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FINANCIAL SERVICES

Anatomy of the Credit Crisis:

The Role of Faulty
Risk Management Systems

Frank Milne



In this issue...

A clash of two different models of debt funding and risk management engendered the credit crisis. Review and reform are required.

THE STUDY IN BRIEF

THE AUTHOR OF THIS ISSUE

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The current credit market crisis reflects system-wide problems in the trading and hedging of credit risks. It started in the US mortgage market, but it has spread more generally into other credit markets, where perceived counter-party risks between financial institutions have risen, impairing their operation.

This is an international, systemic problem, which has become more serious as time has passed. Feedbacks between the financial and real sectors in the economy are acting as multiplier mechanisms, increasing the risk of a recession in Western economies.

This paper argues that the credit crisis was engendered by a clash of two different models of debt funding, and the risk management systems associated with them, that were operating within the banking and financial system. The first model argued that securitization in liquid credit markets was making obsolete, or at least reducing, traditional banking concerns about asymmetric information, uncertainty and illiquid markets. The second model argued that increasing securitization had merely obscured traditional banking problems, which remained important.

To the degree that the first model prevailed, risk managers made false assumptions about the liquidity and transparency of a new generation of credit instruments. The result was the creation of a shadow credit-banking system. I argue that the current crisis reflects not a liquidity problem, but a massive delevering of that shadow system as the credit market model underlying it has been shown to be inadequate. There has been what amounts to a massive run on an insolvent shadow banking system, whose reverberations are far from over.

The paper outlines possible policy reforms, as follows:

- Risk Management (RM) systems in all financial institutions should be thoroughly reviewed internally to take into account the lessons of the last few months.
- Regulators should review the Risk Management systems of the financial institutions under their supervision to check compliance with best practice. Indeed, what was once thought best practice may no longer be regarded as adequate.
- Central banks in cooperation with regulators (in Canada, the Bank of Canada and Office of the Superintendent of Financial Institutions) should thoroughly review the performance of their national systems, practices and policy.
- National central banks, regulators and international regulatory bodies (e.g., the Bank for International Settlements) should cooperate in testing and rectifying weaknesses in their Risk Management systems. Lessons should be drawn about how co-operation across national boundaries can be improved.

Even so, at this stage one should be cautious in adopting specific and major policy changes, either at the national or international level, pending further analysis of what has been a complex systemic failure.

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INDEPENDENT • REASONED • RELEVANT

The recent international debt crisis began in the US in the second half of 2007 and quickly spread to Germany, the UK, Canada and Australia, with effects in other countries too.

Notwithstanding widespread media commentary, its roots were not entirely clear at the time, nor were its remedies. In subsequent months, the stresses on the credit system have had a serious impact on the US housing market, inter-bank markets have contracted, and a run on a UK bank created concerns for depositors and public embarrassment for the UK Financial Services Authority and the Bank of England.

Over time, as the credit contraction has spread and interacted with the real economy in the US, fears of a US and possibly an international recession have risen. A few researchers, bankers and regulators¹ foresaw dangers in the excessive use of credit and in new methods of debt funding, and had the basic elements of a valid critique in place. This critique is even now not complete, however. Its gaps are important, especially when it comes to proposing remedies, so we must be cautious about rushing into regulatory reforms. Policies that promise a short-run quick fix can, if they are based on incomplete analysis, merely create deeper and more serious problems in the longer run.

The credit crisis arose from a clash between two different models of debt funding at work in the banking and financial system. Ideally, a super model that incorporates both approaches as

extreme cases would resolve this clash, but no such model exists. This is not some arcane observation; bridging the gulf between the two models is crucial to the design and implementation of new methods of trading and hedging risks, particularly credit risks.

The first model argued that securitization in liquid credit markets was making obsolete, or at least reducing, traditional banking concerns² about asymmetric information, uncertainty³ and illiquid markets. This securitization model assumed the existence of competitive markets in contingent claims. It allowed for risk – possibly different attitudes to risk by different agents – but assumed that all agents saw the same information. This postulate was fundamental to its approach to the modeling of market processes and the pricing and hedging of credit derivatives and other related products. The model also assumed that quantifiable risks can be traded to hedge other risks, and that differences in attitudes to risk provide additional incentives to hedge. It takes for granted that markets are efficient and quick in discovering and processing information.

The second type of model at work, the traditional banking model, argued that traditional banking concerns were still an important part of the financial system and that increasing securitization had merely obscured them, making them snares for the unwary. While US house prices were increasing and default rates on mortgages were low, the securitization model appeared to be working well. But when they began to fall, its weaknesses became increasingly apparent, and a collapse in confidence in a major segment of the US credit market ensued.

I am indebted to David Laidler and Finn Poschmann for suggesting and providing detailed comments on earlier versions of this paper. I am also greatly indebted to John Crean for discussions on these issues over many years and his detailed comments on earlier drafts. I have benefited from comments from the participants at a C.D. Howe Institute conference and from comments by Douglas Gale, Prasanna Gai, James Thompson and anonymous referees.

- 1 For example, the paper by Gorton and Souleles (2006) presented in 2004 at an NBER conference, proposed a model that showed the root of a possible breakdown in Special Purpose Vehicles. The discussion of the paper is illuminating. We will discuss that research and related research below. The recent Senior Supervisors Group (2008) report observes that some financial institutions were taking precautions in the first half of 2007 to avoid, or at least reduce, losses from tightening credit. Another example is the number of statements by central bankers over the 2005–2007 period, worrying about loose mortgage lending in the US and other countries. For example, see Gramlich (2007) for a summary discussion.
- 2 See Freixas and Rochet (2008) and Gorton and Winton (2003) for thorough reviews of banking theory and policy.
- 3 Risk assumes that people can agree on the probability over future events. Uncertainty assumes that people can differ subjectively over event probabilities, or can disagree on which events are feasible, or that today some future events may not be envisioned.

In short, the securitization model based on the assumptions of liquidity and transparency, which prompted the funding of long-term, illiquid housing assets with short-term borrowing, suffered the equivalent of a classic bank run as short-term lenders withdrew. This left financial institutions that had relied on it with the problem of funding long-term, illiquid loans. (Northern Rock in the UK was an extreme example where depositors lined up in the streets to withdraw.) This run impacted all financial institutions that had relied on the securitization model, from banks and investment dealers to hedge funds and pension funds.

Each view had adherents, who provided institutional and empirical analysis, and their conflicting ideas met inside the risk management departments of financial institutions (FIs) and also – perhaps especially – inside regulatory bodies, but these ideas proved hard to integrate within large, complex risk management (RM) systems. Some efforts in this regard amounted to attempts to incorporate banking realities as adjustments or modifications to versions of the securitization model embedded in RM systems. To compensate for the incompleteness and deficiencies of their models, risk managers were then required to exercise careful judgment based on experience to understand the models, and to continually question their parameter estimates.

Financial regulators face a two-part process: first they have to check the integrity of FI risk management systems; and secondly, perform the very difficult task of evaluating and acting to eliminate or mitigate systemic risks⁴ that can arise from contagion between various financial institutions. Given the increased complexity of FI investment activities, both tasks have become increasingly challenging.

To understand these problems further, and to evaluate possible reactions to them, one must understand both the theoretical and practical elements that underlie RM systems based on the

securitization model, and the evolution of traditional ideas about banking theory and practice. Each area has changed dramatically in the last three decades, and the current credit crisis is an unfortunate consequence of this rapid change. There has been rapid theoretical and empirical development in the area of trading and hedging derivatives and credit instruments, which has been integrated into the trading and complimentary RM systems within financial institutions. In turn, these innovations have impacted on organizational structures and created demands for new types of professional skills. Traditional risk managers have had to adapt to major changes in the mathematical models and new computer systems available to analyze very large data sets. They have also had to adapt to the introduction of new financial products with their associated risk, hedging and legal complexities, and new regulatory requirements based on evolving models of RM systems. Indeed, modern banking regulation relies heavily on regulators monitoring the RM systems in FIs and basing capital requirements on their output. This process can lead to FIs “gaming,” or acting strategically, to evade or modify the impact of the regulatory system. As we will see, such gaming is an important element that complicates the current credit crisis.

In this paper, I will provide a brief sketch the generic securitization model as it has been applied to the RM systems of many financial institutions, showing how it relies on certain specific and fundamental ideas in security pricing, credit analysis, derivative pricing and hedging.

I will then sketch the standard difficulties encountered by any FI attempting to implement these theoretical models in an RM system, difficulties that are well known in the RM literature and practice. These models rely on the assumption that liquid markets⁵ exist where financial instruments are priced and may be hedged. This assumption was introduced so as to

4 Systemic risk is the risk that a default at one FI will cause, through interbank exposures, another FI to default, thus creating a potential chain of defaulting FIs.

5 A liquid market is one where traders are price takers, and cannot move prices by trading. Also transaction costs and bid-ask spreads are assumed small enough to be ignored.

mimic already existing theory and practice in equity markets, and underlying it was the implicit – and false – idea that the very process of securitization would lead to greater liquidity and transparency. In reality, some newly developed markets were neither very liquid nor transparent, but this fact was masked in the US and UK by a housing boom and very low default rates.

Exuberance, naivety and the lure of large returns allowed many investors to overlook the limits of the models they were relying on, ignore the warning signals by central banks and others, and to skimp on their own due diligence. As the US housing market began to decline, the assumptions and empirical calibration of those models, and the construction of credit instruments and their packaging came into question. Lack of transparency became an increasing issue and liquidity in the relevant markets largely disappeared, as buyers refused to buy these instruments except at deep discounts. The real problem was not so much a lack of short-term liquidity, but very serious informational deficiencies compounded by a lack of transparency and trust. Many FIs began to worry about the solvency of, and their exposure to, other FIs.

The resulting crisis is having serious consequences for the US real economy, especially housing and consumer durable markets. Policy needs to address problems in US financial markets so as to minimize disruption and allow them to return to some normalcy. If it is not successful, then there are concerns that their problems will multiply and spread internationally into a major systemic credit crisis that will cause a serious international recession.

Some central banks and financial regulators have been trying to model so-called systemic risks that can arise when problems in one financial institution or sector are transmitted to others and/or across national borders. Drawing on recent models of financial crises, central banks and

regulators have constructed a sequence of increasingly sophisticated models of banking systems where one can analyze financial shocks originating in a single bank, and then track possible contagion. This approach can be applied to and supplemented by real-time “games” where risk managers and regulators explore scenarios of possible crises. These games are new and often rudimentary, but can they be very important in warning of the possible sources and scale of previously unperceived risks.⁶

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In what follows, I shall concentrate first on recent experience in the US, UK and Europe, whose markets dominate the international financial system, but I shall conclude with some comments on the Canadian situation. The Canadian financial system, rather like Australia’s, is a relatively small player, unlikely to be a major source of international disturbances, but bound to be affected by events in the larger system. Some issues, such as Canada’s difficulties with asset-backed commercial paper (ABCP), are clearly symptoms of larger systemic problems. To focus narrowly on the local workout of those problems without paying attention to their international origins would be to miss some very serious and fundamental lessons.

Finally, I shall attempt to derive some policy conclusions, albeit rather general and tentative ones, and discuss some of the issues that require further analysis and resolution before those conclusions can be made more specific.

Financial Institution Trading Strategies: The Underlying Theory

The securitization model that FIs use in their Risk Management systems is based upon traditional asset portfolio theory. This theory assumes that assets are traded in competitive, perfectly liquid markets, and shows that holding diversified portfolios reduces risks. Some risks are undiver-

⁶ For an example of a complex game that integrated financial, strategic and foreign policy aspects in the US, see Kubarych (2001). The Bank of England (2007) reports a summary of a basic banking game checking for systemic risks.

sifiable (such those that arise from broad market movements across asset classes) but others can be eliminated with a large, carefully constructed portfolio taking into account the degree of correlation across asset returns.

This basic model can be extended, with appropriate modifications, to deal with government bonds of different maturities. Credit risks make their appearance when assets in the portfolio are sold short, making it possible that there will be counterparty risk in addition to the usual price or market risk. The FI must take into account risk that parties owing it money cannot pay the amounts contracted. RM systems attempt to deal with counterparty risks, but opacity and systemic risks can make this a very difficult exercise, particularly in times of financial turbulence.

Derivatives can be issued and hedged by using a portfolio of underlying securities (stocks, bonds, traded indices, etc.), this process being modeled in terms of a so-called factor model, where the risky factors, or components, are treated as items in a large portfolio. (Again counterparty risks can be important as hedging involves exposures to other FIs.) Because derivatives require hedging of underlying risks, the FI must continually check its portfolio and trade to keep control of those risks. Again it must be stressed that the models used in making all relevant decisions here assume perfectly liquid markets and transparency in contractual obligations.

A deposit-taking FI might extend the basic model to deal with deposits and loans. This modification is non-trivial, because assessing the credit risks requires careful empirical and theoretical analysis, lender experience from historical episodes and knowledge of subtle legalities. Traditionally, credit was granted and managed by banks, which managed the credit risks by requiring collateral and by careful selection and screening of borrowers. This, in

turn, required ongoing management of credit relationships between banks and borrowers. Funds were supplied largely by depositors, though the bank would hold an equity cushion. More recently, credit relations have come to involve the workings of a financial market system where original loans are often packaged, securitized and placed into legal trust-like entities. The suppliers of funds to these entities are other FIs (a diverse group of hedge funds, banks, pension funds, etc.) who buy tranches of securities with risk characteristics designed to mimic corporate debt's credit characteristics.

Credit instruments created in this way can be traded; as can derivatives written on them.⁷ As we will see below, the models used to inform the trading and hedging of these credit securities, not to mention their pricing, use the same frictionless, liquid market framework as the portfolio and stock option models described above. Such models are always an approximation of reality, and though they work reasonably well in liquid markets, they perform very badly in illiquid ones. Furthermore, the very same model provides the foundation of many Risk Management models at financial institutions.

Conversely, traditional banking models (and their more recent mathematical descendents) assume that credit markets are prone to illiquidity, lack of transparency, and can be open to bank runs and financial disruptions. This family of banking theories was always based on the idea that information is inherently asymmetric, where lenders have limited knowledge of the characteristics and likely behavior of borrowers in credit markets. It required the exercise of subtle judgment when borrowing in short-term, liquid markets (or using deposits that can be withdrawn quickly), and lending long-term in illiquid assets.

But the securitization model of credit trading assumed that these traditional banking problems were absent, or at least of small order, and that it would always be possible to trade credit instru-

⁷ There are two basic models that are used to model credit: one is a dynamic version of the factor model where credit is treated as just another risky factor to be hedged against and traded; the other approach is based on the Merton (1973) model, which models the firm's cash flow directly and derives credit risk on a corporate bond via an interpretation of the famous Black-Scholes-Merton model for pricing a call option. Credit Rating Agencies (CRAs) use these models as aids in rating credit. For complete discussions of both types of models and more recent variations, see Crouhy, Galai and Mark (2001) and Lando (2004).

ments in perfectly liquid markets. This model was thus fundamentally flawed in ignoring asymmetric information, and failing to allow for the possibility of market disruptions. The current credit crisis is the direct consequence of the failure of theoretical assumptions of liquid markets and symmetrical information when applied to credit markets.

The Evolution of Credit Risk Management and its Regulation

CREDIT RISK MANAGEMENT: A risk management system monitors and imposes limits on the positions of traders and lenders in the FI. It has multiple functions. Because in this section we are focusing on credit risk, we will at this stage only mention other risks (e.g., liquidity risks) where necessary.

Traditionally, systems designed to manage credit risk relied on a complicated combination of statistical analysis, experience, legal knowledge and judgment – especially the latter. Securitization in its purest form attempted to replace these older systems with a more structured, statistical system with standardized credit scoring, default rate and recovery rate models, etc. An effective RM system requires that this modern approach be tempered by the older and more tested system, and particularly its judgmental elements.

BANK REGULATION: The RM systems for banks are monitored by financial regulators. Regulators require FIs to set aside liquid funds, or capital. The calculations and models used to calculate required capital have evolved over a number of decades. The key role played by international banks in the financial systems of the world, and the dangers of international financial disruption, gave rise to the 1988 Basel Accord, subsequently known as Basel I, which introduced a regulatory framework focusing primarily on credit. It grouped credit risks, according to issuer, into five categories and assigned appropriate capital weights to compute a total capital requirement. Basel I was

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seen as being inadequate for a number of reasons: for example, astute banks could use the weighting scheme to avoid its regulatory intentions.

Subsequently, the 2004 Basel II Accord evolved to provide a more sophisticated scheme which relied on a “three pillars” concept: minimum capital requirements based on internal RM models; supervisory review; and market discipline. Minimum capital requirements rely largely on the predictions of the internal RM models of the banks to produce estimated

distributions of potential losses. The belief was that the Basel II rules would lead to a uniform set of international banking rules – a level playing field for banks. Because the Basel II regulations relied heavily on the banks’ internal RM systems, which in turn relied, to a greater or lesser extent, on the flawed liquid-market credit models, this suggests that

Basel II may be fundamentally flawed.

Traditionally, bank regulation has been predicated on the observation that banking has suffered periods of instability, bank failures and bank runs; and that these periods of financial instability can impose negative externalities on the general economy. Over the last century, as banking has become more complex, regulators have adapted their methods to use the information produced by RM systems.

The regulations inspired by the Basel I agreement were a first attempt in that direction, but since then there has been an increasingly sophisticated regulatory system imposed on banks and related intermediaries. These more recent regulations, in Basel II, have exploited bank RM systems to provide a structure whereby Value at Risk (VaR) calculations are used to compute, by simple rules of thumb, required bank capital. (VaR is the amount the FI estimates it will lose on average over a period of time, usually a day or week, 1% or 5% of the time, depending on the degree of precision.) This calculation is a by-product of the FI’s estimated distribution of returns computed from its RM system. The idea

is that the regulators are imposing capital requirements to help protect depositors and government deposit insurance schemes, and provide a regulatory auditing system to signal the solvency of the bank.

Problems in the Regulatory System

INCREASING COMPLEXITY: The current regulatory system has a number of well-recognized problems. First, banks have become increasingly complex in their organization and financial trading structures. This requires sophisticated RM systems that are necessarily imperfect as FIs grapple with large and complex trading positions, asset-return correlations across asset classes that can change rapidly in times of financial stress, unfamiliar derivative products, and related issues. (For example, it is well known that in times of financial crisis, the correlations between asset returns can change radically and go to one. This can destroy planned diversification in portfolios and hedges to reduce or eliminate risks, leading to large losses.) FIs use different systems that have evolved over time and their RM employees can be of variable quality, so that the estimated loss distributions can be open to model risk (the choice of illogical or inappropriate models), statistical risk and subtle errors. These problems can be exacerbated by staff turnover, and the introduction of unfamiliar new systems. Any user of the resulting estimated-return distribution who lacks experience in evaluating such systems can be misled or lulled into a false sense of security.

REGULATORY COMPETENCE: This leads to another problem. Discussion in the US literature (Stern and Feldman 2004, for example) has raised the question of whether government examiners and regulators are able to keep up with evolving markets. Appropriate skills are scarce, and some banks complain about regulators who do not understand their RM systems or market operations. Banks worry that regulators will misunderstand risks and curtail certain profitable trading strategies. In turn, regulators complain

about secretive bankers who, they say, may seek to mislead regulators and take on profitable, highly risky activities whose costs are involuntarily shared by the broader market. In the US FI industry, for example, profits rely heavily on specialized trading, pricing, hedging and RM skills and non-transparent activities. FIs are wary of letting this information leak to outsiders – including regulators. This mutual suspicion is reinforced by the conflicting incentive schemes in the management groups in the bank.

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PERVERSE AND CONFLICTING INCENTIVES: Senior management bonuses and stock options on the FI sell-side depend on profitability. Poorly designed trader and managerial incentive schemes can emphasize short-term profitable trading strategies at the

expense of longer-term risks. It is not difficult to come up with trading strategies where steady streams of positive earnings are balanced by large, occasional losses. For example, there is a strategy known as writing a “put” derivative, which requires the issuer to pay out an increasing amount once an underlying asset falls below a certain threshold. In return, the issuer obtains a premium for this contract. If the threshold is set low enough, the trader/manager can run this scheme for some time earning a steady stream of premiums, and handsome bonuses until the time comes when the underlying asset value falls sufficiently far that the “put” requires a large payout. Then the trader can depart, leaving the FIs stockholders or residual claimants with a large loss.

Similar problems arise with credit risks where credit managers are rewarded for generating loans and the FI does not check carefully on credit risks over credit cycles. The purported star loans officer, in a credit boom, can make large bonuses until the credit cycle turns and defaults mount: the loan officer makes the bonuses and the FI stockholders reap the credit losses. These are merely two examples in a long list of possible strategies that can endanger the long-run financial viability of an FI.

RM executives are concerned with generating the distribution of total returns for an FI, and the lower tail of returns in particular. Their incentives

are to avoid large losses and the penalties of failure. Far too often, traders and sell-side executives see the RM as an impediment to profitable strategies and large bonuses (“RM is a speed bump on the way to a bonus”⁸). These tricky incentives facing the diligent RM are compounded by the role of regulators who concentrate on FI losses: in good times regulators are seen by many FIs as an additional barrier to profits. But in the event of large losses, the RM can be a scapegoat for the FI and the regulator.

CONFLICTING INCENTIVES FOR REGULATORS: The regulators have similar incentive problems: during a boom they may be ignored by politicians and the media responding to the euphoria of the moment and treated as an irritant by successful FIs; but when the cycle turns and losses mount, they can be treated as a scapegoat, being blamed for not predicting the losses. Worse, when a serious problem arises in a large FI, regulators can be sidelined by public pressure and humiliated by a politically motivated bailout of the offending FI. These broader incentives can induce regulators to be too slack in a boom and too cautious in a downturn.

Problems with Risk Management Models

THE LIQUIDITY ASSUMPTION: Most RM models assume that markets are liquid so that valuation models using mark-to-market (current market) valuations can be used to calibrate and verify the models. Market illiquidity is an extremely serious issue in attempting to value assets and associated profits and losses. Liquidity problems are a symptom of deviations from the simple competitive market model. They can be due to small numbers of traders in a market, limited by the costs and expertise of trading specialized securities; or they can result from asymmetric information where the other side of the market is suspicious that the seller has superior information. Both causes imply strategic behavior by borrowers

and lenders, and the possibility that prices will respond to the size of trades. Recent developments in RM practice allow trading models to be adapted to simulate changing liquidity in a market.⁹

The ideas are simple adaptations of basic microeconomic theory. Assume that a security is not traded in a competitive market, but the bank faces a downward sloping demand function. When the bank does not trade, it observes the previously traded price; but when it buys, it drives up the price as a function of the trade. Selling, similarly, drives down the price. This model has obvious limitations: it requires estimates of the slope of the demand curve, which may be conditional on market conditions. Less liquid periods will have steeper price responses than more liquid markets. Furthermore, illiquid periods may be correlated across related markets, undercutting strategies based on arbitrage trades and hedging in related securities.

This simple model assumes a single period, whereas traders are well aware that in a more realistic situation they can split up the trades over time, dribbling them out so as to not create large price movements. In recent research, Brunnermeier and Pedersen (2005) quote several historical examples of this type of dynamic trading behavior. They show that in a multi-period, oligopoly theory of asset markets, traders who are forced to sell in an illiquid (non-competitive) market can be open to predation by other traders. The predators are able to exploit the stressed seller by driving down the price to a fire-sale value, and then profiting from the price rebound. This is a real possibility in illiquid markets where traders are wary of revealing their strategies or net positions to potential predators. As far as I know, such modifications have not been attempted in operational RM systems. But it is certain that various rules of thumb used in trading strategies are attempts to avoid these liquidity problems and predation. Some of these rules, and more complex analysis, may have been incorporated into

8 Personal communication from a risk manager.

9 See Jorion (2007), Ch.13 for a discussion.

propriety RM systems in the more sophisticated Wall St. institutions.

THE VALUATION CONUNDRUM: A further implication of modeling liquidity is that valuation of asset positions becomes much more difficult. Do we use the valuation of the asset at the bid or ask price? If the bid-ask spread is very wide, because valuations by the holder and potential buyers greatly differ, which valuations do we use? Do we value the asset with no trading by the seller, or after substantial selling to close out the position. Valuation models using mark-to-market rules assume competitive liquid markets as benchmarks. When this assumption is violated, the rules become much more problematic. Recently, FIs faced with illiquid markets have used mark-to-model valuations. These models usually assume that markets are liquid, and use past data. They have been criticized for using such techniques, but the alternative, mark-to-market valuations can imply fire-sale values and have dire consequences for FIs' asset valuations. There is no easy solution to this valuation problem.

RM systems must be cognizant of various constraints on trading strategies that are imposed by reporting or regulatory restrictions. Some of these constraints, when interacting with trading in illiquid markets, can have dangerous feedback effects where sales drive down prices. In turn, these asset losses trigger constraints that lead to further sales in a downward spiral that may lead to insolvency.

Two possible constraints that have these characteristics have been discussed in the theoretical literature. One is the imposition of increasing capital requirements as VaR calculations show increased expected losses due to asset value declines. Regulations require the FI to post more capital, and this requires either raising more equity, or undertaking more asset sales to obtain liquid funds. This drives down asset prices in the

illiquid market and increases losses, inducing another round of asset sales. As well, mark-to-market trades induced by accounting standards can trigger a selling cycle. As the FI tries to value illiquid assets to satisfy fair value accounting standards, this can induce further sales as the standards interact with the VaR capital requirement constraint. Banks and other FIs are complaining currently about these types of constraints and their impact.¹⁰

Regulators are well aware of the flaws in RM systems and the constraints under which they operate. As an additional source of information and discipline, regulators rely on market prices as signals of FI health and market discipline to control FI behavior. In a perfectly functioning system with symmetric information and competitive markets, there would be no need for regulation as all risks would be fully understood and priced in the market. Profits and losses stemming from different FI strategies and exposures would rapidly discipline banks. But in a more realistic setting, competent regulators may be able to add to the imperfect information available to markets by their oversight of the financial system. In turn, regulatory pronouncements will be noted by investors and incorporated into asset prices to reflect the improved information available to the market.¹¹

Limits to Reliance on Market Discipline

Finally, the market system is normally expected to discipline poorly performing or insolvent FIs. The role of the regulatory system is not to provide government subsidies for incompetence or undue risk-taking. In the US, there are some small bank failures almost every year; the losses are small and covered by depository insurance. US regulators regard these failures as a normal cost of a well-functioning banking system.¹² (The US banking system can be characterized as being a pyramid

10 See Jennifer Hughes and Gillian Tett. "An unforgiving eye: Bankers cry foul over fair value accounting." *Financial Times*, March 14, 2008.

11 For further discussions, see Stern and Feldman (2004), and Barth, Caprio and Levine (2006). These references provide a thorough discussion of current regulatory issues.

12 For a discussion of bank failures, deposit insurance and statistics on the number and losses of US bank failures over the period 1980–2002, see Kaufman (2004). Whether the number of failures and losses are "optimal" given the costs of running the deposit insurance system is another matter. See Kaufman (2004), Stern and Feldman (2004) and Barth, Caprio and Levine (2006).

with large numbers of small banks at the bottom and a small number of very large banks at the top. Countries like Canada and Australia are different in having banking dominated by a small number of large banks.)

A major problem occurs if the failing FI is large, and affects a significant fraction of a national or international financial system. Such a failure can create financial contagion through counter-party risk, or through asset fire sales driving down asset values, and inducing insolvencies for third parties. The fear is that a failure of a large bank, or banks, could precipitate a panic, leading to a credit crunch and a serious downturn in the real economy. Large banks are well aware of their strategic power, and may use the “too big to fail” argument to prevail on politicians and sensitive regulators to bail them out from a mess of their own creation. This is a very serious issue and lurks behind regulatory unease in the current crisis, and uncertainty and concern over various mechanisms used by central banks to lend to FIs. Serious financial commentators speculate whether central bank lending to FIs should be characterized as injections of liquidity, or as disguised bailouts to insolvent or nearly insolvent FIs.¹³ The distinction between insolvency and illiquidity can become increasingly blurred, an ambiguity that will be exploited by endangered FIs, worried financial regulators, central banks and panicking politicians.¹⁴

The recent demise of Bear Stearns is an example where a large FI was in trouble, and there was central bank intervention. Bear Stearns stock plummeted in response to serious concerns that its losses were making the firm insolvent. Given that Bear Stearns was a key FI in the credit market, and there were numerous other large FIs exposed to counter-party risk through dealing with Bear Stearns, the Federal Reserve engineered a takeover by J.P. Morgan. The details of the takeover are not entirely clear, but J.P. Morgan appears to have been subsidized by Federal Reserve loans. Bear Stearns’ shareholders

took large losses on the value of their shares and there were major changes to the management, size of the workforce, etc. for the firm.

A far more extreme scenario would be a major international financial crisis where a number of large international FIs became insolvent. We have seen minor versions of this type of scenario in the 1990s, with the Korean Crisis and the South-East Asian crisis. But the more extreme version would be the simultaneous or serial failure of a number of large FIs who had major international operations and/or exposures. This scenario is unprecedented since the Great Depression of the 1930s. Here the distinction between liquidity and insolvency would become even more difficult for increasing numbers of FIs as credit markets would become even more illiquid, making mark-to-market valuations largely meaningless. Valuations would require assumptions and fairly transparent models to gain acceptance by borrowers and lenders. Workouts would be extremely difficult and time consuming as they impacted many creditors across legal, national and regulatory boundaries. The experience gained in smaller workouts (e.g., Long Term Capital Management, the Korean Crisis) would be useful for regulators and central banks in a full-blown crisis. But the magnitude would be so much greater, the degree of coordination required so far greater that the limited resources of experienced people could well be overwhelmed.¹⁵

Addressing Systemic Risks

Having raised the specter of an extreme financial crisis, let me explore some background to analysis of these systemic risks. Various theories of financial crises have been explored in empirical research trying to detect the basic causes of past financial crises.¹⁶ Were the crises pure panics, were they precipitated by financial weaknesses due to

13 Gillian Tett. “Insight: Election drapes “bail-out” in a politically incorrect shade.” *Financial Times*, March 13, 2008.

14 For a forthright examination of these issues, see N. Roubini, “Step 9 of the Financial Meltdown: one or two large and systemically important broker dealers will go belly up.” *Global Economic Monitor*.

15 A discussion of policy options for dealing with this extreme scenario is not possible within the confines of the present paper.

16 For an excellent summary of empirical literature on financial crises in different countries, real impacts on their economies and lessons for the current crisis, see Reinhart and Rogoff (2008).

incompetence, changes in expectations, or real shocks that greatly reduced asset values? The latter cases can be thought of as rational responses to real losses. Panics may result as a consequence of real losses, and are rational in that depositors may have a run on deposits given that the bank is now insolvent.

The more troubling case is where a panic is generated by a lack of coordination by depositors when they all decide to withdraw at the same time, creating a bank run. The historical and empirical evidence is mixed, and suggests that panics are often precipitated by real losses and compounded by the subsequent panic. Thus, losses from insolvency, or near insolvency, are exacerbated by bank runs.¹⁷ Panics end when there is credible information about the insolvency of particular banks. The banks least likely to survive a financial panic are those that were close to insolvency before the panic struck. A panic typically begins with some real event that casts doubt on the solvency of banks. Which ones are insolvent may not be clear given the opacity of bank portfolios. Sound banks are the most likely to survive once credible information on their financial situation is made available.

LENDER OF LAST RESORT: A traditional instrument for dealing with liquidity crises is the Lender of Last Resort (LOLR) facility operated by central banks. The idea, which was discussed in the classic book by Bagehot (1873)¹⁸ is that the central bank, or its regulatory proxy, stands to lend on good collateral to a bank suffering a temporary lack of liquidity due to short-term shock, rumor, etc. Given that the LOLR judges the bank to be solvent, it lends to the bank at a rate sufficient to quell the short-term liquidity problem. Originally Bagehot was talking about the role of the Bank of England, although nominally a large private bank, its position in the British banking system

effectively gave it the attributes of a modern central bank. Subsequently, this role has been taken by central banks in many countries. Banking regulation is undertaken by the central bank in some countries and by a separate body, closely associated with the central bank, in others. In Canada, the Office of the Superintendent of Financial Institutions (OSFI) handles banking regulation. A complicating factor is that the credit market system has allowed the emergence of a “shadow banking” system¹⁹ where FIs that are not deposit-taking banks can borrow short through asset-backed paper markets, and lend long in illiquid assets. This system has grown rapidly and has been largely free of the regulatory and LOLR safety net of deposit-taking banks. Indeed, because of the non-standard nature of this system, recent intervention by the Federal Reserve required a rarely used power to aid an investment bank. Since then, the Federal Reserve has normalized this mechanism to provide liquidity support for investment banks.

Although the LOLR facility has received considerable discussion, its operation is fraught with imprecision. One only has to reflect on precise, workable definitions of solvency, good collateral, the appropriate interest rates charged, and so on, to see the pitfalls and judgment calls that are required. The lack of a precise theoretical, implementable structure and opacity in asset valuations in disrupted markets can make the LOLR a difficult policy instrument to implement with any precision.²⁰

MODELLING CONTAGION: One can theorize about private- or public-sector arrangements, or regulations, designed to insulate the system from contagion. Central banks and financial stability regulators have taken this idea seriously and some have been attempting to implement models with balance-sheet data that check for contagion by

17 DeBandt and Hartmann (2002) and Gorton and Winton (2003) summarize the empirical research.

18 See Goodhart (2002) and Laidler (2004) for interpretations and comments on the history and current relevance of Bagehot's ideas.

19 The “shadow banking system” is a popular name for the “conduits” and other legal entities run by banks. We will discuss them in more detail below.

20 See Kaufman (2002).

exploring an adverse shock to a bank's balance sheet, and its impact on other banks through counterparty exposures and liquidity effects driving down asset values.²¹ These exercises are promising, but they have gaps and do not exploit the detailed analysis embedded in bank RM models.

Although the banking theory literature provides an excellent framework for exploring traditional banking,²² it seems to miss much of the securitization activity of the last two decades.

There is an inconsistency between the liquid-market models that underpin the derivative and the stylized RM models, and the traditional banking models that assume some form of illiquid asset markets that might imply financial crises and contagion. This inconsistency lies at the centre of the current credit crisis, which has originated in the credit market "shadow banking" system. To understand it, we will need to discuss recent developments in credit markets, their structures and operation.

The Proliferation of Credit Instruments

For adherents of the securitization model, new credit market instruments and credit derivatives are merely recent additions to a long line of contingent claims that financial intermediaries use to make asset markets more complete, diversify risks and improve economic welfare. Some have even claimed that the days of the traditional bank were numbered, since banks were going to be replaced by liquid credit markets with broker/dealers.

Given that one accepts that there is a welfare gain from adding new asset markets, several hurdles remain to their successful implementation. These include serious incentive problems in defining the payoffs, asymmetric information

between borrowers and lenders, and the possibility of fraud. If these limitations have been addressed successfully with manageable costs, then securitization can be a welfare-improving innovation. If these issues are not resolved, the new market could fail, especially in adverse financial conditions.

SECURITIZED REAL ESTATE LOANS: Indeed, a recent disturbing example involved credit securities written on real estate loans and traded

in liquid markets in a benign regime with low default rates. But with the decline in real estate prices, to the consternation of traders, the credit security became illiquid as falling real estate values implied higher default rates. Traders suffered from increased uncertainty over the distribution of payoffs to these securities.

Experience over credit cycles, one would hope, would lead to the elimination of such complex, hard-to-value contracts. But that takes time and can create serious disruption, especially when the securities are widely used.

Certain conditions must be satisfied if a market is to be liquid. Issuers and traders must understand the basic risks underlying the asset returns and the potential for return manipulation by issuers. If this information is obscure, most investors will demand a discount to compensate for the uncertainty implicit in the contract. Furthermore, for the market to be liquid, the number and resources of traders who are well informed must be sufficient to make a market of sufficient depth to support trades. With few informed traders, uninformed traders will be unwilling to trade except at very large discounts. They will fear adverse selection, where informed traders will exploit their monopoly informational advantage. This is a classic "market for lemons" problem.

There is an inconsistency between the liquid-market models that underpin the derivative and the stylized RM models, and the traditional banking models...

21 The idea was first introduced by Elsinger, Lehar and Summer (2006). Upper (2007) provides a critical survey of these types of methods.

22 See Freixas and Rochet (2008) and Gorton and Winton (2003).

In a boom, an asset may appear to pass the test for market liquidity in that investors may believe that the risks are well understood. But as the market slows, and the value of the underlying asset begins to decline, the arguments indicated above begin to play a far more decisive role, and market liquidity can vanish. This seems to be the root of the problem in the crisis that occurred since the summer of 2007. There is evidence that some far-sighted investors were able to foresee this event and made profitable trades betting against the conventional wisdom, or at least reduced their exposure to losses.²³

RAPID GROWTH IN THE MARKET. With those caveats in mind, let us now consider the rapid evolution of the traded market for portfolios of credit instruments. The standard story, until the middle of 2007, was that there had been a rapid increase in consumer lending (mortgages, consumer loans, credit-card funding etc.) through the use of securitization. The basic idea appeared simple: standard bank loans were packaged into portfolios of loans to diversify risk and then the portfolio was sold to investors. The bank, or a related legal entity, was merely an intermediary, packaging loans so that investors could supply funds to borrowers in an economically efficient manner. The investors could have been pension funds, other banks around the world, hedge funds, insurance companies, etc. The portfolio was not sold as a whole, but was divided into tranches that attempted to mimic a company financial structure where there were low-risk bonds, middle-risk bonds and equity, which was the riskiest tranche. Credit rating agencies would rate the risk of each of these tranches using the same terminology used to rate other bonds, AAA, AA, BBB, etc.

This model looked like a transparent method for banks to diversify risks by packaging loans into

tranches with different rated risks for investors. This securitization purportedly created value and economic welfare gains. These gains flowed to borrowers who saw reduced lending rates, and to lenders who were able to access fixed-interest securities with higher yields over prime at moderate risk. Borrowers who normally would have been locked out of the older mortgage market were now securing loans. In the US, homeownership rates rose from 64 percent in 1994, to 68 percent in 2007, with minority and low-income families recording the greatest gains in percentage terms.²⁴ This subprime mortgage market was seen by many as an innovation that allowed higher default risks to be traded and permit marginal mortgage holders to own houses and share in the long-term rise in real estate prices.²⁵ This too-good-to-believe scenario fell apart in mid-2007 as US credit markets for subprime mortgage securities seized up amid credit downgrades. Credit spreads widened substantially, and home equity loans and mortgage refinancing declined rapidly, with serious falls in house prices, especially in parts of California and Florida.

For Canada, the crisis hit home in the summer and fall of 2007 when the asset-backed commercial paper (ABCP) issued by non-Canadian banks and other players froze – a total of about \$36 billion. It was alleged that bank liquidity agreements that supported the non-bank ABCP securities were more stringent than elsewhere, so that the banks would not supply liquidity to the frozen market. The subsequent workout has taken nearly a year to resolve and has required “innovative” legal rulings and interpretations.²⁶

The media reported that the major rating agencies would not rate these funds, and that a Canadian rating agency, DBRS, had rated the funds. There is ongoing discussion over the

23 See Senior Supervisors Group (2008). The *Financial Times* reported that at least one trader made a 1,000 percent return from shorting the housing bubble. (November 25th, 2007, "1000% hedge fund wins subprime bet").

24 Bernanke (2007).

25 See Gramlich (2007). Alan Greenspan was a prominent supporter of innovation.

26 See Burnett (2008) for a summary of the process.

credibility of these ratings.²⁷ The then Governor of the Bank of Canada, David Dodge, observed in a speech in Vancouver (September 2007), that market forces would place pressure on actors in the market to improve incentives, improve the credibility of credit ratings, and that there may be some role for tightening or modifying appropriate regulations. In particular, he mentioned that the Basel Committee may have to revisit their recommendations on capital requirements.

Digging Deeper: Risky Assumptions and Asset-Backed Securities:

Fortunately, for a deeper look into the structure and trading of asset-backed securities, there is a small but informative number of recent studies that provide background theory and observations on this segment of the credit market.

To understand the causes of the credit crisis, one must understand the role of conduits or Structured Investment Vehicles (SIVs).²⁸ Over the last decade, there has been very strong growth in US banks using stand-alone trusts, SIVs, or Special Purpose Vehicles (SPVs). The underlying idea is simple, but the details can be very messy. The basic idea is that the banks create trust structures, usually registered in tax havens for tax purposes, which bundle loans and then sell off tranches to investors. The trust has no residual claimant and is a legal entity with no employees or independent decision-making ability. It is a legal entity that is designed to be transparent and avoid bankruptcy. In principle, the distribution of returns in the portfolio of loans is fully paid out to the investors and there is no residual claimant to go bankrupt. This structure is designed to avoid bankruptcy costs and create a liquid market for

assets that have different degrees of risk. In a perfect world this would allow the benefits of market diversification for loans and credit risks.

One reason these structures were created and became prevalent relates to regulatory capital requirements. The argument goes that the banks claimed that regulatory capital requirements were too restrictive, and that the structures allowed banks, under the existing regulatory framework, to economize on capital by apparently reducing their risks, while generating revenue from originating and processing the loan packaging. (A more realistic assessment of the distribution of risks between the banks, lenders and borrowers will be discussed below.) Although regulators discussed potential problems with the structures, some commentators argued that the US regulators appeared to turn a blind eye to this activity.

A more subtle argument is that regulators observed that astute investors could see through the structure and attempted to evaluate the risks of the loan pool, and the various tranches. Assuming that the originating bank had superior information, the investors would be suspicious that banks were unloading their worst loans. Therefore the banks, if they were to avoid substantial price reductions on tranche sales, would be required to make credible commitments to minimize adverse selection in stuffing the SIV with poor loans. One possibility was for the bank to take the most risky tranche (equity) so that the first serious losses hit the bank. A second mechanism was to use Credit Rating Agencies (CRAs) to rate the pool and the tranches. As long as the CRAs were regarded as arm's length agents with credible rating mechanisms, investors would use this information, along with any other evidence, to assess the riskiness of the tranches.

27 "Toronto-based DBRS has come under fire for giving top ratings to non-bank ABCP despite the fact the issuers were subject to risky arrangements with their banks that left them vulnerable to a credit crunch. The banks refused to provide liquidity to the non-bank ABCP issuers in August, which would have allowed them to roll over the paper – short-term IOUs – into replacement paper when market demand evaporated. That prompted a group of big holders of the paper to freeze the market and attempt to restructure the short-term paper into long-term notes, under a plan known as the "Montreal Accord." Such a scenario had been long foretold by ratings agency Standard & Poors, which refused to rate non-bank ABCP in Canada. Already some holders of non-bank have written down the value of their holdings, while others are considering legal action." "DBRS Cuts Apsley Trust to Junk Status," *Financial Post*, November 7, 2007.

28 For discussions and further references based on the US experience, see Calomiris and Mason (2004), Gorton and Souleles (2006), Green and Wachter (2007), Mason and Rosner (2007), Calomiris (2007), Ashcraft and Schuermann (2007).

Given that many investors (e.g., pension funds) are restricted to accepting bonds above certain credit ratings, liquid markets for tranches can be very sensitive to rating downgrades.

Finally, historical evidence from credit-card securitization suggested that US banks had, in extremis, provided various forms of support to the SIVs and the tranche investors when there were unexpected downgrades. The banks had been careful to not make this a legal agreement, but provided implicit recourse through selling assets to the SPV at discounts, or buying assets from the SPV at a premium.²⁹ The reason for the implicit agreement is that the bank signals to the market that it stands behind the SPV and accepts residual risks, but that these risks are not formal and therefore not part of the calculation for regulatory capital that would be required for any legal agreement. Calomiris and Mason (2004) and Gorton and Souleles (2006) provide evidence from credit-card securitization that investors appeared to understand implicit recourse and priced the SPV assets to reflect the riskiness of the bank. Whether this argument remains credible under the present crisis is another matter. In some cases, banks have undertaken recourse and in other cases banks have abandoned the SIVs.

One issue that becomes apparent is that if this was a one-shot operation, the bank's promise of recourse is not credible – they could simply default and walk away, ignoring future consequences. But as Gorton and Souleles (2006) show, one can create a more realistic theory (a repeated game) where renegeing on one deal would lead to much larger price discounts in later deals. This reputational loss would be very significant for a bank. But this argument is sensitive to the level of losses and the future revenue stream. In some cases, an exogenous economic downturn could impact severely on the bank and provide incentives for a bank that is either insolvent or too close to insolvency to walk away from the implicit agreement. Of course, if the investors understood that implication, then it would be factored into the

tranche discount. Also the bank's equity holders should include possible recourse in their share valuations and the bank's RM should include recourse in their calculations.

One other agent should be aware of these activities: the regulators who provide support through deposit insurance or other support in an emergency. If the regulators do not take these costs into account, they may be subsidizing the banks by effectively charging too low a premium. Calomiris and Mason (2004) indicate that, in their US data, banks appeared to have adequate capital to support recourse and that regulatory arbitrage seemed to be of a smaller order of importance. But they added that in the case of substantial losses, these subsidies could become significant and lead to abuses. The recent turmoil in the US ABCP market has stress-tested this model. Where did it appear to fail?

THE US ABCP MARKET: Substantial quantities of subprime mortgages were written by US mortgage brokers and processed by major US banks. The claim was that econometric modelers could provide detailed analysis and precise parameter estimation of default characteristics using very large databases. This provided the CRAs with good input to rate tranches, and in turn allowed investors accurate estimates of default risks. If this was true, then any deterioration in housing market prices in any region would have shown up in predicted default rates, and tranche yield increases. Investors on the supply side would have shuffled their portfolios in response to yield signals.

But as Green and Wachter (2007) argue, the models were calibrated to a period of increasing house prices (1997 to 2005) and low default rates. Therefore, the models were not calibrated for regional falls in house prices where there were correlated defaults. With rising real estate prices, householders had no incentive to default, but could sell their house and preserve their equity. But as the real estate market slowed, limited quality control in the unregulated mortgage broker industry led to deteriorating underwriting

29 See Calomiris and Mason (2004).

standards, poorly designed or complex mortgage contracts that confused borrowers and provided incentives to default, and alleged collusion between brokers and risky borrowers. Clearly, the incentive mechanisms were breaking down.

Further problems occurred in trying to price and hedge Collateralized Debt Obligations³⁰ (CDOs) across tranches. As Duffie (2007) relates, these models are not reliable in providing default correlations and this fed into poorly calibrated hedging and pricing models for CDOs. He provides an example of the rating downgrade of General Motors, where models that predicted prices and hedges for equity tranche positions faced large losses when tranche prices did not respond as the model predicted. The losses, based on sophisticated models, were reinforced by liquidity losses due to the downgrade forcing an exit of certain classes of investors.

It was clear that the modeling difficulties were plaguing the rating agencies. When, finally in the summer of 2007 they announced a number of downgrades, the US crisis was precipitated. Many investors holding high-quality tranches that were subsequently downgraded were forced to exit the market because of regulatory constraints (e.g., pension funds that are prohibited from holding risky debt); other less well-informed investors panicked and assumed that they had been accepting poor quality paper masquerading as prime. Liquidity in many SPV tranches disappeared and many banks and hedge funds found that model-based hedges and pricing were not responding as predicted: losses mounted.

Not only was the crisis motivated by a decline in credit quality in mortgage-backed securities, but it was also compounded by the traditional banking problem of liquidity disappearing as investors withdrew from investing in illiquid and non-transparent investments. Because the SPVs were outside the deposit insurance framework, the central banks were forced into providing open market operations to investment banks. But the

effectiveness of this tool is limited by the reality that these firms, when trading and hedging risks, used a business model that included malfunctioning financial models.

Current Systemic Risks, Asset Losses and the Real Economy

Recent news from the US reveals tightening mortgage costs and conditions, a dramatic slowing of mortgage origination, falling house prices and slumping house construction. Broker/dealers have revealed large losses and have been dramatically curtailing their activity in mortgage markets. The collapse of a major market supplying funds for mortgages, and especially subprime mortgages, has led to a very serious tightening in mortgage conditions. All credit markets have not been equally affected: traditional and more transparent loan markets are still functioning, albeit at higher spreads than before the summer.

As the crisis has continued, and its systemic nature has become apparent, calculations of credit and asset losses in the US have mounted. Plausible scenarios place losses from mortgages, consumer credit, commercial real estate loans, etc., in the order of \$1 trillion (US); and less likely, but still plausible scenarios estimate losses of up to \$3 trillion (US).³¹

There is a disturbing degree of uncertainty about the true positions of the major FIs and the extent of the losses they will reveal as the SIV and other credit markets are unwound. Estimated costs of credit losses from various major FIs are uncertain since the market for SIV paper has disappeared. Currently, valuations based on models of liquid markets, calibrated to liquid market data are nonsense at two levels: first, theoretically they are largely irrelevant as they assume liquid markets when there is an illiquid market (the model is inappropriate); and second, the inappropriate model is calibrated to stale data. US FIs are faced with valuing these assets using

30 This is a generic term for a portfolio of risky bonds or loans. The claims to the portfolio are split into tranches, or segments, with different risks related to default in the portfolio, starting from the most risky down to the least risky. This structure is meant to mimic the structure of debt obligations in a firm with equity, risky debt and safe collateralized debt. Rating agencies used their bond rating methods to rate these tranches.

31 See Martin Wolf, "Going, Going, Gone: a rising auction of scary scenarios," *Financial Times*, March 14, 2008.

highly suspect models, or mark-to-market valuations in highly illiquid markets. Given the uncertainty of the future cash flows from the mortgages, compounded by the complex tranche structure, buyers of the paper are faced with the problem of highly complex bankruptcy workouts with many players scattered geographically under different regulatory and legal systems. In the background, the slowing US housing market (and the UK and some European housing markets) will compound the problem. Cash flows will require constant recalculation as the market deteriorates, increasing default rates, lowering recovery rates and continually forcing downgrading in tranche ratings. The losses will mount and the recovery rates decline substantially on even nominally highly rated instruments. Valuing such paper, even for experts, will be extremely difficult, leading to higher discounts for valuation uncertainty.

The interbank market has seen a significant contraction as banks worry about counterparty risk (Bank of England, 2007, 9). Through 2007, serious systemic risk and contagion did not look likely in the US, UK and Europe; but as of the time of writing, the risks of contagion have risen substantially. The system is stressed far more than many thought likely in the recent past. Given the possibility of other adverse revaluations (e.g., serious commercial property value declines, rising unemployment, geopolitical risks, major currency movements, etc.) current stresses on FI balance sheets increase the likelihood of major systemic risk.

Lessons from the US Experience

First, there is a general consensus among many commentators that the large US firms that created the SIVs should report their estimated losses. This will be difficult and take some time to work out since the losses will depend on subtle issues of counterparty risks, liquidity and pricing issues, the trend in underlying asset prices and the impact of increasing capital costs as Basel requirements begin to bite. The FIs will suffer asset losses due to direct exposures, reputational losses and legal risks because the SIVs were constructed as a regulatory arbitrage strategy. Many firms profited from fees

for years in a market that they purported to understand well. If they had done due diligence, then they should have been aware through stress-testing and back-testing that their models exposed them to recourse risk (i.e., the risk that they would be liable to support a troubled SIV) and the possibility of reputational and legal risk if they did not support the SIV.

The US credit crisis had been quietly building for some time as the real estate market in key regions of the US began to fall. Warnings by the Federal Reserve Board and regulators about sloppy lending practices, low-documentation loans, etc., were common knowledge in the financial press. The consequences should not have been viewed as a zero probability, or impossible event, for competent risk managers. Market discipline is a key incentive mechanism that regulators should be loath to distort because it forces FIs to carefully consider the risks and uncertainties of their exposures.

Second, the rating agencies will be under strict scrutiny on the appropriateness of their rating methods, and possible conflicts of interest in their role in rating tranches. No doubt legal and regulatory challenges will test their business models and future methods for rating future asset-backed securities traded in markets.

Third, having absorbed the losses, and possible restructuring, the FIs must consider what to salvage from the asset-backed paper market and the associated credit derivative markets. A consensus seems to be that parts of these markets are still functioning to some extent, where the financial structures and assets are simple enough to allow reasonably accurate analysis of cash flows without relying on obscure models. This seems to imply that, when the cycle finally bottoms, more transparent structures, the sophistication of the market, contractual inventiveness, and costs of implementation and depth of market provided by sophisticated investors will determine future products and market structure. The market will determine, in the longer run, which structures will survive.

Fourth, and a difficult issue, are workouts of SIVs and insolvent FIs and the revelation of capital

losses. The workouts will be a painful lesson in the complexity and direct and indirect costs of multilateral workouts for such opaque structures. If nothing else, this exercise should provide RMs with estimates to use in future stress tests of the costs of complex structures. But on a more serious level, regulators may well be faced with calls to judge the potential insolvency of major institutions. This will require careful assessment of potential counterparty risks that could be contagious.

Short-Term Policy Issues

Regulators should be watching interbank rates and credit premiums for signs of informational leakages signaling that a particular FI is judged to have increased risk. If a large FI is in trouble, the regulators should have contingency plans to deal with a speedy resolution to stem possible financial contagion. These contingent plans might be seriously complicated by systemic risks and the degree of severity of a major recession impacting the underlying income and wealth of borrowers and lenders. There is a possibility of a major hard landing that has long-run implications for economic activity and wealth, so any calculations or contingent strategies will require continual revision.

US regulators and their political masters should be aware of the lessons from the savings and loan mess in the US in the 1980s,³² and other examples where insolvent FIs were allowed to gamble for resurrection long after they were judged to be insolvent. There should be careful contingent plans to deal with political “too big to fail” ploys by major FIs looking for implicit publicly funded bailouts.³³

If a major FI fails, there are a number of issues that must be faced. First, the regulator (or

regulators, where regulatory or national jurisdictions overlap) must judge whether this is a liquidity problem or one of insolvency. Second, the regulator must judge whether this will require a private settlement, with a possible private takeover of the firm with regulatory oversight. The takeover offer is usually made by a national or international FI. (Good examples are the takeovers of Countrywide Financial and Bear Stearns.) Any offer, or competing offers, should be examined carefully by regulators, who should have had contingency plans to avoid panic fire sales. They also should have explored, especially in countries like Australia and Canada where banking is dominated by a few large FIs, the impact on long-run competition policy in the banking sector.

Domestic mergers that were politically and economically unjustified in normal times may appear tempting as quick fixes for regulators and politicians in a crisis. Regulators should be searching across other bidders including large, foreign FIs.³⁴ Third, in the situation where there are possibilities of systemic risks and contagion, the regulator (and central bank) should consider the role of public short-term liquidity support, if there is insufficient private liquidity because of financial disruption. Any case for long-term public funding that will serve as a subsidy to the stockholders and management of an insolvent FI should be resisted strenuously. There should be no subsidy for inefficiency: the inefficient should leave the industry.

In the extreme case of a major systemic financial crisis, policy options would be enlarged to take into account potential large financial and economic costs, as well as social disruption to the community. I do not wish to speculate, or explore possible courses of action for this extreme scenario here.

Domestic mergers that were politically and economically unjustified in normal times may appear tempting as quick fixes for regulators and politicians in a crisis.

32 See Kane (1989).

33 See Stern and Feldman (2004). For a discussion of the political complexities involved, in an election year, see Gillian Tett, “Election drapes ‘bail-out’ in a politically incorrect shade,” *Financial Times*, March 13, 2008.

34 This is a complicated topic that I will not explore here. Any such decision should take into account the degree of domestic competition, international diversification and prudential regulatory issues.

As the crisis has progressed, there has been increasing evidence of a macroeconomic downturn in the US, and to some extent in the UK and parts of Europe. The first reaction by the central banks has been to relax monetary policy and credit, increase liquidity in an attempt to free up credit markets, and stimulate investment and consumption expenditure. But recently, some US economists have begun to worry that this policy response will not be sufficient to ward off a serious recession. Major central banks have injected increasing amounts of liquidity into the banking sector in response to credit difficulties, but the impact on credit, mirrored in the value of FI stocks, has often been transitory.

The argument of this paper is that this crisis is not a liquidity problem, but a massive de-levering of the shadow, credit-banking system as the credit-market model failed. This can be characterized as a massive bank run on an insolvent shadow banking system. Conventional liquidity injections, or lending to FIs, are merely palliative responses to a deep-seated insolvency problem in a malfunctioning shadow banking model (i.e., the SIVs and other off-balance sheet “vehicles”). That model assumed securitization could avoid conventional banking problems of lack of transparency; and assumed that statistical models could be calibrated to give sufficiently accurate predictions of default to allow complex credit tranches and derivatives to be traded in liquid markets.

Long-Term Policy Issues

Beginning with the internal operations of FIs, there are two major issues that must be addressed. The first is the development of appropriate credit-risk management models that are more robust than the models used currently. Trading models, and their RM counterparts, will require liquidity risks to be embedded in the pricing and hedging models. These models should be robust enough to allow for changing liquidity and attempt to model and implement leading indicators of variations in

illiquidity. The frictionless trading models that underlay the SIV and credit trading markets did not take into account the real, but latent (until recently) problems related to traditional banking concerns of illiquidity, asymmetric information, etc. This modeling strategy and its implementation has had disastrous consequences.

There have been, in too many cases, indications of incompetent or slack RM practices. The root of these failures may be multiple: insufficient numbers of well-trained RMs, inappropriately trained RMs, inappropriate models, poor application of data to the calibration of models, etc. There should be a thorough, professional analysis by the FIs of their RM systems and potential weaknesses. As all FIs will be undertaking such an exercise, clearly there is

FIs should explore the compensation schemes of different sections of the firm to test for perverse incentives...

a major role for serious research and upgrading of training in RM practices in universities and within FIs. Human Resource departments in major FIs will require professional expertise in hiring appropriately trained personnel, especially at the junior levels. Major FIs require

increasing numbers of staff trained in appropriate, advanced quantitative techniques, modern financial economics and banking and modern RM methods. In far too many cases, it has been my experience that RM modelers in trading and related areas have serious deficiencies in one or more of these skills. I am not suggesting that these skills are sufficient, but they will be necessary, in conjunction with experience and judgment, for competent RMs and senior executives in FIs in the future.

FIs should explore the compensation schemes of different sections of the firm to test for perverse incentives that reward short-term returns and inadequately punish long-term losses. In addition, the FIs may wish to explore different models of promotion and rotation that expose executives to serious training in sales, trading and RM so that senior executives have a broad and sophisticated overview of the consequences of policy and strategy. Serious research on this topic is needed to suggest best practice.

The international experience, so far, is that too many central banks and regulators have not performed well. Periodic flare-ups in the general crisis seem to have caught them unprepared and required them to scramble to keep up with events. Far too often they have exuded an air of complacency that was not mirrored by sophisticated market participants or observers. As the situation deteriorated there was a perception by some serious commentators that a crisis had panicked some of the regulators and/or central banks (e.g., The Federal Reserve and the Bank of England) leading to questionable or delayed interventions.³⁵ Strenuous efforts will be required to remove this impression. This will require a credible and thorough review of the crisis period, and the performance of FIs, regulatory bodies and central banks. These reviews should be undertaken nationally, and internationally through one or more of the international regulatory bodies (e.g., the Basel Committee and the Bank for International Settlements). There should be investigations exploring best practice in international financial regulation, and considering possible mechanisms of enforcement at national and international levels to mitigate international regulatory arbitrage. This is a non-trivial exercise given different national and political priorities and financial lobbying. Perhaps the most one can expect is close international cooperation between national regulators in an international financial crisis.

The training and promotion of financial regulators and central bankers must keep pace with financial innovation and RM skills of the FIs they supervise. This requires hiring and promotion to include training in various sections of banking to keep senior officers current with best practices. Regulators' skills and training should mirror those of RMs in private FIs. Regulators are in the privileged position of seeing inside FIs. FI regulators should explore taking on an educative role as constructive critics of RM practices. This would entail the regulator not merely checking RM rules and models but also

creating regular national and international forums for serious RM discussion and research. Some forums already exist, but there should be serious thought about the adequacy of the existing forums and possible improvements. In particular, one can think of serious deficiencies in modeling and application of liquidity risks and systemic risk to name just two areas. Although there are some activities in this area, the quality and quantity varies widely across countries.

One new possibility is for regulators and risk managers to think seriously of implementing national financial game structures that would regularly think through various possible systemic dislocations. Prudential regulators are in the privileged position of seeing the RM systems and output of banks in a national system. This should provide them with interesting data on inter-bank exposures, possible systemic risks and FI reactions. There have been some national stress tests, but these tests are in their early stages of development and require elaboration. Prudential games testing for systemic risk could be played regularly and treated as part of an educational process, testing the RM systems of national FIs and sharpening the regulator's responses to possible scenarios. The games would not be able to envision all systemic risks, but they should be carefully designed to think through the implications of possible events that do not occur often, stress test the implications of new financial products, consider the impact of financial distress from unregulated vehicles and FIs, and think through new regulations and industry responses. The reports of such games should be collected and studied by appropriate national and international regulators. They should be available for research and RM teaching.³⁶

Given the international nature of financial markets, there is a clear requirement that national regulators be linked so that cooperation can act smoothly in an international financial crisis. Such organizations and cooperation already exist, but the current crisis will be testing their efficiency. National financial games could be linked between

³⁵ Commentators in the *Financial Times* have reported such attitudes.

³⁶ Clearly this information is highly confidential, and could be exploited for financial advantage. The usual caveats apply in the academic use of such highly sensitive data.

major financial centers to track international FIs. This structure would rehearse international workouts to test regulatory inconsistencies and legal complexities that arise from international transactions and workouts.³⁷

Lessons for Canada

Canada has been affected by the US credit crisis: the impact manifested itself in the summer when the ABCP market (sponsored by the non-Canadian banks) froze. The workout of the frozen paper has taken nearly a year to draw to a conclusion and has required “innovative” legal interpretations.³⁸ There are some observations that should be made in general about the impact of the credit crisis, and possible scenarios, for Canada. In the summer and autumn, the losses by Canadian banks appeared to be relatively mild. But since then, the banks have disclosed further losses, some quite large. One comforting thought is that the Canadian mortgage market is different from the US market in that there is no tax deductibility for mortgage payments on home loans. This provides incentives for Canadian borrowers to be more cautious in borrowing, and has led in the past to lower default rates on Canadian home loans.

Nevertheless, the Canadian banking and financial system is exposed to more general contagion through its close economic and financial ties to the US. Real impacts on economic activity are being felt in Eastern Canada through dramatic increases in the exchange rate and through a general slowdown in US activity. A US recession would have a serious impact on Canadian exporters who sell directly or indirectly to US consumers. Western Canada, with its booming energy and commodity sectors exporting to the US and a rapidly growing China, appears relatively immune to a US slowdown. But this may be an illusion if a US recession becomes global and impacts adversely on the international

economy and commodity markets. There are tentative signs that such forces are at work and the Canadian federal and provincial governments are preparing for a downturn in Ontario and to a lesser extent in other provinces. These real economy effects could feed back into real estate prices, employment and other factors that will impact on credit markets and risks. RM systems should be calibrating and stress testing for such macroeconomic feedbacks.

The lessons for US, UK and European financial policymakers have direct relevance for Canadian policy.³⁹ One sensed that in the summer and early autumn there was complacency in Canadian policy discussions. It was not clear whether this apparent complacency reflected the views espoused by the Federal Reserve Board, and the need for reassuring public announcements to dispel panic, or whether policymakers did not understand the severity of the US problems and possible implications for Canada. Developments in the last few months should have dispelled any complacency.

Canadian financial markets are heavily integrated into the US system. Delicate microeconomic issues will arise when Canadian and US interests conflict. For example, if a major US FI defaults, and Canadian FIs were exposed, then potential conflicts could arise over national legal and regulatory details in workouts. A second example concerns talk in the US of regulatory changes. These changes can be of direct relevance to Canadian FIs and companies operating and/or trading in the US. Conversely, US companies operating in Canada may face possible conflicts if regulations change in incompatible ways across the border. These possible developments will require careful management as part of Canada’s ongoing relations with the US.

37 See Kubaruch (2001) for a full account of such an international game, run in the US.

38 See Burnett (2008). The full implications of these legal interpretations for future lending structures and defaults are not clear.

39 I will summarize those policy implications in the conclusion.

Conclusion

The credit crisis started in the US but quickly spread to the UK, Europe, Canada and elsewhere. The reason was a fundamental failure in the market for securitized credit. This market operated internationally with writers and holders of these traded credit instruments scattered around the world. Although this was once thought to diversify credit risks, the reality was that the risks were concentrated in major FIs. This problem was compounded once potential holders retreated from the markets, so that writers of credit instruments were forced to take the loans back onto their books. The result was a credit contraction as FIs de-levered, raised capital, and in a few cases, were bankrupted or absorbed by other FIs. Central banks lent large sums to FIs, either directly or indirectly, to help relieve the full impact of the credit crunch. This raised serious policy issues regarding the long-term implications of such practices.

The policy lessons for all countries are these:

- Risk Management systems in all FIs should be thoroughly reviewed internally to take into account the lessons of the last few months.
- Regulators should review the RM systems of the FIs under their supervision to check compliance with best practice. Indeed, what was once thought best practice may no longer be regarded as adequate.

- Central banks in cooperation with regulators (in Canada's case, the Bank of Canada and OSFI) should thoroughly review the performance of their systems, practices and policy.
- National central banks and regulators will be cooperating with foreign central banks, regulators and other bodies (e.g., the Bank for International Settlements) in testing and rectifying weaknesses in the RM systems. Cooperation in the crisis will have been tested, and lessons should be drawn in looking for possible weaknesses.

At this stage, regulatory bodies and governments should be cautious in adopting major policy changes. The complexity of the credit failure requires very careful analysis. There is a serious debate underway amongst senior FI management, regulators and academics searching for regulatory changes, and changes in best practice for RM systems. The goal must be to reduce the probability of a major recurrence of this event, while not stifling financial innovation and efficiency.

References

- Ashcraft, A., and T. Schuermann. 2007. "Understanding the Securitization of Subprime Mortgage Credit." Federal Reserve Board of New York.
- Bagehot, W. (1873), *Lombard Street*, reprinted Wiley 1999.
- Bank of England. 2007. *Financial Stability Report*. Issue No. 22. Bank of England, October.
- Barth, J., G. Caprio and R. Levine 2006. *Rethinking Bank Regulation*. Cambridge University Press.
- Bernanke, B. 2007. "Housing, Housing Finance, and Monetary Policy." Federal Reserve Bank of Kansas City's Economic Symposium, Jackson Hole, Wyoming, August 31.
- Burnett, H. 2008. "A Uniquely Canadian Creative Solution." *Canadian Lawyer*, July, 2008.
- Brunnermeier, M., and L. Pedersen. 2005. "Predatory Trading." *Journal of Finance* 60(4), pp. 1825-1863.
- Calomiris, C. 2007. "Not (Yet) a 'Minsky Moment.'" Working Paper, October.
- Calomiris, C., and J. Mason 2004. "Credit Card Securitization and Regulatory Arbitrage." *Journal of Financial Services Research* 26, pp.5-28.
- Crouhy, M., D. Galai and R. Mark. 2001. *Risk Management*. McGraw-Hill.
- De Bandt, O., and P. Hartmann. 2002. "Systemic Risk in Banking: A Survey." In C. Goodhart and G. Illing, eds. *Financial Crises, Contagion, and the Lender of Last Resort*. Oxford University Press.
- Duffie, D. 2001. *Dynamic Asset Pricing Theory*. Third edition. Princeton University Press.
- . 2007. "Innovations in Credit Risk Transfer: Implications for Financial Stability." Working Paper. July.
- Elsinger, H., A. Lehar and M. Summer. 2006. "Risk Assessment for Banking Systems." *Management Science*, 52, pp.1301-1314.
- Freixas, X., and J-C Rochet. 2008. *The Microeconomics of Banking*, MIT Press. Second edition.
- Goodhart, C. 2002, "Myths about the lender of Last Resort." In C. Goodhart and G. Illing, eds. *Financial Crises, Contagion, and the Lender of Last Resort*. Oxford University Press.
- Gorton, G., and N. Souleles. 2006. "Special Purpose Vehicles and Securitization." In M. Carey and R. Stulz, eds. *The Risks of Financial Institutions*, NBER, University of Chicago Press.
- Gorton, G., and A. Winton 2003. "Financial Intermediation." In G. Constantinides, M. Harris and R. Stulz, eds. *Handbook of the Economics of Finance*. Vol. A, North Holland.
- Gramlich, E. 2007. *Subprime Mortgages: America's Latest Boom and Bust*. The Urban Institute Press.
- Green, R. and S. Wachter. 2007. "The Housing Finance Revolution." Jackson Hole Meetings, Federal Reserve Bank of Kansas City.
- Jorion, P. 2007. *Value at Risk*. Third edition. McGraw-Hill.
- Kane, E. 1989. *The S&L Insurance Mess: How did it Happen?* Urban Institute Press.
- Kaufman, G. 2002. "Lender of Last Resort: a Contemporary Perspective." In C. Goodhart and G. Illing, eds. *Financial Crises, Contagion, and the Lender of Last Resort*. Oxford University Press.
- Kaufman, G. 2004. "FDIC losses in bank failures: Has FDICIA made a difference?" *Economic Perspectives*, 3Q, 2004. Federal Reserve Bank of Chicago.
- Kubarych, R. 2001. *Stress Testing the System: Simulating the Global Consequences of the Next Financial Crisis*. Council on Foreign Relations Press.
- Laidler, D. 2004. *Central Banks as Lenders of Last Resort – Trendy or Passé?* Economics Dept. University of Western Ontario. Working Paper #2004-8.
- Lando, D. 2004. *Credit Risk Modeling*. Princeton University Press.
- Mason, J., and J. Rosner. 2007. "Where did the Ratings Risk Go? How Misapplied Bond Ratings Cause Mortgage Backed Securities and Collateralized Debt Obligations Market Disruptions." Working Paper. May.
- Reinhart, C., and K. Rogoff. 2008. "Is the 2007 US Sub-Prime Financial Crisis So Different? An International Comparison." Harvard. Working Paper.
- Senior Supervisors Group. 2008. "Observations on Risk Management Practices during the Recent Market Turbulence." March 6.
- Stern, G., and R. Feldman. 2004. *Too Big to Fail: The Hazards of Bank Bailouts*. Brookings Institution Press.
- Upper, C. 2007. "Using Counterfactual Simulations to Assess the Danger of Contagion in Interbank Markets." BIS Working Paper no. 234.

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