2009

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Steven Gjerstad
Chapman University, gjerstad@chapman.edu

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Comments

Working Paper 09-01

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Steven Gjerstad

Economic Science Institute
Chapman University
One University Drive
Orange, CA 92866

gjerstad@chapman.edu

January 27, 2009

Abstract

The subprime mortgage crisis has done more damage to the financial system than any financial crisis since the depression. This paper examines the Federal Reserve's expansionary monetary policy during the early part of this decade, the effect of that expansionary policy on mortgage market liquidity, the effects of that liquidity on housing price movements, and the way that those price movements contributed to the severity of the financial crisis. House prices increased most in the low-priced tier of the market during the expansion, which prompted lenders and investors in mortgage-backed securities to finance highly leveraged purchases in this segment of the market. But house prices also decline most in the low-priced tier during a contraction or collapse, among borrowers with inadequate assets and income to absorb the decline in their home values if forced to sell their homes. Consequently, their losses were transmitted into the financial sector, with an impact far more devastating than in any crisis since the depression. In order to address this structural vulnerability of the residential real estate market, several problems with incentives and information disclosure at almost every stage in the lending and securitization process need to be addressed, including the incentives of home buyers, loan originators, loan servicers, bond rating firms, investment banks, and credit enhancement providers. Alternatively, many of the problems with risk assessment may need to be transferred to investors, who have a clear incentive to gather information and assess risks, and can discipline lenders by directing capital to those lenders who adequately manage lending risks.

Keywords: Business cycles, Case-Shiller tiered price index, financial crises, financial innovation, monetary policy, residential real estate, structured finance, subprime mortgage crisis

JEL Classification Numbers: E3, E5, E44, E5, E65, G01, G2, O31, O33, R21

1 Introduction

The suddenness and severity of the current financial crisis are among its most striking features. The collapse of credit markets has resulted from excessive credit extension, much of which cannot be repaid either in a timely manner or in many cases, ever. Many past crises have had this characteristic: credit is extended further and further, leading to increased output, consumption, and asset values until credit obligations become unsustainable, especially among borrowers with weak asset positions. During the 10 years leading up to the great depression, mortgage and consumer instalment debt grew at their fastest rate of the past century.[1] Between 1919 and 1932, consumer debt grew from 7% of GDP to 23% of GDP.[2] Persons [1930] describes the rapid expansion of many consumer durable good markets between 1919 and 1929, including housing, automobiles, and electric appliances, as well as the growth of mortgage and instalment credit that supported the rapid growth of these markets. These products – and the credit that supported purchases of them – greatly expanded both output and consumption during this period. In the early period of this expansion, wealthier households acquired these goods either from accumulated wealth or with large down payments. As the decade progressed though, the expansion was sustained with increasing credit extension. Fisher [1950] provides an excellent summary of the expansion of household mortgage finance between 1919 and 1929, the sudden contraction of mortgage credit with the 1929 crisis, and the institutional developments that were undertaken starting in 1933 to mitigate undesirable social consequences of the collapse of credit markets. The pattern of debt expansion between 1919 and 1929 closely parallels the expansion in credit over the past 10 years. In both episodes, rapid debt growth strained the capacity of the rapidly expanding financial system to assess and monitor credit risks. In the current crisis as in past crises, losses on major investments strain the financial system, but – as I argue in this paper – the asset position of debtors matters greatly in whether financial strain leads to financial breakdown.

So why is this crisis so much more severe than any in the post-war era? In this paper, I argue that the balance sheet of asset holders is the primary determinant of whether asset value declines produce a manageable episode of financial strain, or a financial breakdown that necessitates a major intervention. Episodes of financial stress have been common over the past two decades. Notable events include Black Monday (October 19, 1987), the collapse of Long Term Capital Management in September 1998, and the downturn in the U.S. equities markets in the early part of this decade. Among all of these crises, why is it that only the current one has led to a breakdown of the financial system?

[1] These forms of debt grew by a factor of 3.77 between 1919 and 1929. Debt figures are taken from Juster [1966, Table B-1] for 1897 to 1960, and from the Flow of Funds, Table L.217 for Q3 1996 and Q3 2008.

[2] Debt figures are from the same source as in footnote 1. GDP figures are from Balke and Gordon [1989, Table 10].

1.1 Asset-holder balance sheets in a downturn

A comparison between the downturn of the equities markets between Q1 2000 and Q3 2002 and the current crisis is instructive in this respect. The Dow Jones Industrials index peaked in December 1999 at $11,497 and fell to its trough in September 2002 at $7,059 (adjusted for inflation to December 1999 prices). In Q1 2000 the value of U.S. corporate equities was $20.23 trillion; by Q3 2002 the value had fallen $9.94 trillion to $10.29 trillion (in Q1 2000 dollars), a loss of 49% in real terms.[3] Keefe, Bruyette & Woods (KBW) produces several indices of the stock prices of financial firms. During this downturn in the equities market, the KBW large capital banking index, BKX, fell from $745.46 in Q1 2000 to $702.55 in Q3 2002 (in Q1 2000 prices), a decline of only 5.8% in real terms. (In nominal terms, the KBX index rose slightly during the large downturn in the equity market.) By contrast, during the downturn in the U.S. housing market that began in 2006, the financial sector had been devastated before $3 trillion was lost in the value of residential real estate.

The value of residential real estate in the U.S. peaked at $21.89 trillion in 2006; by Q3 2008, the value had dropped $2.79 trillion to $19.10 trillion.[4] When we look at the consequences of this decline for the financial markets though, the picture differs strikingly from the picture early in this decade. The BKX peaked in January 2007 at $117.90 and had fallen by over 73% to $31.56 by January 16, 2009 (compared to the decline of 5.8% between Q1 2000 and Q3 2002).[5] The KBW mortgage finance index MFX, which was instituted in November 2005, peaked in December 2006 and had fallen 85% by December 2008. The financial intermediation sector has been hit hard in the current crisis, especially considering the magnitude of the losses in the housing sector in the current crisis relative to the losses in the equity market collapse between 2000 and 2002. Problems in the equities markets now are as severe as those endured during the downturn in the early part of this decade, but the driving factor in the current case is clearly the housing sector. From January 2007 when the KBW BKX index of financial stocks peaked until May 2008, the BKX index fell 40%. During the same period, the Dow

[3] The equity value figure for Q1 2000 is taken from Table L.213, line 1 in the Q4 2000 Flow of Funds document; the equity figure for Q3 2002 is taken from the Q4 2003 Flow of Funds document. The discrepancy between the percentage decline in the DJI index and the Flow of Funds equity value is due to the different composition of the equity value measures.

[4] Residential real estate values are taken from Table B.100, line 4 in the Flow of Funds. For a more direct comparison with the equity market decline, in Q1 2000 prices the value of residential real estate fell $3.56 trillion from $18.32 trillion (in Q1 2007) to $14.76 trillion (in Q3 2008). Even when the amount of the housing losses are adjusted to Q1 2000 prices and compared to the equity loss in the early part of this decade, the loss in the housing market at the time of the financial market meltdown in September 2008 was still only 36% of the losses in the equity market downturn early in this decade.

[5] The BKX stock index had a 10 to 1 stock split on March 22, 2004. The BKX prices before and after this date have different scales.

Jones index increased by 1.5%. The fall of the stock market between May and December 2008 was a reaction to the problem that developed in the mortgage market, was transmitted into the financial sector, and then began to affect the broader economy.

The magnitude of the decline in real estate values has been much lower than the decline in equity value in the early part of this decade, yet the effects on the financial sector differed greatly. Most of the losses early in this decade were absorbed by individual and corporate investors, by pension funds, and by retirement plans. These classes of investors lost a significant portion of their assets in the decline, but the problems never seriously affected the financial system. The stock market decline affected wealth levels, but insolvencies were minimal by comparison with recent events. Although the ultimate losses in the residential real estate market during the current crisis are unknown, losses to date are substantially less than the losses from the downturn in the equities market between 2000 and 2002, but the damage to the financial sector greatly exceeds the damage from the equities market decline early in this decade. The real cost of this damage to the financial system is already becoming apparent.

1.2 Asset loss transmission in Bernanke's model

Bernanke [1983] argues that shocks to the financial system adversely affect its ability to perform its credit intermediation functions, with potentially devastating effects for the broader economy. As household balance sheets have deteriorated (due to lost home equity) and credit markets have tightened, purchases of consumer durable goods have declined. Naturally, the automobile industry was an early casualty of the decline in household asset positions and the consequent cutback on household durable good purchases, since the purchases of an auto is a major expenditure that is typically acquired with instalment debt.[6] The problems have now reached beyond durable goods into the retail sector, with plummeting sales figures, bankruptcies, and even liquidations of some retailers.

Developments over the past two years broadly conform to the pattern that Bernanke observed in the depression. A shock to the real sector was transmitted to the financial sector. Damage to the financial sector impaired its ability to carry out its credit intermediation functions, which then led to broader problems of contraction in production, income, and consumption. In the current crisis, the problems emerged in the housing sector in early 2006. Homeowners' asset losses were transmitted into the financial system because of the weak asset position of many of the most affected borrowers. Losses in the financial system led to declining asset values in that sector beginning at the end of 2006, and also led to a curtailment of the credit that financial firms extended to consumers and to firms. The tight credit market led to decreases in consumption, especially of durable goods.

[6] According to Motor Intelligence, sales of autos and light trucks in the U.S. fell 35.6% on a year-over-year basis (from 1,389,783 in Dec. 2007 to 894,805 in Dec. 2008).

These consumption declines decreased revenues and profits of firms, which led to declining asset prices beginning in the fall of 2007. These developments, which follow the pattern described in Bernanke [1983] for the depression, are shown in figure 1. According to the NBER, a recession began sometime between December 2007 and June 2008.

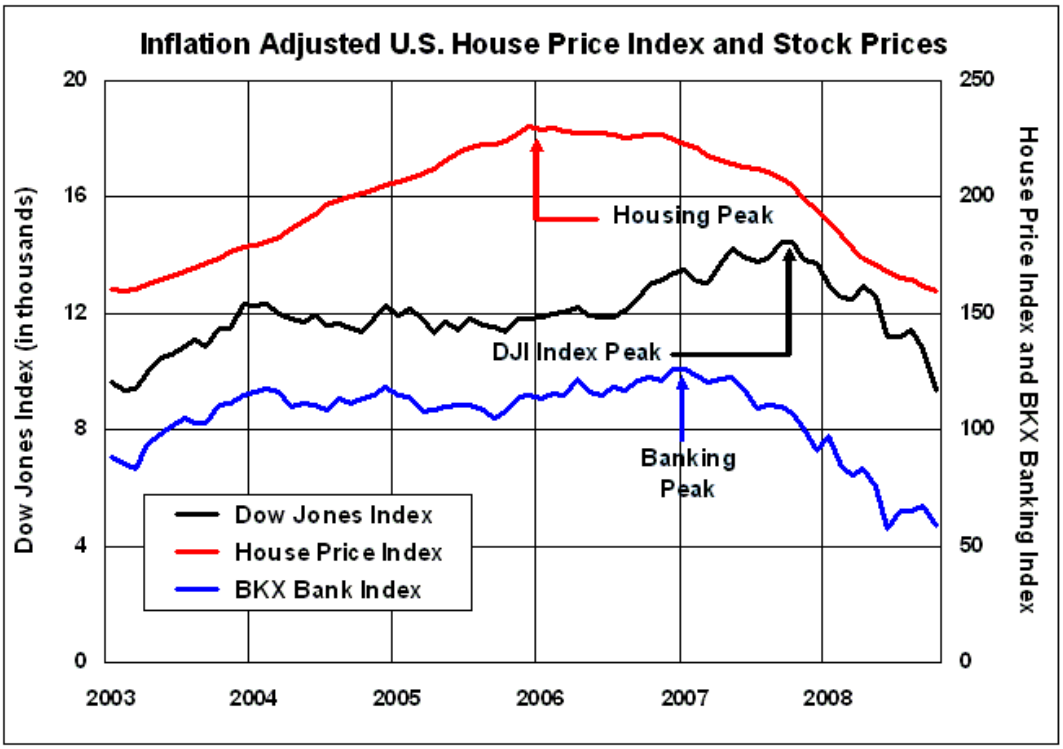


Figure 1: The housing downturn infected the financial sector, which decreased credit to consumers and firms.

In this paper, I augment Bernanke's argument by showing that (1) unsustainable debt loads led to financial strain; and (2) the asset position of borrowers who accumulate this debt is an important determinant of whether financial strain leads to financial breakdown. Bernanke examines a causal sequence that begins with a downturn in a real sector of the economy that adversely affects the financial sector. He argues that damage to the financial sector adversely affects the broader economy when the credit intermediation function of financial firms is impaired. In this paper, I examine a step in the causal sequence that precedes the one that Bernanke investigates. Some real sector declines, such as the equity market decline early in this decade, have little impact on the financial sector, so Bernanke's causal chain isn't triggered. (Recall that the BKX index fell only 5.8% during the equity market downturn between Q1 2000 and Q3 2002.) Other real sector declines, such as the downturn in the housing market starting in 2006, devastate the financial sector, so the causal sequence that

Bernanke describes is triggered with a vengeance. My argument is that a real sector decline that adversely affects a group of borrowers with weak asset positions is much more likely to damage the financial sector, and is therefore more likely to generate a negative the feedback loop from the financial sector to the broad economy.

The losses in the equities collapse early in this decade were largely absorbed by the owners of the equities. Federal Reserve Regulation T restricts the extent of margin buying in such a way that counterparty risk is manageable. The owners of equities suffered the losses; the financial system only absorbs losses to the extent that they too own declining assets. But the structure of the mortgage market in the current crisis has revealed striking weaknesses. The purpose of this paper is to investigate these weaknesses in the mortgage market and to show that an important structural feature of the housing market – in which prices rise and fall fastest in the lowest end of the market – was an important contributing factor in the financial collapse.

1.3 Asset loss transmission in the housing market collapse

In the current crisis, much of the shock has come from defaults in a sector of the economy that does not offer the kind of cushion that existed with the investors affected by the downturn in the equities market that began in 2000. The sharp downturn in the low-price tier of the mortgage market affects people without the assets to absorb a significant asset value decline. In this paper I show that, in a housing market expansion and contraction, natural economic forces accumulate the most risk in the segment of the market with the least capacity to withstand adverse asset value movements. The severity of this crisis derives much of its force from its capacity to concentrate losses in one of the weakest parts of the economy, in households with low income and wealth rank. I also argue that this natural economic force attracted large capital flows into the most fragile segment of the housing market during the housing boom. A structural feature of the housing market made the low price tier appreciate fastest in the upturn, which drew in low income borrowers, subprime lenders, issuers of mortgage backed securities (MBS), and even credit enhancement providers, such as Ambac, MBIA, and AIG, who insured MBS issues with credit default swaps (CDS). The same structural feature also made the low end of the market collapse fastest and farthest during the downturn. Many of the facts of the mortgage crisis are known; what is new here is an explanation as to why so much capital was drawn to (and debt accumulated in) the market tier comprised of homeowners with the lowest income and the fewest assets, who were least able to absorb a shock to their asset value. Many of these households had no asset cushion to absorb the large losses that they ultimately sustained, so the shock from declining house prices was transmitted into the financial system, with disastrous results.

In some of the worst affected markets, price drops in the lowest tier of the Case-Shiller tiered price indices have been much greater than the widely reported decline in the Median Sales Price of Existing Homes from the National Association of Realtors, which has fallen 21% (from $229,000 in July 2007 to $181,300 in November

2008) or the aggregate decline in the Case-Shiller 20 city composite index, which has fallen 23.4% between July 2006 and October 2008.[7] In October 2008 the low-price tier in San Francisco consisted of homes with a value below $361,865. The real price of those homes has fallen 56% since their peak in November 2005. Similar declines for low-price tiers have occurred in Phoenix (with a 51% drop), in San Diego (with a 50% drop), in Los Angeles and Miami (both with a 49% drop), and in Las Vegas (with a 48% drop). Other cities whose housing markets haven't attracted the same attention as these in the southwest and Florida have suffered devastating losses. The price index in the low-price tier (under $308,782 in October 2008) in Washington D.C. has fallen 40%; in Minneapolis it has fallen 33% for the low-price tier (under $169,780 in October 2008). These declines have led to a serious problem with negative equity in many of the hard-hit markets. According to First American CoreLogic, 48% of mortgages in Nevada were under water in Q3 2008. The figure in Michigan is 39%; in Florida and Arizona 29% of all mortgages have negative equity; in California, 27% of all mortgages were underwater at the end of Q3 2008. In the low-price tier of the market, many households have little cushion to absorb a financial shock of this magnitude, so losses due to foreclosure and homeowner walkaway in many cases are transmitted unimpeded into the financial system and to the investors in MBS, who provided liquidity to the mortgage market. Serious delinquency too takes a heavy toll on the value of mortgage backed securities, in addition to its toll on the flow of payments to the owners of these securities.

1.4 Potential benefits of mortgage securities

Despite all of the negative aspects of the current crisis, the mortgage finance revolution over the past 25 years has the potential to solve at least three economic problems, provided that the incentives in the industry can be restructured. Aside from GSE liquidity, prior to 1980 capital for the mortgage market typically came from deposits in a local bank that were then utilized to finance mortgages in the same location. In regions with growing populations or younger populations, mortgage finance was constrained and interest rates were high. Locales with stable and older populations had low mortgage rates. This geographic segmentation of the mortgage market limited housing development in high growth areas and kept mortgage finance costs down in established low growth areas. An effectively functioning market for mortgage backed securities reduces geographical disparities by integrating the capital market. In a geographically integrated market, lenders in low growth areas receive higher yields when they make funds available to high growth areas, and the high growth areas obtain additional liquidity with lower financing costs when mortgage capital flows into these areas.

Before the advent of the MBS market, many institutions looking for investment opportunities could hold volatile equities, low yield treasury bonds, relatively illiquid real assets such as commercial real estate, corporate

[7] Case and Shiller [1989] describes the weighted repeated sales index that they construct. Their aggregate index and their tiered price index data are available at http://www.homeprice.standardandpoors.com.

bonds, or relatively low yield federal, state, and municipal bonds. The advent of the mortgage backed securities market added another investment class with relatively high yield and (historically) low risk to investment grade corporate securities market.

Between 2002 and 2007, commercial banks, savings & loans, and credit unions held between 24.0% and 28.5% of all mortgage backed securities. Pension funds and insurance companies were also major holders of mortgage backed securities. Under normal conditions, when banks hold mortgage backed securities, they continue to receive the high yields and low risks that mortgages offer, but in a more liquid form. So it is natural that banks seek to diversify their mortgage holdings and turn their mortgage holdings into a more liquid form by holding securities based on the mortgages of other lenders.

The asymmetry in maturities between the asset positions of banks and their liabilities (primarily in the form of demand deposits) is another problem that the MBS market can alleviate. This asymmetry is the source of the potential for bank runs, and by extension, it is one significant rationale for federal deposit insurance. Residential and commercial real estate are major components of national wealth, and also constitute major assets on the balance sheets of banks. Securitization of these assets allows banks to push them out toward institutions, such as pension funds and insurance companies, with liabilities that better match these assets. Pension funds need to provide a flow of payments to their claimants over a long time horizon. The same is true of insurance companies. Between 2002 and 2007, pension funds and insurance companies held between 14.0% and 18.1% of mortgage backed securities.[8] An effective MBS market would create an asset that provides flows of payments to pension funds and insurance companies that are well-aligned with their obligations.

1.5 Incentive issues with mortgage securities

Problems with the private issue MBS market must be resolved if it is to effectively diversify mortgage risk among lenders, geographically integrate mortgage capital markets, and better align the maturities of assets and liabilities of pension funds, insurance companies, and banks. The current system of mortgage securitization is rife with misaligned incentives. When mortgages are slated for sale to an investment banks for securitization, banks and other lenders don't care about a buyer's ability to repay.[9] When bond rating companies are paid

[8] The MBS holdings of these investor classes come from calculations based on figures in MMSAII, pp. 285 – 286. According to Juster [1930, p. 104], insurance companies directly held 11.3% of U.S. residential mortgages in 1920; their mortgage holdings had increased to 17.8% of the total by 1929. Mortgage bonds grew monotonically from 4.5% of total mortgage issues in 1920 to 15.4% by 1929, though it is not clear how much of this debt found its way to the insurance companies.

[9] The Government Sponsored Entities (GSEs) managed this moral hazard problem effectively for 70 years, through standardized loan application and underwriting procedures.

by MBS issuers, they assure themselves more business if bond ratings are high.[10] Bond issues have a rigid legal structure that restricts the capacity of loan servicers to modify loan terms for distressed borrowers.[11] Lewis and Einhorn [2009] argue that ratings agencies are reluctant to downgrade the corporate rating of a credit enhancement provider. They consider the example of MBIA, which guaranteed many collateralized debt obligations. They note that "a downgrade of MBIA would force the rating agencies to go through the costly and cumbersome process of re-rating tens of thousands of credits that bore triple-A ratings simply by virtue of MBIA's guarantee." Re-rating these securities would provide no revenue stream, while churning out ratings on new bond issues adds to revenue. Credit enhancement providers who issue credit default swaps may be willing to risk the future of their own firm if those risks allow them to take away hundreds of millions in compensation before the firm fails.[12]

These incentive problems that span a multi-leveled origination process, with at least one serious problem at each level, must be overcome in order for this financial innovation to take hold, add liquidity to the mortgage market, diversify the risks of mortgage lenders, and provide an asset to insurance companies and pension funds that match their liabilities.

[10] For discussions of this issue, see Lowenstein [2008] and Morgenson [2008b]. Morgenson quotes Edmund Vogelius, a Moody's vice president, from a 1957 article in The Christian Science Monitor. "We obviously cannot ask payment for rating a bond. To do so would attach a price to the process, and we could not escape the charge, which would undoubtedly come, that our ratings are for sale." Around 1970, ratings agencies began to charge bond issuers for their ratings. In 1975, when the S.E.C. began to allow banks to meet their capital requirements with highly rated bonds, the position of the bond rating agencies was, in effect, secured by a government endorsement.

[11] I expand on this issue in Section 2.2, based on the assessment of these issues in Bair [2007].

[12] According to Morgenson [2008a], the A.I.G. Financial Products division, with fewer than 400 employees, received total compensation between $423 million and $610 million per year writing credit default swaps from 2001 to 2006. In an August 5, 2007 conference call with investors, Joseph J. Cassano, the head of A.I.G.F.P. assessed the possibility of losses on the A.I.G. derivatives portfolio. "It is hard for us, without being flippant, to even see a scenario within any kind of realm of reason that would see us losing one dollar in any of those [derivatives] transactions." Within 14 months of Cassano's brazen claim, A.I.G. had received $152 billion in U.S. Treasury and Federal Reserve funds, most of which were used to pay for realized losses on the bets at A.I.G.F.P. that Cassano had overseen, or to collateralize unrealized anticipated losses. According to a statement on Oct. 7, 2008 by Representative Henry Waxman, Chairman of the Committee on Oversight and Government Reform, Cassano received compensation of $280 million between 2001 and 2008.

2 The structure of housing and mortgage finance markets

The structure of housing market price tier movements that I describe and model in this paper, and the recent developments in housing market finance are intertwined. Subprime lending developed and grew rapidly because of the way that housing prices move in the lowest tier of the market. The housing market bubble expanded in response to perceived (but illusory) opportunities in the low-price tier of the housing market, and collapsed because of weaknesses in the same market tier. The collapse then infected financial institutions to an extent not seen since the collapse between October 1929 and March 1933. A key step in my argument is to show that house prices move most in the lowest price tier, among homeowners with the fewest assets. I begin with that problem, and later return to the linkages from house price movements to the financial sector. In Section 3 I develop a simple model to show why housing prices increase most in the low-price tier during an expansion, and why they decline most in that tier during a contraction.

2.1 Price tier movements

The Case-Shiller tiered price indices – which are available for seventeen American cities that are home to over 90 million people – track changes in home value in three tiers. Tier ranges differ across cities to reflect their different distribution of home values. At one extreme, the top end of the low-price tier in Cleveland was $118,497 in October 2008; at the other extreme, the top end of the low-price tier in San Francisco was $361,865 (also in October 2008).

A common pattern emerges in 14 of 17 cities. House price increases and decreases were greatest in the low-price tier of most markets and least in the high-price tier. Middle-price tier changes were in almost all cases between the low- and high-price tiers. The model that I develop in Section 3 provides a theoretical rationale for the pattern of price tier changes observed over the past 12 years. The model suggests that this pattern of price movements is a structural characteristic of the housing market, rather than merely a consequence of the practices of subprime lenders. This perspective suggests that subprime lending may have been a reaction to incentives created by the pattern of price movements, rather than a primary cause of these movements. Since prices increased fastest in the lowest price tier, this created the opportunity for lenders to provide loans – even to weak buyers – and then refinance later when the house price had appreciated. This structural characteristic of the market drew capital to the low end of the market where price movements were largest, because strong housing price appreciation in this tier (was believed to) offset weak asset positions of many borrowers in this tier. Yet appreciation in this tier was dependent on entry into the housing market, and when this entry slowed, prices flattened out and eventually fell: then the inadequate asset and income position of the borrowers in this segment of the market contributed importantly to the current crisis.

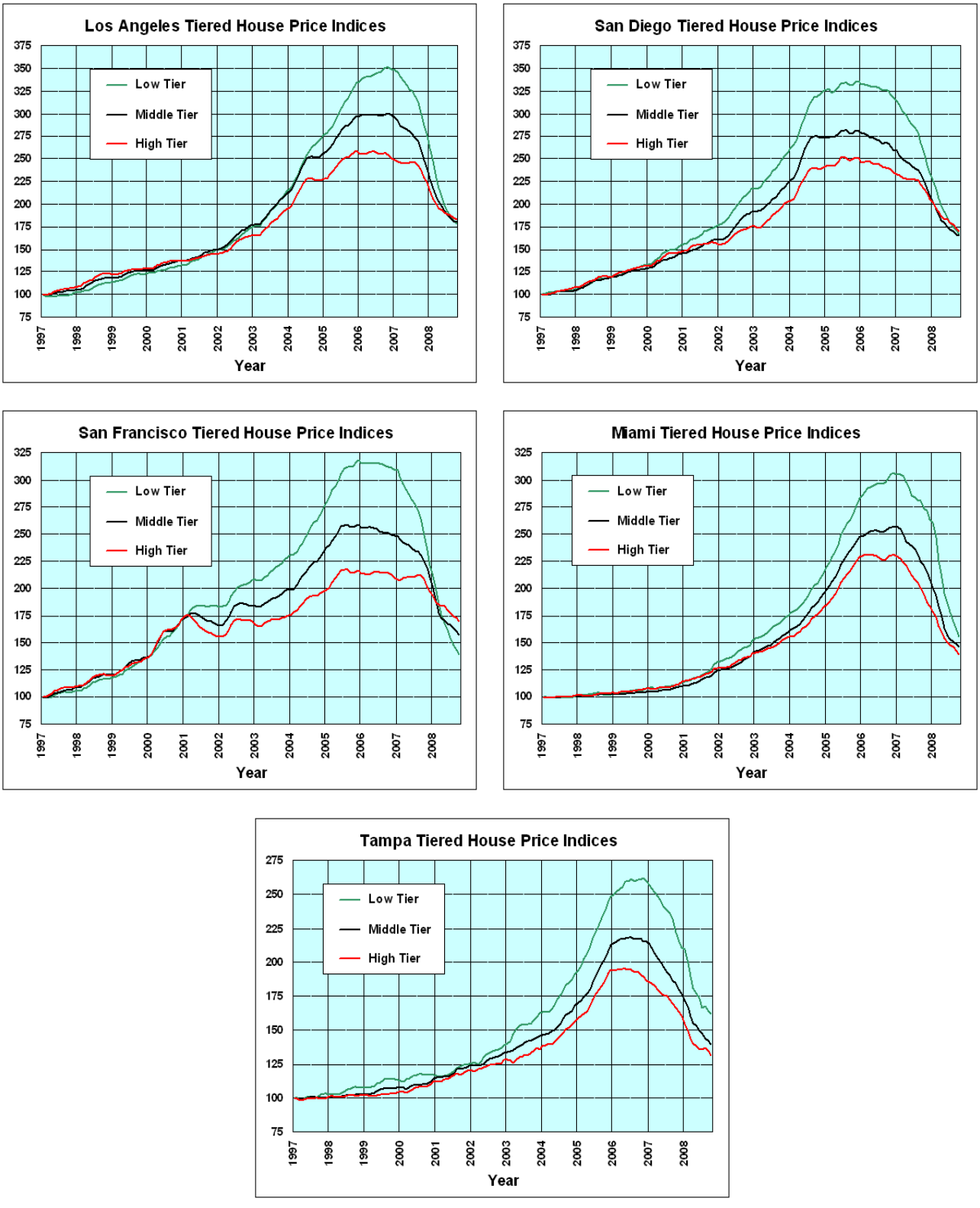


Figure 2: Tiered home price indices in California and Florida.

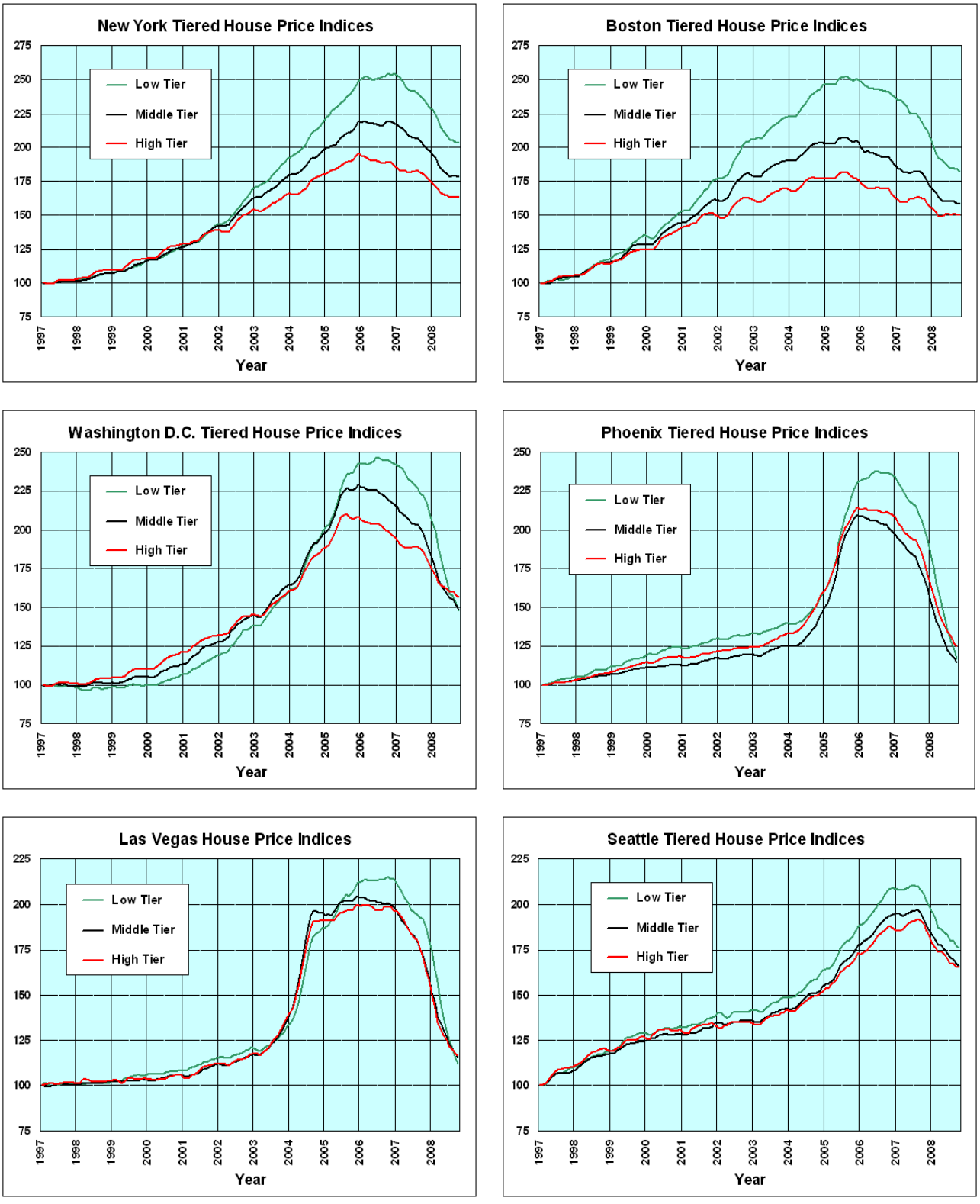


Figure 3: Tiered home price indices in the Northeast and the West.

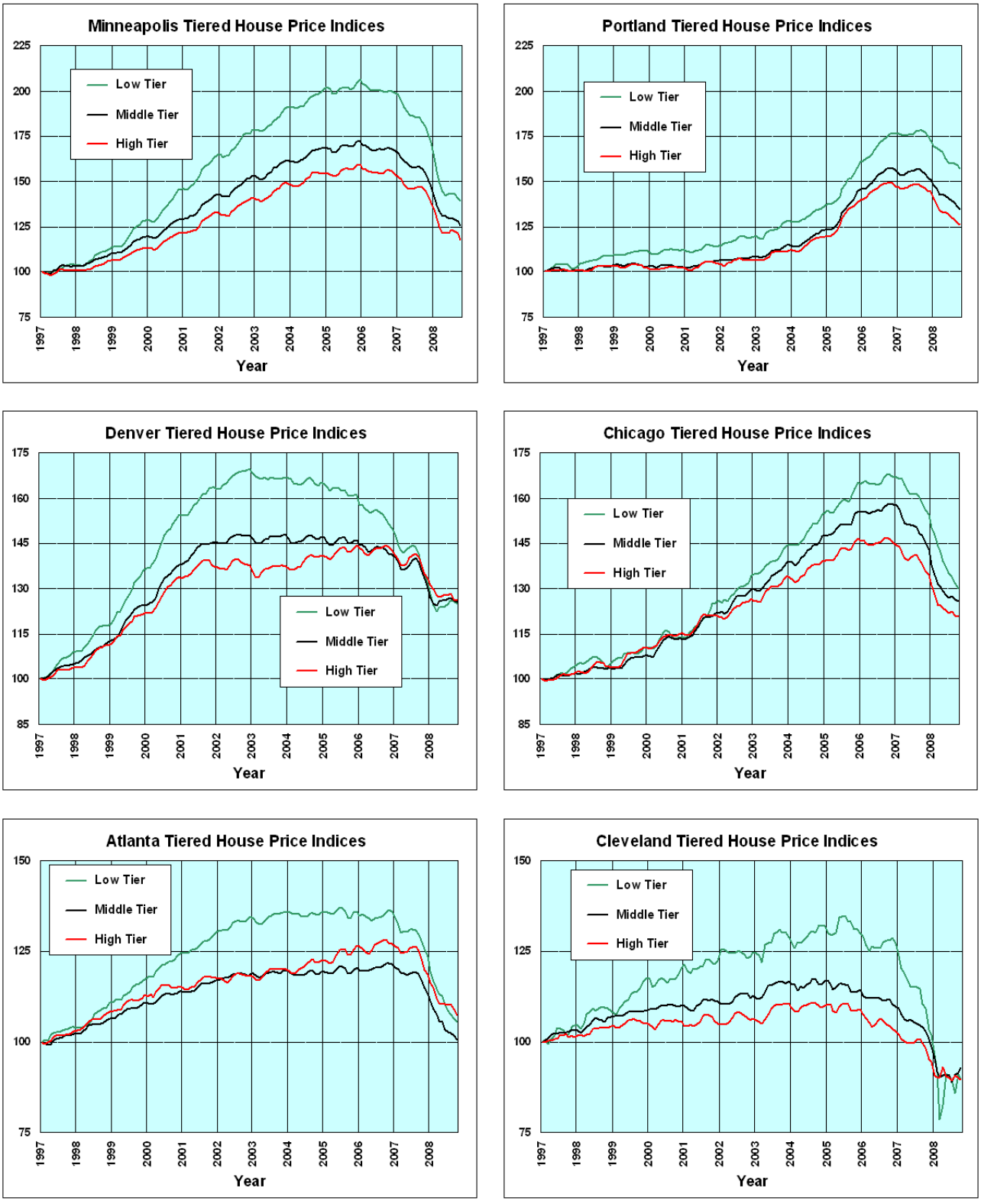


Figure 4: Tiered home price indices for the cities with the slowest growth.

Figures 2 through 4 show the expansion and contraction in home prices for the 17 cities in the Case-Shiller tiered price index. In 14 of the 17 cities, all three indices were in the order predicted: the low price tier grew fastest and fell fastest while the high price tier grew slowest and fell slowest. Of the three exceptions, in Atlanta and Phoenix the middle-price and high-price tiers are in the wrong order, and in Las Vegas the low-price tier lagged but eventually overtook the other two tiers and the descent has the relationship predicted by the model.

Cleveland provides further evidence that financial factors predominated in the recent expansion. The population of the Cleveland-Elyria-Mentor CBSA declined in every year from 1997 to 2005, and the population decrease in each of those years exceeded the decrease in the preceding year, yet the housing price indices grew every year during the contraction in population. By 2005, the population had fallen by 1.6% from the figure in 1997, yet real housing prices had increased by 35% in the lowest tier, and by 15% across all tiers. Under the circumstances that have prevailed since 2000, with annual population declines and no growth in per capita income, home prices would remain stable without a large increase in the amount of financing available for home loans.

2.2 The mortgage finance market

In the housing market bubble between 1997 and 2006, liquidity was a key driver of the rapid price increases. According to Inside Mortgage Finance (2008, Vol. 1, p. 3), total loan originations in the U.S. increased from $711 billion in 1991 to $1,048 billion in 2000 (both in year 2000 prices) for an annual growth rate of 4.4%; by 2003 the total loan originations had reached $3,962 billion (also in year 2000 prices), an annual increase of 52% over these three years. Loan originations haven't reached the 2003 level again, but they averaged $2,653 billion between 2004 and 2006, which is still over 2.5 times the figure in 2000 and more than three times the average from 1991 to 1997.

This massive injection of liquidity into the mortgage market – which was supported by an easy money policy by the Federal Reserve – almost surely played a significant role in the rapid price increases between 2001 and 2006. In the two previous housing bubbles, from 1975 to 1980 and from 1987 to 1990, the Federal Reserve increased the Federal Funds rate throughout the period when home prices were declining, in effect dampening the bubble. As figure 5 shows, the Federal Reserve pursued an expansionary monetary policy even as home prices shot up. Normally, the Federal Reserve would refrain from providing so much liquidity during a rapid increase in a large component of the CPI. But in 1983 the Bureau of Labor Statistics removed homeownership costs from the CPI and replaced them with rental equivalence value for homeowner occupied houses. Davis, Lehnert, and Martin (2008) determined that the price to rental ratio increased steadily from 19.0 to 20.2 between 1983 and 1996, so the change had little effect on measured inflation. Between 1999 and 2006, the ratio shot up from 20.8 to 32.3. In 2004 alone, the price-rent ratio increased 12.3%. Rental equivalence on homeowner

occupied units accounts for almost one quarter of the CPI, so the inflation for that year was underestimated by 2.9%. It should have been 6.2% instead of 3.3%. With nominal interest rates and inflation both close to 6%, the real interest rate was zero. So people borrowed. As the Federal Reserve monitored the economy looking for signs of inflation during the early part of this decade, home price increases were no longer visible in the CPI, so the lax monetary policy continued. On the flip side of this coin, with the price-rent ratio now falling at about 20% per year, the index is underestimating the deflation rate by about 5% per year. Measured deflation between July and December of last year was 10.3% at an annualized rate. If we add to that 5% from declining home prices, deflation is now substantially more than the 10.3% deflation in 1932, which was the most deflationary year during the great depression.

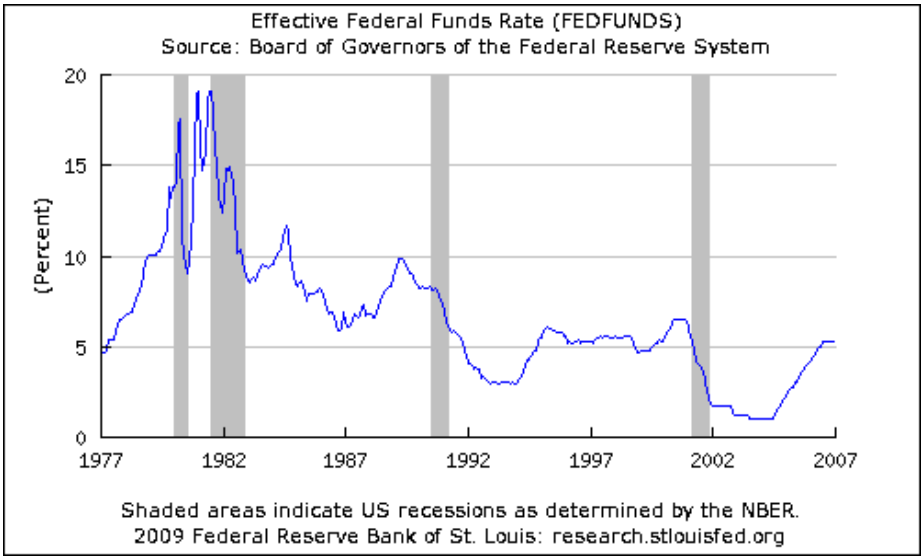


Figure 5: The housing bubble was sustained by mortgage finance market liquidity and an easy money policy.

Liquidity sustained the bubble through a positive feedback loop. While mortgage financing was readily available, new buyers entered the market, and their entrance sustained rising housing prices; rising housing prices sustained the flow of new capital into the market. During the boom, most homeowners who faced mortgage interest rate resets on an adjustable rate mortgage (ARM) were able to refinance. In the worst case, if they were unable to refinance, they could sell their home at a profit. As long as new households entered the ranks of homeowners faster than new homes could be built (as they did between Q3 1995 and Q4 2005), prices continued to rise. The growth of subprime, ARM, and Alt-A lending facilitated the new entrants into the homeownership market, their entrance into the market sustained housing price growth from 1997 to 2006, and housing price growth provided the rationale for lending to borrowers with weak asset, income, and credit.

The purpose of the model in this paper is to show, in a simplified environment, how tightening and slackening of the housing market through entrance into and exit from the market will affect home prices in three house price tiers. The current crisis fits into this model, because there was a rapid expansion in the number of households that owned their home. In 1994, 64.0% of U.S. households owned their home; by Q2 2004 that figure had reached 69.2%. It remained close to that level until Q4 2006. By Q4 2007 the figure had dropped to 67.8%, as shown in the graph on the upper left in figure 6.[13] This movement of households out of the group of homeowners has led to a sudden surge in homeowner vacancy rates. The average homeowner vacancy rate between Q1 1960 and Q4 2005 was 1.4%. This figure displayed a modest structural shift beween 1975 and 1980, but still averaged only 1.6% between 1980 and 2005. Over the past 8 quarters, the vacancy rate has increased to 2.8%, which is 1.75 times as high as the rate over the preceding 25 years, as shown in the upper right graph in figure 6.

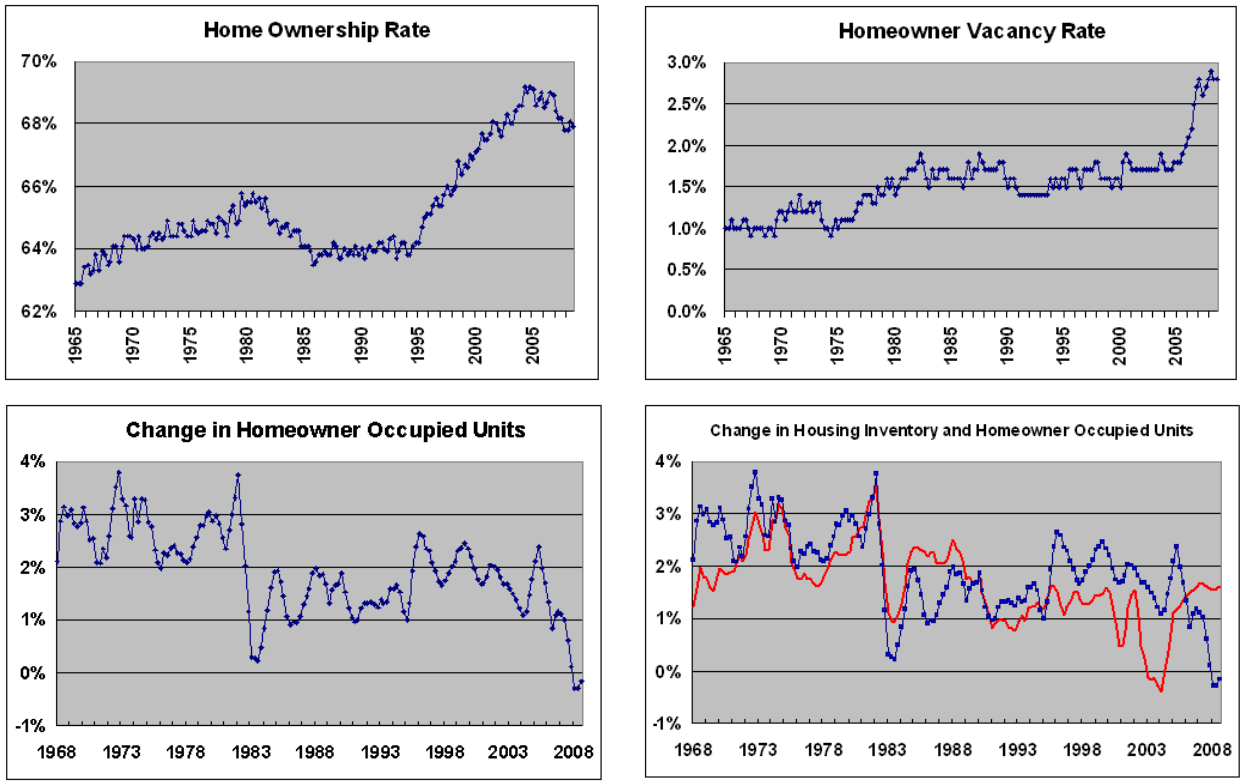


Figure 6: Source: U.S. Census Bureau, Housing Vacancies and Homeownership Survey, Historical Tables, Table 14 (homeownership rates), Table 2 (homeowner vacancy rates), and Table 8 (homeowner occupied units). (http://www.census.gov/hhes/www/housing/hvs/historic).

In the past two years, there has been a sudden contraction in the growth rate of homeowner occupied units.

[13] These data, which are displayed in the upper left graph in figure 6, come from the U.S. Census Bureau Housing Vacancies and Homeownership Survey, Historical Tables 2, 8, and 14.

In one of the worst affected market in the U.S., Merced county in central California, the growth rate has turned sharply negative. The fraction of homes sales in Merced county that are foreclosed properties reached 77.9% in Q2 2008. For the entire state of California, 47.6% of houses sold in Q2 2008 were foreclosure sales. Over the past year in California, foreclosures steadily grew from 31,676 in Q4 2007 to 47,221 in Q1 2008 and then to 63,316 and 79,511 in Q2 and Q3 2008. During the past year, there were 221,724 foreclosures in California out of 6,461,981 mortgages outstanding in the state in October 2008. This foreclosure rate of 3.43% of all loans outstanding is more than two and half times the national foreclosure rate during any year in the depression.[14] The extent of these foreclosures is remarkable, especially in comparison to foreclosure rates during the depression. Bair [2007] describes several aspects of the legal structure of mortgage backed securities (MBS) that can impede the renegotiation process that banks had traditionally followed in order to deal with delinquency and the prospect of foreclosure. It is worth summarizing her observations since the restructuring of these legal arrangements is a critical need for the effective functioning of the MBS market.[15]

Prior to the development of the private MBS, banks would either hold the mortgages that they had issued, or if their loans conformed to FHA or VA guidelines the loans could be sold to a Government Sponsored Entity (GSE).[16] If a bank did retain a loan but the loan became delinquent, the bank would typically deal flexibly with distressed borrowers by renegotiating the borrower's interest rate, by extending the length of the loan and forbearing some payments until the borrower recovered financially, by working with the borrower while the home was sold, or by some combination of these strategies (or possibly other approaches) in order to mitigate the loss. Foreclosure was typically treated as a last resort. Many MBS Pooling and Servicing Agreements (PSA) limit the steps that mortgage servicers can take to avoid foreclosure. Loan forbearance often requires approval of a majority of investors as well as approval of Credit Enhancement Providers (e.g., issuers of Credit Default Swaps that insure various MBS tranches). Moreover, many bonds are structured as Real Estate Mortgage Investment Conduits (REMIC), which significantly alter the tax liabilities of the bond issuer. "To qualify for

[14] These foreclosure figures are taken from quarterly DataQuick foreclosure press releases. The number of loans is from the Q3 2008 First American CoreLogic Negative Equity Report. Foreclosure rates from the depression are taken from the Historical Statistics of the United States, Millennial Edition Table Dc1257.

[15] The next paragraph draws heavily on Bair [2007].

[16] The GSEs are the Government National Mortgage Association (GNMA or Ginnie Mae), the Federal National Mortgage Association (FNMA or Fannie Mae), and the Federal Home Loan Mortgage Corporation (FHLMC or Freddie Mac). Sellin and VanNahmen [1988] provide an excellent summary of the history of the GSEs, of their constructive role in the stabilization of the housing market during the depression, their ongoing role as providers of housing market liquidity, and the early development of the private mortgage finance industry. Lewis [1989] describes the development of the private-issue MBS market at Salomon Brothers starting around 1980, and offers a fascinating and informative first-hand account of its operations between 1985 and 1988.

tax-advantaged status, the pool of loans securitized in a REMIC must generally be treated as a static pool, which usually precludes modifying a loan."[17] These legal limitations on modification of loans that have been packaged in a MBS have most likely exacerbated the difficulties faced by borrowers, mortgage servicers, and investors in the securities derived from the mortgages, although the deterioration of lending standards also implies that many of these loans cannot be restructured to benefit both the lender and the borrower.

Foreclosure proceedings moved people out of the ranks of home owners, which contributes directly to home price decreases. But foreclosures also alarmed MBS investors, which decreased the pool of funds available for additional mortgages, so the cycle of foreclosures reinforces itself. In the current crisis, delinquency and foreclosure risk have dramatically affected the flow of capital to mortgage financing. This reduction of available financing has led to a corresponding curtailment of new homeowners who enter into the housing market.

2.3 The mortgage finance market collapse

Subprime loans comprised 10% of all loan originations in 1995; in 2000 the figure was still only 13%; by 2005 subprime loans represented 21.3% of new loan originations.[18] Credit scores of subprime borrowers in 1995 were low relative to prime borrowers, but there was some minor improvement in credit scores between 2000 and 2006. Other risk factors though deteriorated between 2000 and 2006. In particular, the percentage of borrowers with full documentation fell (from about 80% to under 70%), loan-to-value (LTV) ratios increased (from about 75% to about 82%), the percentage of borrowers with second liens increased (from 1% to about 30%), the percentage of borrowers with LTV ratios over 90% at origination increased (from about 12% to about 54%), and the percentage of loans with non-traditional amortization schedules increased (from about 7% to about 40%). This steady erosion of underwriting standards coincided with a dramatic increase in the amount of subprime lending.

As lending standards were relaxed, the risk associated with these mortgages grew, but lenders were able to push the risks out into the wider financial markets with mortgage backed securities (MBS). By 2006, the characteristics and performance of many of these securities were extremely poor. For example, on August 17, 2006, Goldman Sachs issued a security, GSAMP Trust 2006-S5, which consisted of 5,321 second lien mortgages totaling $330,816,621. The loan-to-value ratio on the pool was 98.7%, the average FICO score of the borrowers

[17] This is quoted from Bair [2007, pp. 10 – 11]. This document is the clearest statement that I have seen of the legal restrictions that limit loan modification options for securitized mortgages, and the way that these restrictions have contributed to the current rash of foreclosures.

[18] These figures are from the Mortgage Market Statistical Annual, 2008, Volume I, pp. 3, 217, 225, and 230) published by Inside Mortgage Finance. Subsequent references to this source will be listed as MMSAI. Volume II will be referenced as MMSAII.

was 666, and the average loan term remaining on these second-lien mortgages at the time the security was issued was 25.25 years. The two top tranches of the bond, A1 and A2, were rated AAA by Moody's and S & P. These tranches amounted to $231,571,000. Thirty-nine days later, in the September 25, 2006 Distribution report filed with the SEC, $26,129,089 of the loan pool was delinquent. By the end of 2006, over $40 million was delinquent. Standard & Poor's downgraded the bonds repeatedly, until they reached D (the lowest rating that S & P issues) on May 28, 2008. In their statement accompanying the downgrade, S & P notes that "As of the May 27, 2008 distribution date, cumulative realized losses for GSAMP Trust 2006-S5 amounted to 36% of the original pool balance, and total delinquencies were 32.34% of the current pool balance." Such performance was not at all uncommon. Standard & Poor's [2008] lists expected losses as of September 12, 2008 on 182 second-lien mortgage backed securities issued between 2005 and 2007. Of these, eight securities had expected losses between 82% and 86%, eighteen had expected losses between 70% and 80%, twenty-five had expected losses between 60% and 70%, twenty-one had expected losses between 50% and 60%, and twenty-one had expected losses between 40% and 50%. The GSAMP Trust 2006-S5 loss estimate from that document was 68%. Other documents from Standard & Poor's portray a similar picture for subprime, Alt-A, and ARM loans.

This trend will most likely continue for several years, and will probably worsen considerably. A recent report from the International Monetary Fund [2007] shows a local peak in the market value of resetting ARM loans in September 2008. Resets will continue to decline (on average) until a minimum is reached in July 2009 after which resets will increase until they reach their absolute maximum of almost $40 billion per month in August 2011. The large decline between September 2008 and July 2009 can almost all be attributed to a decrease in subprime ARM resets. The subsequent increase can almost all be attributed to the surge in Option ARM resets, which promise to be at least as devastating, if not more, than fixed rate subprime losses due to the fact that many of these loans permit a buildup of negative equity (relative to the assessed value of the home at loan origination) and also to the fact that home values have declined rapidly since these loans were issued.

Even with future interventions designed to reduce foreclosures, many of these Option ARM loans have been made to people who do not have the financial means to pay for these homes under any debt restructuring arrangement. The top end of the *low-price* tier in San Francisco in August 2007 (when the Case-Shiller tiered price indices were instituted) was $612,451, and that was twenty months after the peak of the low-price tier in San Francisco; the price index in the low-price tier by then was already 15% below its peak value. Back-of-the-envelope calculations indicate that these prices are unsustainable. In the city of San Francisco, the median household income in 2006 was $65,497, which would leave after-tax income of about $44,000. Loan-to-value ratios were over 90% on almost half of all loans in 2006. About 69% of households owned their homes in 2006, so under the assumption that income rank and house value are strongly correlated, the income rank of a household at the cutoff between the low-price and middle-price tiers should be at about the fifty-fourth percentile in the

income distribution, just above the median household income. If this household takes out a $630,000 30-year loan at a 6% interest rate on a $700,000 house, that would require annual mortgage payments just over $45,000, which is impossible. Of course, many of these loans weren't 30-year fixed rate mortgages with payments that exceeded household income: they frequently were Option ARM loans with interest only payments at interest rates as low as 2.5% in the early years of the loan. A $630,000 interest only loan with an initial teaser rate of 2.5% would have annual payments of about $17,200, which would just be affordable to the borrower.

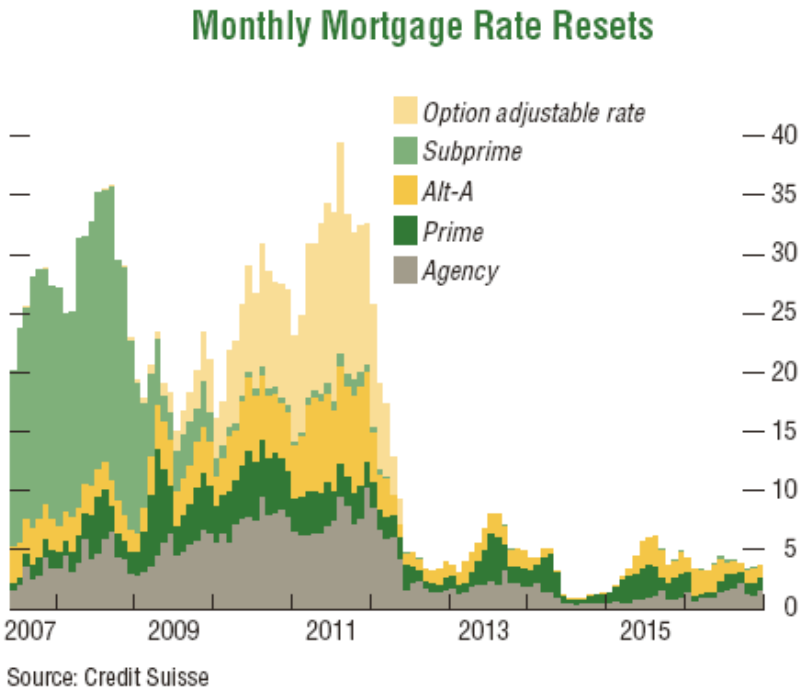


Figure 7: Subprime ARM resets have peaked in September 2008 but Option ARM resets won't peak until 2011.

In 1995, the volume of MBS issues was 49.7% of loan originations; by 2005, this figure was up to 78.6% (MMSAII, pp. 3 and 9.). Many major investors though reduced the risk in their MBS portfolio by purchasing credit default swaps that insured their securities in the case that many of the underlying mortgages were delinquent or foreclosed. Eventually though, even the biggest risk takers balked. At the end of 2005, A.I.G. quit writing new credit default swaps.[19] A year later, Goldman Sachs began to short-sell the MBS market, in effect

[19] Morgenson [2008c] chronicles the missteps of Merrill Lynch in the MBS market. The firm's exposure to risks in the market increased after A.I.G. quit insuring its MBS issues with credit default swaps. "For years, Merrill had paid A.I.G. to insure its C.D.O. stakes to limit potential damage from defaults. But at the end of 2005, A.I.G. suddenly said it had had enough, citing concerns about overly aggressive home lending." One of the most curious aspects of the role

counterbalancing its own long positions in the bonds.[20] When Goldman Sachs began to short the subprime market, stock prices of all subprime lenders were at or near their historical highs. In December 2006 the KBW mortgage finance index MFX was at the highest value that it has attained since its inception in November 2005. Yet a small group of Goldman traders detected problems in the subprime market serious enough to convince the senior management of the firm to bet a substantial amount of the firm's own capital that the market would collapse.

According to Kelly [2007], the structured products trading group at Goldman began trading the Markit ABX, an index of credit default swaps, when it was launched in January 2006. In December 2006, the company's CFO David Viniar pushed these traders to hedge the firm's long positions in mortgage backed securities by loading up on credit default swaps. They loaded up on an issue called ABX-HE-BBB- 2006-2. This asset, which started trading in July 2006, insures subordinate tranches of mortgage-backed securities issued in the first half of 2006. When the price of an ABX issue falls, the cost of insuring mortgage-backed securities rises. For the ABX-HE-BBB- 2006-2 issue, the coupon was 242, which was the cost of insurance in basis points. So insuring $10 million of BBB- rated mortgage-backed securities cost $242,000 per year when the derivative was first issued. Every price drop of one unit below the par value of 100 adds a fixed cost of another 100 basis points to the insurance price. As the prices of ABX derivatives collapsed, the cost of insuring new mortgage-backed securities skyrocketed. Goldman had loaded up on these derivatives between the beginning of December 2006 and late February 2007, as their price dropped from 97.5 to around 60. At a price of 97.5 it cost $250,000 plus the annual premium of $242,000 to insure $10 million of BBB- rated mortgage-backed securities; at a price of 60, the same insurance cost $4 million plus the annual premium of $242,000.

As the cost of insuring mortgage-backed securities shot up, investment banks backed away from acquiring new loans, so the flow of capital to the loan originators slowed suddenly. During 2007 several large subprime lenders

of A.I.G.F.P. in the crisis is why, knowing that their CDS position was too risky to pursue further, they did not try to counterbalance their position. Goldman Sachs didn't realize until more than a year later, in December 2006, that they had too much exposure in the mortgage market, yet they managed to completely counterbalance their mortgage position with credit default swaps. But A.I.G. either believed that they had just the right amount of exposure in their CDS position, or they recognized the risk but couldn't find a way to counteract it, or they decided to hope for the best. Joe Cassano and Gary Gorton are two of only a few people know what happened there.

[20] Kelly [2007] and Lewis [2008b] both provide excellent accounts of the way that Goldman disguised its short sales so that other MBS market participants (including its own customers) were unable to detect its decision to short the MBS market. Lewis [2008a] also provides a compelling account of short-sales at FrontPoint Partners, which was an independent hedge fund at the time but is now owned by Morgan Stanley. Interestingly, the two investment banks that bet heavily on the collapse of the MBS market with short sales of credit default swaps were the last two American investment banks left standing.

suspended their lending operations. In the fourth quarter of 2007, the combined subprime loan originations of Ameriquest, New Century Financial, Countrywide Financial, Option One Mortgage, Fremont Investment & Loan, Washington Mutual, and First Franklin Financial amounted to $565 million; in 2005 these firms were seven of the ten largest issuers of subprime loans with total subprime loan originations of $88 billion in Q4 2005 and $347.3 billion for the year. Both the Q4 2005 figure and the 2005 annual figure amounted to over 50% of subprime lending.[21] Yet by Q4 2007 their loan originations had fallen to less than 1% of their 2005 originations.

At this point, all of the forces that produced the run up in prices began to work in reverse. Homes were still being built at a record pace[22], but the financing to keep new households moving into home ownership was reduced.[23] Inventories of new homes built up[24], and once the flow of new potential homeowners fell below the rate of new construction in Q4 2005 (as shown in the graph on the lower right in figure 6), the source of upward pressure on prices was diminished. As prices flattened out and even fell[25], many homeowners with limited assets and income who faced mortgage rate resets were unable to meet their mortgage payments and could not refinance because the credit market tightened their home price in many cases had fallen below their outstanding loan balance. Even homeowners with fixed rate subprime loans face the same situation if they have limited assets and suffer a financial setback, such as unemployment, illness, or even unexpected home maintenance problems. As this happens, the number of homeowners begins to decline (or in a more dynamic setting with growing housing stock, the number of homeowners fails to keep pace with the number of new housing units). The next section analyzes these house price movements as homeowners enter and exit the rank of homeowners.

[21] These figures are calculated from data in the MMSAI, pp. 216, 219, and 220.

[22] In the NIPA (BEA [2008]), residential fixed investment was 3.3% of GDP in Q1 1991. At the peak of housing construction in Q1 2006 it was 6.2% of GDP. Since then it has fallen back to 3.3% of GDP in Q3 2008, which matches the lowest figure in the post-war era. Even so, its trend is strongly downward, which suggests the new low post-war residential fixed investment figure will be attained during 2009, or perhaps even later.

[23] This is particularly true of Non-Agency (i.e., private label) MBS financing, which fell from $302.9 billion in Q2 2006 to $52.5 billion in Q4 2007. Agency (GSE) financing peaked at $2,131 billion in 2003, but fell rapidly to about $1 trillion per year between 2004 and 2007. The exact figures were $1,019 billion in 2004, $965 billion in 2005, $900 billion in 2006, and $1,161 billion in 2007 (MMSAII p. 9).

[24] According to the U.S. Census Bureau, "Houses For Sale by Region and Months' Supply at Current Sales Rate," inventories of unsold homes went from 4.7 months in October 2005 to 11.4 months in October 2008.

[25] Figures 2 through 4 show prices for the seventeen cities covered by the Case-Shiller tiered price indices. Fourteen of these peaked between the end of 2005 and the end of 2006. Portland and Seattle peaked later. Denver peaked earlier.

3 Model

This section describes a simple model of sorting in a housing market during an expansion and during a contraction. In the model, the income distribution of those who depart the housing market in a collapse and the income distribution of those who enter the market during the expansion are both scaled versions of the income distribution of the incumbent homeowners. That home prices might appreciate most in the low-price tier when mortgage lending standards – including down payment, income, and credit quality requirements – are relaxed is unsurprising. But the same is true even under the assumption that new entrants to the housing market have the same characteristics as those already in the market. In an expansion, competition among potential homeowners for new homes drives prices above the initial prices, and this is the case even when new homes have the same distribution of values as the existing homes. In a contractions, filtering of households into the interstices in the market left open as some incumbent homeowners move out leads to pronounced differences in price movements across quality tiers.

The driving factor in an expansion is that potential homeowners arrive in the market faster than new homes are built. This is strongly supported by data from the Census Bureau on homeowner occupied units and housing inventory. The graph on the lower right of figure 6 shows the rate of growth of these two series. These two series track one another quite closely, but starting in Q3 2005, the growth rate of homeowner occupied units begins to exceed the growth rate of housing units. The growth rate of homeowner occupied units stayed above the growth rate of housing units for 42 consecutive quarters. Clearly this is strong evidence that there were more potential buyers than there were new housing units, which provides some justification for the assumption in the model that competition among potential homeowners for new housing units drives price changes. Since Q1 2005, the rate of change of homeowner occupied units has fallen well below the growth rate of new housing units. This supports the modeling assumption that homeowners are leaving the market in the contraction. In fact, there have been very small decreases in the number of homeowner occupied units in each of the first three quarters of 2008, but the real issue is that the number of units is growing while the number of homeowners is not. In the model I treat the similar but simpler case with the number of units constant and the number of households falling.

In the current crisis, the expansion of the housing market and house price increases were driven largely by an exogenous flow of housing finance from relaxed monetary policy and from new financial instruments. The contraction though resulted from endogenous forces. Regardless though of what caused the collapse, the relative size of price movements in each price tier can be evaluated by simply assuming that some homeowners enter the market during the expansion and some leave during the contraction. The model is kept parsimonious by leaving out the mortgage market collapse that drove the collapse of housing prices. The purpose is of the model is not to capture either the magnitude of price changes or the specific entry and exit processes. Rather, the purpose

is to illustrate the mechanics of filtering and its effect on relative price movements across quality tiers.

Entrance into and exit from the homeownership market have systematic effects on the relative price movements of price tiers. In the model, homes are of uniform quality but they differ in size. Households are alike, except that there is a distribution of income levels. Households have homogeneous preferences over housing and non-housing consumption. Each household spends the same fraction of income on housing, so those with higher income acquire a larger house. In equilibrium the size of the house that each household owns is proportional to its income, so the income rank of a household is perfectly correlated with the size rank of the house that the household owns. A change to the population of households that are homeowners generates a shift in home values. Even under the weak assumption that the income distribution of households that enter or exit the housing market is a scaled version of the income distribution of households already in the market, prices will rise fastest at the low end of the housing market when the housing market becomes tight, and prices fall fastest in that tier when there is a net outflow of homeowners from the market.[26] Under this assumption, the price in each tier, ranked from lowest in value to highest, is more volatile than the next one. Under the more realistic assumption that entry into and exit from the housing market is heavier at the lower end of the income distribution, the result is strengthened: prices are then even more volatile at the lower end of the distribution. These predictions are consistent with evidence from 14 of the 17 cities in the Case-Shiller tiered price index. Even among those cities that don't conform to the model predictions at all times, they do conform to predictions during the decline (in Las Vegas) and there is only one reversal in the other two cities (Phoenix and Atlanta), where the high-price tier movements exceeded middle-price tier movements.

The model focuses primarily on the relationship between income distribution, home size, and home value. Many forces might lead to entry into or exit from the home ownership market, but these forces are not determined endogenously in the model. Ortalo-Magne and Rady [2007] construct a model in which two forces, either individually or in combination, impact house prices. Increased household incomes leads to an increase in the rate at which households meet qualification requirements for home loans. A reduction to down payment or income requirements leads to a more sudden increase in the number of households that qualify for home loans.

According to the U.S. Census Bureau, the aggregate increase in per capital real income between 1992 and 2000 was 25.2% for an average of over 2.8% per year. Increasing household incomes probably contributed to the turnaround in housing prices that began around the beginning of 1997.[27] By contrast, between 2000 and

[26] This is a weak assumption only in the sense that it understates the extent to which low income households are new entrants into the housing market. Even with this understatement of their representation among new homeowners, price movements at the low end of the market are larger than in any other tier.

[27] The Case-Shiller 10 city composite index peaked in October 1989, fell to its trough in February 1996, and then rose until June 2006.

2007, real per capita income fell by 0.4%.[28] The rapid growth in housing prices during these last seven years did not result from income growth. Rather, it came from a highly expansionary monetary policy pursued by the Federal Reserve, from relaxed lending standards, and from a rapid flow of capital into mortgage lending through the securitization of mortgages. This loosening of qualification requirements can add households to the pool of potential homeowners much more quickly than rising incomes. All three factors appear to have played a role in the path of prices over the past 11 years.

3.1 Price tier movement model

Suppose that there is an economy with a measure μ_0 of agents. For simplicity, take $\mu_0 = 1$. Suppose also that each agent has the same Cobb-Douglas utility function $u(h, c) = h^\alpha\, c^{1-\alpha}$ over housing H and a composite commodity C. Housing all has the same quality, but house price varies with size. An agent with higher income selects a larger house.

Assume also that the distribution of incomes m is given by some density function $f(m)$. An agent takes out a mortgage to purchase a house with value V. For an agent with income m, the mortgage payment is $P = \alpha\, m$. The house price (or its value) V and the mortgage payment P are related by the equation

$$\begin{aligned} V &= P + \frac{1}{1+i}\, P + \left(\frac{1}{1+i}\right)^2 P + \cdots + \left(\frac{1}{1+i}\right)^T P \\ &= P\left[\frac{1+i}{i} - \frac{1}{i}\left(\frac{1}{1+i}\right)^T\right] \\ &= P\, h(i,T), \end{aligned} \tag{1}$$

where $h(i,T) = \frac{1+i}{i} - \frac{1}{i\,(1+i)^T}$. The agent makes a down payment equal to one annual payment, and then makes additional annual payments over the life of the mortgage.[29] An agent with income m spends $P = \alpha\, m$ on housing annually, so the agent can purchase a home with value $V = \alpha\ m\ h(i,T)$.

Assume that the housing market is in a steady-state equilibrium in which the measure of homes is equal to the measure μ of agents, so that each agent owns a home. In this equilibrium, the distribution of home prices V will be proportional to the distribution of incomes m, with the constant of proportionality equal to $\alpha\, h(i,T)$.

[28] These data come from the U.S. Census Bureau, Historical Income Tables, Table P-1.

[29] This assumption appears restrictive, because it implies that an agent has no equity at the time of purchase. It probably has only a minor effect on the conclusions of the model, since only a small fraction of homeowners move in response to the disruption of the housing market, and many households use their accumulated home equity as a form of retirement savings.

3.2 Price tier movements in a contraction

During a housing market contraction, as homeowners leave the market, some desirable housing units are vacated. Even in the case that the distribution of people who move out of their homes is a scaled version of the overall distribution of homeowner households, the value low-price tier homes falls more than the value of high-price tier homes. The least desirable homes are most affected in a collapse and lose nearly all of their value, since the remaining homeowners during an adjustment period naturally abandon the least desirable homes.

In the current crisis, a general recognition of the risks inherent in subprime mortgage lending first caused a precipitous decline in that form of lending. But many subprime loans could only be maintained in a rising market. When subprime lending diminished and the market turned down, losses from subprime loans accumulated and banks had to curtail loans to all classes of borrowers, so the population of homeowners has contracted. The model in this paper shows why home prices will typically be more volatile at the lower end of the housing spectrum.

In the model, the distribution of incomes of new households that enter the home ownership market is flexible, but even in the case when that distribution is the same as the distribution of income of current homeowners, prices rise and fall more at the lowest end of the housing market.

If, due to an exogenous shock such as an increase in foreclosures or an increase in emigration, the measure of homeowners declines, this will change the distribution of home prices.[30] Assume that after emigration, the measure of agents is $\mu_1 = \gamma\,\mu_0$. Assume also that the distribution of incomes is reduced proportionately, so that there is no change to the shape of the distribution. This means that the density function shifts to $f_1(m) = \gamma\, f_0(m)$. In the new equilibrium, the measure ν of homes remains the same, but the number of homeowners is only $\mu_1 = \gamma\,\mu_0$, so the fraction $1-\gamma$ of the homes are vacant.

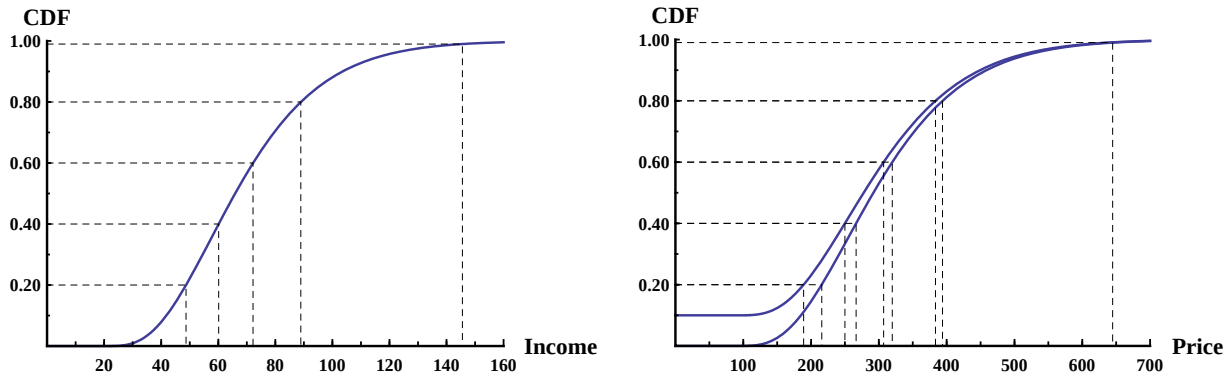
For each $r \in (0, \mu_0)$, the income of the agent with income rank r is $m = F^{-1}(r)$. Prior to the population decrease, the agent with income rank r owned the home with size rank $s = r$. After the population decline and adjustment (or sorting) in the housing market, the agent with income rank r acquires the home with size rank $s(r) = 1 - \gamma + \gamma\, r$ (and the fraction $1-\gamma$ of homes with the lowest size rank are vacant).

Since the housing payment made by an agent with income m is unaffected by the population change, but the agent will move to an unoccupied larger home, the population decline leads to a change in the housing prices. A numerical example illustrates the key concepts in the model.

This example illustrates the construction of the price function. Suppose that the income distribution is $\Gamma(4, 12.5)$. Assume, for this numerical example, that the interest rate is $i = 0.06$, the term of the loan is T = 30 years, and the coefficient α in the agents' Cobb-Douglas utility functions is $\alpha = 0.3$. The price of the home

[30] The measure of agents before the population decrease was $\mu_0 = 1$. This isn't a probability measure though.

owned by an agent with income m is $V = \alpha\ h(i,T)\ m = 0.3\ h(0.06,30)\ m$. The cumulative distribution of income $F(m)$ has a $\Gamma(4, 12.5)$ distribution with a right shift of 20. In the steady-state equilibrium, an agent with income m owns a home with value $m \times 0.3 \times h(0.06,30))$. Figure 8 (a) shows this distribution of home prices.



(a) Income distribution (b) Home price distribution

Figure 8: Income and home price distributions in a contraction.

After the population decreases by 10% and the housing market has adjusted to this decrease, the smallest 10% of the homes are unoccupied. Prices on all homes adjust in response to the decrease in demand. Figure 8 (b) shows the distribution of home prices before and after the population decrease. The value of a home after the contraction is determined by looking at the income of the person who is able to acquire the home after the population decrease. Before the contraction, the household with income at the top of the first quartile owned the home at the top of that quartile. This household has income \$48,710 and owns a home worth \$215,758. After 10% of the population leaves, the household with income one ninth of the way from the bottom to the top of the distribution will end up owning the home at the top of the first quartile. Income for this household is \$42,686 so its housing expenditure is \$189,076. The dashed lines in figure 8 (b) show price declines at the first through fourth quartiles.[31]

Home prices before and after the contraction are shown for several percentiles in table 1. From the the table it is apparent that the price decline is greater even in absolute terms at the lower end of the market.

[31] In figure 8 (b), the value of the lowest 10% of the homes fall to zero. If there is an expectation that population growth will occur in the future, then the prices of these unoccupied homes would fall significantly, but they should command a price that accounts for the capital cost and depreciation during the interval until they are reoccupied. For a reasonable interest rate of 6% and annual depreciation rate of 5%, the price decline would be about 42% if the recovery is expected to take 5 years.

Home value percentile rank	Initial homeowner income	Initial home price	New required income	New home price	Percentage decrease	Absolute decrease
0	$20,000	$88,589	——	$0	100%	$88,589
10	$42,686	$189,076	$20,000	$88,589	53%	$100,487
20	$48,710	$215,758	$42,686	$189,076	12%	$26,682
40	$60,142	$266,394	$56,415	$249,888	6%	$16,506
60	$72,191	$319,765	$69,303	$306,973	4%	$12,793
80	$88,938	$393,947	$86,573	$383,473	3%	$10,474
99	$145,564	$644,768	$143,763	$636,793	1%	$7,976

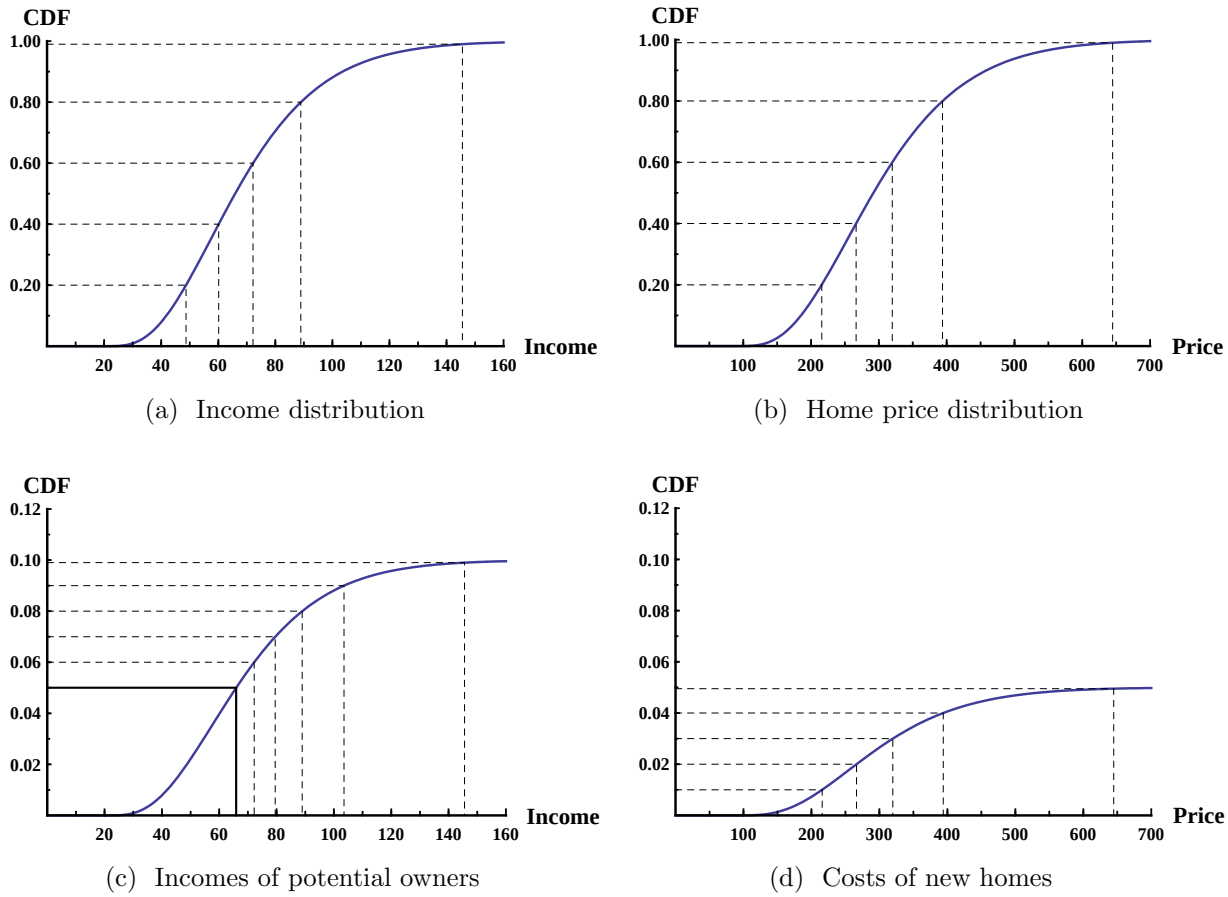
Table 1: Prices at several percentiles before and after expansion

3.3 Price tier movements in an expansion

The model of price tier movements in an expansion is similar to the model for contraction, with two minor changes. Like the model of a collapse but with a reversal of direction, new households enter the market. Potential buyers have incomes that are distributed just like the households currently in the market. New homes are added to the stock of existing homes to accommodate potential new home buyers, but we assume that in a rapidly expanding market, the number of potential new home buyers exceeds the number of new homes. The model doesn't specify how new home buyers arrive in the market. Over the course of the past sixteen years, the reasons for entrance into the home ownership market have included the large increase in per capita income (between 1992 and 2000), a reduction to the capital gains tax on residential housing (1997), the rapid increase in subprime lending (from $65 billion in 1995 to $173 billion in 2001 and then to $600 billion in 2006), and the even more rapid increase in ARM lending (from $330 billion in 2001 to $1,340 billion in 2006). In most markets the same basic pattern of relative price movements occurred regardless of the source of new entrants into the market, so this assumption seems reasonable. In the model, I assume that the distribution of new home values is the same as the distribution of existing home values.[32]

Figure 9 (a) shows a hypothetical income distribution. As in the model of a contraction, assume that homeowners spend 30% of their income on housing, and they take 30-year fixed-rate mortgages at a 6% interest rate. The distribution of home values is in a steady-state when each homeowner makes a monthly payment

[32] Between 1990 and 2007, the ratio of the median price of existing homes to the median price of new homes has been fairly steady and has averaged 88.3%. This figures is from a calculation based on the United States Census Bureau [2009, Chapter 20, Tables 933 and 936].



(a) Income distribution

(b) Home price distribution

(c) Incomes of potential owners

(d) Costs of new homes

Figure 9: Income and home prices of initial homeowners and of new homeowners.

$P = 0.3\,h(0.06, 30)\,m$. Figure 9 (b) shows the steady-state home value distribution that corresponds to the income distribution in figure 9 (a). Assume that a mass of new homeowners arrives, and that their income distribution is a scaled version of the distribution for the population as a whole. New potential buyers arrive at a greater rate than new homes are constructed, so the buyers with higher incomes outbid those with lower incomes for the new homes. Figure 9 (c) shows the distribution of the new potential buyers. The total mass of these at every income level is one tenth of the mass of the incumbent homeowners. The distribution of costs of the new homes is a scaled version of the existing distribution, but at each home value, there are only one twentieth as many new homes as existing homes. Due to the shortage of new homes, only buyers in a top portion of the income distribution will be able to acquire a new home. If the mass of new homes is β times the mass of potential buyers, then the fraction β of the potential buyers with the highest incomes will be able to purchase a home (and the fraction $1 - \beta$ of the potential buyers with the lowest incomes will not be able to purchase a home).

Home value percentile rank	Initial homeowner income	Initial home price	New required income	New home price	Percentage increase	Absolute increase
0	\$20,000	\$88,589	\$65,901	\$291,904	230%	\$203,315
1	\$30,291	\$134,171	\$66,199	\$293,226	119%	\$159,055
20	\$48,710	\$215,758	\$72,191	\$319,765	49%	\$104,407
40	\$60,142	\$266,394	\$79,528	\$352,265	32%	\$85,871
60	\$72,191	\$319,765	\$88,938	\$393,947	23%	\$74,182
80	\$88,938	\$393,947	\$103,510	\$458,491	16%	\$64,544
99	\$145,564	\$644,768	\$145,564	\$696,391	8%	\$51,623

Table 2: Prices at several percentiles before and after expansion

Taking the example in which the number of new homes is half as big as the number of potential buyers, the potential buyer with the median income is the buyer at the threshold between the potential buyers who are able to purchase a home and those who are not. A buyer with income at the 60^{th} percentile is able to buyer the home at the 20^{th} percentile, a buyer with income at the 70^{th} percentile is able to buyer the home at the 40^{th} percentile, and so forth. The example shown in the figure has incomes that come from a $\Gamma(4, 12.5)$ distribution, with 20 added to each value, scaled so that the total mass of new potential buyers is one tenth the mass of the incumbent homeowners. (Households with incomes below 20 aren't incumbent homeowners or potential homeowners.) The income distribution and the steady-state home value distributions are those in figures 9 (a) and (b). Table 2 shows several home value percentile ranks in the first column. The second column shows the income of the homeowner at this rank before the expansion begins. The third column shows the home price, which initially is $0.3 \times h(0.06, 30) = 4.42$ times income. The fourth column shows the income required to make a purchase at that home value percentile after the expansion. The fifth column shows the amount that a buyer with the income in the fourth column can pay, which again is $0.3 \times h(0.06, 30) = 4.42$. The last two columns show price increases in the different market tiers in both percentage terms and in absolute terms.

4 Conclusions: credit, growth, and financial strain

Past financial crises have one common element. Growth of output is fed by lending for investment or consumption. In a well-functioning economy credit serves an important function. An ideally functioning credit market directs resources toward those who have particulary productive enterprises, so that they can expand their production more rapidly than they would be able to if they had to rely on accumulated profit to expand. Yet

through stages of an economic expansion, each new group of borrowers is likely to be less creditworthy than the previous group, even in the rational model. When new borrower delinquency and default rates approach a level comparable to the spread between the borrowing and lending rates of the financial intermediary, loans become unprofitable (and that even neglects the operations costs of the intermediary). That leaves a fairly narrow range for default rates within which financial firms must operate. Yet this spread between lending and borrowing rates is often taken as a measure of the efficiency of financial sector. As the sector becomes more efficient, its margin for error in managing default rates becomes narrower.

Prior to the nineteenth century, finance was primarily used as a means to carry out international trade. The growth of industrial enterprises, especially railroads, created a need to raise large sums of capital and deploy it for a much longer time span than what was needed in the earlier era to support international trade. During this period, bank runs became a chronic feature of American banking. Changes to the structure of the loans during the rise of industrial capitalism exacerbated the potential for bank runs by increasing the length to maturity of a major part of the asset portfolio of banks. Institutional responses to this systemic fragility included the formation of the New York Clearinghouse Association, the creation of the National Banking system, and finally, the creation of the Federal Reserve System.

The twentieth century too has involved major structural changes in the provision of finance. In the nineteenth century, growth was sustained with major investments in transportation (canals, railroads, and roads) that tied different regions of the country together and facilitated trade and specialization. But with the advent of the automobile, the focus of production tilted toward the household. The extensive railroad system met the needs of large scale interregional transport, but the automobile solved the problem of flexible local transit. But the automobile industry faced a new problem: in order to accelerate growth, financing the consumers' automobile purchases was necessary. At this point, the American economy entered into a new phase. Industrial capitalism grafted industrialization of production and its required financial capabilities onto the older system of mercantile capitalism, which had been engaged in international trade. With the advent of widespread consumer credit to support purchases of automobiles, appliances, and housing, a new system of consumer capitalism grafted production of ever more consumer goods on the older systems of mercantile and industrial capitalism. But with this new development, new strains in the financial system appeared, and these strains erupted during the depression.

Consumer finance demands far more information processing and credit risk assessment capabilities from lenders. Instead of assessing credit risks of scores or hundreds of productive enterprises (e.g., railroads, mines, foundries, and so forth), the financial system was forced to assess the financial positions of millions of consumers. These informational demands partly explain the severity of the debt crisis in the depression. The financial system broke down as a result of excessive credit extension. In that crisis, the institutional response centered largely on

shifting the underwriting risk to the federal government. Over the past quarter century, the development of the private issue mortgage-backed securities market has partially shifted the initiative back to the private sector, but the government continued to guarantee the loans explicitly through the GSEs and implicitly through the position that many lenders and insurers are "too big to fail."

The breakdown of this system has created two problems. One is the immediate need to reconstitute the financial system before we have a breakdown in credit intermediation of the type that Bernanke [1983] describes from the depression. The second problem is to restructure the private issue mortgage-backed securities market. Curiously, the short-term problem appears to be the more perplexing of the two. Even during the depression, the larger banks fared better than the smaller banks. In the current crisis, risk accumulated in the largest financial institutions, which are now our most serious concern. Citigroup, Bank of America, and A.I.G. are all now on life support. Bernanke [1983] persuasively argues that our prospects depend upon the capacity of financial institutions to finance production by profitable firms and consumption by creditworthy households. But we don't know how to recapitalize these firms, or how we should structure their incentives so that they manage their credit intermediation role effectively.

In the longer term, the problems with the mortgage finance industry are easier to address. Surely, reliance on bond rating agencies to assess credit risk has been a dismal failure. This industry developed in response to a need for *independent* risk assessment. But its government endorsement and its incentives to accommodate bond issuers desire for high credit ratings have seriously compromised its capacity to perform its role. It appears inevitable that risk assessments will devolve to bond holders and possibly to third parties that devote real resources to risk assessment.

Insurers that back these assets have strayed from their former practices. When a company like A.I.G. provided insurance against hurricanes or earthquakes, their exposure and their capital were closely monitored by the firm and by regulators, and the firm had to be highly capitalized to support its exposure and assure its solvency. This approach was abandoned in the recent past. Moreover, the derivatives that created the enormous exposure of many of these firms are not exchange traded, and reporting requirements for them have been inadequate. All of these problems will have to be resolved to reduce the risk of another systemic meltdown.

References

[1] Bair, Sheila C. (2007). "Possible Responses To Rising Mortgage Foreclosures," Statement before The Committee On Financial Services, U.S. House Of Representatives, April 17.

[2] Balke, Nathan S. and Robert J. Gordon (1989). "The Estimation of Prewar Gross National Product: Methodology and New Evidence," *Journal of Political Economy*, **97**, pp. 38 – 92.

[3] Bernanke, Ben S. (1983). "Nonmonetary Effects of the Financial Crisis in the Propagation of the Great Depression," *American Economic Review*, **73**, pp. 257 – 276.

[4] Bureau of Economic Analysis (2008). "National Income and Product Accounts of the United States."

[5] Case, Karl E. and and Robert J. Shiller (1989). "The Efficiency of the Market for Single-Family Homes," *American Economic Review*, **79**, pp. 125 – 137.

[6] United States Census Bureau (2009). Statistical Abstract of the United States. http://www.census.gov/compendia/statab/

[7] DataQuick. "California mortgage default filings drop amid procedural change," October 23, 2008. http://www.dqnews.com/News/California/CA-Foreclosures/RRFor081023.aspx.

[8] Davis, Morris A., Andreas Lehnert and Robert F. Martin (2008). "The Rent-Price Ratio for the Aggregate Stock of Owner-Occupied Housing," *Review of Income and Wealth*, **54**, pp. 279 – 284.

[9] Fisher, Ernest M. (1950). "Changing Institutional Patterns of Mortgage Lending," *Journal of Finance*, **5**, pp. 307 – 315.

[10] Frame, Scott, Andreas Lehnert, and Ned Prescott (2008). "A Snapshot of Mortgage Conditions with an Emphasis on Subprime Mortgage Performance,"

[11] Gerardi, Kristopher, Andreas Lehnert, Shane Sherlund, and Paul Willen (2008). "Making Sense of the Subprime Crisis," Brookings Papers on Economic Activity.

[12] Gordon, Robert A. (1974). Economic Instability and Growth: the American Record. New York: Harper & Row.

[13] Inside Mortgage Finance (2008). Mortgage Market Statistical Annual: Volumes I and II.

[14] International Monetary Fund (2007). Global Financial Stability Report. http://www.imf.org/external/pubs/ft/gfsr/2007/02/

[15] Juster, F. Thomas (1966). Household Capital Formation and Financing: 1897 - 1962. National Bureau of Economic Research, New York: Columbia University Press.

[16] Kelly, Kate (2007). "How Goldman Won Big On Mortgage Meltdown," Wall Street Journal, December 14.

[17] Lewis, Michael (1989). Liar's Poker: Rising through the Wreckage on Wall Street. New York and London: W. W. Norton and Company.

[18] Lewis, Michael (2008a). "The End," *Portfolio*, December 2008.

[19] Lewis, Michael (2008b). "What Does Goldman Know That We Don't?," *Bloomberg News*, January 17.

[20] Lewis, Michael and David Einhorn (2009). "The End of the Financial World as We Know It," *New York Times*, January 4.

[21] Lowenstein, Roger (2008). "Triple-A Failure." New York Times Magazine, April 27.

[22] Morgenson, Gretchen (2008a). "Behind Insurers Crisis, Blind Eye to a Web of Risk," New York Times, September 28.

[23] Morgenson, Gretchen (2008b). "Debt Watchdogs: Tamed or Caught Napping?," New York Times, December 7.

[24] Morgenson, Gretchen (2008c). "How the Thundering Herd Faltered and Fell," New York Times, November 9.

[25] Ortalo-Magne, Francois and Sven Rady (2006). "Housing Market Dynamics: On the Contribution of Income Shocks and Credit Constraints, *Review of Economic Studies*, **73**, pp. 459 – 485.

[26] Sellin, Gordon H. and Deana VanNahmen (1988). 'The Securitization of Housing Finance," Federal Reserve Bank of Kansas City *Economic Review*, pp. 3 – 20.

[27] Standard & Poor's (2008). Revised Projected Losses For 2005 – 2007 Vintange U.S. Closed-End Second-Lien RMBS Transactions. September 12.

[28] Streitfeld, David (2008). "In the Central Valley, the Ruins of the Housing Bust," New York Times, Aug. 23.

[29] Wheelock, David C. (2008). "The Federal Response to Home Mortgage Distress: Lessons from the Great Depression," *Federal Reserve Bank of St. Louis Review*, **90**:3, pp. 133 – 148.