LEVERAGED LOSSES:
Lessons from the Mortgage Market Meltdown

Proceedings of the U.S. Monetary Policy Forum 2008

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Foreword

The U.S. Monetary Policy Forum (USMPF) is an annual conference that brings academics, market economists, and policymakers together to discuss U.S. monetary policy. A standing group of academic and private sector economists (the USMPF panelists) has rotating responsibility for producing a report on a critical medium-term issue confronting the Federal Open Market Committee (FOMC).

The 2008 USMPF panel includes private-sector members David Greenlaw (Morgan Stanley), Jan Hatzius (Goldman Sachs), Ethan Harris (Lehman), Peter Hooper (Deutsche Bank), Bruce Kasman (JP Morgan Chase), and Kim Schoenholtz (Citigroup), as well as academic panelists Stephen Cecchetti (Brandeis), Anil Kashyap (Chicago), Matthew Shapiro (Michigan), Hyun Song Shin (Princeton), and Mark Watson (Princeton).

This volume reports the results of the second USMPF conference, held on February 29, 2008 in New York, N.Y. The meeting, attended by over 100 central bankers, academics, business economists, and journalists, began with a presentation of this year's report, followed by a luncheon address delivered by former FOMC Secretary Vincent Reinhart, and ended with a panel discussion.

The second USMPF report, Leveraged Losses: Lessons from the Mortgage Market Meltdown, authored by Greenlaw, Hatzius, Kashyap, and Shin focuses on lessons from the credit crisis for central banking. Following the authors' presentation, Federal Reserve Board Governor Frederic Mishkin, and Eric Rosengren, President, Federal Reserve Bank of Boston, offered their comments.

This year's policy panel was entitled "Balancing Financial Stability, Price Stability, and Macroeconomic Stability: How Important is Moral Hazard?" The discussion featured presentations by Charles Evans and William Poole, Presidents of the Federal Reserve Banks of Chicago and St. Louis, respectively, as well as by panel members Hooper and West.

The USMPF is sponsored jointly by the Initiative on Global Markets at the University of Chicago Graduate School of Business and the Rosenberg Institute for Global Finance at the Brandeis International Business School.

Stephen G. Cecchetti and Anil K Kashyap, Co-Directors
Waltham, Massachusetts and Chicago, Illinois, June 2008

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Acknowledgements

The U.S. Monetary Policy Forum acknowledges the generous financial support of the Rosenburg Institute for Global Finance and the corporate partners of the Initiative on Global markets: AQR Capital Management, Barclays, Chicago Mercantile Exchange Trust, John Deere, and Northern Trust. We also wish to thank Goldman Sachs and Morgan Stanley for providing their support.

In addition to institutional support, there were a number of people whose help was essential to our success. First, there are all of the members of the USMPF panel, who offered comments and encouragement. Second, we thank the FOMC members, who attended the meeting and spoke on the record. We extend a special thanks to William Dudley, System Open Market Manager, Jeffrey Lacker, Charles Plosser, and Gary Stern, the Presidents of the Federal Reserve Banks of Richmond, Philadelphia, and Minneapolis respectively, who accepted our invitation to attend the meeting. Finally, there were several people behind the scenes who deserve special mention. These include Allan Friedman and Janice Luce of the University of Chicago Graduate School of Business and Matthew Parillo at the Brandeis International Business School. We owe a special thanks to Jennifer Williams for organizing the conference and overseeing all the conference operations.

U.S. Monetary Policy Forum 2008

LEVERAGED LOSSES: Lessons from the Mortgage Market Meltdown*

by

David Greenlaw, Jan Hatzius,
Anil K Kashyap, Hyun Song Shin

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Initiative on Global Markets, University of Chicago Graduate School of Business, 2008

* Affiliations are Greenlaw (Morgan Stanley), Hatzius (Goldman Sachs), Kashyap (University of Chicago GSB, National Bureau of Economic Research, and Federal Reserve Bank of Chicago), and Shin (Princeton). We thank the USMPF panelists, Tobias Adrian, and Raghuram Rajan for helpful comments and suggestions. We thank Biliana Kassabova, Yian Liu, and Shirla Sum for outstanding research assistance. We also thank Tim Grunwald, Vishwanath Tirupattur and Andrew Sheets for supplying data. Finally, we thank Patrick Oliver for editorial assistance. The views expressed here are those of the authors only and not necessarily of the institutions with which they are affiliated. All errors are our own.

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Abstract

This report discusses the implications of the recent financial market turmoil for central banks. We start by characterizing the disruptions in the financial markets and compare these dislocations to previous periods of financial stress. We confirm the conventional view that the current problems in financial markets are concentrated in institutions that have exposure to mortgage securities. We use several methods to estimate the ultimate losses on these securities. Our best (very uncertain) guess is that the losses will total about $500 billion, with about half being borne by leveraged U.S. financial institutions. We then highlight the role of leverage and mark-to-market accounting in propagating this shock. This perspective implies an estimate of the eventual contraction in balance sheets of these institutions, which will include a substantial reduction in credit to businesses and households. We close by exploring the feedback from credit availability to the broader economy and provide new evidence that contractions in financial institutions' balance sheets cause a reduction in real GDP growth.

1. Introduction

This report seeks to characterize and explain the credit market turmoil that began to grab headlines in August 2007. The associated fall-out has been an important driver of central bank policies since that time. Indeed, a number of Fed officials have linked these developments to monetary policy actions taken over the course of the past several months (see Bernanke [2007a,b and 2008], Evans [2007], Kroszner [2007], Mishkin [2007a,b], Poole [2007], and Rosengren [2007a,b]). This report offers a theory as to why credit market disruptions matter for the macro economy and some estimates of what the turmoil might imply about future growth.

Our analysis is broken down into four parts. We begin, in section 2, with a description of the key credit market events since August 2007. In doing so, we demonstrate that the credit crisis was not an across-the-board deterioration of all credit markets, but — at least in its early stages — an acute crisis that affected certain markets while leaving others virtually unscathed. At the epicenter of the turmoil are mortgage-related securities.

Having established the central role of mortgage-related debt in the crisis, in section 3, we try to assess the size of these credit losses and where those losses are concentrated. We find that the brunt of the losses are borne by the financial intermediary sector – both the traditional banks and broker dealers, as well as other entities involved in the securitization process.

In section 4, we offer an argument as to why the *incidence* of the losses (i.e., who bears the losses) is as important as how large those losses are. The characteristic feature of the financial intermediary sector is that it is composed of leveraged institutions whose capital is a small proportion of the total assets they hold. Credit losses deplete their capital cushion. We show that in past episodes, when faced with capital losses, intermediaries have scaled back their leverage and tried to rebuild their capital. Consequently, the overall decline in lending following the losses depends not only on the size of the initial shock, but also on the ability to raise new capital and on the extent to which the intermediaries reduce their target level of leverage. We provide a range of possible adjustments, but as a rule the overall lending reduction is many times larger than the capital losses. Our baseline estimates imply a $2.3 trillion contraction in intermediary balance sheets, of which roughly $1 trillion would represent a decline in lending to households, businesses, and other non-levered entities.

This impending reduction in lending provides a possible link between the initial problems in the mortgage market and the rest of the economy. In section 5, we explore this channel. We first confirm past findings that have shown growth in total business credit to be strongly correlated with subsequent GDP growth. We then attempt to isolate the portion of this correlation that is due to fluctuations in the supply of credit. We find that, if anything, supply-induced credit contractions have stronger effects on GDP than non-supply-related changes. Our baseline estimates imply that the *independent effect* of the decline in credit due to the mortgage market losses will be to reduce GDP growth over four quarters by roughly 1.5 percentage points. While these estimates entail many caveats,

they still suggest that the feedback from the financial market turmoil to the real economy could be substantial.

We conclude with some provisional lessons for central banks from the events thus far.

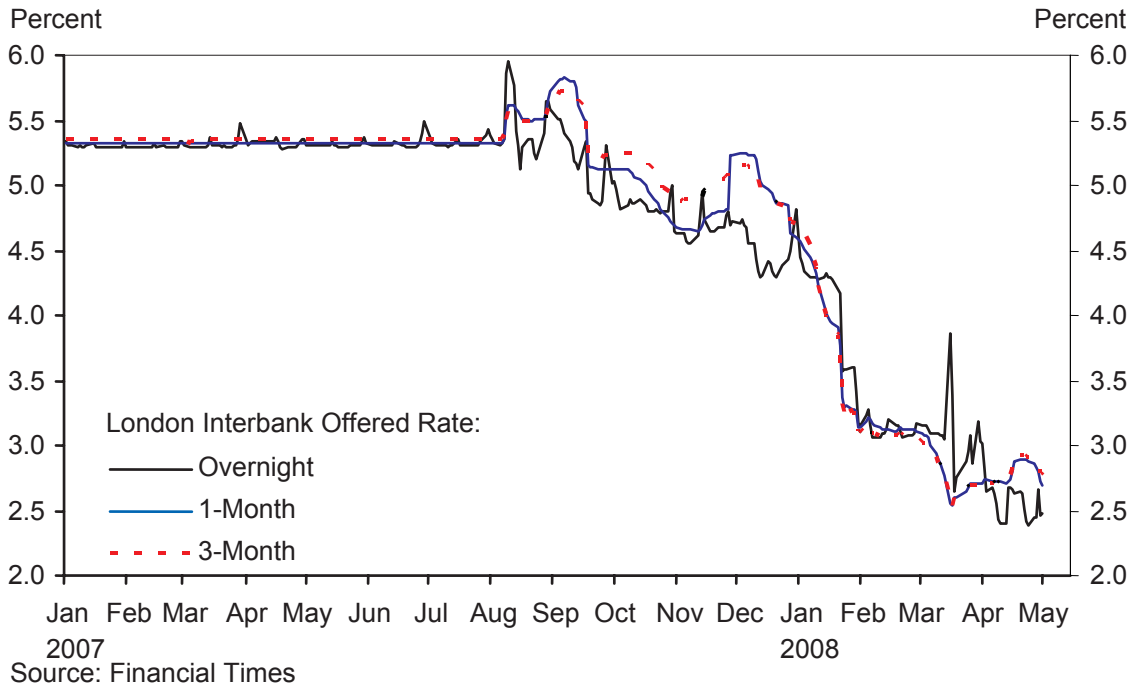
2. Credit Market Developments Since August 2007

We begin by describing the main events in the credit market since August 2007. In doing so, we note that some markets did not initially show signs of stress, which we will argue in the rest of the report helps pinpoint the transmission channels operating during this crisis.

2.1 The markets that were disrupted

Signs of severe pressures in some credit markets became evident across the globe on August 9. In an interesting geographic twist, the proximate trigger seemed to be the announcement by a large European bank that it would close three investment funds because problems in the U.S. mortgage market had made it impossible to value the underlying assets.

Exhibit 2.1 LIBOR Rate



Source: Financial Times

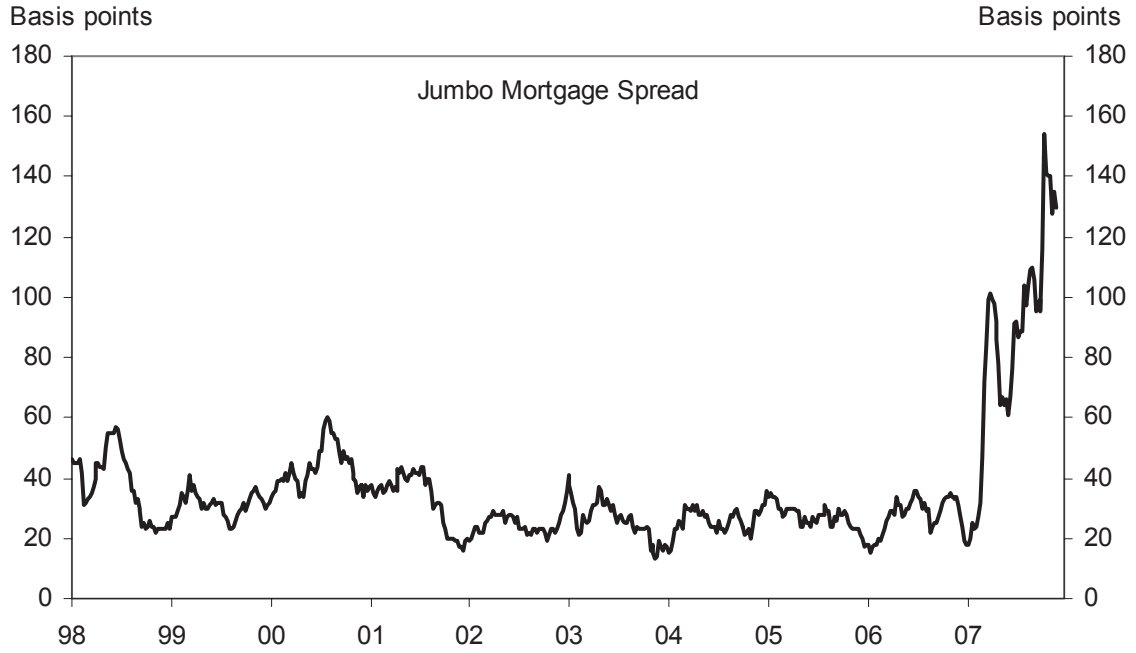
In response to emerging signs of stress, the overnight London Interbank Offer Rate (LIBOR) set more than 50 basis points (bp) higher than the previous day (see Exhibit 2.1). Term interbank funding rates — a measure that we will return to throughout this study — showed a similar move. LIBOR is a key benchmark rate for many types of consumer and business loans. Indeed, data compiled by the Federal Reserve Bank of New York (2007) indicate that 6-month LIBOR serves as the index rate for virtually all subprime

mortgage loans outstanding in the U.S. As we will demonstrate, the move in LIBOR on August 9 and the days immediately following was particularly noteworthy given evolving market expectations of future Fed rate cuts.

Meanwhile, the ECB — citing "tensions in the euro money market" — injected more than $130 billion into the system on August 9 in the type of emergency operation that had not been conducted since the aftermath of the September 2001 terrorist attacks. The Federal Reserve followed with unusually aggressive open market operations of its own a few hours later. Just days earlier, the Federal Open Market Committee (FOMC) had decided to leave monetary policy unchanged and had issued a statement that indicated the predominant policy concern was tilted toward inflation risk. But, on August 17, as signs of tightening credit conditions became increasingly apparent, the FOMC formally altered its assessment of the risks confronting the economy, and the Board of Governors slashed the discount rate by 50 bp.

The events that began to play out on August 9 triggered an intense examination of investor exposure to risk in the U.S. mortgage market. In the next section of this report, we assess the magnitude of losses tied to subprime mortgages, but it's clear that one of the reasons that problems in this sector began to have far-reaching effects is that the loans under scrutiny were embedded in a wide variety of securities. Moreover, financial intermediaries had exposure to both the securities and the underlying loans. Thus, not only did the elevated risk now apparent in the subprime mortgage market lead to a sharp slowdown in origination of such loans, but there was significant spillover to other sectors such as jumbo mortgages, asset-backed commercial paper, and collateralized debt obligations (CDO's).

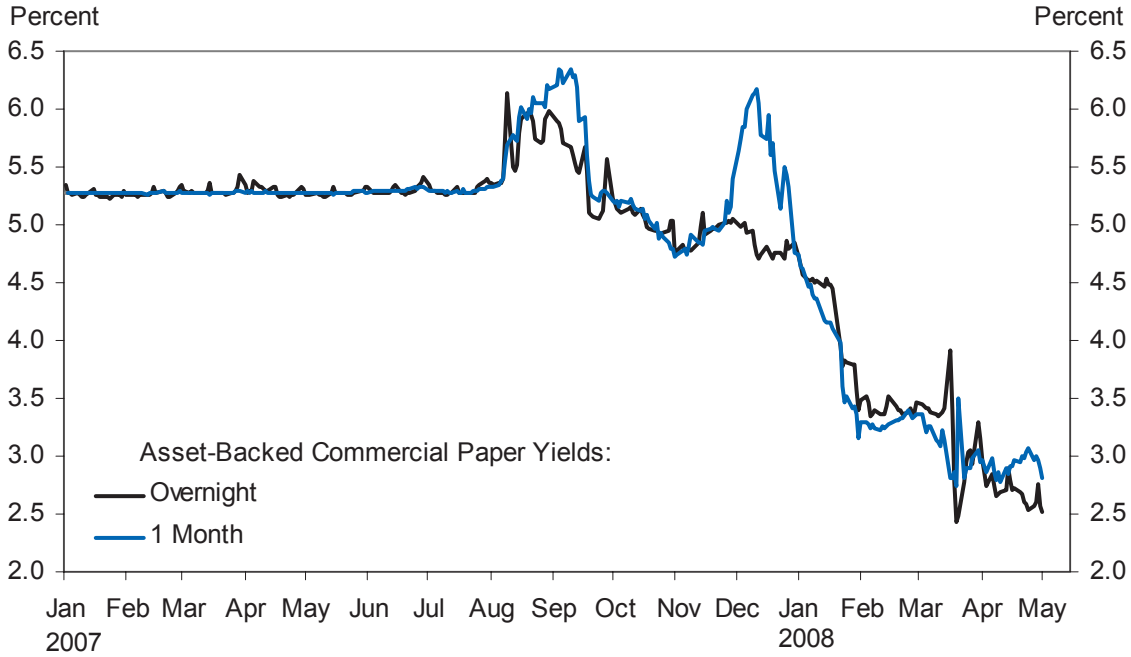
Exhibit 2.2 Jumbo Mortgage Spread



Source: BankRate.com

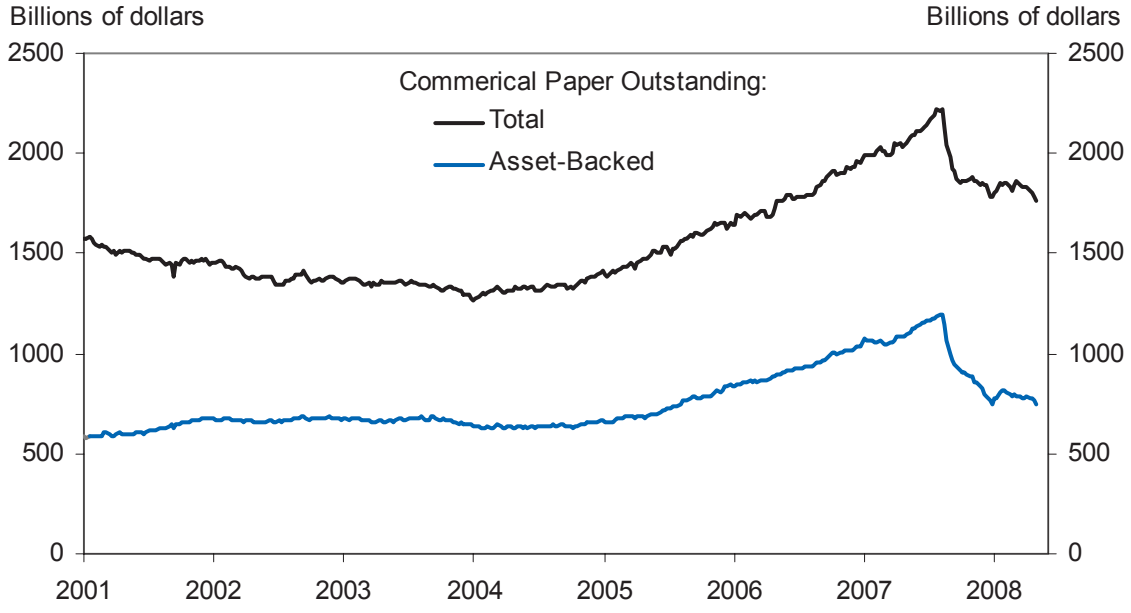
Jumbo mortgages account for 17% of the dollar value of all first-lien mortgage debt outstanding in the U.S., with nearly half of the loans being securitized. Roughly 50% of all jumbo mortgages are tied to homes located in the state of California (Office of Federal Housing Enterprise Oversight [2008]). Exhibit 2.2 shows a spike in the spread between jumbo and conforming mortgage rates that appeared first in August 2007. The typical spread is in the range of 20bp to 40bp, but since mid-August it has been much higher.

Exhibit 2.3 Asset-Backed Commercial Paper (ABCP) Yields



Source: Federal Reserve Board

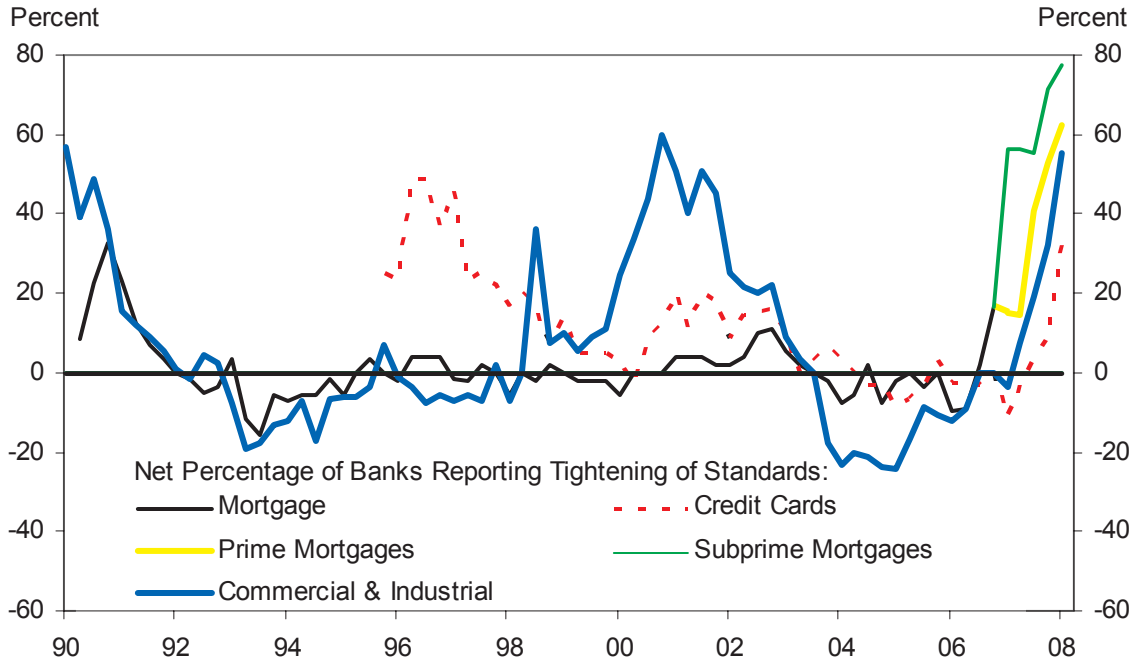
Exhibit 2.4 Commercial Paper Outstanding



Source: Federal Reserve Board

Similarly, rates on asset-backed commercial paper spiked in mid-August (see Exhibit 2.3). Asset-backed Commercial Paper (ABCP) is a security issued by a bank or other financial entity with a maturity that is typically between 1 and 180 days. The notes are backed by the physical assets that are used as collateral for loans to households or businesses. The asset-backed component of the commercial paper (CP) market had grown at a phenomenal clip in recent years, and at the start of August it accounted for more than one-half of the $2.2 trillion of all CP outstanding (see Exhibit 2.4). According to a speech by William Dudley of the Federal Reserve Bank of New York, data from Moody's show that only about 25% of the collateral underlying ABCP as of mid-2007 consisted of residential mortgages (Dudley [2007]). However, while the direct exposure to subprime mortgage debt was relatively limited and the majority of ABCP programs were highly rated, investors appeared to have a great deal of difficulty evaluating the credit quality of the underlying assets. Issuers were confronted with an inability to roll maturing paper. Such a development would likely lead to either a forced liquidation of the underlying assets or the triggering of backstop credit agreements that would bring the assets onto bank balance sheets and intensify the strains that were already evident in term funding markets.

Exhibit 2.5 Senior Loan Officer Survey

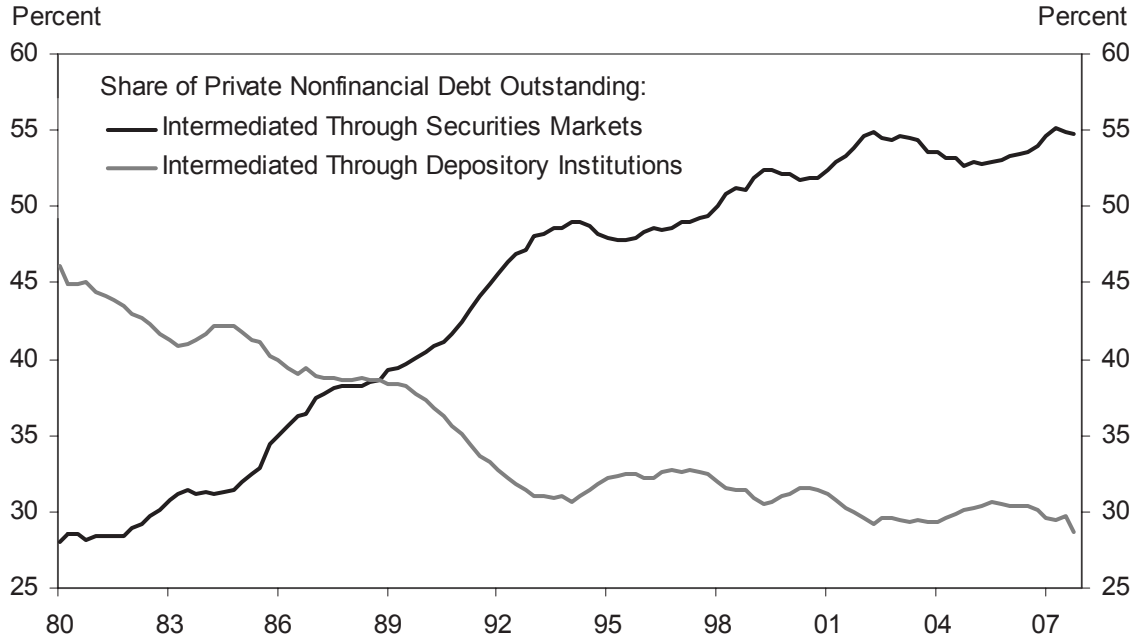


Source: Federal Reserve Board

As funding rates rose and as problems in some securitized markets emerged, banks moved to tighten credit standards on a wide variety of loans — not just subprime mortgages. As seen in Exhibit 2.5, the Fed's Senior Loan Officer Surveys for October 2007, January 2008, and April 2008 showed a progressive tightening of standards for prime mortgages, commercial & industrial loans for businesses, and credit cards. Thus, both of the main avenues of credit intermediation in the U.S. economy — the banking sector and the securities markets — were under some degree of stress. Exhibit 2.6 shows

the share of credit intermediation by depository institutions and by the securities markets. Examples of the former include mortgages, C&I loans, and credit card debt that remains on balance sheet. Examples of the latter include corporate bonds, commercial paper, and asset-backed securities. Note that the shares do not add up to 100% because a small amount of intermediation occurs in a direct fashion – such as when a pension fund provides financing for a commercial mortgage. The securities market is certainly the dominant source of intermediation in the U.S. today. This is one of the ways in which the latest episode of credit tightening differs from those experienced in the 1980s and earlier. However, while the banking sector currently plays a much smaller role in the intermediation process than it did a couple of decades ago, it can still serve as an important allocator of credit and provider of liquidity in times of stress.[2]

Exhibit 2.6 Share of Intermediation through Banks and Securities Markets



Source: Morgan Stanley calculations based on Federal Reserve Flow of Funds Accounts

2.2 Other non-affected markets

We now turn to another important characteristic of recent financial market developments – the delayed spillover effects. In the midst of the considerable pressures that we have described during the early stages of the credit tightening, some important asset classes seemed little affected. Indeed, even relatively high-risk assets appeared to be immune to the initial signs of stress in the banking sector, mortgage market, and commercial paper market. Exhibit 2.7 shows monthly total returns for a variety of asset classes starting in July 2007. While most assets classes had negative returns in July, the cumulative returns

[2] See also Tucker [2007] for a helpful discussion of the linkages between the two channels that can become important during times of turbulence.

from July through October for all of the domestic indices, except the S&P financials, were positive. Only in November did clear signs of stress begin to appear.

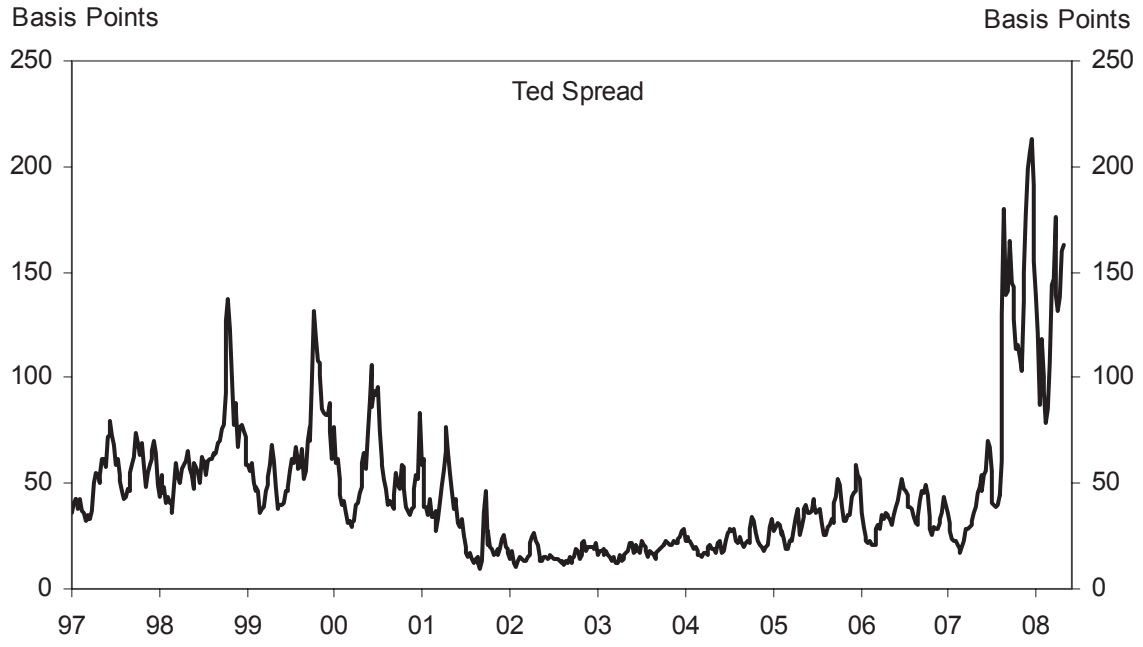
Exhibit 2.7 Monthly Total Returns on Various Asset Classes, July 2007 to January 2008

	Jul-07	Aug-07	Sep-07	Oct-07	Nov-07	Dec-07	Jan-08
S&P 500	-3.1%	1.5%	3.7%	1.6%	-4.2%	-0.7%	-6.0%
S&P Financials	-7.8%	1.5%	2.3%	-1.8%	-7.7%	-5.4%	-0.3%
Nasdaq	-2.2%	2.0%	4.0%	5.8%	-6.9%	-0.3%	-9.9%
Ryan Labs US Treasuries	1.8%	2.3%	-0.2%	2.8%	2.9%	-0.6%	3.7%
Merrill Lynch High Grade Corporate Bonds	0.6%	1.0%	0.5%	0.7%	1.4%	0.3%	2.2%
Merrill Lynch High Yield Bonds	-3.1%	1.1%	2.4%	0.6%	-2.0%	0.3%	-1.4%
EMBI+	-0.9%	1.6%	2.4%	2.6%	-0.5%	0.6%	0.7%
MSCI Europe (Local)	-3.5%	-0.5%	1.7%	2.9%	-3.8%	-0.5%	-11.4%
MSCI EAFE (Local)	-3.2%	-1.4%	2.3%	2.4%	-4.1%	-1.2%	-10.9%
MSCI EM (Local)	4.9%	-0.9%	8.4%	9.0%	-6.2%	0.6%	-12.4%

Sources: Factset, Haver, Bloomberg

While U.S. equities, high-yield bonds, and emerging market debt were performing well through October, other measures of financial distress were already flashing clear warning signals. The TED spread — the difference between the 3-month Eurodollar deposit rate and the yield on 3-month Treasury bills — is a conventional gauge of credit risk since it measures the difference between an unsecured deposit rate and the rate on a government-backed obligation.[3] Exhibit 2.8 shows the TED spread plotted on a weekly basis. The widening in this measure that occurred during the final five months of 2007 far outstripped the moves associated with the LTCM crisis, Y2K and 9/11.

Exhibit 2.8 Treasury-Eurodollar (TED) Spread



Source: Financial Times, Federal Reserve Board

[3] Note that the Eurodollar deposit rate is essentially the same as LIBOR.

The accompanying correlation matrices (Exhibit 2.9) show an alternative examination of the recent divergence between measures of credit risk and the performance of some important asset classes. The normal relationship — as measured by correlations during the 20-year period ending in June 2007 — is that a high TED spread is associated with a widening of corporate bond spreads, higher rates on jumbo mortgages (in relation to conventional mortgages), and a somewhat weaker stock market. In contrast, during the first few months of the credit market turbulence that began last summer, the correlation between the TED spread and corporate bond spreads was negative! There was a similarly counterintuitive change in sign for the correlation between the TED spread and equity returns — albeit at a much lower level of statistical significance. Meanwhile, we see an even more powerful positive link between the TED spread and jumbo mortgages. This divergence in correlations during the early stages of the credit stress highlights the concentrated nature of a problem that would appear to have far-reaching implications.

Exhibit 2.9 Correlations Between Measures of Credit Risk and Asset Returns

Correlations: January 1987 through June 2007

	TED	Baa-Aaa	S&P500	Jumbo
TED	1			
Baa - Aaa	0.22	1		
S&P500	-0.07	-0.07	1	
Jumbo	0.38	-0.19	0.05	1

Correlations: July 2007 through October 2007

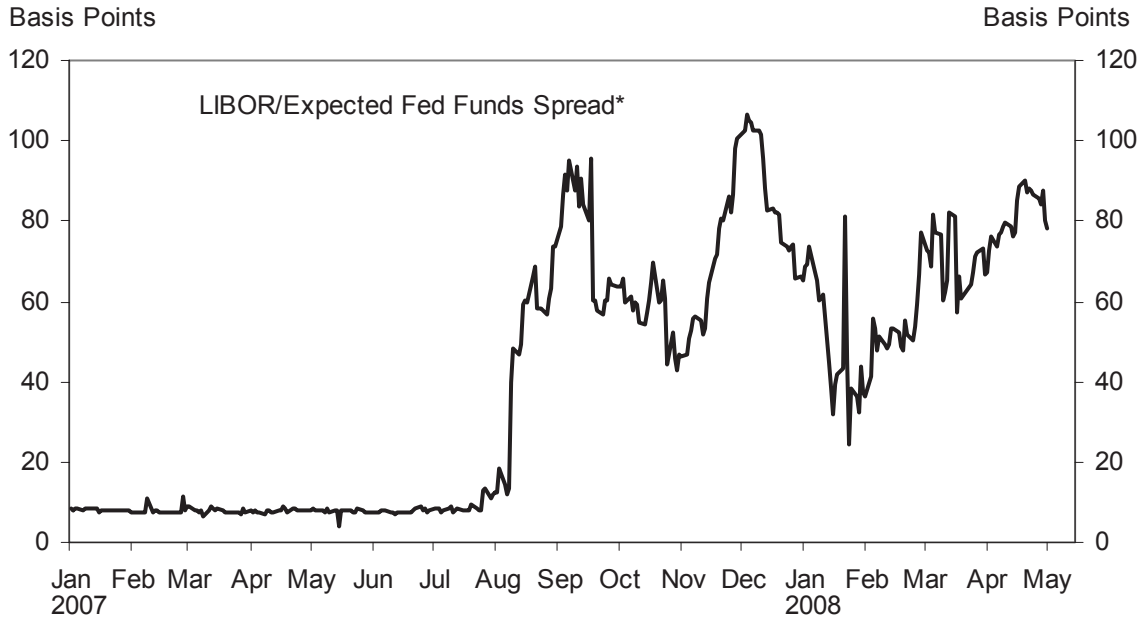
	TED	Baa-Aaa	S&P500	Jumbo
TED	1			
Baa - Aaa	-0.46	1		
S&P500	0.05	-0.28	1	
Jumbo	0.93	-0.45	0.09	1

Series descriptions:
TED = Treasury/Eurodollar spread
Baa-Aaa = Spread between Baa and AAA seasoned bonds
S&P500 = 1 month return on S&P500
Jumbo = Spread between rates on Jumbo 30 year mortgages and conventional 30 year mortgages
Note: All data are weekly and start in August 1987, except Jumbo, which starts in June 1998.

The TED spread can be influenced by "fight to quality" flows that move Treasury bill yields, as well as the funding pressures that drive LIBOR rates. For our purposes, a "purer" gauge of interbank funding pressures is the spread between LIBOR and the overnight indexed swap rate (or OIS). The OIS rate is a measure of the expected overnight federal funds target rate over a certain period. Meanwhile, LIBOR presumably incorporates the same policy expectation along with an assessment of credit and liquidity risks. Exhibits 2.10 and 2.11 show the 3-month LIBOR-OIS spread on a daily basis for 2007 and early 2008 and on a monthly basis beginning in 1989[4].

The high frequency LIBOR-OIS spread series (Exhibit 2.10) shows the relative calm that prevailed until August 9, 2007. This was followed by a fairly steady intensification of pressures through mid-September and then some relief in the wake of the 50 bp cut in the fed funds target at the September 18 FOMC meeting. There was renewed deterioration during early December as write-downs tied to mortgage-related losses mounted at banks and other financial services firms. However, the December 12th announcement of coordinated central bank action, including the Fed's introduction of the Term Auction Facility (or TAF), appeared to trigger some significant moderation in term funding pressures. This trend continued through year-end and into early 2008. In February, there was a renewed widening in the spread that seemed to be at least partly related to the ECB's February 1st announcement that it would discontinue the dollar liquidity operations that had commenced in December.

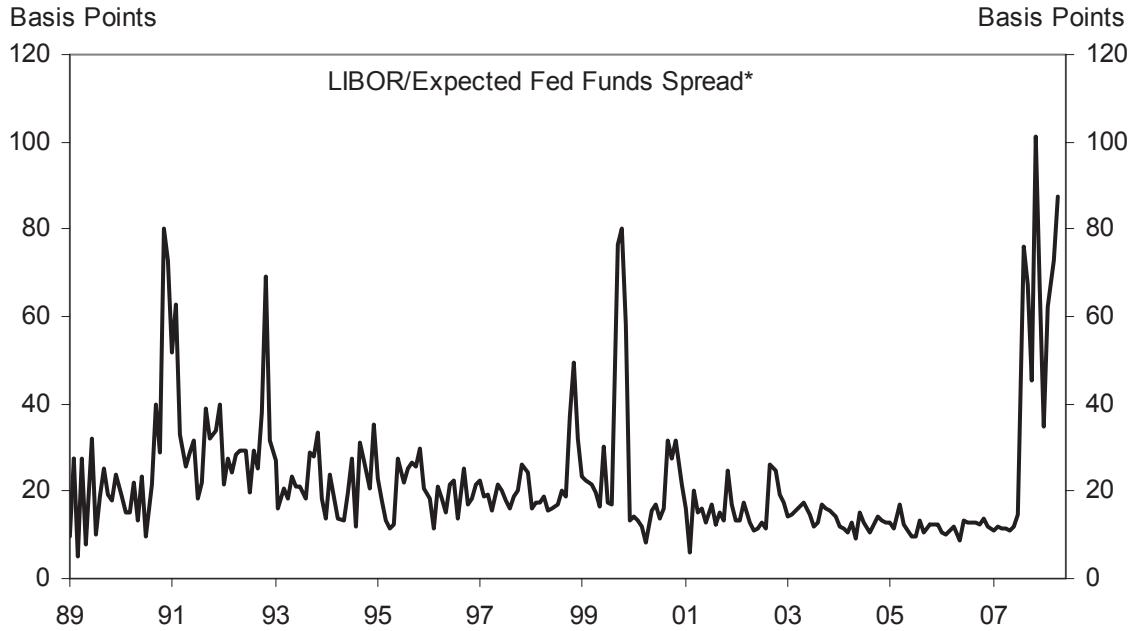
Exhibit 2.10 LIBOR-Overnight Indexed Swap (OIS) Rate (Daily)



*Spread of 3-Month LIBOR over 3-Month OIS
Source: Financial Times, Wall Street Journal

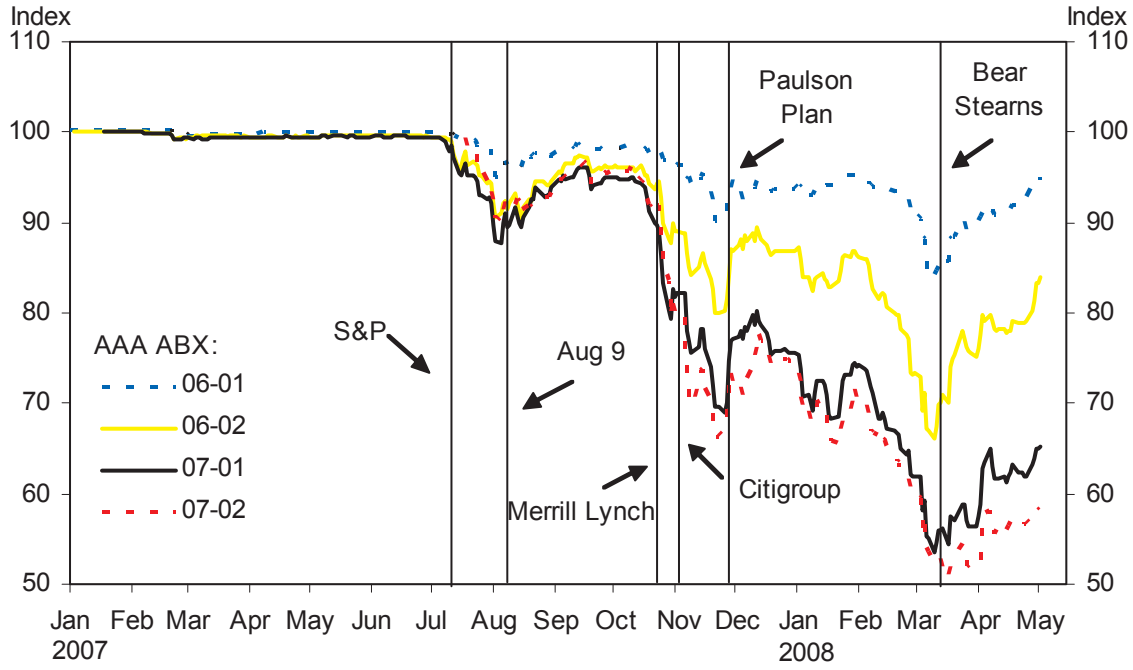
[4] The monthly series is constructed by comparing the end-of-month LIBOR rate to the expected fed funds rate constructed using the next 3 months' fed funds futures contracts.

Exhibit 2.11 LIBOR-Overnight Indexed Swap (OIS) Rate (Monthly)



*Spread of 3-Month LIBOR over Average of Next 3 Fed Funds Futures
Source: Financial Times, Wall Street Journal

Exhibit 2.12 ABX Indices (AAA Rated Vintages)



Source: Goldman Sachs

Compared to historical norms, the recent episode is also unusual. Exhibit 2.11 shows that, as with the TED spread, the current degree of stress is significantly greater than anything experienced in the past 18 years — surpassing the Y2K episode, the LTCM debacle in 1998, and the 1990-91 S&L crisis.

Not surprisingly, market estimates of subprime mortgage losses — as measured by the ABX index — have escalated since mid-2007. The ABX index represents a basket of credit default swaps linked to subprime mortgages. The indices are constructed by pooling mortgages with similar (initial) credit ratings. Exhibit 2.12 shows the indices for four vintages of AAA mortgages — the highest quality tranche of the underlying mortgages — which often include credit guarantees aimed at insulating these securities from credit risk. One of the hallmarks of the crisis has been the steep increase in the insurance costs associated with these so-called "super senior" tranches.

Many of the largest price swings in the ABX indices are associated with specific events that appeared to play a role in perceptions of the ultimate losses that will be realized. For example, a conference call with mortgage analysts at Standard and Poor's (a major rating agency) on July 10 seemed to drive the indexes lower. Following the liquidity injections of August 9, prices stabilized. Announcements in November 2007 of write-downs by major financial institutions, such as Citigroup and Merrill Lynch, appeared to help drive the index lower. Lastly, around Thanksgiving 2007, the unveiling of the so-called Paulson Plan by the Bush administration seemed temporarily to stem the steady erosion in ABX pricing that had been evident in the weeks leading up to that point – even though the effort was viewed with skepticism by many analysts and investors.[5] But prices soon began falling again with most reaching their lows on March 17 (the day of the announcement of the acquisition of Bear Stearns by JP Morgan).

Finally, as Boston Fed President Eric Rosengren has argued (Rosengren [2007a]), the recent problems evident in credit markets did not initially trigger a wholesale repricing of risk. Instead, the pressures evident in some key sectors (i.e., interbank funding, jumbo mortgages, and commercial paper) resulted from "liquidity problems" tied to the deterioration in the subprime mortgage market.[6] As we will examine in greater detail in sections 4 and 5, the resulting disruptions have gradually spilled over to other markets, and this has contributed to a significant tightening of credit conditions across important sectors of the economy.

[5] The Paulson Plan represents a broad-based attempt to modify the terms on certain subprime adjustable rate mortgages in a manner that might help avoid default. A few days after the plan was announced, a CNBC viewer poll found that more than 75% of respondents were opposed to its adoption.

3. Estimating Mortgage Credit Losses

In estimating the credit losses for financial intermediaries, it is important to distinguish between the initial impact of losses tied to residential mortgages and the wider potential losses that would arise from knock-on effects. For example, a subdued pace of real activity that might arise due to problems in the residential mortgage market is likely to have an impact on the credit quality of commercial property and non-mortgage household debt (such as credit cards).

Our primary aim is to quantify the losses arising from mortgage assets alone — in particular those in the subprime sector — and to assess the impact of such losses on broader credit conditions in the U.S. economy. However, the progressive deterioration in credit quality outside residential mortgages is likely to add to the overall squeeze. In our baseline, we restrict our attention to residential mortgages, but we discuss other types of credit in the appendix. The appendix also addresses the impact of corporate income taxes on our estimates.

Conventional estimates of the likely mortgage credit losses over the next few years rose sharply during 2007. As recently as July 2007, Federal Reserve Chairman Bernanke noted that losses on subprime mortgages could total $50–$100 billion. Given typical estimates of the distribution of total losses between subprime and other mortgages, this number corresponds to overall losses of less than $150 billion. By the end of 2007, most mortgage credit modelers believed that total losses would be substantially higher. For example, by December 2007, Lehman Brothers [2007] was estimating that credit losses on the currently outstanding stock of mortgages would total $250 billion in their baseline scenario of a 15% peak-to-trough home price drop and $320 billion in a stress scenario with a 30% drop. Similarly, as of late November, Goldman Sachs [2007] was estimating mortgage losses of $243 billion in their baseline scenario and $495 billion in a stress scenario.[7] In fact, during Congressional testimony on January 17, Chairman Bernanke admitted that losses could amount to "several multiples of [$100 billion] as we go forward and the delinquency and foreclosure rates rise." Subsequently, the International Monetary Fund [2008] estimated that losses on residential mortgages could total $565 billion.

In the remainder of this section, we explain the procedure used by most private-sector analysts to arrive at their estimates. We then explore the robustness of these estimates to alternative assumptions about house price dynamics and arrive at our own baseline forecast. We close by discussing the likely distribution of the losses across different entities.

[6] In this sense, the failure of additional money to flow quickly to reduce these abnormal spreads is similar to the limits to arbitrage phenomena highlighted by Shleifer and Vishny [1997].

3.1 Deconstructing conventional loss estimates

The mechanics of these estimates is best explained by focusing on the $243 billion baseline estimate produced by the global bank analysts at Goldman Sachs. Their model simply extrapolates the performance — defaults, loss severities, and total loss rates — of each "vintage" (origination year) of subprime and other mortgage loans, based on its own history as well as the typical progression pattern through time. For example, suppose that the cumulative default rate on the 2006 subprime vintage was 3% at the end of 2007. Suppose further that the 2004 vintage showed a cumulative default rate of 1% after 1 year and 4% after 3 years, i.e., a fourfold increase over 2 additional years. Their procedure is to use the data on the 2004 vintage to extrapolate the cumulative default rate on the 2006 vintage. In this scenario, the default rate on the 2006 vintage would be 12% by the year 2009.

In arriving at aggregate estimates, three basic observations prove to be important. First, default rates on virtually all types of mortgages originated prior to 2004 are relatively low, partly because most of these mortgages have already been refinanced. Second, default rates historically climb relatively quickly after the first two years, so that by years three or four one already has a good estimate of how a group of mortgages is likely to perform. One can think of a cohort of mortgages having an important common factor that drives defaults, and the magnitude of the factor is revealed relatively quickly. Third, the mix of mortgage originations shifted abruptly starting in 2004. Prior to that time, there were relatively few subprime mortgages outstanding, whereas during 2004, 2005, and 2006, subprime and "Alt-A" originations surged.[8] Putting these facts together implies that most of the guesswork involved in arriving at aggregate loss estimates turns on how one assesses the performance of the lower-quality mortgages made during these three years (although by the end of 2007 most of the 2004 loans had been prepaid and either converted into prime mortgages or reissued as new subprime loans). Below we show some suggestive calculations that help to put bounds on the expected losses using this methodology.

[7] The Goldman Sachs analysis is not directly linked to an assumed path for home prices, but the "stress" scenario stipulates a recession and peak historical default rates not only on subprime but also other mortgages.

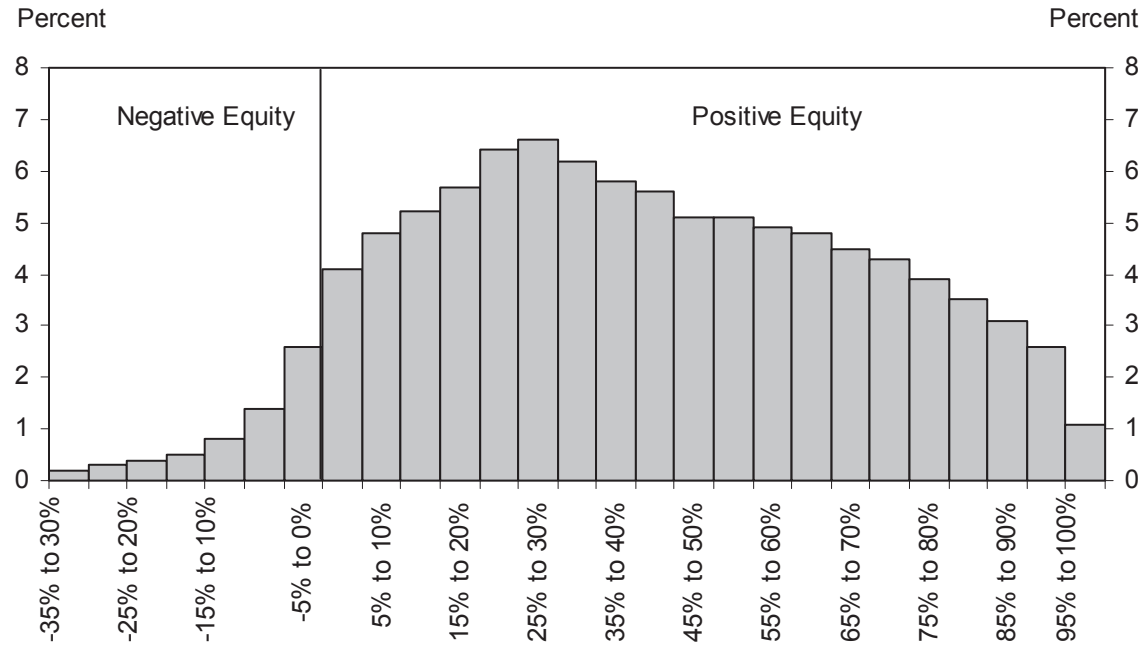
3.2 Adjusting the conventional estimates for falling house prices

Although the modeling strategy described above seems quite logical, it does not account for the possibility of a structural break that might result from falling home prices. In particular, because the detailed mortgage performance data required to build these types of models are available only back to the mid-1990s, there are no observations on how defaults and losses on a particular vintage change through time when home prices start to fall. It is likely that simply extrapolating from the historical progression of defaults and losses will produce an overly optimistic picture. At the same time, it is difficult to know just how much to adjust the estimates given the lack of historical precedents. In the example given above, we suspect strongly that defaults on the 2006 vintage will not just grow in line with the progression observed in the past, but that the rise in defaults will exceed the historical norm, perhaps by a considerable margin.

The basic problem is that house price declines create large amounts of negative equity. Homeowners with negative equity cannot draw upon their capital gains buffer to cushion against adverse financial events such as job loss or mortgage reset by refinancing, and they therefore become much more likely to default. The importance of this problem is illustrated in Exhibit 3.1, which shows data compiled by First American CoreLogic on the distribution of home equity among U.S. mortgage holders at the end of 2006. About 7% of U.S. mortgage holders had negative equity at that point. Another 4% had equity of 0–5%, 5% each had equity of 5–10% and 10–15%, and 6% each had equity of 15–20% and 20–25%. Thus, the proportion of mortgage holders with negative equity would rise to 21% given a (uniform) home price decline of 15%, 27% given a drop of 20%, and 33% given a drop of 25%.[9] These are very large numbers. There are approximately 54 million households with mortgages in the United States, so 27% of all mortgage holders corresponds to about 14.6 million households. If negative-equity homeowners on average have mortgage debt of $250,000, this would imply that a 20% home price decline from late-2006 levels would put about $3.6 trillion of mortgage debt "under water."

[8] Alt-A loans are those whose credit quality is deemed to fall between that of prime and subprime - usually reflecting differences in items such as FICO score, loan-to-value ratio, and loan documentation.
[9] Fitch Ratings [2007] reports that 70% of the residential mortgage backed securities issued in 2006 were in areas that had negative housing price appreciation as of 2007Q2.

Exhibit 3.1 Falling Prices Leave Homeowners with Negative Housing Equity



Note: All data as of December 2006
Source: First American CoreLogic, Inc.

3.3 Alternative estimates for mortgage credit losses

What do these considerations imply for the likely amount of mortgage credit losses? We see three possible approaches that might be used to generate an estimate. First, we can start from the mortgage vintage models and judgmentally steepen the path for losses and severities relative to historical experience to reflect the expected home price declines. This suggests that total losses would be higher than the $243 billion baseline estimate in the Goldman Sachs analysis, which is simply based on "walking forward" recent credit quality trends without explicit consideration of the negative-equity dynamics. For example, if we raise the cumulative default assumptions for the 2004–07 subprime vintages by one-third to take account of the negative-equity dynamics and assume that non-subprime mortgage losses rise to half their historical peak rate, the Goldman Sachs analysis would imply total mortgage credit losses of around $400 billion. Of course, these are some extremely arbitrary assumptions, but they do illustrate that loss estimates are highly sensitive to a relaxation of the "business as usual" assumptions that are inherent in a simple vintage analysis.

Second, we can look at the pricing of traded pools of different quality mortgage tranches to arrive at a market-based estimate of the losses. Exhibit 3.2 shows data from the trade publication *Inside Mortgage Finance* on the distribution of mortgages that were

originated during this decade. As mentioned above, the share of subprime plus Alt-A mortgages jumped from around 10% of total originations during the period from 2001 to 2003, to nearly 25% in 2004, and then to better than 30% in the two succeeding years.

Exhibit 3.2 Mortgage Types by Year of Origination

Mortgage Originations by Product ($Bn)									
Year	FHA/VA	Conform-ing	Jumbo	Sub-prime	Alt-A	HEL	Total	ARMs	Refinan-ces
2001	175	1,265	445	160	55	115	2,215	355	1,298
2002	176	1,706	571	200	67	165	2,885	679	1,821
2003	220	2,460	650	310	85	220	3,945	1,034	2,839
2004	130	1,210	510	530	185	355	2,920	1,464	1,510
2005	90	1,090	570	625	380	365	3,120	1,490	1,572
2006	80	990	480	600	400	430	2,980	1,340	1,460
1Q06	19	236	103	140	105	102	705	297	348
2Q06	20	275	126	165	104	110	800	392	382
3Q06	22	241	128	160	91	113	755	332	368
4Q06	19	238	123	135	100	105	720	319	362
1Q07	19	273	100	93	98	97	680	240	388
2Q07	25	328	120	56	96	105	730	220	377
3Q07	26	286	83	28	54	93	570	166	263
4Q07	31	275	44	14	27	60	450	98	234

% of Originations by Product (except for Total Loans)									
Year	FHA/VA	Conform-ing	Jumbo	Sub-prime	Alt-A	HEL	ARMs	Refinan-ces	Total Loans ($Bn)
2001	7.9%	57.1%	20.1%	7.2%	2.5%	5.2%	16.0%	58.6%	2215
2002	6.1%	59.1%	19.8%	6.9%	2.3%	5.7%	23.5%	63.1%	2885
2003	5.6%	62.4%	16.5%	7.9%	2.2%	5.6%	26.2%	72.0%	3945
2004	4.5%	41.4%	17.5%	18.2%	6.3%	12.2%	50.1%	54.7%	2920
2005	2.9%	34.9%	18.3%	20.0%	12.2%	11.7%	47.8%	50.4%	3120
2006	2.7%	33.2%	16.1%	20.1%	13.4%	14.4%	45.0%	49.0%	2980
1Q06	2.7%	33.5%	14.6%	19.9%	14.9%	14.5%	42.1%	49.4%	705
2Q06	2.5%	34.4%	15.8%	20.6%	13.0%	13.8%	49.0%	47.8%	800
3Q06	2.9%	31.9%	17.0%	21.2%	12.1%	15.0%	44.0%	48.7%	755
4Q06	2.6%	33.1%	17.1%	18.8%	13.9%	14.6%	44.3%	50.3%	720
1Q07	2.8%	40.1%	14.7%	13.7%	14.4%	14.3%	35.3%	57.1%	680
2Q07	3.4%	44.9%	16.4%	7.7%	13.2%	14.4%	30.1%	51.6%	730
3Q07	4.6%	50.2%	14.6%	4.9%	9.5%	16.3%	29.1%	46.1%	570
4Q07	6.9%	61.0%	9.8%	3.0%	6.0%	13.3%	21.8%	52.0%	450

Source: Inside Mortgage Finance, Morgan Stanley

To arrive at a set of losses we multiply the estimated distribution of different pools of mortgage-backed securities by the prices for the pools. While not all of these mortgages have been securitized, the implied losses can still be evaluated using the market prices for

the securitized portion. We rely on analysis from Moody's that maps subprime originations into a distribution of mortgage-backed securities with various credit ratings (Moody's Investors Service [2007]). This distribution is shown in the Exhibit 3.3. The critical implication from the Moody's data is that roughly 80% of all subprime mortgages were converted into AAA pools. This means that any loss estimates will be particularly sensitive to the prices of the AAA tranches.

Exhibit 3.3 Estimates of Subprime Mortgage Originations by Rated Tranche ($Bn)

Year	All Subprime 100%	AAA 80.8%	AA 9.6%	A 5.0%	BBB 3.5%	BB/Other 1.1%
2005	625	505	60	31	22	7
1Q06	140	113	13	7	5	2
2Q06	165	133	16	8	6	2
3Q06	160	129	15	8	6	2
4Q06	135	109	13	7	5	1
1Q07	95	77	9	5	3	1
2Q07	56	45	5	3	2	1
3Q07	28	23	3	1	1	0
4Q07	14	11	1	1	1	0
Total: 2005-2007	**1,418**	**1,145**	**135**	**71**	**51**	**16**

Source: Inside Mortgage Finance, Morgan Stanley

The prices for the pools are taken from Markit.com's ABX indices.[10] The first set of ABX indices were launched in January 2006 and covered mortgages originated in 2005. Since the term to initial reset for adjustable rate mortgages in the subprime sector is generally two years, we assume that mortgages originated prior to 2005 were refinanced by 2007 and that those issued in 2005 and later were not able to be refinanced due to the tightening of credit standards. Notice the very sharp drop-off in subprime originations by the end of 2007. Thus, the cumulative issuance from 2005 through 2007 should approximate the universe of subprime mortgage debt that is currently outstanding. Indeed, note that subprime issuance during the 2005–07 timeframe totaled $1.4 trillion. Roughly 80% of this amount was adjustable rate. This means that the calculations are based on about $1 trillion of outstanding adjustable rate subprime debt — the same figure that Chairman Bernanke has often cited.

To compare loss estimates, we report ABX prices as of three benchmark dates: August 9 (when the turmoil began), November 21 (just before the announcement of the so-called Paulson plan and the low point for 2007), and March 17, 2008 (the low point through May for most of the ABX indices). The model shown in Exhibit 3.4 links the volume of originations during a certain time period to the price of the ABX index that most closely

[10] The ABX has five separate indices based on the rating of the underlying security, from AAA to BB. Until recently, a new series was issued every six months to reflect the 20 largest deals. Therefore, each of the indices is constructed by averaging the quoted prices from roughly 20 trusts. The specific trusts included in each index are shown on the Markit.com web site.

corresponds to that same timeframe. We find that the losses implied for subprime in the earlier periods range from $146 billion on August 9, 2007, to $511 billion on March 17, 2008. Meanwhile, as of May 19, 2008, the ABX market's implied loss had slipped back to $355 billion. Including losses for other types of mortgages, this would be consistent with well over $400 billion for total mortgage credit losses[11].

Exhibit 3.4 Mortgage Credit Losses Implied by the ABX Contracts, various dates

August 9, 2007

	ABX Prices by Vintage						MtM Loss ($Bn) based on ABX Pricing					
	ABX Index	AAA	AA	A	BBB	BB/ Other	Sub-prime	AAA	AA	A	BBB	BB/ Other
Year	100%	*80.8%*	*9.6%*	*5.0%*	*3.5%*	*1.1%*	100%	*80.8%*	*9.6%*	*5.0%*	*3.5%*	*1.1%*
2005	ABX 06-1	96.42	94.50	85.95	60.94	49.06	38	18	3	4	9	4
1Q06	ABX 06-2	91.58	89.28	66.25	36.28	30.54	18	10	1	2	3	1
2Q06		91.58	89.28	66.25	36.28	30.54	21	11	2	3	4	1
3Q06	ABX 07-1	89.47	80.69	48.61	31.22	29.00	26	14	3	4	4	1
4Q06		89.47	80.69	48.61	31.22	29.00	22	11	3	3	3	1
1Q07	ABX 07-2	91.38	87.17	61.64	38.86	37.08	12	6	1	2	2	1
2Q07		91.38	87.17	61.64	38.86	37.08	7	4	1	1	1	0
3Q07		91.38	87.17	61.64	38.86	37.08	4	2	0	1	1	0
							146	**76**	**14**	**21**	**26**	**9**

November 21, 2007

	ABX Prices by Vintage						MtM Loss ($Bn) based on ABX Pricing					
	ABX Index	AAA	AA	A	BBB	BB/ Other	Sub-prime	AAA	AA	A	BBB	BB/ Other
Year	100%	*80.8%*	*9.6%*	*5.0%*	*3.5%*	*1.1%*	100%	*80.8%*	*9.6%*	*5.0%*	*3.5%*	*1.1%*
2005	ABX 06-1	90.09	78.24	50.41	25.46	22.75	100	50	13	15	16	5
1Q06	ABX 06-2	80.10	52.23	33.66	18.61	16.90	39	23	6	5	4	1
2Q06		80.10	52.23	33.66	18.61	16.90	46	27	8	5	5	2
3Q06	ABX 07-1	69.73	39.93	24.54	17.67	16.89	60	39	9	6	5	1
4Q06		69.73	39.93	24.54	17.67	16.89	51	33	8	5	4	1
1Q07	ABX 07-2	66.45	35.09	23.97	19.88	19.01	38	25	6	4	3	1
2Q07		66.45	35.09	23.97	19.88	19.01	23	15	3	2	2	0
3Q07		66.45	35.09	23.97	19.88	19.01	11	8	2	1	1	0
							369	**219**	**55**	**43**	**38**	**12**

[11] For instance, Citigroup [2008] provides a much more sophisticated analysis of loan level data and estimates that losses on "Alt-A" mortgages alone will be about 20% of losses on subprime mortgages. In an environment of broad home price declines, this estimate may prove to be conservative. Moreover, there will also be some losses on prime and jumbo mortgages. In sum, this probably implies that the ABX market is discounting total mortgage credit losses of well above $400 billion.

March 17, 2008

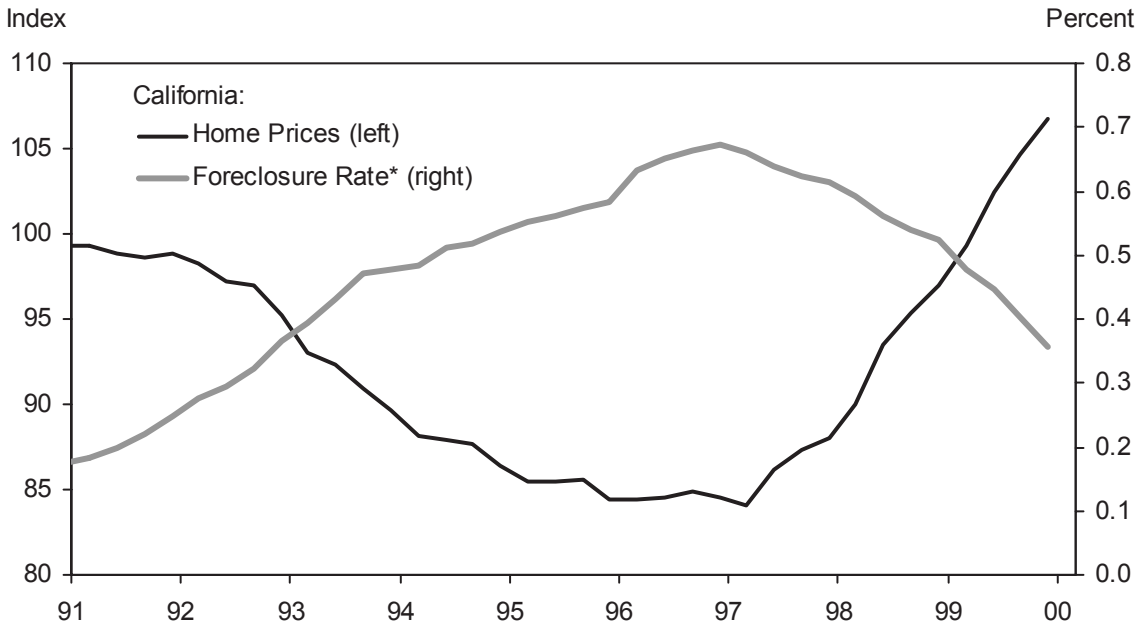
	ABX Prices by Vintage						MtM Loss ($Bn) based on ABX Pricing					
	ABX Index	AAA	AA	A	BBB	BB/ Other	Sub-prime	AAA	AA	A	BBB	BB/ Other
Year	*100%*	*80.8%*	*9.6%*	*5.0%*	*3.5%*	*1.1%*	*100%*	*80.8%*	*9.6%*	*5.0%*	*3.5%*	*1.1%*
2005	ABX 06-1	85.81	64.34	33.22	16.19	14.81	138	72	21	21	18	6
1Q06	ABX 06-2	70.06	35.99	16.00	10.03	9.99	54	34	9	6	4	1
2Q06		70.06	35.99	16.00	10.03	9.99	64	40	10	7	5	2
3Q06	ABX 07-1	54.45	20.66	10.97	9.06	8.88	85	59	12	7	5	2
4Q06		54.45	20.66	10.97	9.06	8.88	72	50	10	6	4	1
1Q07	ABX 07-2	50.67	20.66	15.75	12.56	12.44	52	37	7	4	3	1
2Q07		50.67	20.66	15.75	12.56	12.44	31	22	4	2	2	1
3Q07		50.67	20.66	15.75	12.56	12.44	16	11	2	1	1	0
							511	**325**	**76**	**54**	**43**	**14**

Source: Inside Mortgage Finance, Markit, Morgan Stanley

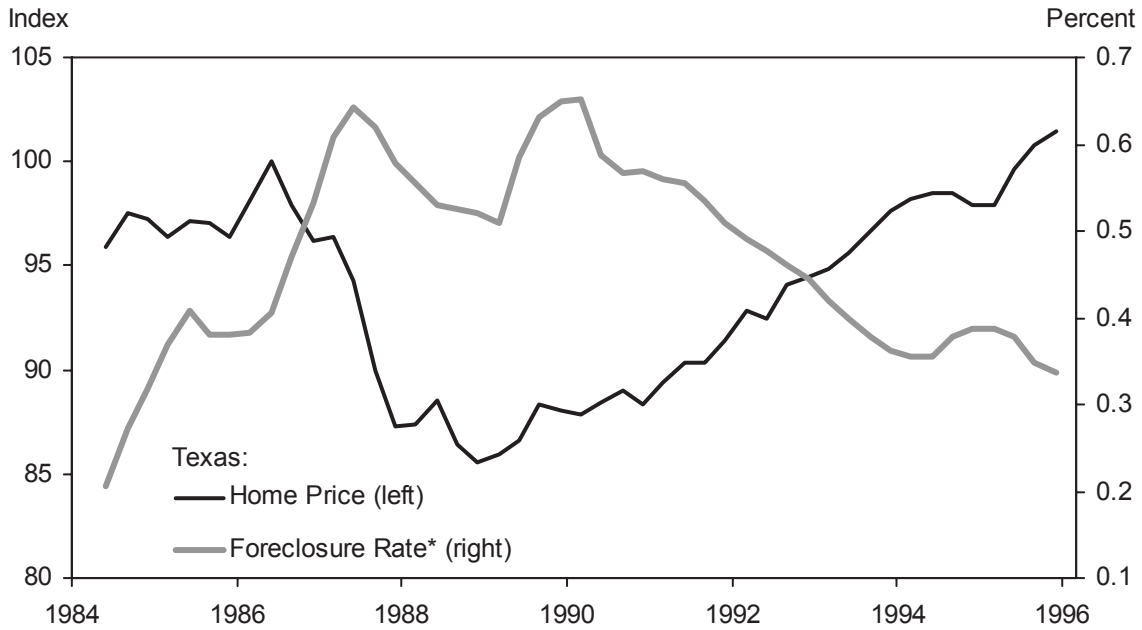
There are many caveats that come with these estimates. We know that trading is thin in the underlying loan pools. More importantly, the ABX prices probably include a risk premium that is necessary to induce investors to bear mortgage credit risk in the current mortgage credit crisis. It may therefore overstate the market's true expectation of future losses, although the size of this overstatement is difficult to gauge. Nonetheless, we find it interesting that the range of losses from this exercise is not too different from the one obtained using calculations from method one above.

Our third method for estimating the losses draws on the past foreclosure experience of individual regions that have seen significant nominal home price declines. While nationwide nominal home price declines have been rare in the United States — at least in the four decades for which we have reasonably reliable data — the same is not true for states such as California, Massachusetts, and Texas in different periods during the 1980s and 1990s. The experiences of these three states are shown in Exhibit 3.5. In all cases, nominal house prices fell 10%–15%, and the foreclosure rate — the (not annualized) percentage of all outstanding mortgages entering foreclosure per quarter — continued to rise until home prices had bottomed. Subsequently, foreclosures did not normalize until after home prices had regained their previous peak, which took another 3-6 years.

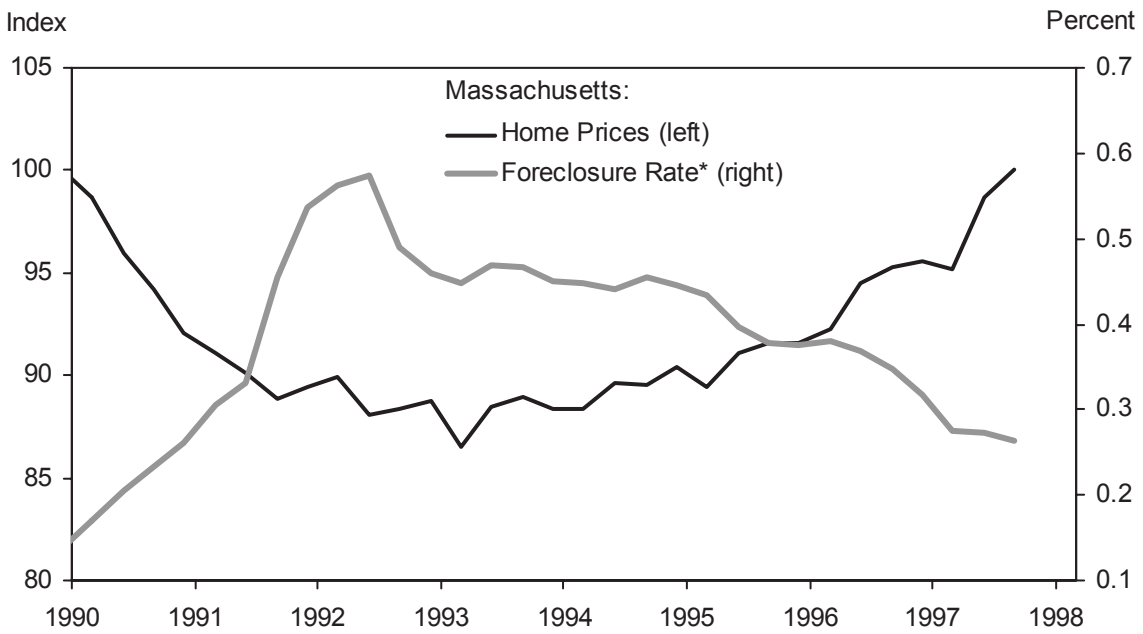
Exhibit 3.5 A Look at Three Regional Housing Busts



* 4-quarter moving average
Source: Mortgage Bankers Association, OFHEO



*4-quarter moving average
Source: Mortgage Bankers Association, OFHEO

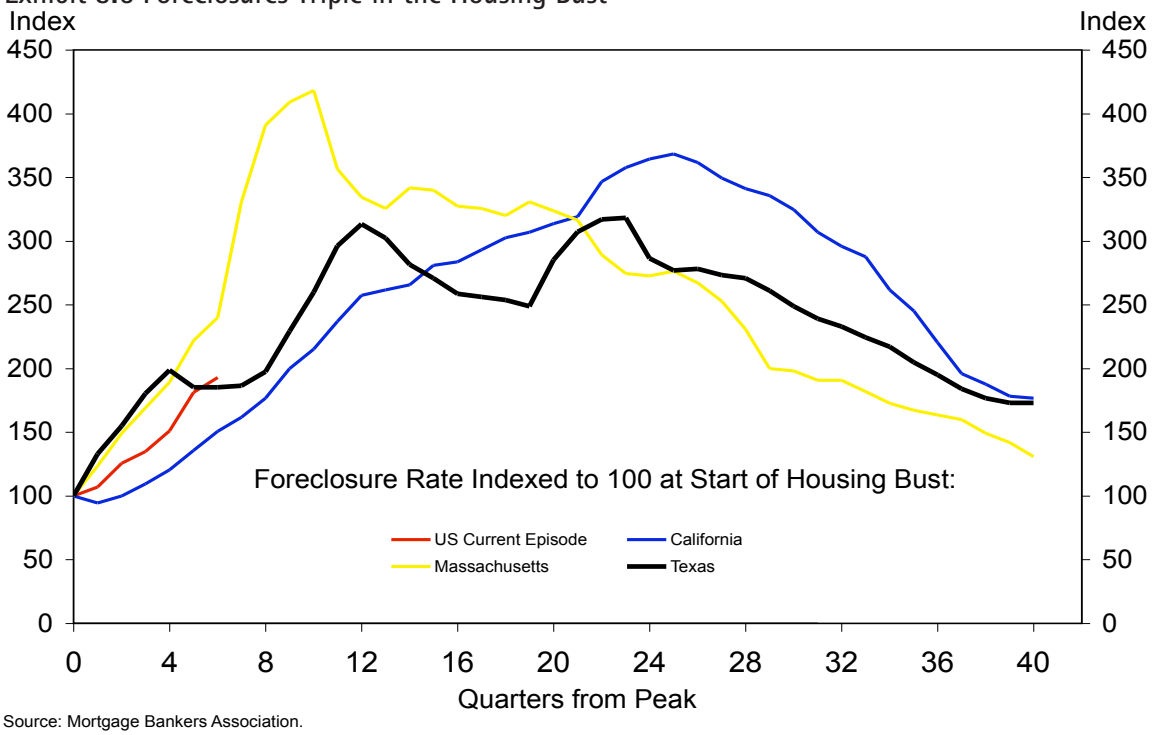


* 4-quarter moving average
Source: Mortgage Bankers Association, OFHEO

Exhibit 3.6 summarizes the experience of the three regional housing busts by indexing the foreclosure rate at the beginning of the episode to 100 and then tracing its evolution over the following decade. The average rate triples within several years, and this same tripling holds for each of the individual states. After peaking between years 2 and 6, foreclosures gradually fall back towards the original level. Moreover, the chart shows that the initial experience with the national foreclosure rate in the first year of the current downturn is roughly consistent with what we saw in the typical regional housing bust episode.

To get an estimate of future U.S. defaults and losses under a scenario of 10–15% peak-to-trough decline in home prices (as measured by the OFHEO index), we could simply apply the pattern of Exhibit 3.6 to the national data. One might argue that this analysis is too pessimistic because California, Massachusetts, and Texas all saw statewide recessions during their housing market downturn. Nationally, a recession is very possible, but it is not a foregone conclusion at this point. However, we believe that the potentially more resilient macroeconomy is likely to be offset by two factors that point to a more difficult environment than in the statewide downturns. First, credit standards as measured by loan-to-value ratios or debt service-to-income ratios were much looser in recent years than in the 1980s and early 1990s. Second, resets on adjustable-rate mortgages are likely to exert a bigger drag on household finances in coming years than they did in the regional housing busts of the early 1990s. This suggests that the pace of the mortgage credit deterioration could rival that seen in the regional housing busts, even if the national economy avoids a serious recession.

Exhibit 3.6 Foreclosures Triple in the Housing Bust



Source: Mortgage Bankers Association.

Hence, we conclude from our analysis that a housing downturn that resembled the three regional busts, with a 10–15% peak-to-trough home price fall, could triple the national foreclosure rate over the next few years. This would imply a rise from 0.4% in mid-2006 to 1.2% in 2008 or 2009. Once home prices recover, the foreclosure rate might gradually fall back toward 0.4%.

So what does this mean for the total amount of mortgage credit losses over the next few years? To calculate the incremental defaults, we cumulate the differences between the projected foreclosure rate and the 0.4% rate prevailing at the start of the downturn in mid-2006 over the entire 2006-2013 period. This is a simple way of adjusting for the fact that this framework does not allow us to isolate defaults on the stock of mortgages outstanding in February 2008 from defaults on mortgages that have yet to be originated. We believe this is a conservative choice, as quality standards on mortgages originated over the next few years are likely to return to the pre-2004 levels. Hence, the vast majority of the defaults in coming years are likely to involve mortgages originated up to 2007.

These assumptions imply cumulative "excess" foreclosures of 13.5% of the currently outstanding stock of mortgages over the next few years.[12] On a base of $11 trillion of 1-4 family mortgage debt, this implies cumulative foreclosure starts of $1.5 trillion. Not every mortgage entering the foreclosure process will end up as an outright repossession, as some homeowners will manage to become current on their payment, sell, or refinance

[12] The calculation is that the foreclosure rate exceeds its baseline level by an average of 0.48 percentage points per quarter for a 7-year period, which implies cumulative excess foreclosures of 13.5%.

before the home is repossessed. However, the percentage of all foreclosure starts that turn into repossessions — measured by the number of Real Estate Owned (REO) notices divided by the lagged number of Notices of Default (NoD) — rose to 68% in the first quarter of 2008 according to Data Quick, Inc., a real estate information company. Assuming that repossessions continue to average about two-thirds of all initiated foreclosures and the average loss severity is 50%, as is typical in a depressed housing market, we calculate that $1.5 trillion of foreclosure starts could translate into mortgage credit losses of about $500 billion.[13] Moreover, if home prices fall by more than the 10–15% drop seen in the California, Massachusetts, and Texas busts, the losses could be significantly larger.

We conclude from our review that total mortgage credit losses on the currently outstanding stock of mortgages could total around $500 billion. This is somewhat more than implied by most vintage-by-vintage analyses, unless these are adjusted aggressively for structural changes resulting from the decline in home prices, approximately in line with the losses implied by the ABX indexes (once we adjust the latter for losses on non-subprime mortgages), and somewhat less than the losses suggested by our state-by-state analysis (once we adjust this analysis for the likely larger home price decline). We reiterate that the uncertainty around our estimate is undoubtedly very high.

3.4 Allocating the losses

To allocate the losses to different types of institutions, we rely on two sources of information: 1) top-down data on the mortgage exposures of different sectors and 2) bottom-up data on announced and estimated subprime exposures by company. In these calculations we exclude any losses on synthetic securities (such as credit default swaps), and this is important to recognize in comparing our estimates with others.

We first use data from the Federal Reserve Board and the Federal Deposit Insurance Corporation to allocate the total outstanding mortgage debt to different sectors. For each part of the "leveraged sector" — banks, savings institutions, credit unions, investment banks, government-sponsored enterprises, and finance companies — we add direct holdings of mortgages backed by 1-4 family homes and holdings of residential mortgage-backed securities (RMBS). Direct mortgage holdings by different sectors are available from the Federal Reserve's Flow of Funds accounts. Holdings of RMBS by commercial banks and savings institutions are available from the FDIC. However, we need to estimate holdings of RMBS by credit unions, investment banks, and government-sponsored enterprises — which are not broken out separately in the Flow of Funds or FDIC data — by extrapolating from the asset-backed securities on their balance sheets and the share of RMBS in the total amount of outstanding asset-backed securities. As shown in Exhibit 3.7 below, our top-down calculation suggests that U.S. leveraged institutions hold 55% of all outstanding mortgage debt, either directly or via RMBS.

[13] The Goldman Sachs [2007] analysis cited previously assumes that severities on recently originated subprime loans will reach 60%. We use the slightly more conservative 50% figure to account for the fact some will occur on non-subprime loans, which are typically larger and where the administrative costs of repossessing and selling the home are therefore smaller in percentage terms.

Our second approach relies on data from Goldman Sachs [2007] that are based on mortgage issuance, default, and prepayment data to calculate exposures to subprime mortgages across a broad range of leveraged and unleveraged institutions. We have made several adjustments to these data in order to estimate the share of all exposures held by U.S. as opposed to foreign leveraged institutions. First, we have reclassified $95 billion of subprime mortgage exposure held in the form of direct subprime loans by Household Finance, the U.S. subsidiary of HSBC, as a U.S. rather than a foreign exposure. This is because our definition of U.S. institutions in the macro data includes the U.S. subsidiaries of foreign banks. To the extent that the data for other foreign banks may also include exposures held by their U.S. subsidiaries, our estimates may understate the share of subprime exposures held by U.S. leveraged institutions.

Exhibit 3.7 Home Mortgage Exposures of U.S. Leveraged Institutions

Home Mortgage Debt	Billion ($)
Total	**11,136**
US Leveraged Institutions	**6,134**
Commercial banks	**2,984**
Direct	2,012
RMBS	971
Savings Institutions	**1,105**
Direct	840
RMBS	265
Credit Unions	**351**
Direct	311
RMBS (estimate)	40
Brokers and Dealers	**257**
Direct	0
RMBS (estimate)	257
Government-Sponsored Enterprises	**963**
Direct	445
RMBS (estimate)	519
Finance Companies	**474**
Direct	474
RMBS	0

Source: Federal Reserve Board, FDIC. Authors' calculations

Second, we need to decide what percentage of hedge fund exposures estimated by the GS analysts refers to U.S. as opposed to foreign hedge funds. Unfortunately, no good information is available on this issue. However, we believe it is safe to assume that U.S. hedge funds account for most subprime mortgage exposures by hedge funds globally and so we assume their share is 80%.

As shown in Exhibit 3.8, our bottom-up analysis implies that U.S. leveraged institutions account for 49% of all identified subprime mortgage exposures. (Note that these data say nothing about exposures to non-subprime mortgage debt.) Based on these data and the top-down estimates shown in Exhibit 3.7, we estimate that roughly 50%, or

$250 billion, of our $500 billion estimate of credit losses on the currently outstanding stock of mortgages will hit U.S. leveraged institutions.[14]

Exhibit 3.8 Subprime Mortgage Exposures, Bottom-Up

	Total reported sub-prime exposure	Percent of reported exposure
U.S. Investment Banks	75	5%
U.S. Commercial Banks	250	18%
U.S. GSEs	112	8%
U.S. Hedge Funds	233	17%
Foreign Banks	167	12%
Foreign Hedge Funds	58	4%
Insurance Companies	319	23%
Finance Companies	95	7%
Mutual and Pension Funds	57	4%
US Leveraged Sector	671	49%
Other	697	51%
Total	1,368	100%

Note: The total for U.S. commercial banks includes $95 billion of mortgage exposures by Household Finance, the U.S. subprime subsidiary of HSBC. Moreover, the calculation assumes that U.S. hedge funds account for four-fifths of all hedge fund exposures to subprime mortgages.
Source: Goldman Sachs. Authors' calculations.

4. Leverage and Amplification

We now attempt to reconcile the evidence presented in the last two sections. In doing so, we focus on three questions. First, can we understand how a shock of roughly $250 billion to the leveraged intermediary sector might cause the type of turmoil that we have documented? Second, can we simultaneously explain why other markets were not initially disturbed? Finally, what will the credit losses imply for lending by the intermediaries?

4.1 The mechanics of active balance sheet management

The first ingredient in our explanation relates to the risk management practices of modern financial intermediaries. Financial intermediaries manage their balance sheets actively in response to changes in anticipated risk and asset prices. When balance sheets are marked to market, asset price changes show up as changes in net worth and elicit reactions from financial intermediaries to changes in their net worth. Even in the absence of asset price changes, shifts in perceived risks will also elicit reactions from leveraged institutions. Moreover, financial intermediaries react in a very different way to the fluctuations in net

[14] In Exhibit 3.8, we have not included the finance companies as part of the leveraged sector. Finance companies are not banks in the traditional sense, but arguably, they could be subject to the same forces in the adjustment of balance sheets. If we were to include finance companies in the leveraged sector the estimated impact of deleveraging to be reported below will be even higher.

worth as compared to households or non-financial firms. Indeed, there is a wealth of evidence dealing with the role of home prices in the monetary transmission mechanism (see Mishkin [2007a]). However, households tend not to adjust their balance sheets drastically to changes in asset prices. In general, leverage *falls* when total assets rise. For households, the change in leverage and change in balance sheet size are negatively correlated.

However, the picture for financial intermediaries is very different. There is a *positive* relationship between changes in leverage and changes in balance sheet size. Far from being passive, financial intermediaries adjust their balance sheets actively and do so in such a way that leverage is high during booms and low during busts. Leverage is procyclical in this sense (Adrian and Shin [2007, 2008]). For financial intermediaries, their models of risk and economic capital dictate active management of their overall value at risk (VaR) through adjustments of their balance sheets. Value at risk is a numerical estimate of an institution's "approximately" worst-case loss, in the sense that anything beyond this worst-case loss happens only with some benchmark probability.

Let V be the value at risk per dollar of assets held by a bank[15]. The total value at risk of the bank is given by $V \times A$ where A is total assets. Then, if the bank maintains capital E to meet total value at risk, we have $E = V \times A$. Hence, leverage L satisfies

$$L = A/E = 1/V$$

Procyclical leverage can be traced directly to the counter-cyclical nature of value at risk. Leverage is high when values at measured risks are low — which occurs when financial conditions are buoyant and asset prices are high. Leverage is low in the troughs of the financial cycles, reflecting increased volatility of asset prices as well as increased correlation of asset returns.

Exhibit 4.1 plots the value-weighted quarterly change in leverage and change in assets for the five major U.S. investment banks up to 2008 Q1[16]. Leverage is defined as the ratio of total assets to book equity. Two features stand out. First, leverage is procyclical. Leverage increases when balance sheets expand, and leverage falls when balance sheets contract. Second, there is a striking contrast between the observation for 1998 Q4 associated with the LTCM crisis and the credit crisis that began in 2007. While balance sheets contracted sharply in 1998, there had not (at least through 2008 Q1) been a comparable contraction of balance sheets during this latest crisis. Indeed, it is one of our central contentions that understanding the reasons for the difference between 1998 and 2007 holds the key to unlocking some of the mysteries surrounding the severe pressures evident in the interbank credit market during the period from August 2007 to the spring of 2008.

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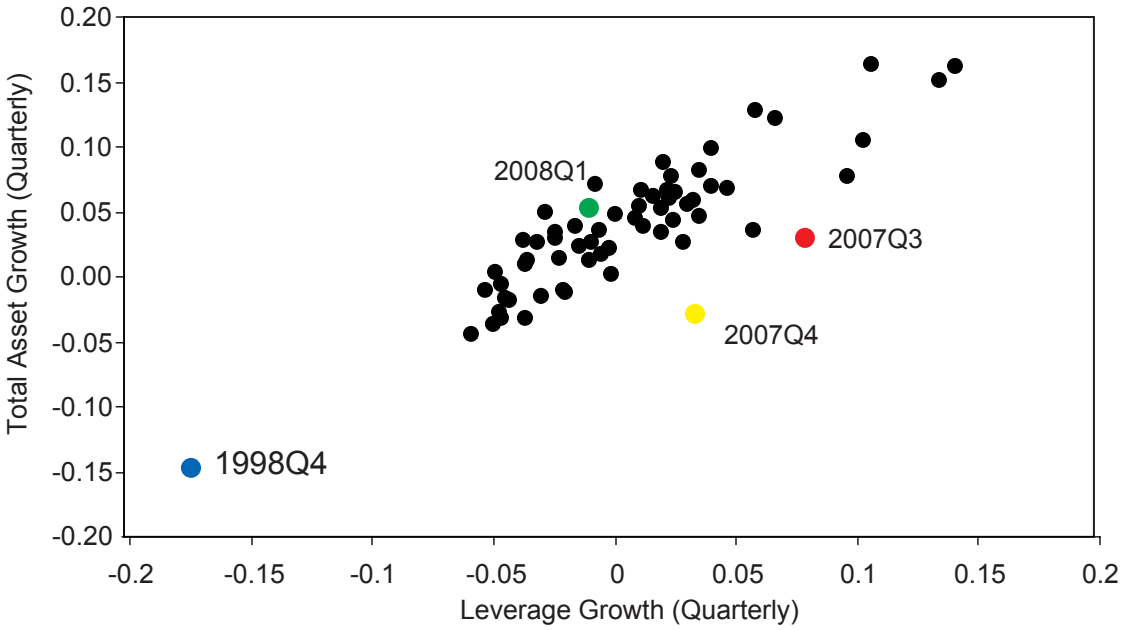
[15] Formally, the value at risk (VaR) associated with some time horizon T is the smallest non-negative number V such that the estimated probability that a bank's loss is greater than V is less than some benchmark probability p. Value at risk is used widely by financial institutions and by regulators, and is incorporated into the Basel capital rules. We use "value at risk" to include the expected losses as well as the unexpected losses. Thus, V should be seen as including the expected losses.

[16] Bear Stearns, Goldman Sachs, Lehman Brothers, Morgan Stanley, and Merrill Lynch, 1991Q1 – 2008Q1. The panel is unbalanced, since not all of these firms were public through the sample period.

Exhibit 4.1 Quarterly Changes in Assets and Leverage of U.S. Investment Banks



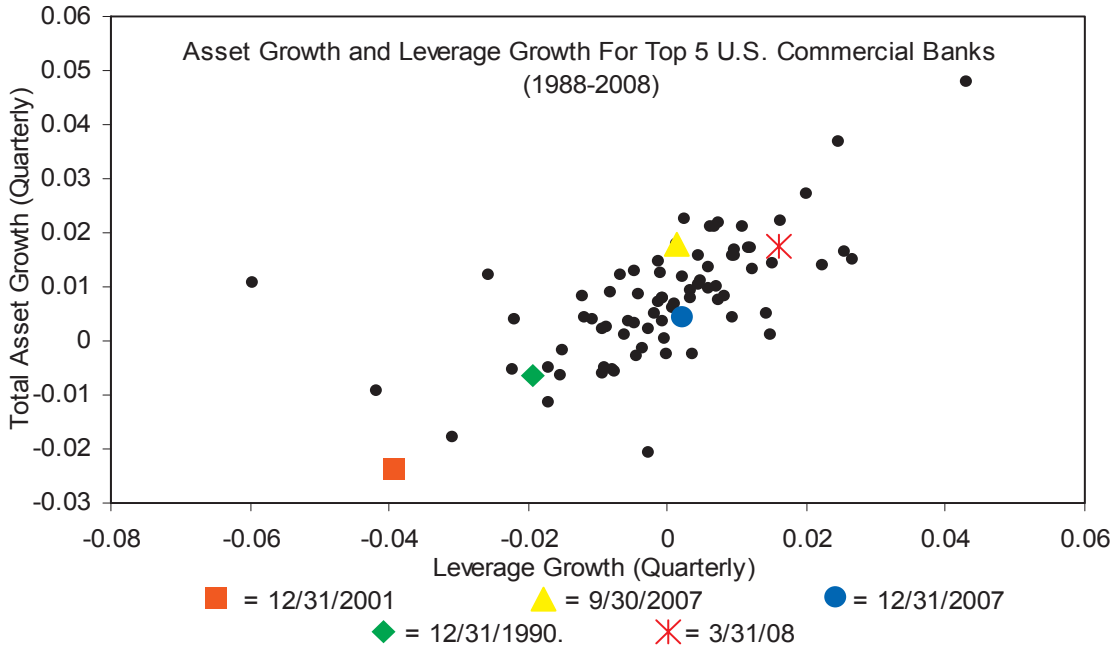
Note: Growth rates are assets-weighted.
Source: SEC

The leverage ratios of commercial banks is typically much lower — at around 10-12 — than that of investment banks (which have leverage ratios of roughly 20–25). However, the relationship between total assets and leverage reveals a similar picture to that given by the investment banks. Exhibit 4.2 plots the relationship between the quarterly change in total assets and the quarterly change in leverage for the five largest U.S. commercial banks — Bank of America, JP Morgan Chase, Citibank, Wachovia, and Wells Fargo — over the period 1988 Q1 to 2008 Q1. One important issue that arises in studying the banks is that each of them has been involved in multiple mergers and acquisitions over this period, so we have adjusted the data to remove these effects.[17]

Commercial banks also exhibit the positive relationship between changes in assets and changes in leverage. Investment bank balance sheets consist largely of very short-term claims (such as repurchase agreements and reverse repurchase agreements), so that their balance sheet values approximate the marked-to-market values of the underlying securities. The same is not true for the commercial bank balance sheets, since loans are carried at face value. Thus, the scatter chart for commercial banks should be interpreted with some caution. Nonetheless, it is interesting to see that through 2008 Q1 the commercial banks had also not shown signs of deleveraging, and in fact leverage actually rose in the first quarter of 2008. This stands in contrast to the experience in the past two recessions, where there was at least one quarter during which shrinking balance sheets were accompanied by falling leverage.

[17] For instance, if banks A and B merge in quarter t so that bank B disappears, we compute the growth rate in assets and leverage by forming a combined bank in quarter t-1.

Exhibit 4.2 Changes in Leverage and Assets for Major U.S. Commercial Banks



Note: Data are adjusted for mergers.

The adjustment of leverage has aggregate consequences that may lead to the amplification of the financial cycle. Consider a simple example. Take a financial intermediary that manages its balance sheet actively so as to maintain a constant leverage ratio of 10. The hypothesis that the intermediary has a constant leverage target is for clarity of the illustration only. Our numerical estimates on credit contractions that follow later in the report recognize the possible role of deleveraging.

Thus, for this illustration only, suppose that the intermediary targets constant leverage of 10. Suppose the initial balance sheet is as follows. The intermediary holds 100 worth of assets (securities, for simplicity) and has funded this holding with debt worth 90.

Assets	Liabilities
Securities, 100	Equity, 10
	Debt, 90

Assume that the price of debt is approximately constant for small changes in total assets. First, let's assume the price of securities increases by 1% to 101.

Assets	Liabilities
Securities, 101	Equity, 11
	Debt, 90

Leverage then falls to 101/11 = 9.18. If the bank targets leverage of 10, then it must take on additional debt of D to purchase D worth of securities on the asset side so that

$$\text{assets / equity} = (101 + D)/11 = 10$$

The solution is $D = 9$. The bank takes on additional debt worth 9, and with the proceeds purchases securities worth 9. Thus, an increase in the price of the security of 1 leads to an increased holding worth 9. The demand curve is upward-sloping. After the purchase, leverage is now back up to 10.

Assets	Liabilities
Securities, 110	Equity, 11
	Debt, 99

The mechanism works in reverse, on the way down. Suppose there is shock to the securities price so that the value of security holdings falls to 109. On the liabilities side, it is equity that bears the burden of adjustment, since the value of debt stays approximately constant.

Assets	Liabilities
Securities, 109	Equity, 10
	Debt, 99

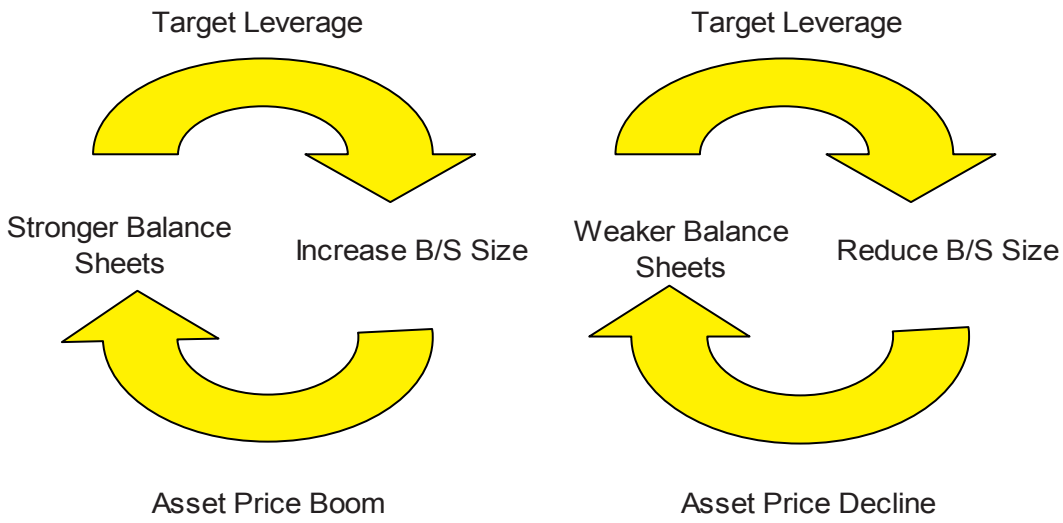
Leverage is now too high (109/10 = 10.9). The bank can adjust down its leverage by selling securities worth 9, and paying down 9 worth of debt. In this way, a fall in the price of securities leads to sale of securities. The supply curve is downward-sloping. The new balance sheet is hence restored to where it stood before the price changes and leverage is back down to the target level of 10.

Assets	Liabilities
Securities, 100	Equity, 10
	Debt, 90

Leverage targeting entails upward-sloping demands and downward-sloping supplies. The perverse nature of the demand and supply curves is even stronger when the leverage of the financial intermediary is pro-cyclical — that is, when leverage is high during booms and low during busts. If, in addition, there is the possibility of feedback, then the

adjustment of leverage and of price changes will reinforce each other in an amplification of the financial cycle.

Exhibit 4.3 The Leverage Circle



If greater demand for the asset tends to put upward pressure on its price, then there is the potential for feedback in which stronger balance sheets trigger greater demand for the asset, which in turn raises the asset's price and leads to stronger balance sheets. The mechanism works in reverse in downturns. If greater supply of the asset tends to put downward pressure on its price, then weaker balance sheets lead to greater sales of the asset, which depresses the asset's price and leads to even weaker balance sheets.

The balance sheet perspective gives new insights into the nature of financial contagion in the modern, market-based financial system. Aggregate liquidity can be understood as the rate of growth of aggregate balance sheets. When financial intermediaries' balance sheets are generally strong, their leverage is too low. The financial intermediaries hold surplus capital, and they will attempt to find ways in which they can employ their surplus capital. In a loose analogy with manufacturing firms, we may see the financial system as having "surplus capacity." For such surplus capacity to be utilized, the intermediaries must expand their balance sheets. On the liabilities side, they take on more short-term debt. On the asset side, they search for potential borrowers that they can lend to. Aggregate liquidity is intimately tied to how hard the financial intermediaries search for borrowers. With regard to the subprime mortgage market in the United States, we have seen that when balance sheets are expanding fast enough, even borrowers who do not have the means to repay are granted credit — so intense is the urge to employ surplus capital. The seeds of the subsequent downturn in the credit cycle are thus sown.

4.2 The implications of active balance sheet management

The amplification mechanism driven by leverage adjustments sheds light on two key features of the current credit crisis:

- First, the early phase of the crisis presented a tale of divergence between those markets that suffered acute distress — including the interbank funding market and mortgage-related markets, such as asset-backed commercial paper (ABCP), collateralized debt obligations (CDOs), and jumbo mortgages. But the stock market and the markets for sovereign debt and high-grade corporate bonds remained relatively unscathed through the early stages of the crisis.
- Second, the current credit crisis began with the deterioration in the credit quality of subprime mortgages in the United States. However, we have seen that, by most measures, the total size of expected losses from credit exposures is small relative to other benchmarks, such as household sector net worth or total stock market capitalization. And yet, the anticipated losses have caused large disruptions.

The key to both features lies in the identity of the holders of the different asset classes in the financial system. Take the case of the stock market. Total U.S. equity holdings (including foreign stocks) stand roughly at $23 trillion. However, only a small fraction (less than 1.3%) of this total is held by leveraged players, such as banks and broker dealers. Most stocks are held by non-leveraged investors — either directly by households, or indirectly through long-only financial institutions such as mutual funds and insurance companies. For households and long-only investors, their reactions to the waxing and waning of balance sheets tend to be passive.

Consistent direct data on sovereign debt holdings by different entities are difficult to obtain. Conventional wisdom suggests that sovereign debt is held by long-only institutions that act as hold-to-maturity investors rather than being held by leveraged institutions that manage their balance sheets actively. Based on footnotes in the annual reports of investment banks, this can be confirmed in a couple of cases.[18]

For corporate debt, it is important to distinguish the cash bonds themselves from the over-the-counter derivatives that have been written on them — such as the credit default swaps. Even among the cash bonds, it may be important to distinguish the holders of high grade corporate debt from the holders of speculative grades. For high-grade bonds, conventional wisdom suggests that these are owned mainly by hold-to-maturity investors, who are not particularly sensitive to changes in their balance sheet size.

In contrast, mortgages and asset-backed securities built on mortgage assets are held in large quantities by leveraged institutions — by the broker-dealers themselves at the warehousing stage of the securitization process, by hedge funds specializing in mortgage securities, and by the off-balance-sheet vehicles that the banks had set up specifically for the purpose of carrying the mortgage securities and the collateralized debt obligations that have been written on them. According to the Federal Reserve's Flow of Funds

[18] As of the end of the 2006 fiscal year, Morgan Stanley reported that 7.2% of the financial instruments owned and securities sold but not yet purchased was sovereign debt. Bear Stearns had 0.3%. Lehman Brothers and Goldman Sachs do not separately show sovereign holdings.

accounts, banks and thrifts held 37% of mortgage debt at the end of the third quarter of 2007.

More importantly still, mortgage-related losses of $250 billion for the financial intermediaries would be quite substantial in comparison to their capital. Below, we provide calculations to document this claim and then explore the endogenous effect that these losses could have on the lending by the intermediaries.

Referring back to Exhibit 4.1, the scatter chart for the U.S. investment bank assets and leverage, we note the contrast between the observations for 1998 Q4 and those for 2007 Q3, 2007 Q4, and 2008 Q1. During the LTCM crisis of 1998, both leverage and balance sheet size contracted very sharply, as we see on the bottom-left corner of the chart. Such a move is consistent with increased value at risk and the desire by the financial intermediaries to conserve capital in the face of heightened uncertainty.

The four major investment banks reported the average daily VaR over the last three months in each of their quarterly SEC filings. Exhibit 4.4 shows these data since May 2006. Through February 2008, VaR had more than doubled relative to May 2006. At the same time, balance sheets had not shrunk.

Exhibit 4.4 Reported Average Daily Value at Risk over the previous 3 months

	May-06	Aug-06	Nov-06	Feb-07	May-07	Aug-07	Nov-07	Feb-08
Index of VaR	1.00	0.89	1.05	1.29	1.38	1.58	1.95	2.12

Source: Authors' calculations using reported figures from Bear Stearns, Goldman Sachs, Lehman Brothers, and Morgan Stanley. Note data for Goldman Sachs are missing for November 2006.

Together these two observations are puzzling. Given what we know about how financial intermediaries behave, we would have expected the 2008 Q1 observation to be in the bottom-left corner of Exhibit 4.1 — near the 1998 Q4 observation. The fact that it is not in the bottom-left corner suggests that other factors are preventing the banks from making such an adjustment.

One conjecture is that off-balance-sheet vehicles such as conduits and SIVs (structured investment vehicles) have played an important role in the current crisis. Conduits and SIVs were designed to hold mortgage-related assets funded by rolling over short-term liabilities such as asset-backed commercial paper (ABCP). However, during the initial stages of the crisis (roughly mid-August 2007), they began to experience difficulties in rolling over their ABCP liabilities. Many of the off-balance-sheet vehicles had been set up with back-up liquidity lines from commercial banks, and such liquidity lines were beginning to be tapped by mid-August.

As credit lines were tapped, the balance sheet constraint at the banks must have begun to bind, making them more reluctant to lend. In effect, the banks were "lending against their will." The fact that bank balance sheets did not contract is indicative of this involuntary expansion of credit. One of the consequences of such an involuntary expansion was that banks sought other ways to curtail lending. Their natural response was to cut off, or

curtail, lending that was discretionary. The seizing up of the interbank credit market can be seen as the conjunction of the desired contraction of balance sheets and the "involuntary" lending due to the tapping of credit lines by distressed entities.

Other factors, such as concerns over counterparty risk and the hoarding of liquidity in anticipation of new calls on the capital of the bank would certainly have exacerbated such trends. However, the hypothesis of an "involuntary" extension of credit appears important in explaining some of the salient features of recent credit market events.

4.4 Deleveraging

Our analysis suggests that the current crisis will abate once one or more of the following three conditions are met.

1. **Either** banks and brokers contract their balance sheets sufficiently that their capital cushion is once again large enough to support their balance sheets.
2. **Or** banks and brokers raise sufficient new equity capital to restore the capital cushion to a size large enough to support their balance sheets
3. **Or** the perceptions of risk change to a more benign outlook so that the current level of leverage can once again be supported with existing capital.

Our working hypothesis is that (3) has not yet happened, although the acute phase of the crisis that reached a peak with the run on Bear Stearns in March has given way to somewhat more orderly market conditions. Although we cannot rule out (3) altogether, we believe options (1) and/or (2) to be more plausible as the mechanism that will bring leverage back into line.

The most optimistic scenario would be (2), i.e., new equity is raised from investors. We have seen substantial amounts of new capital raised so far. In fact, as of May 20, 2008, write-downs announced by about 60 banks and brokerage firms (including numerous non-U.S. institutions) totaled $381 billion, while new capital injections amounted to $266 billion.[19] For US firms only, write-downs were $162 billion while capital injections had reached $138 billion. Of course, some losses were borne by the U.S. subsidiaries of foreign firms, and thus the volume of write-downs and associated recapitalization relevant for our purposes is somewhere between the global total and the U.S.-only amount. The extent of the decline in credit will depend on the combination of the ultimate losses suffered by banks and the amount of new capital they can raise. In the remainder of this section, we explore the various ways in which deleveraging might occur.

In doing so, we will trace the change in "aggregate assets" for the leveraged sector. The logic of the foregoing analysis points to tracking something akin to the sum across all leveraged institutions of their total assets. This can be thought of as the total lending provided by the leveraged sector. But this construct involves a double-counting of assets held by a leveraged institution against another leveraged institution. For instance, a bank

[19] These figures are based on public announcements of write-downs and recapitalizations compiled by Bloomberg (see page WDCI<GO>).

that holds bonds issued by Fannie Mae counts these bonds on the asset side of its balance sheet, but the bonds are a claim held against an entity *within* the leveraged sector.

Adjustments of claims between leveraged institutions in principle need not spill over to the real economy. To identify these spillovers we are interested in the leveraged sector's total claims against other sectors (such as households and corporates). We will refer to these claims as the "aggregate end-user assets" of the leveraged sector.

To quantify the spillovers, define A to be the initial aggregate assets of the leveraged sector, and A^* as the aggregate assets of the leveraged sector after the adjustment of balance sheets. We denote by E the initial equity of the leveraged sector, and by E^* the equity of the leveraged sector following the credit losses, and augmented by recapitalizations (if any).

We will allow for the leverage ratio to change in our hypothetical examples to reflect possible shifts in the stance of banks toward measured risks. We denote by μ the ratio of the new leverage to the old leverage. In other words,

$$\frac{A^*}{E^*} \equiv \mu \times \frac{A}{E}$$

Let L be the total credit losses suffered by the leveraged financial sector as a whole, and k be the proportion of total credit losses that are made up by the raising of new capital. Hence, the shrinkage in total assets of the leveraged sector can be expressed in terms of the ratio:

$$\frac{A^*}{A} = \mu \times \frac{E^*}{E} = \mu \times \left(1 - \frac{L(1-k)}{E}\right)$$

In order to make further progress on estimating the shrinkage of total assets, we need estimates of the parameters. We acknowledge the uncertainty that surrounds μ and k by tabulating our estimates for different combinations of these two parameters.

We are on slightly firmer ground regarding the other two parameters, namely L and E. From our earlier calculations, we believe that a reasonable estimate of L (the losses suffered by the leveraged sector as a whole) is $250 billion. We will work out an estimate of E by calculating the total assets of the leveraged sector and its overall leverage.

First, let us come to an estimate of the total balance sheet size of the leveraged financial sector as a whole. For this, we take account of the following figures.

- The total financial assets of the U.S. commercial banking sector stood at $11.194 trillion at 2007 Q4, according to the Federal Reserve's Flow of Funds accounts.
- Adrian and Shin [2007] estimate the combined total size of balance sheets of the brokerage sector and hedge fund sector to be just over 50% of the commercial banking sector. Thus, as a very conservative figure, we may put a lower bound on the size of the combined broker-dealer and hedge fund sector at half of the total commercial bank balance sheet, or $5.597 trillion.

- We also include the total assets of Fannie Mae and Freddie Mac, which stood at $1.669 trillion.
- Finally, we include the total assets of savings institutions and credit unions ($1.815 trillion and $759 billion, respectively).

Summing these figures, we arrive at an estimate for the total assets of leveraged institutions of $22.945 trillion. In what follows, we will use the rounded figure of $23 trillion as our estimate of leveraged institutions' total assets.

We now turn to the calculation of leverage. The leverage ratios of the different classes of financial institutions vary widely, as is clear from Exhibit 4.5.[20]

Exhibit 4.5 Leverage of Various Financial Institutions

	Assets ($bn)	Liabilities ($bn)	Capital ($bn)	Leverage
Commercial banks	11194	10050	1144	9.8
Savings Inst	1815	1607	208	8.7
Credit Unions	759	672	87	8.7
Finance Companies	1911	1720	191	10.0
Brokers/hedge funds	5597	5390	207	27.1
GSEs	1669	1598	71	23.5
Leveraged Sector	**22945**	**21037**	**1908**	**12.0**

Source: Authors' calculations based on Flow of Funds, FDIC Statistics on Banking, Adrian and Shin (2007), and balance sheet data for Fannie Mae, Freddie Mac, and broker-dealers under Goldman Sachs equity analysts' coverage

Given the wide dispersion in the leverage figures, we will be conservative and choose the round figure of 10 for leverage. This figure is very close to the leverage ratio for commercial banks.

Exhibit 4.6 lists the ratio A^*/A in a two-dimensional tabular form as combinations of different values of k (the proportion of losses recouped by raising new capital) and the desired reduction in leverage. We list three cases — the first is where there is no change in desired leverage, which corresponds to $\mu = 1$, the second is where there is a 5% decline in desired leverage, and the final case is when there is a 10% decline in desired leverage. As we have seen from our scatter charts, experience suggests that changes in leverage can be quite substantial. Thus, although the outcome is very uncertain, we see the 0–10% range as covering the plausible range of declines in leverage. We maintain the assumption that L is $250 billion, and we set E = $2.3 trillion, reflecting our estimate of total assets of $23 trillion, and initial leverage of 10.

[20] In Exhibit 4.5, the liabilities of credit unions is shown so that leverage of credit unions is set equal to that of savings institutions. Finance company liabilities are imputed to produce a leverage estimate of 10.

Exhibit 4.6 Aggregate Asset Contraction as a Fraction of Initial Assets

		Decline in Leverage		
		0%	5%	10%
k	100%	1.00	0.95	0.90
	75%	0.97	0.92	0.88
	50%	0.95	0.90	0.85
	25%	0.92	0.87	0.83
	0%	0.89	0.85	0.80

Exhibit 4.7 translates the proportional contractions in total credit into dollar figures, using our initial estimate of total assets of $23 trillion dollars.

Exhibit 4.7 Total Asset Contraction ($Trillion) Associated with Deleveraging

		Decline in Leverage		
		0%	5%	10%
k	100%	0.00	1.15	2.30
	75%	0.63	1.74	2.86
	50%	1.25	2.34	3.43
	25%	1.88	2.93	3.99
	0%	2.50	3.53	4.55

Shading indicates baseline scenario.

The raw numbers are substantial, especially for the bottom-right cells of the table that correspond to reductions in leverage, combined with meager recapitalization of the leveraged sector losses.

Our baseline scenario (marked in grey) is that leverage will decline by 5%, and that recapitalization of the leveraged system will recoup around 50% of the $ 250 billion loss incurred by the banking system. Under this baseline scenario, the total contraction of balance sheets for the financial sector is $2.34 trillion.

Although the degree of recapitalization is uncertain, it is notable that our estimate for the contraction of balance sheets is not particularly sensitive to the choice of *k*. For instance, if *k* were to turn out to be 25% rather than 50%, the contraction would be only somewhat larger (at $2.93 trillion) than our benchmark case. Alternatively, if *k* were to turn out to be 75% rather than 50%, the contraction would fall to $1.74 trillion.

Calibrating the baseline estimate for the change in leverage is more challenging. As shown in both Exhibits 4.1 and 4.2, there have been occasions in the past when the leverage of intermediaries has shrunk by more than 5%. One reason for choosing this as the reference point is the "lending against their will" phenomenon noted earlier. Because leverage actually increased for both large investment banks and commercial banks during 2007, some of the contraction from that point forward is required just to move back towards the target value that had been obtained before the crisis. Given the more than 50% increase in Value at Risk relative to a year earlier, the 5% assumption strikes us as conservative. But this baseline is admittedly arbitrary. Unfortunately, as can be seen by

scanning across any row in the table, the implied size of the contraction is more sensitive to this assumption than to the one on *k*.

So far, we have examined the contraction in total assets of the leveraged sector, which includes a large degree of double-counting of claims that one leveraged institution holds against another one. For the overall economic impact of credit contraction associated with the end-users of credit (such as households and corporates), we must separate the overall contraction of balance sheets into those that affect other leveraged institutions, and those that affect households and firms.

The rationale behind such a calculation rests on the overall leverage of the financial intermediary sector as a whole. More concretely, it is helpful to write out a stylized balance sheet of a leveraged institution:

Assets	Liabilities
s	d
y	h
	e

Here, s denotes claims on other leveraged parties — such as a bank's holding of Fannie Mae bonds (the "s" stands for "securities"). Loans to end-users outside the leveraged sector are denoted by y. On the liabilities side, the institutions have obligations to other leveraged institutions (d), obligations to non-leveraged entities (h), and equity (e).

Let capital letters corresponding to these items be the sum across the set of all leveraged institutions. Thus, $S = \sum_i s_i$ and $Y = \sum_i y_i$ etc. Then, we have

$$A = S + Y = D + H + E$$

The important point for us is that the claims and obligations between leveraged institutions cancel out when summed. In other words, $S = D$. This is intuitive, since it reflects the fact that the total loans to end-users Y must either be funded through the equity of the banking system E or must come from outside the banking system through H. Hence,

$$Y = H + E$$

Define the ratio of deposits to total assets as:

$$z = \frac{H}{A}$$

Let $\lambda = A/E$ denote aggregate leverage. Then, we have

$$\frac{H}{E} = \frac{H}{A} \times \frac{A}{E} = z\lambda$$

Hence,

$$\begin{aligned} Y &= E + H \\ &= E\left(1 + \frac{H}{E}\right) \\ &= E(1 + z\lambda) \end{aligned}$$

Thus, if we know z (the ratio of deposits of non-leveraged entities to total assets), we can estimate the ratio of the decline in credit to end-users to the decline in total assets from:

$$\frac{Y}{A} = \frac{Y/E}{A/E} = \frac{1 + z\lambda}{\lambda}$$

Exhibit 4.8 shows Flow of Funds data on currency and deposit holdings of various sectors as of 2007 Q4.

Exhibit 4.8 Total Deposits held by Non-Financial Entities

	($bn)
Checkable deposits and currency, personal sector	468
Time and saving deposits, personal sector	6,335
Checkable deposits and currency, nonfin corp	161
Time and saving deposits, nonfin corp	392
Checkable deposits and currency, public sector	112
Time and saving deposits, public sector	248
Total	7,716

Source: Federal Reserve, Flow of Funds accounts

From the total of $7.716 trillion we need to subtract currency holdings. Total U.S. currency in circulation, as of 2007 Q4, was $774 billion. If we assume that three quarters of U.S. currency is held abroad[21], currency holdings would be around $194 billion, which would give us about $7.522 trillion for total deposits.

Using our earlier estimate of $23 trillion for total assets of the leveraged sector, we arrive at a figure for z of 0.327, and our ratio $(1 + z\lambda)/\lambda$ of 0.427. So that:

$$Y = \frac{1 + z\lambda}{\lambda} A = 0.427 \times A$$

[21] See Judson and Porter [1996] for various methods of estimating this percentage.

Hence, if we multiply the aggregate asset reduction shown in Exhibit 4.7 (that includes double-counting) by 0.427 we arrive at the implied credit contraction for non-levered entities. The corresponding figures are shown in Exhibit 4.9; recall that this continues to presume a $250 billion credit loss to the leveraged sector as a whole.

In our baseline scenario of $k = 50\%$ and a decline in leverage of 5%, the contraction of credit to end-users is $1 trillion. We can see that our baseline estimate is somewhat insensitive to higher values of k. For instance, a higher recapitalization ratio of $k = 75\%$ results in a contraction of $740 billion.

Exhibit 4.9 Decline in Credit ($Trillion) to Non-Levered Entities

		Decline in Leverage		
		0%	5%	10%
k	100%	0.00	0.49	0.98
	75%	0.27	0.74	1.22
	50%	0.53	1.00	1.46
	25%	0.80	1.25	1.70
	0%	1.07	1.51	1.94

Shading indicates baseline scenario.

5. Feedback from Balance Sheet Positions to the Real Economy

We turn finally to considering the link between the balance sheet adjustments by the leveraged intermediaries and the real economy. As is well understood, if the conditions assumed by Modigliani and Miller in their pioneering work on capital structure were true, then there would be no reason for the conditions of intermediary balance sheets to matter for any investment decisions; loosely speaking, in this environment agents make investment decisions based purely on net present value rules, and financing is readily available for any positive net present value projects. But when capital markets are imperfect, then balance sheet positions for firms and individuals can affect their creditworthiness, and access to financing is not assured. Furthermore, if some borrowers are dependent on intermediaries for financing, then any factors that disrupt the supply of financing from intermediaries will have real effects.[22]

There is a large existing body of literature suggesting that both these conditions hold, so that fluctuations in credit availability matter for investment decisions (see Stein [2003] and Hubbard [1998] for surveys). There has been less research tying consumer spending to the availability of intermediated credit, although a large body of literature documents that consumers appear to be liquidity constrained (see Agarwal, Liu and Souleles [2007] for recent evidence). Thus, rather than trying to make a major contribution to these vast literatures, we opt for some very simple evidence that provides some quantitative guidance for the implications of the calculations in the prior exhibit.

[22] See Bernanke and Blinder [1988] and Kashyap and Stein [1994] for further elaboration of these points.

5.1 Correlations between GDP and credit

The first challenge in this exercise is coming up with an empirical counterpart to end-user credit extended by the intermediaries. We use domestic non-financial debt (DNFD) as our proxy; we deflate the series in the Flow of Funds with the GDP deflator to arrive at a constant dollar series. The principal advantage of this series is that it has been widely studied and is familiar to both policymakers and market participants. The main drawback is that this series includes financing that comes from non-leveraged entities. However, deposits in the leveraged sector — our measure H in section 4 — seem to be a key driver of DNFD. Deposits lead DNFD by several quarters, and the (phase-adjusted) year-on-year growth rates are highly correlated.[23] However, H is substantially more volatile than DNFD.

Our summary spending measure is gross domestic product (GDP). Again, we could try to trim out parts of GDP such as government spending that would be insensitive to intermediated credit, but we doubt that would make a difference. Rather, we think the transparency of using a standard, known series to establish the correlation is preferred.

As a baseline specification we relate the quarterly log difference of GDP (multiplied by 400 to convert to an annualized rate) to three of its own lags and the lagged four-quarter (log) change of DNFD (times 100). We view the lags of GDP as providing the simplest set of controls for the inertia that characterizes the business cycle.[24] We estimate the model starting in 1983 Q1 and use data through 2007 Q4. We choose this starting date because it roughly coincides with the so-called "great moderation" in most macroeconomic aggregates in the U.S. and because the monetary policy regime has been relatively constant over this period.[25] The coefficients and heteroskedasticity-corrected standard errors from this regression are shown in Exhibit 5.1. Last quarter's year-over-year growth in DNFD is positively and significantly correlated with current quarter real GDP growth; so that if DNFD falls by 1 percentage point and stays below baseline for 1 year, quarterly GDP growth would be predicted to fall by 0.13 percentage points initially and by 0.21 percentage points eventually. Thus, our regression specification implies that credit shocks will be spread over successive quarters.

Exhibit 5.1 OLS Regression of GDP Growth on DNFD

Dependent Variable Quarterly GDP Growth (at an annual rate)

Independent Variable	Coefficient	Standard Error	T-Statistic
Constant	1.470	0.475	3.080
GDP Growth$_{t-1}$	0.290	0.112	2.590
GDP Growth$_{t-2}$	0.284	0.102	2.800
GDP Growth$_{t-3}$	-0.224	0.107	-2.100
4 quarter DNFD Growth$_{t-1}$	0.140	0.072	1.950

[23] For example, from 1953 to 2007 the correlation between DNFD growth and GDP growth two periods later is 0.66.
[24] Additional lags of GDP growth were not significantly different from zero.
[25] See Stock and Watson [2002] for a survey on the Great Moderation and Cecchetti et al [2007] for a discussion of how this relates to monetary policy.

There is an existing literature dating back to Friedman [1983a,b] showing that DNFD and other credit aggregates have some predictive power for GDP, so the correlation in Exhibit 5.1 is hardly surprising. Given this literature, we do not present many alternative specifications. But the basic findings in the exhibit show up in a variety of other regression specifications, including ones that add more lags of GDP, that use contemporaneous growth in DFND, and that use quarterly growth of DFND. One consistent finding is that if we use data starting in the 1960s, the estimated credit coefficient is much larger, so we view the reported coefficient as being conservative.

While the basic correlation is robust, its interpretation is ambiguous. One reading holds that changes in credit availability cause changes in spending. But it is also possible that the causality runs in the other direction. Specifically, if desired purchases were to unexpectedly increase, it is possible that the financial system would accommodate the increased demand to borrow. Under this view, the fluctuations of the intermediary balance sheets represent the passive accommodation of the fundamental preferences of consumers and firms. Based solely on the evidence in Exhibit 5.1 there is no way to separate these two interpretations.

5.2 Instrumental variables estimation of the credit and GDP relation

To sort out the direction of causality, we must find a proxy that will allow us to separate movements in credit demand from credit supply. One proxy is the TED spread that we discussed in section 2; recall that most of the time this series is relatively constant, but it occasionally widens substantially when bank balance sheets are stressed or when there is a generalized credit event.[26]

Our second proxy comes from Senior Loan Officer's survey on the willingness of banks to make installment loans. This component of the survey is the only one available back to the 1980s. One advantage of this series is that it can move both because credit conditions become noticeably looser or tighter.[27] The possibility that loose credit supply during the 2004 to 2006 period, as opposed to just innovation, was an important driver of the housing boom has been noted by many observers. See Rajan [2008] for a fully articulated description of this mechanism that involves an interaction between low interest rates and intermediary incentives.

Exhibit 5.2 shows the same regression as Exhibit 5.1, except that we use four lags of the TED spread and of the willingness to lend variable as instruments for DNFD. The standard error on the coefficient on credit variable is more than twice the size of the standard error in the OLS specification.

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[26] Ideally we would use the LIBOR-OIS spread, since that spread would not reflect developments in the Treasury market. The expected funds rate is not available before 1989. The correlation between this spread and the TED spread (using quarterly data) since that period is 0.86.

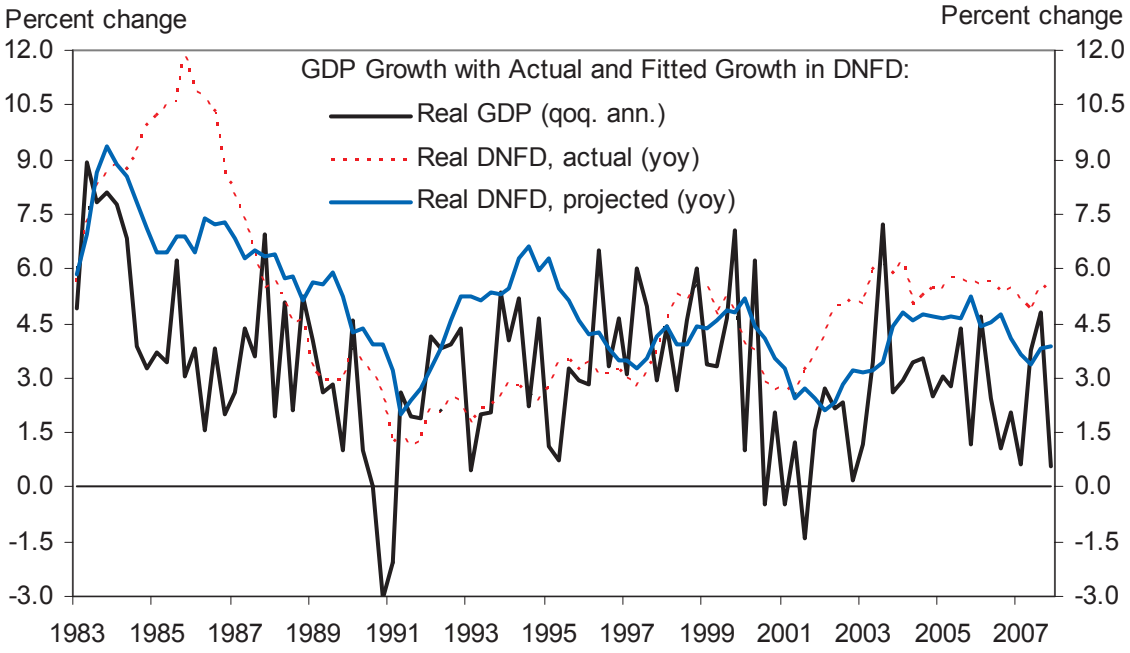
[27] A disadvantage is that respondents can be responding to changing business conditions, so that the answer to the question is not purely a measure of supply.

Exhibit 5.2 Instrumental Variable Estimates of GDP Growth and DNFD

Dependent Variable Quarterly GDP Growth (at an annual rate)

Independent Variable	Coefficient	Standard Error	T-Statistic
Constant	0.904	0.590	1.530
GDP Growth$_{t-1}$	0.247	0.118	2.100
GDP Growth$_{t-2}$	0.242	0.111	2.190
GDP Growth$_{t-3}$	-0.264	0.110	-2.410
4 quarter DNFD Growth$_{t-1}$	0.338	0.176	1.920

Exhibit 5.3 GDP Growth with Actual and Fitted Growth in DNFD



Source: Department of Commerce, Authors' calculation

Again the credit variable is estimated to have a positive and statistically significant correlation with impact on GDP growth. This was also true in the other instrumental variable estimates that we calculated — for instance, when using only one of the instruments, or using longer samples. Across these various estimates, the coefficient on DNFD was always much larger than the OLS estimate. The estimates in Exhibit 5.2 imply that a 1 percentage point decline in DNFD growth would predict a decline of 0.34 percentage points of GDP growth in the short run and 0.47 percentage points in the long run.

Exhibit 5.3 shows a graph of quarterly GDP growth, along with DNFD and the projected value of DNFD from the first stage of instrumental variables estimation. The figure shows why GDP growth is more strongly correlated with the supply-related variation isolated by the instrumental estimation than with the raw DNFD growth; the projected series tracks much better through the 1980s, especially during the first five years of the sample when raw credit growth was negatively correlated with GDP growth. Thus, the larger estimate in Exhibit 5.2 is not accidental.

As a back-of-the-envelope calculation, we can use the estimate from Exhibit 5.2 along with the potential $1 trillion contraction in end-user credit to calculate a GDP effect from the deleveraging. This contraction is equivalent to a 3.2-percentage-point drop in DNFD growth. The results in Exhibit 5.2 imply that this corresponds to a hit to real GDP growth of 1.5 percentage points over the course of the following year. This impact should be viewed as additive to the impact of housing on real GDP growth via other channels, such as the decline in residential investment and any potential wealth effects tied to falling house prices. We emphasize that the calculation is very rough and should be viewed as quite speculative. But it does suggest that the feedback to the economy from the deleveraging could be substantial.

In our estimate of the impact on GDP, we have taken account only of the contraction of end-user credit to borrowers outside the leveraged sector. However, the diminished activity of the leveraged institutions and other entities involved in the securitization chain may well have an effect on GDP more directly through employment and other real decisions. We have not included such effects here, and so our estimates of the impact on GDP should be seen as being conservative.

6. Conclusions

Taking stock of the recent events, several lessons for central banks emerge. We mention a number of the prominent ones by way of concluding our report.

First, unlike the LTCM crisis of 1998 or the stock market crash of 1987, which bore the hallmarks of crises driven by a collapse of confidence, the current crisis has its roots in the credit losses of leveraged financial intermediaries. Liquidity injections by the central bank are an invitation to the financial intermediaries to *expand* their balance sheets by borrowing from the central bank for on-lending to other parties. However, a leveraged institution suffering a shortage of capital will be unwilling to take up such an invitation. Recognition of this reluctance is the key to understanding the protracted turmoil we have witnessed in the interbank market.

Thus, the rationale for cutting short-term interest rates must rest instead on two other channels. For one thing, lower short-term interest rates will typically result in a steeper yield curve. Over time, this improves the profitability of banks and thereby allows them to rebuild scarce equity capital. Moreover, lower interest rates stabilize the real economy by stimulating demand. If stabilizing the real economy improves the positions of borrowers to which the intermediaries are exposed, these cuts can help the intermediaries.

A more effective means to attack directly the financial turmoil would be to facilitate the raising of new equity capital by the banks and to encourage them to retain cash flow by cutting dividends if necessary. Of course, the cutting of dividends will need to overcome the considerable stigma attached to doing so. On this score, ministers of finance and central bankers may have a role to play in facilitating coordinated action so as to overcome the stigma across regions.

The current crisis has the distinction of being the first "post-securitization" credit crisis, and so it has many unfamiliar features. For this reason, the formulation of a policy response that builds on a clearer recognition of the mechanisms of the crisis is more important than ever. As we have seen, the crisis of 2007–08 has presented a tale of divergence between those markets that suffered acute distress — such as the interbank market and mortgage-related markets, including asset backed commercial paper (ABCP), collateralized debt obligations (CDOs), and jumbo mortgages — and other markets, such as the stock market, which came through the early stages of the crisis largely unscathed. Indeed, it is noteworthy that all the major U.S. stock market indices ended up for the year 2007 and only began falling sharply after concerns took hold that a recession was imminent.

The second lesson to emerge for central banks from recent events is the role of short-term rates in the transmission of monetary policy. Standard macro models presume that short-term rates matter because they signal the central bank's intentions regarding the future course of monetary policy (and hence influence longer-term rates that are held to be relevant for most inter-temporal decisions). But short rates are the prices at which collateralized borrowing and lending are rolled over, and hence determine the marginal price of quantity adjustments. In the current episode, this second function of short-term rates has been critical.

The third related lesson is the importance of balance sheet quantities as a gauge of financial market liquidity (see also Adrian and Shin [2008]). The balance sheet adjustment mechanism described in our report places emphasis on the amplifying effects of balance sheet changes. The mechanism we have outlined emerges because of the interaction of marking assets to their market prices and the risk-management practices of levered financial institutions. Both these ingredients seem destined to remain a part of financial system for the foreseeable future. Therefore, we would caution against viewing this episode as an outlier that cannot recur. While the intermediaries are particularly exposed to real estate prices, there is no reason to believe that another credit crisis could not emerge if intermediaries suffered losses in another important asset class.

Our empirical results suggest that supply-induced changes in credit do affect spending. In gauging the strength of this channel, it would be useful to know how much lending capacity is left for the intermediaries. It appears that during the autumn of 2007 many banks were being called upon to provide credit as part of prior loan commitment agreements, which likely delayed their ability to adjust to increasing risk. Ironically, the United States once had a regular monthly survey that tracked how much lending was being done under commitment and how much was truly voluntary. Reinstating that survey seems prudent, and collecting similar information in other advanced economies would also be useful.

Finally, while the importance of tracking quantities on financial intermediaries' balance sheets has some resonance with the traditional monetarist emphasis on the money stock, the analogy is misleading. The securitized markets that have developed over the course of the past decade or so, as well as our balance sheet amplification perspective, make it clear why the traditional monetarist emphasis on the growth of the money stock does a poor job of capturing the fluctuations in market liquidity. Confining attention to deposits alone misses other important and more volatile components on the balance sheets of leveraged financial intermediaries. Central bankers may need to take account of broader balance sheet quantities in the conduct of monetary policy.

Appendix: Two Extensions to Our Credit Loss Estimates

In the main body of the analysis, we restricted our attention to residential mortgages. We estimated that total losses could reach $500 billion, with $250 billion hitting the US leveraged sector. In what follows, we consider two extensions to the analysis in the main text, namely (1) losses on debt other than residential mortgages and (2) the impact of corporate income taxes.

The first extension is to include nonmortgage credit losses. Residential mortgages are the most important single component of the credit deterioration, but the problems are also becoming increasingly visible in other markets. For example, the performance of both commercial real estate (CRE) loans and credit cards is also deteriorating sharply. According to the International Monetary Fund [2008], losses on residential mortgages, CRE, consumer loans, corporate loans, and corporate bonds could total $945 billion, or almost twice as much as our $500 billion estimate of total losses on residential mortgages. (The IMF's residential mortgage credit loss estimate is $565 billion.)

The second extension is a consideration of the offset from corporate income taxes. If a firm records a $10 billion write-down on a pretax basis, this overestimates the hit to equity capital because the writedown will eventually reduce the firm's tax liability. Assuming for simplicity that the effective marginal tax rate equals the current statutory rate of 35%, this reduces the hit to equity capital accordingly. However, this assumes that all firms suffering losses are sufficiently profitable to benefit from the corporate income tax reduction. This may be too optimistic, especially if we consider that some of the affected firms are likely to end up going out of business. Hence, it may be safer to assume an offset in the 25–30% range.[28]

On balance, these extensions are likely to raise the estimated hit moderately. The first extension seems likely to almost double overall losses, while the second could reduce the hit by between one-quarter and one-third. Overall, and assuming a proportional modification to losses for the leveraged sector, this could raise the total hit from about $250 billion to around $300 billion.

[28] Under the current net operating loss (NOL) provision of the tax code, firms are able to carry back losses for two years. Legislation is pending in Congress that would extend the period to four years. Still, even if this legislation is enacted, we suspect that some companies will be unable to use the full amount of the loss.

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Comments

by Frederic S. Mishkin, Member Board of Governors of the Federal Reserve System*

The paper being discussed today, "Leveraged Losses: Lessons from the Mortgage Meltdown," by David Greenlaw, Jan Hatzius, Anil Kashyap, and Hyun Song Shin, examines the following puzzle: How could the recent residential mortgage-market meltdown, which the authors estimate will lead to credit losses of around $400 billion — less than 2 percent of the outstanding $22 trillion in U.S. equities — possibly have such large negative effects on economic activity in the United States? After all, a 2 percent decline in stock market prices sometimes happens on a daily basis and yet leads to hardly a ripple in the U.S. economy.

The authors conclude that these losses have such a large potential impact because they are borne by highly leveraged financial institutions, primarily banks. Their theory is basically as follows: Because banks have so much leverage, they contract their lending by a multiple of their credit losses in order to restore their balance sheets. The resulting contraction in bank lending then leads to a substantial decline in aggregate spending, because bank loans cannot be replaced by credit from other sources. Banks are "special" — that is, they have intermediation capabilities not fully shared by other financial market participants, and those capabilities allow banks to overcome informational barriers between borrowers and lenders and thus make loans that otherwise could not be made.

I find the basic story the paper tells to be reasonably plausible and, therefore, find the paper to be valuable. I do, however, want to put the analysis of the paper in a broader perspective and provide some different views on their results.[29]

The Residential Mortgage Meltdown: A Financial Development Perspective

The first part of the paper provides a nice summary of how recent events in the credit markets led to the subprime meltdown. Let me offer my own view on how the recent disruptions to financial markets have many features in common with typical cycles in financial development.

Financial markets perform the essential economic function of channeling funds to those who have productive investment opportunities (which can include consumer purchases of goods and houses). As I have argued elsewhere,[30] this function of financial markets is critical to a well-functioning economy; without it, countries, and their populations, cannot get rich. Enabling financial markets to effectively perform this essential function is by no

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*These comments refer to the version of the report that was delivered at the conference and do not take into account the revisions made thereafter.

[29]I thank Andreas Lehnert for his excellent assistance and helpful comments. My remarks reflect only my own views and are not intended to reflect those of the Federal Open Market Committee or of anyone else associated with the Federal Reserve System.

[30] Frederic S. Mishkin [2006], *The Next Great Globalization: How Disadvantaged Nations Can Harness Their Financial Systems to Get Rich*, Princeton: Princeton University Press.

means easy; financial markets must solve information problems to ensure that funds actually go to those with productive investments, so that they can pay back those who have lent to them. Financial development involves innovations or liberalization of financial markets that improve the flow of information. Unfortunately, however, financial liberalization and innovation often have flaws and do not solve information problems as well as markets may have hoped they would. When these flaws become evident, financial markets sometimes seize up, often with very negative consequences for the economy.

I would argue that we have been experiencing exactly such a cycle in recent years. Advances in information and communications technology have allowed for faster and more disaggregated mortgage underwriting decisions. A mortgage broker with an Internet connection could quickly fill out an online form and price a loan for a customer with the help of credit-scoring technology. The same technological improvements would allow the resulting loan to be cheaply bundled with other mortgages to produce mortgage-backed securities, which could then be sold off to investors. Advances in financial engineering could take the securitization process even further by aggregating slices of mortgage-backed securities into more complicated structured products, such as collateralized debt obligations (CDOs), to tailor the credit risks of various types of assets to risk profiles desired by different kinds of investors.

As has been true of many financial innovations in the past, the benefits of this disaggregated originate-to-distribute model may have been obvious, but the problems less so. The originate-to-distribute model, unfortunately, created some severe incentive problems, which are referred to as principal-agent problems, or more simply as agency problems, in which the agent (the originator of the loans) did not have the incentives to act fully in the interest of the principal (the ultimate holder of the loan). Originators had every incentive to maintain origination volume, because that would allow them to earn substantial fees, but they had weak incentives to maintain loan quality. When loans went bad, originators lost money, mainly because of the warranties they provided on loans; however, those warranties often expired as quickly as ninety days after origination. Furthermore, unlike traditional players in mortgage markets, originators often saw little value in their charters, because they often had little capital tied up in their firm. When hit with a wave of early payment defaults and the associated warranty claims, they simply went out of business. While the lending boom lasted, however, originators earned large profits.

Many securitizers of mortgage-backed securities and resecuritizers, such as CDO managers, also, in retrospect, appear to have been motivated more by issuance and arrangement fees and less by concern for the longer-run performance of these securities.

These agency problems combined to lower underwriting standards, so that borrowers with weaker financial histories had access to larger loans. When the housing market cooled and house prices no longer rose at a rapid pace, these subprime borrowers found themselves unable to either repay their loans or refinance out of them. Investors apparently failed to realize the importance of these agency problems and, it seems, did

not insist on practices to align the incentives of originators, securitizers, and resecuritizers with the underlying risks.

When these problems came to light with the end of the house-price boom, investors — including leveraged financial institutions — took large losses as mortgage-related assets were marked down in anticipation of high defaults. The market for newly issued subprime and alt-A mortgage-backed securities virtually closed. In addition, investors realized that they were sadly mistaken regarding their assumption that structured credit products with high credit ratings embodied very little risk. The unprecedented losses on, and downgrades of, those products suggested that they were far more opaque than investors had suspected, and that investors had had too much confidence in the ability of the credit rating agencies to assess the true risk of these securities. The result was that the originate-to-distribute business model, as well as structured credit products more broadly, have come into question. In turn, this situation has had a chilling effect on securities markets and has put pressure on the balance sheets of leveraged financial institutions.

Although the perspective I have outlined here is consistent with the story told in the paper, it does emphasize that there are two parts of the recent disruption in the credit market: credit losses at banks and the near-collapse of broad classes of securities markets. This perspective raises the issue, which I will return to later, of whether the negative consequences of the decline in intermediation required both of these elements to be present.

Estimating Mortgage-Credit Losses

The paper performs a very useful function by providing estimates of the credit losses likely to be realized on the current stock of outstanding loans. Not only is this calculation crucial for their analysis, it is a useful survey of three different methodologies for arriving at loss estimates. The authors first use a standard vintage curve analysis on outstanding mortgage-backed securities. Although this method makes the strong assumption that future loss curves will follow the same shape as previous loss curves, albeit at much higher levels, it provides a reasonable rough guess of the magnitudes of the losses.

The second method the authors use is ABX pricing of subprime mortgages plus standard loss estimates on prime and near-prime mortgages to come up with loss estimates. ABX prices, in principle, ought to reflect the up-to-the-minute credit losses expected by market participants as well as changes in the price of liquidity and market risk. Indeed, I was worried that ABX pricing might overestimate credit losses because it carries premiums for these other risks, and trading may be light. For example, the AAA-rated tranches of recent vintages are trading for around sixty-six cents on the dollar, which seems to build in either extreme credit-loss estimates or compensation for other risks. However, the authors weight the various vintages and tranches of the ABX by outstanding dollar amounts and get reasonable estimates, which suggests that this approach to estimating mortgage-credit losses may have some value.

The authors' third method is quite clever and uses state-level foreclosure models to estimate how declines in house prices would increase foreclosure starts and thus lead to losses. Figure 1 displays a reasonably tight relationship between the rate of foreclosures started in the third quarter of 2007 and the previous four-quarter change in house prices in the fifty states and the District of Columbia. This figure provides some backing for their approach, which, in effect, uses the historical relationship between house price declines and foreclosure starts in states that have had significant house price declines to estimate the likely effect of current projected house price declines on foreclosure starts. However, their method requires the assumption that future foreclosures will respond to house prices as they have in the past. In addition, past experience was with prime mortgages, because there was little subprime lending. Will foreclosures in the subprime market in the current episode have a similar pattern of behavior to that which has occurred for prime mortgages?

Although each method of calculating mortgage credit losses has problems, the beauty of the authors' approach is that they go at the problem in very different ways. It is striking that three very different methodologies produce similar estimates of around $400 billion in total credit losses over the next couple of years. The authors then estimate that roughly half of mortgage loans are held by U.S. leveraged financial institutions, which include commercial banks, thrifts, hedge funds, the government-sponsored enterprises, and others, and come up with losses to this sector of around $200 billion. This estimate might not be unreasonable, but it is very rough, because it assumes that institutions do not differ significantly in the kinds of risk they take on and that mortgage-related securities are evenly distributed across these financial institutions.

Effect of Credit Losses on Domestic Lending

The authors go on to show that what might appear to be a small amount of losses to financial institutions can lead to an amplified decline in domestic lending. This amplification can then explain how modest losses can lead to a substantial effect on the overall economy. Their calculation is fairly straightforward. They assume that leveraged financial institutions have a target 10-to-1 leverage ratio, so that each dollar of a loss of capital will lead to a contraction of their balance sheet, and hence lending, by $10. Assuming that institutions can make up half of their $200 billion mortgage credit losses by raising new capital, leaving them with a decline of capital of around $100 billion, they come up with a contraction of domestic lending near $1 trillion. Actually, the authors' calculation is a bit more complicated than my simple characterization. They assume that the target leverage of banks and others decreases, as it has in previous lending cycles, but they also net out reduced lending from one leveraged entity to another. On balance, under their baseline scenario, they predict that lending to the unleveraged sector will decline by about $910 billion.

These mechanical calculations are useful, but they miss some important subtleties. First, small losses can hit key institutions, such as bond and mortgage insurers, and have large, unpredictable effects. Second, if leveraged financial institutions such as banks were the

only ones that had credit losses and, as a result, cut back lending, other institutions or securities issuance could replace some of the lost lending. Put another way, although banks are special because they have advantages in processing information and making loans, a big contraction in their assets would not necessarily choke off all lending. Banks are special, but not that special. As I discussed earlier, a key characteristic of this episode of financial disruption is that it has spread far beyond leveraged financial institutions. It has led to a sharp decline in securities issuance; this decline has to be an important part of the story of why the current financial market turmoil is affecting economic activity. In other words, mortgage credit losses are a problem
because they are hitting bank balance sheets at the same time that the securitization market is experiencing difficulties.

Effect of Decreased Leveraged Institution Lending on Aggregate Spending

The paper then examines the well-known correlation between growth in debt and gross domestic product (GDP) to estimate the effect of the $910 billion decline in leveraged institution lending on economic growth. The authors first estimate an ordinary-least-squares (OLS) regression of quarterly GDP growth on four lags of GDP growth and the past four-quarter growth rate of domestic nonfinancial debt growth. They find that if debt growth falls by 1 percentage point and stays below baseline for a year, quarterly GDP growth is predicted to fall by 0.14 percentage point initially and by 0.22 percentage point over time. The authors rightfully recognize, however, that the coefficient on debt growth may be biased upward because of reverse causality — that is, causality might run from higher economic growth to higher debt growth, because when desired purchases increase, households and business finance them by borrowing more. Another way of stating the problem is that the debt-growth coefficient may not only reflect the affects of changes in credit supply but also changes in the demand for credit.

To deal with the possible bias in the OLS regression and estimate the effect of credit supply on economic growth, the authors appropriately turn to instrumental variable (IV) estimation by instrumenting debt growth in their regression with two instruments, the Treasury-Eurodollar (TED) spread and the Senior Loan Officer Opinion Survey on the willingness of banks to make installment loans. The IV estimate of the coefficient on debt growth more than doubles, so that a 1 percentage point decline in debt growth predicts a decline of 0.34 percentage point in GDP initially and 0.44 percentage points in the long run. Because a standard reverse causality story from GDP growth to debt growth suggests that the OLS estimate of the debt-growth coefficient is upwardly biased, the finding that the IV estimate is larger than the OLS estimate is indeed quite surprising.

This surprising finding raises several questions. It can call into question the validity of the instruments, which, to be valid, need to be correlated with debt growth and yet be unaffected by economic growth. This assumption, however, is unlikely to be correct because poor prospects for economic growth surely raise credit risk, thereby leading to a

higher TED spread and less willingness to lend on the part of banks. Thus, a higher TED spread and less willingness to lend may reflect the likelihood of tougher economic times ahead and *not* an exogenous shift in credit supply.

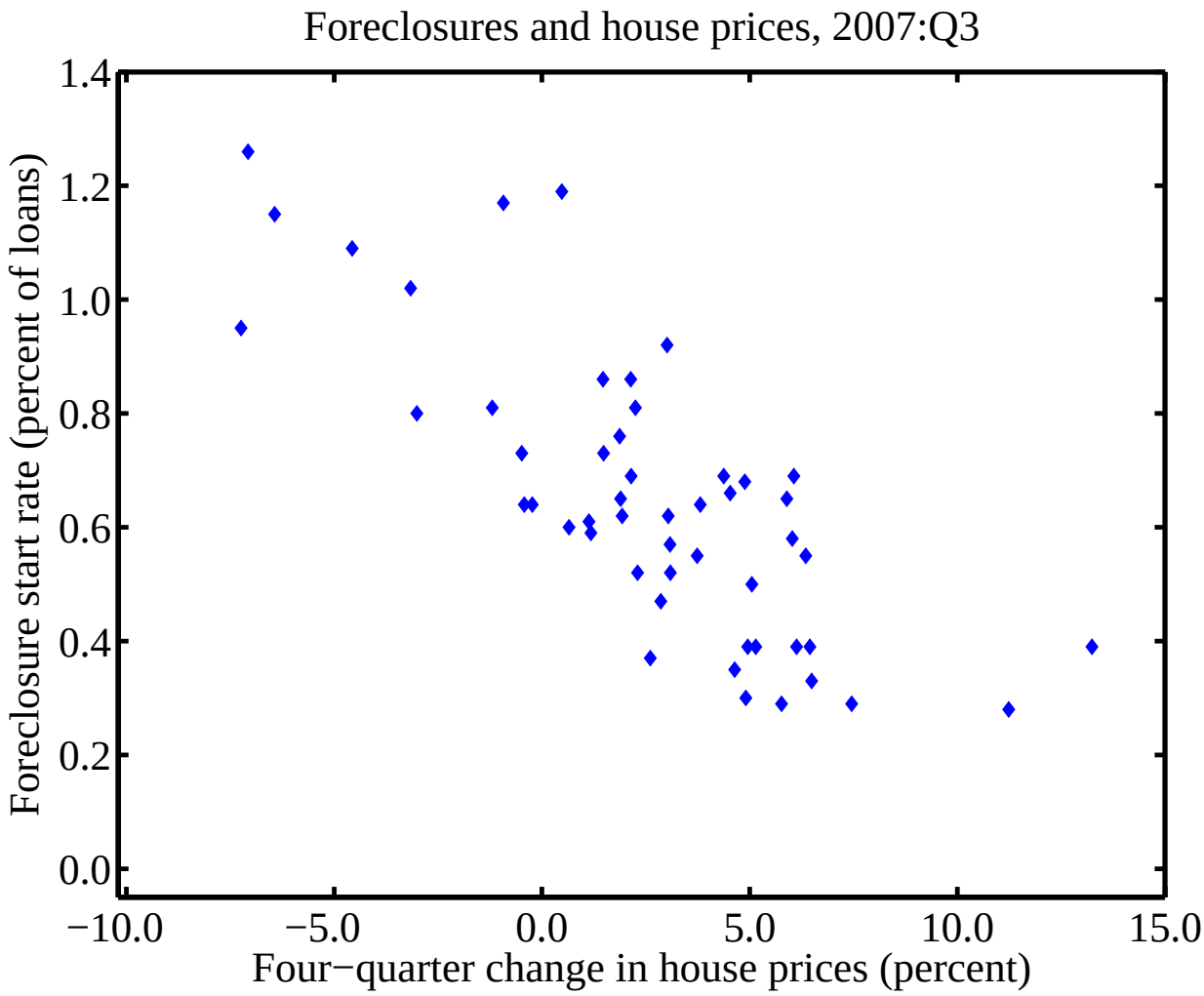
The final calculation in the paper is to combine the authors' IV estimates with their estimate of the decline in lending from leveraged institutions of $910 billion to estimate the impact on GDP growth. The $910 billion drop in debt against a $30.3 trillion amount of nonfinancial debt outstanding is a 3 percentage point drop in nonfinancial debt growth, which when multiplied by the 0.44 long-run coefficient on debt growth, leads to a slowing of GDP growth of 1.3 percentage points over the following year.

Although this number is not implausible, there are reasons to be suspicious of it. On the one hand, even if you accept the IV coefficient estimate, despite the reasons to doubt its accuracy, it might overstate the impact of the decline in leveraged institution lending on the economy; as mentioned earlier, other sources of lending might come online if leveraged institutions stop lending. On the other hand, the estimated impact on the economy could be too low. As I have discussed, the disruption to the financial system is far broader than just to leveraged institutions. To the extent that the meltdown in the mortgage market has revealed even deeper problems in the financial system, the negative impact on economic activity could be even larger.

Conclusion

I very much enjoyed reading this paper. Many of the calculations in the paper are especially useful and help us get a better handle on how the recent turmoil in credit markets can affect the economy. I agree with the basic story that the authors tell, which is that relatively small losses in one sector of the credit market can have an outsized impact on aggregate economic activity if they cause a disruption to the financial system that leads to an amplified impact on lending. However, as my comments suggest, the authors may not have the full story. It is not just the impact on leveraged financial institutions that matter, but on the overall ability of the financial system to channel funds to those institutions with productive investment opportunities.

Figure 1. State-level foreclosure starts (as a percent of loans) in 2007:Q3 and four-quarter house price changes (2007:Q3/2006:Q3).



Comments

by Eric S. Rosengren, President and CEO, Federal Reserve Bank of Boston*

I am very pleased to be able to discuss the paper "Leveraged Losses: Lessons from the Mortgage Meltdown" by Greenlaw, Hatzius, Kashyap and Shin (GHKS).

It is somewhat ironic that several current participants on the Federal Open Market Committee (FOMC), including myself, wrote extensively about the credit crunch period in the early 1990s and now have the opportunity as policy makers to consider how financial problems may be spilling over to the real economy.[31] So it is particularly appropriate that the paper we are discussing today asks whether problems that originated in mortgage markets are likely to cause a credit crunch that significantly impacts growth in the economy, and what that implies for central banks.

The paper provides a variety of new facts about the current financial turmoil and does a very nice job of detailing the extent of current and potential problems that may impact future public policy. I plan first to discuss the issue of the size of the losses to financial institutions stemming from the current financial turmoil. I will highlight both the uncertainty around the GHKS estimate, and the possible downside risk that may remain to their estimate. I will next discuss the issue of the impact on balance sheets. I will argue that, to date, the balance sheet constraints are primarily occurring at a few large institutions with significant exposure to more complicated financial products; but that again, there is downside risk that balance sheet constraints could become more widespread in the future — particularly if housing prices experience more significant declines. I will then amplify an issue touched on only lightly in the paper, and that is the implications of mortgage problems for securitization and complicated financial products. I will conclude with a few observations on policy.

Residential Real Estate Losses — The Role of Declining Housing Prices

GHKS use three different methods to determine mortgage credit losses. The first is a migration analysis that looks at historical trends of each vintage year and then adjusts the trends for falling home prices. The second extrapolates from the current pricing of mortgage-backed securities' expected losses. The third uses foreclosure rates from previous regional periods of falling housing prices and applies those rates to the current distribution of mortgages. With several assumptions and caveats, they find losses are expected to be $400 billion, with about half of that figure being borne by leveraged institutions.

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*These comments refer to the version of the report that was delivered at the conference and do not take into account the revisions made thereafter.

[31] For example, see the following. Peek and Rosengren, "The Capital Crunch: Neither a Borrower or a Lender Be" in the *Journal of Money Credit and Banking*, August 1995, pp. 625-638. Bernanke and Lown, "The Credit Crunch" in *Brooking Papers on Economic Activity,* 1991, 205-48. Mishkin, "Preventing Financial Crises: An International Perspective," published by The Manchester School of Economic and Social Studies, 1994, pp. 1-40.

The authors highlight the significant uncertainty around their estimates. This is particularly appropriate since two critical components of the calculation, the path of housing prices and the path of the economy, are not directly estimated in the model. Analysis by Gerardi, Shapiro, and Willen of the Federal Reserve Bank of Boston[32] finds the probability of a default and foreclosure is highly sensitive to the macroeconomic environment — particularly to house price appreciation.

In making adjustments for falling housing prices, GHKS discuss house price declines of 5, 10, and 15 percent from the end of 2006. While housing prices are critical to understanding the extent of overall mortgage credit losses, the absence from the historical record of a sustained *national* decline in housing prices makes it problematic to extrapolate the future solely with historical data. As shown in Table 1, all 10 major metropolitan areas followed by the Case-Schiller home-price index declined in the past year, and five of the major metropolitan areas show double-digit declines. These declines have occurred despite an unemployment rate in January 2008 of 4.9 percent. Should the economy weaken more than expected, one can envision downside risks to even the rather bleak forecast of GHKS — especially given the large number of high loan-to-value (LTV) loans made in the past three years.

From a policy perspective, it is important to understand not only what would happen if the economy behaves as expected — which would currently be that we skirt a recession and housing prices show only modest declines — but also how significant the downside would be if the rise in the unemployment rate and the decline in housing prices were significantly greater than currently expected. The authors' estimates of expected losses do not try to factor in the potential — though hopefully unlikely — outcome of housing prices interacting with sharper declines in employment and further financial difficulties at mortgage lenders. While not the most likely outcome, it is an outcome that policymakers and others may consider "taking out some insurance against."

An additional factor left out of the analysis involves the nature of the housing recovery that is likely to occur if the mortgage securities market and financial institutions are unwilling to lend to subprime borrowers. Given the recent difficulty in securitizing troubled or high LTV mortgage credits, and the possibility that many financial institutions will be reticent to lend to risky borrowers in a declining house price market, the housing malaise could be more protracted and the recovery more anemic than we have experienced in previous housing downturns.

Balance Sheet Constraints

GHKS argue that the distribution of mortgage losses is important. Many of these losses are in leveraged financial institutions, which will be forced to shrink their balance sheets

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[32] Kristopher Gerardi, Adam Hale Shapiro, and Paul S. Willen, "Subprime Outcomes: Risky Mortgages, Homeownership Experiences, and Foreclosures." Federal Reserve Bank of Boston Working Paper 07-15.

to maintain desired capital ratios. Thus the analysis is in the spirit of earlier credit-crunch literature that highlights that binding capital constraints at financial institutions can result in significant headwinds, as experienced in the United States in the early 1990s and in Japan during the "lost decade."[33]

To date, there have been several significant differences in the distribution of losses compared to the 1990s. The 1990s credit crunch resulted from regional losses in commercial real estate and construction, and to a lesser degree residential investment. These losses essentially impacted all financial institutions in the affected region. To date in our current situation, the mortgage problems have been concentrated in some of the largest financial institutions involved in structured finance and the securitization of subprime mortgages.

In fact, three large financial institutions alone have already announced almost $60 billion in write-downs in the last two quarters of 2007.[34] Despite the very significant write-downs, the losses have been mitigated by the ability of these global institutions to attract new capital. In fact, these same three institutions have together announced $36 billion in new capital in the last four months (October-January).[35] This ability to raise new capital has helped mitigate capital constraints.

Table 2 shows that, despite large financial losses announced by some commercial banks in the past two quarters, many banks have experienced increases in capital and in their capital ratios. In fact, more than two-thirds of bank holding companies had increases in capital in the last two quarters of 2007. Note, however, that the decreases are more prevalent among the largest bank holding companies, while the increases are more prevalent among the smaller bank holding companies. In terms of capital ratios, 354 bank holding companies had increases in capital ratios in the last two quarters of 2007, while 592 had decreases. This reflects that even at bank holding companies with increased capital, the asset growth has exceeded the capital growth.

Table 3 shows that in aggregate, while capital was basically flat, assets did increase, as banks provided liquidity to many firms and financial market participants. To date, the resulting potential capital constraints are concentrated in the largest banks with the largest exposure to securities tied to subprime mortgages. While some of the capital losses have been mitigated by new capital, the losses in combination with involuntary growth in assets can potentially restrain the willingness of these institutions to engage in activities that would further swell their balance sheet.

Because these institutions are actively engaged in structured products and loans to finance leveraged deals, it is not surprising that participants in these markets are finding tighter financial constraints. For some markets where these banks are major market

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[33] An overview of the credit crunch literature is provided in Peek and Rosengren, (forthcoming) "The Role of Banks in the Transmission of Monetary Policy," in the *Oxford Handbook of Banking*.
[34] Source: Bank earnings announcements
[35] Source: Bank announcements

makers, the unwillingness to increase balance sheets further has impacted the liquidity in those markets.

Many small- and medium-sized businesses are not complaining about credit conditions. This reflects the lack of exposure that many small and medium-sized banks had to securitized products or the subprime market. However, should housing prices continue to fall, losses in prime residential mortgages and construction loans are likely to cause these institutions to be more capital constrained. Banks under $100 billion still retain significant exposure to residential mortgages and construction loans that account for 26 percent of assets or $750 billion. Should housing prices continue to fall and the housing sector get worse, it is likely that these institutions will begin being impacted more significantly.

Spillovers From the Mortgage Meltdown

An issue not directly addressed in this paper, but nonetheless critical to the discussion, is the loss in confidence in the ratings process and the consequent uncertainty in the pricing of a wide variety of structured products.

As Exhibit 3.4 in GJKS highlights, AAA tranches for recently issued contracts are selling for less than 70 percent of their par value. Since lower-grade tranches would experience losses first, such pricing implies very severe losses on the underlying assets. It also highlights that the default probabilities on a large number of highly-rated securities are likely to be higher than would normally be expected by investors in the highest-grade securities. While the problems with ratings accurately reflecting probabilities of default are primarily related to mortgage products, their impact has moved well beyond residential mortgages.

The largest banks have increasingly moved to an originate-to-distribute model for a variety of assets formerly held on balance sheets. Leveraged loans, credit card receivables, commercial real estate loans, student loans, and municipal borrowings have all increasingly been moved off banks' balance sheets and into a variety of new securities. As investors have lost faith in the ratings process, many of these highly rated securities have begun to sell at significant discounts, which will likely result in additional losses.

In addition to the losses experienced by the holders of these securities, the borrowers have had their financing disrupted. Many of these loans will need to be financed by bank balance sheets, and the terms may be significantly different from what they experienced prior to the recent financial turmoil.

Difficulties in selling structured financial products have resulted in the disappearance or near-disappearance of trading in some collateralized loan obligations (CLOs) and collateralized debt obligations (CDOs), have disrupted the auction-rate securities market, have made it difficult to sell asset-backed commercial paper, have created problems for monoline insurers, and have caused the winding down of many structured investment

vehicles. Many of these markets financed assets above and beyond mortgages and as a result may produce losses not captured in the analysis by GHKS. While problems in rating mortgages may have been the trigger, the drying up of the market for structured financial products is a downside risk and could make it more difficult or more expensive to meet the financing needs of a variety of organizations.

Public Policy

GHKS express some pessimism regarding the ability of monetary policy to help mitigate problems. I am less pessimistic. Most subprime loans had reset rates tied to the London Interbank Offered Rate (LIBOR) — generally around 6 percentage points over the six-month LIBOR. The reductions in the federal funds rate, as well as the reduction in the spread of LIBOR over the federal funds target after the introduction of the Federal Reserve's Term Auction Facility, have significantly reduced the reset rate for most subprime borrowers (Figure 1). For many borrowers, the reset rate may at this point not be dramatically different from the original rate — a significant difference from what would have occurred in the absence of appropriately aggressive monetary policy.

In addition, lower rates are likely to result in higher house prices than would occur in the absence of monetary easing. This should reduce the foreclosure rate and reduce some of the concern that housing problems will become more widespread. Finally, lower rates should result in less unemployment — one of the main drivers in forced sales of houses. Thus, monetary policy actions may significantly reduce the depth of problems, but are of course not a panacea.

Many of the possible steps to mitigate these problems involve policy solutions not tied to monetary policy. In recent years the subprime market became the major avenue for low- and moderate-income borrowers to buy homes. There would seem to be a strong economic incentive for borrowers to seek FHA insurance and get a prime rather than a subprime rate. Examining how FHA programs could continue to be modernized and streamlined and become a more viable choice for borrowers may be an important mitigant for housing problems.

Given falling housing prices, many financial institutions are likely less willing to be exposed to the mortgage market. One aspect of the current situation is the high LTV ratios facing many borrowers, as low down-payments and falling housing prices have made refinancing homes difficult. A possible solution would be shared appreciation loans with FHA guarantees. This approach, variants of which are currently being discussed, would provide the FHA and the lending institution with a portion of future appreciation in return for providing the FHA insurance on high LTV loans.

While too large a topic for today's discussion, I believe there is also a need to increase transparency and create more consistent prices for complex financial products. We need to think about the ramifications and possible remedies of a situation where parties are

unable to accurately value financial assets tied to the mortgage market — a market whose prices are more easily determined than are many other types of balance sheet assets.

Conclusion

GHKS have done a nice job of highlighting some of the ramifications of the mortgage meltdown. A critical factor in the size of losses, and whether balance sheet constraints become more widespread, is the extent to which housing prices fall. Unfortunately, we have little historical precedent for sustained declines in national housing prices, which makes it difficult to forecast future home prices. However, one of the significant downside risks to the economy is that further declines in housing prices could depress residential investment, reduce consumer spending, generate elevated foreclosures, and contribute to financial instability. Taking appropriate monetary, regulatory, and fiscal actions to mitigate this risk seems prudent.

Table 1

S&P/Case-Shiller Home Price Index: Ten Metro Areas and Composite

	Percent Change from Year Earlier				
	Dec-03	Dec-04	Dec-05	Dec-06	Dec-07
Composite 10	13.4	18.7	15.9	0.2	-9.8
Boston	7.7	9.4	3.5	-5.1	-3.4
Chicago	8.6	8.6	9.6	2.8	-4.5
Denver	1.3	4.3	3.9	-0.3	-4.5
Las Vegas	17.2	45.5	10.5	0.9	-15.3
Los Angeles	21.4	24.9	21.8	2.0	-13.7
Miami	14.8	23.6	31.5	6.1	-17.5
New York	11.8	14.1	14.9	0.5	-5.6
San Diego	19.2	26.6	6.6	-4.2	-15.0
San Francisco	8.6	20.1	15.8	-1.4	-10.8
Washington DC	14.4	24.3	20.0	-2.8	-9.4

Table 2

U.S. Bank Holding Companies*

By Asset Size and Change in Tier 1 Capital and Tier 1 Capital Ratio
June 2007 - December 2007

Asset Size	Number of Bank Holding Companies**			
	Change in Tier 1 Capital		Change in Tier 1 Capital Ratio	
	Decrease in Tier 1	Increase in Tier 1	Decrease in Tier 1 Ratio	Increase in Tier 1 Ratio
Greater than $100 billion	10	8	15	3
$10 billion to $100 billion	19	30	35	14
$1 billion to $10 billion	114	261	248	127
Less than $1 billion	126	378	294	210
Total	269	677	592	354

* Financial Top Tier Y-9C Filing Bank Holding Companies, filing in both June and December 2007, merger adjusted.

** Analysis excludes one large institution for which capital changes are significantly affected by recent merger activity.

Source: Federal Reserve Board and author's calculations

Table 3

U.S. Bank Holding Companies*

Growth in Assets and Tier Capital 1 by Asset Size
June 2007 to December 2007

Asset Size	BHCs**	June Assets	December Assets	June Tier 1 Capital	December Tier 1 Capital	Asset Growth	Tier 1 Capital Growth	Total Risk Based Capital Growth
	Number	Dollars in Billions				Percent		
Greater than $100 billion	18	7,980	8,239	434	431	3.25	-0.65	2.86
$10 billion to $100 billion	49	1,435	1,499	104	105	4.49	0.94	2.31
$1 billion to $10 billion	375	969	1,003	88	89	3.50	0.85	1.25
Less than $1 billion	504	314	326	29	30	3.77	2.43	2.47
Total	946	10,698	11,067	655	655	3.45	-0.06	2.57

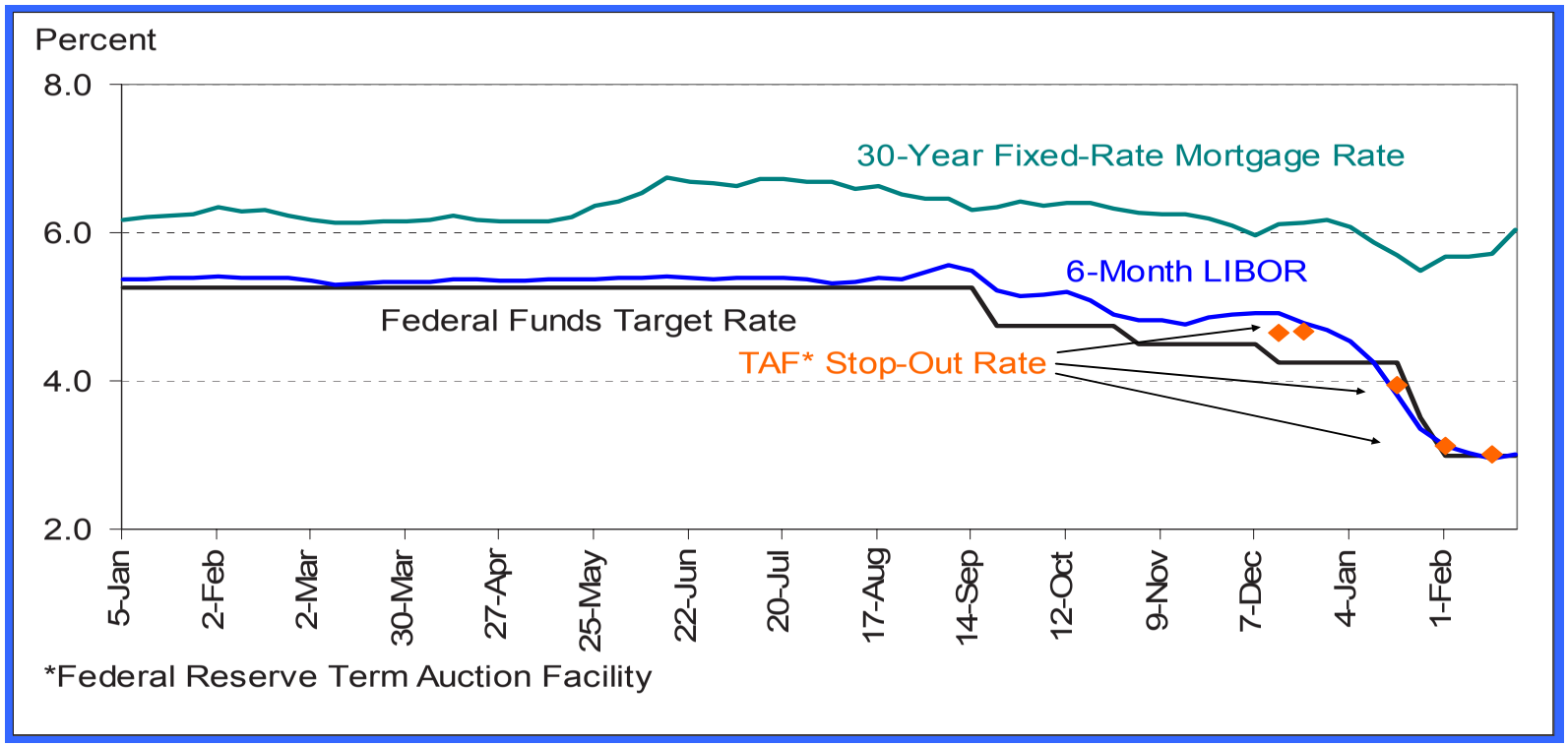
* Financial Top Tier Y-9C Filing Bank Holding Companies, filing in both June and December 2007, merger adjusted.

** Analysis excludes one large institution for which capital changes are significantly affected by recent merger activity.

Source: Federal Reserve Board and author's calculations

Figure 1

LIBOR, Federal Funds Target Rate, 30-Year Fixed-Rate Mortgage Rate, and TAF Stop-Out Rate



Source: Federal Home Loan Mortgage Corporation, Federal Reserve Board, Financial Times / Haver Analytics

Luncheon Address by

Vincent Reinhart, Resident Scholar, The American Enterprise Institute

Introduction

Thank you for the invitation to speak at the second Monetary Policy Forum. This is a rare venue in the way that policy makers and market participants mingle. You can understand why the organizers might have the ambition to brand this as Jackson Hole East. Or Jackson Hole without the mountains. Or the rivers. Or Bill Poole in a cowboy hat. I advise pitching that as a virtue: At Jackson Hole East, there is no western-wear fringe to distract from a pure discussion of monetary policy making.

But first a little background. I left the staff at the Federal Reserve's Board of Governors at the end of September, although I had not participated in policy discussions in a meaningful way for the prior two months. Fifteen minutes of job search led me to the American Enterprise Institute, which offered the security of unconditional support for research and the lightest touch of the invisible hand of management that could be imagined. My intent was to work quietly on issues related to the intersection of finance, global macroeconomics, and the communication of monetary policy. Who knew that quiet contemplation was not in the cards?

What I have observed from my new position on the sidelines of monetary policy and markets is a failure to communicate. In all aspects of life, such a failure usually involves both parties. My central premise today is that market participants do not appreciate the extent to which the Federal Reserve has changed in the past year. Those changes reflect an ambitious attempt to apply the economic profession's understanding of the science of monetary policy to improve the governance of the policy process, the communication of policy intent, and the conduct of policy. At the same time, I will also argue that Federal Reserve officials have not always appreciated the difficulties in applying lessons from the textbook, in part because those economic models are incomplete and in part because the Federal Reserve's uneasy relationship with the Congress sometimes hampers plain speaking.

My discussion will follow the arc of these three ambitious changes in monetary policy, powered initially by good intentions, pulled down by the gravity of reality, and headed ultimately to orbit at a lower altitude than originally envisioned. I do not believe, however, that the U.S. Navy will need to be called in to shoot the debris out of the sky. Rather, the failure to communicate will be resolved over time as both sides adapt. The good news is that the necessary learning process is at work. The bad news is that this learning takes place while some of you in this room have open positions, which might explain why the commentary surrounding monetary policy-making has gotten so heated at times.

Collaboration: Governing the Policy Process

Doubtless, Alan Greenspan was a tough act to follow. But so too was Paul Volcker. We forget that investors were concerned about the inflation-fighting resolve of a man who was more associated with economic forecasting and corporate consulting than policy prescribing and committee negotiating. Alan Greenspan learned on the job. Or more accurately, market participants came to learn about how Alan Greenspan would do his job. And it is that deified version who retired two years ago that has been the benchmark of comparison.

Replicating that iconic figure would be difficult, to say the least, nor is it obvious that it would be in the best interest of the institution.[36] Concentrating authority in principle (and to be sure it was never in practice as concentrated as outsiders imagined) has its drawbacks. It does not develop bench strength in an institution, it poses continuity problems when so much of the world comes to view policy as the exercise of an individual's virtues rather than a group's common principles, and it does not tap into the resources available from other members.

I believe that Ben Bernanke began his chairmanship influenced by his own experience on the Board as a governor, by academic research that tended to show groups perform better than individuals, and by the foreign precedent of argumentative yet still successful monetary policy committees.[37] [38] And he embarked on a fundamentally selfless act by attempting to make the Federal Open Market Committee more central to policy making. Eschewing the power and trappings of authority is not an everyday occurrence in Washington, DC.

There are four key pieces of evidence of enhanced collaboration within the FOMC. First, the meetings are longer. Do the arithmetic of the starting and ending times and note that four meetings a year now span two days. Second, Chairman Bernanke's testimonies and speeches about the economic outlook almost always have a role for the survey of the economic projections of Committee participants — that is, those opportunities to be alone on the public stage usually are taken to summarize the view of the whole and not the individual. Indeed, those testimonies and speeches are notable for what they do not include — they do not typically include personal speculations on unfolding macroeconomic trends. There are other opportunities to speak to those issues, and mixing the group's economic view with one person's interpretation of the channels of effects might risk confusing the public. Third, increasing the survey of economic projections to four times a year and using the minutes as platform for a more complete discussion of them also elevates the group's view. Fourth, changes in the guidance about the path of policy mostly always come from the group's official statements, not a personal statement.

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[36] Romer and Romer [2004] provide some historical background on the choice of Federal Reserve chairman, with particular emphasis on the multiple attributes required to be successful in the job.

[37] Blinder and Morgan [2005] present some laboratory experiments showing that decisions made by a group are better than by a single person. Lombardelli et al. [2005] also go to the laboratory in a complementary analysis.

[38] Ehrmann and Fratzscher [2005] review the different styles of the major monetary policy committees.

Indeed, the recent exception from this rule is instructive on that score: We now know from the most recently published minutes that Chairman Bernanke convened a conference call on January 9th, presumably so that he could be confident that his speech the next day conveyed a consensus view that additional policy easing would be forthcoming.

Increased collaboration within the FOMC is not, however, an unalloyed blessing and may be at the root of some of the displeasure about policy makers expressed by market participants. It is true that increasing the number of observations improves the standard error of a test statistic. It might follow that more voices in the deliberation of policy improve the average policy outcome. But the statistical result is the product of mathematical proof. The assertion about group dynamics is an expression of hope.[39] Larger groups are more prone to information cascades, especially when expertise and access to private information are seen to be distributed unevenly across the members.[40] The attempt to forge a consensus among a large group might slow the Committee's responsiveness to changed events or muddle the clarity of its statement. I cannot help but suspect when reading the FOMC's post-meeting statements that sometimes the role of the release is more to placate nineteen people sitting around the Board table in Washington and less to educate the public. And relying on official, joint statements may slow the flow of information. At a minimum, it makes the arrival of information more lumpy, and market participants more sensitive to specific events.

What should market participants do differently in this world of enhanced collaboration? I suggest that three changes are in order. First, emphasize the joint statements. If the Committee deliberates more as a group, then those group statements are a more precise summary of the group view, despite the unsanitary way in which the sausage might be made and the mixed results on tasting. Second and as a consequence, remember that silence from the Chairman is just silence. That is, I believe that this is a chairman more willing to defer changes to an upcoming Committee statement than to make news on his own. And third, prepare for more dissents, both in numbers at a time and in the range of people who do so over time. Do not get me wrong, tradition and consensus hold such considerable sway at the Federal Reserve that I do not expect a swing to the Bank of England model of close votes.[41] But the enhanced opportunity to deliberate, the fact that they vote on the entire statement, and the importance of the statement make it likely there will be more nays in your future.

As I said earlier, progress usually is only made when both parties in a conversation make concessions. What should the Federal Reserve do differently? Most importantly, recognize that committees have one appointed among them as chairman for good reasons.

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[39] The review of the theory on the workings of committees in Gerlach-Kristen [2006] shows how complicated are the issues, depending, among other aspects, on the objective of the group versus the individual, the differences among group and individual information, and the degree of pre-meeting consultation.

[40] I address some of these issues in Reinhart [2003].

[41] Blinder and Reis [2005] review the pattern of dissents.

Accept that there are times when quick action and a decisive voice are needed. Those are the times that the chairman has to step up to the plate.

Communication: Balancing Risks

I am a strong believer in listening to what policy makers say, but the problem is sometimes they shout and sometimes they whisper. Last year, even as policy action brought the policy rate down 1 percentage point, the FOMC was explicitly balancing risks to its dual objectives of sustainable economic growth and price stability. It cared both about potential slowing to spending, which was a threat that loomed larger and larger as financial markets frayed, and inflation, which was above the FOMC's informal goal.

But what was that informal goal? Here is where the Committee decided to whisper. From the end point to the October survey of economic projections, we can infer that the FOMC had an ECB-like goal for core PCE inflation of something less than 2 percent.[42] We can only infer it from a chart at the back of the minutes, of course, because otherwise the Committee did not explain its actions in light of its goal. That is, it was ECB-like in its goal and ECB-lite in explaining policy setting in terms of its goal. It was so, I suspect, because Congressional support of an inflation goal has always been weak. And that support weakened more with the change of political party in charge of the two houses of the Congress last year.

Because the FOMC was sensitive to both goals and the performance relative to those goals cut in opposite directions, it was slow in providing policy accommodation in 2007. But because the FOMC was reluctant to publicize its inflation goal, it had to rely on other reasons to protest the more substantial easing of policy built into money market futures rates. So it shouted about the fundamental strength of the economy and the resilience of markets and probably as a result appeared somewhat deaf to the multitude of messages from markets.

I am not arguing with having an inflation goal in principle or with the apparent range for that goal. Well, I might argue a bit with the apparent range. Why did the center of the Committee settle on "somewhat less than 2 percent"? Probably in part because when they first talked individually in public a few years back about their working definitions of price stability, inflation was running comfortably in that neighborhood. Those public remarks framed the goal around the current level, which they continued to hold even as inflation drifted up and after we learned through the data revision process that inflation had never been that low in fact. But because the goal was settled on informally, we never had the chance to engage in the public discussion that would air those issues. I am arguing that if you have an inflation goal, you should use it. And an important part of its use should be to explain the prospects for policy.

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[42] For some cautionary evidence about taking those FOMC forecast too seriously, see Romer and Romer [2008], who show that the FOMC forecast performs poorly when compared to the forecast of the FOMC's staff.

Here I expect more of the movement to resolve the communications failure to come on the monetary policy side. Having a goal but not being forceful in using it as an explanatory device clearly falls short of best practice. But I would not expect a change any time soon. The political climate, accentuated by the current cyclical position of the economy, will be chilly toward explicit recognition of an inflation goal in the United States. That means market participants will have to be particularly attentive to both the shouts and the whispers of the Federal Reserve because volume does not always convey significance.

Post-Gradualism: Conducting Policy

I must admit that there is a lot I do not understand about marketing in the economics profession. Sometimes when observed behavior is at variance with predictions from models, it is anointed as an anomaly, and a cottage industry develops to explore alternative explanations. Shortfalls in standard consumption theory, for instance, gave the profession two important anomalies. The equity premium puzzle tells us that the observed reward to risk taking in the equity market is too large relative to the smoothness of consumption.[43] And the excess-sensitivity problem tells us that this-self-same very smooth consumption path tends to vary more with income than the permanent-income hypothesis would predict.[44]

I bring this up because I fail to understand why the great beast that is the economics profession has never risen on its hind legs and growled in a menacing way about an obvious anomaly in policy rates. Over time and in many countries, policy interest rates tend to be very inertial, in that their current trajectory is extended far more often than reversed. In industrial economies over the last twenty years, policy continuations — that is, changes in the same direction as the previous change — tend to be observed five-to-ten times more than policy reversals — that is, changes in the opposite direction as the previous change. And the discrete change in the policy rate tends to be small, almost always and everywhere one-quarter percentage point.

Most sensible theoretical models, however, have the property that it is the level of the policy rate that matters for the level of economic activity. If that is the case and a forward-looking central bank is told to achieve a well-designed objective function focused on economic activity and inflation, then the policy rate should not be nearly so predictable. Why? As in textbooks, the level of the policy rate should be set to balance current risks to economic performance (both resource use and inflation to a national authority given dual objectives, as in the Federal Reserve Act). This assessment should incorporate a view about any exploitable (i.e., predictable) correlation in the shocks. But if the level of the policy rate reflects the response to all shocks known at the time, including the knowledge that some shocks are serially correlated, the decision on setting the level of rates the next time the policy committee meets will change only based on the

[43] Fama and French [2002] review the evidence on the equity premium. At this writing, Google Scholar reports approximately 127,000 academic items on the Internet related to the equity premium.
[44] Flavin [1985] or the other approximately 147,000 related items on the web (again according to Google Scholar)

arrival of new information. And that pertains only to genuinely new information, or that which could not have been predicted by the exploitable serial correlation in the data. New information — news — is unpredictable, and as a result so too should the next setting of the policy rate. Moreover, there is no reason in statistical theory to believe that the arrival of new information should conveniently round to one-quarter point on the policy rate so frequently.

That said, there is a strand of academic work holding that gradualism may be anomalous, but that it is a relatively innocuous violation. It is innocuous, this line of works holds, because if a central bank is relatively transparent in its intent ultimately to adjust the policy rate, even if it does so in small steps, the longer-term rates critical in shaping spending will be priced appropriately. That is, if there are a lot of paths of the overnight rate that can produce the same ten-year rate, why sweat the difference if policy makers chose one exhibiting a slow, measured trajectory?

I always found the argument about shaping expectations to be compelling, especially as applied to the zero bound to nominal interest rates.[45] Even if the current policy rate was very low, policy stimulus could still be imparted by conveying the sense that the policy rate would stay lower for longer than currently expected. But believing that the mechanism is helpful around the zero bound to nominal interest rates does not logically imply that it renders gradualism innocuous.

In particular, gradualism creates inter-temporal bargains that are outside the settled order of many models. Arithmetic guarantees that you can get the same path for the ten-year yield with a multiplicity of paths of the policy rate, but those paths that have slow and small increases will provide sustained and predictable bargains to those who want to fund at the short end of the yield curve. I cannot help but think that the gradual tightening from 2004 to 2006 encouraged funding at the short end of the yield curve, including adjustable-rate mortgages and their more exotic cousins, as well as any many carry-related trades.

The theoretical prediction — a random-walk policy rate — is so clean and stark and so at variance with the data outcomes of policy gradualism that I believe this anomaly should have been enshrined more prominently in the profession's firmament.[46] But what do I know? Actually, what I do know is that it might be too late to do so, because the final significant change I want to highlight is the patent rejection of policy gradualism expressed though the FOMC's behavior over the past six months.

A Committee that lowers the policy interest rate 125 basis points in nine days, as it did last month, is not acting gradually.[47] But even last year, the early efforts in this easing cycle, including a half-point move in September, were generally described as sufficient to balance the risks. Those statements sounded like they were written by a committee that

[45] As discussed in Bernanke and Reinhart [2004]
[46] Citations according to Google Scholar run about one-tenth those associated with the prior two anomalies I mentioned. Sack and Vieland [2000] examine the literature on policy gradualism.
[47] This is an impressive accomplishment, even when not put at an annual rate.

believed it was frontloading policy accommodation. This assessment of the forces pressing down on aggregate demand and the resilience of financial markets were too optimistic in the event. But that does not change the intent behind the actions — bringing forward policy accommodation sufficient to the perceived problem.

Avoiding the gradualism of small and predictable changes in the policy rate brings policy practice more in accord with the textbooks. But I must admit to four main worries about how well it will work in fact.

First, front-loading policy changes can be difficult to calibrate as it requires an explicit judgment on the appropriate level of the policy rate. As a profession, we have a poor track record in getting the level of potential output right, among our failings, and we should correspondingly be bad at nailing the equilibrium real short-term interest rate. In contrast, a policy rule that says keep changing the rate in small amounts until the evidence tells otherwise may be inelegant but have the advantage of robustness.[48]

Second, some importance might accrue to changing the rate as well as getting the level right. In particular, changing the policy rate at a time of stress (symmetrically either in response to a weakening in demand or a pick-up in inflation expectations) might have an important and helpful effect on confidence. If so, there is some value in reserving changes in policy for the right window when the public would view it receptively.

Third, and related, front-loading policy accommodation requires that the central bank be willing to keep to its plan. That is, it may be in a situation in which it pulls the level of the policy rate down on the expectation of weakness. If the data run in line with that forecast, the appropriate policy action is to do nothing subsequently — because it has already been done. The temptation for double counting — to act on the expectation and the realization — could be high if at least a portion of the public believes that changes in the rate have an independent effect on the economy. Entering the post-gradualist world might be the right move in theory, but it may take acts of courage in practice.

And fourth, speaking of courage, post-gradualist policy has to be symmetric so as not to impart a bias in policy. That is, the same Federal Reserve that eased aggressively to sustain economic expansion has to tighten aggressively should inflation expectations begin to creep up.

For their part, market participants should recognize that the federal funds rate will likely follow a different track than that of the past few decades. In particular, do not automatically extrapolate that large changes will be followed by large changes. That initial large change might be the front-loaded action substituting for smaller, gradual changes.

[48] See the discussion in Orphanides and Williams [2007], for example.

Conclusion

These are interesting times for monetary policy. And mindful of the Chinese proverb, I am glad I am seeing them as a spectator. To be sure, there is ample scope for more progress, but do not let that blind you to the fact that there has been significant progress already. And progress has to be two sided. Market participants have to be more attentive to the messages from the Federal Reserve and less expectant of explicit guidance on the path of interest rates. And policy makers have to appreciate that there may have been good reasons why the textbook was not already put into direct application.

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U.S. Monetary Policy Forum 2008

Proceedings of the Roundtable Discussion

"Balancing Financial Stability, Price Stability, and Macroeconomic Stability: How Important is Moral Hazard?"

Introduction by

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AS THE FINANCIAL CRISIS GATHERED MOMENTUM THROUGH THE FALL OF 2007, policymakers and observers became increasingly concerned about the potential conflict between the traditional objectives of low, stable inflation and high, stable growth on the one hand; and financial stability on the other. And, as central banks in both the U.S. and Europe responded with a combination of large liquidity injections and transformed lending programs, moral hazard concerns began to arise. To sharpen the discussion, we asked the panelists to consider the four specific questions:

1. Do central bank actions during times of financial system stress, either through interest rate reductions or by changing the terms under which reserves are injected, encourage excessive risking taking?

2. Can central banks provide greater liquidity to markets without signaling an easing in monetary policy? Is it possible for policymakers to separate their financial stability and macroeconomic stabilization objectives when interacting with financial institutions?

3. Do central banks need additional instruments to address credit booms?

4. Does successful monetary stabilization policy encourage excessive risk taking that leads to financial instability?

What follows are the responses of our four panelists.

Comments

Charles L. Evans, President and CEO, Federal Reserve Bank of Chicago

I would like to compliment the organizers for posing a very challenging set of questions for the panel to address. Although you will quickly notice that I am not going to respond to each question explicitly, I will address what I think are the key issues. And in doing so, I think you will see how I have approached monetary policy decision-making during the challenging environment that has inspired these questions. As always, these are my own views and not those of the FOMC or my other colleagues in the Federal Reserve System.

The four questions for the panel can be boiled down to two broad issues:

1. When and how does excessive risk-taking lead to a degree of financial instability that substantially complicates the conduct of monetary policy?
2. Are current policy tools adequate to deal with this instability?

Let me start by summarizing my views. First, because periods of financial stress are relatively rare in economies with strong commitments to price stability and low variability in economic activity, the normal approaches to monetary policy — as summarized by the Taylor Rule — generally serve us quite well. Second, during periods of nascent or even actual financial stress, it is appropriate for policy to maintain its focus on obtaining its macroeconomic goals over the medium term. Third, timely access to substantive information about financial market participants' activities is a critical aid to policymakers when assessing disruptions to the credit intermediation process that could adversely affect the real economy. In the United States, the Fed's supervisory responsibilities have been a helpful tool in obtaining such information.

Before I go on, allow me to quibble with the term "excessive risk-taking." As we all know, it is difficult to define what "excessive" is.

We need to bear in mind that risk-taking is an important ingredient in economic growth and the efficient allocation of resources. Developing new technologies and their applications requires creativity and a willingness to take risks. Some innovators will succeed and invent great things, and some will fail. Resources will flow to the successful innovators, which boosts productivity and economic growth. Workers also take risks, choosing new careers and job opportunities to improve their standard of living. Clearly risk-taking is an important ingredient in well-functioning competitive economies, and living standards are enhanced by such activities.

But when is this risk-taking "excessive" and when could it have large downside economic effects? This is difficult to know simply by observing the decisions and investments as they are made. For example, a large investment project may appear to be relatively safe when the probability of its success is judged to be high. In addition, the investment might be part of a larger diversified strategy designed to reduce the overall risk profile of the firm. Of course, in the end the investment strategy may turn out to be more risky than understood *ex ante*. The greater risk could be due to overly optimistic assessments of the likelihood of the investment payoffs or the lack of diversification achieved by the portfolio as the returns to the various investments turn out to be more correlated than had been anticipated.

The financial developments that spawned some of last summer's turmoil in subprime mortgage markets have some of these properties. The extent to which risk-taking was excessive at the outset remains unclear. But the important question for today is whether our policy responses to these events in themselves will lead to further excesses at some point in the future. There is no way to answer this question

for sure. But I think that we can minimize the potential for problems if monetary policy focuses clearly on our legislative mandate to facilitate financial conditions that promote effectively the goals of maximum employment and price stability.

Now, let me discuss how I see financial markets and financial stability fitting into our policy objectives. There is no analogy in financial markets to macroeconomic price stability. The prices of financial products may change quite substantially when new information arrives. Indeed, one of the most important activities of financial markets is price discovery — the efficient assimilation of all available information into asset values. This promotes the appropriate allocation of capital among competing demands and supports maximum sustainable growth. And it is this efficient functioning of markets that is our concern with regard to financial stability.

Most of the time, monetary policy intersects financial markets directly at our primary policy tool — the federal funds rate. To alter the trajectory of inflation and economic growth toward their goals, changes in the federal funds rate directly alter short-term risk-free rates of interest. Perceptions of our willingness and ability to adjust future policy then may also alter risk premiums in fixed-income markets and result in a change in the cost of financial credit to numerous other borrowers.

When the economy is weak and we lower rates to stimulate activity, we encourage risk-taking. This is a natural consequence of lowering rates. At the margin, projects that previously had too much risk relative to their expected return become more attractive for two reasons: The future returns may look better, and the financing costs are lower. And this may be a good thing, for example, if it can help stimulate an economy that is mired in a situation where overcautious businesses or households are holding back on investment and spending. These actions would further reduce macroeconomic risk.

However, in principle, these effects could go too far and encourage too much risk–taking. How would we know? In my mind, we would begin to see imbalances emerge that would put our policy goals at risk over the medium term. For example, in the late 1990s, we felt that the increases in household wealth — much of it related to the booming stock market — were causing spending to outstrip the economy's productive capacity at that time and posing a threat to price stability.

When thinking about policy adjustments, a useful benchmark is the line of research on policy rules pioneered by John Taylor. This research indicates that most historical policy actions have been *systematic responses to changes in the prospects for our goal variables* of output growth, employment, and inflation. The main ideas are the systematic response component, and that particular rules are benchmarks for typical policy. Financial developments play a role in these systematic responses through the normal effects of changes in the funds rate on other credit conditions that affect the real economy. So policy responds to economic developments that affect the achievement of its goals. As long as the goals themselves are compatible with the structure of the economy, it is hard to see how the normal conduct of policy would generate excessive risk-taking.

Of course, even Taylor's research points out that periods of financial stress may require policy responses that differ from the usual prescriptions. It's not that we downgrade our focus on the policy goals. It is that during these times we often are highly uncertain about how unusual financial market conditions will influence inflation and economic activity. The baseline outlook may be only modestly affected by the conditions, but there may be risks of substantial spillovers that could lead to persistent declines in credit intermediation capacity or large declines in wealth. These in turn would reduce business and household

spending. In such cases, policy may take out insurance against these adverse risks and move the policy rate more than the usual prescriptions of the Taylor Rule.

Now if we took out such insurance too liberally or too often, then private sector markets would change their views regarding policy and alter their base level of risk-taking. But in doing so, we likely would observe inflationary imbalances emerging or unusual volatility in output. So part of our job as a central bank is to price these insurance premiums properly against the achievement of maximum employment and price stability over the medium term. Importantly, when insurance proves to be no longer necessary, removing it promptly and recalibrating policy to appropriate levels will reiterate and reinforce our commitment to these fundamental policy goals. And if we are transparent so that markets understand that we will adhere to this strategy, such insurance-based monetary policy will not encourage excessive risk-taking.

We also must remember that we can't eliminate risk and uncertainty completely, nor would it be a good idea to do so. But by the same token, we don't want to add to uncertainty. The literature on asset bubble pricking is related to this discussion of excess risk-taking: Should a policymaker deflate a bubble before it becomes problematic? I am skeptical that we can identify bubbles with enough accuracy and know enough about how to act to say that we wouldn't have more failures than successes. Remember that in 1996, many commented that the stock market might be overvalued; however, the then-unappreciated acceleration in productivity eventually justified even higher valuations. Furthermore, as former Chairman Greenspan (2004) noted, in order to make sure you burst a bubble, you have to attack it aggressively, because if your attack fails, it just gets bigger. And there are big risks to the real economy of making such large moves.

I would now like to say a few words about the adequacy of our toolkit during periods of financial disruptions. We have several ways to add liquidity to the economy in addition to the normal open market operations: the discount window — extended to term borrowing and the new Term Auction Facility — and foreign exchange swaps to help enhance liquidity abroad. In these operations, we accept as collateral assets that others see as less readily marketable. I do not think this adds undue risk, since we only lend to qualified solvent institutions, and the collateralization rates include appropriate haircuts on riskier assets. In addition, we sterilize the effects of the borrowings on aggregate reserves, so that the liquidity injections are done while maintaining the fed funds rate target. This keeps the funds rate at a level we see as consistent with achieving our announced policy goals.

Another tool we have is the ability to obtain timely information directly from financial market participants that can help us gauge the extent and potential fallouts of financial disruptions. One way we do so is through our role as a supervisor: Our experience here has given us a good base of understanding and timely access to a wide range of information regarding financial intermediaries' activities. This is important, since most financial crises involve developments in new or unusual products that affect the income flows and balance sheets of these institutions. There seem to be synergies from the knowledge we gain through supervision and the policy questions we are faced with during periods of unusual financial stress. In addition to information from banking entities, it is important to have information flows from other financial sector participants.

Thanks and I look forward to a lively discussion.

The views presented here are my own, and not necessarily those of the Federal Open Market Committee or the Federal Reserve System.

Comments

Peter Hooper, Managing Director and Chief Economist, Deutsche Bank Securities

1. Do central bank actions during times of financial-system stress, either through rate reductions or by changing terms under which reserves are injected, encourage excessive risk-taking?

The short answer is: perhaps sometimes, but not this time around.

To elaborate, obviously, one can construct scenarios in which central bank action does create moral hazard or encourage *excessive* risk taking, but I see at least several reasons why moral hazard is not an issue this time around.

First, central banks have at least an implicit mandate to ensure stability of the financial system. No central bank has the option to allow a financial crisis to get out of hand. By getting out of hand, I mean, for example, allowing what Rick Mishkin and others on the FOMC have referred to recently as an "adverse feedback loop," or to quote the most recent FOMC minutes, "a situation in which a tightening of credit conditions could depress investment and consumer spending, which, in turn, could feed back to a further tightening of credit conditions." Such an event could well induce a deflationary spiral that would clearly run counter to the price stability objectives of even the most ardent inflation-targeting central bank. The probability of such an outcome may not be large, but the risks associated with it are great enough that our monetary authorities do not have the luxury of holding back needed policy measures at this juncture simply because of concerns about moral hazard.

Second, central bank intervention to stabilize the financial system does not mean that the "transgressors" in a financial crisis will go unpunished and fail to learn a lesson. During the current crisis, losses incurred by financial institutions have been large, certainly large enough to make a major impression on the firms and individual players involved, many of whom have either gone out of business or scaled back operations substantially, or are fundamentally rethinking their current business models. The paper prepared for this conference estimates the financial losses at $400 billion (half of which has been incurred by leveraged financial institutions). This is roughly consistent with the Street consensus. Indeed, the drop in the market capitalization for the S&P financial stocks from its peak a year ago has been double that amount at $800 billion, or in percentage terms, a 30% decline, setting these stocks back to their levels of 10 years ago on average. Yes, some "wrong-doers" will undoubtedly get off free and may fail to learn a needed lesson. But then, what useful lesson would the much more numerous innocent bystanders learn when they lose their jobs and/or a big chunk of their life savings because the economy has been allowed to tank to ensure that all of the transgressors have learned their lesson?

Third, monetary authorities generally are appropriately wary of lending to or aiding troubled financial institutions, at least those that do not pose a systemic risk. Indeed, the U.S. Federal Deposit Insurance Corporation Act of 1991 placed limits on the extent to which the Federal Reserve can lend to troubled depository institutions: The Act specifically limits discount window loans to undercapitalized banks. The ECB is similarly prohibited by its statute from bailing-out insolvent banks. These limits can be overridden in exigent circumstances.

Finally, the prevention of excessive risk-taking must be dealt with through adequate supervision and regulation. When major crises have occurred, they have often been exacerbated by a *failure* of existing regulations to cover sufficiently or to be enforced sufficiently to deal with excessive risk-taking. In the current crisis, to cite several examples, (1) Northern Rock Bank in the UK failed because of the combination of a flawed business model that was tolerated by the regulators and a defective deposit insurance system; (2) German public banks appear to have failed because of inadequate supervision of institutions that were being managed by active and retired government officials; (3) U.S. mono-line insurers got into trouble when insurance supervisors failed to blow the whistle as these companies expanded into non-traditional business; (4) More fundamentally, subprime lending excesses and deficiencies arose initially under lax state-level supervision and regulation mortgage brokers, and (5) There was apparently wide-spread ignorance among regulators about the "shadow banking system" of SIVs, conduits, and so on. My point is that, to the extent that key driving events in the current crisis can be attributed to faulty supervision and regulation as opposed to excessive risk-taking by investors, moral hazard would not seem to be a relevant issue. If a failure of government helped create the mess, it is appropriate for government action to help clean it up. So, the varying government actions that have been taken in these cases seem justified, including nationalization of Northern Rock, capital injections for German public sector banks, official encouragement of a private solution for the mono-lines, and easing liquidity conditions in the banking sector when they seized up last summer.

Undoubtedly, action will be taken (indeed is being taken) to shore up the flaws in existing supervision and regulations. Indeed, there is always pressure to shore up supervision and regulation in the wake of financial crises in a hurry, and we need to be mindful that such enhancements be done wisely and judiciously, so as not to discourage that fundamental ingredient of growth, risk-taking.

2. Can central banks provide greater liquidity to markets without signaling an easing in monetary policy? Is it possible for policymakers to separate their financial stability and macroeconomic stabilization objectives when interacting with financial institutions?

The short answer is, yes, up to a point, but it helps to have the right tools.

To simplify things, I'll define "providing greater liquidity" as accommodating increases in the demand for reserves at an unchanged policy rate, as well as accommodating an increasing preference for term funding over overnight funding, and doing so by accepting a wider set of collateral than normal in open market operations. And I'll define changing monetary policy as altering the level of the policy rate target.

As the current credit crisis unfolded last summer, the Fed clearly acted fairly promptly on the liquidity front by increasing the provision of overnight funding to banks to limit upward pressure on the fed funds rate as the demand for reserves shot up in the money market. The Fed also opened the discount window more widely by cutting the discount rate (and penalty) by 50 basis points and actively encouraging banks to "come to the window." This second set of moves was almost totally ineffective because of the strong stigma attached to going to the window. Banks were very sensitive about how they were viewed by their peers, especially under unsettled money market conditions, and any hint that they had gone to the window would be viewed as a sign of weakness and cause for an immediate increase in the premium on

their funding costs in the market. The failure of the discount window to provide relief was important. Banks had ample overnight funding, but were increasingly short on term funding. Interbank lending at maturities of two weeks to three months had all but dried up in the private market. Banks were increasingly reluctant to lend at term either because of concerns about counterparty risk or because of uncertainty about how much liquidity they would need for themselves to fund assets they might well be forced to take onto their balance sheets (SIVs, etc). The absence of term funding and growing balance sheet uncertainties caused large banks, at least, to grow much more cautious about expanding their business voluntarily. This increasing caution sowed the seeds of the credit crunch that followed with the substantial tightening of bank lending standards and reduced availability of credit to households and firms.

With the Discount window still effectively closed, things could have gotten much worse early on if the Fed had not blurred the lines between the provision of liquidity and changing monetary policy. It did so by aiming low (or avoiding errors to the high side) in its efforts to hit the fed funds target during this period. Over the month between the onset of the crisis in mid-August and the first official policy easing in mid-September, the fed funds' effective rate averaged more than 25bps below target, the largest such "miss" on a sustained basis in more than two decades. Whether the miss was fully intended or not, the increased provision of liquidity associated with it was most welcome to the money markets and, in the minds of many money market traders, helped to avert a significant worsening of the crisis at the time.

With the introduction of the Term Auction Facility, the Fed did effectively open the discount window, and it gave itself the tool it needed to provide term liquidity while also accepting a much wider range of collateral than it accepts in open market operations. This introduction of the TAF was welcomed immediately in the money market, and helped ease the liquidity situation by reducing the spread between LIBOR, the cost of interbank loans, and the average level of the fed funds rate expected to prevail over the same term. This de facto opening of the discount window now allows the Fed to provide liquidity more effectively without having to ease policy.

> [A word on the European Central Bank, which has been maligned of late in some quarters for being behind the curve on monetary policy. The ECB's reserve auction facility was set up much better to provide liquidity without changing monetary policy, and it did do so by providing more liquidity earlier in its reserve maintenance periods and by substantially increasing the average term or maturity of its lending. The ECB's actions, along with the Fed's undershooting the fed funds target and substantial FHLB advances did much to ease the initial funding crunch on the money market, or at least to keep things from getting much worse than they did.]

Finally, I find the distinction between changes in liquidity and changes in monetary policy somewhat artificial. There is a considerable grey area between the two. If the fed cuts rates simply to offset a sustained 50 bp widening of the spread between LIBOR and the expected fed funds rate that has resulted from a tightening of liquidity conditions in the market, that action could arguably be viewed as either a liquidity enhancement to offset the closing of a key channel of transmission of monetary policy, or a change in monetary policy, or both.

3. Do central banks need additional instruments to address credit booms?

In short, probably not; they just need to utilize the ones they now have more effectively.

I take this to be a variant of the question of should central banks factor asset price movements directly into their monetary policy decisions — i.e., should they tighten when they see a bubble inflating in order to limit potential damage caused when the bubble eventually does burst. Academic papers in this area contain very stylized assumptions about asset prices being driven by purely exogenous factors and not by central bank policy or flaws in regulation. Also, I think too much is made of the notion that bubbles cannot be identified ex ante, only ex post. I'm not going to try to recommend that central banks should endeavor to prick bubbles via monetary tightening. But I will suggest that the appearance of froth in financial markets can be used more effectively as a warning sign that something is amiss somewhere in the area of supervision and regulation. Investors naturally seek ways to legally circumvent regulations, especially where there are deficiencies or shortcomings in the drafting and/or enforcement of regulations. This is not necessarily an admonition to tighten regulations whenever markets are looking unusually buoyant — risk taking is a key ingredient of economic growth and innovation, and we certainly want to do as little as possible to discourage it. Rather, it is a suggestion to be more on the lookout for something amiss. The U.S. housing market was looking bubbly as early as 2005. Had this froth been taken as a hint to look carefully at the trends and practices in the mortgage market that were driving it, the inadequacy of mortgage origination guidelines and the absence of state-level enforcement of those guidelines may have come to light sooner and helped to avoid some of the worst of the excesses that we are now paying for. Central banks may not have all the supervisory authority they would like, and perhaps more can be done in that area, but they certainly have ample scope to jawbone when they see something amiss.

One other thought in response to this question of whether more instruments are needed to deal with credit booms and busts, the Fed has at its disposal in exigent circumstances considerable power to create liquidity and distribute it widely through the Discount Window or special facilities if needed, as it has done on occasion in the past.

4. Does successful monetary stabilization policy encourage excessive risk-taking that leads to financial instability?

In short, maybe, but if so, the associated costs fall well shy of the benefits of successful monetary stabilization policy.

One conclusion of the paper that was prepared for this conference last year was that successful monetary stabilization policy has indeed been the key factor underlying the great moderation of variability in growth and inflation in recent decades. The associated reduction in "macroeconomic risk" no doubt also has contributed to the willingness of risk-takers to place larger bets in the current economic environment than they would have in decades past. It is noteworthy that the decline in volatility of growth and inflation has not been matched by declines in the volatility of prices in financial markets. But has this continued volatility in financial markets been a problem? Not judging from the longer-term trend in overall macroeconomic performance. The ten-year moving average of the so called misery index in the U.S., the simple sum of unemployment and CPI inflation has declined steadily since the early 1980s and now stands at its lowest point in more than four decades. This suggests that if some excessive risk-taking has been induced along the way, so far at least, its costs in terms of macroeconomic performance has not been substantial.

Comments

William Poole, President and CEO, Federal Reserve Bank of St. Louis

Balancing Financial Stability, Price Stability, and Macroeconomic Stability: How Important is Moral Hazard?

There are two ways to view the question that comprises the title for this panel discussion. One concerns the *potential* for moral hazard issues to decrease stability. The other is the extent to which, currently, the issue in *actuality* has decreased stability or raised a problem for the Federal Reserve. The potential is clearly enormous. However, I believe that in the macroeconomic policy sphere, actual moral hazard problems today are relatively minor, with the exception of a small number of large financial institutions whose managements and investors believe they can count on government assistance should these firms find themselves in deep trouble.

Before continuing, and although I have attended my last FOMC meeting, I need to emphasize that the views I express here are mine and do not necessarily reflect official positions of the Federal Reserve System. I thank my colleagues at the Federal Reserve Bank of St. Louis for their comments, but I retain full responsibility for errors.

Moral Hazard in Monetary Policy

I addressed moral hazard in monetary policy in a speech at the Cato Institute last November, "Market Bailouts and the 'Fed Put.'"[49] Let me repeat the gist of that argument.

The concept of moral hazard is most easily explained in the context of insurance. The very existence of insurance may change the behavior of the insured person, who becomes less careful in taking care of insured property than he otherwise would if the property were uninsured. Being less careful with others' property than your own is not moral behavior and is a hazard to the insurance company.

Some claim that Federal Reserve policy responses to financial market developments should be regarded as "bailing out" market participants and creating moral hazard by doing so. In my view, this argument is incorrect because there is a benefit rather than a hazard to sound monetary policy that stabilizes the economy.

Consider a monetary policy that maintains low and stable inflation. If market participants have confidence in continued success of that policy, then they need not structure their activities to be robust against a serious outbreak of inflation. Monetary policy does change behavior, but it is not a hazard to the economy that firms and households make their plans on the assumption of continuing price stability. Indeed, one of the arguments for price-level stability is *precisely* that markets will work better and private decisions will be more efficient than in an environment of price-level instability. Outcomes are more efficient because behavior changes in response to the environment of price-level stability.

The same argument holds for monetary policy actions that serve to stabilize financial markets in the face of market turmoil of the sort that broke out last August. A monetary policy response to market turmoil is an application to modern financial markets of the traditional function of the central bank as a lender of last resort to the banking system. A belief that Federal Reserve policy actions will serve to stabilize the financial system will affect behavior, but not on the whole in a hazardous way. The validity of this assertion is less obvious than in the case for price-level stability; I will argue the case.

[49] Federal Reserve Bank of St. Louis *Review* 90 (March/April 2008), 65-73 [http://research.stlouisfed.org/publications/review/08/03/Poole.pdf]

When financial markets are generally stable, many firms will decide that they can get along with less capital. All else being equal, higher leverage obviously increases risk. Should there be a shock, a firm with less capital is more likely to have difficulty. However, in the more stable financial environment, shocks are less common and less severe when they do occur. If that were not the case, we would not describe the situation as being "a more stable financial environment."

However, whatever the degree of financial stability, nothing protects an individual firm from its mistakes. The Fed's actions in recent months have not prevented many financial firms from having to write down the value of billions of dollars' worth of assets. Fed actions have been successful in helping to protect the financial *system* without protecting any particular firm. A number of hedge funds and mortgage brokers have gone under without a finger of public support being lifted to save them. That is as it should be.

Lenders have foreclosed on thousands of homeowners in default on their mortgages and have forced the former owners to leave their homes. So far, we have not seen significant government funds being supplied to prevent foreclosures, although proposals for such support are common. The public debate on this issue seems pretty healthy to me. People understand the anguish of foreclosure but also the potential moral hazard from bailing out homeowners who took out mortgages they could not afford or from bailing out investors who made loans they should not have made. There is also a widespread belief among homeowners who are meeting their financial obligations that it would be unfair for the government to bail out "irresponsible" borrowers when responsible ones, perhaps with considerable struggle, are meeting their obligations.

As an aside, it seems to me that most of those advocating some sort of government action are supporting relatively narrowly drawn proposals that do not apply to investor-owned houses and to properties already in foreclosure. Whether or not a sound proposal can be enacted that avoids creating moral hazard remains to be seen, but current public debate is sensitive to the issue.

Too Big to Fail

In the context of macroeconomic stability, the main moral hazard issue arises in the context of "too big to fail." I believe that it was Alan Greenspan who put the issue this way: No firm should be too big to fail, but some may be too big to liquidate quickly. Suppose a large firm gets into trouble and the potential adverse consequences for stability are so great that intervention is unavoidable. In that situation, any intervention ought to take a form such that the costs to shareholders and management are so large that no firm in the future will want to allow itself to fall into such a situation. Lest I be regarded as a soft touch when I say that a situation could arise that could make intervention "inevitable," I would set a very high bar to any intervention. Here is what I think is sound advice: "Experience suggests that the path of wisdom is to use monetary policy explicitly to offset other disturbances only when they offer a 'clear and present danger.'" Some may be surprised to learn that the author of this sentence was Milton Friedman in his presidential address to the American Economic Association in 1967.[50]

In recent months, some boards of directors have forced out their CEOs, and companies have raised new capital, diluting the ownership position of existing shareholders. I am sure that these costs will not be lost on future managements, but it remains to be seen how long recent pain remains in managers' memories. In any event, we are fortunate that in the current episode, so far anyway,

[50] *The American Economic Review* 58 (March 1968), p. 14

no large financial firms have been so weakened by large losses that they were unable to raise new capital.

We have known for many years that moral hazard is a potentially serious issue. If a firm believes that it will be bailed out if it gets into trouble, that expectation encourages excessive risk-taking and increases the probability of trouble. There are two complementary ways to deal with moral hazard. First, firms in trouble ought not to be bailed out, unless the bailout takes a form that imposes heavy costs on managers and shareholders. Second, firms subject to government regulation ought to be compelled to maintain adequate capital to reduce the probability of failure. U.S. banks entered the period of turmoil last year pretty well capitalized and have been able to withstand large losses.

I am more skeptical of the financial strength of the GSEs and believe that we could see substantial problems in that sector. According to the S&P Case-Shiller home value data released earlier this week, as of December 2007 average prices had declined by 15 percent or more over the past 12 months in Phoenix, San Diego, Miami, and Las Vegas. We can add Detroit to the danger list, as the home price index for that city is down by almost 19 percent over the 24 months ending December 2007. With house prices falling significantly in a number of large markets, many prime mortgages issued a few years ago with a loan-to-value ratio of 80 percent may now have relatively little homeowner equity, which increases the probability of default and amount of loss in event of default.

As I emphasized some time ago, GSE losses will depend on the variance as well as the mean of changes in national home prices. Losses in markets with home prices falling more than the national average will not be offset by gains in markets with price changes above the national average. I do not have a new message here; we have known for a long time that advance preparation and a strong balance sheet are the keys to riding out a financial storm. As I have emphasized before, the Federal Reserve can deal with liquidity pressures but cannot deal with solvency issues. I do not have any information on the GSEs that the market does not also have. Nevertheless, in assessing the risk of further credit disruptions this year, I would put the GSEs at the top of my list of sources of potential serious problems. If those problems were realized, they would be a direct result of moral hazard inherent in the current structure of the GSEs.

Moral Hazard Risks to Economic Stability

The title of this session starts with the word "balancing." Monetary policy is a balancing act, with dangers of recession and inflation both very real. My view, oft stated, is that the FOMC should give primacy to the inflation objective because, if inflation develops while the FOMC is concentrating on avoiding recession, the consequence will be to delay recession but not to avoid it. And, most likely, the delayed recession in an environment of rising inflation and rising inflation-expectations will be worse than the mild recession avoided in the immediate future.

The FOMC's "prime concern," though, must not be confused with "exclusive concern. " The FOMC has good reason to respond to employment problems, and doing so need not be inconsistent with maintaining an environment of price stability. Of course, different observers have different views as to whether the FOMC is striking the right balance, but the need to strike the balance ought not to be at issue.

The traditional monetary policy problem of balancing inflation and employment risks is seriously complicated when an event raising a moral hazard problem intervenes. When

an event occurs risking extreme financial instability, the best course of action is probably for policymakers to keep the ship afloat and worry about the compass course later. However, when bailing out a firm to keep the ship afloat, the aim should be to allow as much pain as possible to flow through to managements and investors to discourage future risky behavior. To avoid a future inflation problem, monetary policy accommodation, which may be a part of the policy response, should be reversed promptly when the markets settle down.

Since World War II, the number of financial upsets is so few that we do not have a large sample from which we can draw lessons as to better and worse ways of handling the aftermath of financial turmoil. With the benefit of hindsight — and the importance of the word "hindsight" should be emphasized — it is not hard to argue that the FOMC was too slow to raise the federal funds target after taking the target down to 1 percent in 2003. I also believe that, with hindsight, the FOMC was too slow to start raising the fed funds target in 1999 after dropping it by 75 basis points to deal with the turmoil created by Long-Term Capital Management. The problem in these episodes, however, was not related to moral hazard but to policy judgments of the usual sort of trying to strike the right balance between inflation and unemployment concerns.

The Current Episode of Financial Turmoil

We are currently living through an episode that will provide considerable evidence on several important questions. In five years or so, we will see whether the FOMC withdrew cuts in the fed funds rate target on an appropriate schedule.

The current episode will also provide evidence on a vexing issue of causation. As Greenlaw, et al., emphasize in their very interesting paper, the relation of finance to the real economy has long been a puzzle because of the difficulty of sorting out cause and effect. There is a large literature on this issue. One tradition flows from Friedman-Schwartz, and before them the work of Irving Fisher, relating fluctuations in money growth to the business cycle. Greenlaw, et al., report evidence on the relation of growth in domestic non-financial debt to growth in real GDP.

Although there have been a number of interesting efforts, no one has come up with a really convincing model of why fluctuations in nominal magnitudes should cause fluctuations in real magnitudes. A contrary view, also with an extensive literature, flows from work on real business cycles. From this perspective, the business cycle is a real phenomenon, and nominal magnitudes are along for the ride. In the real business cycle model, causation runs from the business cycle to nominal financial magnitudes.

My own work has been within the Friedman-Schwartz tradition. I do not have any doubt that monetary policy mistakes can create recession. In trying to sort out the causality between money and output, Friedman emphasized the importance of evidence from natural experiments. I think it useful to think about that same approach in analyzing the current situation in the credit markets. We are dealing with something close to a natural experiment because the turmoil spreading from the subprime mortgage market was clearly unanticipated and, for the economy outside housing, basically exogenous and not closely related to changes in monetary policy. We are living through an episode that is as close as we have seen to a pure credit disturbance without an accompanying monetary disturbance.

Let me develop this theme a bit more carefully. The FOMC did, of course, raise the target federal funds rate from 1 percent in mid

2004 to 5.25 percent in mid 2006. The effect of rising interest rates in slowing mortgage finance was not a surprise, nor was a slowing in home price appreciation a surprise. In the quarters before August 2007, we did not observe a marked decline in money growth or any of the other usual symptoms of a monetary disturbance.

The growing scale of defaults of subprime mortgages in the spring and summer of 2007 was a surprise. I think it reasonable to regard the effects of these defaults on credit markets beyond the mortgage market as an exogenous credit disturbance — perhaps as exogenous as we get in our discipline. The issue at hand is whether this disturbance will cause a significant contraction in economic activity outside housing.

I focus on activity outside housing because it is obvious that this particular sector is overbuilt. The U.S. economy has experienced problems in particular sectors before, such as steel and agriculture in early 1980s. Those problems lingered after recovery from the 1981-82 recession began but did not prevent the recovery.

Weakness in investment in residential structures has been holding down GDP growth in a significant manner since the second quarter of 2006 but, through the last quarter of 2007, was not sufficient to push growth of GDP excluding housing below 1.5 percent. The issue is whether the credit market problems will have a significant adverse impact outside housing. By way of comparison, the shock of 9-11 had a quick and large impact; firms shed one million jobs in October, November, and December of 2001. We have not yet seen an effect of credit turmoil on real activity of this magnitude.

Concluding Remarks

I suspect that the origin of this panel topic was the view that a central bank response to market turmoil creates moral hazard. A generalized monetary policy response, in the form of the FOMC cutting the target federal funds rate, is completely unlike the effects of government flood insurance on homeowners. Flood insurance will compensate the homeowner, period. A monetary policy response may or may not occur at a time when a financial firm gets into trouble and may or may not be adequate to prevent a firm from failing.

Moreover, a financial firm cannot expect targeted aid for just the firms in trouble. An exception to this general statement is that, unfortunately, the GSEs probably can expect targeted aid. Thus, putting the GSEs aside because they might get assistance directly from Congress, expectation of a monetary policy response to financial turmoil is completely unlike the situation faced by the homeowner with underpriced flood insurance. Many homeowners do build houses in areas where they would not build if they were totally responsible for losses, or had to buy insurance in a competitive market. Financial firms, on the other hand, cannot expect aid if they build on the financial flood plan. And that is as it should be.

Comments

Kenneth D. West, Ragnar Frisch Professor of Economics and Chair of the Economics Department, University of Wisconsin-Madison

I will respond selectively rather than comprehensively to the important list of questions posed to the panelists.

A paraphrase of some of these questions is: Should the central bank respond to financial dysfunction, and does the central bank encourage excessive risk-taking by so doing. It is not easy to distinguish between excessive and optimal risk-taking. But I do think that there are some general principles that should guide central bank behavior, and that will be the subject of my brief remarks.

These principles include the view that cries for help from financial institutions, the housing industry, and advocates for homeowners deserve a sympathetic hearing at the central bank. But that is not because it is the job of the central bank to prevent particular businesses from failing or to make whole homeowners whose housing values haven't performed as homeowners had expected. I would hope that everyone, even central bankers, famous for having the self-assigned job of taking away the punch bowl just when the party starts getting really good, would be sympathetic to those in trouble. But sometimes decisions are made that lead to bad outcomes, and it will often be better to let private markets sort out the consequences.

On the other hand, cries for help deserve a sympathetic response from the central bank when the underlying problem is macroeconomic or systemic. Let me briefly expand on that point.

The panelists have been asked to consider how central bank actions relate to financial instability. I think we can all agree that financial instability is bad, financial stability is good. More specifically, I think we can all agree that we expect our economy to channel funds efficiently from households and firms who wish to save to households and firms who wish to invest. Our expectation is that the pricing of loans or assets involved in such lending appropriately reflects risk.

If the economy's ability to channel funds in this fashion becomes impeded, and funds from lenders cannot be channeled to creditworthy borrowers, at an appropriate risk-adjusted price, then, that is, well, bad. That's what I call financial instability. And the central bank should do something about this sort of financial instability — that is, financial instability that is systemic, economy-wide, and is manifested in widespread clogging of channels that move funds to creditworthy borrowers. By definition, such general drying up of credit implies some sort of macroeconomic, economy-wide dysfunction.

A mandate to respond when credit dries up may not, or may no longer, be given pride of place in central bank legislation in various countries. But insofar as central banks are charged with promoting employment or growth or some other measure of real activity, central banks are de facto charged with promoting financial stability.

How can central banks promote financial stability? A central bank can serve as lender of last resort. A central bank can inject liquidity. And a central bank can promote financial stability by lowering nominal interest rates. Low nominal interest rates on federal funds (to take the U.S. example) can serve to shift down the level of interest rates on various assets quite generally. That will cut back on credit rationing through mechanisms that have been well explored in the academic literature.

But doesn't this protect some private investments that otherwise would fail? And, if such a policy comes to be expected, doesn't it encourage risk-taking behavior? My answer is: I should hope so. Households and businesses of the U.S. and other countries *should* expect government institutions, including the central bank, to provide a financially stable environment. And as a consequence, during normal stable times, loans and investments will be made that would have been priced out of the market in an alternative, hypothetical economy in which there is a central bank that is not willing to work to ensure financial stability.

Many commentators — which, in the U.S. context, include both those who fault and those who laud the Fed for responding to what the Fed views as financial instability — draw on an analogy with insurance, likening the work of a central bank vis a vis financial stability to that of an insurance firm. As is obvious, I side with those who use the analogy to argue that central banks should respond to financial instability. The payoff from an insurance firm to a legitimate claim does indeed make whole an entity that would otherwise take a hit. And the existence of insurance no doubt encourages some risk-taking behavior. Some people who are a bit shaky when driving at night or in poor road conditions might stay at home if they did not have insurance to protect them from some of the consequences of an accident. And so car insurance no doubt indirectly leads to an increase in accidents. But surely that doesn't mean we ought to prohibit or abolish auto insurance. Instead, we need to accept that an inevitable byproduct of insurance, including a commitment by a central bank to provide a financially stable environment, is an increase in risk-taking behavior. We cannot fine-tune our auto insurance, or our monetary policy, to the point that we insure only against risks that would be taken in a world without informational or other frictions.

In this as in everything in policy, the devil is in the details. I have expressed the view that in principle the central bank should stand ready to lower interest rates as one possible tool to help restore financial stability. In practice, there is the question of when and how much. Recent interest rate reductions by the Fed might — or might not — lead to a bout of inflation in the U.S. so severe that, with hindsight, less aggressive interest rate cuts might look preferable.

I'll leave analysis of that to my fellow panelists.

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Charles L. Evans, Federal Reserve Bank of Chicago

Charles L. Evans took office on September 1, 2007, as the ninth president and CEO of the Federal Reserve Bank of Chicago. In that capacity, he serves on the Federal Open Market Committee (FOMC), the Federal Reserve system's most important monetary policy-making body. Before becoming president, Evans was director of research and a senior vice president at the Chicago Fed, where he oversaw the bank's research in monetary policy, banking, and financial markets, and regional economics. In addition, he had supervisory responsibility for the bank's consumer and community affairs unit and the public affairs department. Evans also served as an associate economist on the FOMC.

Prior to his appointment as research director in July 2003, Evans served as vice president and senior economist in the economic research department with responsibility for the macroeconomics research group. His research has focused on measuring the effects of monetary policy on U.S. economic activity, inflation, and financial market prices, and he has been published in the *Journal of Political Economy, American Economic Review, Journal of Monetary Economics, Quarterly Journal of Economics,* and the *Handbook of Macroeconomics.* In addition to his work at the Chicago Fed, he has taught at the University of Chicago and the University of Michigan. Prior to joining the Chicago Fed in 1991, he was an assistant professor of economics at the University of South Carolina. Evans received a BA in economics from the University of Virginia and a PhD in economics from Carnegie Mellon University.

David Greenlaw, Morgan Stanley

David Greenlaw is a Managing Director and Chief U.S. Fixed Income Economist with the investment banking firm of Morgan Stanley. His primary duties involve analysis of the U.S. economy and credit markets, including Federal Reserve and Treasury activity. He is also responsible for the projections of key economic indicators. Greenlaw was recently named Best Fed Forecaster in a Bloomberg Markets magazine survey. He was also the first back-to-back winner of the Dow Jones Market Watch Forecaster of the Month award. Before joining Morgan Stanley in 1986, Greenlaw served on the staff of the Federal Reserve Board in Washington DC for four years. Greenlaw holds an MBA from New York University and a BA from the University of New Hampshire. He has also done extensive graduate work at the University of Chicago and The George Washington University.

Ethan Harris, Lehman Brothers

Ethan Harris is managing director and chief economist at Lehman Brothers in New York. He is responsible for the firm's forecast and analysis of the U.S. economy. In this capacity, Harris has written extensively about the linkages between geopolitical events and the economy, the unique nature of the current business cycle, and the outlook for monetary and fiscal policy. Harris' work has received extensive coverage in both print and broadcast media. In 2006, his team earned the number-one ranking among economists for the fixed income *Institutional Investor* poll. Harris joined Lehman Brothers in 1996. He previously worked for nine years at the Federal Reserve Bank of New York, where he served as the research officer in charge of the Domestic Division and as the assistant to the President of the Bank. He also worked for several years as an international economist at JPMorgan. Harris received his PhD in economics from Columbia University, where he was a University Fellow. He earned a BA in economics from Clark University.

Jan Hatzius, Goldman Sachs

Jan Hatzius, Managing Director and Chief U.S. Economist for Goldman Sachs, is based in the New York office, where he is responsible for setting the firm's U.S. economic and interest-rate outlook. Hatzius has published widely on monetary and fiscal policy, the Goldman Sachs Financial Conditions Index, the housing market, inflation, corporate profits, consumption, and capital spending. He is frequently quoted in the financial press, such as the *Economist*, the *Financial Times*, and the *Wall Street Journal*, and writes a regular column on the U.S. economy for the German daily *Frankfurter Allgemeine Zeitung*. Prior to joining Goldman Sachs in 1997, Hatzius was a research officer at the London School of Economics. He holds an economics doctorate from Oxford University, as well as degrees from the University of Wisconsin-Madison and the Kiel Institute of World Economics.

Peter Hooper, Deutsche Bank Securities

Peter Hooper is Managing Director and Chief Economist for Deutsche Bank Securities, Inc. He joined Deutsche Bank Securities in 1999 as Chief International Economist. He shortly thereafter assumed responsibilities as Chief U.S. Economist; he became Chief Economist in 2006 and Co-Head of Global Economics in 2007. Hooper frequently comments on U.S. and global economic and financial developments in the media. Prior to joining Deutsche Bank Securities, Hooper enjoyed a distinguished 26-year career at the Federal Reserve Board in Washington DC. While rising to the upper levels of the Fed staff, he held numerous positions, including as Associate Economist to the FOMC and as Deputy Director of the Division of International Finance. Hooper earned a BA in economics from Princeton University and an MA and PhD in economics from the University of Michigan. He has published numerous books, journal articles, and reviews on economics and policy analysis.

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Anil K Kashyap is the Edward Eagle Brown Professor of Economics and Finance at the University of Chicago Graduate School of Business. Kashyap joined the faculty in 1991 and currently teaches the courses Corporation Finance and Understanding Central Banks. He serves as one of the faculty Co-Directors of the Chicago GSB Initiative on Global Financial Markets and is a Co-Founder of the U.S. Monetary Policy Forum. Kashyap also is a member of the Bellagio Group of academics and economic officials, a consultant for the Research Department of the Federal Reserve Bank of Chicago, and a Research Associate at the National Bureau of Economic Research. Under the auspices of the National Bureau, he serves as the co-director of a working group that studies the Japanese economy.

Kashyap also serves on the board of directors of the Bank of Italy's Einaudi Institute of Economics and Finance. Previously he served as a staff economist for the Board of Governors of the Federal Reserve System. He earned his PhD in economics in 1989 from the Massachusetts Institute of Technology and his bachelor's degree in 1982 in economics and statistics from the University of California at Davis.

Bruce C. Kasman, JPMorgan

Bruce C. Kasman is Managing Director and Chief Economist of JPMorgan and is the editor of *Global Data Watch*. From 1996 to 1999, Kasman was JPMorgan's Head of Economic Research, Europe. Prior to his arrival at JPMorgan in 1994, Kasman was Senior International Economist at Morgan Stanley & Co. He started his career at the Federal Reserve Bank of New York, where he was a Research Officer in the International Research Department. Kasman received a PhD in economics from Columbia University in 1985.

Frederic S. Mishkin, Federal Reserve System

Frederic S. Mishkin took office on September 5, 2006, to fill an unexpired term ending January 31, 2014. Before becoming a member of the board, Mishkin was Alfred Lerner Professor of Banking and Financial Institutions at the Graduate School of Business, Columbia University, from 1999 to 2006 and served as A. Barton Hepburn Professor of Economics (1991–99) and as professor at the Graduate School of Business (1983–91). He also has taught at the University of Chicago, Northwestern University, and Princeton University. Mishkin also was a research associate at the National Bureau of Economic Research (1980–2006) and a senior fellow at the Federal Deposit Insurance Corporation's Center for Banking Research (2003–06). Before joining the board, Mishkin served the Federal Reserve system from 1994 to 1997 as executive vice president and director of research at the Federal Reserve Bank of New York and as an associate economist of the Federal Open Market Committee of the Federal Reserve System. He was the editor of the Federal Reserve Bank of New York's *Economic Policy Review* and later served on that journal's editorial board. From 1997 to 2006, Mishkin also was an academic consultant to and served on the Economic Advisory Panel of the Federal Reserve Bank of New York. Mishkin has been an academic consultant to the Board of Governors and a visiting scholar at the board's Division of International Finance. Mishkin's research focuses on monetary policy and its impact on financial markets and the aggregate economy. He is the author of more than fifteen books and has published numerous articles in professional journals and books. Mishkin has served on the editorial board of the *American Economic Review* and has been an associate editor at the *Journal of Business and Economic Statistics,* the *Journal of Applied Econometrics,* and the *Journal of Economic Perspectives.* He is currently an associate editor (member of the editorial board) at the *Journal of Money, Credit and Banking; Macroeconomics and Monetary Economics Abstracts; Journal of International Money and Finance; International Finance;* and *Finance India.* Mishkin has been a consultant to the World Bank, the Inter-American Development Bank, and the International Monetary Fund, as well as to numerous central banks throughout the world. He also was a member of the International Advisory Board to the Financial Supervisory Service of South Korea and an adviser to the Institute for Monetary and Economic Research at the Bank of Korea. Mishkin received a BS (1973) and PhD (1976), both in economics, from the Massachusetts Institute of Technology. In 1999, he received an honorary professorship from the Peoples (Renmin) University of China.

William Poole, Federal Reserve Bank of St. Louis

William Poole took office on March 23, 1998, as the eleventh chief executive of the Eighth District Federal Reserve Bank, in St. Louis. He is serving a full term that began March 1, 2001. In 2007, he served as a voting member of the Federal Open Market Committee, bringing his district's perspective to policy discussions in Washington.

Poole began his career at the Board of Governors of the Federal Reserve System in 1964 and worked as a senior economist there from 1969 to 1974. In 1974, he joined the faculty at Brown University in Providence, Rhode Island. He twice served as chairman of the economics department and for five years directed the university's Center for the Study of Financial Markets and Institutions. He was the Herbert H. Goldberger Professor of Economics there when he joined the Federal Reserve Bank of St. Louis. Poole has served as a visiting scholar and an advisor at numerous institutions. From 1970 to 1990 he was a member of, and became senior advisor to, the Brookings Panel on Economic Activity, and from 1982 to 1985, he was a member of the Council of Economic Advisers and a member of the Academic Advisory Panels of the Federal Reserve Banks of New York and Boston. From 1985 until his appointment to the St. Louis Bank, Poole was an adjunct scholar at the Cato Institute and a member of the Shadow Open Market Committee. From 1989 to 1995, he served on the Congressional Budget Office Panel of Economic Advisors. In addition, he has been an adviser and consultant to the Federal Reserve Bank of Boston, a visiting scholar at the Federal Reserve Bank of San Francisco, and a visiting economist at the Reserve Bank of Australia. Poole wrote *Money and the Economy: A Monetarist View*, published in 1978, as well as numerous scholarly papers in professional journals, and he was coauthor of *Principles of Economics*, published in 1991.

Poole is a director of the United Way of Greater St. Louis and member of the Webster University Board of Trustees. He was a member of the Chancellor's Council of the University of Missouri–St. Louis from 1999 to 2003. Poole received a BA in 1959 from Swarthmore College and an MBA in 1963 and a PhD in economics in 1966, both from the University of Chicago. Swarthmore honored him with a doctor of laws degree in 1989.

Vincent R. Reinhart, Federal Reserve System

Vincent R. Reinhart, former director of the Federal Reserve Board's Division of Monetary Affairs, has spent more than two decades working on domestic and international aspects of U.S. monetary policy. He held a number of senior positions in the divisions of monetary affairs and international finance and served as secretary and economist of the Federal Open Market Committee for the last six years of his Federal Reserve career. Reinhart has worked on topics as varied as economic bubbles and the conduct of monetary policy, auctions of U.S. Treasury securities, alternative strategies monetary policy, and the efficient communication of monetary policy decisions. Reinhart has a B.S. from Fordham University and an M.A. and M.Phil. from Columbia University.

Eric S. Rosengren, Federal Reserve Bank Boston

Eric S. Rosengren took office on July 23, 2007, as the thirteenth CEO of the Federal Reserve Bank of Boston, serving the First District. He serves the remainder of a term that began on March 1, 2006. In 2007, he was a voting member of the Federal Open Market Committee. Rosengren has held senior positions within the Federal Reserve in both the research and bank supervision functions. He joined the Federal Reserve Bank of Boston in 1985 as an economist in the research department. He was promoted to assistant vice president in 1989 and to vice president

in 1991 as head of the banking and monetary policy section of the research department. In 2000, he was named senior vice president and head of the supervision and regulation department. He assumed the additional title of chief discount officer in 2003, and in 2005, he was named executive vice president. While in the bank supervision function, he obtained significant domestic and international regulatory experience related to the Basel II Capital Accord.

In his work as an economist, Rosengren has made the link between financial problems and the real economy a focus of his research, and he has published extensively on macroeconomics, international banking, bank supervision, and risk management. He has been an author of more than 100 articles and papers on economics and finance, including articles in many of the top economics and finance journals. Rosengren graduated summa cum laude from Colby College with a BA in economics. He then spent one year in Australia as a Thomas Watson Fellow. Following his year in Australia, he attended the University of Wisconsin–Madison, where he earned an MS in economics in 1984 and a PhD in economics in 1986.

Kermit L. Schoenholtz, Citigroup

Kim Schoenholtz is Managing Director and Senior Advisor in Citigroup Corporate and Investment Bank's Economic and Market Analysis (EMA) department. Schoenholtz served as the firm's Global Chief Economist from1997 until 2005. After taking a year's leave, he returned in 2006 as a Senior Advisor in EMA on a part-time basis. Schoenholtz joined Salomon Brothers in 1986. He worked in Bond Market Research in New York before moving to Tokyo in 1988. As Director of EMA in Tokyo, he was responsible for the firm's view on the Japanese economy and markets. In 1992, he moved to London to serve as the head of EMA in Europe. He became the firm's Chief Economist in 1997 and returned to New York in this role in 1999. Schoenholtz was a Visiting Scholar at the Bank of Japan's Institute for Monetary and Economic Studies from 1983 to 1985. He received an MPhil in economics from Yale University in 1982 and an AB from Brown University in 1977. He also studied for one year in Marburg, Germany.

Matthew D. Shapiro, University of Michigan and NBER

Matthew D. Shapiro is the Lawrence R. Klein Collegiate Professor and Chair of Economics and Research Professor at the University of Michigan and a Research Associate of the National Bureau of Economic Research. Shapiro has carried out research on macroeconomics, investment and capital utilization, business-cycle fluctuations, consumption and saving, financial markets, fiscal policy, monetary policy, time-series econometrics, and survey methodology. Among his current research interests are modeling how recent changes in tax policy affect investment, employment, and output, modeling saving, retirement, and portfolio choices of households, improving the quality of national economic statistics, and using surveys to address questions in macroeconomics. Shapiro is chair of the Federal Economic Statistics Advisory Committee — the advisory committee of the Bureau of Labor Statistics, the Bureau of Economic Analysis, and the economic programs of the Census Bureau. He also is a member of the Academic Advisory Panel of the Federal Reserve Bank of Chicago. Shapiro has been a National Academy of Science's Committee on National Statistics member and on its Panel on Non-Market Accounts. Shapiro received BA and MA degrees from Yale in1979 and a PhD from the Massachusetts Institute of Technology in 1984.

Hyun Song Shin, Princeton University

Hyun Song Shin is professor of economics at Princeton University, affiliated with the

department of economics and the Bendheim Center for Finance. Prior to coming to Princeton, he was professor of finance at the London School of Economics. His research interests are in financial economics and economic theory with particular reference to financial crises, disclosures, risk, and financial stability issues — topics on which he has published widely, both in academic and practitioner outlets. He has served as editor or editorial board member of several scholarly journals and has served in an advisory capacity to central banks and policy organizations on financial stability issues. He is a fellow of the Econometric Society and of the British Academy. Shin has a B.A. in Philosophy, Politics and Economics from Oxford University (Magdalen College, 1985) and a Ph.D. in Economics from Oxford University (1988).

Paul Tucker, Bank of England

Paul Tucker was appointed to his current position in June 2002. Tucker is a member ofthe Monetary Policy Committee and has executive responsibility for the bank's implementation of monetary policy via open market operations, the bank's foreign exchange market operations including management of HMG's foreign currency reserves and related risk management, and market intelligence and analysis supporting the bank's monetary and financial stability core purposes. He is a member of the governor's executive team, the bank's Asset and Liability Committee, and the Financial Markets Law Committee. Tucker also chairs London's Money Markets Liaison Group. From 1980 to 1989, Tucker worked as a banking supervisor, as a corporate financier at a merchant bank, and on projects to reform the Hong Kong securities markets and regulatory system following the 1987 crash, and then the UK's wholesale payments system, leading to the introduction of real-time gross settlement. He was principal private secretary to Bank of England Governor Leigh-Pemberton for 3½ years until 1993, at which time he moved to the domestic market operations area. He became head of Gilt-Edged & Money Markets Division in mid-1994, during the period of reforms in the gilt and sterling money markets. From 1997 to 1998, he was head of Monetary Assessment and Strategy Division, which is responsible for assessing UK monetary conditions and issues concerning the monetary framework. In January 1999, he became deputy director of financial stability, and he was closely involved with the bank's financial stability review. He also was a member of the bank's management committee. From May 1997 until his current appointment, he was on the Secretariat of the Monetary Policy Committee, preparing the published minutes. Tucker was educated at Trinity College, Cambridge, Mathematics (Parts I and II) and Philosophy (Part II), 1976–80.

Mark W. Watson, Princeton University

Mark Watson is the Howard Harrison and Gabrielle Snyder Beck Professor of Economics and Public Affairs at Princeton University and a research associate at the National Bureau of Economic Research. He is a fellow of the American Academy of Arts and Sciences and of the Econometric Society. His research focuses on time-series econometrics, empirical macroeconomics, and macroeconomic forecasting. He has published articles in these areas and is the author (with James Stock) of Introduction to Econometrics, a leading undergraduate textbook. Watson has served on the editorial board of several journals including the *American Economic Review, Applied Econometrics, Econometrica,* the *Journal of Business and Economic Statistics,* the *Journal of Monetary Economics,* and *Macroeconomic Dynamics.* He has served as a consultant for the Federal Reserve Banks of Chicago and Richmond. Before coming to Princeton, Watson served on the economics faculty at Harvard and Northwestern. Watson did his undergraduate work at Pierce Junior College and California State University at Northridge, and he completed his PhD at the University of California at San Diego.

Kenneth D. West, University of Wisconsin-Madison

Kenneth D. West is the Ragnar Frisch Professor of Economics and Chair of the Economics Department at the University of Wisconsin-Madison. West taught at Princeton University from 1983 to 1988 before coming to the University of Wisconsin in 1988. He has held visiting scholar positions at several central banks and at several branches of the U.S. Federal Reserve System. He is currently co-editor of the *Journal of Money, Credit and Banking* and previously served as co-editor of the *American Economic Review*. West has published widely in the fields of macroeconomics, finance, international economics, and econometrics. Honors include the John M. Stauffer National Fellowship in Public Policy at the Hoover Institution, Alfred P. Sloan Research Fellowship, Fellow of the Econometric Society, and Abe Fellowship. He received a BA in Economics and Mathematics from Wesleyan University in 1973 and a PhD in Economics from the Massachusetts Institute of Technology in 1983.

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Notes

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