

**The U.S. Subprime Mortgage Crisis:
Issues Raised and Lessons Learned**

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1. Introduction

The subprime mortgage crisis already ranks among the most serious economic events affecting the United States (US) since the Great Depression of the 1930s. This study analyzes the key issues raised by the crisis. These issues are fundamental to risk bearing, sharing, and transfer in financial markets and institutions around the world. The hope is that the analysis in this paper will facilitate the design of new and efficient policies to mitigate the costs of the current crisis and to reduce the likelihood and costs of similar future events.

The paper has been prepared for the Commission on Growth and Development, which was initiated in 2006 to explore the most effective approaches to stimulate growth in developing countries, and is sponsored by various governments, foundations, and the World Bank. Many of the issues raised by the US subprime crisis are particularly important for high-risk loan markets in developing countries; after all, most borrowers in these countries are subprime. The lessons learned from the crisis can thus play an important role in the growth and development of emerging economies for decades to come.

Because the causes, propagation mechanisms, and results of the subprime mortgage crisis are themselves highly complex, an analytic framework is essential if the discussion is to proceed in a cohesive fashion. The framework applied in this paper analyzes subprime mortgage lending as a major financial market innovation. Section 2 briefly describes the innovation process and its connection to the subprime mortgage crisis. Section 3 provides an annotated list of issues raised and lessons learned, in effect an executive summary. Sections 4 to 6 provide the more detailed analyses that underlie the listed issues and lessons. Section 7 provides brief concluding comments.

2. Subprime Mortgage Lending as a Financial Innovation

Financial market innovations generally occur in the context of three fundamental conditions, all of which are highly relevant to the origins of subprime mortgage lending:

- The existence of previously underserved borrowers and investors. Subprime borrowers were eager to use mortgage loans to finance home purchases, while a worldwide savings glut created large numbers of investors eager to earn the relatively high interest rates promised on US subprime mortgage securities.¹
- The catalyst of advances in technology and know-how. Subprime mortgage securitization applied state of the art tools of security design and financial risk management, expanding on the successful implementation of similar tools to earlier classes of high-risk securitizations ranging from credit card loans to natural disaster catastrophe bonds.²
- A benign and even encouraging regulatory environment.³ While US mortgage lenders face a complex network of state and federal regulations, few of these regulations impeded the origination of subprime loans.⁴ Furthermore, the existing system of commercial bank capital requirements provides banks with strong incentives to securitize many of the subprime mortgage loans they originated.

¹ See Bernanke (2005) for just one of many discussions of the worldwide savings glut. See Bardhan and Jaffee (2007) for a discussion of how the demand for US mortgage securities was significantly expanded by the enormous pools of foreign-held, but dollar-based, investment funds created by the US trade deficits.

² As part of an extensive literature on financial innovation, Allen and Gale (1994) and Molyneux and Sharmroukh (1999) are two books which emphasize innovations in contract design and risk sharing techniques, making them highly relevant to the innovation of subprime lending. Duffee (1995) provides a survey which includes a focus on the role of incomplete markets as a motivation for financial market innovation and security design. Silber (1975) provides a more institutional approach, including a chapter on mortgage market innovations by Jaffee (1975).

³ The regulatory environment should be interpreted broadly, certainly to include tax inducements for innovation. Papers that focus on the various forces creating innovation include Frame and White (2002), White (2000), Tufano (1995), Merton (1992), and Miller (1986 and 1992).

⁴ US Treasury (2008), Bernanke (2007), and Angell and Rowley (2006) highlight the many earlier regulatory changes that provided an accommodating setting for the innovation of subprime lending.

Financial innovations are risky undertakings, all the more so when they create new classes of risky loans and securities. For example, the innovation of synthetic “portfolio insurance,” introduced during the 1980s based on the then newly developed concept of dynamic portfolio replication, came asunder during the stock market crash of 1987. Similarly, the new market for trading “junk” bonds broke down as a result of the Michael Milkin scandals of the early 1980s.⁵ Most recently in the mid-1990s, Long-Term Capital Management (LTCM) was among the first hedge funds applying an innovative arbitrage strategy, but it had to be liquidated in the aftermath of the 1998 Russian financial crisis. Although each of these innovations was associated with a crisis, modified forms of the innovations still provide significant benefits today. It is hoped that the subprime mortgage innovation can be similarly reformed and refined, in order to provide future subprime borrowers with a continuing opportunity for homeownership.

3. Issues Raised and Lessons Learned

This section summarizes the study’s conclusions, in the form of an annotated list of issues and lessons. The complex issues require the analysis to be separated into three broad categories:

- 1) Issues directly and specifically relating to subprime mortgage lending;
- 2) Issues relating to the securitization of subprime mortgages;
- 3) Issues affecting financial markets and institutions.

The section will conclude with a discussion of how these issues are linked to financial markets in developing countries.

⁵ The US Savings and Loan crisis of the 1980s is not included because it was not the result of a failed innovation. Instead, it was the result of a misguided investment policy, in which the thrifts maintained a severe maturity mismatch, funding a portfolio of fixed rate mortgages with variable rate deposits. It is noted below that the portfolio losses afflicting certain subprime mortgage investors are the result of strikingly similar investment strategies.

3.1 Issues Arising Directly from Subprime Mortgage Lending⁶

(1) The Benefits of Subprime Mortgage Lending

Subprime mortgage lending is estimated to have funded more than 5 million home purchases, including access to first-time homeownership for more than an estimated 1 million households. Young and minority households have been among the primary beneficiaries. These are key benefits in view of long-standing US policy goals for increased homeownership. The increased homeownership has also stimulated a corresponding amount of new home construction.

(2) Predatory Lending

Competitive market forces generally protect uninformed consumers from predatory forces, but subprime lending has revealed market failures in this regard. The substantial existing consumer protection regulations notwithstanding, regulatory improvements are needed. Care must be taken, however, not to create destructive regulations which effectively end all subprime lending.

(3) Loan Modifications for Defaulting Borrowers

Home mortgage lenders and servicers have traditionally been reluctant to modify loan terms, lest all their borrowers (current and future) request such changes; servicers also face contractual limitations. Nevertheless, lenders and servicers have been amenable to current governmental plans, perhaps because the resulting loan modifications can be characterized as one-time emergency transactions. Unfortunately, it is also the case that many defaulting subprime borrowers are beyond such help, and the default rate on once-modified loans is itself quite high.

(4) Limiting Borrower Costs from Subprime Mortgage Default and Foreclosure

The costs imposed by subprime loan foreclosures are limited because mortgage borrowers simply give up their the home in lieu of making the mortgage payments. While a borrower's (already subprime) credit rating will fall further, and access to a new mortgage is unlikely for several years, steps can be taken to minimize even these costs; see, <http://youwalkaway.com/>.

3.2 Issues Relating to the Securitization of Subprime Loans⁷

(5) The Securitization Process was Not A Substantial Source of the Subprime Mortgage Crisis

The recent report of the President's Working Group on Financial Markets (2008), among others, suggests that incomplete disclosures and the securitization process caused investors to be duped into purchasing high-risk subprime mortgage securities. The purchasers of these securities, however, almost uniformly include only the most sophisticated institutional investors worldwide. The name "subprime" also seems clear enough, and data documenting the extremely high foreclosure rates on subprime loans have been publicly available at least since 2002. In short, the securitization process *per se* was not a fundamental source of the subprime mortgage crisis.

⁶ Background material on the issues listed here is provided in Section 4 below.

⁷ Background material on the issues listed here is provided in Section 5 below.

(6) Mortgage Lending and Real Estate Price Cycles

Boom and bust cycles in real estate prices are a recurring phenomena, in good part based on the reinforcing process in which expected rising real estate prices expand mortgage lending, while expanded mortgage lending drives prices higher. Of course, fundamentals eventually take hold, and a crash inevitably ensues. If there has been a “moral hazard” in subprime mortgage lending and securitization, it lies with the failure of lenders, investors, the credit rating agencies, and the monetary authority to recognize that mortgage lending booms almost inevitably end in crashes.⁸

(7) The Credit Rating Agencies Underestimated Correlated Risks and House Price Declines

The credit rating agencies (CRAs) systematically underestimated the risk on subprime mortgage pools, attributing too much weight to FICO scores and too little weight to the likelihood of falling house prices and its powerful effect in creating mortgage defaults.⁹ For similar reasons, the CRAs also underestimated the risk on collateralized debt obligations (CDOs) which were backed by subprime securitization tranches. The major CRAs have now all announced plans to modify their rating methodologies for subprime mortgages pools and CDOs.

(7) Investor Strategies Concentrated Investor Losses

The intensity of the losses suffered by many subprime mortgage investors is primarily the result of their having concentrated the risks by leveraging their positions with borrowed funds. The use of 10 to 1 leverage, for example, can transform a 10% realized loss into a 100% loss for a given initial capital. Furthermore, many of the positions were funded with very short-term loans. This strategy remarkably parallels that of the Savings and Loan Associations of the 1980s, who also used maturity mismatched and leveraged portfolios, and with similarly dire results.

3.3 Issues Regarding Regulatory Policies for Financial markets and Institutions¹⁰

(9) The Federal Reserve Loan to Expedite the Bear Stearns Merger

The Fed’s emergency loan to expedite the Bear Stearns merger deviated from its standard rules by allowing the borrower both to post low quality collateral and to deny the Fed the right of recourse to other assets if the loan were not repaid. The unique circumstances of the Bear Stearns crisis include (i) the very large dollar amounts, (ii) the generally weakened condition of most investment banks, and (iii) the need to avoid a formal Bear Stearns bankruptcy in view of that firm’s very large positions as a derivative counterparty; see also issue (10).

⁸ An extensive literature, extending across many countries and time, documents how expanded mortgage lending creates a boom in real estate prices, invariably followed by a crash. See, for example, Reinhart and Rogoff (2008), Gramlich (2007b), Brunnermeier and Julliard (2007), Jaffee (1994), and Litan (1992).

Mian and Sufi (2008) specifically show that mortgage lending and house prices rose rapidly between 2001 and 2005 in precisely those zip codes with previously high rates of loan denial (based on HMDA data). And after 2005, these zip codes faced slowing price appreciation and rapidly rising mortgage default rates.

⁹ FICO is an abbreviation of Fair Issac Company, which standardized the concept of individual credit scores.

¹⁰ Background material on the issues listed here is provided in Section 6 below.

(10) *Interlinking Counterparty Risks Require Regulatory Action*

The Federal Reserve's direct participation in the Bear Stearns merger formally recognized, for the first time, the fundamental risks posed for the financial system by interlinking counterparty risks among the largest commercial and investment banks. The Fed feared that the failure of one central counterparty could topple the entire system. The implication is that the derivative counterparty system now parallels the payments system as a fundamental component of the financial system's infrastructure. Federally mandated capital requirements should be required of the primary derivative market counterparties, just as they have long been imposed on depository institutions to safeguard the payments system.

(11) *Market Illiquidity and Opaque Subprime Securities*

A major factor in extending the subprime crisis has been a breakdown in financial market trading and liquidity, which has allowed the market prices for many subprime securities to fall well below what many would consider their "fundamental value". The unwillingness of investors to purchase these apparently undervalued subprime securities and CDOs can be attributed in part to the complex, opaque, nature of the instruments. Investment banks are also generally required to report the declines in the market value of their investment portfolios, which then reinforces the illiquidity problem. The Federal Reserve has responded appropriately by offering huge volumes of liquidity, but to date it has not succeeded in reviving the effective demand for the subprime and CDO securities.

3.4 Applying the Lessons of Subprime Mortgage Lending to Emerging Economies

Financial markets in general, and mortgage markets in particular, provide great potential benefits for economic growth and development in emerging economies.¹¹ The defining feature of mortgage loans, of course, is that land and structures can serve as collateral, allowing lenders to make loans in amounts that far exceed what they would otherwise be willing to extend to most consumer borrowers. Most developing countries have a comparatively rich endowment of land and structure collateral, giving the market a feasible starting point. A mortgage market will also encourage new home construction, since mortgage borrowing creates an expedited path to homeownership. A mortgage market will also increase the market liquidity for existing home sales, which has the key benefit of promoting a more mobile labor force.

¹¹ See Levine (1997) and (2003) for surveys on the benefits financial development provides for economic growth in emerging economies. See also Warnock and Warnock (2007), Renaud and Kim (2007), Buckley, Chiquier, and Lea (2006), and Jaffee and Renaud (1995) for the specific benefits of mortgage markets in emerging economies.

3.4.1 Mortgage Market Innovations in Emerging Economies

The earlier discussion highlighted three key factors associated with mortgage market innovation in developed economies, namely (i) an effective demand and supply, (ii) access to expanding technology and know-how, and (iii) an accommodating regulatory structure. These three factors are equally critical for emerging economies. A strong demand for mortgage credit can be assumed in emerging economies, since financial services are generally underprovided. Figure 1 shows the mortgage debt to GDP ratios of a range of countries, developed and emerging, illustrating that the mortgage debt ratios tend to be very low in most emerging economies. Various methods of technology transfer also now allow mortgage technology and know-how to be readily available to emerging economies from any number of international firms and organizations (including the World Bank).

The dominant bottleneck for mortgage market innovations in emerging economies is an accommodating regulatory and legal system; governments must recognize that the benefits of a mortgage finance system will only be realized if property rights are reliably protected by the State. A sufficient supply of loanable funds is a second critical bottleneck. The banking system normally takes the lead in innovating mortgage lending, but there is a limited supply of deposit funds and many competing loan demands. Therefore, as the mortgage market expands, the banking system inevitably outruns its own capacity to hold all the originated mortgage loans. Solutions for augmenting bank resources for holding mortgages can include:

- A bank may issue special “covered mortgage bonds” secured by pools of mortgages owned by the bank. The bonds would be sold in local or foreign capital markets.
- The banking system or the government may set up a “mortgage bank” that purchases mortgages, funding the portfolio with debt issued in local or foreign capital markets.
- Securitization can expedite the sale of mortgages to capital market investors, either locally or abroad.

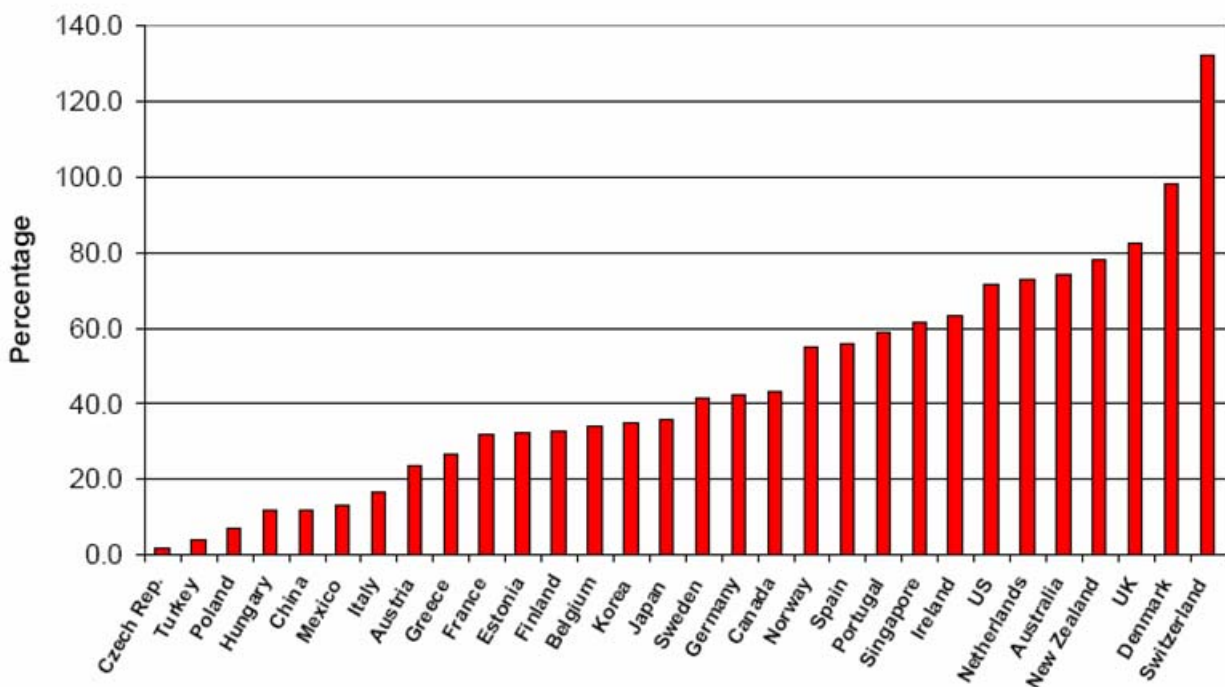


Figure 1: Ratio of Mortgage Debt Outstanding to GDP

Source: Renaud and Kim (2007).

It is worth stressing that securitization provides a unique mechanism for accessing capital market funding for mortgage loans.¹² The key advantage of securitization is that a structured vehicle distributes the overall risk across the various tranches, thus creating a range of risk levels from the very high quality senior tranche to the riskiest equity tranche. Securitization thus allows the risks to be allocated to different investors, matching each investor's risk tolerance with the appropriate tranche. None of the events of the US subprime mortgage crisis have changed this fundamental benefit of securitization.

3.4.2 The Pitfalls of Subprime Mortgage Lending Must Also Be Recognized

The subprime mortgage crisis also demonstrates that mortgage markets, and especially subprime mortgage markets, come with a potential cost. The following summarizes the lessons

¹² Jaffee and Renaud (1997) stress the importance of capital market funding for mortgage markets in emerging and transition markets, and they provide a comparison of the different methods for accessing the capital market funding.

learned that may be considered particularly relevant for mortgage markets in emerging economies:¹³

- (i) Consumer protection legislation is essential if loans of significant size are made to relatively inexperienced and uninformed consumer borrowers. A review of the many existing US programs is a good starting point.¹⁴ The creation of standardized mortgage contract designs and forms may be particularly valuable.
- (ii) Incomplete income records is common in emerging economies, especially where the grey market economy may dominate the organized economy in size and importance. Lenders in emerging economies, however, can develop the equivalent of FICO scores, based on the borrower's credit card payment record. The concept is simple: a borrower must have a source of income if (s)he stays current on large credit card expenditures.
- (iii) A legal infrastructure is critical to document ownership and to allow eviction in case of default. Co-signers are common on emerging economy loans, creating a form of recourse that goes beyond the real estate collateral. Local bank lenders may consider co-signers an adequate substitute for clear ownership and eviction powers. Investors in securitized mortgage pools, however, will consider strong title and eviction powers to be essential.
- (iv) A regulatory and institutional infrastructure is needed to moderate the costs associated with the borrower defaults which are sure to occur. This should include a mechanism for providing loan modifications to avert loan defaults and a legal structure that minimizes the costs imposed on those borrowers who do default.
- (v) Mortgage loans are unavoidably risky, raising the possibility of large-scale loan losses. It is thus essential that the banking regulations and regulators creating suitable capital requirements and develop plans to deal with distressed institutions.
- (vi) The same forces of mortgage market innovation and increased mortgage lending that created the boom-bust real estate cycle as a component of the US subprime crisis are an evident risk in a emerging economy; see Renaud and Kim (2007) for an excellent discussion of the US housing price boom with comments on the comparable risk in emerging economies.

¹³ An extensive literature exists, of course, analyzing the benefits and pitfalls of creating mortgage markets in developing countries. See, for example, Buckley, Chiquier, and Lea (2006) and Renaud (2007) and the literature they cite. Buckley, Hendershott, and Villani (1995) discuss the privatization of the housing sector in transition economies.

¹⁴ See the discussion in the following Section 4.

4. Subprime Mortgage Lending in the United States

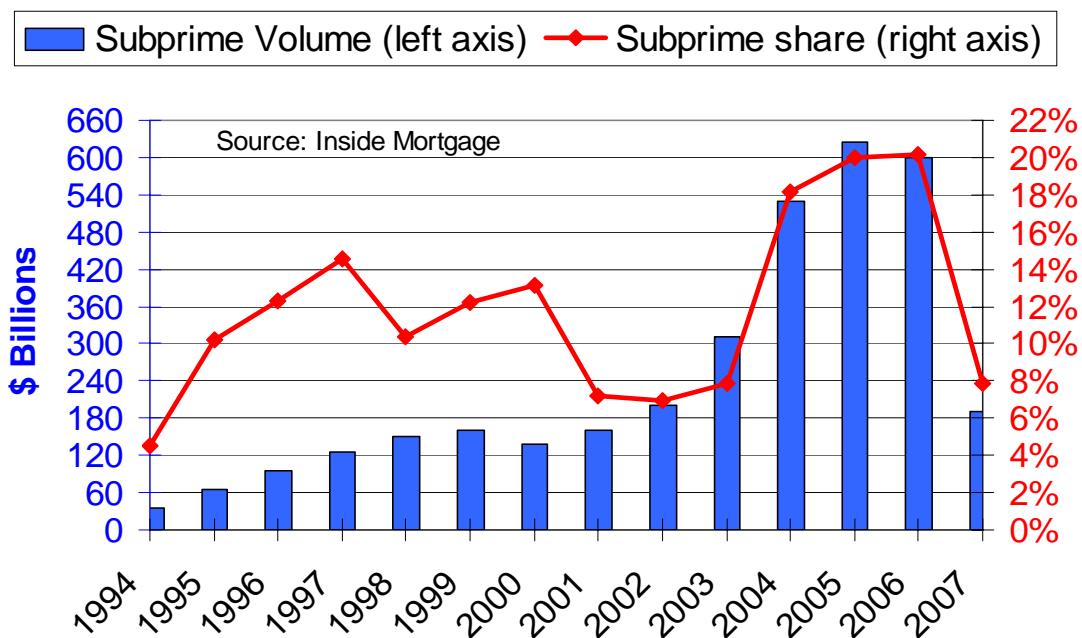
This section provides more detailed background on the development of subprime mortgage lending in the United States. Figure 2 shows the growth in subprime lending, starting with the first available data in 1994 and continuing through 2007, based on data from Inside Mortgage Finance (IMF). The figure shows two distinct periods of expansion in subprime lending. The first expansion occurred during the late 1990s, with subprime lending reaching an annual volume of \$150 billion and as much as 13% of the total annual mortgage originations. That expansion ended with the dot-com bust in 2000/2001. The second expansion started in 2002, reaching annual loan volumes of over \$600 billion in 2005 and 2006 and representing over 20% of the total annual mortgage originations in those years.

4.1 Subprime Mortgage Lending: Benefits

The benefit of subprime mortgage lending can be measured by the number of households who purchased homes and achieved homeownership as the direct result of subprime mortgages. Table 1 shows the number of subprime loans originated, including the percentage that represented loans for home purchase, from 2000 to 2006 using the LoanPerformance (LP) data from First American CoreLogic. While the LP data indicate almost 9 million first-lien subprime loans were made between 2000 and 2006, just over one-third, that is 3.28 million subprime loans, were made with the stated purpose of home purchase.¹⁵ On the other hand, the LP data cover only approximately 70% of all subprime loans. Adjusting the LP home purchase number to be consistent with the universe of all subprime mortgages (column 4 of Table 1), we find approximately 5.34 million home purchases were funded with subprime mortgages.

¹⁵ Gerardi, Shapiro and Willen (2007) also stress the importance of recognizing that almost two-thirds of subprime mortgages just refinanced already existing mortgages. One result is that the aggregate number of subprime loan originations involves substantial double counting and thereby exaggerates their risk. This motivates our focus on home purchase subprime loans, which avoid this obvious double counting.

Figure 2: Subprime Mortgage Originations,
Annual Volume and Percentage of Total
Originations



	1	2	3	4
				Adjusted *
	Total # of Subprime Loans Thousands	Loans For Home Purchase Percent	Number Home Purchase Thousands	Number Home Purchase Thousands
2000	422	32.4%	137	433
2001	508	30.3%	154	385
2002	768	29.0%	223	400
2003	1273	29.9%	381	567
2004	1932	35.8%	692	1059
2005	2274	41.3%	940	1296
2006	1777	42.4%	753	1201
Total				
2000 to 2006	8,954	36.6%	3,280	5,340
* Adjusted to subprime dollar volume universe from <u>Inside Mortgage Finance</u> (see Figure 2) versus sample total for the LoanPerformance data.				
Source: LoanPerformance (LP) data from First American CoreLogic.				

	1	2	3	4	5
	Home Sales			Subprime	Subprime
	Existing	New	Total	Originations	Home Sales
	Thousands	Thousands	Thousands	Percent	Thousands
2000	4,603	877	5,480	13.2%	722
2001	4,734	908	5,642	7.2%	408
2002	4,975	973	5,948	6.9%	412
2003	5,443	1,086	6,529	7.9%	513
2004	5,959	1,203	7,162	18.2%	1,300
2005	6,180	1,283	7,463	20.0%	1,495
2006	5,677	1,051	6,728	20.1%	1,355
Total					
2000 to 2006	37,571	7,381	44,952		6,204

An alternative measure of subprime homeownership benefits is based on the number of existing home and new home sales that used subprime lending. In Table 2, the third column shows the total number of home sales, the sum of new and existing home sales. The fourth column shows subprime mortgage loans as the percentage of total mortgage originations, as graphed in Figure 2. The estimate of the number of home sales that can be attributed to subprime lending is then derived as the product of the total number of home sales and the subprime share of total mortgage originations. Summing the years 2000 to 2006, we obtain an estimate of 6.2 million home sales, which given the coarseness of the two methods, is reasonably close to the estimate of 5.3 million subprime home purchase mortgage loans shown in Table 1.

The two estimates indicates that somewhat more than 5 million home purchases can be attributed to subprime mortgage lending. It should be understood, however, that this estimate will exceed, and probably far exceed, the number of first-time home purchases that can be attributed to subprime mortgages. Three key factors are:

- Some subprime borrowers had already owned homes purchased with prime mortgages;
- Some subprime borrowers bought and sold several homes;
- Some subprime borrowers were investors, and possibly purchased multiple homes.

A third method of measuring subprime homeowner benefits is based on the number of new home owners tabulated in the American Community Survey of the US Bureau of the Census.

Table 3 shows the basic structure of the computation. Part A of Table 3 shows the homeownership rates, defined as the percentage of households which own the unit in which they live. The data are tabulated by the age of the head of the household. It can be seen that the ownership rates were generally rising between 2000 and 2006, although most of the age groups reached their peak ownership rate before 2006.

Owner Occupancy Rates							
Age of Household Head	2000	2001	2002	2003	2004	2005	2006
15 to 24 years	0.170	0.174	0.184	0.179	0.177	0.177	0.178
25 to 34 years	0.446	0.451	0.459	0.467	0.470	0.466	0.467
35 to 44 years	0.657	0.661	0.666	0.668	0.671	0.664	0.663
45 to 54 years	0.746	0.748	0.752	0.751	0.752	0.747	0.745
55 to 59 years	0.788	0.790	0.794	0.798	0.800	0.789	0.788
60 to 64 years	0.806	0.805	0.813	0.812	0.804	0.810	0.807
65 to 74 years	0.812	0.811	0.814	0.820	0.822	0.816	0.813
75 to 84 years	0.770	0.774	0.783	0.786	0.786	0.785	0.789
85 years and over	0.670	0.666	0.677	0.673	0.681	0.683	0.680
Total for All Ages	0.653	0.657	0.664	0.668	0.671	0.669	0.673

Source: American Community Survey, US Bureau of the Census

Age of Household Head	Total Change in Ownership 2000 to 2006 Millions	# of Households 2000 Census Millions	Maximum Change Ownership Rate Percent	Subprime Induced New Ownership Millions
15 to 24 years	-0.07	6.0	0.014	0.08
25 to 34 years	0.15	18.5	0.024	0.44
35 to 44 years	-0.43	23.9	0.014	0.33
45 to 54 years	2.31	21.0	0.006	0.13
55 to 59 years	2.20	7.6	0.011	0.08
60 to 64 years	1.37	6.2	0.003	0.02
65 to 74 years	0.17	11.3	0.010	0.11
75 to 84 years	0.50	7.9	0.019	0.15
85 years and over	0.39	2.3	0.013	0.03
Total	6.59	104.8		1.38

Source: American Community Survey, US Bureau of the Census

Part B of Table 3 tabulates the number of new homeowners during the 2000 to 2006 time period controlling for the “compositional” increase in homeownership that would arise simply due to population aging and other changes in the demographic basis of homeowners.¹⁶ The first column in Part B shows that 6.59 million net homeowners were added between 2000 and 2006. This value includes the natural increase due to population aging, which is quantitatively dominant because older households have distinctly higher ownership rates (as shown in Part A of Table 3) and because the very large post-war baby boom cohort is just reaching the age of maximum homeownership. We control for this compositional increase in ownership by multiplying the number of households in 2000 for each age group (column 2) by the maximum increase in the homeownership rate observed for that age group between 2000 and 2006 (column 3). The resulting estimate is an increase of 1.38 million new homeowners between 2000 and 2006. We interpret this number as a first rough estimate of the number of first-time homeowners that might be attributed to subprime lending.¹⁷

¹⁶ Haurin and Rosenthal (2004) provide a careful empirical analysis of the factors inducing changes in US homeownership rates between 1970 and 2000. Eggers (2005) provides a detailed analysis of the evolution of homeownership rates during the 1990s. Eggers, in particular decomposes the increase in homeownership into a rate effect—reflecting changes in homeownership that arise due to changes in the homeownership rates within specific age and racial categories—and a composition effect—arising as the result of changes in the demographic structure of households (ownership rate remaining constant). The paper shows that of the aggregate increase in the homeownership rate during the 1990s of 1.96 percentage points, the rate effect accounted for 1.54 percentage points and the composition effect for .54 percentage points. We employ a similar method in Table 3 B to control for the compositional effect during the 2000s.

¹⁷ The finding of a significant number of first-time homebuyers among subprime borrowers is consistent with the results of Mian and Sufi (2008). They use the HMDA data to determine the specific set of zip codes that faced exceptionally high rates of loan application denials prior to 2001. They then show that it is precisely these zip codes that benefit from a large increase in mortgage lending during the subprime boom period from 2001 to 2005. The analyses of Gerardi, Shapiro, and Willen (2007) and Demyanyk and Van Hemert (2008) also focus on home purchase decisions.

4.2 Subprime Mortgage Loan Design

Mortgage contract design has played an essential role in the subprime innovation process.¹⁸ Numerous subprime mortgages have been created, including:¹⁹

- Standard, long-term, fixed-rate, mortgages;
- Option” mortgages, which allow borrowers to defer some of their payments;
- Converting ARMs, which start with fixed rates, then convert to adjustable rates.
- Low document loans, for borrowers that cannot provide complete documentation.

These mortgages were all designed to meet specific needs: option mortgages for borrowers with widely fluctuating incomes, converting ARMs for borrowers who expect a rising income profile, and so on. Many subprime loans were also originated with the expectation that the borrowers would soon refinance into higher quality loans, assuming the borrower’s credit rating would improve and/or the borrower’s equity in the house would rise as the result of rising home prices; see Pennington-Cross and Chomsisengphet (2007)..

The credit quality of subprime mortgages also covers a wide spectrum.²⁰ For example, at the higher quality levels, subprime mortgages were purchased by the GSEs. The subprime lenders also succeeded in attracting a significant number of borrowers who would otherwise have been among the higher quality FHA borrowers.²¹

¹⁸ The design of US mortgage contracts has an interesting history. The now standard long-term, fixed-rate, mortgage was developed by the Federal Housing Administration in the depths of the Great Depression to provide a functional instrument for homebuyers. The wave of soaring inflation and interest rates during the late 1970s and early 1980s created another wave of innovation; see Modigliani and Lessard (1975) and Jaffee (1984). Green and Wachter (2005) provide a recent overall survey of the history of mortgage lending in the US.

¹⁹ Piskorski and Tchisty (2007, 2008) motivate the security design of subprime mortgages and. Mayer and Piskorski (2008) provide a corresponding empirical analysis. Cutts and Van Order (2005) provide a general introduction to the economics of subprime lending.

²⁰ Chomsisengphet and Pennington-Cross (2006) provide an informative discussion of the evolution of subprime lending and the various terms on them. Their data, for example, show FICO scores that range from prime values approaching 700 to the very low, distinctly subprime, levels below 550.

²¹ See. Jaffee and Quigley (2007b) for a more complete analysis of the decline in FHA lending volume created by the expansion of subprime mortgage lending and a discussion of possible policy solutions.

4.3 Subprime Mortgage Loan Performance

Figures 3 to 5 show the available delinquency and foreclosure data from the Mortgage Bankers Association, with clear evidence that subprime loans included a significant number of low quality credits. Figure 3 shows the percent of loans in each category that are past due by any amount. The lower line shows that past due prime loans have ranged from 2 to 4 percent of the total prime loans since 1998, while past due FHA mortgages ranged from 8 to 14 percent, and past due subprime mortgages ranged from 10 to 19 percent.

Figure 4 shows the foreclosures started quarterly as a percent of the total loans outstanding in each category. Here the distinction between subprime and FHA loans is more dramatic, with many more subprime loans reaching the stage of foreclosure. This is likely the result of at least two factors: (i) FHA loans have generally been underwritten with lower initial loan to value ratios, and (ii) the average FHA loan has been outstanding much longer, allowing a greater buildup of borrower equity. It is also plausible that the underwriting standards applied on FHA were generally higher than the standards applied on subprime loans. While the percentage of subprime loans starting foreclosure is now at its all-time high, there was a previous cycle in the 2000 to 2002, at the time of the dot-com bust. Mortgage Bankers data on subprime loans were first publicly released in the Fall of 2002, and have been updated quarterly ever since. Thus, since the Fall of 2002, investors in subprime mortgage securities would have been aware of the relatively severe foreclosure behavior of subprime mortgages during the earlier cycle.

Figure 3: All Loans Past Due as Percentage of Category Total Outstanding

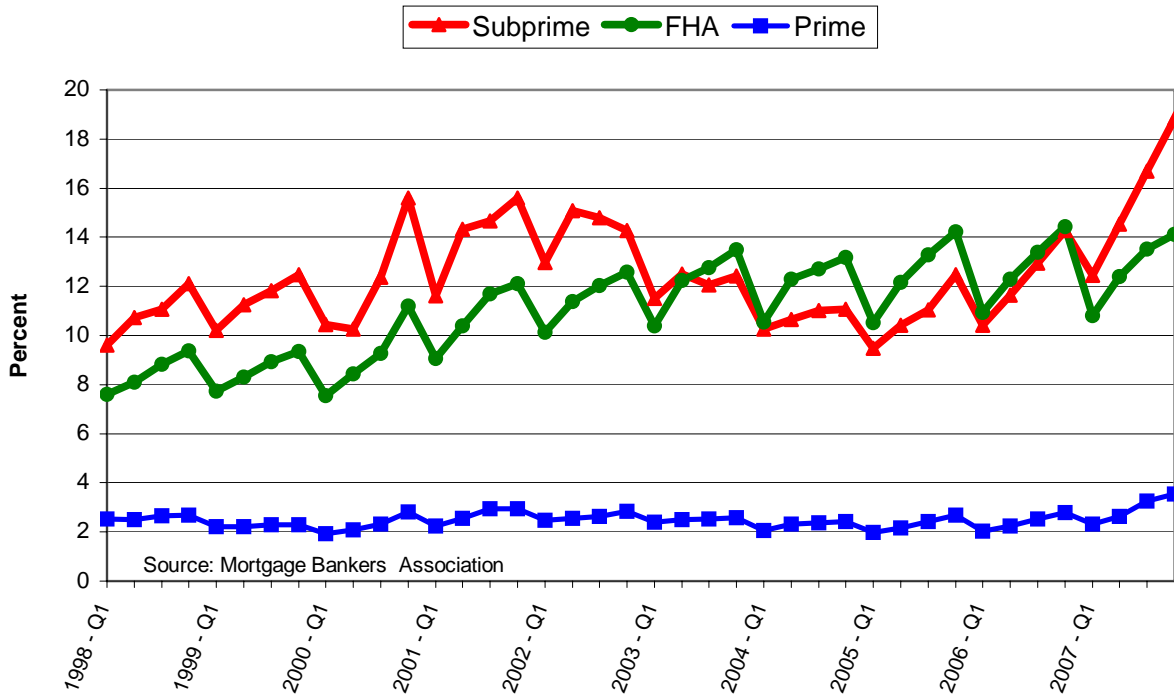


Figure 4: Foreclosures Started During Quarter as Percent of Category Total Outstanding

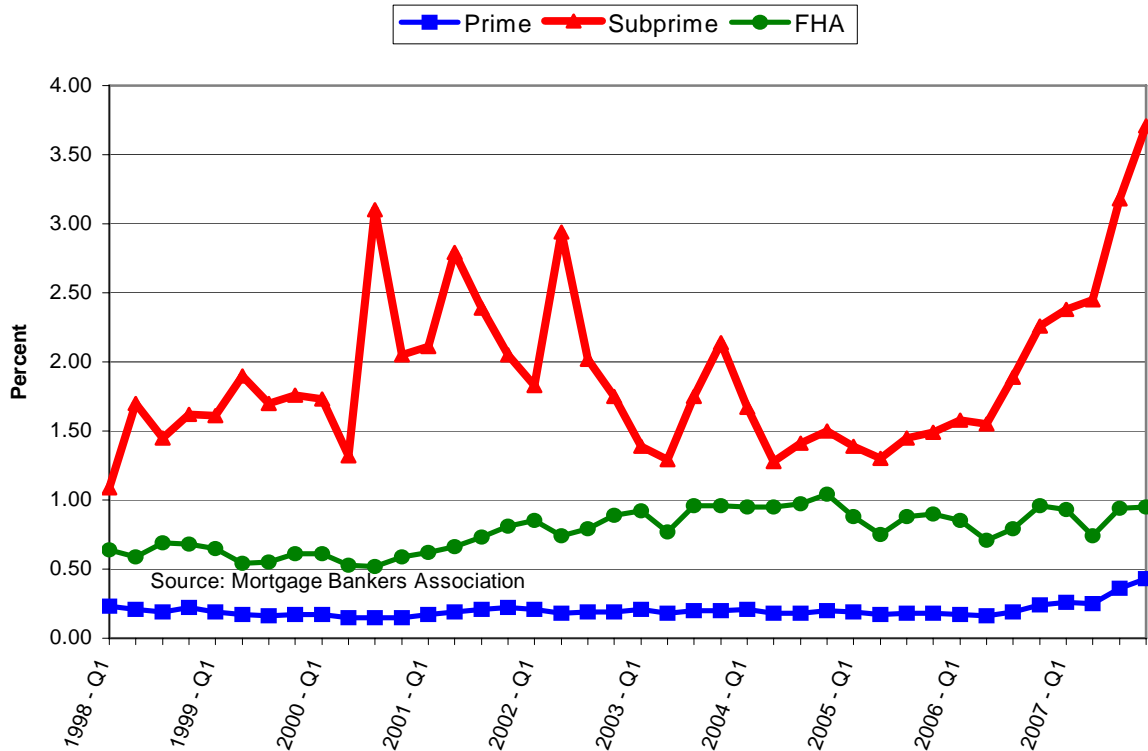


Figure 5: Loans In Foreclosure as Percent of Category Total Outstanding

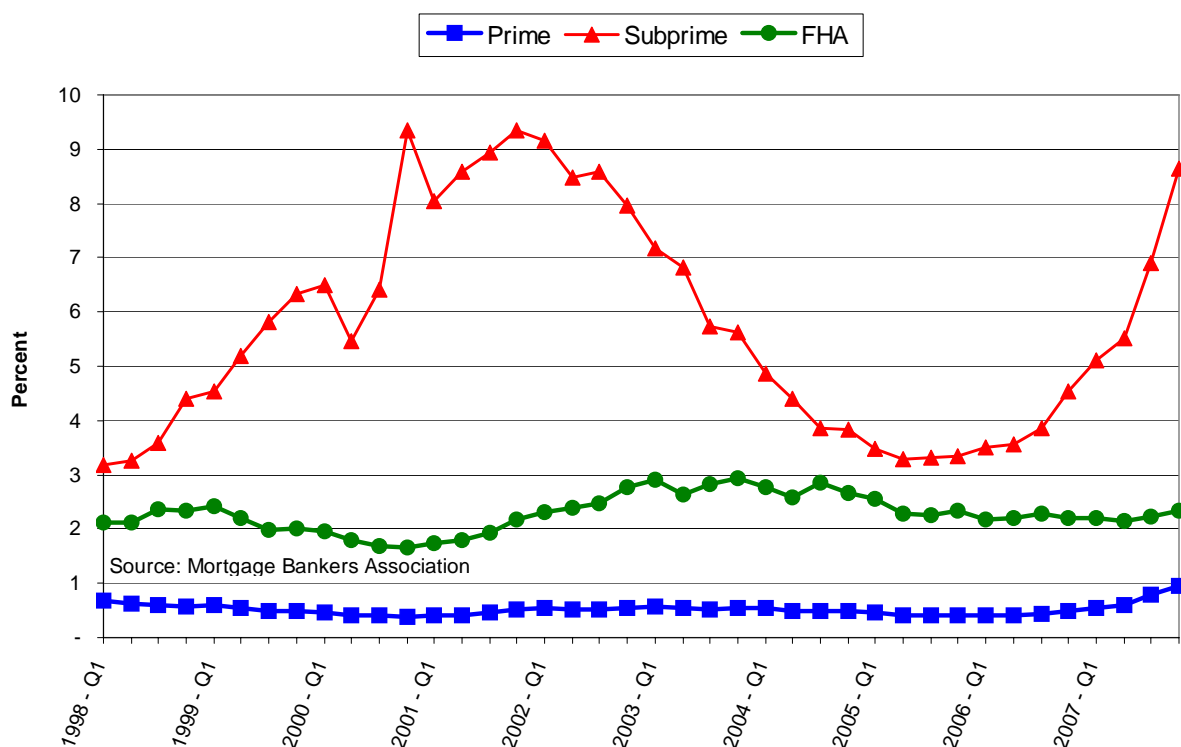


Figure 5 shows the inventory of loans in foreclosure as a percent of each category total. The foreclosure inventory percentages for prime and FHA have fluctuated within relatively narrow bands over time. In contrast, the percent of subprime loans in the process of foreclosure has fluctuated widely, with a baseline of about 3 percent, but reaching a peak in excess of 9 percent in the 2000 to 2002 period; the most recent observation at year-end 2007 is 8.65 percent. It is worth stressing that the data showing the earlier peak during the 2000 to 2002 period have been available to investors since 2002. This would belie the suggestion of the President's Working Group (2008) that investors had not received adequate disclosures concerning the riskiness of subprime loans.

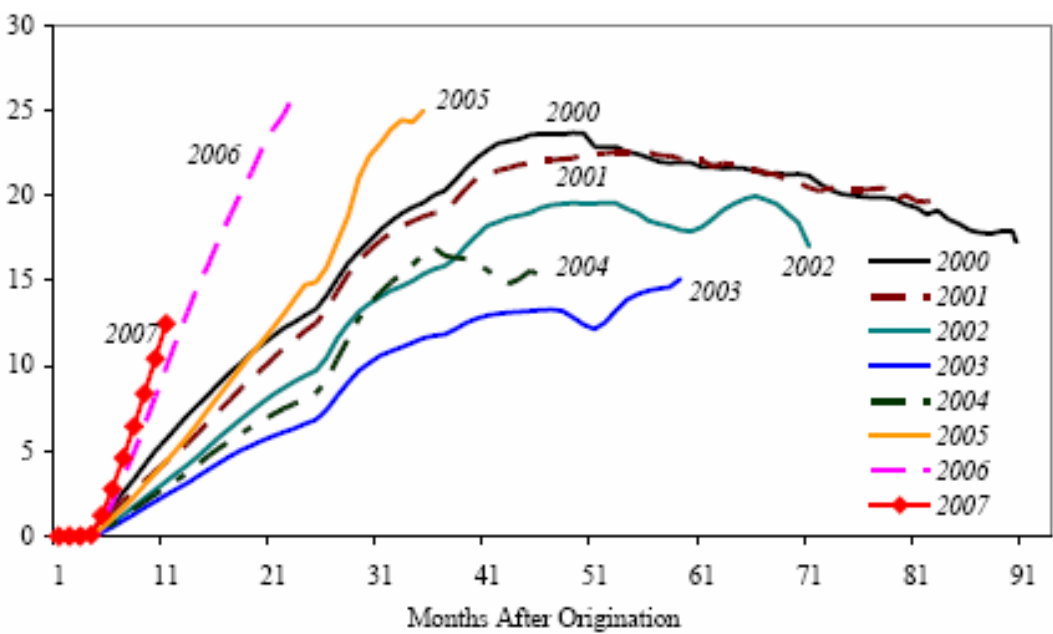
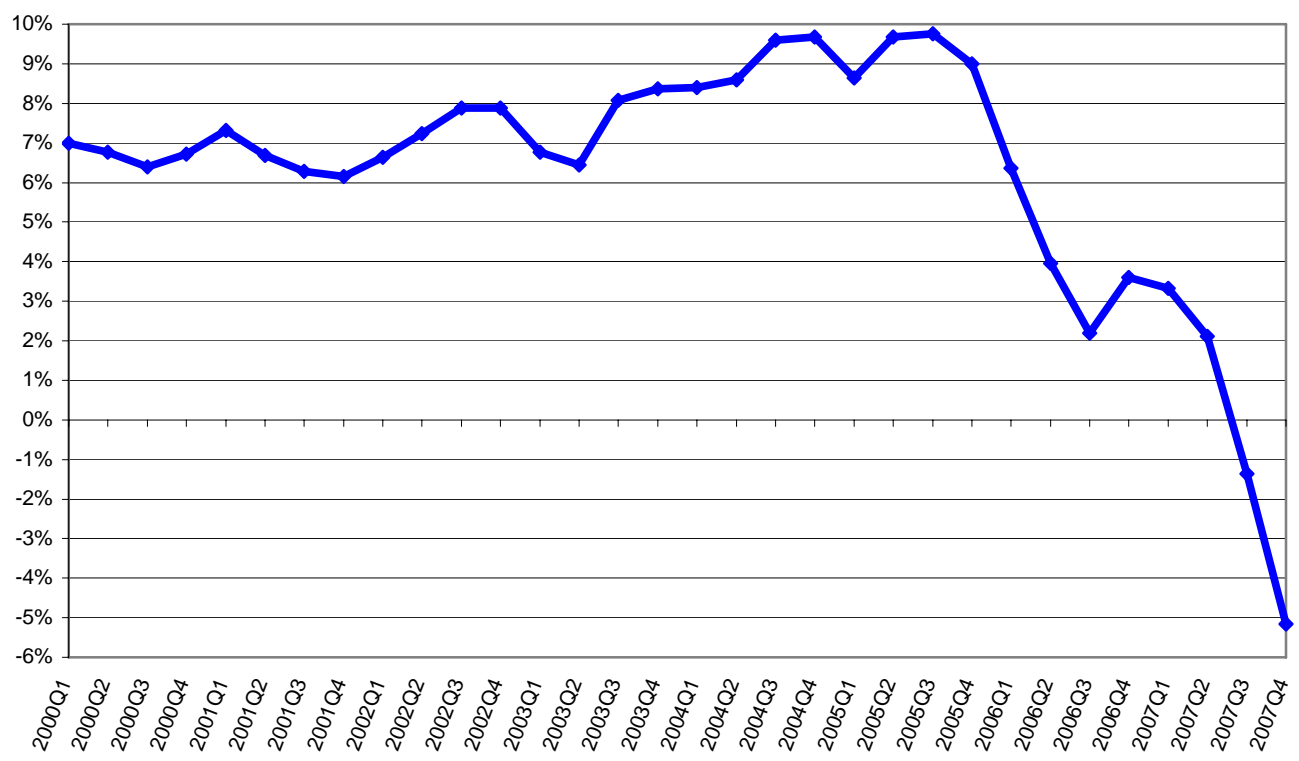


Figure 6: Subprime Delinquency Rate 60+ Days, By Age and Year of Origination
 Source: Source: LoanPerformance (LP) data from First American CoreLogic.

Figure 7: The OFHEO House Price Index, Quarterly Changes at Annual Rates



4.4 Changing Credit Standards on Subprime Mortgage Originations

While Figures 3 to 5 show the aggregate delinquency and foreclosure rates on subprime mortgages since 2000, they do not provide information on how the credit quality on subprime mortgages may have varied based on the year of origination. In particular, it has been suggested that the standards imposed by lenders may have deteriorated over time, such that the loans made in 2005 and 2006 were of substantially lower quality than the loans made in, for example, 2000 and 2001. Figure 6 sheds light on the issue, showing the delinquency rates (60 days or more) on subprime loans based on months since origination and the year of origination. The figure shows that the default rates on the 2005 to 2007 vintages far exceed the rates observed on the earlier vintages. Beyond the three most recent vintages, however, the pattern is much less clear, since the 2000 vintage is the next worst after 2005, while the 2003 vintage has the lowest delinquency rates of all the vintages.

An obvious issue in interpreting this evidence is whether changes in other factors over time might also be affecting the observed delinquency and foreclosure rates. At least the following three sets of potential determinants of delinquency and foreclosure rates could be relevant:

- Measurable Loan and Borrower Characteristics. Both the types of subprime loans made and the objective borrower characteristics have changed over time. Table 4 provides a summary of some of the more important of these characteristics. FICO scores have actually been systematically improving from 2001 to 2006. The debt service to income ratio, in contrast, shows a progressively heavier payment burden over time. Similarly, the rising combined loan to value ratios (which include both first and second lien mortgages) and the falling share of fixed-rate mortgages are both further signs of riskier loans.

	2001	2002	2003	2004	2005	2006
FICO Score	620	631	641	646	654	655
Debt Service to Income	37.8%	38.1%	38.2%	38.5%	39.1%	39.8%
Combined Loan to Value Ratio	80.0%	79.9%	80.6%	82.8%	83.5%	84.4%
Fixed Rate Mortgages, %	41.4%	39.9%	43.3%	28.2%	25.1%	26.1%

Source: Table 1, Demyanyk and Van Hemert (2008).

House Price Inflation. Whatever the objective loan and borrower characteristics, rising home prices will discourage mortgage defaults—borrowers can just sell their homes if need be—whereas falling home prices will dramatically increase the default rates. Figure 7 shows that as recently as 2005, house prices were rising at 9% annual rates, clearly counteracting any other tendencies toward rising mortgage defaults. House price appreciation, however, suddenly slowed starting in mid-2006, and significant house price declines have been the norm since mid-2007. The recent studies by Demyanyk and Van Hemert (2008) and Gerardi, Shapiro, and Willen (2007), among others, document the critical role that declining house prices have played in subprime mortgage defaults.

- Implicit Underwriting Standards. Beyond the objective factors of borrower and loan characteristics and the observed house price inflation, lenders may have access to other borrower information that is not objectively available to investors. For example, loan officers may enforce either weaker or stronger standards at different times with respect to factors that are not objectively included on loan applications. Fraudulent misstatements, such as inflating the borrower's income or the house appraisal, are more extreme examples. By their very nature, these factors are not objectively measurable.

The recent study by Demyanyk and Van Hemert (2008) attempts to tease out a measure of changes in the implicit underwriting standards from the actual delinquency and foreclosure data. They first estimate equations explaining the observed delinquency and foreclosure rates on the

basis of the actual data on borrower and loan characteristics and house price inflation.

Interpreting the residuals from these equations as the implicit underwriting standards, they then determine the role the three factors played over time in determining the delinquency and foreclosure rates. Their key results is that a significant and systematic decline in the implicit credit standards remains after controlling for the objective changes in loan and borrower characteristics and house price inflation.

4.5 Predatory Subprime Lending and Loan Modifications

As the subprime mortgage crisis has unfolded, the two most pressing issues from the consumer standpoint have been predatory lending and loan modifications.

4.5.1 Predatory Lending

Predatory lending arises when borrowers are induced to take out mortgage loans that are not in their best interest. The borrowers would presumably not have taken out such loans had they had full disclosure and understanding of the actual loan terms. A well functioning and competitive market should protect uninformed borrowers from such predatory tactics, since it would be in the best interest of a competitor to inform the borrowers of a better alternative in order to obtain their business.

The evidence is clear, however, that certain parts of the subprime mortgage market have failed in this regard. One part of the problem is that the mortgages can be quite complex, with options both to defer payments and to refinance, as well as offering choices that include fixed rate, adjustable rate, and switching from fixed to floating rate over time. A second problem is that mortgage brokers obtain their fees as soon as the mortgage is originated, and some brokers have clearly acted without regard to their future reputation. A third problem is that fraud has appeared within the origination process, such as intentionally overstating borrower income or

house values. The investors in the mortgage securities and the borrowers who ultimately default are both harmed by such activity.

Predatory lending has occurred even in the presence of a significant array of mortgage borrower protection legislation and regulations. Major existing programs include:

- The Truth in Lending Act (TILA) is part of Regulation Z of the Federal Reserve Act and is administered by the Federal Reserve. It requires clear and accurate information on loan terms and conditions, including disclosure of the Annual Percentage Rate (APR) which informs the borrower of the effective interest rate including the effects of fees and points.
- The Homeowners Equity Protection Act (HOEPA) was passed in 1994 to augment the TILA, in order to provide further protections for consumers on mortgages with exceptionally high contract rates or fees. HOEPA requires a variety of additional disclosures as well prohibiting a variety of practices. The Federal Trade Commission handles HOEPA complaints.
- The Real Estate Settlement and Procedures Act (RESPA) is a third consumer protection act, passed in 1974, and administered by the department of Housing and Urban Development (HUD). It sets detailed rules and procedures for the mortgage origination transaction, including the requirement of various disclosures at the closing.
- The general US legal prohibitions on fraud and deceptive practices apply to mortgage lending, and are enforced by the Federal Trade Commission.

Given the breadth and depth of the existing mortgage borrower protection legislation, the open issues are not matters of principle, but rather how to make the existing protections generally more effective and how to improve certain specific components. For example, the President's Working Group on Financial Markets (2008), among others, has proposed licensing requirements for mortgage brokers, while the newly issued Blueprint from the US Treasury

(2008) proposes the creation of a new federal commission, the Mortgage Origination Commission (MOC). While the existing protections can surely be improved, it must be recognized that destructive legislation would simply end all subprime lending.²²

Jaffee and Quigley (2007b) also offer two innovative proposals for dealing with the predatory lending problem. The first is to use a specifically designed FHA mortgage as a standard alternative loan, and to require that all subprime lenders bring this alternative to the notice of their borrowers. The second is to create a new suitability standard, which would require that subprime lenders affirm that the borrowers to whom they are lending meet the standard. Stock brokers, for example, have long been required to apply a suitability standard that ensures an investors' goals and expertise are matched with the type of securities they are allowed to trade. The result, for example, is that only the more knowledgeable investors are allowed to trade in futures and options contracts. A potential drawback to suitability standards, however, is that the financial service providers may become overly cautious. This problem might be avoided if there were administrative remedies through which a consumer could petition to obtain the services, thus providing the service provider with a safe harbor against future complaints.

4.5.2 Loan Modifications²³

Loan default and foreclosure create deadweight costs, meaning that the process is costly to both the borrower and the lender, in effect a “lose—lose” outcome. It thus may be beneficial to both the borrower and the lender to avoid a mortgage default by modifying the loan terms to a level the borrower can afford. Lenders, however, are reluctant to gain a reputation for modifying

²² For example, the city of Oakland CA, among others, passed an ordinance in 2002 that imposed punitive damages and unlimited assignee liability on all investors and securitizers, if a mortgage loan in which they were involved was later judged to be predatory. Not surprisingly, all securitization of Oakland mortgages abruptly ceased, as did most Oakland mortgage lending, until the ordinance was rescinded; See Fitch (2003) for further details.

²³ Two recent studies, Brinkman (2008) and Cutts and Merrill (2008), provide extensive data and analytic discussions of the issues and experience relating to subprime loan modifications.

loans, lest all their borrowers (current and future) apply for such modifications. The servicers on securitizations face similar reputational dilemmas, as well as contractual limitations on their powers.

It is noteworthy that loan modifications, or workouts as they are called, are common on commercial real estate loans. A key factor is that loan payments on commercial mortgages derive primarily from the rental income the landlord receives. If the rental income falls below the debt service required on the loan, then a default will be imminent. Since the rental income receipts are generally objective and verifiable, lenders do not face significant reputational costs when offering loan modifications to such commercial borrowers. On home mortgages, in contrast, borrowers may substitute consumption for the mortgage payments, and it will be difficult for lenders to objectively identify those consumers for whom the loan payments are truly impossible.

The outcome has been that relatively few home loan foreclosures have been avoided through the use of loan modifications. Facing rising pressure, the government has intervened to create a number of voluntary programs, and the FHA has set up a specific program, FHA Secure, through which it could refinance modified loans. Lenders and servicers have been generally amenable to these government programs, perhaps because the resulting loan modifications can be characterized as one-time emergency transactions. To date, however, the programs have achieved only limited success. In particular, it appears that many defaulting subprime borrowers are beyond such help, a point in evidence being that the default rates on once-modified loans are themselves very high.

There are also pending proposals for the government to intervene more directly with explicit subsidies to purchase or modify subprime loans. These proposals face three fundamental pitfalls:

- Prudent mortgage borrowers who have managed their budget and are making their loan payments object strenuously to using taxpayer dollars to bailout their less prudent brethren.
- Current mortgage borrowers will have incentive to stop making their payments in order to benefit from government bailout programs. It is implausible that government programs can be efficiently designed to identify only the proper beneficiaries of such subsidies.
- A current government bailout program provides future borrowers and lenders with an incentive to take on risky mortgages on the presumption that a future government bailout program will be available as needed.

5. The Securitization of Subprime Mortgages

The securitization of subprime mortgages represents just the most recent step in a series of mortgage securitization innovations dating back 40 years. The GNMA passthrough security, created in 1968, may be considered the starting point for the evolution of modern mortgage-backed securities (MBS). The GNMA innovation created, for the first time, a standardized format for pooling mortgages, which greatly expedited the sale of mortgage pools by lenders to final investors. The innovation was immediately accepted in the marketplace because both the underlying mortgages and the MBS were directly guaranteed by the US government.²⁴ Related innovations soon followed, such as the first organized futures market for trading long-term debt securities, which in turn helped to create a wide range of derivative instruments for hedging interest rate risk. Based on the GNMA innovation, Fannie Mae and Freddie Mac, the two large US government sponsored enterprises (GSEs), soon created their own MBS programs. While the mortgages underlying the GSE programs are generally not government guaranteed, the two firms

²⁴ GNMA was, and is, an agency within the US Department of Housing and Urban Development. The underlying mortgages must be either FHA or VA government guaranteed mortgages. GNMA provides a further guarantee for payment of all interest and principal on the overall pool. The securities have equal standing with Treasury bonds.

guarantee the interest and principal payments on their MBS, a guarantee that investors generally treat as tantamount to a government guarantee.

5.1 “Private-Label” Mortgage Backed Securities

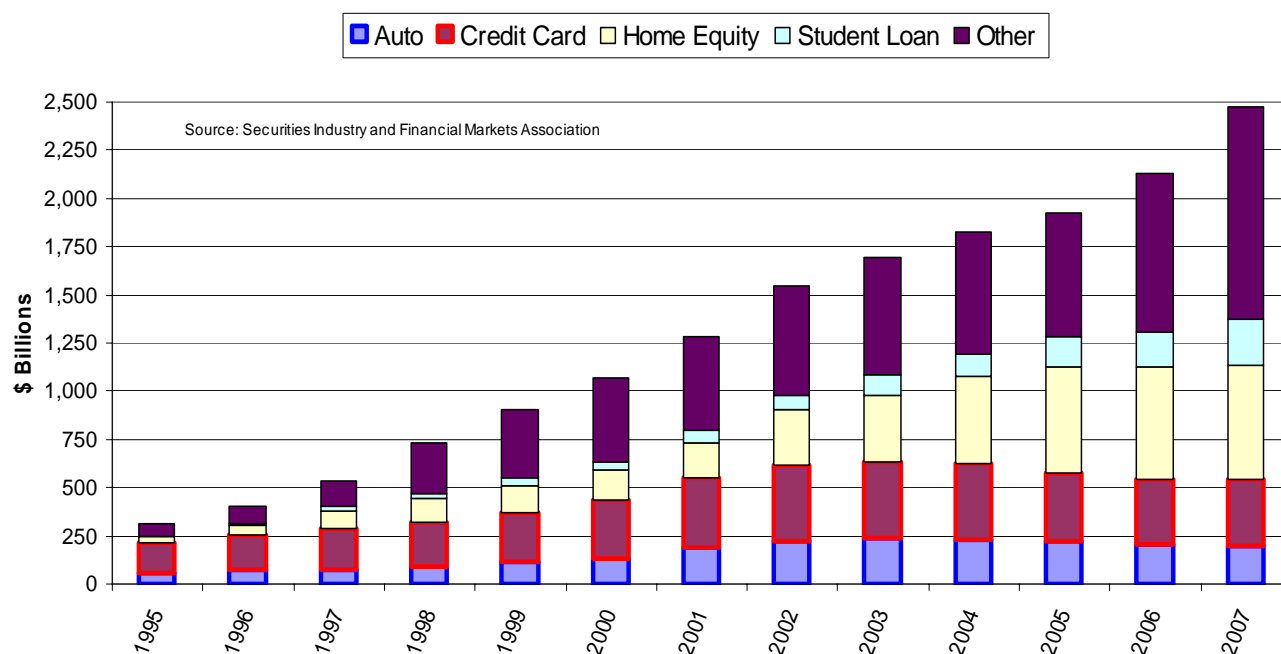
The first fully private-market MBS programs—started during the mid-1980s—created mortgage securities which presented investors, for the first time, with a very real risk of default, since neither the mortgages nor the issuers had any actual or presumed links to government guarantees. The key innovation was a subordination structure—hence the term “structured finance”—in which the principal payments from the underlying mortgages were directed first to the most senior tranche, then to the second most senior tranche, and continuing downward, as in a waterfall, to each junior tranche, ending with the residual equity tranche. Nevertheless, unlike the GNMA and GSE MBS, these so-called “private label” MBS contained an undeniable default risk, which in principle could reach even the most senior tranche. It was thus critical that there be objective measures of these risks, so they could be disclosed to investors and priced appropriately. Solutions for the measurement problem included FICO scores for borrower creditworthiness and rating agency methodologies to evaluate each securitization tranche.

In addition to the basic senior and junior tranche structure, most private MBS used a variety of additional credit enhancements to raise their credit ratings. The most economically interesting is an “excess spread” account. Excess spread refers to the excess of the weighted average coupon on the underlying mortgages over the weighted average coupons promised on the securitization tranches. This spread can be interpreted as compensation for the annual losses due to default that are expected to occur on the underlying mortgages annually. Most securitizations, therefore,

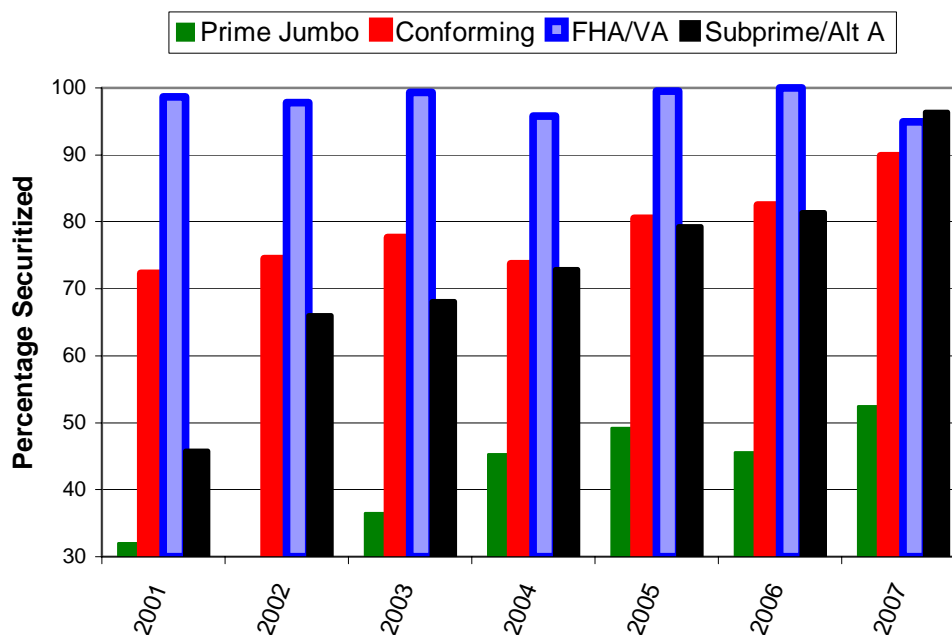
accumulate their excess spreads in a reserve account to cover future losses. As long as the actual losses do not exceed the excess spread, investors receive their promised payments.²⁵

Starting in the 1990s and continuing to the present, similar securitization methods were successfully applied to an ever expanding range of risky loan classes, including auto, credit card, commercial mortgage, student, and business loans. Even catastrophe risks from natural disasters were covered through insurance-linked securitizations. Figure 8 shows the growth in the outstanding amount of the major categories, which totaled almost \$2.5 trillion at year-end 2007. The “other” category includes CDOs among other items. The introduction of each new asset class required specific methods to measure the risk and to rate the new securities. To date, there have been no crises among these loan classes.

Figure 8: Non-MBS, Asset-Back Securities Outstanding



²⁵ Unfortunately, in some subprime mortgage securitizations, the excess spread reserve account was distributed as a cash payout after a period of good performance. Then, when major defaults suddenly arose, the accumulated excess spread earnings were no longer accessible to protect the existing tranche holders.

Figure 9: Securitization Rates for Mortgage Categories

5.2 Subprime Mortgage Securitization

The securitization of subprime mortgages started in the 1990s, and it has steadily accelerated since then. Figure 9 shows the annual securitization rates—the percentage of the originated loans that were securitized—for the available mortgage categories since 2001. The securitization rates for FHA and VA mortgages—which are the mortgages used to create GNMA MBS—have always been close to 100%. The securitization rates for conforming mortgages—which are the mortgages eligible for the Fannie Mae and Freddie Mac MBS programs—have grown from 70 percent to now over 90 percent. The securitization rates for Prime Jumbo mortgages—which are prime mortgages that are not eligible for GSE securitization—have been much lower, now just reaching 50 percent. The relatively high securitization rates for the FHA/VA and GSE conforming mortgages reflects the fact that investors recognize that the risk of loss due to mortgage default is virtually zero on these MBS. In comparison to these categories, the

securitization rates on subprime and Alt A mortgages, have grown steadily, from under 50% to almost 100% in 2007.²⁶ It is important to note that the securitization rates for subprime and Alt A mortgages far exceed the corresponding rates for Prime Jumbo loans, even though the expected default rates on the subprime and Alt A category are far higher.

In most respects, subprime mortgage securitization represented a natural progression in the trend of the previous twenty years toward the securitization of increasingly risky loan classes. Subprime loans, however, represented the first time that securitization was applied to an entirely new loan class; previously, securitization was applied only to loan classes with an already well documented record of satisfactory performance. The absence of a subprime loan track record limited the information that could be disclosed to investors and complicated the task of the rating agencies. Investors, however, received promised returns that exceeded the returns available on other classes of comparably rated securities. These excess returns appear to have been particularly effective in attracting investors to purchase the highest rated AA and AAA tranche. Given that the purchasers were only institutional investors, representing the largest and most sophisticated funds and banks, it is reasonable to assume that they understood that the excess spreads they were receiving were compensation for the “excess” risks they were bearing.

A less positive evaluation of the process used to securitize subprime mortgage loans is developed in the March 2008 *Policy Statement on Financial Market Developments* from the President’s Working Group (PWG) on Financial Markets (2008, p.2, italics in original):

²⁶ Alt A mortgages are mortgages with incomplete documentation and possibly other attributes that make them less than prime. Alt A mortgages could also be interpreted as A-, compared with the B or C ratings of subprime loans. Unfortunately, the available data on subprime securitization rates do not separate Alt A and subprime mortgages.

“... Originators, underwriters, asset managers, credit rating agencies, and investors failed to obtain sufficient information or to conduct comprehensive risk assessments on instruments that often were quite complex. Investors relied excessively on credit ratings, which contributed to their complacency about the risks they were assuming in pursuit of higher returns. *Although market participants had economic incentives to conduct due diligence and evaluate risk-adjusted returns, the steps they took were insufficient, resulting in a significant erosion of market discipline.*”

The PWG statement raises two points, also raised in other discussions, namely that (1) securitization contributed to a decline in subprime lending standards by allowing the risks to be inappropriately transferred from the originating lenders to the final investors; and (2) the rating agency methodologies failed to alert investors to the risks. We discuss these issues in turn.

5.2.1 Risk Transfer Within the Securitization Process

The PWG and others have suggested that the securitization process has created a “moral hazard,” allowing subprime lending risks to be passed in a sequence starting with mortgage brokers, then to lenders, then to securitizers, and ending as risks in investor portfolios. While it is understandable that each of these transactors might participate in the chain as long as they were confident they could transfer the risk to the next stage, it is perplexing why the final investors would accept the risks knowing that they were the end of the line. Had the final investors been unwilling to hold the risks, then, of course, the whole process would unravel.

So the key question is why the final investors purchased and held these highly risky securities. It has already been noted that the investors included only the most sophisticated institutional investors, in the form of hedge, pension, and foreign sovereign funds, and commercial and investment banks.²⁷ Thus, the PWG and others must be suggesting their either

²⁷ The good news is that consumer investors were considered unqualified to purchase these securities directly, and that there were few, if any, attempts to create retail entities to sell the securities.

the institutional investors were duped by inaccurate or incomplete disclosures, or that they had been negligent in their risk evaluations. To date, however, there is no direct evidence of either factor, and it does appear *prima facie* implausible that the largest, wealthiest, and most sophisticated institutional investors were systematically either duped or negligent. It also worth recalling that subprime lending was a new loan class with a limited historical record, so there had to be a large band of uncertainty around any estimate of expected loss.

The outcomes from risky lending are, of course, probabilistic. Thus, there is always the possibility of a disaster, and the newer the loan class, the less information there is to rule that out. Two source of publicly available evidence also confirmed that subprime loans were highly risky:

- (1) Figures 3 to 5 above indicate that data from the Mortgage Bankers Association were already publicly released and publicized by 2002 showing that very large percentages of subprime loans had ended in foreclosure. In fact, the current percentage of loans in foreclosure (Figure 5) has not yet reached the peak foreclosure rate from that earlier episode.
- (2) Subprime mortgage loans with annual interest rates of, say, 3 percentage points above prime mortgage rates directly imply expected annual default rates on the order of perhaps 10 percent.²⁸ Furthermore, it appears that many of the hedge fund and investment bank investors were holding highly leverage positions, which could readily create an effective 100% default rate. Consider, for example, an investor purchasing a \$100 portfolio with \$10 of equity and \$90 of loans. A 10% loss rate wipes out 100% of the investor's capital. These investors surely understood the ramifications of using high leverage.

²⁸ The derivation is straightforward. Assume, for the argument, that lenders lose 30% of the loan value on foreclosed loans. Then, if 10% of the loans default each year, the resulting loss rate will equal 3% ($= .30 * 10\%$). Thus a 3% excess annual loan interest rate can compensate for a 10% expected annual default rate.

In summary, it is not plausible that the securitization process led to a systematic misrepresentation of the riskiness of subprime loans.²⁹

There is a real problem, but is caused by the intense concentration of securitized risks in certain investor portfolios. The concentration of securitized risks is ironic because a key benefit of securitization is to provide a flexible mechanism for disbursing risks across a wide class of diversified investors. The obvious explanation for why investors, such as Bear Stearns, concentrated subprime mortgage risks in their portfolios is that they expected to earn excess returns. This is also the obvious reason for why such investors also maintained a severe maturity mismatch, using very short-term borrowings to leverage a portfolio of long-term MBS.

The bottom line is that the massive losses associated with the subprime loan crisis are due not to the process of securitization, but to the investors who concentrated the risks from subprime MBS by adding leverage and a maturity mismatch, and both in extreme proportions. The basic value of securitization as a means for distributing and allocating risky securities to a wide range of diversified investors remains intact. It is investors, not securitization, which propagated the crisis.

²⁹ Two recent empirical papers, however, argue that the securitization of subprime loans did create lax lending standards. Mian and Sufi (2008), also discussed in footnote (9), rely on the fact that loans in zip codes with intensive subprime lending were also intensively securitized. However, most classes of risky consumer loans, including credit card and auto loans, are also highly securitized. Thus, it would appear that the primary causation is that risky loans are securitized, not that securitization makes loans risky.

Keys, Mukherjee, Seru, and Vig (2008) rely on the fact that securitized subprime loans with FICO scores just above 620 (say 620+) have higher delinquency rates than securitized subprime loans with FICO scores just below 620 (say 620-), leading to their claim that lenders provided lax screening on their 620+ loans. The paper focuses on the 620 FICO score because it has been considered the standard minimum for Fannie Mae and Freddie Mac to securitize mortgages; the paper argues that lenders were lax on the 620+ loans because they anticipated these loans would be securitized. However, the 620- loans in the sample were also securitized, so it is not clear why the lenders would have had different incentives on these loans. Furthermore, it could just as well be said that the lenders provided superlative screening on their 620- loans; in other words, there is no clear standard for the comparison. Most importantly, there is no evidence to suggest that the empirical effects were not well known to institutional investors in subprime securities.

5.2.2 Rating Agency Methodologies for Subprime MBS and CDO

The President's Working Group on Financial Markets (2008) and many others have attributed a key role in the subprime crisis to the significant underestimation by the major credit rating agencies (CRAs) of the risks associated with subprime MBS. Indeed, the major CRAs have all now acknowledged the underestimation and they all have programs in process to rectify the methodological failings. Nevertheless, it is useful in this part (i) to describe the primary basis for the methodological failings and (ii) to connect these failings with the comparable failings in the CRA ratings of Collateralized Debt Obligations (CDOs).

The Failure in Rating Subprime Loan Securitizations

If they were rated, most subprime mortgages would receive a letter rating of B or C, depending on the quality of the specific mortgage.³⁰ Investors in subprime mortgage securities, however, purchase the tranches of securitized pools of subprime mortgages. Thus, the ratings provided by the CRAs are determined tranche by tranche. The basic method employed to determine these ratings is easily summarized:

- (1) A distribution for the annual default rates is estimated for each mortgage in the pool, based on historical data and the objective features of the loans and the borrowers in the specific pool (such as FICO scores, loan to value ratios, etc).³¹
- (2) An estimate is made of the correlation coefficient that is expected to hold pairwise among all the loans in the pool. It is usually assumed that a single common correlation coefficient applies to all the pairs.
- (3) Based on (1) and (2), the probability distribution of possible outcomes is computed.

³⁰ For example, a primary newsletter covering the subprime market is called Inside B and C Lending; see http://www.imfpubs.com/imfpubs_ibcl/about.html . Also, LoanPerformance, the source of a primary database of subprime loans, refers to subprime loans as "BC loans".

³¹ The CRAs vary (individually, over time, and by loan class) whether their ratings are to be interpreted in terms of expected annual default rates or expected annual loss rates, the difference being whether expected recoveries are themselves modeled as part of the process. Once an average default or loss rate is determined for the pool, the simplifying assumption is commonly made that that the average rate applies to each individual loan as well.

- (4) Based on the subordination structure proposed by the issuer and the distribution in (3), the probability of default and the associated letter rating is assigned to each tranche.
- (5) The issuer may propose revised subordination structures and will receive revised ratings per (4), until the final subordination structure and ratings are determined.

Errors in this rating process arise primarily from errors in estimating the distribution in (1) or the correlation coefficient in (2). In understating the default probabilities of subprime mortgages (step 1), it appears the primary mistake of the CRAs was to understate the importance of house price declines in two regards: (i) house price declines were given insufficient weight as a determinant of mortgage default and (ii) the likelihood of a significant decline in those prices was understated. This led to overstated ratings, especially for the more junior tranches. At the same time, house price declines are a key systematic factor creating correlated mortgage defaults. Thus, by underestimating the importance of possible house price declines, the CRAs also underestimated the correlation of mortgage defaults (step 2). Higher correlation coefficients significantly raise the probability of a major crisis that may even reach the senior tranches. The bottom line is that by underestimating the importance of house price declines in the default process, the CRAs systematically underestimated the risks, and thereby overstated the ratings, across all tranches.

The Failure in Rating Collateralized Debt Obligations (CDOs)

CDOs represent a “resecuritization” in which a pool is created from the tranches of already issued securitizations, and a new structured vehicle is then issued on the basis of this new pool. As a common example, a CDO could be created by combining the already issued B tranches from, say, 20 existing subprime MBS. The goal for the issuer is to create a new securitization that provides additional highly-rated (that is, above B) tranches. This is possible because the CRAs give CDOs credit for the diversification benefits they provide compared to individual MBS. In

effect, a CDO is a “fund of funds” and there will be diversification benefits, assuming that the individual MBS tranches from which it is formed are not themselves too highly correlated.³²

Unfortunately, the CRAs underestimated the impact that house price declines would have in creating correlated losses on the subprime MBS tranches that formed the subprime CDOs. The result was a serious underestimation of CDO losses across all tranches.

5.3 Subprime Mortgage Securitization: Conclusions

The primary factor creating the subprime mortgage crisis was the boom and bust cycle in house prices. In the boom phase, rising prices motivated lenders and investors to put ever more money at risk. The CRAs reinforced these investment decisions by posting ratings that underestimated the impact that falling house prices would have on subprime mortgage defaults. The error, however, is properly shared among all the market participants--lenders, investors, CRAs, and even the monetary authority—since they all failed to recognize that their actions were creating a house price boom that almost surely would end in a crisis.

A second factor that significantly broadened the impact of the subprime crisis was the action of institutional investors to concentrate the riskiness of their subprime MBS portfolios by using extremely high leverage and by creating extreme maturity mismatches in their funding. This investment strategy will always be crisis-prone independent of the underlying securities, as two examples confirm:

³² Issuing a CDO can also be analyzed as an arbitrage transaction, in which a new pool is created by purchasing tranches from existing securitizations, then creating a new structure and selling the new tranche components. This raises the question why the arbitrage did not extinguish any profit: that is, the very process of purchasing the existing tranche and selling the new tranche could be expected to drive the profits to zero. A possible answer is that the glut of world savings has created an almost insatiable demand for highly rated debt instruments, and while individual investors potentially could have created their own diversified portfolios, transaction costs and perhaps asymmetric information induced these investors to accept a slightly lower yield on market-created CDOs. In this sense, the underlying markets are incomplete, and the CDOs provide an economic benefit in helping to span them.

- The US Savings and Loan crisis of the 1980s arose from leveraged and maturity mismatched portfolios, although the underlying securities were prime mortgages with minor default risk.
- The Long Term Capital Management crisis also arose from a leveraged and maturity mismatched portfolio, even though US Treasury bonds were a primary instrument.

Subprime mortgage securitization has been intrinsic to both the over-expansion of subprime mortgage lending and the concentration of subprime risks in investor portfolios, so it must be considered an accessory to the crime. However, the fundamental economic benefit of securitization is that it allows risks to be widely distributed across diversified portfolios, while also matching each investor's risk tolerance with the appropriate tranche. This basic economic rationale for securitizing subprime mortgages has not been challenged by the subprime mortgage crisis.

6. The Subprime Mortgage Crisis and Financial System Regulation

The most dramatic ramifications of the subprime mortgage crisis have occurred at the level of the overall financial system, including the Federal Reserve's role in the recent merger of Bear Stearns. The discussion in this section reviews the major events of the subprime mortgage crisis that have had system-wide impacts on financial markets and financial institutions. The most important lesson learned at this level is the need to create significant government regulation of the major investment banks.

6.1 The Systemic Risks Revealed by the Bear Stearns Crisis

The Federal Reserve's actions to provide emergency funding to expedite the Bear Stearns merger reveals a fundamental weakness in the US financial system that requires swift regulatory action. Two key facts were revealed by the Fed's actions:

- The Bear Stearns portfolio of subprime MBS and CDOs was sufficiently leveraged to create serious concerns that the firm's investment losses could exceed its capital resources. Furthermore, the portfolio had been funded with short-term loans, in effect a major maturity mismatch. By Friday March 14, 2008, Bear Stearns feared it could no longer rollover over its debt, and if actions were not taken before markets opened on Monday March 17, Bear Stearns expected to fail on its obligations and therefore would require bankruptcy protection.
- Bear Stearns operated as a principal counterparty in the over-the-counter (OTC) markets for a wide range of interest rate, foreign exchange, and credit default derivatives. The worldwide outstanding notional amount of OTC derivative positions as of June 2007 was \$516 trillion, with credit default swaps alone accounting for \$43 trillion.³³ Bear Stearns was a central counterparty in all of these markets. It was thus plausible, even likely, that were Bear Stearns to take bankruptcy protection, there would be a cascade of failures, as Bear Stearns' creditors, upon not receiving their payments from Bear Stearns, would fail on their own obligations, and so on.

The Fed's emergency loan to expedite the Bear Stearns merger deviated from its standard rules by allowing the borrower both to post low quality collateral and to deny the Fed the right of recourse to other assets if the loan were not repaid. The unique circumstances of the Bear Stearns crisis include (i) the very large dollar amounts, (ii) the generally weakened condition of most investment banks, and (iii) the need to avoid a formal Bear Stearns bankruptcy in view of that firm's very large positions as a derivative counterparty; Facing this situation, the Federal Reserve

³³ See The Bank for International Settlements (BIS) Semiannual OATC Derivatives Statistics. The BIS maintains an extensive data base of the notional value of derivative positions outstanding by instrument, currency, maturity, contract form, etc.

took the emergency action of providing the loan.³⁴ A key component of the agreement was that JP Morgan Chase took over all the counterparty obligations of Bear Stearns.

The Bear Stearns event has revealed that the derivative counterparty system now parallels the payments system as a fundamental component of the financial system's infrastructure. The implication is that the risky investment strategies of investment banks and their central role as counterparties in the OTC derivative markets are fundamentally incompatible. As long as the investment banks carry out highly leveraged and maturity mismatched investment strategies, it is only a matter of time before another crisis occurs.

The US has long experience with creating a sensible and effective regulatory structure for the payments system as administered by the country's commercial banks. The core elements are (i) a set of risk-based capital requirements, and (ii) a requirement for "prompt corrective action" (PCA). The latter requires that the commercial bank regulators take prompt action to require a troubled bank to obtain additional capital or to merge. Otherwise, the bank is promptly closed. Bank managers, of course, anticipate this regulatory action and thus take ex ante actions to avoid them. As a result, the number of US commercial bank failures since 1995 has been minimal.

The proposal offered here is that those investment banks that choose to participate as counterparties in the OTC derivative markets must satisfy capital requirements that would make a replay of the Bear Stearns experience highly unlikely. One possible format for such regulation is to allow the investment banks to separate the capital that underlies their counterparty activities from the capital that underlies their investment activities. If this format were in force, losses suffered by the investment division, or even market fears of such losses, would not endanger the

³⁴ In comparison,, the Fed had no financial participation in the 1998 Long-Term Capital Management liquidation. That asset liquidation was carried out entirely within the private markets. Ironically, Bear Stearns was the only major investment bank that did not participate in the liquidation process.

counterparty division, and therefore would not require Federal Reserve action. In brief, federally mandated capital requirements should be required of the primary derivative market counterparties, just as they have long been imposed on depository institutions to safeguard the payments system.

As it happens, the US Treasury just issued (March 2008) a major policy proposal for the US financial system, *The Department of the Treasury Blueprint for a Modernized Financial Regulatory Structure*, US Treasury Department (2008), hereafter referred to as the Blueprint. The Blueprint proposes a new regulatory framework based on three primary functions—market stability, prudential regulation, and business conduct regulation—to replace the current system which is a complex mixture of functional and charter-based regulations. The Blueprint also proposes to rationalize the chartering of financial institutions, to merge the SEC and CFTC, and to create, for the first time, federal regulation of insurance activities.

The Blueprint, however, does not discuss the special problems relating to investment banks and their counterparty activities as they were revealed through the Bear Stearns merger. Presumably, it is intended that investment banks would continue to be loosely regulated by the SEC as they are currently. Furthermore, under the market stability function, the Federal Reserve would continue to supervise the payments and settlement systems, but this activity would be distinct from prudential regulation, which is to be carried out by a new and separate entity.

In contrast, the Bear Stearns crisis would appear to require that the market stability and prudential regulation functions be highly integrated in order to ensure that the losses from a firm's investment activities not endanger its role as a central counterparty in the OTC derivatives system. It would seem that a core principle in this regard would be to impose capital requirements on OTC counterparties, a topic that the Blueprint does not raise.

6.2 Market Illiquidity and Opaque Subprime Securities

A second major factor in extending the subprime crisis has been a breakdown in financial market trading and liquidity, which has allowed the market prices for many subprime securities to fall well below what many would consider their “fundamental value”. In part, this reflects a “flight to safety” in which investors attempt to acquire additional liquidity when facing a suddenly uncertain financial situation; this regularly occurs in financial panics. The unwillingness of investors specifically to purchase the apparently undervalued subprime securities and CDOs must also be attributed to the complex, opaque, nature of these instruments.

The illiquidity problem is reinforced by “mark to market” accounting rules that generally require investment banks to report the declines in the market value of their investment portfolios. While mark to market accounting has the obvious benefit of providing investors with current information based on market prices, more complex questions arise when the informational content of the market prices themselves is itself limited due to illiquid markets and disrupted trading. It is unclear how the situation can be improved, but it has been an evident factor in propagating the effects of the subprime mortgage crisis across the financial markets. The Federal Reserve has responded appropriately to this situation by offering huge volumes of liquidity, including its new Term Auction Facility. However, to date it has not succeeded in reviving the effective demand for the subprime MBS and CDO instruments.

The subprime mortgage crisis has also revealed a comparable and fundamental weakness in the US financial markets concerning Structured Investment Vehicles or SIVs. US commercial banks have long faced the dilemma that it is difficult, if not impossible, for an A-rated commercial bank to lend money to a AAA rated operating corporation. In principle, the corporation has access to loanable funds in the commercial paper market at a lower cost than the

bank could provide. As this issue developed in the 1980s, the banks acted to maintain their relationships with their AAA clients by creating SIVs, through which they could lend funds to AAA corporations at AAA interest rates. The SIV was an off-balance sheet entity which would hold only AAA loans, and therefore could fund itself in the commercial paper (CP) markets at AAA interest rates. The CP markets, however, are subject to potential liquidity crises, and thus to ensure continuity in the SIV funding, the commercial banks provided their SIVs with an emergency backup line of credit.

The SIV mechanism worked well for many years, but it has been challenged as a result of the subprime mortgage crisis. The primary new issue is that some SIVs have invested in longer-term and riskier securities, including subprime MBS and CDO, while continuing to use short-term CP funding. It was thus only a matter of time before the CP lenders would become concerned with the quality of the SIV portfolios they were funding. The problem has further expanded because the underlying MBS and CDO securities are themselves complex and opaque, reinforcing the fears of the CP investors. The result has been a funding crisis for many of the SIVs, including a number of cases where the parent bank's backup facility has been used. The primary issue here lies with the investment and funding strategies applied by the SIVs, which is the same issue described above for subprime MBS and CDPO investors more generally.

7. Concluding Comments

The subprime mortgage crisis raises issues at three distinct levels: the subprime mortgage markets themselves, the securitization of subprime mortgages, and their system-wide impacts on financial markets and institutions. The same issues are also relevant to the operation of mortgage markets in emerging economies. The following summarizes the major conclusions in each category:

Subprime Mortgage Lending

Subprime mortgage lending has provided funding to more than an estimated 5 million home purchasers, including more than 1 million first-time home purchasers. This benefit, however, is offset by the costs created by predatory lending practices, the difficulty of modifying loans, and the ramifications of borrower default. Various solutions have been proposed and some are already in action. The predatory lending practices should be controlled through additional regulatory actions. Programs have already been enacted to facilitate loan modifications for defaulting borrowers, but many of these borrowers are simply beyond help. The costs imposed on defaulting borrowers are actually limited, and useful information is already available to help these borrowers minimize the costs they face.

Subprime Mortgage Securitization

The recent report by the President's Working Group on Financial Markets (2008) and other studies have focused on securitization as a primary source of the subprime crisis. In contrast, the argument in this paper is that information regarding the high risk of subprime mortgage securities has been readily available, and that it is implausible that the large and sophisticated institutional investors that purchased subprime mortgages were either duped or were negligent.

Responsibility for the subprime mortgage crisis is more properly shared among the market participants--lenders, investors, and the credit rating agencies—since they all failed to recognize that their actions relating to subprime mortgage lending were creating a house price boom that almost surely would end in a crisis. The subprime mortgage crisis, in fact, is only the most recent in a worldwide series of real estate boom and bust cycles. It is at least fitting, therefore, that the major direct costs of the crisis have been imposed precisely on these market participants. It can

also be hoped that future market participants will better anticipate these developments, and it is possible that monetary policy should also take a more active role in dampening the boom phase..

System-Wide Effects on Financial Markets and Institutions

The subprime mortgage crisis has had major effects on both the financial markets and financial institutions. As a result of their highly leveraged and maturity mismatched investments in subprime MBS and CDOs, many investment banks have suffered enormous losses. In particular, Bear Stearns had to be merged in order to avoid an imminent bankruptcy, and rumors continue to circulate concerning serious financial distress at other investment banks.

The near-bankruptcy of Bear Stearns and the clearly weakened condition of other investment banks has also had impacts on the financial markets. One serious problem is that the major investment banks are all central counterparties in the enormous over-the-counter derivative markets. The actual failure of a major investment bank could thus create a chain reaction of failures and a financial market catastrophe. The Federal Reserve took its unique actions to facilitate the Bear Stearns merger precisely to avoid such a disaster. To avoid future reoccurrences, it is essential that the major investment banks face prudential regulation and capital requirements.

A second serious financial market problem has been the lack of trading and liquidity for many of the subprime MBS and CDO instruments. This is a common symptom of a “flight to safety”, but it has been magnified in the current crisis by the particularly opaque and complex nature of the subprime MBS and CDO instruments. Eventually, of course, the actions of opportune investors will drive market prices to their fair fundamental value and the trading volume and liquidity will return. In the meantime, the Federal Reserve has responded appropriately by dousing the system with liquidity, but with limited success to date.

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