

**The Known, the Unknown and the Unknowable in Financial Policy:
An Application to the Subprime Crisis**

by

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This essay is drawn upon a project conducted by the Wharton Financial Institutions Center focused on the known, the unknown and the unknowable in financial risk management.¹ The “known” (K) refers to a situation where we know the probability of a future event with sufficient certainty that we can specify all the parameters of the probability distribution with a high degree of confidence. This may occur because we have extremely powerful a priori knowledge – for example, a theory of what determines the event about which nearly all experts agree – or because we have sufficient data collected over a sufficient range of conditions that we can estimate the distribution with a high degree of confidence.

The “unknown” (u) refers to a situation in which we can specify an event but there is considerable uncertainty about when or whether it may occur because we have a variety of alternative theories without consensus among experts about which is correct or because we lack sufficient data or sufficiently powerful statistical techniques to estimate a distribution with even negligible levels of confidence. The “unknowable” (U) refers to events that we have not even identified because they have not happened or because we have no widely accepted theory that leads us to expect that they might happen. Much of the history of the development of risk management has been converting U to u to K – although it would be a mistake to infer that we have enjoyed continuous progress to K. The boundaries are not fixed and behavior is dynamic. We may find that K has become u and that an entirely new U has become important.

Prudential Regulation

¹ The project was generously supported by the Sloan Foundation. The results of the project will appear in a book under contract to Princeton University Press edited by Frank Diebold, Neil Doherty and Richard Herring. I am deeply indebted to my coeditors and the other scholars who participated in this project for increasing my understanding of these issues.

Financial policy becomes most relevant when a shock that was unknown or unknowable shifts the financial system from the domain of K into the domain of u. Financial policy-makers are charged with limiting the vulnerability of the financial system to such shocks and mitigating the consequences of such shocks once they occur. Financial policy-makers aim to promote monetary and financial stability, but virtually every aspect of financial policy-making is subject to substantial uncertainty. For example, how precisely should these objectives be defined? With regard to monetary policy, what amount of inflation is consistent with achieving stable, sustainable growth? For that matter, what measure of inflation is appropriate? Is it feasible, both technically and politically, for the monetary authorities to prevent asset bubbles during periods of low and stable inflation?²

With regard to prudential policy, the primary goal of financial stability must be to protect the functioning of the financial system in providing payments services and facilitating the efficient allocation of resources over time and across space. This may be threatened by a loss of confidence in key financial markets or institutions, as we have seen in the current subprime crisis. But how safe should financial institutions be? Should all failures be prevented? Would the consequent, necessary restrictions on risk-taking by financial institutions reduce the efficiency of financial intermediation and reduce investment? Would this deprive the economy of the dynamic benefits of creative destruction? Or would they shift risk-taking and innovation to unregulated entities where it could not be monitored, much less controlled? But, if financial institutions should not be required to be perfectly safe, what degree of safety should the prudential authorities try to achieve?

² Jacob Frenkel (Thornhill and Michaels, 2008, p. 4), former Governor of the Bank of Israel has expressed doubt about whether the monetary authorities know enough to deflate bubbles before they become dangerous. He asserts that the real choice is “Which system do you want: one in which the [monetary authority] pricks three bubbles out of five or five out of three bubbles? Because we know for sure that it will not be able to solve four out of four.”

What tools should be used to achieve these objectives? And what governance structure is most likely to motivate policy-makers to act in the public interest? Public-sector compensation contracts are much more highly constrained than compensation contracts for senior executives in financial services firms. And even where there has been complete freedom of contracting in private institutions we have learned that the outcome may be dysfunctional leading risk-takers to accept much more risk than shareholder principals or certainly the taxpayers, who are increasingly having to pay for the consequences of reckless risk-taking, would want. More fundamentally, when objectives are not crisply defined, it is difficult to establish and enforce accountability. Blame avoidance is, by default, the primary objective of most bureaucrats.

Although the prudential supervisory authorities have enormous, if ill-defined responsibility, they have relatively little power to constrain risk-taking by profitable institutions that they believe to have excessive exposures to uncertain shocks. In order to guard against the arbitrary use of regulatory and supervisory power, most countries subject disciplinary decisions by officials to some sort of judicial or administrative review. In order to discipline a bank, a supervisor must not only know that a bank is taking excessive risk, the supervisor must also be able to prove it to the satisfaction of the reviewing body – perhaps beyond a reasonable doubt. This leads to a natural tendency to delay disciplinary measures until much of the damage from excessive risk-taking has already been done. The US has tried to limit the scope for forbearance through Prompt Corrective Action measures contained in the FDICIA legislation by removing a substantial degree of supervisory discretion, but experience during the crisis with Indy Mac, an institution that was permitted to lose nearly \$9 billion before it was closed, indicates that even explicit rules may be insufficient to limit forbearance in times of crisis.

Review of supervisory actions also leads officials to react mainly to what has already happened (and is, therefore, objectively verifiable) rather than to act on the basis of expectations about what may happen (which are inherently disputable). Moreover, supervisors are seldom, if ever, held accountable for the misallocation of resources that occurs when an insolvent institution is permitted to continue operation.

In Charles Goodhart's (2009) refinement of the KuU framework in which K is partitioned into actual past data and expected values, supervisors generally react to past actual losses rather than mean expected losses, much less the unexpected losses, even when the governing probability distribution is believed to be known. Alan Greenspan, former Chairman of the Board of Governors of the Federal Reserve System, has expressed doubt about whether regulators know enough to act preemptively.³

Information issues present a fundamental challenge to supervisory authorities who must oversee the solvency of regulated financial institutions. Neither actual past data, not expected values can be relied upon in times of crisis when difficult supervisory decisions must be made. Bank accounting has traditionally been a mix of historical cost accounting, accrual accounting and mark-to-market accounting. This has sometimes undermined incentives for hedging risks by valuing a risky position and the offsetting hedge differently, thereby increasing the volatility of earnings, even though risk has been reduced. Most external observers doubt this mix of standards conveys a true and fair account of the current position of a financial institution. New financial accounting standards require firms to classify assets in three different categories: (1) assets that can be marked to market based on prices in active markets for identical instruments; (2) assets that are marked to matrix, based on observable market data for similar assets; and (3) assets that are marked to model, based on judgment regarding how the market would price such assets if they were traded in active markets. (This is sometimes referred to as marking to model, or more cynically, marking to myth.)

This third category presents significant difficulties for regulators, who face a severe asymmetric information problem vis-à-vis the regulated institution. How can the regulatory authorities comfortably rely on the estimated values of category three assets? Yet the question of the correct price for such assets

³ Alan Greenspan (2008, p. 9) has said, "Regulators, to be effective, have to be forward-looking to anticipate the next financial malfunction. This has not proved feasible. Regulators confronting real time uncertainty have rarely, if ever, been able to achieve the level of future clarity required to act preemptively. "

is critical for policies such as the Troubled Asset Relief Program (TARP) in the United States, asset guarantee programs deployed in the United States and bad bank proposals under consideration in many countries. If the price is set too low, banks will not willingly participate. Yet if the price is set too high, it can be the source of enormous concealed taxpayer subsidies. Professor Elizabeth Warren, the Chairman of the TARP Congressional oversight board has recently stated that the Treasury has overpaid \$78 billion in the \$254 billion it has spent in TARP transactions so far (Guha et al 2009).

Part of the problem is that financial theory offers only two kinds of tools for valuing assets that are not traded in active markets: (1) the present value of discounted cash flows, which works well in a world of K , where cash flows can be predicted and risks estimated; and (2) real option theory, which works well only if you can write a decision tree that captures most of the key uncertainties and decision points in the future and assign them plausible probabilities. When shocks occur, these fundamental prices move from the realm of K to u . Thus, during a crisis, fundamental values rest on relatively infirm foundations.

Even category 1 assets may become a problem in a crisis. Setting aside the issue of asset price bubbles, market values can be relied upon so long as assets are traded in broad, deep resilient markets. In such markets, however, assets tend to be priced on the basis of comparisons to their own past prices or to the prices of comparable assets. When a shock undermines confidence in these relative values and causes losses, traders tend to withdraw from markets until they regain confidence in their valuation models. Concerns may arise about counterparties who may have had excessive exposures to the shock and markets become thin. A flight to quality may occur and liquidity will be restored only when confidence in valuation models and counterparties is restored.

This dynamic has been very much in evidence during the current crisis and has destroyed much of the endogenous liquidity in the system. Two channels may be identified (Geneva Report, 2009). First is the tendency of counterparties to demand more collateral or larger “haircuts”. This reduces the

leverage that their counterparties can obtain by borrowing against their assets and they must either raise more capital (which is expensive and difficult to do during a crisis) or deleverage by selling assets. If several institutions are selling assets at the same time, prices will drop and the market will become less liquid. This is likely to lead counterparties to demand still more collateral and still larger haircuts until the market simply evaporates. The second channel is driven by the losses that occur in institutions that hold long positions in the assets that decline in value. They too will be forced to try to raise additional capital or to attempt to deleverage by selling once liquid assets into an increasingly illiquid market. Efforts by central banks to add liquidity to the system to revive these markets have had little effect so long as concerns persist regarding the solvency of key counterparties. Indeed, many US banks have chosen to hold excess reserves at the central bank rather than participate in interbank markets and the flight to quality has been so extreme on occasion that Treasury bill yields have turned negative.

Crisis Prevention

Most policymakers would agree with Don Kohn (2009), Vice Chairman of the Federal Reserve Board, that it is better to prevent such crises than to try to manage and mitigate them once they have occurred. Crisis prevention is an enormous burden, however, which falls mainly on the shoulders of the prudential authorities. Prudential regulation attempts to establish rules for the sound operation of financial institutions and critical elements of the financial infrastructure such as clearing and settlement arrangements. Ideally, prudential policymakers should be looking beyond the known to anticipate emerging sources of systemic vulnerability in order to calibrate appropriate prudential policies. In the dynamic world of modern finance this requires trying to understand how changing institutions, products, markets and trading strategies create vulnerabilities to new kinds of shocks and new channels of contagion such as the margin/haircut spiral and the loss spiral just described. But the known cannot be neglected. Institutions still fail in familiar ways by taking excessive concentrations of credit risk or by imprudently borrowing short and lending long as recent experience with Northern Rock and dozens of Structured Investment Vehicles have shown.

Prudential supervisory authorities confront a number of trade-offs that must be made on uncertain terms. How safe should banks be? Goodhart (2009) notes that it is relatively easy to establish a set of penalties that would make the banking system perfectly safe, but largely irrelevant in intermediating between savers and investors. Scott (2009) argues that a central feature of corporate governance is aligning the risk neutral preferences of well-diversified shareholders with risk-averse managers. This calculus is unlikely to take account of the systemic costs of an institution's failure and so the prudential authorities will presumably prefer a higher degree of safety, but how much higher?

How much competition is desirable? Competition is generally viewed as a positive feature of the financial system. It stimulates innovation and lowers the cost of financial services. But, it also reduces the charter values of incumbent banks and may lead to increased risk taking (Herring and Vankudre 1987).

Should financial innovation be encouraged? Securitization has facilitated diversification of risk reduced costs and liberated borrowers from dependence on particular lenders, but the subprime crisis has shown that the fragmentation of responsibility in the securitization process can also undermine credit standards and enable banks to achieve higher leverage by evading capital requirements. Derivatives had enabled financial institutions to partition and manage risks much more efficiently, but they can also be used to take enormous, highly leveraged risks. The growing sophistication of risk management techniques has enabled institutions to push out the boundaries of the known, but the very complexity of these techniques presents a challenge in the event of a crisis because it is very difficult for the authorities and potential investors and counterparties to comprehend the full range of positions and how they are managed. As Ralph Gomory (199X) warned in his essay on KuU, "[A]s the artifacts of science and engineering grow ever larger and more complex, they may themselves become unpredictable."

The supervisory authorities have a number of tools. These include licensing requirements, restrictions on certain kinds of activity believed to be excessively risky, liquidity requirements, capital

requirements and disclosure requirements. The authorities may also try to identify and encourage the widespread adoption of best practices in risk management, in effect urging the private sector to convert u into K.

By far the most ambitious effort at prudential regulation has been the development and of the Basel II standards for capital adequacy which try to emulate “economic capital”, which is used by the most sophisticated institutions to measure and aggregate risks. But the concept is firmly rooted in the world of K. It depends on being able to estimate downside tail risks at a high level of confidence and enables the financial institution to establish the amount of capital it needs to protect against earnings volatility at a prescribed level of confidence, to achieve a probability of default associated with the financial institution’s target debt rating.

Bank regulators began to take note of the evolving concept of economic capital when they expanded the original Basel Accord on Capital Adequacy to take account of market risk. The 1996 Market Risk Amendment provided an entirely new approach to setting capital requirements that relied on the way that leading banks were measuring and managing this risk. The original Accord set capital requirements roughly in line with expected losses. The concept of economic capital made clear that the role of capital should be to absorb unexpected losses, with reserves established to absorb expected losses. And so instead of requiring banks to allocate their positions to crude risk buckets or applying mechanical asset price haircuts to positions in an attempt to approximate risks, the regulatory authorities provided the opportunity for qualifying banks to rely on the supervised use of their internal models to determine their capital charges for exposure to market risk.

The internal models approach was expected to deliver several benefits. First, it would reduce or eliminate incentives for regulatory capital arbitrage because the capital charge would reflect the bank’s own estimate of risk. Second, it would reward diversification to the extent that a bank’s internal models captured correlations across risk positions. Third, it would deal more flexibly with financial innovations,

incorporating them in the regulatory framework as soon as they were incorporated in the bank's own risk management models. Fourth, it would provide banks with an incentive to improve their risk management processes and procedures in order to qualify for the internal models approach. And fifth, compliance costs would be reduced to the extent that the business was regulated in the same way that it was managed. By and large, the internal models approach for market risk has proven to be highly successful, even when it was severely tested by the extreme market disruption in 1997, 1998, and 2001. But they failed spectacularly during the subprime crisis failing to capture the default risk and associated liquidity risk in sub-prime related instruments.

Nonetheless, this early success, in combination with the progress made in modeling credit risk, led to calls from industry to revise the original Basel Accord to incorporate an internal models approach to capital regulation of credit risk. Basel II attempts to extend this new approach to setting capital requirements to credit risk and operational risk. Although the supervisory authorities were convinced that credit scoring models had significantly expanded the amount of credit risk that could be regarded as falling in the domain of the known, they were skeptical that internal models of credit risk were as reliable and verifiable as models of market risk. While some kinds of credit risk like retail lending have rich and granular data sets comparable to market risk, other kinds of credit risk are less amenable to empirical analysis because data are sparse relative to past credit cycles and distinctly non-granular. In the end, the regulators rejected the supervised use of internal models, but permitted qualifying banks to use their internal model inputs – estimates of probability of default, loss given default, exposure at default and duration of exposure -- as inputs in the regulatory model that would determine capital requirements. These Pillar 1 capital requirements recognized the analytical and empirical advances banks had made in expanding the extent to which credit risk can be regarded as known. Unfortunately the losses experienced by the institutions most heavily engaged in packaging and selling sub-prime related debt have cast considerable doubt on the reliability of such models. And the Standardized version of Basel II, which relies on ratings issued by Nationally Recognized Statistical Ratings Organizations hasn't fared

much better. In many cases, more than half the tranches of sub-prime related securities were subjected to triple notch downgrades a degree virtually unknown in corporate issues.

Because Basel II is an agreement negotiated among the members of the Basel Committee on Banking Supervision it reflects a number of political compromises that undermine its aspirations for technical precision. This is most evident in the definition of regulatory capital which is based on accounting values and includes a number of items that do not reflect an institution's capacity to bear unexpected loss. This undercuts the link to best practices in risk management and the logic of the approach.

Pillar 1 capital charges are intended to deal with known risks. Pillar 2, the supervisory review process, is intended to deal with unknown risks that can be identified, but are not sufficiently well-quantified to establish Pillar 1 capital charges. Presumably, as theoretical and empirical advances succeed in moving some of these risks into the domain of K, Pillar 1 capital charges will be established for them as well.

Benoit Mandelbrot and Nassim Taleb (2009) warn that there is much more u in K than is commonly acknowledged. The past is never a perfect predictor of the future. New factors may become important and relationships estimated in times of normal market functioning tend to break down at times of market stress. What we thought was mild randomness often proves to be wild randomness – or at least more often than it should if it were governed by a Gaussian distribution. In Will Roger's phrase, one of the key risks may be what we think we know "that just ain't so." Undue reliance on ratings by a wide variety of financial markets participants is a good example of this problem in the subprime crisis.

The principal tools of supervisory analysis in the domain of the unknown are stress testing and scenario analysis. Stress-testing requires economic judgment to formulate and calibrate scenarios that expose potential vulnerabilities. It requires a careful consideration of which relationships will continue to hold and which relationships will break down in time of stress. Mandelbrot and Taleb (2009) caution that

traditional stress testing, which relies on selecting a number of worst-case scenarios from past data, may be seriously misleading because it implicitly assumes that fluctuations of this magnitude would be the worst that should be expected. They note that crashes happen without antecedents. Before the crash of 1987, for example, stress testing would not have included a 22% drop in share prices within a single day and that just ten trading days account for 63% of the returns on the stock market over the past 50 years. In their view fractal methods should be used to extrapolate multiple projected scenarios that would enable risk managers and prudential supervisors to evaluate the robustness of a portfolio over an entire spectrum of extreme risks.

Goodhart (2009) emphasizes a different concern regarding stress testing and scenario analysis. What may matter most in a crisis are interactive effects that occur when many institutions attempt to adjust their portfolios in the same way at the same time. These are critical to understanding an institution's vulnerability in a crisis, but are omitted from most scenarios.

Stress-testing and the simulation of crises may be of value even if such crises never occur. The data necessary to simulate a crisis may prove useful in monitoring vulnerability and a careful consideration of the consequences of such a crisis may lead to changes in strategy and/or risk management. Crises seldom unfold according to the anticipated scenario, but strategies for responding to one kind of shock may prove useful when a different kind of shock occurs. For example, evacuation procedures that Morgan Stanley established after the bombing of the World Trade Center in 1993 enabled the firm to safeguard all of their employees in the much more severe terrorist attack on September 11, 2001.

The key element of regulatory discipline under Pillar 2, however, is the ability of the prudential supervisor to impose an additional capital charge on an institution if they are uncomfortable with the results of its stress tests. This places supervisors in the role of imposing discipline on an institution thought to be vulnerable to a shock of unknown probability. This will inevitably prove challenging for

supervisors that are usually much less well paid and less well informed than bank managers. The history of bank supervision does not provide much basis for optimism that they will succeed. Northern Rock provides a recent example of a notable failure to do so. In June 2007, just before the near collapse of the bank, the British Financial Services Authority (FSA) authorized Northern Rock to apply the Pillar I internal-ratings- based risk weights, which reduced its required regulatory capital by nearly 30% which Northern Rock, in turn, paid out in dividends to its shareholders the next month. The FSA made no attempt to offset the reduction in Pillar 1 capital charges with a Pillar 2 capital nor did it require Northern Rock to conduct a stress scenario that would have shown that it was fatally exposed to a liquidity shock.

How should prudential supervisors deal with U? As Scott (2009) notes, firms can limit their leverage and maintain enough capital and liquidity to absorb unknowable losses if they should occur. But how much slack is sufficient? By assumption that's unknowable, but almost all of the things that banks could do to cope with the unknowable are very costly and competitive pressures may make it very difficult to sustain such precautions. Should regulators therefore require that banks hold capital substantially in excess of the regulatory minimum as a safeguard against unknown and unknowable shocks? Increasing capital charges for risks that cannot be identified becomes a deadweight cost and may lead to the circumvention of regulation and riskier outcomes. As Sir Andrew Crockett observed during a panel discussion at the Wharton School, it is inherently difficult for policy-makers to strike the proper balance between the efficiency losses associated with excessively onerous preventative policies and the cost effectiveness of responding ex post to adverse events. For regulators as well as firms, the appropriate amount of financial slack is an unknown.

Pillar 3 of the Basel II approach is intended to enhance market discipline by improving disclosure. The authorities may collect and publish data that helps market participants understand the current state of the economy and financial markets and the condition of regulated financial institutions. But growing reliance on dynamic trading strategies to manage risk has made it increasingly difficult to provide a meaningful picture of risk exposures. Positions may change so rapidly that information is out-

of-date before it can be published. Moreover, the chief motive for market discipline – the fear of loss – is often undermined by the reluctance of the authorities to permit the creditors and counterparties of systemically important financial institutions to suffer loss. The extraordinary bailouts of Bear Stearns, Citi Group and Bank of America are recent cases in point. The exception, the bankruptcy of Lehman Brothers, proved so disruptive that members of the Group of 20 vowed that it should never happen again.

The ambitious new Basel II approach attempts to incorporate in capital regulation what is known about risk management, but it may generate several unintended consequences that could shift the financial system into the domain of the unknown. The attempt to force all major firms to adopt one version of “best practice” and especially the imposition of a regulatory model of credit risk may increase the likelihood of herding. Banks may be much more likely to attempt to move the same direction at the same time which can undermine the liquidity of markets and increase volatility.

To the extent that Basel II succeeds in making capital requirements more risk sensitive, it will make bank lending more pro-cyclical. This tendency is reinforced by the fact that banks increasingly hold marketable assets that must be fair valued. In a boom, measured risks are likely to decline and prices are likely to rise and so measured capital will rise just as required capital falls thus facilitating additional lending and accentuating the boom. In a recession, internal ratings will migrate downward, thus increasing required capital and asset prices will fall adding erosion of the bank’s capital position caused by credit losses erode the bank’s capital position thus exacerbating the constriction of the supply of loans. More risk-sensitive capital requirements interacting with a higher proportion of fair valued assets may inadvertently accentuate booms and busts. This is a clear case where micro-prudential and macro-prudential objectives may conflict. Basel II may make individual banks safer, but weaken the banking system. More fundamentally, Basel II fails to deal with systemic risk.

Crisis Management

Because it is so difficult for prudential supervisors to fulfill their responsibilities *ex ante*, policy-makers must often shift into crisis management mode to mitigate, *ex post*, the consequences of a shock. Kohn (2009) observes that in a financial crisis, the ratio of u and U will be especially large relative to K . Policy-makers must deal with unknowns such as the size of the disruption. How large will it be? How many firms will be involved? How long will it last? How likely is it to have serious spillover consequences for real economic activity?

Part of the problem is in anticipating the channels of contagion. Which firms have direct exposure to the shock? Which firms have indirect exposure because they are counterparties or creditors of the firms that sustain a direct impact or because they have similar exposures and could lose access to external financing? Which other firms might be placed in jeopardy because of the forced liquidation of assets in illiquid markets? Risk preferences and perceptions of risk are dynamic and so a flight to quality often occurs. Market participants may sell assets whose prices are already declining and avoid any counterparty that might be impaired.

Another part of the problem is that policy-makers must operate with incomplete knowledge about the current state of the economy and how their actions (or inaction) may affect economic activity. Moreover, monetary policy operates with long and variable lags and it is difficult to anticipate market responses to shocks. Yet the monetary authorities, Kohn argues, must immediately determine whether there is adequate liquidity in the financial system and whether monetary policy needs to be adjusted to counter the effects on the economy of a crisis-induced tightening of credit. During the subprime crisis policy-makers have learned that they have a much more limited ability to substitute central bank liquidity for endogenous liquidity created by the financial system than was once believed.

In a crisis, policy-makers must try to convert u into K as quickly as possible. This requires close cooperation across regulatory authorities within a country and, increasingly, across borders. Inevitably,

the primary source of information is major market participants. But conflicts of interest may corrupt flows of information. Information may be selectively communicated to serve the self-interest of market participants who might be the beneficiaries of crisis management policies. Does this argue for a direct role of the crisis manager in supervising systemically important institutions? The Fed insists that it does, but central banks lack such authority in many other countries (Herring and Carmassi (2007)) and the 2008 Treasury proposal for reforming the US financial system removes supervisory authority from the Fed while increasing its responsibility for crisis management. How best to organize prudential supervision and crisis management remains a significant unknown.

Policy-makers must also convey information in a crisis. Kohn (2009) raises the question of what is the appropriate response. They may urge firms to do what the policymakers believe they should do in their own self-interest, as happened in the LTCM crisis in 1998. But when is it appropriate to be reassuring? When might reassurance prove counterproductive?

Crisis management may inadvertently lead to larger future crises. If risk-takers are protected from the full negative consequences of their decisions, they may be likely to take greater risks in the future. This presents a difficult dilemma for crisis management. The costs of inaction are immediate and obvious. It's easy to imagine damaging outcomes and self-interested market participants will press for official support and can easily muster political support. Inaction in a crisis is likely to be subject to blame even when it is appropriate. This may contribute to an inherent tendency to oversupply public support. Once it has been provided, entrenched interests will lobby to keep it and new additional activity may depend on it. Moreover, moral hazard manifests itself slowly and may be difficult to relate to any one particular policy choice. The history of crises teaches us that it is very difficult for the authorities to exit from guarantees issued in a crisis once normal conditions are restored.

Ultimately, efficient resolution policy may be the best safeguard against moral hazard. But in most countries policy-makers lack the appropriate tools to resolve a large, complex financial institution

without jeopardizing the rest of the financial system (Herring 2004). And large complex financial institutions have adopted corporate structures that defy efficient resolution. The 16 large complex financial institutions identified by the International Monetary Fund have two-and-a half times as many majority-owned subsidiaries as the 16 largest non-financial corporations (Herring and Carmassi, 2009). Moreover, most of these firms are managed in an integrated fashion, along lines of business with minimal regard for national boundaries or the entities which must be taken through some sort of bankruptcy process in the event of failure. Thus, if the inevitable tendency to oversupply bailouts during crises is not to lead to greater systemic risk, the regulatory authorities will need to devise ways of resolving institutions without creating intolerable spillovers. The financial authorities could accomplish more by doing less, if they can credibly restore a role for market discipline in the system by devising a credible resolution plan for every systemically important institution.

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