SFA episodes. This coordination problem can be reduced through different international conferences such as the G7 or others, which is the mechanism used for most other macroeconomic policy coordination issues. This process can be further facilitated by having cross-pledges proportional to these cross-border exposures. That is, the U.K. would stand behind a share of the U.S. TICs, were these to be activated, and vice-versa.

conditionality was further reduced. The FCL increased the size of the committed resources to 10 times the member's quota (compared to 3-5 under the CCL and SLF) and extended the repayment period to 3.5 to 5 years (compared to 3 months under the SLF). It is not clear whether it was the redesign or the fact that countries were in the middle of the global crisis when they signed on, but by now several of them have joined: Mexico ($47 billion), Poland ($21 billion), and Colombia ($11 billion), are currently enrolled in the FCL. The FCL is the right kind of facility for SFA, since it is not a contingent capital injection but a contingent *insurance* injection (it gives the right to a credit line during crises).

The IMF's FCL is the equivalent to a LOLR for sovereigns. As such, it addresses some but not all the effects of a widespread panic on the country's ability to tap global capital markets during a global SFA episode. There is scope for complementary facilities.

At the beginning of the millennium I was asked to write an article on "The Future of the IMF" for an AEA session (Caballero 2003). Uncomfortable with the broad mandate, I began by changing the meaning of the IMF acronym to that of "International Markets Facilitator." Basically, the idea was to have a division of the (original) IMF play the role of a (well capitalized) AIG or monoline in insuring CDOs of contingent emerging market debt. Countries would issue debt with contingencies that would insulate them from their main real and financial external into a CDO, and the IMF would add insurance to the senior tranches of these CDOs. The IMF's wrapping would serve both the role of signaling to the market the soundness of the underlying assets and it would lower the effective cost for emerging markets to buy external insurance.[20] This would be a sort of PPIP for sovereigns, which would leverage IMF's anti-crisis resources.

[20] See Caballero and Panageas (2007, 2008) for models and calibrations of the hedging gains for emerging markets subject to sudden stops in net capital inflows and terms of trade shocks.

The sudden stop phenomenon is just one more manifestation of the flight of quality mechanism that can be triggered by conventional financial multipliers and greatly exacerbated by SFA. As such, it would make sense to develop a system akin to the TIC framework but customized to contain the effect of panic on the value of emerging market new and legacy emerging debt held by investors during global SFA episodes. There is extensive evidence that severe non-idiosyncratic sudden stops are caused by runs against emerging markets as an asset class (see, e.g., Broner et al. 2008). By insuring these assets during a crisis, they would become part of "quality" and hence limit the run against them.

These E-TICs (emerging markets TICs) would typically be activated at the same time as TICs, but there could be other instances when both decouple. For this reason they should be controlled by a global institution such as the IMF rather than by the governments of the U.S. or other developed economies.

Conclusions

To recap, the absence of systemic insurance is a very weak incentive mechanism during the boom and an economic tragedy during a financial crisis. A pragmatic anti-crisis system needs to complement regulatory constraints (healthy financial lifestyle guidelines) during the boom with an institutionalized systemic insurance arrangement for crises (a readily available financial defibrillator).

The standard LOLR should be complemented with three kinds of anti-crisis mechanisms:

- Self-insurance through higher (and cyclical) capital-adequacy ratios,
- Pre-paid/arranged contingent capital injections, and
- Pre-paid/arranged contingent asset and capital *insurance* injections.

In practice, there are good reasons to have some of each of these types of mechanisms. For small shocks, it is probably easiest to have banks self-insure. For large shocks, there is always a fundamental component, which is probably best addressed immediately with contingent capital. However, the large panic component of an SFA episode requires large amounts of guarantees, which would be highly impractical and costly to achieve through capital injections. For this component, a contingent-insurance policy is the appropriate response.

The same principles carry over to the international arena, especially for emerging market economies, where the sovereign itself is at risk of becoming embroiled in an SFA event. The IMF has an important role to play in facilitating contingent insurance arrangements for these economies.

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