Three Years After Takeover, How Have Fannie Mae and Freddie Mac Benefited the U.S. Housing Market?

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Abstract

The purpose of this paper has been to provide evidence on the economic benefits of the federal government's takeover of Fannie Mae and Freddie Mac. In theory, there are reasons to think that the government's takeover of Fannie Mae and Freddie Mac has lowered mortgage rates in the U.S. and made housing relatively more affordable compared with affordability elsewhere. However, previous studies have yet to examine whether the takeover of Fannie Mae and Freddie has lowered homeowner borrowing costs in the U.S., or if these changes have had an effect on housing affordability. One reason for the dearth of empirical investigations on this issue is the fact that residential mortgage terms vary greatly from country to country. These differences make cross-country comparisons difficult to perform. The current paper develops a methodology that uses synthetic mortgage yield data in different countries to test whether homeowner borrowing costs are lower in the U.S. compared with costs elsewhere. The test is then applied bilaterally vis-à-vis 13 foreign countries (United Kingdom, Canada, Germany, Denmark, Switzerland, Spain, Belgium, France, Australia, Italy, Japan, Sweden, and Finland, with the U.S. as the reference country) for January 1998 to December 2010. I generally find that the average mortgage rate in the U.S. today would be about 1.59% higher if a public Fannie Mae and Freddie Mac with explicit government guarantees were taken out of the equation. I also find that, in the absence of a private Fannie Mae and Freddie Mac, mortgage rates today would be only about 0.84% higher in the U.S. These results allow me to carry out a simple counterfactual exercise. First, I construct an in-sample backcast of the mortgage rate in the U.S. under two counterfactual situations: the absence of public Fannie Mae and Freddie Mac, and the absence of private Fannie Mae and Freddie Mac. Second, I construct a counterfactual housing affordability index that would arise in the absence of public and private Fannie Mae and Freddie Mac. Assuming no change in house prices or housing demand, the simulations suggest that a public Fannie Mae and Freddie Mac have probably raised housing affordability in the U.S. by about 15% in the current environment. If instead housing prices are treated as endogenized, the analysis suggests that the rise in mortgage rates and fall in house prices net out almost to the same affordability. However, in the latter situation charge-offs and single-family residential loan delinquencies would have been much higher since house prices would have been lower.

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1. Introduction

It is the purpose here to provide evidence on the economic benefits of the federal government's takeover of Fannie Mae and Freddie Mac. There is a big debate at the moment about whether the federal government's takeover of Fannie Mae and Freddie Mac was really worthwhile for U.S. homeowners. To keep U.S. mortgage markets operating efficiently, the takeover of Fannie Mae and Freddie Mac at the time was seen as a necessary move.[1] Still, in February of this year (2011) the Obama Administration delivered a report to Congress recommending that Fannie Mae and Freddie Mac should be wound down, and that the federal government should get out of the business of operating a secondary market for residential mortgages altogether. But the fact remains the Obama administration is none too eager to move forward with the closing down of Fannie Mae and Freddie Mac while the nation's housing market is still in a fragile state.

In such a policy environment, it is important to understand what the federal government's takeover of Fannie Mae and Freddie Mac has meant for the nation's housing market and how the housing market might fare without the two mortgage behemoths in the mix. A key point of contention is whether Fannie Mae and Freddie Mac, independent of their implicit (now explicit) government guarantee, have, in fact, lowered mortgage rates in the U.S. and, as a

[1] Various explanations have been given for the insolvency of Fannie Mae and Freddie Mac and the government's subsequent decision to place Fannie Mae and Freddie Mac into conservatorship. One view, advanced by Morgenson and Rosner (2011), one of several books on the financial crisis, is the 2007 recession was caused by the financial collapse, which was caused by the insolvency of Fannie Mae and Freddie Mac, which was caused by flawed internal compensation and control, and Congressional meddling (government deciding who should be approved for loans). The second view is generally taken to be the view that the financial crisis was caused by the issuance and securitization of subprime mortgages in the private-label market, and as these mortgages began to default, the complex securities based on these loans burst the housing bubble and caused the collapse of financial institutions like Bear Stearns, Lehman, AIG, and Fannie Mae and Freddie Mac. One variant of this view is the argument that the financial crisis was caused in part by the underestimation of the risk inherent in these private-label securities by the credit rating agencies, either because of a lack of competition, poor account the risk in the balance sheets of financial institutions, or an inherent difficulty in assessing risk due to the complexity of these securities, or all three. Hancock and Passmore (2010) argue that Fannie Mae and Freddie Mac were taken over because they posed a systemic risk to the U.S. financial system, and that this risk mainly arose because of the debt they issued to fund their portfolio purchases.

result, made housing more affordable. The received wisdom is that securitization is cheaper than bank intermediation, and so homeowner borrowing costs should be, holding all else constant, far lower in the United States than in countries where mortgage securitization is much less prevalent (see, for example, Van Order (2000 and 2001)).[2] Two counter arguments have been raised. First, some have argued that depository-based systems can, with the right laws and regulations, do much the same thing that secondary markets do. The genesis of this argument is Modigliani and Miller's (1958) capital structure argument that capital structure is irrelevant in a world with perfect information and no transaction costs, and that a bank should neither be able to create or destroy value by issuing a mortgage-backed security or unsecured debt. Another argument in counterpoint is that securitization need not be value enhancing for borrowers. Instead, having a duopoly position in the market, Fannie Mae and Freddie Mac may be able to set prices that extract above-normal returns (see Passmore (2003), and Passmore and Sparks (1996)). This argument may or may not be valid, primarily because intense competition among primary mortgage lenders could easily result in the cost savings being passed on to borrowers (see Blinder, Flannery, and Kamihachi (2004) for an argument to this effect). Still further, Laeven, Igan, and Dell'Ariccia (2008), among others, argue that securitized markets are prone to periods of extremely lax lending practices, causing mortgage rates to be far-from-equilibrium.

It is not an easy task to test whether Fannie Mae and Freddie Mac have lowered mortgage rates and made housing more affordable in the U.S. One basis for judgment of the former is to compare homeowner borrowing costs across countries. However, because residential mortgage terms vary greatly from country to country, homeowner borrowing costs can vary

[2] Further, Green and Watcher (2008) argue that risks are likely to be better shared in securitized markets, and that homeowners face less interest-rate volatility in their portfolios because they are likely to choose fixed-rate mortgage than variable- or reviewable-rate mortgages.

from country to country, obfuscating any such statistical test. The general procedure that I use to deal with this problem is as follows: (i) I ascertain the actual cost of residential mortgage borrowing in each country, (ii) I convert this cost into a long-term (noncallable) fixed rate by assuming that the foreign homeowner enters into a 30-year interest rate swap agreement, (iii) I use a 10-year call swaption to replicate the refinancing (or prepayment) option that is built into 30-year fixed-rate mortgages in the U.S. (the call swaption enables the homeowner in this case to effect interest savings should market interest rates fall over this time period), (iv) I add an adjustment factor to compensate for right to prepay the loan at any time before the loan is due rather than at a single point in time, and then (v) I compute a mortgage yield spread in excess of a 10-year government rate.

On these data, I perform two sets of analyses. The first set tests whether significant statistical differences exist between homeowner borrowing costs in the U.S. compared with costs elsewhere during the housing finance bubble period 2003-2006 and earlier and the second set tests whether the magnitude of these differences varies significantly after September 2008. I estimate an ARCH model on these data in an attempt to estimate jointly the conditional mean and conditional variance and multivariate conditional covariance of the mortgage yield spreads. The tests are confined to bilateral tests on pairs of countries, with the U.S. as the reference country.

The selected countries for this study are: the United States, the United Kingdom, Canada, Germany, Denmark, Switzerland, Spain, Belgium, France, Australia, Italy, Japan, Sweden, and Finland. The 13 foreign countries were selected because (i) they provide a juxtaposition to the United States housing finance system, (ii) they have the available mortgage coupon rates and interest rate swap data needed to compute a synthetic 30-year mortgage yield, and

(iii) they are advanced industrial economies of the world's economic core.[3]

There is precedent for testing whether mortgage yield spreads are equated across countries. In fact, the issues addressed in this paper are much the same as those taken up by Mishkin (1984), Cumby and Obstfeld (1982), Cumby and Mishkin (1986), and others, and yet different. In testing whether interest rates are equal across countries, Mishkin (1984), Cumby and Obstfeld (1982), and Cumby and Mishkin (1986) focus on the euro deposit market. In contrast, I focus on the residential mortgage market. Complicating my analysis is the fact that there could be systematic differences in mortgage interest rates across countries depending on whether banks or capital markets are the main source of financing for residential mortgages, which is why I run a series of bilateral tests instead of aggregating all countries together into a single, pooled cross-section/time-series test.

The above results are used to construct an in-sample backcast of the mortgage rate in the U.S. under two counterfactual situations: the absence of Fannie Mae and Freddie Mac when they were operating as private, for-profit corporations, with an implied or implicit guarantee, and the absence of Fannie Mae and Freddie Mac after the Federal Housing Finance Agency placed Fannie Mae and Freddie Mac in government conservatorship. The methodology to calculate these in-sample backcasts is as follows. First, to assess how much higher homeowner borrowing costs would have been in the U.S. if a private Fannie Mae and Freddie Mac were taken out of the equation, I look to the mean difference between the mortgage rate in the U.S.

[3]This allows me to reduce some of variation in mortgage yield spreads due to the level of government involvement in funding housing. There is a whole spectrum of policy instruments through which government reduce the price of housing paid by homeowners. Many countries offer demand side subsidies to homeowners in the form of low interest loans. These countries tend to be countries with developing economies. Countries that are advanced industrial economies are typically too big to rely on demand side subsidies in a major way (see Diamond and Lea (1992)). The hope, then, is that by focusing on advanced industrial economies this will reduce some of the confounding effects in the data that might bias the results toward finding higher, rather than lower, long-term fixed-rate mortgage yields in the United States. Further, I would argue that a comparison of homeowner borrowing costs across the United States, the United Kingdom, Canada, Germany, Denmark, Switzerland, Spain, Belgium, France, Australia, Italy, and Finland (like simple comparisons of wages or consumption functions) is interesting and may be desired for its own sake, since it affords us an opportunity to see how well we compare relative to our peers.

and the synthetic mortgage rate elsewhere over the subsample period January 1999-December 2007. Second, to assess how much higher homeowner borrowing costs would have been in the U.S. if a publicly-owned Fannie Mae and Freddie Mac were taken out of the equation, I look to the difference between the mortgage rate in the U.S. and the synthetic mortgage rate elsewhere over the subsample period October 2008-December 2010. I then compute two separate in-sample counterfactual backcasts of the mortgage rate by adding these premiums to the actual U.S. mortgage rate for January 1999-December 2010.

Next, I calculate a counterfactual housing affordability index that would have resulted if the mortgage rate in the U.S. were higher. This housing affordability index is calculated as the ratio of the median income in the U.S. to the income needed to buy the median-priced home in the U.S. with an 80% loan-to-value ratio and a mortgage-payment-to-income ratio of 0.25 (based on the counterfactual mortgage rate). These counterfactual housing affordability indexes are then compared with the actual affordability index to measure how housing affordability would have changed if Fannie Mae and Freddie Mac were taken out of the equation.

I have several key findings. First, the average mortgage rate in the U.S. today would be about 1.6% higher (based on my comparison with homeowner borrowing costs elsewhere) if a public Fannie Mae and Freddie Mac with explicit government guarantees were taken out of the equation. Second, I estimate that, in the absence of a private Fannie Mae and Freddie Mac, mortgage rates today would be only about 0.9% higher in the U.S. Third, the counterfactual simulations suggest that a public Fannie Mae and Freddie Mac with government guarantees have probably raised housing affordability in the U.S. by about 15% in the current environment. In other words, the takeover of Fannie Mae and Freddie Mac has brought substantial

benefits to U.S. home buyers. Fourth, my results indicate a private Fannie Mae and Freddie Mac have, on the whole, raised housing affordable in the U.S. by about 10%. The implications of these findings are many. With higher levels of housing affordability, households would be more likely to decide to own rather rent (and to own larger houses), home sales would be higher (more people are able to buy houses), housing inventories (i.e., the number of homes for sale) would be lower, and with this, the housing down-cycle is less severe.

The remainder of the paper is organized as follows. Section 2 presents the theoretical background on mortgage pricing. Section 3 attempts to describe the actual housing finance systems that have emerged in the United States, the United Kingdom, Canada, Germany, Denmark, Switzerland, Spain, Belgium, France, Australia, Italy, and Finland. Sections 4 and 5 explain the methodology used to construct a comparable synthetic 30-year fixed rate in those countries outside the U.S. Section 6 provides summary statistics on the constructed yield spreads. Sections 7 and 8 present the ARCH regression model and examine how homeowner borrowing costs vary across countries. Section 9 discusses the counterfactual analysis, followed by conclusions in Section 10.

2. Theoretical Background on Mortgage Pricing

The first issue to discuss is whether securitization lowers the cost of mortgage credit if done without a government guarantee. Certainly, most would concede that securitization lowers the cost of mortgage credit if one has the explicit ability to borrow at artificially low rates (as Fannie Mae and Freddie Mac can now do), and if profit maximization is not one's sole purpose. However, in the absence of these conditions, in some cases securitization might or might not lower the cost of mortgage credit. There are two views that one can take toward

the effect of securitization in this case.

2.1 Market Segmentation View

This section describes how securitization may lower homeowner borrowing costs in the U.S. Here I assume that the demand for long-term fixed-rate mortgages from banks and the secondary mortgage market consists of two parts: a horizontal part with equation $r = r_0$ for the secondary market, and a horizontal part with equation $r = r_1$ for banks, where $r_0 < r_1$. This general view is illustrated in Figure 1. The mortgage market in this case shows segmentation in the sense that banks (with their short-term deposits) prefer variable- or reviewable-rate mortgages but if the premium in the long-term fixed-rate mortgage market is adequate (in this case the vertical distance between points B and C in the figure), banks will fund long-term fixed-rate mortgages.

With the supply of mortgage credit given by EF, the market demand is given by AB, the equilibrium is at point Z, and the interest rate is r_0. Here the secondary market (with its big cost differential) completely dominates the mortgage market, and the secondary market will continue to dominate this market until it bumps up against regulatory constraints (at point B). Then banks would take over, essentially funding all loans thereafter at an interest rate r_1.

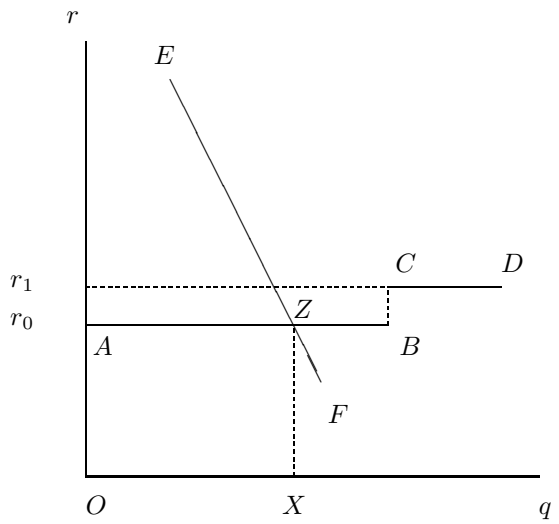


Figure 1: Market Segmentation View of the Mortgage Market. Vertical axis: Interest rate. Horizontal axis: Loan volume. EF = supply curve for mortgages. AB = demand curve of the secondary market. CD = demand curve of banks. $ABCD$ = market demand curve. r_0 = interest rate at which the secondary market will buy mortgages. r_1 = interest at which banks will hold mortgages. The representation of AB and CD as perfectly elastic is a limiting case, namely, the situation where banks and the secondary market are infinitely responsive to price changes: at any lower r they exit the market and are unwilling to originate a single loan; at any price higher r, they flood the market and are willing to originate an infinite number of loans (subject to regulatory constraints).

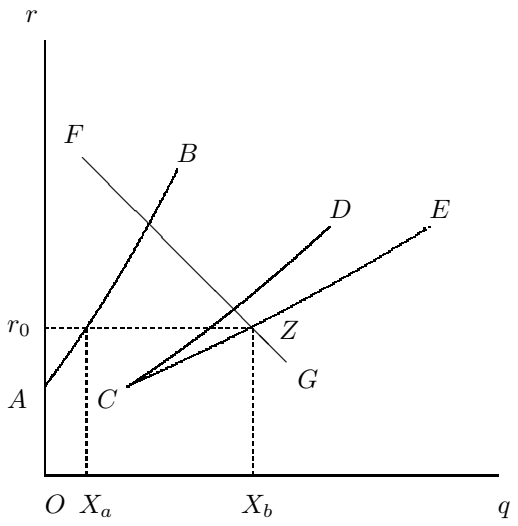
This type of model is consistent with Van Order (2000), who argues that secondary markets are inherently a more (socially) efficient means of funding long-term fixed-rate mortgages than depository institutions, whether because of better risk sharing, whether because of scale economies (or, for that matter, diseconomies) of production, whether because of specialization in the lending process, or whether because of technological innovations.[4] Furthermore, if

[4]Compare this to Pennacchi (1988), who argues that while some institutions may enjoy comparative advantages in loan funding and warehousing, other institutions may enjoy comparative advantages in loan originating. These comparative advantages suggest that borrowing costs can be reduced if institutions concentrate on what they do best (which is what secondary markets allow institutions to do). Flannery (1989) shows that bank examination procedures may induce banks to hold only certain classes of loans while profitably selling the rest. Benveniste and Berger (1987) argue that securitization enables banks to optimize the allocation of risk sharing by shifting risk from risk-averse to risk-neutral investors. Depositories can do this by securitizing

supply of credit is stronger, and cuts the demand curve in segment CD, this type of model would suggest that the secondary market could make inframarginal profits, since banks now become the marginal provider of mortgage financing.

2.2 Competitive View

Blinder, Flannery, and Kamihachi (2004) provide an alternative view of securitization. The starting point for their model is a competitive mortgage market, or more accurately one in which banks and the secondary market are willing to fund long-term fixed-rate mortgages without adding an additional risk premium. This competitive mortgage market has an equilibrium – as I show in Figure 2 – where market supply, given by FG, intersects market demand, given by CE.



their safest assets and retaining their risky assets on balance sheet. These points suggest the hypothesis that, all else equal, mortgage rates set by capital markets should be lower than those set by depositories, and that secondary markets could easily lead to lower cost funding in other countries where the principal/agent issues are small, and where individuals cannot costlessly repackage securities on their own.

Figure 2: Competitive View of the Mortgage Market with Two Rising Supply Curves. Vertical axis: Interest rate. Horizontal axis: Loan volume. FG = supply curve for mortgages. AB = demand curve of banks. CD = demand curve of the secondary market. CE = market demand curve. r_0 = equilibrium interest rate at which the demand for mortgages is equal to the supply of mortgages.

The demand curves slope upward, because of increasing marginal cost of funds to banks (i.e., they use jumbo CDs and outside borrowings instead of low cost deposits to raise funds), and because of the increase in bond yields needed to market and sell mortgage-backed securities to banking institutions and to individuals. The demand curve AB is steeper than CD, because of the economies in raising money and in processing the purchase and servicing of large numbers of mortgage loans.

The equilibrium interest rate is r_0. This equilibrium interest rate is given and unalterable to all lenders. Market shares are then determined where this interest rate equals the lender's marginal cost. Banks end up with OX_a of mortgages. The secondary market ends up with $OX_b - OX_a$ of mortgages.

This type of model leads to an equilibrium in which method of funding does not matter. In equilibrium, both lender types are marginal suppliers of funds at the same marginal cost, which argues against finding significant differences in long-term fixed-rate mortgage yield spreads across countries.

Of course, this view of the mortgage market is completely different from the market segmentation view of the mortgage market (which would argue that mortgage rates set by capital markets are generally different from than those set by banks). Here I should also note that homeowner borrowing costs may be cheaper in security-based housing finance systems like in the U.S. not because of better risk sharing or scale economies of production, or specialization in the lending process, but because of moral hazard. In a moral hazard framework, secondary

market participants like Fannie Mae and Freddie Mac care only about the upside outcomes, not the downside outcomes. This asymmetry may lead to a mispricing of risk in mortgage-related securities and massive bouts of crazy lending (see Calomiris and Wallison (2008) for an argument to this effect). Ultimately, it is an empirical question as to which of these views is correct. In what follows, I offer a test of which hypothesis is most likely.

3. Institutional Background

The paper looks at borrowing rates on residential home mortgages for the following countries:

United States. Broadly speaking, residential mortgages in the U.S. are classified either as conventional or FHA/VA-insured. A conventional loan is one not insured by the Federal Housing Administration (FHA) nor guaranteed by the Veterans Administration (VA).

Conventional loans may be further classified as fixed- or adjustable-rate (loans on which the interest rate are normally reset once a year, depending on the designated adjustment period). Generally, however, the conventional mortgage market in the U.S. is dominated by fixed-rate mortgages. Conventional fixed-rate mortgages account for about 80% of all newly issued conventional mortgages on average.

Conventional fixed-rate loans generally have repayment terms of 15, 20, or 30 years. Both the interest rate and the monthly payments (for principal and interest) stay the same during the life of the loan.

Most conventional fixed-rate mortgages will also allow the borrower to prepay all or part of a mortgage debt before it is due. This could mean refinancing the mortgage or making

substantial payments against the principal (without a prepayment penalty).

Conventional loans in the U.S. can come with loan-to-value ratios as high as 95%, 97%, or even 103% or 107% of the home value. However, homeowners with less than a 20% down payment are normally required to purchase private mortgage insurance in order to protect the lender against loss in the event of default.

Conventional loans can be subclassified into two broad categories: conforming and non-conforming loans. Conforming loans are loans that comply with the guidelines set forth by Fannie Mae and Freddie Mac for "conforming" lending. These are loans to homeowners with good credit and borrowing less than the conforming loan limit.[5] Nonconforming loans are loans that are ineligible for sale to Fannie Mae or Freddie Mac (this includes so-called "jumbo" mortgages).

Conforming fixed-rate loans are originated by a variety of lenders. Once originated, however, most conforming fixed-rate loans are sold to Fannie Mae or Freddie Mac either for cash, or packaged with other loans and exchanged for securities such as Fannie Mae or Freddie Mac MBSs. Fannie Mae and Freddie Mac finance themselves issuing MBSs as well as non-callable corporate debt. Any abatement of this activity would clearly limit the demand for long-term, fixed-rate mortgages. This point seems pretty obvious.

United Kingdom. The residential mortgage market in the U.K. differs from the U.S. mortgage market in several respects. First, there is very little lending in the U.K. where rates

[5] Currently, the conforming loan limit for the U.S. is $417,000, with several exceptions. In 2007, a temporary conforming loan limit was established for high cost areas in the U.S. This temporary conforming loan limit applies to loans originated from July 1, 2007 to December 31, 2008. The temporary loan limit generally permits Fannie Mae and Freddie to purchase loans in high cost areas up to 1.25 times the median house price for that area, but with an absolute ceiling of $729,750 in most of the highest priced areas (except in Alaska, Hawaii, Guam, and the Virgin Islands, where loans cannot exceed $1,094,625).

are fixed for more than five years. Rather, most loans are variable- or reviewable-rate mortgages, in which the interest rate payments can be (and are) reset frequently, often monthly.[6] In fact, the stock of outstanding mortgages in the U.K. is made up of approximately three-fourths variable- or reviewable-rate mortgages, and one-fourth fixed-rate mortgages (fixed for no more than two or three years).[7]

Second, most residential mortgages in the U.K. are endowment mortgages. Endowment mortgages combine an interest-only nonamortizing loan with an insurance policy. Endowment mortgages have no gradual buildup of equity by the homeowner per se. Instead, the arrangement calls only for a monthly interest payment to be paid by the borrower throughout the entire life of the mortgage. To pay off the mortgage at term, the borrower purchases an insurance policy. On the insurance policy, the lender is the beneficiary. The risk of default is covered by mortgage indemnity insurance, and is purchased from separate providers offering coverage against default. Like in the U.S., the coverage is typically for the portion of the loan above an 80% loan-to-value ratio.

Third, most residential mortgages in the U.K. are held on the balance sheets of lenders. Very few loans – less than 10% of the residential mortgage market – are securitized, and, those loans that are securitized, are securitized by centralized lenders without a direct or indirect government guarantee. To obtain favorable bond ratings for these securities, the securities are

[6] The rates on variable- or reviewable-rate mortgages in the U.K. are generally tied to the lender's base lending rate. This rate is set by the major clearing banks and is an interbank rate (analogous to the prime rate in the U.S.). Consequently, unlike adjustable-rate mortgages (ARMs) in the U.S., mortgage rates in the U.K. have a tendency to respond much more quickly to changes in the central bank's repo or base rate. This means that changes in the central bank's repo or base rate will translate quickly into a higher effective rate on the outstanding stock of mortgages (see Miles (2003)).

[7] U.K. homeowners can also chose a variety of options, including discount and flexible mortgages to name a few. Discount mortgages carry a discounted interest rate that is set below the lender's standard variable rate for a specified period of time (analogous to teaser-rate ARMs in the U.S.). Flexible mortgages allow homeowners to make additional payments (within limits) that will shorten the mortgage or to forego some payments, if need be, thereby extending the life of the mortgage. That said, most mortgages in the U.K. have prepayment penalties. In contrast, in the U.S. almost two-thirds of loans held by the federal agencies are 30-year fixed-rate loans and a further 15% are 15-year fixed rates. Just 10% of the loans are adjustable-rate mortgages.

generally supported by credit enhancements (e.g., pool insurance) or a senior-subordinated structure (much like the market for "private label" MBSs (of jumbo mortgages) in the U.S.). The subordinated bonds are those that absorb the first fraction of any losses up to the limit of their nominal value. Any further losses are then absorbed by the senior bonds. The senior bonds are the MBSs that receive the favorable bond ratings, and are suitable for investment by financial institutions. The subordinated bonds are considered quite risky and require a selective clientele – which is a big reason why so few loans in the U.K. are securitized.

Canada. The Canadian mortgage market is dominated by so-called "roll-over mortgages." Roll-over mortgages are mortgages where the interest rate is established for a specific term. At the end of this term the mortgage is said to "roll over" and borrower and lender may agree to extend the loan. If satisfactory terms cannot be agreed upon, the borrower may be forced to seek alternative financing elsewhere.[8]

Since early 1980s, most mortgages in Canada have interest rates that adjust every 3 years; although, borrowers can choose terms as short as 6 months or as long as 10 or even 25 years.

The Canadian residential mortgage market mirrors the U.K. market in having penalties for prepayment of debt, though Canadian homeowners can choose to take out an open mortgage. Open mortgages are mortgages where the borrower is allowed to pay off part or the entire mortgage at any time without penalties. Open mortgages usually have short terms of six-months or one-year (so that par value is always close to market value).

Another interesting feature of the Canadian mortgage market is that the vast majority of mortgages are funded by a relatively few major financial institutions directly from deposits.

[8]The lender is under no obligation to renew the mortgage. Consequently, if the borrower missed or had been late with any payments, the lender can use this as an excuse not to renew the loan. A loss of job may be another reason not renew. A lender could also decide not to renew the loan if, for example, they did not like the economic climate of a particular geographic area.

That said, the Canadian Mortgage and Housing Corporation, established in 1946 as Canada's housing agency to provide access to housing finance, does operate a secondary mortgage market in MBSs. But the size of this market is quite small – it accounts for less than 8% of all Canadian mortgages. There also is a market for "private label" MBSs. But, again, the size of this market is quite small – it accounts for about 5% of all Canadian mortgages.

Germany. A unique aspect of the German residential mortgage market is the use of Pfandbriefe. A Pfandbriefe is a mortgage-backed bond that is issued by private and public mortgage banks (the so-called "Pfandbriefe" institutions) for the explicit purpose of funding their assets.

The mortgage loans backing a Pfandbriefe are usually long-term with maturities as long as 30 years. Interest rates on these loans, however, are normally fixed for a maximum of ten years (which makes Germany unusual relative to the U.K. and Canada).

The interesting feature of a Pfandbriefe is the low loan-to-value ratio imposed on the mortgages that secure the bond. The maximum loan-to-value ratio on these mortgages is 60% of the mortgage lending value (or approximately 50 to 55% of appraised property value). The mortgages also contain a 10-year lock-out provision. This lock-out provision completely forbids the prepayment of the loan for a period of 10-years (which just so happens to coincide with the running period of the Pfandbriefe).

The market for Pfandbriefe is the largest class of fixed-income securities in Europe (with more than E1100bn outstanding). As a consequence, the Pfandbriefe market plays a major role in the overall credit framework in Germany.[9] The government is involved in these mar-

[9] Pfandbriefe institutions hold 23% of the residential mortgage debt outstanding. The other major suppliers of residential mortgage credit (private commercial banks, public savings banks, cooperative banks, and the

kets, but only through state-owned savings banks (and this guarantee is scheduled to end in 2005).

Denmark. The Danish mortgage market generally offers two types of loans: a fixed-rate, fully-amortizing (i.e., annuity), level-payment mortgage with a maturity option of 10 to 30 years, and a long-term, adjustable-rate mortgage where the interest rate may be specified for a period of 1 to 10 years.[10]

The loans are originated by mortgage banks that specialize in making residential mortgage loans. The loans are funded by selling mortgage-backed bonds in the capital markets with the same nominal value and interest rate as the principal on the underlying mortgages.[11] The interest rate on the mortgage is set equal to the note rate on the mortgage-backed bond, plus the bank's markup. As the mortgage loans are repaid, the bank passes along the payments to the bondholders in proportion to the amount of the total pool that they own.

Loans are normally originated with an 80% loan-to-value ratio (which is the maximum allowable loan-to-value ratio for single-family dwellings); although, most borrowers get about a 90 to 95% loan-to-value by going to a commercial bank or savings bank to get a second mortgage (with a shorter term and a higher rate) for the extra 10 to 15%.[12] Unlike in the U.S., however, the loans are not priced individually for risk. This generally leads to a situation where borrowers with poor credit are not served, at least not by mortgage banks.

Bausparkassen) hold the rest. In Germany there are 34 Bausparkassen (or building societies). The Bausparkassen system is a contract savings scheme, where people commit to save at below-market fixed rates for a period of time and then once this is over qualify for a loan at a fixed interest rate (normally at below capital market rates).

[10] The use of adjustable-rate mortgages is a relatively recent phenomenon. These loans typically have an amortization term of 20- to 30-years and are funded based on short-term, non-callable bonds with a life time of mostly 1- to 5-years.

[11] The bonds are denominated both in Danish krone and in the euro (and tied to Euribor).

[12] In determining the loan-to-value ratio, the valuation of the property must be market-determined and conservative.

Borrowers with fixed-rate mortgages are free to refinance when market interest rates go down by buying bonds in an amount equal to their mortgage balance. Prepayment in this case is permitted without a prepayment fee.[13] In contrast, borrowers with adjustable-rate mortgages can prepay only when the rate is adjusted, and at a small cost.

The Danish mortgage bond market is among the largest mortgage bond markets in Europe, second only to the German Pfandbriefe market. Additionally, there is quite a high level of mortgage debt in Denmark as a percentage of Gross Domestic Product.

Switzerland. Switzerland has traditionally been a nation of renters. Just 35% of the households are homeowners. One reason for this is that homeowner imputed rental income is taxed for income tax purposes. Another reason is affordability. When compared to countries like Germany or the United Kingdom, the price level of homes in Switzerland tends to be quite high, and high house prices increase the real burden of debt service and cause the household's real financial position to deteriorate.

Most residential mortgages in Switzerland are variable-rate mortgages, in which the interest rate is reset every 6 months with no caps on the change. Yet fixed interest rate mortgages are also used. This has been especially true in recent years. More than half of all borrowers have used fixed-rate mortgages over the last several years in order to take advantage of historically low nominal interest rates. The interest rates on these fixed-rate mortgages are, however, fixed for no more than five years, after which time the rate is renegotiated.

Debt levels in Switzerland are quite high for such a low-homeownership country because

[13] It does cost, however, about $100 to buy back the bonds, regardless of the amount of the purchase. Because of this, partial prepayments on fixed-rate mortgages (where the borrower pays a little more each month in order to pay the loan off sooner) are not practical.

most Swiss homeowners save taxes by being able to deduct the mortgage interest on their home. As a result, Swiss homeowners have little incentive to pay off their debt. In addition, most loans are initially originated with a 75% loan-to-value ratio (of market value).

There are two types of repayment schemes in Switzerland: direct and indirect. In the case of direct repayment, the borrower repays part of the mortgage every year, reducing the remaining debt and the interest. In the case of indirect repayment, the borrower repays part or all the mortgage at one time with the capital from a life insurance policy. In this case the borrower also enjoys insurance benefits and tax advantages.

Few residential mortgages are securitized in Switzerland. Instead, most mortgages are funded by Swiss banks primarily through short-term deposits.

Spain. As in the United Kingdom, the vast majority of mortgages originated in Spain are variable- or reviewable-rate mortgages. The interest rate payments on these loans are normally fixed for the first period, say, the first year and then are reset to the Euribor, plus the lender's margin.[14] However, unlike in Denmark, the margin as a rule varies according to borrower.

Spanish mortgage lenders also originate fixed-rate mortgages. Fixed-rate mortgages, however, account for only about 10% of all newly issued mortgages. These mortgages often involve a fixed interest payment for a certain period (for instance 5-years), and a floating rate thereafter. Spanish mortgages are fully-amortizing, so that monthly mortgage payments are comprised partly of principal repayment and partly of interest on the loan. Some mortgages

[14]Thus, as the European Central Bank swings into action to bring the quantify of money supplied and the quantity of money demanded in the European Monetary Union into balance, and as the change in money supply affects the short-term interest rate throughout, mortgage rates in Spain will adjust regardless of whether or not this effect is intended.

are interest-only to start with (for instance for the first 10-years) and revert to fully-amortizing mortgage thereafter.

Almost all mortgages contain a prepayment penalty clause. The prepayment penalty clause generally comes into effect when interest rates fall and the borrower wishes to refinance with a newly found lower-cost lender. Many Spanish mortgages also impose a partial prepayment penalty on borrowers who wish to pay off part of their mortgage early.

The amortization period on most Spanish mortgages is typically for a period of 25-years or even longer. These new amortization periods went into effect in the mid-1990s in order to stimulate housing demand by reducing level nominal payment and making mortgages accessible to a wider market.[15]

Spanish homeowners are normally permitted to borrow up to 95% of the value of the property or purchase price, whichever is smaller. In general, though, Spanish mortgage lenders do not like to lend more than 60 to 70% of the value of the property to most buyers.

Mortgage securitization is a relatively new phenomenon in Spain. Spain's first major mortgage bond issued, called Cedulas Hipotecarias, was in January 1999. Despite this, most mortgages continue to be funded by Spanish savings banks with short-term deposits.

Belgium. In Belgium, most mortgages today are variable rate, with a 1- and up to a 3-year initial rate fixation. However, this has not always been the case. In Belgium, both fixed- and variable-rate mortgages are widely available, and there have been definite cycles in their shares. For example, during the late 1990s, fixed-rate mortgages were dominant. In

[15] The degree to which fraction of income taken up by monthly mortgage payments interferes with housing demand and the efficient allocation of savings has attracted substantial attention in the literature. Poole (1972) first suggested that this phenomenon interferes with the capital accumulation in 1972.

contrast, during the early 2000s, both fixed- and variable-rate loans were being sought out. But as of late, variable-rate mortgages have become dominant, partly as a consequence of the recent rise in the proportion of household disposable income devoted to the payment of monthly installments, and in part as a result of the low level of interest rates.

Most variable-rate mortgages in Belgium offer a cap formula, whereby the interest rate always remains within a certain range in relation to the initial rate. The cap formula gives full protection against rising interest rates beyond the cap level. Similarly, the cap formula limits the interest rate decline to a predetermined level.

Most variable-rate loans in Belgium also contain an "accordion" provision, where instead of the monthly payments being increased as a result of an increase in interest rates, the term of the loan is extended. Most variable-rate loans also give the borrower the option to convert to a fixed interest rate at any time.

The amortization period on most Belgian mortgage instruments is typically for a period of 20 years; however, even the term has expanded in recent years, as Belgian households have opted more frequently for 25- to 30-year loans, owing in part to a generally available tax concession on mortgage interest.

Most Belgian banks do not rely extensively on securitization operations to finance their mortgage lending activities. That is evident by the small amount of structured residential mortgage-backed securities outstanding in 2007 (as a percent of total mortgage debt outstanding).

Lastly, most Belgian banks have eased their lending terms in the past few years, especially in terms of loan-to-value. Hence, today, Belgian banks offer a range of loan-to-value ratios to match the changing pattern of household income over their lifetime.

France. Two characteristics distinguish the French mortgage market from other mortgage markets (especially other European mortgage markets): first, the market is remarkably small for an economy of the size of France; and second, more than half the loans are fixed rates, but the term is typically for 10, 15, or 20 years.

Loan-to-value ratios in France are quite low; generally, the standard maximum was 60 to 70% until recently and is now 70 to 80% of current valuation with the majority of banks, and some banks may permit lending up to 85 to 90% of property value in some circumstances (e.g., for more creditworthy borrowers). Most lenders in France will focus on the borrower's capacity to pay rather than on the underlying value of the property. As a result, the choice of the loan-to-value comes as a second step, after the loan has been approved in principle.

For most fixed-rate loans, there will almost always be prepayment penalties applied to any amount paid in addition to the regularly scheduled payment throughout the whole mortgage term. In addition, most lenders will normally apply a prepayment penalty for either partial or full repayment of a variable-rate mortgage during the fixed rate period. After the fixed rate period, borrowers are typically free to repay without penalty.

Many French banks use mortgage securitization as a way to borrow money in the capital markets in order to finance their purchases. This trend toward securitization has made France more like Germany than it used to be.

Australia. The Australian mortgage market is dominated by a few large banks of national character, and the loans they make are funded primarily through deposits with short duration (or through offshore borrowings). Hence, most mortgage loans in Australia – approximately

80 to 90% – are variable-rate loans that track the official cash rate, set by the Reserve Bank of Australia.

There is a modest amount of fixed-rate lending in the Australian mortgage market, owing to the use of securitization. However, unlike in the U.S., the loan terms are fixed for only 5 years or less, after which time the loan converts automatically to a variable-rate loan.

Mortgage loans in Australia are classified as follows: first there are basic loans with limited options. Next, there are flexible loans with facilities such as the option to redraw, and the option to make early repayments or convert from a variable- to a fixed-rate, or vice versa. Then there are discounted loans, where the loan has a discounted or "honeymoon" rate of interest for the first year of the life of the loan.

Almost all home mortgages in Australia are underwritten solely on the basis of the ability to pay back the loan. For example, most lenders set maximums for these ratios, such as, e.g., the monthly mortgage repayment cannot exceed 25 to 35% of the borrower's monthly income. However, most lenders will allow a higher payment-to-income ratio for borrowers who are well-qualified.

Loan-to-value ratios in Australia can range in size from 80 to 95%, but seldom exceed 60 to 70%. These low loan-to-value ratios offset a high debt-to-income ratio.

The typical loan term is 25 years, but could range from 20 to 30 years. In practice, most mortgages are often paid off well before stated maturity (typically over a 12-year period), with households choosing to make excess repayments on standard loans.

Italy. A well-known feature of the Italian mortgage market is its inability to enforce

liens against homeowners. In Italy, it typically takes between 3 and 5 years to repossess a house in case of foreclosure; that compares with one year or less in the U.S. Not surprisingly, then, high loan-to-value mortgage lending in Italy is quite limited. For example, the typical loan-to-value ratio in Italy is only between 50 and 60% of purchase price, even though lending laws allow a maximum of 80 to (in some cases) 100%.

Mortgage loans in Italy also have a rapid amortization period, as rapid as 10 to 15 years. The rapid amortization period provides further protection against unanticipated changes in future house prices that could lead to default.

At the beginning of the 1990s, most mortgages in Italy were variable rate. Since then, an assortment of fixed- and variable-rate mortgages have become available, including mixed-loans that allow the borrower to switch from fixed to variable and vice versa at a specified date. Even so, variable-rate mortgages still comprise over 75% of Italy's market.

There is little securitization of mortgages in Italy. Instead, most mortgage loans are held by the original bank that underwrote the loan, which means that funding is primarily through deposits.

Perhaps surprisingly, Italy has – despite the costly restrictions that they impose on the ability to enforce liens against homeowners – a high homeownership rate.

Japan. In Japan, there are two types of mortgages: variable-rate mortgages, where the typical adjustment period is between 1 and 2 years, and hybrid loans, where the interest rate is fixed for an initial period of between 2 and 5 years, and then adjusts to a variable rate thereafter. Hybrid mortgages are, by far, the most popular; they account for between 70 and 80% of the market.

Still, for more than a decade variable-rate mortgages have been becoming more popular, due in part to the extended period of very low (and stable) interest rates in Japan, and partly due to changes in the Government Housing Loan Corporation, which is a semi-autonomous government agency, set up in 1950 to provide long-term, low-interest funds to those who were going to construct or purchase houses. In this regard, securitization is being used more and more each year to fund mortgages in Japan.

Loan-to-value ratios in Japan are typically between 40 and 50%; although, good credit borrowers can, as a rule, borrow up to 100% loan-to-values. The standard term of repayment in Japan is 25 years, but mortgages can be amortized over 30, 40, or 50 years – the average term for owner-built detached houses is approximately 26 years, and 33.5 years for condominiums.

Obviously, with downpayments of 50 to 60% of house value, high savings rates are needed to purchase housing in Japan. Hence, it is not surprising Japan has an owner-occupancy rate that is lower than in the United States, the United Kingdom, and many other countries.

Sweden. There is very little heterogeneity in mortgage lending activities in Sweden. Almost all mortgages are underwritten and held by banks on their own books. The funding of these mortgages is split between deposit-taking and the issuance of securitized mortgage debt.

Loan terms generally range between 30 and 50 years, with interest rates that are fixed for periods between one and two years (between 40 and 60% of all mortgages fall into this category). The longest duration for which a lender will lock the rate is typically 10 years.

Banks in Sweden will generally loan up to 75% of the assessed property value. Most variable-rate mortgages in Sweden provide explicitly that the loan can be prepaid in part or

in full any time before the maturity date. However, this is not the case for fixed-rate loans. When a borrower prepays a fixed-rate loan before it is due, the borrower must typically pay a prepayment penalty on the loan. This prepayment penalty is an extra expense that is associated with a fixed-rate loan that makes up for the interest that the lender loses.

With most banks in Sweden borrowers can transfer their mortgage loans to another home property on the sale of the existing property. However, most banks, but not all, will typically charge a loan transfer fee to extend the life of the mortgage.

These loan terms allow Swedish banks to separate a loan's prepayment risk from its credit risk, and to restrict the amount of credit risk that arises by placing limits on the maximum allowable loan-to-value ratio.

Finland. There are three sources of finance for housing in Finland. The state is one; in Finland, state loans provide an important source of funds for new construction (and renovation of rented housing). State loans are generally subsidized, either through a below-market interest rate or more favorable than market lending terms.

Bank loans are another important source; in Finland, banks lend funds on a floating-rate basis, where the interest rate tends to be either renegotiable after one year, tied to market rates, or adjusted after one year at the lender's discretion.

The third source of funds for housing in Finland is the capital market. Many Finish banks issue mortgage-backed securities in Finland in order to fund their purchase activities.

In Finland, most loans are variable rates. In fact, variable-rate loans account for approximately 90 to 95% of the home mortgage market. Hence, when interest rates rise in Finland,

they rise for most outstanding loans, causing most borrowers to have to pay more in interest.

4. Construction of U.S. Equivalent Mortgage Rates

4.1 Basic Idea

To construct U.S. equivalent mortgage rates for each of the above foreign countries, the following procedure is used. First, I obtain monthly data on mortgage yields for each of the above countries. Then direct adjustments are made to these yield series to account for those factors affecting them differently. These include the impact of call risk and maturity (i.e., term structure) on the spread between the adjusted yield series.

To make the adjustment for maturity, I use a 30-year interest rate swap. An interest rate swap is simply an exchange of one set of cash flows (e.g., a floating-rate payment) for another (e.g., a fixed-rate payment). I assume that the foreign homeowner pays the fixed amount of interest in the swap agreement and receives at the same intervals a floating amount of interest on some notional principle (i.e., the mortgage amount). The homeowner uses the floating-rate payments to make the payment on his or her short-term variable-rate or receivable-rate mortgage. This eliminates the homeowner's exposure to general increases in the level of interest rates. Hence, on net the homeowner is left with a single obligation to pay a long-term fixed interest rate.

To make the adjustment for the call option, I use a 10-year call swaption (an option to receive fixed and pay floating on a swap). Economically, residential mortgages in the U.S. are equivalent to lending money with no chance of early repayment but at the same time giving the homeowner the option to be prepay, usually without penalty, any time prior to the originally stated maturity. This call option effectively allows U.S. homeowners to refinance

their current property at a lower interest rate, just the moment when the lender does not want to be repaid. A 10-year swaption replicates this option by essentially allowing the foreign homeowner to effect interest savings at time $t = 10$ years. I choose year 10 because the average life for a residential mortgage in the U.S. (when the remaining balance of the mortgage is prepaid in full) is typically between 8 to 12 years. If swap rates have fallen, the homeowner would exercise the swaption and elect to receive the agreed-upon fixed rate and pay the floating rate on the swap. Simultaneously, the homeowner would enter into a fixed-for-floating interest-rate swap based on the market. Here, the homeowner would agree to pay the fixed rate of interest and receive a floating rate of interest. On net, the floating rate payments would cancel out, and the homeowner would effectuate an interest savings equal to the difference between the fixed interest-rate on the 10-year call swaption and the fixed interest-rate based on the market. Should, of course, swap rates rise over this time period, the swaption would expire unexercised, and the homeowner would simply continue to pay the 30-year swap rate he or she negotiated above. So the effect of the swaption is to allow the homeowner to benefit from falling interest rates, albeit only at time $t = 10$ years.

To illustrate the effect of these adjustments on the interest rate paid by the foreign homeowner, let rm_n denote the actual interest rate on a short-term variable-rate mortgage that reprices in n-years (where $n \leq 10$). Similarly, let i_n and sw_n denote the annual swap and swaption rate on an n-year contract. Using this notation, the yield on a synthetic 30-year (U.S. equivalent) fixed-rate mortgage can be decomposed into three terms as follows:

$$y = i_{30} + sprd_{10} + sw_{10} \tag{1}$$

where

$$sprd_{10} = \begin{cases} rm_{10} - i_{10} & \text{if } n = 10, \\ rm_{10}^{'} - i_{10} & \text{if } n < 10 \end{cases}$$

$$rm_{10}^{'} = rm_n + (i_{10} - i_n)$$

The term i_{30} is the opportunity cost of the lender's money at time t. The second term $sprd_{10}$ can be interpreted as a default premium. This default premium should vary, according to standard option pricing theory, with the loan-to-value ratio. Hence, if loan-to-value ratios differ greatly across countries, then $sprd_{10}$ will differ greatly across countries, too. Finally, the term sw_{10} is the added interest rate that the homeowner pays for the privilege to refinance the loan at the end of year 10.

To construct estimates of y, there must be estimates of rm_n, i_{30}, i_n, and sw_{10}. The sources of these data are as follows. The mortgage rates for the U.S. are taken from a survey of rates and terms on conventional mortgage loans known as the Monthly Interest Rate Survey (MIRS). The MIRS is a survey of mortgage lenders concerning the terms and conditions on all single-family, fully amortized, conventional mortgages that they close during the last five business days of the month. The former Federal Home Loan Bank Board conducted the surveys before October 1989 and the Federal Housing Finance Board has conducted the surveys since then.

The 150-odd participants of the survey are savings associations, mortgage companies, commercial banks, and savings banks. The survey asks all participants to provide information on interest rates, loan terms, and house prices by property type (all, new, previously occupied), by loan type (fixed- or adjustable-rate), and by lender type, as well as information on 15- and

30-year fixed-rate loans. The data from this survey are used by Fannie Mae and Freddie Mac to determine the maximum size of loan that they can purchase or guarantee.

Here and for the rest of the paper, I use the effective interest cost reported by MIRS for a standard 30-year fixed-rate loan as a measure of rm_n for the U.S. This rate is calculated as $rm_n = c + PT/PVAF10$, where c is the coupon rate on the loan, PT is the up-front points and fees, $PVAF10$ is a present value annuity factor using rm_n as the discount rate, and the loan is assumed to be outstanding for 10 years.

For Australia, Finland, Italy, Japan, Spain, Sweden, and Switzerland, the mortgage rate used for rm_n is the coupon rate on a variable-rate loan, with an initial fixation period between 1 and 3 years. For Belgium, Canada, and the United Kingdom, the mortgage rate used for rm_n is the coupon rate on a fixed-rate loan, fixed for a period of 5 years. For Denmark, France, and Germany, the mortgage rate used for rm_n is the coupon on a 10-year fixed-rate loan. The sources of these mortgage rates are listed in footnote 17 below.[16]

The interest rate swap data i_{30} and i_n are taken from Bloomberg for all countries except the United Kingdom. For the United Kingdom, the interest rate swap data i_{30} and i_n are collected from Global Financial. The swaption data sw_{10} are collected from Bloomberg for all countries. In the case of Belgium, Finland, France, Germany, Italy, and Spain, I deal with missing values of sw_{10} by using the Euro swaption (collected from Bloomberg). In the case of Canada, I deal with missing values of sw_{10} by using the US swaption (collected from Bloomberg). All data are collected on a monthly basis.

[16]The variable loan rates for Australia, Finland, Italy, Japan, Spain, Sweden, and Switzerland are taken from the following sources: Reserve Bank of Australia, Monthly Statistical Bulletin; Bank of Finland, Monthly Bulletin; Banca d'Italia, Bollentio; Bank of Japan; Banco d'Espana, Bulletin Mensual; Sveriges Riksbank, Quarterly Review, and Schweizerisches Nationalbank, respectively. The 5-year fixed loan rates for Belgium, Canada, and the United Kingdom are taken from Banque National de Belge, Bulletin, Bank of Canada, Weekly Financial Statistics, and Bank of England, Quarterly Bulletin, respectively. The 10-year fixed loan rates for Denmark, France, and Germany are taken from Danmarks Bank, Monetary Review, Banque de France, Bulletin Trimestriel, and Deutsche Bundesbank, Monthly Report, respectively.

The sample is restricted to the following time periods: the United States (January 1998-December 2010), the United Kingdom (April 1999-December 2010), Canada (January 1999-December 2010), Germany (November 2001-December 2010), Denmark (April 2001-April 2002 and July 2002-November 2010), Switzerland (May 2001-December 2010), Spain (April 2003-July 2008), Belgium (March 2000-December 2010), France (April 1999-December 2010), Australia (May 2004-December 2010), Italy (November 1999-December 2010), Japan (September 1999-February 2008 and February 2009-December 2010), Sweden (June 2005-February 2010), and Finland (March 2000-December 2010). To avoid an expected rate of currency depreciation bias, all tests reported in this paper are conducted using mortgage yield spreads rather than levels.

4.2 Refinement and Extension

A computational problem arises with this modeling because homeowners in the U.S. generally pay for the privilege to prepay (call) their loans at any time before the loan is due rather than at a single point in time, even though, it is correct to say that the duration of a mortgage in the U.S. is typically between 7 and 12 years. I use a simple approach to correct for this problem. I start by using (1) to obtain the equivalent yield y on a 30-year synthetic fixed-rate mortgage in the U.S. This rate is calculated from values of rm_n, i_{30}, i_n, and sw_{10} for the U.S. The mortgage rate used for rm_n is the coupon rate on a 1-year adjustable-rate mortgage as reported by Freddie Mac.[17] The interest rate swap data i_{30} and i_n are from Bloomberg as are values of sw_{10}.

Next, with data available on rm_{30}, I subtract y from rm_{30} and get the difference:

[17] The 1-year adjustable-rate are from Freddie Mac's Primary Mortgage Market Survey.

$$e = rm_{30} - y \tag{2}$$

where e is a measurement error (caused by the fact that y incorporates only sw_{10}, whereas rm_{30} allows for borrower prepayment at any time before the loan is due) and rm_{30} is the actual 30-year fixed mortgage rate.

Next, I specify that at time t e is related to the slope of the (Treasury) yield curve, $\Delta r = r_{30} - r_1$, and the level of (risk-free) interest rates, r_{30}:

$$e = \beta_0 - \beta_1 \Delta r + \beta_2 r_{30} + u.$$

where u is a random error term. One expects e to be higher when there is a downward sloping yield curve, because the implied increased probability that mortgage interest rates will fall increases the probability that the mortgage will be be prepaid early.[18] Also, when interest rates are high, interest rate risk is high (or the risk associated with fluctuations in value of principal due to changes in the level of interest rates is high).[19]

Estimated on U.S. data over the period 2000.1 to 2010.12, the result is

$$\begin{array}{ccccccc} e & = & 0.10 & - & 0.27\Delta r & + & 0.18 r_{30} \\ & & (0.29) & & (-2.29) & & (2.67) \end{array}$$

$$R^2 = 0.49 \quad \text{F-value} = 20.9$$

The figures given in parentheses are t-ratios. The coefficients on Δr and r_{30} are both significant and have the correct signs, and although the R^2 is low ($R^2 = 0.49$), the F-value for the equation is significant at 1% level.

[18] This prediction stems from option-oriented pricing models (see, for example, Dunn and McConnell (1981)).

[19] The theory that interest rate risk varies directly with the level of interest rates implies that interest rate risk premiums should depend positively on its conditional variance. For evidence supporting this supposition, see Hess and Kamara (2005).

Next, this equation is used to predict values of e for each country for the period 2000.1-2010.12 from actual values of Δr and r_{30} over the period. For example, for Spain the actual values of Δr and r_{30} in January 2007 were 0.29% and 4.35%, respectively. Plugging these values into the above expression for e yields a value of 0.7912%. With $i_{30} = 4.5139\%$, $sprd_{10} = 0.0731\%$, and $sw_{10} = 0.1135\%$ the value of y is 4.7005%. If I now add the adjustment factor e, the latter becomes 5.4917%.

Typically, the value of e, including the constant term, varies, on average, between 0.28 and 1.01% for most countries. Therefore, in what follows, rather than computing $y = i_{30} + sprd_{10} + sw_{10}$ for each country, as suggested above, I shall use $y = i_{30} + sprd_{10} + sw_{10} + e$ to estimate the U.S. equivalent mortgage rate.

5. Illustrative Calculations

Example 1: Germany. A simple example serves to illustrate the construction of U.S. equivalent mortgage rates. Suppose the following situation exists: A German homeowner takes out a mortgage on a fixed basis for 10 years. The mortgage has an amortization period of 30 years. Further suppose that the German homeowner wishes to match the duration of the homes it own times its value to the duration of the mortgage on the house times its value. The homeowner is therefore seeking to exchange its 10-year mortgage for a 30-year fixed-rate mortgage.

Here are the four steps that the German homeowner would need to undertake (see Figure 3):

Step 1: The homeowner enters into a 30-year swap agreement. The homeowner agrees to pay i_{30} to a counterparty. In return, the counterparty agrees to pay a short-term rate

of interest, rs, to the homeowner.

Step 2: The homeowner enters into a 10-year swap agreement. The homeowner agrees to pay rs to a counterparty. In return, the counterparty agrees to pay i_{10} to the homeowner.

Step 3: The homeowner purchases a 10-year call swaption for sw_{10}. The swaption allows the homeowner to receive an agreed-upon rate commencing in 10-years. The homeowner uses the call swaption to effect an interest rate savings in year 10 should interest rates fall over this time period.

Step 4: Add an adjustment factor, e, to compensate for right to prepay the loan at any time before the loan is due rather than at a single point in time (i.e., to effectuate an interest rate savings at any time before the loan is due).

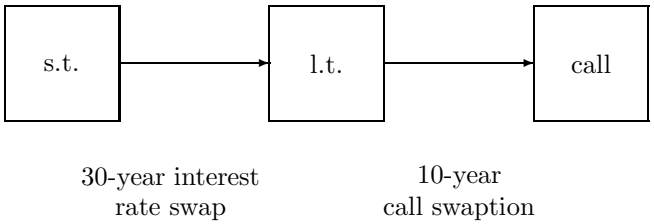


Figure 3: Construction of U.S. Equivalent Mortgage Rate. The figure shows the process used to construct U.S. equivalent mortgage rates. *s.t.* = short-term mortgage rate. *l.t.* = long-term fixed rate. *call* = long-term callable mortgage rate.

In this case, the net obligation of the homeowner is

$$\begin{aligned} y &= rm_{10} + (i_{30} - rs) - (i_{10} - rs) + sw_{10} + e \\ &= i_{30} + (rm_{10} - i_{10}) + sw_{10} + e \\ &= i_{30} + sprd_{10} + sw_{10} + e \end{aligned} \tag{4}$$

Which shows that y is the borrowing rate on a synthetic 30-year fixed-rate mortgage.

For $rm_{10} = 5.71\%$, $i_{30} = 4.979\%$, $i_{10} = 4.415\%$, $sw_{10} = 0.0977\%$, and $e = 0.824\%$ (which are actual values for June 2004), the value of y is 6.3717%. Adding the adjustment factor e, the latter becomes $y^* = 7.1957\%$. With a 10-year government bond rate of $r = 4.318\%$, the result for $y^* - r$ is 2.8777%.

Example 2: Canada. The construction of a U.S. equivalent mortgage rate for Canada is illustrated for a 5-year conventional mortgage. The 5-year conventional mortgage rate in Canada for January 2003 is $rm_5 = 6.05\%$. I judge the cost to convert this 5-year variable-rate mortgage into a 30-year (non-callable) fixed-rate mortgage to be $i_{30} - i_5 = 1.63\%$. This conversion cost is simply the difference between going long a 30-year swap and going short a 5-year swap.

I next judge the cost to create a call option (calling at 10-years) to be $sw_{10} = 0.132\%$. This call option gives the homeowner the flexibility to effect interest savings at a lower net cost at the end of year 10 if interest rates are lower. In the event of the call, the homeowner would receive an agreed-upon fixed rate and pay the floating rate on the swap. Next, the homeowner would enter into a fixed-for-floating interest-rate swap based on the market, thus producing an interest savings equal to the difference between the fixed interest-rate on the 10-year call swaption and the fixed interest-rate based on the market. If, on the other hand, interest rates were to increase over this time period, the homeowner would allow the swaption to expire unexercised and would simply continue to pay the 30-year swap rate.

In adding up these costs, the (unadjusted) U.S. equivalent mortgage rate is found to be 7.82%. Adding the adjustment factor e, the latter becomes $y^* = 8.3764\%$, and the mortgage yield spread over the 10-year government bond rate is $y^* - r = 3.1864\%$.

Example 3: United Kingdom. Analogous calculations for the United Kingdom for January 2003 are shown below. We generally know that few households in the United Kingdom take out long-term fixed-rate mortgages (greater than 5 years). Miles (2003) contends that this occurs partly because U.K. households attach enormous weight to the level of initial monthly repayments, partly because most borrowers have a poor understanding of risk, and in part because U.K. homeowners are, to use Wojnilower's (1985) terminology, "bribed" to accept variable rates.

I generally find that prices of synthetic long-term mortgages in the United Kingdom are similar to the prices of actual mortgages in the U.S. To illustrate the calculations required in computing the synthetic mortgage yield in the United Kingdom, the 5-year fixed mortgage rate in United Kingdom for January 2003 is $rm_5 = 5.54\%$. The 30-year swap rate is $i_{30} = 4.903\%$, while the 5-year swap rate is $i_5 = 5.085\%$. Hence, the cost to convert the 5-year fixed-rate mortgage into a 30-year (noncallable) fixed-rate mortgage is $i_{30} - i_5 = -0.182\%$.

The cost of a 10-year swaption is $sw_{10} = 0.1417\%$. Substituting these values into (1) yields a (unadjusted) U.S. equivalent mortgage rate of

$$\begin{aligned} y &= i_{30} + (rm_5 - i_5) + sw_{10} \\ &= 4.903 + (5.54 - 5.085) + 0.1417 \\ &= 5.4997\% \end{aligned}$$

Adding the adjustment factor e, the latter becomes $y^* = 6.4349\%$. To calculate the synthetic 30-year mortgage yield spread, I go short the 10-year government bond rate. The result is a synthetic 30-year mortgage yield spread of $y^* - r = 1.7049\%$.

This compares with a 30-year mortgage yield in the U.S. for January 2003 of $rm_{30} = 5.88\%$, a 10-year government bond rate of 4.16%, and a 30-year mortgage yield spread of $rm_{30} - r =$

1.72%, which is well below the synthetic 30-year mortgage yield spread in Canada, but is similar to the level seen in the United Kingdom.

6. Summary Measures of Cost Differences

6.1 US-European Union Comparison

Figure 4 shows that the relative picture for homeowner borrowing costs in the U.S. compared with costs for member states of the European Union (the United Kingdom, Germany, France, Belgium, Italy, Spain, Finland, Sweden, and Denmark). There appears to be quite a difference in relative homeowner borrowing costs over the subsample periods January 2000-September 2008 and November 2008-December 2010, in that the actual 30-year standard fixed-rate mortgage yield spread in the United States is only slightly lower than the average mortgage yield spread in European Union states for the subsample period January 2000-September 2008, but contrasts sharply with mortgage yield spreads in European Union states for the subsample period November 2008-December 2010. Overall, mortgage yield spreads are lower in the U.S. compared with spreads for European Union states over the subsample period January 2000-September 2008 by 0.24%. The highest difference between homeowner borrowing costs in member states of the European Union and the U.S. is 2.1% in July 2003; and the lowest is -1.4% in June 2000.

Interestingly enough, since September 2008 homeowner borrowing costs appear to be much higher in European Union states than in the U.S., no doubt due to the federal government's decision to takeover Fannie Mae and Freddie Mac. Fannie Mae and Freddie Mac provide very long-term mortgage guarantees, which have been made more credible by the federal government's takeover decision in September 2008. Without such a credible guarantee, whole

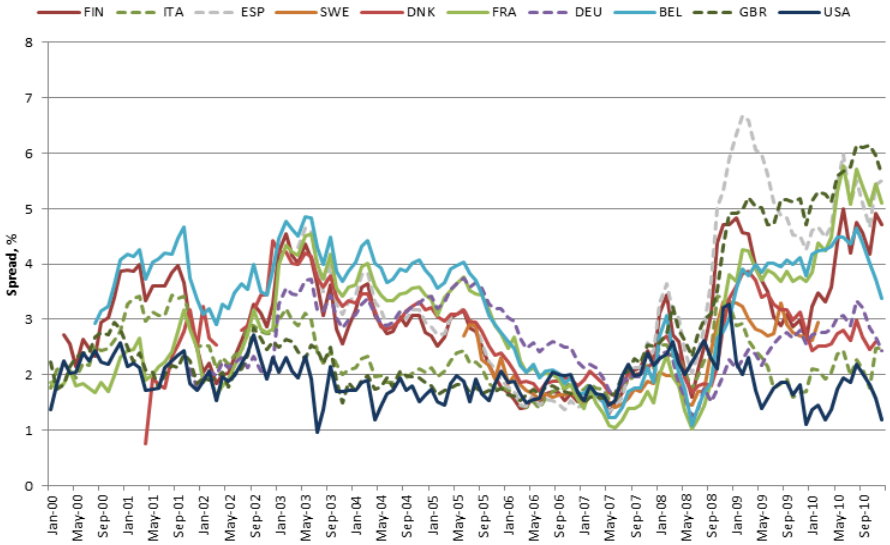


Figure 4: Plot of Actual versus Synthetic 30-year Mortgage Yield Spreads in the US and European Union Countries. Horizontal axis: Month. Vertical axis: Mortgage interest rate spread over the 10-year government bond rate. The synthetic 30-year mortgage yield spread is the difference between the yield on a synthetic 30-year fixed-rate mortgages and the 10-year government bond rate. The countries include the United States, the United Kingdom, Germany, France, Belgium, Italy, Spain, Finland, Sweden, and Denmark. All statistics are in percent.

loans in the U.S. could be sold to other investors only at a substantial discount, which means a decrease in the market price of a mortgage and an increase in its yield. Along these lines, between January 2009 and December 2010 homeowner borrowing costs in European Union states (where there are no government guarantees) have been between 2 and 2.5% higher than the costs in the U.S.

6.2 US-Japan Comparison

A comparison of the homeowner borrowing costs in the United States with Japan is shown in Figure 5. The results obtained differ from those shown in Figure 4, for European Union states. Between January 2000 and February 2007, homeowner borrowing costs in Japan and the U.S. have largely been identical. To illustrate, the mortgage yield spread in Japan between January 2000 and February 2007 was 1.94% compared with a U.S. yield spread of 1.90%, a difference of 0.04%.

The most interesting observation about Figure 5 is that between February 2008 and December 2010 mortgage yield spreads in Japan narrowed compared with the U.S. For example, Japan's yield spread between February 2008 and December 2010 were only 1.24% compared with a U.S. spread of 1.95%. The lower homeowner borrowing costs in Japan can be explained in part by the Bank of Japan's efforts to stimulate an economy in need of reflating. Japan's economy stagnated from 1992 to 2002 – its "lost decade" – grew from 2002 to 2008, only to fall back into a recession in 2008.Q4. With the advent of global financial crisis in 2008, the Bank of Japan cut the key rate twice, to its current level of 0.1%.

6.3 US-Canada Comparison

As Figure 6 makes clear, homeowner borrowing costs are higher overall in Canada than in the U.S. The specific differences range from 1.28% in January 2002-June 2003, to 2.20% in April 2006-December 2010, with an average difference of 1.84% over the entire January 1999-December 2010 period.

The comparison in Figure 6 is interesting because the two economies are generally similar,

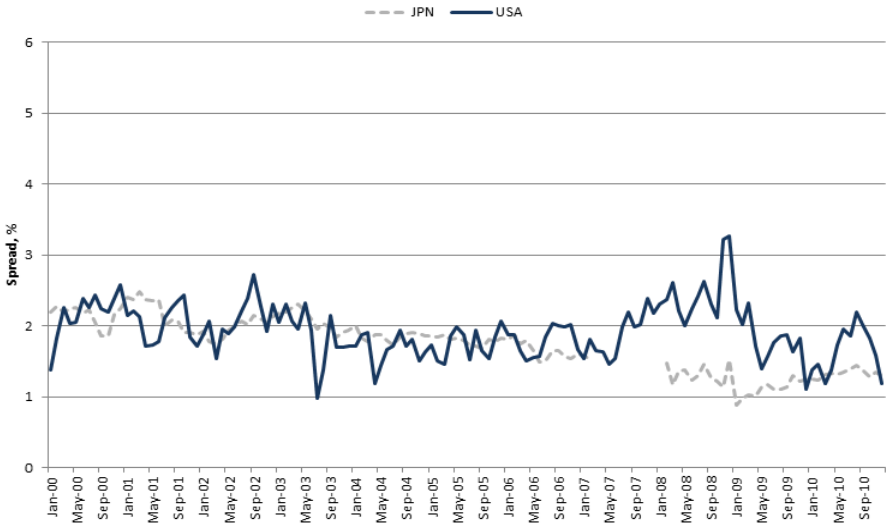


Figure 5: Plot of Actual versus Synthetic 30-year Mortgage Yield Spreads in the US and Japan. Horizontal axis: Month. Vertical axis: Mortgage interest rate spread over the 10-year government bond rate. The synthetic 30-year mortgage yield spread is the difference between the yield on a synthetic 30-year fixed-rate mortgages and the 10-year government bond rate. All statistics are in percent.

with the notable exception of the mortgage market and banking system – the Canadian mortgage market (as noted above) is deposit-based; dominated by a few large banks; and there is very little securitization. These results suggest that branching and informational problems might make it difficult for a fully deposit-based lending system to compete with secondary market institutions in pricing long-term fixed-rate mortgages, and compete effectively.

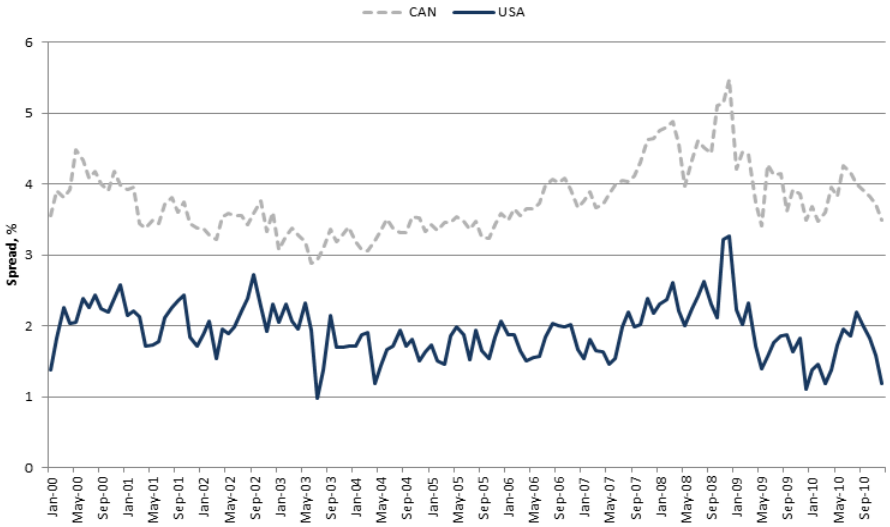


Figure 6: Plot of Actual versus Synthetic 30-year Mortgage Yield Spreads in the US and Canada. Horizontal axis: Month. Vertical axis: Mortgage interest rate spread over the 10-year government bond rate. The synthetic 30-year mortgage yield spread is the difference between the yield on a synthetic 30-year fixed-rate mortgages and the 10-year government bond rate. All statistics are in percent.

6.4 US-Australia-Switzerland Comparison

Figure 7 plots the synthetic 30-year mortgage yield spreads for Australia and Switzerland (compared to the U.S.). The interesting result here is that the mortgage yield spreads in Australia and the U.S. are quite different in magnitude. The former has a mean yield spread of 3.32% over the May 2004-December 2010 period, while the latter has a value of 1.89% over the same period.

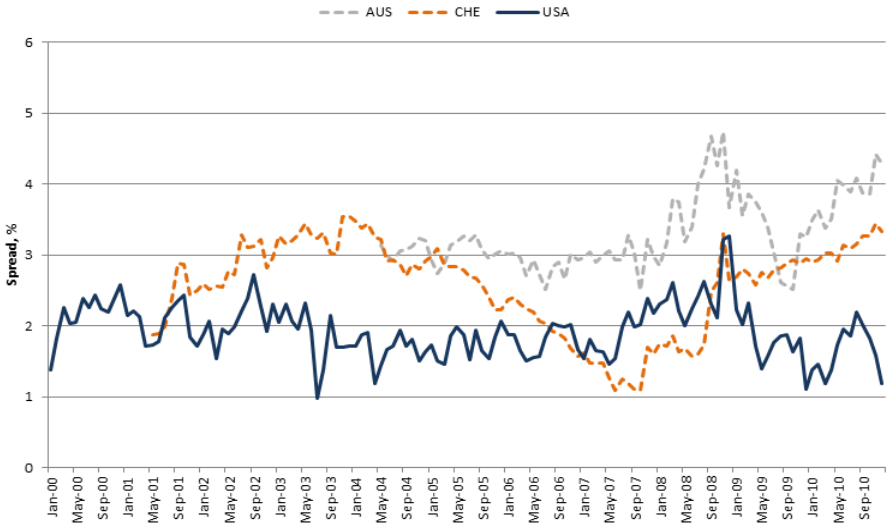


Figure 7: Plot of Actual versus Synthetic 30-year Mortgage Yield Spreads in the US, Australia, and Switzerland. Horizontal axis: Month. Vertical axis: Mortgage interest rate spread over the 10-year government bond rate. The synthetic 30-year mortgage yield spread is the difference between the yield on a synthetic 30-year fixed-rate mortgages and the 10-year government bond rate. All statistics are in percent.

Homeowner borrowing costs in Switzerland are 0.98% higher than in the U.S. over the September 2001-September 2006 period, -0.53% lower over the January 2007-September 2008 period, and 1.11% higher over the October 2008-December 2010 period. In some ways, it is odd to say that homeowner borrowing costs were lower in Switzerland than in the U.S. over the January 2007-September 2008 period, given Switzerland's unusual market structure and low ownership rate (see Bourassa and Hoesli (2006)). However, overall the mean mortgage

yield spread in Switzerland is 2.57% over the May 2001-December 2010 period, while the mean mortgage yield spread in the U.S. is 1.89%.

7. Exploring Cross-Country Differences in Homeowner Borrowing Costs

The purpose of this section is to explain the statistical procedure that will be used to test whether significant statistical differences exist between homeowner borrowing costs in the U.S. compared with costs elsewhere. I begin with the assumption that capital markets and banks can avail themselves of the same cost of funds. I then assume that there are no significant differences across countries in homeowner borrowing costs, regardless of the type of funding system that has been chosen by a country. I test this hypothesis against the alternative hypothesis that there are statistically meaningful differences.

The test I conduct consists of estimating a simple univariate ARCH model, of the following form:[20]

$$Y_{it} = \gamma_i + \beta_i X_i + \epsilon_{it},\ i = 1, 2, \ldots, n \tag{5}$$

$$\epsilon_t \mid \Lambda_{t-1} \sim N(0, \Omega_t) \tag{6}$$

$$E(\epsilon_{it} \mid \Lambda_{t-1}) = 0 \tag{7}$$

[20] This ARCH methodology was used Kim and Wallis (2005) to test whether the market for American state government bonds had higher prices (lower yields) in the U.S. than in Britain during the depression of 1839 to 1842.

$$E(\epsilon_{it}\epsilon_{jt} \mid \Lambda_{t-1}) = \Omega_{ijt} = a_{ij} + b_{ij}\epsilon_{it-1}\epsilon_{jt-1} \tag{8}$$

where the dependent variable, Y_{it}, is the (actual and/or synthetic) mortgage yield spread in country i, Λ_{t-1} is the information set at time $t-1$, γ_i is the constant term measuring the average mortgage yield spread in each country, ϵ_{it} is a market specific disturbance term, X_i equals one if it is a housing finance bubble period (from 2003 to 2006), and zero otherwise,[21] a_{ij} is the constant element of the covariance of the disturbances between country i and j, b_{ij} is an error covariance coefficient.

This model has an easy interpretation. If depository-based systems are able to do much the same thing that secondary markets do, then the null hypothesis is $\gamma_1 = \cdots = \gamma_n$ (which can be interpreted as a test of absolute purchasing power parity). Similarly, if securitization is not value enhancing for borrowers, then, again, the null hypothesis is $\gamma_1 = \cdots = \gamma_n$.

Another hypothesis is that $\beta_i < 0$ in the case of the U.S. This occurs if securitization, for example, has a tendency to create additional credit at underpriced rates in boom periods than in normal times. Furthermore, if lenders everywhere get caught up in this hubris (as in models by Gorton and He (2003), and Dell'Ariccia and Marquez (2006)) or if lenders irrationally follow other lenders for psychological reasons (as in Rajan (1994)), then $\beta_1, \cdots, \beta_n < 0$ for all i.

A final test, based on the relative purchasing power parity theory, is that $b_{ij} \sim 1$. In (5), if the relative law of one price holds in each period, then the pricing errors in Y_{it} and Y_{jt} should be related (which would mean that b_{ij} should be close to one). On the other hand, if the markets are segmented, then b_{ij} should be close to zero. Similarly, if markets are integrated, then $a_{ij} \sim 0$.

[21] These relevant bubble dates are consistent with Renaud and Kim (2007).

8. Evidence that U.S. Really has Lower Mortgage Rates

8.1 Preliminary Stationarity Tests

My first step is to perform a unit root test. While mortgage yields should possess a unit root in their autoregressive representation, mortgage yield spreads should not. The testing for a unit root in mortgage yield spreads is done using the Dickey-Fuller (1979) test.

The test results are presented in Table 1. Here I am able to reject at the 10% level the null hypothesis of a unit root for the case of the United States, Canada, Denmark, and Italy. In the case of Germany, Japan, and Finland, the unit root test hypothesis is rejected at approximately the 30% level, which in view of the relatively low power of the Dickey-Fuller test should not give great pause. For the United Kingdom, Switzerland, Spain, Belgium, France, and Sweden, the scarcity of the data do not permit a good test and the unit root test results are inconclusive. In order to address this problem, I also use panel unit root tests. The panel unit root tests (results not shown) are able to reject the null hypothesis of a unit root at the 5% confidence level.

	Test Statistic Z(t)	MacKinnon p-value	lag order
United States	-3.15	0.03	2
United Kingdom	-0.07	0.96	2
Canada	-2.59	0.09	1
Germany	-2.06	0.26	2
Denmark	-2.67	0.08	4
Switzerland	-1.23	0.68	2
Spain	-1.24	0.65	2
Belgium	-0.97	0.76	1
France	-1.42	0.56	2
Australia	-1.61	0.47	2
Italy	-2.76	0.06	2
Japan	-2.15	0.22	2
Sweden	-0.40	0.90	1
Finland	-2.35	0.15	2

Table 1: Unit Root Tests. The table shows the results of unit root tests. The tests use monthly data for April 1999-January 2003. The model estimated is

$$x = \alpha + \rho x_{-1} + \Sigma_{i=1}^{n} \alpha_i \Delta x_{-i} + \mu$$

where x refers to either the synthetic 30-year mortgage yield spread in other countries or the 30-year mortgage yield spread in the U.S., μ is a random error term, and n is the number of lagged differences needed make μ serially uncorrelated. A time trend does not enter significantly into any of the tests, so it from omitted from them to preserve the power of the tests. Statistic $Z(t)$ is the OLS t-test of $\rho = 1$. According to MacKinnon (1991), the 1% (10%) critical value of the performed Dickey-Fuller test statistic is -3.47 (-2.58).

8.2 ARCH Regression Model Results

I now turn to the univariate ARCH results. For these results, I proceed as follows. First, I provide a set of thirteen paired regression tests of $Y_{it} = \gamma_i + \epsilon_{it}$, where I compare homeowner borrowing costs in each country to the homeowner borrowing costs in the United States as the reference group.[22] Here I assume $E(\epsilon_{it}) = a_{ij} + b_{ij}\epsilon_{it-1}\epsilon_{jt-1}$. I then ask whether a_{ij} is close

[22] I settled on this approach rather than on a matched-panel data approach so as not to lose too many observations. This helps matters in getting better (i.e., more precise) estimates.

to zero and b_{ij} is close to one. Next, I re-estimate the model including X_i as a right-hand side variable to control for the housing finance bubble in the U.S. between 2003 and 2006.

The results of estimating the model over the full sample period for each country are presented in Table 2. The statistics reported in the first column are estimates of γ_1 for the U.S. The second column reports estimates of γ_2 for foreign markets. Columns (3)-(8) report the estimates of a_{ij} and b_{ij}. The final column reports the time period.

Table 2 highlights several crucially important facts. First, the values of b_{ij} are, on average, positive and significant. The average of b_{12} – which measures the extent to which the determinants of $y - r$ are common across different markets – is 0.20; and excluding the case of Japan, it is 0.39. When (5)-(8) is estimated for the sample period 2000.1-2006.12, evidence of commonality in $y - r$ between the U.S. and Japan is quite strong. The estimate of b_{12} is 1.1 and statistically significant at the 1% level. Second, the values of a_{ij} – the constant covariance of returns in the different markets – are very close to zero, and none is statistically significant. For example, the average of a_{12} is -0.026, with a low of -0.1 in Australia and a high of 0.02 in Belgium. Third, the estimate of volatility clustering in the U.S. – i.e., the extent to which large changes in $y - r$ are followed by more large changes in $y - r$ – is captured by the coefficient b_{11}. The average value of b_{11} is 0.22 and statistically significant at the 5% level. Fourth, foreign markets show a similarly positive ARCH effect, as measured by the coefficient b_{22}. The average of b_{22} is 0.38 and statistically significant at the 5% level.

Country	γ_1	γ_2	a_{11}	b_{11}	a_{12}	b_{12}	a_{22}	b_{22}	Time Period
United Kingdom	1.9	2.71	-0.04	0.24	-0.02	0.25	-0.88	0.57	1999.4-2010.12
	(5.08)	(2.09)	(-1.15)	(1.81)	(-0.3)	(3.01)	(-4.8)	(9.6)	
Canada	1.9	3.72	-0.05	0.25	-0.09	0.48	0.11	0.5	1999.1-2010.12
	(5.10)	(7.76)	(-1.36)	(1.88)	(-1.4)	(3.8)	(1.4)	(4.8)	
Germany	1.88	2.63	-0.09	0.27	0.01	0.02	0.06	0.57	2001.11-2010.12
	(4.94)	(4.34)	(-2.22)	(1.98)	(0.1)	(0.040	(0.8)	(5.7)	
Denmark	1.89	2.79	-0.11	0.26	-0.01	0.44	0.16	0.55	2001.4-2002.4 and 2002.7-2010.11
	(4.88)	(3.90)	(-2.50)	(1.90)	(-0.1)	(3.3)	(2.8)	(13.4)	
Switzerland	1.89	2.57	-0.09	0.26	0.02	0.67	-0.05	0.87	2001.5-2010.12
	(4.98)	(3.98)	(-2.13)	(1.95)	(0.3)	(3.4)	(-0.5)	(3.2)	
Spain	1.84	3.39	-0.12	0.33	-0.03	0.17	0.77	0.18	2003.4-2008.7
	(4.75)	(2.30)	(-2.73)	(2.32)	(-0.5)	(4.5)	(6.2)	(16.6)	
Belgium	1.93	3.74	-0.05	-0.09	0.04	0.42	0.07	0.49	2000.3-2010.12
	(5.10)	(1.72)	(-1.35)	(-0.43)	(0.7)	(3.5)	(0.8)	(13.3)	
France	1.9	2.85	-0.04	0.24	0.01	0.27	0.54	0.31	1999.4-2010.12
	(5.08)	(2.53)	(-1.15)	(1.81)	(0.3)	(4.2)	(6.6)	(16.8)	
Australia	1.86	3.29	-0.1	0.35	-0.1	0.75	-0.03	0.54	2004.5-2010.12
	(4.79)	(6.38)	(-1.97)	(2.29)	(-1.8)	(4.9)	(-0.4)	(4.1)	
Italy	1.91	2.28	-0.05	0.25	-0.07	0.53	(0.13)	0.72	1999.11-2010.12
	(5.03)	(4.49)	(-1.33)	(1.87)	(-1.1)	(3.6)	(-2.0)	(5.7)	
Japan	1.95	1.25	-0.24	0.08	-0.05	-2.04	0.01	-1.46	1999.8-2007.2 and 2008.2-2010.12
	(5.05)	(16.12)	(-3.52)	(0.45)	(-0.9)	(-4.4)	(0.2)	(-3.7)	
Sweden	1.93	2.17	-0.08	0.17	-0.02	0.46	-0.08	0.86	2005.6-2010.2
	(4.68)	(3.57)	(-1.28)	(2.04)	(-.3)	(3.3)	(-1.1)	(8.50	
Finland	1.93	2.95	-0.07	0.26	-0.04	0.23	0.65	0.25	2000.3-2010.12
	(5.16)	(3.11)	(-1.85)	(2.00)	(-0.8)	(4.7)	(6.8)	(12.4)	

Table 2: Univariate ARCH Results. The results are for the regression $Y_{it} = \gamma_i + \epsilon_{it}$, where $E(\epsilon_{it}) = a_{ij} + b_{ij}\epsilon_{it-1}\epsilon_{jt-1}$, where Y_{it} is the interest rate spread (over the 10-year government bond rate) on mortgages in country i. The regressions are estimated separately, with each country compared to the United States as a reference group ($i = 1$ for the US). Values of γ_1 and γ_2 are in percent. t-statistics are reported in parentheses.

I am now in a position to examine whether homeowner borrowing costs become cheaper in boom periods and whether the declines have a tendency to be larger in a security-based system where originated loans are sold in a secondary market, and where there are less incentives to undertake careful underwriting. Both hypotheses are probable. For example, bank lending models by Bernanke and Gertler (1989), Rajan (1994), Ruckes (1998), Gorton and He (2003), and Dell'Ariccia and Marquez (2006) find that normal banking behavior leads to boom-bust credit cycles. In addition, Dell'Ariccia, Igan, and Laeven (2008) find that credit booms and declines in lending standards are larger in markets where lenders sell a larger proportion of originated loans compared with markets where a high proportion of originated loans are held largely by depository-based institutions, operating with virtually no secondary market. The essence of Dell'Ariccia, Igan, and Laeven's (2008) argument is that, in a depository-based system, lenders have a strong incentive to undertake careful underwriting because all loans are kept in-house. In contrast, in a security-based system where originated loans are sold in a secondary market, there are less incentives to undertake careful underwriting because the lender is simply paid an up-front fee, without any back-end compensation depending upon performance, for delivering the loan. I test for these tendencies by adding a dummy variable to the regression model. This indicator variable is coded 1 for the housing finance bubble between 2003 and 2006 and zero otherwise.

Country	X	Full Period	For Period Ending in 2007	For Period After 2008.9
United Kingdom	-1.52	0.8	0.17	3.36
	(-7.80)	(7.05)	(3.68)	(22.58)
Canada	-0.44	1.82	1.69	2.21
	(-6.11)	(35.67)	(36.10)	(15.64)
Germany	0.63	0.76	0.91	0.77
	(6.37)	(11.08)	(11.34)	(6.29)
Denmark	0.05	0.9	0.96	0.43
	(0.36)	(11.11)	(9.33)	(2.96)
Switzerland	-0.09	0.68	0.67	1.11
	(-0.72)	(9.70)	(8.04)	(10.10)
Spain	-2.21	1.55	0.8	3.45
	(-9.42)	(9.78)	(6.24)	(21.03)
Belgium	-0.36	1.81	1.42	2.09
	(-1.54)	(9.38)	(12.81)	(15.20)
France	0.07	0.95	0.7	2.45
	(0.34)	(9.46)	(7.52)	(13.36)
Australia	-0.63	1.43	1.21	1.82
	(-6.08)	(19.78)	(27.23)	(12.50)
Italy	-0.4	0.36	0.38	0.46
	(-4.91)	(6.59)	(6.04)	(3.25)
Japan	-0.23	-0.71	0.06	-0.61
	(-5.03)	(-7.85)	(1.46)	(-5.90)
Sweden	-0.85	0.24	0.02	1.02
	(-6.26)	(2.46)	(0.29)	(6.56)
Finland	-0.77	1.03	0.79	2.12
	(-4.72)	(11.49)	(8.64)	(12.00)
USA	-0.26			
	(-3.76)			

Table 3: Estimates of Mean Effects. Column 1 reports the results of estimating the coefficient β_i in equation (5). Columns 2-4 reports the results of t-tests for paired differences in $\gamma_2 - \gamma_1$ for each country for the full sample regression and two subsample regressions. Values of β_i and $\gamma_1 - \gamma_2$ are in percent. t-statistics are reported in parentheses.

Column 1 of Table 3 shows the results of estimating the coefficient β_i in equation (5). Columns 2-4 reports the results of t-tests for the difference $\gamma_2 - \gamma_1$ for each country for the full sample regression and two subsample regressions. Estimated values of β_i are negative and statistically significant (with t-values between -3.7 and -9.4) in all countries except Germany, Denmark, and France. These results are consistent with the broader literature suggesting that lending standards declined in most markets during the housing finance bubble period 2003-2006. Interestingly enough, the largest declines occur in the United Kingdom, Spain, Australia, Sweden, and Finland.

The values of $\gamma_2 - \gamma_1$ are positive in the full sample regression for all countries except Japan. The average of $\gamma_2 - \gamma_1$ for the full sample is 0.89% and statistically significant. The t-values range from a low of 2.5 in Sweden to a high of 35.7 in Canada. In the case of Japan, the value of $\gamma_2 - \gamma_1$ for the full sample is -0.71 and statistically significant at the 1% level. However, the most interesting result in Table 3 is the estimate of $\gamma_2 - \gamma_1$ for the sample period after 2008.9 (the current, still-indefinite Fannie/Freddie conservatorship period). The estimate of $\gamma_2 - \gamma_1$ for the sample period after 2008.9 is greater than that of $\gamma_2 - \gamma_1$ for the full sample in every country except Germany, and generally by a substantial amount. The average of $\gamma_2 - \gamma_1$ for the Fannie/Freddie conservatorship period is 1.59%, 0.7% greater than the average of $\gamma_2 - \gamma_1$ for the full sample. Of course, one would naturally expect an increase in $\gamma_2 - \gamma_1$ in this new era, since Fannie Mae and Freddie Mac now enjoy the full faith and credit guarantee of the Federal government. For the sample period ending 2007.12, the average of $\gamma_2 - \gamma_1$ is 0.75%, making the difference in $\gamma_2 - \gamma_1$ between the pre-conservatorship era and post 2008.9 period equal to 0.84%, on average. This latter result has several important policy implications, which I turn to next.

9. The Counterfactual Experiment

Suppose, hypothetically, that the Bush Administration had not taken over Fannie Mae and Freddie Mac in September 2008. In the absence of this takeover, the presumption is that the 30-year fixed mortgage rate in the U.S. would have been higher; and this would not necessarily have been good for housing affordability. To determine how much worse the situation would have been, I perform the following counterfactual analysis. First, I compute counterfactual values for the 30-year fixed mortgage rate in the U.S. Here I start with the actual 30-year fixed mortgage rate path over the full sample period 1996-2010. I then assume that had the federal government's takeover of Fannie Mae and Freddie Mac not occurred the 30-year fixed mortgage rate would have been 1.59% higher, on average, during the subsample period 2008-2010 (see Table 3). Next, I compute the ratio of median income to the amount of qualified income that would have been needed to purchase the median-priced home, on the assumption of a 20% down payment and a mortgage-payment-to-income ratio of 0.25. I then compare the results to the actual affordability of housing based on the actual 30-year fixed mortgage rate and housing costs. In what follows, I also compare the results to what housing affordability would have been if the 30-year mortgage rate were more like the synthetic 30-year mortgage yield that existed outside the U.S. over the subsample period 1998-2007 and then remains at this level over the subsample period 2008-2010. In these first two simulations, all the other exogenous variables remain the same.

I start by looking at the actual housing affordability index for the U.S. over the full sample period 1996-2010. The actual index – the dark line – goes from a low of 115 in 2000.Q3 to a high of 138 in 2004.Q1, to a low of 95 in 2006.Q2, and to 176 in 2010.Q3. The reasons for the increase in recent years are several. The median priced resale home in the U.S., as reported

by the National Association of Realtors (NAR), has fallen from a peak of $254,000 in 2005.Q4 to a low of $180,000 in 2010.Q3, a cumulative decline of 30%. In addition, median income has gone from $50,000 in 2000.Q4, to $60,000 in 2006.Q4, and to $64,000 in 2010.Q3. At the same time, effective interest rates on 30-year conventional, fixed-rate mortgages were 8.2% in 2000.Q2, but then receded to 5.7% in 2004.Q2, and then increased to 6.7% in 2007.Q3, before steadily receding to 4.8% in 2010.Q3. The joint effect of declining house prices and declining interest rates has lowered how much of family income is required for mortgage payments on the median loan from a peak of 22% of income in 2000.Q3, to a low of 18% in 2001.Q4, and then to a peak of 26% in 2006.Q2, before falling to 14% in 2010.Q3. Under these conditions, a family earning the median family income had 0.95 times the needed income to qualify for the purchase of the median-priced home in 2006.Q2 and 1.76 times the needed income in 2010.Q3.

The difference between the dark line and the solid gray line is the estimated housing affordability benefits that U.S. home buyers have generally experienced vis-à-vis foreign home buyers and had there been no need for a government bailout of Fannie Mae and Freddie Mac. The latter is calculated by supposing the 30-year fixed-rate mortgage rate in the U.S. is raised by 0.89%, on average, in both subsample periods 1996-2007 and 2008-2010. As a result of the increase in the mortgage interest rate, actual mortgage payments would rise, taking away buying power and negatively affecting affordability.

Now consider the dashed gray line. It highlights the difference between mortgage rates inside and outside the U.S. in the Fannie/Freddie conservatorship era. By providing explicit guarantees on 30-year fixed-rate mortgages, the Treasury has been able to keep mortgage rates in the U.S. low through 2010 (relative to rates outside the U.S.). These low mortgage rates

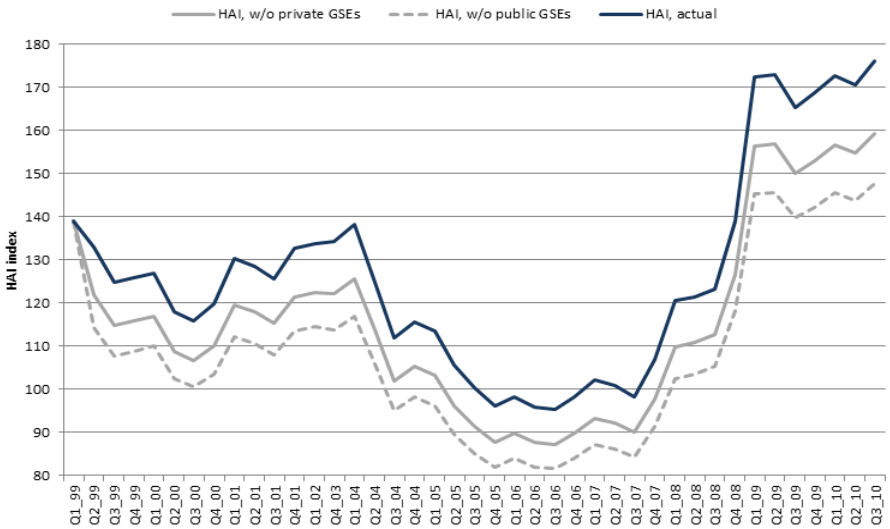


Figure 8: Plot of Actual versus Simulated Housing Affordability in the US during the 1996-2010 Period. Horizontal axis: Month. Vertical axis: Housing affordability index. The actual housing affordability index (dark line) measures whether or not a typical family could qualify for a mortgage loan on a typical home. The source of the actual housing affordability index is the National Association of Realtors. Two counterfactual housing affordability indexes are presented: one assuming the absence of Fannie Mae and Freddie Mac when they were operating as private, for-profit corporations, with an implied or implicit guarantee (solid gray line), and the other assuming the absence of Fannie Mae and Freddie Mac after the Federal Housing Finance Agency placed Fannie Mae and Freddie Mac in government conservatorship (dashed gray line). Here house prices are unchanged from their actual levels.

have positively affected housing affordability, which is what Figure 8 shows. I estimate that in the absence of the federal government's takeover of Fannie Mae and Freddie Mac housing affordability would have been about 15% lower than it actually is, such as 147 instead of 176 in 2010.Q3. Moreover, had housing affordability been worse, housing transactions would have

been even less, and the housing down-cycle would have been far worse.

Next, this counterfactual does not account for the behavior of house prices. With higher mortgage rates, house prices should fall, thereby improving housing affordability. To measure this impact, I need to identify the relation between house prices and mortgage rates. Interestingly, the slope coefficient in a univariate regression of median house prices on the mortgage interest rate is -16.8, which is statistically significant. This slope coefficient suggests that an increase in mortgage interest rates of between 0.89 and 1.59% should lower house prices by about $15,000 to $27,000, respectively. In this case, the reality is that higher mortgage rates need not decrease housing affordability. Figure 9 is laid out as Figure 8 is, showing what affordability would have been if mortgage interest rates would have been higher and house prices lower. In these simulations, the higher interest rates but lower house prices in the two different counterfactuals net out almost to the same affordability. Here I estimate that in the absence of the federal government's takeover of Fannie Mae and Freddie Mac housing affordability would have been only about 2% lower than it actually is. However, with the now lower house prices, charge-offs and single-family residential loan delinquencies would have been much higher.

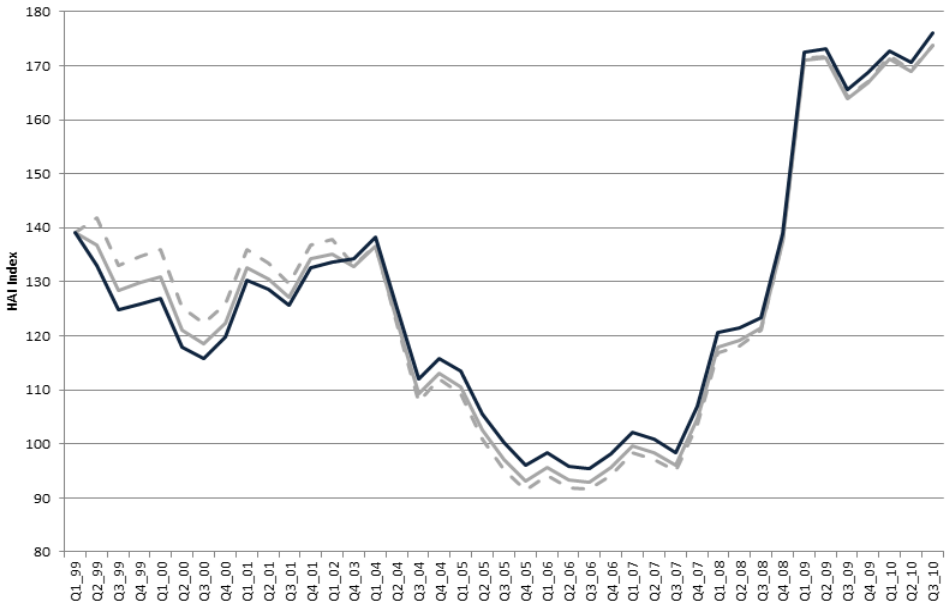


Figure 9: Plot of Actual versus Simulated Housing Affordability in the US assuming Endogenous House Prices. Horizontal axis: Month. Vertical axis: Housing affordability index. The actual housing affordability index (dark line) measures whether or not a typical family could qualify for a mortgage loan on a typical home. The source of the actual housing affordability index is the National Association of Realtors. Two counterfactual housing affordability indexes are presented: one assuming the absence of Fannie Mae and Freddie Mac when they were operating as private, for-profit corporations, with an implied or implicit guarantee (solid gray line), and the other assuming the absence of Fannie Mae and Freddie Mac after the Federal Housing Finance Agency placed Fannie Mae and Freddie Mac in government conservatorship (dashed gray line). Here changes in mortgage rates affect house prices negatively.

10. Summary and Conclusions

The purpose of this paper has been to provide evidence on the economic benefits of the federal government's takeover of Fannie Mae and Freddie Mac. In theory, there are reasons to

think that the government's takeover of Fannie Mae and Freddie Mac has lowered mortgage rates in the U.S. and made housing relatively more affordable compared with affordability elsewhere. However, previous studies have yet to examine whether the takeover of Fannie Mae and Freddie has lowered homeowner borrowing costs in the U.S., or if these changes have had an effect on housing affordability. It must also be acknowledged that previous studies have yet to demonstrate whether Fannie Mae and Freddie Mac, operating as private, for-profit corporations from 1968 (which is when Fannie Mae was made a private corporation) through 2008, or 1970 (which is when Freddie Mac was created) through 2008, were able to lower homeowner borrowing costs in the U.S. compared with costs elsewhere.

One reason for the dearth of empirical investigations on this issue is the fact that residential mortgage terms vary greatly from country to country. For example, interest rates on residential mortgages in Germany are normally fixed for a maximum of ten years, whereas most residential mortgages in the U.K. and Canada usually have fluctuating monthly payments if the prime rate moves. These differences make cross-country comparisons difficult to perform.

The current paper develops a methodology that uses synthetic mortgage yield data in different countries to test whether homeowner borrowing costs are lower in the U.S. compared with costs elsewhere. The test is then applied bilaterally vis-à-vis 13 foreign countries (United Kingdom, Canada, Germany, Denmark, Switzerland, Spain, Belgium, France, Australia, Italy, Japan, Sweden, and Finland, with the U.S. as the reference country) for January 1998 to December 2010. The estimates of a simple, univariate ARCH model, which tests whether homeowner borrowing costs are lower in the U.S., lead to the following conclusions. I find that the average mortgage rate in the U.S. today would be about 1.6% higher if a public

Fannie Mae and Freddie Mac with explicit government guarantees were taken out of the equation. I also find that, in the absence of a private Fannie Mae and Freddie Mac, mortgage rates today would be only about 0.9% higher in the U.S.

These results allow me to carry out a simple counterfactual exercise. I first construct an in-sample backcast of the mortgage rate in the U.S. under two counterfactual situations: the absence of public Fannie Mae and Freddie Mac, and the absence of private Fannie Mae and Freddie Mac. I then simulate what effect a higher mortgage rate would have on housing affordability in the U.S. I carried out these simulations by computing whether the typical household in the U.S. would have more than enough income to qualify for a mortgage loan on a median-priced home if actual lending rates charged to borrowers were higher.

Three results of the simulations seem to stand out. First, assuming no change in house prices or housing demand, the counterfactual simulations suggest that a public Fannie Mae and Freddie Mac have raised housing affordability in the U.S. by about 15% in the current environment. Second, under the same conditions of no change in house prices or housing demand, the results suggest that a private Fannie Mae and Freddie Mac have, in general, raised housing affordable in the U.S. by about 10%. Third, in simulations in which mortgage rates rise and house prices fall, the two effects net out almost to the same affordability. However, in the latter situation charge-offs and single-family residential loan delinquencies would have been much higher since house prices would have been lower.

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