The Housing Finance Revolution

Richard K. Green and Susan M. Wachter

I. Introduction

Houses are expensive. Consequently, the availability and cost of housing finance are critical determinants of how well housing markets function around the world. Changes in housing finance mechanisms are drivers explaining the dramatic changes in housing markets and housing activity seen in industrialized countries in recent years. Historically, in many countries, housing finance relied on funds provided by local lenders, typically depository institutions. With the development of capital markets and mortgage securitization, however, funding for housing comes from a much broader set of investors, including international investors. This paper examines the institutional changes in housing finance in industrialized countries over the past 30 years, including securitization and new types of mortgage contracts.

In several countries, most prominently the United States, there has been a major shift to financing housing through mortgage-backed securities (MBS). The market structure that supports securitization as the predominant funding source for mortgage finance in the United States has changed dramatically over time. We describe these changes and the related developments of home equity extraction and borrowing, credit scoring, and the development of the subprime market

and its recent implosion. We consider how government policy and market forces have contributed to these developments.

Housing finance systems have evolved differently across countries, although there are elements in common. National institutional factors remain important and there remains variety in housing finance institutions. What accounts for these cross-country differences in the structure of housing finance? Is there a process of convergence in structure? And how have these changes affected housing affordability? We begin with an international perspective examining these issues first broadly and then in the particular cases of Bangladesh, Korea, and Australia.

We then turn to the U.S. and consider how the assignment of risks associated with mortgage lending has changed as a result of recent housing finance innovation, while reflecting on the new stress points and implications for financial stability. Finally we consider what are the implications for supervisory policies or financial market regulation.

II. The Housing Finance Revolution: A Global Perspective

Over the past 30 years, housing finance systems in industrialized countries have undergone revolutionary change. Historically, housing finance has been provided by heavily regulated local lenders and by government-run entities. Mortgage finance had not been funded by international capital flows. Today, integration of housing finance into capital markets is a global phenomenon, albeit in varied forms. The deregulation of housing finance and its integration into global financial markets is occurring throughout the world. Nonetheless, the nation-specific historical structures of housing finance have heavily influenced current structures. Housing finance systems can be divided into four major types. These include: depository systems, directed credit (including provident funds, raised by payroll taxes and contractual savings schemes); specialized mortgage lending (through government-regulated or -owned banks or "covered bonds" as described below); and, more recently, secondary mortgage market systems through securitization.

The traditional methods of housing finance were constrained by government policies that segmented the financing of housing into specialized circuits that were cut off from the rest of the economy. Through the 1980s even the most market-oriented approach, which provided housing finance through a depository system, was heavily regulated. For example, in the U.K., housing finance in the early 1980s was largely funded by building societies that charged below-market interest rates. Building societies were historically formed by co-operatives that pooled savings to finance the purchase of homes. With lenders cooperating to set below-market rates on loans, the mortgage market was shielded from macroeconomic fluctuations, thus making them "intentionally rather unresponsive to market rate changes" (Diamond and Lea, 1992). Under these circumstances, institutions raising capital through market channels, such as commercial banks, could not compete, and so mortgage financing largely rested in institutions shielded from market pressures.

The integration of housing finance into capital markets resulted from the deregulation of these cooperatives. The Building Society Act in 1986 resulted in these institutions offering competitive banking services equivalent to that of normal banks in the U.K. Building societies were allowed to convert to corporate status, operate as private firms and access capital markets via controlled public offerings of stock. The Act also made provisions allowing commercial banks to offer variable-rate mortgage products to borrowers. The leveling of the playing field enabled the larger and more financially integrated commercial banks to increase their market share through issuance of variable-rate mortgages funded by deposits.[1] As a result, specialized building societies declined in the U.K., and commercial banks grew: Building societies provided 70 percent of mortgage debt outstanding in 1980, and by 2000, they were providing less than 15 percent with commercial banks providing over 70 percent.[2]

Within what was to become the Euro-currency market, mortgage finance institutions underwent even greater transformation, given their historically greater government involvement. Directed credit supplied by contractual saving schemes and state-regulated mortgage banks declined and was here also replaced by commercial bank lending. For

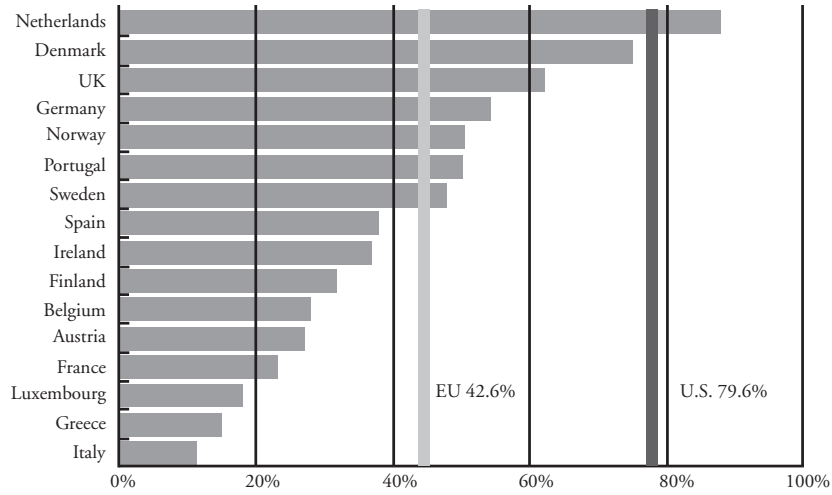
example in Spain, until the mid-1980s, the Central Bank controlled the housing finance system by setting savings and borrowing rates for local savings banks, restricting their investing to public debt and mortgages. In addition, the government was the principal originator of mortgage loans. But beginning in the mid-1980s, the government lifted its regulations to allow commercial lending institutions to enter the market, raise funds through demand deposits, and offer variable-rate mortgage loans. In addition, vehicles for securitization were developed, although as in the U.K., these remained a limited source of funding.

Throughout Europe, similar changes were occurring. From heavily regulated and rationed systems, modern housing finance emerged with funding increasingly supplied through market-oriented commercial banks. Even in Germany, where prior to 1980 most funds had been provided by heavily regulated or state-owned mortgage banks,[3] private sector depository institutions—although with a different menu of mortgage products as discussed below—predominated by 2000. The result has been the explosion of mortgage growth throughout Europe as shown in Chart 1, although in some countries the high growth rates reflect very low starting levels, as seen in Chart 2.

Similar changes occurred throughout the industrialized world, in formerly socialist and, to some degree, in emerging economies as well. The changes that have transformed housing finance have been global in scale and are the result of global forces. These include: new technology, a societal-wide move from government regulation to greater market orientation, and the worldwide decline in interest rates.

Technological innovation has proved instrumental to the changes that have swept housing finance. The development of money market funds forced the elimination of the constraints of interest rate ceilings, providing an alternative investment vehicle largely grounded on highly rated, short-term debt securities. As a liquid and highly stable investment, money market funds first came to fruition in the early 1970s with the Reserve Fund in the United States. Such innovation was abetted by the dismantling of capital barriers that had once hindered cross-border flows. Money flowed out from regulated institutions into the new, higher-yield money market accounts, thus diminishing the ability to rely on protected savings deposits to fund loan origination.

Chart 1
Residential Mortgage Debt Outstanding to GDP



Sources: European Mortgage Federation, Federal Reserve System, Dübel (2004)

Chart 2
Selected Mortgage Market Growth Rates Per Annum

European Union *average of 15 countries (1992/2002)*	8.2 %
Greece	23.5%
Portugal	22.5%
Ireland	18%
Spain	17%
Germany	6%
France	4%
Finland	3.5%
Sweden	2.5%
United States (1993/2002)	8%

Source: European Mortgage Federation, Federal Reserve System, A. Dübel (2004)

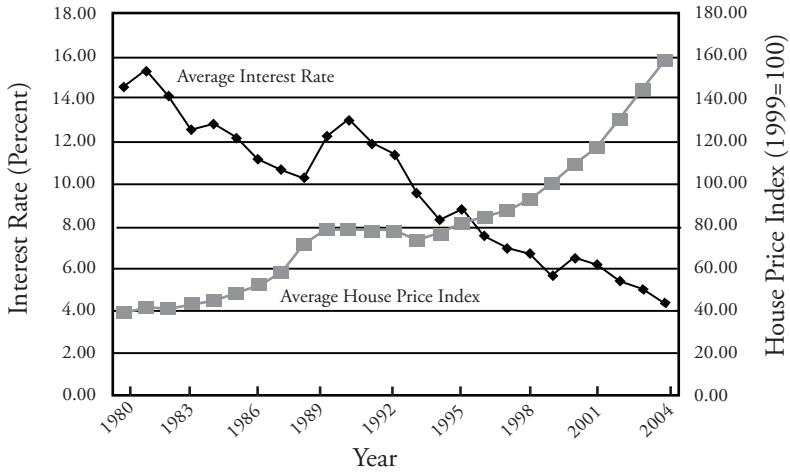
This outflow occurred in episodes of dis-intermediation, which worsened over time.

An important example of this was the savings and loan (S&L) crisis in the U.S. which is further discussed below. Countries such as the United Kingdom and elsewhere where variable rates predominated avoided similar crises, but nonetheless, rate ceilings were unsustainable. Similarly in Europe, this same force undermined contractual savings, whose low returns were easily beaten by returns in the money markets. The mortgage bank system in Germany, which provided long-term mortgage financing through on-the-balance-sheet "covered bonds," was not directly affected by this change.[4] Nonetheless, commercial banks in Germany also moved to increase their market share by offering an alternative to the covered-bond-financed non-prepayable mortgage, which was the depository financed variable- rate mortgage with the option to prepay.

Forces of deregulation operating in many markets throughout the world also contributed to the development of commercial banks as primary providers of housing finance globally. Governments increasingly recognized that markets could deliver lower-cost financing with less rationing. A consensus emerged that the most effective way to increase access to credit and to secure sustainable finance was through market-based systems linked to capital markets. This did not necessarily imply securitization. Rather, commercial banks emerged as the major mortgage lenders in Europe and in developed Asian economies as well.[5]

The third characteristic that linked housing finance to global capital markets was a major decline in interest rates worldwide. We show in Chart 3 average nominal prime interest rates from 1980 to 2004 for industrialized nations,[6] which declined from an average of 15 percent in 1980 to 4.4 percent in 2004.[7] This historic decrease has been instrumental in achieving lower-cost financing for mortgage lending in country after country, which adopted monetary policies to control inflation and to enable linkages to global capital flows. The decline in the cost of market funding rewarded the move to market-based financing. As examples, we depict how mortgage rates have declined

Chart 3
Global Average Interest Rate and House Price Index



Sources: Bank for International Settlements House Price Index, Interest Data from U.N. Statistical Database

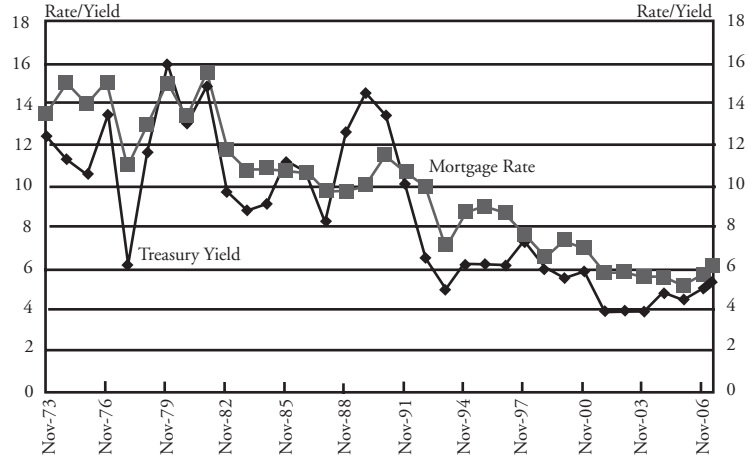
with government debt yields in Charts 4 and 5, which track these series for the U.K. and France over the last 30 years.

The major consequence of the link, provided by global capital flows, to cheap debt is an increased access to financing for homeownership, a resulting increase in housing demand, and a surge in housing prices in industrialized economies throughout the world. Housing prices surged for three decades (through 2004). A sustained price increase of this sort across so many economies' housing markets, which are local markets, is highly unusual and perhaps unprecedented. While there are specific factors contributing to the run-up in individual countries, it is clear from the ubiquity of the price acceleration over the past several decades that a common global factor is at work.

The new factor is the translation of interest rate declines into country specific mortgage rate declines. In the 1990s, the integration of segmented mortgage markets into global capital markets generated mortgage rate declines that both increased housing affordability and decreased the relative cost of housing with a resulting boom in housing.

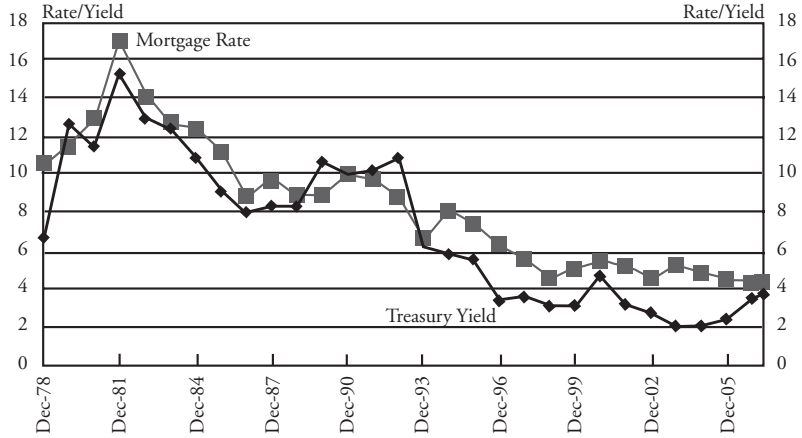
Chart 6 presents simple regression results for six countries. The regressions are specified to find whether nominal interest rates Granger

Chart 4
Treasury Yields and Mortgage Rates
United Kingdom



Sources: Global Financial Data; V. Morgan, Studies in British Financial Policy, 1914-1925: Central Statistical Office, Annual Abstract of Statistics, London: CSO (1924-); Bank of England, Quarterly Bulletin

Chart 5
Treasury Yields and Mortgage Rates
France



Sources: Global Financial Data; League of Nations, Monthly Statistical Bulletin, Geneva: League of Nations (1936-45), Banque de France, Bulletin Trimestriel (1946-) and Web site

Chart 6
Interest Rate Coefficient on Simple Granger Causality Regressions

Country	Interest rate coefficient, C(3)	St. Error	t-statistic
Pooled (1980-2004)	-0.46	0.12	-3.87
Australia (1986-2004)	-0.40	0.49	-0.81
Belgium (1991-2004)	-0.02	0.28	-0.07
Canada (1980-2004)	-0.42	0.29	-1.48
Sweden (1981-2004)	-0.53	0.21	-2.49
United Kingdom (1980-2004)	-1.08	0.48	-2.25
United States (1980-2004)	-0.19	0.14	-1.35

Note: *Regression is* ***P – P(-1) = C(1) + C(2)*(P(-1) – P(-2)) + C(3)* I(-1), where P is house price level and I is nominal interest rate.***
Source: *BIS Price Data*

cause changes in house prices.[8] In all cases, the sign on the interest coefficient is negative, and in two cases, it is significant at the 95 percent confidence level. A pooled regression for the full set of countries shown in Chart 6 is significant at the 99 percent confidence level. While these are nothing more than stylized facts, they are consistent with declining nominal interest rates driving house price appreciation. This suggests that the erosion of rationing and lending constraints is tied to high nominal rates. Interestingly, no relationship is found between real interest rates and house prices (Kim and Wachter, 2007).[9]

Of course, supply elasticity is the key factor in housing price appreciation resulting from interest rate declines. While lower mortgage rates improve housing affordability, they also increase demand. In the presence of supply constraints, this increase in demand results in housing asset price appreciation, which partially offsets the affordability benefit of the lower interest rates. Though we have no direct data on supply constraints in Europe, it is notable that there are systematically higher rates of house price appreciation rates in cities (where supply of developable land is limited) relative to national rates of increase (Kim and Wachter, 2004). There is also evidence

in the U.S. that housing price increases occurred disproportionately on the two coasts, where supply is more limited.[10] Thus, in the U.S., mortgage rate declines have resulted in very different affordability outcomes across markets.[11]

There is also the possibility that price acceleration, initiated by one-time mortgage market innovations that increase demand, may go beyond levels justified by fundamentals. If homeowners understand that declines in interest rates and mortgage innovation are one-time events, then the changes will lead to stable and higher equilibrium house prices. However, if expectations about future house prices are based on observed ex post house price changes, bubbles can emerge (Malpezzi and Wachter, 2005; Case and Schiller, 1989).

Magnifying the impact of declining interest rates is the current ubiquity of adjustable-rate mortgages (ARMs), which move with lower-cost short-term interest rates. Mortgages, around the world, range from short-term, bullet loans due every three years, as in Korea, to mortgages where upward increases are at the discretion of the banks, in the U.K., to mortgages which roll over every five years with funding, but not interest rates guaranteed, as is the case in Canada. Volatility concerns surrounding the use of variable-rate mortgages have led to a movement by governments to implement the introduction and growth of securitization.[12] Securitization and growth in market share of longer-term fixed-rate mortgages (FRMs) are being encouraged by government entities to mitigate households' exposure to interest rate risk and the resulting house price and macroeconomic volatility. Nonetheless, securitization has not been widely adopted and variable-rate mortgages remain pervasive. As discussed below, banks may have little interest in raising capital to offer alternatives to the variable-rate mortgage.[13] Moreover, the current securitization-related subprime crisis in the United States may raise doubts about the viability of housing finance systems grounded in securitization, also further discussed below.

To consider whether housing finance systems will converge to systems centered on bank-funded ARM-lending or on capital market-based, securitization-backed longer-term mortgages, we examine in more detail the current transition in public sector and specialized

housing financing institutions across several non-European countries. In the following, we trace developments in three countries: Bangladesh, Korea, and Australia. Even Bangladesh illustrates how mortgage markets are being transformed, despite the fact that mortgage markets are still small there. Nevertheless, the mortgage market is increasingly reliant on private sector institutions and privately held banks. In Korea, an economy that is now the tenth largest in the world, mortgages are currently funded almost entirely through private depository institutions that have evolved to replace government entities. These countries illustrate the most common evolution pattern in both Asia and in Europe, which is relying on depositories, instead of the securities market, for mortgage funding.

An exception is the Australian market, where securitization has become an important channel for mortgage finance. It remains an outlier, but provides an illustration of how a large asset-backed securities market can develop.

The outcome of these differing trends for global capital markets will be strongly impacted by the direction taken by the fast emerging economies of China and India. The shift from public intervention (in the form of state-owned enterprises) to private finance in the mortgage market is being replicated in India and even more strongly in China. The shape housing finance systems will take in these two countries will, in turn, be influenced by developments elsewhere, particularly in Asia.

The Mortgage Revolution in Bangladesh

Bangladesh has one of the least sophisticated financial institutions of any country in the world. While it has a banking sector, it is only recently that private banks have developed; it also has nearly nonexistent pensions and insurance sectors. Yet despite these primitive conditions, the housing finance sector in Bangladesh has changed materially recently, and these changes are consistent with those contemplated by the Washington Consensus.[14]

For many years, the principal housing lender in Bangladesh was the Bangladesh Housing Building Finance Corporation (BHBFC), a

government-owned mortgage institution. As recently as 2001, nearly half the par value of mortgages in Bangladesh was held by BHBFC. This heavily subsidized institution also did business outside of the mortgage market, and as such, had little incentive to make good lending decisions.

BHBFC was funded by the Bangladesh Treasury, with a cost of funds of 5 percent per year, an amount well below the market rate of interest. Mortgages were managed administratively, rather than financially: Bureaucrats originated and serviced mortgages through rules (some formal, others not) instead of through market-tested underwriting guidelines. This led to all manner of inefficiencies. First, BHBFC approval times were exceptionally long—sometimes as much as a year from application to approval. Second, because mortgages carried below-market rates of interest and were essentially granted by the government, they were allocated via rationing, rather than underwriting. The allocation process was often political, rather than financial. Third, because BHBFC was for many years not held to general performance standards, the agency had little incentive to service loans, and so loan performance was poor. Typically, 20 percent of loans would be in arrears. When BHBFC did foreclose, it would typically collect less than 50 percent of the outstanding loan balance.

The most important thing the Bangladesh government did to begin the mortgage finance revolution in Bangladesh was to stop directly funding BHBFC. The corporation does still retain a number of advantages—it gets a tax exemption, has much more lax capital requirements than other financial institutions in Bangladesh, and has its bonds guaranteed by the national government. But since it has lost its direct government funding, its mortgage volume has stagnated, and its market share of mortgage debt outstanding dropped from 48 percent to 40 percent in just the period from 2001 to 2003.

About one-quarter of this loss in market share was filled by nationally owned banks, which were subject to many of the same perverse incentives as BHBFC. However, three-quarters of the change in market share was filled by private sector institutions, including privately held banks and private housing finance corporations (HFCs).

What is remarkable is that these private corporations (especially Delta BRACK housing finance and IDLC) were able to gain a toehold in the Bangladesh mortgage market despite a huge disadvantage in "cost-of-funds. For example, in June 2003, public sector financial institutions had a cost of funds of less than 5 percent, while private commercial banks had a cost of funds of nearly 8 percent and housing finance corporations had a cost of funds of 12 percent. Yet, these private banks and HFCs were able to take business away from government-owned institutions because they operated with far more efficiency. Delta BRACK and IDLC are particularly interesting stories. Management at these institutions worked to develop underwriting standards for mortgages which are consistent with practices in the developed world. Borrowers are required to put substantial equity (typically 25 percent) into their houses, and must meet payment ratio requirements. The HFCs also attempted developing standards for evaluating potential borrowers' credit histories, having inferred from other countries' experiences that past history of bill payment is a strong predictor of future payment.

HFCs also pay far more attention to servicing than their government-owned counterparts; in particular, HFC management maintains that threatening to foreclose is an effective mechanism for getting borrowers to continue on-time payment, or to redeem themselves quickly should they fall behind on their payments. Foreclosure laws in Bangladesh are rather weak, and it is questionable as to whether lenders would succeed in reclaiming property quickly and efficiently. Because of this, the HFCs do two things to protect their assets: They insist on holding titles until mortgages are retired, and they are aggressive about making borrowers aware when their payments are deficient.

While HFCs are still a small part of the housing finance system in Bangladesh, they are examples of the worldwide revolution in housing finance. They treat housing finance decisions as a business matter rather than an administrative matter; they use an empirical foundation for making underwriting decisions, and they are as aggressive as possible about curing deficient loans. Again, what is remarkable is that HFCs are able to attract borrowers even though their cost-of-funds is substantially higher than their government-guaranteed competitors.

Executives from IDLC maintained in 2004[15] that lack of capital prevented more rapid growth in Bangladesh. The country is hampered by a lack of access to long-term capital markets; and it does not have long-term savings vehicles, such as pension funds and life-insurance companies. At the same time, the banking system, until recently, has been entirely nationalized. So while Bangladesh has taken some important steps in redeveloping a more rationalized and efficient mortgage system, until its financial institutions become more mature in general, there were be limits to how much housing finance can develop.

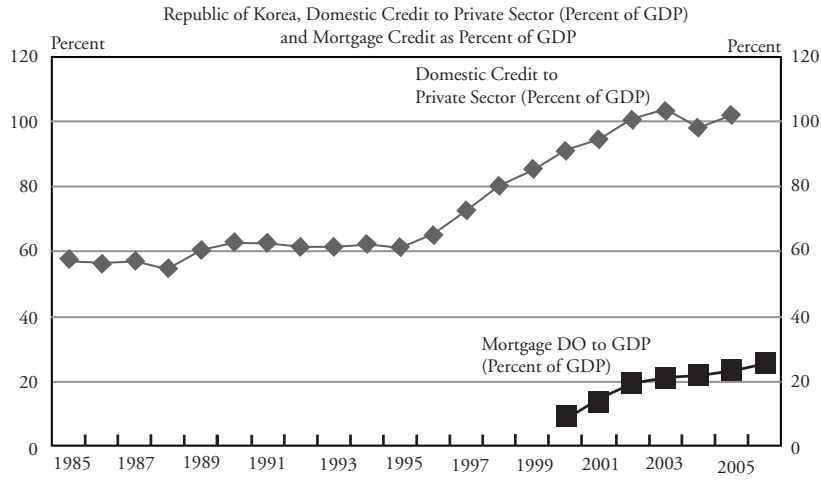
The Mortgage Market in Korea

While South Korea's economy grew rapidly between the end of the Korean War and the middle 1990s, the sophistication of its mortgage market did not. Overall, the mortgage market was largely in the hands of two government institutions: the Korea Housing Bank and the National Housing Fund.[16] Conventional depository institutions were not interested in holding mortgages, because the regulatory regime held mortgage interest rates below short-term market interest rates. On the other hand, households could only obtain mortgages if they placed deposits in one of the two housing institutions, both of which paid below-market interest rates.

The upshot of these factors was stunted development of the Korean mortgage market. Borrowers had to wait in a queue before becoming eligible to receive a very low loan-to-value ratio loan. This, in turn, led to a very low Mortgage Debt Outstanding-to-GDP ratio compared with other small markets—in the early 1990s, the ratio of the number of households to the number of housing units in Korea was roughly two-to-one.

The 1998 Asian financial crisis gave the Korean government motivation to initiate reforms[17] including the development of a more market-driven mortgage market. And as Bank of Korea data demonstrate, both the consumer credit market in general and the mortgage markets in particular have grown quite rapidly in the aftermath of these reforms (see Chart 7).

Chart 7
Growth of Mortgage and Consumer Credit
Korea



Source: Bank of Korea

But the Korean mortgage system now very much resembles the U.S. system before the Great Depression. Loans generally have very low loan-to-value ratios, variable rates of interest, and balloon payments. Mortgages in Korea are still financed almost entirely through depositories, rather than capital markets. Some policymakers in Korea believe that securitization is necessary for mortgages there to become more like their counterparts in other parts of the world. The Korean government has a set of schemes, such as the Korean Mortgage Corporation (KOMOCO), to securitize mortgages, and although there is growth recently in the use of longer-term mortgages backed by securitization, ARMs still predominate.

The various European mortgage systems, however, suggest that securitization is not the magic bullet for the creation of a viable solution. As discussed above, countries with robust mortgage systems have variations in the market share of ARMs. The United Kingdom relies almost exclusively on ARMS, while Germany relies heavily on longer-term FRMs. And as we have seen, the U.K. system is funded almost exclusively through deposits to banks while the German system is funded by covered bonds as well. Both systems work, although the homeownership rate in the U.K., at 68 percent, is substantially higher

than it is in Germany, where it is 40 percent (International Union for Housing Finance, 2005).[18] Thus, these are two models of a viable mortgage system, each with its risks. A third model, also with its own risks, is to rely on securitization through collateralized MBS, as Korea has attempted and as Australia has accomplished, as discussed in the following section.

The Australian Asset-Backed Security Market[19]

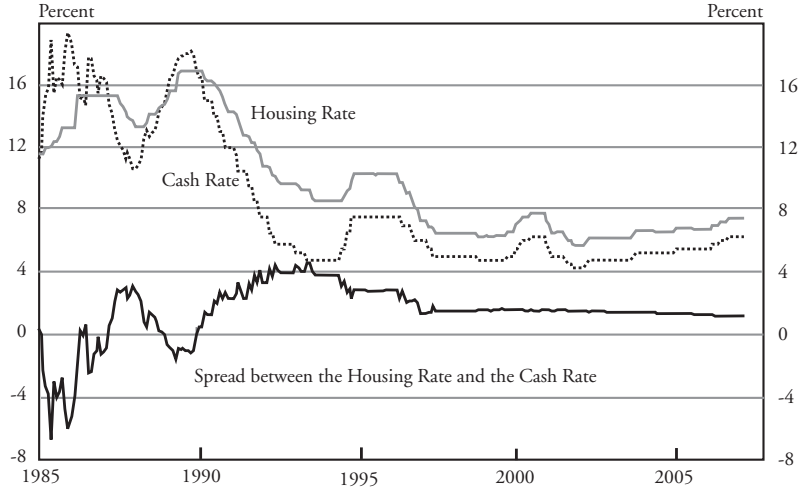
The Australian asset-backed security (ABS) market has grown rapidly over the past decade and is now one of the largest ABS markets in the world. As of March 2007, Australian entities' ABS outstanding amounted to $215 billion, up from $18 billion a decade earlier. Roughly $138 billion of these ABS are issued in Australia, with the remaining $77 billion issued offshore.[20]

ABS were first issued in Australia by the New South Wales and the Victorian government housing agencies in the mid-1980s. However, the ABS market really started to develop in 1994, when specialist mortgage lenders entered the Australian mortgage lending market. These lenders relied on residential mortgage-backed securities (RMBS), rather than deposits, to fund their housing loans. Three factors allowed specialist mortgage lenders to enter the Australian mortgage market:

First, in the early 1990s, banks' interest margins on housing loans were a very high 4¼ percentage points (Chart 8). High interest margins and very low default rates meant that housing loans were very profitable.[21] The bank bill rate, which is the benchmark interest rate for most floating-rate bonds in Australia, stabilized in the early to mid-1990s at an interest rate that was well below this housing rate (Chart 9). The decrease in the bank bill rate was largely due to the sharp fall in the inflation rate in Australia and provided specialist mortgage lenders with stable and predictable funding costs.

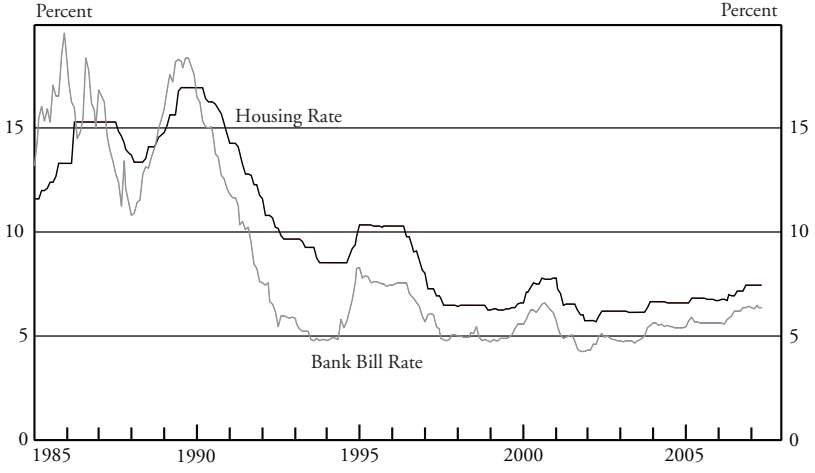
Second, Australian and overseas banks without large mortgage lending operations in Australia were willing to provide specialist mortgage lenders with wholesale lending facilities and help them develop their securitization procedures.

Chart 8
Australia Banks' Housing Interest Rates



Source: Reserve Bank of Australia

Chart 9
Bill Rate and Housing Rates
Australia



Source: Reserve Bank of Australia

Finally, Australia's managed funds industry was growing rapidly, mainly due to the introduction of compulsory superannuation in the late 1980s. These institutional investors had a healthy appetite for highly rated debt (including ABS).[22]

During the late 1990s, banks and other deposit-taking institutions started to issue reasonable quantities of RMBS. Regional banks, in particular, have significantly increased their issuance of RMBS because their housing lending has been growing rapidly and securitization is a cost-effective source of funding.

Comparison of ABS Markets in Australia and Asia

In Australia, the securitization market developed within a year or two of the issuance of ABS becoming profitable. The ABS market was developed by specialist mortgage lenders in conjunction with a few banks that did not have large mortgage lending operations in Australia. These entities were keen to exploit the supernormal profits earned on housing loans.

ABS issuance is growing, although slowly, in many countries in Asia, off of a low base. Given government encouragement in many of these countries, the relevant question may be "why aren't Asian securitization markets growing more quickly" rather than "why did the securitization market develop in Australia." Possible factors inhibiting growth in securitization in Asia include: ample liquidity and the resulting relatively low interest margins on housing loans in the banking system of some countries; resistance on the part of domestic banks in other countries where interest margins are high; and a lack of good data on mortgage default and prepayment rates available to potential securitizing institutions, which inhibits their underwriting of ABS. Next, we turn to the U.S. case, a country where the housing finance revolution has led to a predominant reliance on securitization.

III. The Mortgage Revolution in the U.S.

Home mortgages have become an increasingly large part of American household balance sheets. In 1949, mortgage debt was equal to 20 percent of total household income; by 1979, it rose to 46 percent

of income and to 73 percent of income by 2001 (Mischel, Bernstein, and Boushey, 2003). Similarly, mortgage debt was 15 percent relative to household assets in 1949, but rose to 28 percent relative to household assets by 1979 and 41 percent of household assets by 2001.

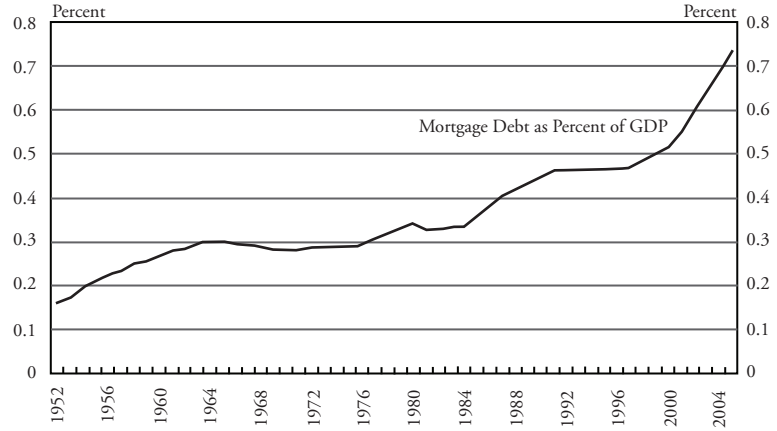
This enormous growth of American home mortgages (as a percentage of GDP), as shown in Chart 10, has been accompanied by a transformation in their form, such that American mortgages are now distinctively different from mortgages in the rest of the world. In fact, Cho (2004) shows that the growth in Mortgage Debt Outstanding in the United States has closely tracked the mortgage market's increased reliance on securitization.

The structure of the modern American mortgage has changed substantially over time. The U.S. mortgage before the 1930s would be nearly unrecognizable today: It featured variable interest rates, high down payments, and short maturities. In fact, before the Great Depression, homeowners typically renegotiated their loans every year.

The ignition of inflation in the later 1960s and 1970s altered the ability of depositories to fund long-term, FRMs: Inflation pushed up nominal interest rates and eroded the balance sheets of depositories that funded FRMs. Depositories found themselves in a straitjacket due to Regulation Q, a federal rule that placed a ceiling on the rate that depositories could pay depositors. As nominal interest rates rose, depositories could not match what the market was paying for large-scale investors on U.S. Treasury securities (assets backed by the full faith and credit of the United States which pay a market rate of interest). Moreover the major factor (as described above), operating in both the U.S. and elsewhere to limit the ability of depositories to fund FRMs was the rise of new, competing savings vehicles, such as money market funds, mutual funds, and pension funds, which paid higher rates than depositories and were also accessible to small savers.[23]

The result of the ignition of inflation and the new savings vehicles was an outflow of funds. This led to a crisis in the S&L industry, a major structural change in U.S. mortgage markets, and ultimately a transformation of the housing finance system.[24] Legislation responded to the new environment and removed deposit ceilings and allowed thrifts to invest in ARMs.[25]

Chart 10
Mortgage Debt as a Percent of GDP
United States



Source: Federal Housing Finance Board

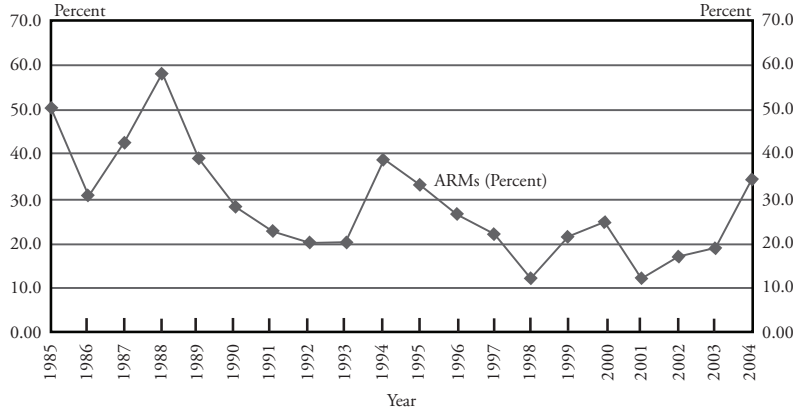
For a time in the late 1970s and early 1980s, when many pundits were projecting massive and variable inflation for years to come, it even appeared that the FRM might become an historical anomaly and that the U.S. mortgage market would return to the ARMs common before the 1930s. In a highly volatile inflationary context, FRMs become exorbitantly costly, effectively eliminating their market (Chart 11).

The First U.S. Mortgage Revolution

One cannot grasp the modern housing finance revolution without considering the revolution of the 1930s—the revolution in which the long-term, self-amortizing, FRM was born.

Before 1933, the typical first-lien mortgage in the United States had a short-term, a variable rate of interest, and a loan-to-value ratio of 50 percent or less. Mortgages usually had no amortization, and consequently required a balloon payment at the end of the mortgage term, which was usually something less than five years. Mortgages were funded by two types of lenders: S&Ls, which were local mutual, depository institutions; and mortgage bankers, who acted as brokers between borrowers and investors, such as insurance companies. In

Chart 11
ARMs as a Percentage of All Loans
United States



Source: Federal Housing Finance Board

the 19th century, loans were often funded by life-insurance companies, and for some insurance companies, such as Northwest Mutual Life Insurance, farm and home mortgages were the principal repository for investment.[26]

Lenders set mortgage terms to insulate themselves from risk. The variable interest rate protected depository institutions from fluctuations in interest rates, and the low loan-to-value ratios protected them from credit risk. But the bullet payment feature created a problem for borrowers when unemployment rose and bank liquidity fell during the Great Depression. As Bernanke and Gertler (1989) note, periods of price deflation, such as the Great Depression, create particular problems for debt holders, as interest rates cannot fall below zero. At the time mortgages came due in the early 1930s, with prices declining, real interest rates were very high, which exacerbated the fall in house prices. At the same time, the nominal value of outstanding debt remained unchanged, so loan-to-value ratios effectively rose. This led financial institutions to avoid extending credit to borrowers wishing to refinance. Borrowers therefore had to sell their houses to pay off their mortgages, which led to a flood of houses on the market, which further depressed prices. Borrowers who couldn't sell defaulted and lenders foreclosed and then sought to sell in order to raise liquidity. This weakened the market even further.

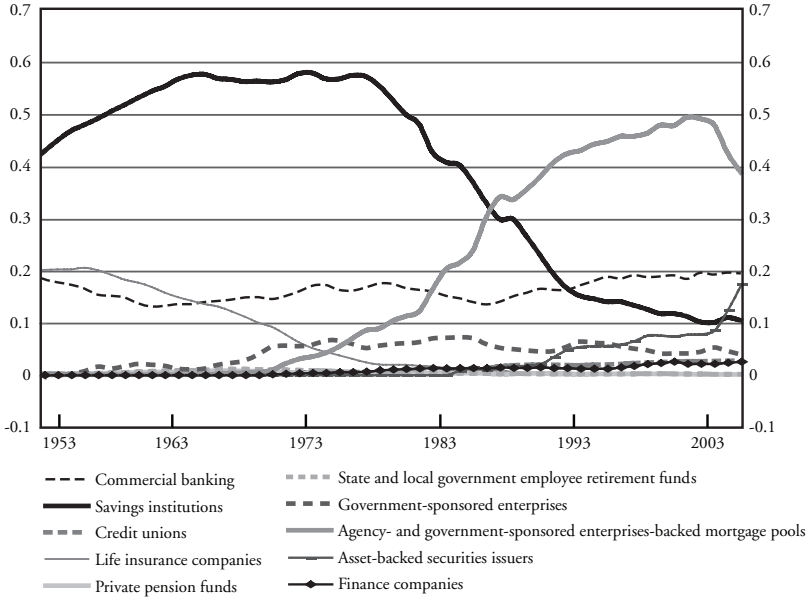
To restore liquidity to the mortgage market, New Deal Housing Finance legislation created the Federal Housing Administration (FHA) to insure long-term mortgages and created the Home Owners Loan Corporation (HOLC, and its successor, the Federal National Mortgage Association) to tie the mortgage markets to capital markets. Green et al. (2007) notes:

> The HOLC, backed with the full faith and credit of the U.S. Government, raised money in the bond market to purchase non-performing mortgages from depository institutions. They reinstated the loans as 20 year fixed payment mortgages (Green and Wachter, 2005). One could look at this as the first example of mass "loan modification." Borrowers were relieved from an impossible position (where they had to raise a large amount of cash to pay off a mortgage balance) and placed in a manageable position. At the same time, by changing the terms of the loans, the federal government reduced the risk embedded in them, and therefore increased their value to depositories,[27] who ultimately bought them back from the HOLC.

While the government's intervention in the credit market was successful, one could also argue that the success arose in part from extraordinarily good timing. FHA was created *after* the housing market had cratered, and after the general price level had fallen about as much as it was going to fall. Bureau of Labor Statistics data (2007) report that the consumer price index fell by 22.8 percent between January 1930 and January 1934, but rose by 7.5 percent between January 1934 and 1938.

Nevertheless, New Deal housing finance legislation created two important precedents: the direct intervention of the federal government in the U.S. housing finance market, and the creation, within the United States, of long-term, self-amortizing, FRMs with relatively high loan-to-value ratios.

Chart 12
Mortgage Holdings by Institutional Type
United States



Source: Board of Governors of the Federal Reserve System, Table 1173.
Mortgage Debt Outstanding by Type of Property and Holder: 1952 to 2005

Antecedents and Fomenters of the Current Mortgage Revolution

Market Conditions

The "first" modern mortgage system in the United States lasted from the New Deal era through the 1970s. Under this system, the principal source of mortgage finance was local S&Ls; during the 1970s, more than half of home mortgage debt outstanding was held by S&Ls (Chart 12).

These institutions were heavily regulated and federally insured. Assets held by S&Ls were largely restricted to home mortgages on properties within a fifty-mile radius of the institution. This geographical limitation was supposed to ensure that lenders had "local expertise" in underwriting mortgages. More generally, mortgage underwriting

was based at least in part on relationships, and as such, was quite different from the empirically based metrics that are the foundation of prime mortgage underwriting today.

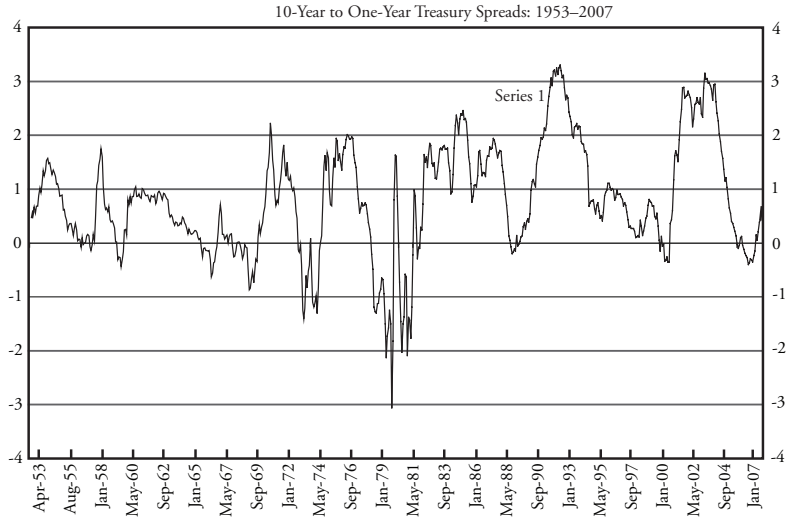
Liabilities, for S&Ls, were deposits whose interest rates were limited by a ceiling extended to S&Ls in 1966 and removed in 1986 by the Monetary Control Act of 1980. Depositors were protected by the full faith and credit of the United States government through the Federal Savings and Loan Insurance Corporation (FSLIC).[28] Finally, S&Ls could receive advances from a Federal Home Loan Bank at below-market rates of interest to finance mortgages. They were required to hold regulatory capital of 5 percent, although the definition of capital was not particularly rigorous. Federal government supervisory staff for S&Ls was fairly small and poorly paid, so that competent examiners would move from S&L supervision to bank supervision, where work was more interesting and pay was better.

Before the late 1960s, the S&L system worked quite well for the United States. While supervision was lax, the inability of S&Ls to do anything other than make mortgage loans largely prevented moral hazard. The S&L Charter also gave S&L management a franchise worth protecting—the ability to borrow at below-market interest rates[29] to fund market rate mortgages. This meant that S&Ls were steadily, if not spectacularly, profitable.

Favorable macroeconomic conditions helped the system work. Nominal interest rates remained low, and perhaps just as important, the yield curve sloped upward at almost all times before 1966 (Chart 13). Before the 1980s, mortgages were overwhelmingly long-term fixed-rate products, subject to substantial interest rate risk. As Fisher and Van Order (2006) put it, "the institutions were not allowed to originate "balloon" mortgages, which had caused the Depression-era wave of foreclosures. Through its provision of uniform underwriting standards for the provision of mortgage insurance, FHA made the long-term fully amortizing loan with a fixed rate of interest (FRM) ubiquitous in the U.S. starting in the 1930s.[30]

So long as interest rates remained stable (and so long as the yield curve remained positively sloped), interest rate risk had little impact

Chart 13
Yield Curve, Treasury Spreads
United States



Source: U.S. Federal Reserve

on profitability—or at least on solvency. But a hint of problems to come arose in 1966, when the yield curve turned and remained negatively sloped for more than a year (specifically December 1965 through February 1967). During this time, some S&Ls became insolvent, and all faced dis-intermediation problems. Changing macroeconomic conditions revealed an unsustainable regulatory regime.

In 1968, the Federal National Mortgage Association (FNMA) was divided into two pieces: the Government National Mortgage Association, known as Ginnie Mae, and the "new" FNMA, known as Fannie Mae, which was now privately held and able to buy and sell non-government-backed mortgages to raise additional funds for mortgages. Congress' intent with the creation of Ginnie, the new Fannie, and Freddie Mac, the Federal Home Loan Mortgage Corporation created in 1970 to assure S&Ls always had adequate liquidity, was at least partly to ensure that the mortgage liquidity problems of 1966 would never happen again.[31] In fact, the federal charters granted to Fannie and Freddie required them to promote liquidity and stability in the secondary market for mortgages as well

as to provide mortgage credit throughout the nation. These institutions would, in turn, bring uniformity to the mortgage market and invent financial instruments—derivatives of MBS—that would help keep the mortgage market liquid for the entire period from the mid-1980s to today.

At the same time, some S&Ls attempted to deal with the problem by issuing ARMs, and by 1969, around 19 percent of new mortgages did have floating rates. It was not actually clear, however, whether they were permitted to make such loans. The Federal Home Loan Bank did not believe that S&Ls could do so, and so promulgated a rule preventing payments from ever rising over the life of a loan (Fisher and Van Order, 2006). By effectively barring ARMs, the Federal Home Loan Bank Board prevented S&Ls from managing market risk, and removed incentives to learn more sophisticated balance sheet management.

The problems of the 1960s were minor when compared to the late 1970s. Double-digit inflation produced double-digit long-term interest rates, and recessionary expectations led to a sharply negative yield curve. S&Ls became substantially insolvent. In an environment where the one-year Treasury rate rose to 15.06 percent, the present value of a mortgage with a 7 percent coupon rate and a ten-year expected life fell to 28 percent less than par. Additionally, the minimum capital requirement for S&Ls was only 5 percent, and the institutions were required to invest almost exclusively in long-term FRMs.

Beyond the problem of interest rate risk, S&Ls in the late 1970s faced credit risk for the first time. Between the end of World War II and the 1970s, house prices in the United States rose in almost all years across almost all locations. Conventional loans had credit enhancements (either relatively low loan-to-value ratios or private mortgage insurance), and FHA loans were backed by the full faith and credit of the U.S. government. This meant that residential mortgages were very safe, as equity or insurance protected against default loss.

The early 1980s, however, brought about nominal house price declines in the Rust Belt. Office of Federal Housing Enterprise Oversight (OFHEO) data show that in 1982, house prices fell in Detroit

by 17 percent and in Flint by 15 percent. Prices in Cleveland fell by a small amount over the course of 1982, but neither did nominal prices go up much between 1980 and 1984, meaning that borrowers accrued little equity just by sitting in their houses.

Defaults rose substantially. S&Ls were prevented from lending beyond a very limited geographical area, meaning that they were unable to diversify geographically. This combination of events produced a broken housing finance system. Mortgage debt outstanding relative to personal income fell by 7 percent between 1979 and 1981. In the face of this situation, lenders and government officials recognized a need to change mortgage loan procedures. While part of the "solution" to the mortgage finance crisis was the catastrophic Garn-St. Germain Act of 1982 (the Act was catastrophic because it postponed an effective solution and the problem worsened), part of it was the development of a revolution that still reverberates.

Specifically, Congress recognized that ceilings on returns to deposits were counterproductive, and passed the Monetary Control Act of 1980 phasing out Regulation Q. Moreover, the Federal Home Loan Bank Board recognized that depositories could protect themselves against interest rate risk by issuing ARMs. The Federal Home Loan Bank Board in 1982 gave explicit permission for S&Ls to originate and hold ARMs, and the market share of ARMs responded accordingly.

While other countries dismantled their segmented housing finance systems and linked housing finance to capital markets through deregulated depositories, the U.S. linked housing finance to capital markets through depository deregulation and securitization.

Thrifts restructured their portfolios by exchanging FRMs for MBS that could be sold to one of the U.S. secondary market agencies. This behavior was encouraged by rules that allowed losses to be amortized rather than realized immediately (Wachter, 1990). Thrifts then solved their asset liability mismatch going forward by holding in their portfolios newly available ARMs.

Elsewhere, securitization has not developed in part because the "infrastructure requirements for mortgage security issuance are demanding, time consuming, and costly" (Chiquier, Hassler, and

Lea 2004). The U.S., on the other hand, provided the underpinnings for its mortgage security infrastructure with the creation of HOLC in 1934 and FNMA in 1938. Freddie Mac invented MBS pass-throughs, instruments that passed cash flows from borrowers to securities holders, in 1971. The mortgage securities market became increasingly sophisticated as it integrated the tools of modern finance, as further discussed below.

One of the mechanisms the government-sponsored enterprises (GSEs) used to create liquidity in the mortgage market was the standardization of mortgage documentation. This documentation allowed the GSEs to parsimoniously collect the data necessary to develop robust underwriting models and guaranteed that home mortgages within securities would be sufficiently homogeneous that they could trade in liquid markets.

These developments allowed 22 years of uninterrupted liquidity in the market for conventional conforming mortgages.[32]

State of Knowledge

So far as we know, no one applied option pricing theory to mortgages before the late 1970s, when Asay (1978) wrote an innovative and seminal dissertation. Dunn and McConnell (1981) and Foster and Van Order (1984) followed with influential papers of their own. Yet on reflection, mortgages obviously have lots of optionality embedded in them. Borrowers have an option to put houses back to lenders through default, and an option to call mortgages back from lenders through low-cost refinancing. Black-Scholes modeling techniques thus helped investors gain insights into the spreads they required in order to be compensated for underlying mortgage risk.

The mortgage market made for a particularly interesting application of option pricing theory because borrowers often do not exercise optimally. While the frequency of the exercise of both the call and put options increases as they get deeper and deeper into the money (Foster and Van Order, 1984 and 1985; Kau, Keenan, and Kim, 1993), households appear to neither default ruthlessly nor prepay optimally. With respect to default, many households seemed particularly

immune to market conditions. Foster and Van Order found that of households whose mortgage debt exceeded 110 percent of house value, only around 4 percent defaulted.

Archer and Ling (1993) and Green and Lacour-Little (1999) also found that households did not exercise prepayment optimally. In fact, in the middle 1990s, many borrowers had mortgages whose coupon rates were more than 200 basis points above market rates, and yet failed to refinance. Identifying such borrowers became an important part of mortgage pricing because slow, prepaying, premium mortgages were highly profitable. So as mortgages began to be funded increasingly in capital markets, and as computer power became cheaper, investors in mortgages developed sophisticated models of default and prepayment behavior.

Residential borrowers do not (or at least did not) behave in the same manner as corporate borrowers, and indeed, may not behave in a manner easily explained by any theory of utility maximization.[33] Thus, investors that could identify the characteristics of borrowers who did not behave "optimally" gained a considerable advantage over others.

Changing behavior and changing loan origination costs have, however, undermined the ability of econometric models to predict prepayment speeds. Borrowers have become much more aggressive in the exercise of the call option. Bloomberg data show that the Public Securities Administration Conditional Prepayment Rates (CPR) for a mortgage with a 100-basis-point spread over market has increased by three to four times between 1993 and 2006. In 2005, when mortgage interest rates were low, around 40 percent of existing mortgages were refinanced in a single year. The instability of models predicting prepayment may be a harbinger about how much we can glean about future defaults based on past default models.

The Succession to the Revolution: The Terror?

A variety of indicators imply that the housing finance revolution in the U.S. has improved efficiency and consumer welfare. Nevertheless, recent events suggest that, just as in 1789, a revolution has produced a terror.

An important precursor to the subprime crisis was the development of the private label MBS market for non-conforming prime mortgages. This market developed in parallel with the Fannie/Freddie security structure and allowed for capital market financing of mortgages whose balances were larger than that permitted for Fannie/Freddie purchase.[34] The private label market worked to support growth in securitization of "jumbo" mortgages, just as the Fannie/Freddie agency debt supported the growth of prime mortgages, although it was in a few ways critically different from the agency market.

Because private label securities have no government backing, implicit or otherwise, the coupon rates on loans backed by such securities are higher than they are in the conforming market. The Congressional Budget Office (2004) estimates that borrowers in the non-conforming market historically pay a premium of 25 basis points relative to borrowers in the conforming market. Green and Wachter (2005) note that non-conforming mortgages typically have higher down payments and a greater tendency to be ARMs than conforming mortgages, but that could be a result of borrower choice, rather than security structure.

The most meaningful way in which private label securities differ from agency-backed securities is with respect to structure. Fannie and Freddie securities are tranched for prepayment risk, but are generally not tranched for credit risk. Private label securities are, however, tranched for credit risk. As a result, early tranches are presumed to have virtually no credit risk (particularly in the prime market for jumbo loans), while later tranches take on more credit risk, and therefore, earn higher expected rates of return. Over the period of the late 1990s, when house prices were rising and the private label market was largely confined to prime mortgages, credit losses on even junior tranches remained low.

This all changed recently. The private label market grew dramatically, with issuances rising from $586 billion in 2003 to $1.2 trillion in 2005. A large share of the growth came from the subprime and Alt-A markets,[35] whose share of the private label market grew from 41 percent to 76 percent over this two-year period (England, 2006).

The creation of structured finance for mortgage credit risk abetted the rise of the subprime market. For a time, capital markets seemed to have an appetite for almost any kind of risk, so long as it received sufficiently large yields in exchange. But as we shall discuss below, investors in junior credit tranches often faced uncertainty, rather than risk. Many subprime loans had essentially no underwriting, and insufficient data were available to calibrate default risk for subprime mortgages.

At the heart of the subprime crisis are three basic issues: pricing vs. rationing, asymmetric information between lender and borrowers, and asymmetric information between originators and investors. While the subprime crisis is too recent to develop formal empirical tests of its causes, we can list a set of possible candidates.

Pricing vs. Rationing

One of the truly astonishing transformations of the mortgage market has been the increase in the access to mortgage credit. American Housing Survey data show that between 1997 and 2005, the number of households with a mortgage increased by 20 percent while the number of households increased by 9 percent. Nominal mortgage debt outstanding grew by 2.5 times over that time period,[36] while nominal GDP grew by 50 percent.

This market growth was in part a function of more efficient average cost pricing of credit or "rationing": Prime mortgages are now usually underwritten with logit models, and borrowers are either accepted or rejected based on these logits. Those accepted into the pool pay the same average-cost price, with the exception of those with loan-to-value ratios in excess of 80 percent who must pay mortgage insurance premiums. The companies developing these models—Fannie Mae, Freddie Mac, Wells Fargo, Citibank, etc.—hire econometric modelers and have millions of observations with which to work. Consequently, they estimate models with precise coefficient estimates and small residuals. These well-estimated models mitigate against adverse selection among the pool of borrowers who are deemed to be good credit risks. Indeed, econometric underwriting models have shown that two observables—loan-to-value ratio and credit history—have

enormous power in predicting default risk. Lenders have also used automation to assure the integrity of both of these measures. Automated valuation models (following the pioneering repeat sales techniques of Bailey, Muth, and Nourse, 1961, and Case and Shiller, 1989) help in monitoring appraisers while attempted tinkering with Fair Isaac Credit Scores leads to a reduction in those scores.

As models have become more precise, more borrowers have become eligible to receive prime mortgages. Certain potential borrowers, however, do not qualify for prime mortgages, usually because of poor credit history. And so, as these borrowers become pushed out of the prime market, lenders have used pricing to bring them into the subprime market. Subprime originations increased from 8 percent of new loans in 2003 to 22 percent in 2005 (England, 2006).[37] Chairman Greenspan praised this development, noting:

> "where once marginal applicants would have simply been denied credit, lenders are now able to quite efficiently judge the risk posed by individuals and price that risk appropriately…
>
> …Improved access to credit for consumers, and especially these more-recent developments, has had significant benefits. Unquestionably, innovation and deregulation have vastly expanded credit availability to virtually all income classes. Access to credit has enabled families to purchase homes, deal with emergencies, and obtain goods and services. Home ownership is at a record high, and the number of home mortgage loans to low- and moderate-income and minority families has risen rapidly over the past five years. Credit cards and installment loans are also available to the vast majority of households."[38]

Risk-based pricing became widespread in the subprime market in the late 1990s along with the development of private label securitization of non-conforming mortgages. But while the algorithms for rationing credit became sophisticated, the algorithms for pricing subprime mortgages (to the extent such things even exist) faced a serious identification problem. From 1997 to 2005, the period in which the subprime market grew dramatically, nominal house prices

in the United States rose rapidly and nearly ubiquitously. This meant that the incentive to default was extremely low—households had a strong incentive to sell their houses and preserve their equity rather than default.

At the same time, the subprime market developed new products whose features had never faced a market test. In particular, lenders introduced 2/28 and 3/27 ARMs with prepayment penalties. These mortgages would have introductory teaser rates (for two or three years) that would reset to London Interbank Offered Rate or one-year Treasuries with a large spread. Borrowers would qualify for the loan based on the initial teaser rate, and then would be locked into the higher rate after the teaser expired.[39]

Past research originated in the 1980s on teaser-rate ARMs showed that borrowers had a strong propensity to prepay when rates adjusted to a market rate of interest plus a large margin (see Green and Shilling, 1997). These ARMs did not have prepayment penalties, but research suggests that borrowers as a group understood the product they were getting themselves into: They would take advantage of the teaser and then exit the mortgage at the moment when it became profitable for the lender.

Default is a much more serious credit event than prepayment. Yet, it should not be too surprising that borrowers would react to a payment shock. Indeed, originating this kind of mortgage is almost asking for adverse selection: For example, the rational borrower who uses a 2/28 will take advantage of the ability to live in a house at a below-market rate of interest for two years, and will then compare the present value of the mortgage relative to the present value of the house at that point. Because the mortgage carries a premium interest rate (i.e., a rate whose foundation is a large spread over some benchmark), the chances are that the mortgage's value, from the borrower's perspective, will be greater than the value of the asset, and so there will be an incentive to default. Once good data are available, it will be useful to observe whether 2/28 borrowers—or borrowers of negative amortization and optional payment ARMs—default more ruthlessly than others. As it is, we know from Federal Reserve data that almost all of the subprime delinquency problems arise from ARMs.

But let us return to the point. The lending industry attempted to use pricing to expand the market to borrowers not served by the prime market. The mistake the industry apparently made was offering a loss-leader price in the early years of a loan in order to get borrowers into the market, in hopes that they would make up the difference in later years. Though mortgage lenders attempted to enforce the higher price in the future through use of prepayment penalties, prima facie evidence suggests that this did not work.

Asymmetric Information and Adverse Selection: Borrowers and Lenders

Asymmetric information also arises because it is likely that mortgage originators understand mortgage pricing and risk better than borrowers. To make this concrete, consider the nature of mortgage disclosures. The Truth in Lending Act requires that borrowers be informed of the annual percentage rate (APR) on their mortgage. The APR is the internal rate of return on a mortgage based on its coupon rate, discount points, amortization, and term. The APR calculation assumes that borrowers never refinance, and makes no provision for fees other than discount points. As such, it does not give an accurate picture of mortgage cost.

Both borrowers and investors in mortgages are interested in yield, which is the internal rate of return on a mortgage. But of course, the yield is not the same thing as the mortgage coupon rate (the basis on which the mortgage amortizes) or the APR (a rate that amortizes the cost of discount points over the amortization period of the mortgage). The yield is rather the true return/cost of a mortgage. Even in the context of an FRM, disclosing effective cost is not straightforward.

Yield comes from six components: the note or coupon rate, discount points (up-front cash a borrower pays to lower the coupon rate), fees, prepayment penalties, the life of the mortgage (i.e., how long the borrower actually pays the mortgage before refinancing or selling it off), and frequency of amortization.

To give a sense of how these components interact, consider three fairly simple mortgages. Mortgage one has a 6 percent fixed rate, no points, no fees, 30-year amortization and an expected life of three years. Mortgage two has a 4.5 percent fixed rate, two points, 2 percent fees, a 2 percent prepayment penalty if prepaid within five years, 30-year amortization, and an expected life of three years. Mortgage three is the same as mortgage two, except that it has an expected life of ten years. The regulatory APR for the three mortgages is 6.16 percent, 4.86 percent, and 4.86 percent, respectively.[40]

But these APR calculations do not reflect the true cost of the mortgages (nor, obviously, do the coupon rates). The true cost of the mortgage is a function of how the borrower behaves after the mortgage is originated. For example, the borrower of mortgage two decides to repay the mortgage after three years. This means that little time has passed to amortize points and fees, and that the borrower is subject to a prepayment penalty. As a consequence, while both the coupon and the APR on this mortgage are lower than the first mortgage, the actual cost to the borrower of the second mortgage, at 6.6 percent, is higher than the cost of the first mortgage, at 6.16 percent.

Now let us consider the third mortgage. The borrower pays off this mortgage in ten years; consequently, enough time passes to substantially amortize the upfront mortgage costs and to eliminate the prepayment penalty. As a consequence, the cost of this mortgage to the borrower (4.86 percent) is substantially lower than the cost of the first mortgage.

The point of this illustration is to show that it is difficult to characterize exactly what a mortgage price is, and that the price is driven in part by the behavior of the borrower after the loan is originated.

Price revelation is elusive for subprime borrowers (Wachter, 2003). This is exacerbated by the lack of a guarantee in pricing at the closing of all the terms, which adds complexity and reduces transparency.

This means that even under the best of circumstances, disclosing true costs and risks to even well-informed borrowers is difficult; to a borrower without financial literacy, it is nearly impossible.

Asymmetric Information and Adverse Selection: Originators and Investors

The subprime crisis has revealed a number of puzzling aspects about investor behavior with respect to (1) the relationship between investors in securities and loan originators, (2) the nature of diversification, and (3) investor understanding about housing market risk.

The behavior of investors with respect to subprime mortgages is puzzling, to say the least. Mortgage originators had powerful incentives to originate loans, regardless of quality: Every mortgage that was successfully originated and sold to an investor produced a fee for the originator. While companies originating the loan, such as New Century, could give representations and warranties to investors that loans met some minimum standard, they were not capitalized well enough to make good on any promises in the event of large-scale default. It is difficult to understand why this was not clear to investors ex ante.

The second puzzle is that investors and rating agencies appeared to believe that diversification per se could cause systematic risk to disappear. It is of course the case that as a security becomes more diversified, unsystematic risk will become smaller, but mortgages with 10 percent default probabilities will continue to carry such probabilities, regardless of the securities in which they are packaged (Coval et al., 2007).

The third puzzle is investors' seeming lack of understanding about housing market risk. Commentary in the popular press could be schizophrenic about potential risks in the housing market. On the one hand, stories about a potential housing bubble in the United States date back to at least 2002.[41] On the other hand, Fannie Mae and Freddie Mac came under severe criticism for having high current returns on equity in their guarantee business. The Fannie and Freddie guarantee business collects fees from holders of MBS in exchange for guaranteeing timely payment of principal and interest. Implicit in the criticism

of Fannie and Freddie was a charge that the fees they collected were "too high" in light of how rare default and foreclosure were.

Indeed, Fannie and Freddie had credit losses of a basis point or less in every year between 1999 and 2004.[42] The reason for this is that house prices rose smartly and ubiquitously over this period of time. In past periods, however, when house prices fell in various regions of the country—such as in the upper Midwest in the 1970s, in the Old Patch in the 1980s, and on the coasts in the 1990s—default costs were considerably higher. In fact, some FHA cohorts from the 1980s had a default rate of more than 19 percent (Capone, 2000). It is not clear what history of house prices investors were relying on when they decided the yields they received were acceptable in exchange for the risks they were taking on.

The Wall Street Journal reported (August 15, 2007) that rating agencies chose not to change the ratings of MBS which were more liberally underwritten until they actually began to fail. Moreover, when investors mis-price risk, the result is the artificial inflation of housing prices. The pricing boom of 2006 was likely in part due to this unsustainable credit boom (Pavlov and Wachter, 2007a).

A theme across all these puzzles is the lack of transparency, which in turn led agents to make uninformed decisions.

Conclusion

We take away three lessons from our observations on the housing finance revolution. First, mortgage markets that are linked to capital markets are better for consumers and investors than are mortgage systems where the price and allocation of mortgages is determined by government.

Second, there are countries that do not have access to long-term capital and therefore do not have fully functioning mortgage markets. The development of such markets would allow borrower access to mortgages with long terms. Nonetheless, among the alternate vehicles of depositories, covered bonds, and securitization, it is not at all clear whether there is a "best" channel for attaching mortgages to capital markets.

To some extent, the policy issue with respect to channels is determining where risk is best managed. Depositories manage interest rate risk by having such assets as adjustable-rate mortgages. But if households only have ARMs available to them, they must balance their long-duration asset—their house—against a short-duration liability. This can expose homeowners to mortgage payment shocks and thereby induce macroeconomic instability.

On the other hand, the U.S. MBS structure gives borrowers access to fixed rates over long terms as well as the option of prepayment. This means holders of MBS are exposed to interest rate risk regardless of how rates move: They take capital losses when rates rise and they must reinvest in securities with lower interest rates at par when rates fall. While investors in agency MBS take on substantial interest rate risk, they do not take on much credit risk, which is instead born by the GSE intermediaries—Fannie Mae and Freddie Mac. The relatively low spreads on Fannie Mae and Freddie Mac securities imply that investors either have a great deal of confidence in their ability to manage credit risk, or confidence in the amorphous relationship between the GSEs and the federal government. A key issue is the relationship between the government and the GSEs which has allowed Fannie Mae and Freddie Mac to develop and maintain uniform underwriting instruments, which in turn has produced homogenous mortgages that can easily be bundled into liquid securities.

Finally, the German covered bond system divides risk between investors and borrowers differently. Mortgages in Germany have long terms, but carry less market rate risk relative to American MBS for investors because borrowers are effectively prevented from prepaying their mortgages. German mortgages which are funded with covered bonds are also heavily over-collateralized and, consequently, carry little credit risk. Borrowers, on the other hand, are faced with large prepayment penalties should they wish to refinance or even sell their house, but have the benefit of knowing that their payments are fixed for a long period.

The current U.S. crisis is centered in the private label securitization market and is driven by the uncertainty of credit outcomes in subprime and jumbo MBS. As a result of the crisis, bank originators of

these loans may need to provide additional information on balance sheet funding. If banks fund these mortgages on balance sheets, they will face additional interest rate risk (unless either only short-term maturities are offered or prepayment is sharply curtailed), as well as credit risk.

Third, underwriting is necessary. No amount of sophisticated structured finance can overcome the lack of sound underwriting. Indeed the complexity of structural finance vehicles limits their trading and the revelation of the market price of risk. Moreover the absence of underwriting means investors face uncertainty, rather than risk, making informed investor choice impossible.

Endnotes

[1]MBS were also introduced in the latter half of the decade (a development first introduced in the United States). Securitization of mortgage pools has been accompanied by increased borrower access to longer-term mortgages. To date however, variable-rate mortgages predominate.

[2]For further discussion, please see Flanagan and Reardon (2002, p3).

[3]For further discussion, please see Dübel (1996).

[4]Germany primarily uses covered bonds to finance mortgages. The German system is funded both by commercial banks via deposits and by covered mortgage bonds directly funded via capital markets, with heavy restrictions on prepayment to limit the banks' interest rate risk. The bonds are structured in such a way that they largely keep risk with borrowers: The mortgages funded by the bonds are tightly underwritten and generally have substantial prepayment penalties.

[5]See Kim (2000) for an excellent discussion of deregulation of housing and infrastructure finance in Asia.

[6]The countries covered are Spain (ES), Ireland (IE), the United Kingdom (UK), the Netherlands (NL), Belgium (BE), the United States (US), Japan (JP), France (FR), Canada (CA), Italy (IT), Australia (AU), Sweden (SE), and Germany (DE). The data on Korea is based on housing price index compiled by Kookmin Bank. Data are not available for all countries for all years. The source interest rate data is Economy.com and for price indexes is BIS (see Kim and Wachter, 2004).

[7]Interest rate declines have continued, across many economies, even with rising gross domestic product (GDP) growth rates in recent years. While declines in interest rates are to be expected with declining GDP growth rates of 2001, it is notable that the decline in rates continued even as world GDP growth resumed at high levels.

[8]The Granger tests are with one lag only, because we have small numbers of degrees of freedom.

[9]For further discussion of the impact of the declining interest rates on housing prices, see Kim and Wachter.

[10]See Green, Malpezzi, and Mayo (2005) and Glaeser, Gyourko, and Saks (2005).

[11]Housing is less affordable throughout the industrialized world than it is in most of the U.S. And while mortgage rate declines (and increased access to mortgage financing) have increased affordability in many markets, elsewhere, prices have increased more than interest rates have declined (in part due to other exogenous demand shifters). This shift is partly due to the improved access to mortgages, which increases demand from segments of the population who previously did not have access to financing. Ireland stands as a prime example of this phenomenon (Second

Annual Demographia International Housing Affordability Survey, 2006).

[12]A report in the *Daily Express* this week revealed that FRMs will cost the average borrower at least £165 a month extra. Gordon Brown cited housing volatility as a key barrier to euro entry in June in his five tests speech and announced a push towards FRMs as an attempt to combat this volatility. The research in the *Daily Express* reveals however that FRMs are unlikely to be popular. Simon Tyler of independent adviser Chase de Vere Mortgage Management said "they (fixed-rate mortgages) are never the cheapest deals on the market, so they will probably never be the most popular" (*Daily Express*, 18 November).

[13]For further discussion, please see Green, Mariano, Pavlov, and Wachter (2007).

[14]A specific set of policy prescriptions considered to constitute a "standard" reform package promoted for *crisis-wracked* countries by *Washington*-based institutions. It is broadly associated with expanding the role of market forces and constraining the role of the state.

[15]In addition, in Korea a unique informal housing finance system, Chan Sei, developed. Households put up money for apartments for a fixed term which allows the owners of the apartment building to finance the dwellings. Green interviewed officers of both IDLC and BRACK while on a World Bank mission in May 2004.

[16]See Renaud (1988) and Struyk and Turner (1986) for excellent descriptions of the Korean housing finance system.

[17]See Kim (2001).

[18]We don't want to make too much of this difference, as there are other profound differences between the two countries' housing markets. But the fact that the British system is funded by banks has not seemed to retard the access of homebuyers to reasonably priced mortgage capital.

[19]The foundation of this material is discussion at the EASE NBER Conference, June 2007, as well as Battellino (2004) and Bailey, Davies, and Smith (2004).

[20]ABS data are available from Reserve Bank of Australia *Bulletin* Table B19 Securitization Vehicles (http://www.rba.gov.au/Statistics/Bulletin/index.html).

[21]The negative interest margins in the late 1980s are partly explained by: housing interest rates being capped until 1986 and the government's announcement in 1988 that statutory reserve requirements would be phased out, with the banks agreeing to the quid pro quo that the savings be translated into lower lending rates (Gizycki and Lowe, 2000).

[22]Managed Funds data are available from Reserve Bank of Australia *Bulletin* Table B18 Managed Funds (http://www.rba.gov.au/Statistics/Bulletin/index.html).

[23]At the same time, long-term savings vehicles, such as pension funds, were better

suited for investment in long-term assets, such as securitized long-term mortgages.

[24]Commercial banking industry was not nearly as affected since, unlike S&Ls which by statute invested in mortgages, banks were able to invest in a variety of assets. For a discussion of the S&L crisis and its aftermath, see Bentson and Kaufman (1997).

[25]The legislation that allowed adjustable-rate mortgages and eliminated interest rate ceilings for S&L banks was the St. Germain Depository Institutions Act of 1982. Specifically, Title VIII—the "Alternative Mortgage Transaction Parity Act of 1982" Sec.803 (A) "in which the interest rate or finance charge may be adjusted or renegotiated."

[26]This statement is based on a conversation with Eugene Skaggs, who was Executive Vice President for equity investment for the Northwest Mutual Life Insurance Company.

[27]Particularly since they were insured by the Federal Housing Administration.

[28]Deposits initially insured up to $2,500; they are now insured up to $100,000.

[29]Thanks to both FSLIC and the Federal Home Loan Bank system.

[30]As we shall discuss later, the regulatory climate, as interpreted by the Federal Home Loan Bank Board, was at least partially responsible for this ubiquity in fixed-rate loans.

[31]A separate motivation was to move debt off of the government balance sheet in a time of rising government expenditure.

[32]Conventional mortgages are those not backed by the full faith and credit of the U.S. government. Conforming mortgages are those eligible for purchase by Fannie Mae and Freddie Mac.

[33]Kau, Keenan, and Kim (1994) dispute this, arguing that both rational and "irrational" behavior could be observationally equivalent to each other.

[34]Every year, the OFHEO uses a formula based on house prices to determine the maximum-sized loan that Fannie Mae and Freddie Mac may purchase. This is known as the "conforming loan limit."

[35]Alt-A loans are those whose credit characteristics fall in between prime and subprime mortgages.

[36]*Federal Reserve Bulletin*, Table 1.54.

[37]Additional growth including more aggressive negatively amortizing mortgages occurred in 2006 (Pavlov and Wachter, 2007a).

[38]See remarks by Chairman Alan Greenspan at the Federal Reserve System's Fourth Annual Community Affairs Research Conference, Washington, D.C., April 8, 2005. The ellipsis is used for brevity: The remarks within the ellipsis emphasize that consumer worries about the use of technology for underwriting are largely misplaced. Available at http://www.federalreserve.gov/boarddocs/speeches/2005/20050408/default.htm.

[39]Pavlov and Wachter (2007a) show how prices increased specifically in markets where subprime's market share grew, so that a portion of the price increases were credit induced rather than based on fundamentals.

[40]APR assumes that discount points are amortized over the term of the loan. Fees and prepayment penalties are not included in APR.

[41]See, for example, Erin Schulte (2002).

[42]See OFHEO (2006).

References

Archer, Wayne R., and David C. Ling. 1993. "Pricing Mortgage-Backed Securities: Integrating Optimal Call and Empirical Models of Prepayment," *Real Estate Economics*. 21(4):373-404.

Asay, Michael R. 1978. "Rational Mortgage Pricing," Ph.D. diss. University of Southern California, Los Angeles. (Also in Research Paper in Banking and Financial Economics, No. 30, Board of Governors of the Federal Reserve System, 1979.)

Battellino, Ric. 2004. *Some Comments on Securitisation*, Speech by Assistant Governor of Financial Markets Group. (http://www.rba.gov.au/Speeches/2004/index.html)

Bailey, Kirk, Michael Davies, and Liz Dixon Smith. 2004. "Asset Securitisation in Australia," *Reserve Bank of Australia Financial Stability Review*, September. (http://www.rba.gov.au/PublicationsAndResearch/FinancialStabilityReview/Sep2004/Html/financial_stability_review_0904.html)

Bentson George J., and and George G. Kaufman. 1997, FDICIA After Five Years *The Journal of Economic Perspectives*, Vol. 11, No. 3 (Summer, 1997), pp. 139-158.

Bernanke, Ben, and Mark Gertler. 1989. "Agency Cost, Net Worth and Business Fluctuation," *American Economic Review*, 79(1), 14:31.

Bailey, Martin, Richard Muth, and Hugh Nourse. 1963. "A Regression Method for Real Estate Price Index Construction," *Journal of the American Statistical Association*, 58: 933-42.

Bureau of Labor Statistics. 2007. *Consumer Price Index, All Urban Consumers, Series CUUR0000SA0* (http://data.bls.gov/PDQ/servlet/SurveyOutputServlet.) Accessed August 20, 2007.

Capone, Charles E. 2000. "Credit Risk, Capital, and Federal Housing Administration Mortgage Insurance," *Journal of Housing Research* 11(2): 373-401.

Case, Karl E., and Robert J. Shiller. 1989. "The Efficiency of the Market for Single Family Homes," *American Economic Review*, 79(1): 125-37.

Chiquier, Loic, Olivier Hassler, and Michael Lea. 2004. *Mortgage securities in emerging markets*, World Bank Policy Research Working Paper No. 3370. Aug.

Cho, Man. 2004. "Evolution of the U.S. Housing Finance System: A Historical Survey and Lessons for Emerging Mortgage Markets," Working paper.

Congressional Budget Office. 2004. *Updated Estimates of the Subsidies to the Housing GSEs, April 8*. (http://www.cbo.gov/ftpdoc.cfm?index=5368&type=0)

Coval, Joshua, Jakub W. Jurek, and Erik Stafford. 2007. "Economic Catastrophe Bonds," Harvard Business School. Working paper.

Cox,Wendell, and Hugh Pavletich. 2006. "2nd Annual Demographia International Housing Affordability Survey." Pavletich Properties Limited.

Diamond, Douglas B., and Michael Lea. 1992. "The Decline of Special Circuts in Developed Country Housing Finance," *Housing Policy Debate* 3(3): 747-775.

Dübel, Hans-Joachim. 2004. European Mortgage Markets: Efficiency and Completeness, *Presented to American Enterprise Institute*, March.

Dübel, Hans-Joachim. 1996. "Privatization and Restitution of Real Estate—Principles and Process in the New Länder of Unified Germany." *In The Land Reform Process in the Post-Communist Countries*. Seoul: Korean Research Institute for Human Settlements.

Dunn, Kenneth B., and John McConnell. 1981. "Valuation of GNMA Mortgage-Backed Securities," *Journal of Finance*, 36(3): 599-616.

England, Robert. 2006. "The Rise of Private Label, Mortgage Banking," October. (http://www.robertstoweengland.com/documents/MBM.10-06EnglandPrivate-Label.pdf.) Accessed August 20, 2007.

European Mortgage Federation. 2003. *Study on Financial Integration of European Mortgage Markets* (http://www.hypo.org/Content/Default.asp?PageID=106.) September.

Fisher, Lynn, and Robert Van Order. 2006. "Economics of the Mortgage and Mortgage Institutions: Differences between Civil Law and Common Law Approaches," University of Michigan Working Paper No. 1081. Dec.

Flanagan, Christopher, and Edward Reardon. 2002. *UK Mortgages and the RMBS Market*. JP Morgan Global Structured Finance Research.

Foster, Chester, and Robert Van Order. 1984. "An Option-Based Model of Mortgage Default," *Housing Finance Review*, 3(4):351-77.

Foster, Chester, and Robert Van Order. 1985. "FHA Terminations: A Prelude to Rational Mortgage Pricing," *AREUEA Journal*, 13(3):273-91.

Freddie Mac. 2005. *19th Annual Adjustable Rate Mortgage Survey* (2005), (http://www.freddiemac.com/news/archives/rates/2002/arms2002.html)

Gizycki, Marianne, and Philip Lowe. 2000."The Australian Financial System in the 1990s," *Australian Economy in the 1990s*, Reserve Bank of Australia 2000 Conference. (http://www.rba.gov.au/PublicationsAndResearch/Conferences/2000/index.html)

Glaeser, Edward, Joseph Gyourko, and Raven Saks. 2005. "Why Have Housing Prices Gone Up?" *American Economic Review*, 95:2, 329-333.

Green, Richard K., and Michael Lacour-Little. 1999. "Some Truths about Ostriches: Who Never Prepays Their Mortgages and Why They Don't," *Journal of Housing Economics*, 8:3 233-248.

Green, Richard K., Roberto Mariano, Andrey Pavlov, and Susan Wachter. 2007. *Mortgage Securitization in Asia: Gains and Barriers*. Prepared for the NBER 18th Annual East Asian Seminar on Economics. June.

Green, Richard K., Stephen Malpezzi, and Stephen Mayo. 2005. "Metropolitan Specific Estimates of the Price Elasticity of Housing Supply and their Sources," *American Economic Review*, 95:2, 334-339.

Green, Richard K., and James D. Shilling. 1997. "The Impact of Initial-Year Discounts on ARM Prepayments," *Real Estate Economics*, 25, 373-385.

Green, Richard K., and Susan Wachter. 2005. "The American Mortgage in Historical and International Context," *Journal of Economic Perspectives*, Fall.

International Union for Housing Finance. 2005. IUHF Fact Sheets, www.housingfinance.org, March.

Kau, James B., Donald C. Keenan, and Taewon Kim. 1994. "Default Probabilities for Mortgages," *Journal of Urban Economics*, 35:278-296.

Kim Kyung-Hwan. 2000. "The Political Economy of Korean Government Policies on Real Estate," *Urban Studies* 37(7):1167-1179.

Kim, Kyung-Hwan, 2001, "Korea: Could a Real Estate Price Bubble Have Caused the Economic Crisis?," in Mera and Renaud, ed. *Asia's Financial Crisis and the Role of Real Estate*, M.E. Sharpe: Armonk, NY.

Kim, Kyung-Hwan, and Susan Wachter. 2005. International Comparisons of Mortgage Markets, Lecture at Singapore Management University.

Kim, Kyung-Hwan, and Susan Wachter. 2005. "Housing and the Government Policy in the Global Economy: The Cases of Korea and the U.S.," *Residential Welfare and Housing Policies: The Experience and Future of Korea*, Korea, Development Institute Conference Proceedings, December.

Malpezzi, Stephen, and Susan Wachter. 2005. "The Role of Speculation in Real Estate Cycles," *Journal of Real Estate Literature*.

Mercer, Oliver, and Wyman. 2003. "*Study on the Financial Integration of European Mortgage Markets*," Brussels: European Mortgage Federation (http://www.hypo.org/)

Miles, David. 2003. "*The UK Mortgage Market: Taking a Longer-Term View*," Interim Report to HM Treasury, December. (www.hm-treasury.gov.uk/miles)

Mischel, Lawrence, Jared Bernstein, and Heather Boushey, The State of Working America 2002/2003, ILT Press: Ithaca.

Office of Federal Housing Enterprise Oversight. 2006. "Mortgage Markets and the Enterprises, 2006" (http://www.ofheo.gov/media/pdf/MortgageMarkets2006.pdf)

Organisation for Economic Co-operation and Development. "2005. *Consumer Price Indices for OECD Countries* (www.oecd.org) March.

Pavlov, Andre, and Susan Wachter, 2007, Underpriced Lending and Real Estate Markets, University of Pennsylvania Working Paper.

Renaud, Bertrand, 1988, Compounding Financial with Rigid Urban Regulations: Lessons of the Korea Housing Market. World Bank Discussion Paper.

Schulte, Erin, Housing Strength Raises Another Bubble Concern, *TheWall Street Journal*, March 29, 2002.

Struyk, Raymond, and Margery Austin Turner, 1986. *Finance and Housing Quality in Two Developing Countries*, Urban Institute Press: Washington.

Wachter, Susan, 1990. "The Limits of the Housing Finance System." *Journal of Housing Research* 1(1):163-174.

Wachter, Susan, 2003. "Price Revelation and Efficient Mortgage Markets," *Texas Law Review*, Vol. 88(2):413-419.