Interest Rates and Consumer Choice in the Residential Mortgage Market

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Preliminary Work – Comments Welcome

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ABSTRACT

This paper estimates a coefficient of substitution between fixed rate mortgages (FRMs) and adjustable rate mortgages (ARMs), exploiting a discontinuity in legal rules governing the types of mortgages that may be purchased by the housing agencies Fannie Mae and Freddie Mac. I find that consumer choice between these two mortgages is strikingly price sensitive: a 10 basis point increase in FRM interest rates reduces the FRM market share by 10.4 percentage points. Using this coefficient, I calculate that the high FRM share in the US compared to the UK can be almost entirely explained by differences in relative mortgage interest rates, rather than household preferences. Around 30 per cent of this US-UK mortgage interest rate differential is accounted for by the difference in the secondary mortgage market conditions between the US 'conventional' and 'jumbo' markets.

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1. Introduction

Home mortgages represent a large and growing share of US consumer balance sheets. As of June 2006, US households owed 9.3 trillion dollars in residential mortgage debt, making up 73 percent of total consumer liabilities outstanding (source: Flow of Funds). Even today, most US mortgages are long-term fixed-rate contracts prepayable at little or no cost, a contract popular almost nowhere outside the United States. Home mortgages in other Anglo-Saxon countries such as the UK, Canada and Australia are generally closely tied to short-term interest rates. Although fixed-rate contracts are more common in continental Europe and Japan, they generally involve significant prepayment penalties and shorter repricing periods than in the US (Green and Wachter, 2005; European Mortgage Federation, 2006).

This continued popularity of prepayable FRMs has significant implications for consumer portfolios, bank balance sheets and the transmission of monetary policy. The effect on monetary transmission is asymmetric due to the nature of the prepayment option; overall a high share of FRMs is thought to dampen the transmission of monetary shocks (IMF, 2004; Miles, 2004), but FRM refinancing during episodes of falling long-term interest rates significantly stimulates consumption spending during such periods (Hurst and Stafford, 2004). From a lender's perspective, FRMs generate significant interest rate and prepayment risk, stimulating growth in secondary mortgage-backed securities (MBS) markets to provide ways to hedge this risk. Mortgage contracts are also relevant to discussions of optimal currency areas; in the UK, the high level of mortgage debt and low share of FRMs is considered to be a key impediment to the adoption of the Euro, since it implies UK consumption is sensitive to short-term interest rates relative to Euro-zone member countries (UK Treasury, 2003; Miles, 2004).

This paper estimates a coefficient that measures US consumers' willingness to substitute between FRMs and adjustable rate mortgages (ARMs), the main alternative contract type. My main empirical result is that consumer choice between these two contracts is surprisingly interest-rate sensitive; holding fixed the the term structure of interest rates and other time-series factors, I find that a 10 basis point increase in FRM mortgage interest rates is associated with a 10.4 percentage point decline in the FRM market share at the mean of the data.

This empirical estimate exploits a discontinuity in mortgage supply generated by legal rules that define the types of mortgages that may be purchased by the housing agencies Fannie Mae and Freddie Mac (F&F). Namely, these two institutions are prohibited from purchasing 'jumbo' mortgages larger than a certain size known as the 'conforming loan limit'; in 2005, the final year of my data, this limit is $359 650. This rule generates discontinuous changes in mortgage interest rates around the limit. Most important for the purposes of this paper, it disproportionately shifts interest rates on FRMs relative to ARMs.

Corresponding to this shift in relative interest rates, I show that the FRM share also drops discontinuously at the conforming loan limit. My central estimates imply that, holding ARM rates constant, a 17 basis point shock to FRM interest rates generates a 17.5 percentage point decline in the share of FRMs, implying a 'coefficient of substitution' of around 1 percentage point of market share per basis point shift in mortgage interest rate. Importantly, this estimate is based only on *cross-sectional* variation in mortgage supply. Thus it holds fixed all time-series factors that might influence mortgage choice, such as variation in the term structure of interest rates, compositional change in the types of households purchasing mortages, expectations about future interest rates, the state of the business cycle, and so on. (Koijen, Van Hemert and Van Nieuwerburg (2006) present a model and empirical evidence on the time-series determinants of mortgage choice; they conclude that the inflation risk premium is the main determinant of time-series variation in the FRM share).

I then conduct a range of robustness checks to check that the estimated coefficient is not an artefact of compositional shifts in borrower characteristics around the conforming loan limit. For example, I re-estimate the results using a different dataset that allows controls for a range of borrower covariates. I show that the addition of these covariates has almost no effect on the regression coefficients, suggesting that the results are not an artefact of demand-side changes in mortgage choice around the conforming loan limit.

The estimate in this paper suggests that consumer mortgage choice is strikingly price sensitive, implying that small institutional changes in the mortgage market, such as a shock to secondary market liquidity or a change in retail competition, may have significant effects on equilibrium mortgage contracts. As an application of this principle, I consider the implications of cross-country differences in mortgage pricing between the US and United Kingdom. The UK is a country with common legal and cultural origins to the US, and a similar ratio of mortgage debt to GDP, but in which FRMs, although available, have a negligible market share. Using hand-collected data, I show that US FRM mortgage interest rate spreads are relatively low compared to the UK, controlling for differences in contract features and the shape of the yield curve. Using ARMs as a baseline, FRMs are 59 basis points cheaper in the US non-jumbo market than the UK mortgage market. Applying the coefficient of substitution estimated in the first part of the paper, this interest rate differential implies that if US mortgages were priced as in the UK, the average US share of FRM originations would decline from 76 per cent to only 16 per cent.

This exercise suggests the high share of FRMs in the US compared to the UK can be mainly accounted for by differences in mortgage interest rate spreads. Comparing ARM and FRM interest rates in the US jumbo and non-jumbo markets, I estimate that around 30 per cent of this UK-US interest rate differential is accounted for by the presence of F&F in the conforming market. The other 70 per cent of the differential is most likely due to the liquidity of the US MBS market for FRMs. The US market which trades claims to 60 per cent of mortgages outstanding, compared to only 13 per cent in the UK; moreover the UK secondary market is almost completely illiquid for mortgages with a repricing period greater than a few years. (See Green and Wachter, 2004, for a summary of international differences in mortgage markets.)

The results in this paper have a number of implications for our understanding of the mortgage market and for economic policy. First, several recent papers present structural models of mortgage choice, in which mortgage interest rates enter as a model parameter (eg. Campbell and Cocco, 2003; Van Hemert, 2006). The estimate in this paper presents an empirical coefficient against which these models can be evaluated.

From a policy perspective, the high coefficient of substitution estimated in this paper suggests that policy innovations that shift mortgage supply (eg. efforts that stimulate the development of a covered bond market, or improve the liquidity of the MBS market) may have substantial effects on the types of mortgages purchased by consumers. In the UK, a government enquiry, the 'Miles commission', recently sought to understand reasons for the unpopularity of long-ter FRMs, and to recommend ways to increase their market share (Miles, 2004). The estimates in this paper suggest that efforts to improve the liquidity of the MBS market may significantly increase the FRM market share, assuming that UK mortgage demand is similarly elastic to the US.

The results in this paper also have implications for the debate over the proper role and regulation of F&F. These two institutions often cite their role in promoting the FRM and protecting households from fluctuations in short-term interest rates; for example consider the following quote from congressional testimony by the CEO of Fannie Mae, Daniel Mudd:

> *'By creating two companies that invest only in residential mortgages, Congress laid the foundation for the 30-year fixed-rate pre-payable mortgage, which is an important tool for wealth creation, stabilizing communities and neighborhoods, and allowing low-and middle-income homeowners to manage other financial obligations without having to worry about their mortgage costs changing.'* (Mudd, 2005).

My results suggest that the agencies are associated with an 18 percentage point higher FRM share in the non-jumbo market in which they are active. This provides some support for the agencies' claim that they promote the availability of FRMs to consumers. However, at least in partial equilibrium, the results suggest that F&F are not the primary explanation for the high share of FRMs in the United States, simply because FRMs are still popular in the 'jumbo' market where the agencies are not allowed to operate. A plausible proposition is that F&F were important to the initial development of the MBS market in the US, but that, now that the private-label market for FRMs is active and liquid, these institutions are no longer essential to the continued availability of long-term prepayable FRM contracts.

The rest of this paper proceeds as follows. Section 2 reviews background information and academic literature on F&F. Section 3 explains the empirical strategy. Section 4 estimates how the FRM share shifts around the conforming loan limit. Section 5 estimates how interest rates on FRMs and ARMs shift around the conforming loan limit, and calculates the coefficient of substitution between these two contract types. Section 6 compares the UK and US mortgage markets. Section 7 concludes.

2. Background on F&F and Related Literature

F&F were founded as government agencies charged to improve liquidity in the residential mortgage market and improve home ownership amongst low- and middle-income households; Fannie Mae was founded in 1938, Freddie Mac in 1970. Today, F&F are publicly traded, commercial financial enterprises that underwrite nearly half of all US home mortgage debt outstanding. Although no longer government owned, F&F's Congressional charters restrict their range of business activities and the types of mortgages they may purchase, and directs them to make special efforts to improve the availability of mortgage finance to low- and middle-income households. See Green and Wachter (2005) for more institutional details and further references.

Reflecting their history and special status, F&F are classified as Government Sponsored Enterprises (GSEs). Debt issued by F&F is often perceived as carrying an implicit government guarantee, partially because of F&Fs background as government agencies, and partially due to their sheer size and systemic importance. F&F enjoy other advantages also; for example, mortgage-backed securities (MBS) issued by F&F attract a lower risk-rating than MBS issued by other financial institutions for the purposes of calculating risk-weighted capital. Reflecting these factors, F&F are able to raise debt finance at lower interest rates than other large US financial institutions.

F&F's charters disallow them from purchasing 'jumbo' loans larger than a conforming loan limit set by OFHEO, their regulator. OFHEO adjusts this limit on January 1 of each calendar year to reflect movements in average house prices. In 2005, the last year of my sample, the conforming loan limit for a single unit dwelling is \$359 650 (it was raised to \$417 000 in 2006).

Several papers study whether F&F improve mortgage affordability by comparing mortgage interest rates on 30 year FRMs above and below the conforming loan threshold (Blinder, Flannery and Lockhart 2006; Passmore, Sherlund and Burgess 2005; Ambrose, LaCour-Little and Sanders, 2004; Hendershott and Shilling, 1989). Estimates vary across these different studies, but in general suggest that F&F reduce 30-year FRM rates in the non-jumbo sector by 15-30 basis points. A recent paper by Loutskina and Strahan (2006) finds that liquidity-constrained banks apply more stringent loan approval standards to jumbo loans, which are more difficult and expensive to sell into the secondary mortgage market.

Like several of these papers, I also exploit the discontinuity in mortgage supply generated by the conforming loan limit, but to study a quite different set of questions. I estimate how the conforming loan limit affects the market shares of different mortgage contracts, as well as the overall share of FRMs relative to ARMs. I then estimate how mortgage interest rates change at the conforming loan limit for each of these different contracts. Combining these estimates, I calculate a coefficient of substitution between ARMs and FRMs.

The fact that F&F are profitably able to reduce primary mortgage interest rates in the non-jumbo sector likely reflects a combination of inter-related factors, including: (i) market perceptions that MBS issued by F&F carry little or no credit risk (ii) F&F's low cost of debt finance, (iii) the liquidity of the secondary market for MBS issued by F&F (iv) any comparative advantage that F&F have in managing interest rate risk and prepayment risk for mortgages held on-balance-sheet. This paper remains agnostic on which of these factors are most important, and on the debate over the size of F&Fs implicit government guarantee (see Blinder, Flannery and Kamihachi, 2004, Passmore, 2003, and Kane, 1999 for contributions to this debate and links to further literature).

Little research attention has been directed towards studying how F&F affect the market share of different mortgage contracts. Berkovec, Kogut and Nothaft (2002) is the most closely related contribution that I am aware of. These authors estimate time-series models of the ARM share in the conforming, jumbo and FHA markets. They find some differences in the way the ARM share moves with interest rates across these different markets, and note that that the raw share of ARMs is substantially higher in the jumbo market. Berkovec, Kogut and Nothaft's focus on time series variation in the ARM share is, however, quite different to the analysis in this paper. There are also substantial differences in methodology; for example, they do not use microeconomic data, or examine behavior around the conforming loan limit.

2.1 F&F and the mortgage contract mix

What influence do F&F have on the market shares of different mortgage contracts in the non-jumbo market? One plausible hypothesis is that they actually have little or no effect; perhaps F&F simply provide a proportionate subsidy for all types of mortgages, leaving the market shares of different contracts unchanged?

The most likely alternative hypothesis is that the 'gains from trade' between mortgage originators and F&F are largest for long-maturity FRMs, because such contracts expose the originator to a substantial amount of interest rate risk and prepayment risk. Bank balance sheets are generally characterized by maturity mismatch, where medium and long term fixed rate assets such as FRMs are funded by short-term deposits, leaving bank profits exposed to rising interest rates. Wright and Houpt (1996) and Sierra and Yaeger (2004) present evidence that commercial banks and particularly savings banks are subject to maturity mismatch. The interest rate risk embedded in an FRM is particularly complex, since it depends on the non-linear relationship between mortgage prepayment rates and the term structure of interest rates, borrower demographics, the age structure of the mortgage portfolio, and the distribution of original coupon rates.

FRMs also expose the mortgage originator to pure prepayment risk, that is, systematic fluctuations in prepayment rates that are orthogonal to movements in interest rates. Gabaix, Krishnamurthy and Vigneron (2006) present evidence that pure prepayment risk is priced in MBS yields, reflecting financial constraints amongst MBS arbitrageurs.

Since interest rate risk and prepayment risk are most significant for long-term FRMs, lenders have strong incentives to securitize such mortgages. This is consistent with the data; between 1990 and 2002, ARMs made up around 25 per cent of mortgage originations, but only 10 per cent of securitization activity (Gabriel, 2003). By this argument, any factor that makes mortgage securitization cheaper or easier, such as the market presence of F&F, should disproportionately affect the supply of FRMs, the mortgages for which the 'demand for securitization' is greatest.

As well as securitizing mortgage pools, F&F also hold around $1.5tr of mortgages on-balance-sheet (OFHEO, 2006, Table 24). One explanation for the size of these portfolios is that F&F have a comparative advantage in managing mortgage prepayment risk and interest rate risk due to their size and sophistication, and that F&F perform a 'buffer-stock' role by purchasing mortgages during times of MBS market illiquidity, such as the period after the LTCM and Russian crises of 1998 (Syron, 2005). A less sanguine 'risk-shifting' perspective is that F&F have incentives to hold excessive interest rate and prepayment risk because part of the risk is implicitly government-guaranteed.

3. Empirical strategy

In the next two sections I estimate how the market share of FRMs, and the mortgage interest rate on FRMs relative to ARMs, change at the conforming loan limit. I present several pieces of evidence to demonstrate that these changes reflect a shift in mortgage supply due to the presence of F&F in the non-jumbo sector, rather than a shift in mortgage demand. Under this identifying assumption, by comparing market shares and interest rates on either side of the conforming loan limit, we are tracing out the slope of the demand curve for FRMs, and can calculate a coefficient of substitution between the two contracts.

I assume the data is generated by the following reduced form model of mortgage choice:

$$[1] \quad P(FRM) = \Phi[\ \alpha_0 + \beta.(m.rate_{FRM} - m.rate_{ARM}) + \alpha_1 \text{ borrower \& loan controls} + \alpha_2 \text{ time dummies} + e\ ]$$

This equation posits that the probability of selecting a FRM rather than an ARM depends on the mortgage interest rate differential between the two mortgage types ($m.rate_{FRM} - m.rate_{ARM}$), a set of borrower and loan controls, and time dummies. This model can be viewed as a reduced form approximation to a structural model of mortgage choice such as Campbell and Cocco (2003).

$m.rate_{FRM}$ and $m.rate_{ARM}$ in equation [1] are measured for a fixed reference borrower (ie. these interest rates should be thought of as quoted 'prime' interest rates for a borrower with a particular fixed level of credit risk, prepayment risk and so on). Individual borrower characteristics that shift the household's mortgage interest rate relative to these reference rates would then be reflected in 'borrower & loan controls'. A primary coefficient of interest in equation [1] is the 'coefficient of substitution' β, which measures the sensitivity of demand for FRMs to a 1 unit change in FRM interest rates relative to ARM rates.

Data on ($m.rate_{FRM} - m.rate_{ARM}$) is needed to estimate equation [1] and identify β. One possible strategy would be to use time-series variation in the spread of different mortgages over an appropriate risk free rate. However, this approach is not feasible if time dummies are included in the specification, as they are in equation [1]. Including the time dummies seems essential, to soak up time series variation in expectations about future interest rates, shifts in mortgage preferences and so on.

The alternative approach pursued here is to consider the presence of F&F in the non-jumbo market as an exogenous shock that differentially shifts interest rates on FRMs relative to ARMs. The identifying assumption underlying this strategy is that the shift in the FRM share exactly at the limit reflects only a supply-side shift in mortgage interest rates, rather than a discontinuous jump in household preferences. If we denote by Δ the shift in interest rates on FRMs relative to ARMs at the conforming loan limit [ie. $\Delta = (m.rate_{FRM,jumbo} - m.rate_{FRM,non\text{-}jumbo}) - (\Delta m.rate_{ARM,jumbo} - \Delta m.rate_{ARM,non\text{-}jumbo})$], then equation 1 can be rewritten as:

$$[1a] \qquad P(FRM) = \Phi[\alpha_0 + \delta.jumbo + \alpha_1 \text{ . borrower \& loan controls} + \alpha^*_2 \text{ time dummy} + e]$$

where $\delta = \beta.\Delta$, and 'jumbo' is a dummy variable equal to 1 if the loan size is above the conforming loan limit. In Section 4, I estimate equation [1a] and obtain an estimate of δ. In Section 5, I estimate Δ, the shift in interest rates on FRMs compared to ARMs at the conforming loan limit. Taking the ratio δ / Δ recovers the coefficient of substitution β.

4. FRM market share effects around the conforming loan limit

In this section I study how the share of FRMs and ARMs shifts around the conforming loan limit. The primary source of data is the Monthly Interest Rate Survey (MIRS), although I also utilize two other sources of mortgage data, the Survey of Consumer Finances (SCF) and the Residential Finance Survey (RFS).

The estimates in this section help us to estimate the coefficient of substitution β, as described above. However, the results in this section are also of substantial independent interest. A large negative coefficient on δ implies that F&F significantly increase the share of FRMs in the non-jumbo market, consistent with claims made by the agencies themselves that their securitization activities help stimulate US demand for FRMs.

4.1 The Monthly Interest Rate Survey (MIRS)

The MIRS is a microeconomic survey of home mortgage terms collected and maintained by the Federal Home Financing Board. Each month, the MIRS surveys a sample of commercial banks, savings banks and mortgage companies, who report terms and conditions on first-lien mortgages closed out during the last five business days of the previous month. The MIRS survey includes only single-family, fully amortized, purchase-money, nonfarm loans, and also excludes FHA-insured and VA-guaranteed loans, multifamily loans, mobile home loans, and refinancings. Although data is available from the 1970s onwards, the MIRS sample used here begins in January 1992, after the survey methodology was reformed, and the MIRS began to report additional information on the repricing of ARMs.

The MIRS has several attractive features for studying patterns in mortgage contracts. It is a large dataset (around 3 million mortgage observations collected monthly over a continuous period between January 1992 and October 2005), and surveys lenders rather than borrowers (lenders are likely in a better position to report precise information about mortgage characteristics). The survey reports many key features of the mortgage contract, such as the mortgage size and term, the initial interest rate, the date at which the interest rate first adjusts, the frequency of subsequent adjustments, and the value of the property that secures the loan. The lender institution type is reported (eg. commercial bank, mortgage company etc.), although the individual identity of the lender is not. The main disadvantage of the dataset is the lack of mortgageholder characteristics. In particular, there is no explicit measure of borrower creditworthiness such as a FICO score.

From the original MIRS dataset, I drop loans not within 20-200 per cent of the conforming loan threshold, and loans where the loan-to-valuation ratio (LTV, ie. the ratio of the loan size to the mortgaged property value) is below 20 per cent or above 97 per cent. These LTV filters are applied because loans with a very low loan-to-valuation ratio are likely to be refinancings that are mistakenly reported as new loans, while on the other end, omitted variable problems due to the lack of credit risk controls are likely to be most important for highly leveraged mortgages.

[INSERT TABLE 1 HERE]

Weighted summary statistics are presented in Table 1. The upper part of the table summarizes the full pooled sample. 76 per cent of contracts are FRMs. Mortgages have an average real principal of $148.7 thousand, the average LTV is 77.6 per cent, and the average loan term is 27.2 years. Around 9 per cent of originations are for amounts above the conforming loan threshold. The table also shows how the threshold itself has evolved over the sample period; in nominal dollars increasing from $202 300 in 1986 to $359 650 in 2005.

The lower parts of the table present summary statistics for the subsamples of FRMs and ARMs. ARMs are substantially larger on average, $188 thousand compared to $132 thousand for FRMs. Nearly all ARMs have 30-year terms (the average is 29.6 years). FRMs have an average term of 26.9 years.

4.2 *The FRM share at the conforming loan limit*

A simple plot of the data illustrates the striking shift in the FRM share at the conforming loan limit. For each year, I group mortgages into 1 percentage point 'buckets' based on loan size relative to the limit (ie. loans with principal between 50-51 per cent of the conforming loan limit in the relevant year are grouped together, 51-52 per cent etc.). I then calculate the raw percentage of fixed rate mortgages in each bucket for each year. The results are plotted in Figure 1 below.

[INSERT FIGURE 1 HERE]

The y-axis of the chart is the proportion of fixed rate mortgages, while the x-axis is loan size divided by the conforming loan limit. The FRM share is plotted separately for each year between 1992-2005 (the thin lines) along with the average across all years (the thick black line).

Differences for a given bucket across different years reflect the substantial time series variation in the FRM share, which has fluctuated between 30-90 per cent since 1981, the first year mortgage lenders were legally permitted to originate ARMs. The average across years reveals a slight but steady negative relationship between loan size and the market share of FRMs. More striking however is the sharp drop in the FRM share observed at the conforming loan limit. This decline in the FRM share occurs exactly at the limit in every year, and resembles a step function – the share of FRMs falls by approximately 20 percentage points, and remains permanently lower for all loan buckets above the conforming loan limit.

Also evident is an upward spike in the FRM share just below the limit, and an 'excess dip' just above (flattening out around 104 per cent of the conforming loan limit). This instability very close to the limit reflects the fact that loan size is to some extent a choice variable of the borrower. A household who finds themselves needing a mortgage just larger than the conforming loan limit has various options to reduce their mortgage size, such as selling other assets, borrowing from family or friends, taking out a small second-lien mortgage, or buying a slightly smaller house. Taking these steps to reduce the mortgage size will be more attractive if the household intends to take out an FRM, because the difference between jumbo and non-jumbo interest rates is larger for FRMs than ARMs

(This is shown directly in Section 5). To minimize any bias induced by this endogeneity, I drop mortgages between 98-104 per cent of the conforming loan limit, the region where this substitution appears to occur based on Figure 1.

4.3 Probit model

I estimate the following model of mortgage choice, which is an empirical version of equation [1a] discussed in section 3:

$$[2] \quad P(FRM) = \Phi[\, b_0 + b_1 .\ \text{loan size dummies} + b_2 \log(\text{loan size}) + b_3\ \text{real loan size} + b_4\ LTV + b_5 \log(1+LTV) + b_6\ \text{lender dummies} + b_7 .\ \text{new house dummy} + b_8 .\ \text{month/year dummies} + b_9 .\ \text{state dummies} + b_{10} .\ \text{FHFB district dummies} + e]$$

'Loan size dummies' is a series of dummies defined relative to the conforming loan limit for the calendar year in question. Separate dummies are defined for loans between 80 and 90 per cent, 90 to 100 per cent, 100 to 110 per cent, 110-120 per cent and > 120 per cent of the conforming loan limit. The omitted category is loans less than 80 per cent of the limit. (N.B. As shorthand, I refer to the dummy for loans between 80 and 90 per cent of the conforming loan limit as 'dummy80', and so on.). The discontinuity at the conforming loan limit is measured by (dummy100 – dummy90).

The two loan size variables (real loan size and log[real loan size]) are intended to capture any smooth underlying relationship between loan size and mortgage choice outcomes, while the loan size dummies will reflect any discontinuity in mortgage choice at the conforming loan limit. If the model is correctly specified, the coefficients on the loan size dummies should resemble a step function. Namely, the coefficients on dummy80 and dummy90 will be close to zero, and there will be a statistically significant coefficient of approximately similar size on dummy100, dummy110 and dummy120, reflecting a permanent shift in the FRM share once the conforming loan threshold has been crossed.

4.4 Probit results

Results from estimating equation [2] using a probit are presented in Table 2 below. To account for cross-sectional dependence in the standard errors, coefficients are estimated using the two-step procedure proposed by Fama and MacBeth (1973). In the first step, separate cross-sectional probit regressions are estimated for each year (in fact, a weighted probit is estimated using the MIRS sampling weights), and marginal effects of each covariate on the dependent variable are calculated. In the second step, I calculate time-series sample means of these cross-sectional marginal effects, as well as the standard deviations of these means.

[INSERT TABLE 2 HERE]

As the table shows, the coefficients on the loan size dummies do resemble a step function as predicted. Coefficients on dummy80 and dummy90 are close to zero, while coefficients on dummy100, dummy110 and dummy120 are negative and significantly significant.

The difference 'dummy100 – dummy90' measures the effect of the discontinuity at the conforming loan limit, the empirical counterpart to the parameter δ from equation [1a]. This estimate indicates that the FRM share is 17.5 percentage points lower just above the conforming loan limit than just below it. Since the non-jumbo ARM share is 22.5 per cent, this implies that conditional on other covariates, ARMs are nearly nearly twice as common above the limit as below it (40 per cent compared to 22.5 per cent).

4.5 Multinomial logit estimation

I now repeat the analysis using a finer breakdown of mortgage contracts. I categorize the data into 9 different contracts, listed in Table 3 below along with their share of the total weighted sample size [N.B. I use an *x* / *y* nomenclature for ARMs, where *x* is the number of years until the mortgage first reprices, and *y* is the periodicity of subsequent repricings measured in years]:

[INSERT TABLE 3 HERE]

Table 3 shows that the 30-year FRM is by far the most popular single contract, with nearly a 60 percent market share. This is followed by a 15 year FRM and 1/1 ARM.

I now estimate a multinomial logit model of mortgage choice, based on this 9-contract classification system. As before, loans between 98-104% of the conforming loan limit are excluded, and the same Fama-MacBeth procedure is used for estimation (ie. I estimate cross-sectional multinomial logits year-by-year, calculate marginal effects, and then compute time-series averages and standard deviations of these marginal effects).

Results are presented in Table 4. The table includes a column for each contract; the dependent variable in each column is the probability of that contract being selected. For expositional purposes, the table also includes an additional column which sums the coefficients across all contracts of that type (ie. FRM or ARM).

[INSERT TABLE 4 HERE]

As the table shows, the coefficients for each individual contract do also resemble a step function. Coefficients on dummy80 and dummy90 are generally close to zero, while coefficients on dummy100, dummy110 and dummy120 are significantly different from zero.

The conditional share of each of the five ARM contract is statistically significantly higher above the conforming loan limit than below it. The percentage point increase in market share is largest for 5/1 ARMs (3.5 percentage points). Conversely, with one exception the share of every FRM contract is lower above the limit. The exception is mortgages with maturity between 15-30 years, which make up only 2.5 per cent of the overall market; the coefficient for this mortgage type is not statistically significant. Around three-quarters of this change comes from a decline in the share of 30 year FRMs at the conforming loan limit.

These results highlight in more detail how F&F's securitization activities shift the equilibrium share of different mortgage types. It shows that F&F are associated with an increase in the share of all fixed rate contracts, not just the 30 year FRM, and reduce the market share of both hybrid mortgages (eg. 5/1 ARMs) as well as mortgages that reprice more frequently.

4.6 Evidence from other surveys

Since our goal is to isolate the supply-side effect of F&F on contract shares, we ideally wish to compare mortgage contracts for otherwise identical borrowers, one group just above the conforming loan limit, the other just below the limit. It seems unlikely that differences in borrower characteristics could account for more than a small part of the sharp discontinuities observed in Figure 1. However, the MIRS contains no borrower demographic characteristics, which limits our ability to rule out this hypothesis entirely.

To confront the lack of borrower characteristics, and as a robustness check on the results presented so far, I now present empirical estimates from two other data sources, the Survey of Consumer Finances (SCF), and the Residential Finance Survey (RFS). The SCF is a triennial survey of the balance sheet, pension, income, and other demographic characteristics of U.S. families, collected by the Federal Reserve Board. The RFS is a national sample survey of residential properties, conducted every 10 years as part of the Census. Both these surveys contain microeconomic data on mortgages held by individual families, they also include a large set of borrower covariates.

Two probit models of the FRM-ARM choice are estimated for each survey. The first specification in each pair includes only the right-hand-side variables available in the MIRS. The second specification adds a range of household covariates, such as income, household size, sex, age, risk aversion and so on. Results are presented in Table 5. To conserve space, only the 'jumbo dummy' coefficient estimate is presented in the Table. The full set of estimates is available on request, however.

The first two columns are based on SCF data. The SCF sample size is 2875, pooled from five SCF surveys conducted triennially between 1989 and 2001. Column 1 controls only for variables available in the MIRS dataset. The probit specification essentially copies the MIRS probit model (equation [2]), using a somewhat more parsimonious functional form because of the smaller sample size. The dependent variable is equal to 1 for a FRM, and 0 for an ARM. The right-hand-side variables are a 'jumbo' dummy (ie. a dummy equal to one if the loan size exceeds the conforming loan limit), as well as ln(real loan size), LTV, dummies for the financial institution type of the lender, region dummies and year dummies. A weighted probit is used, using the weights provided with the SCF and employing the repeat imputation procedure recommended for SCF data (see Kennickell, 1998, for details).

[INSERT TABLE 5 HERE]

The jumbo dummy in Column 1 is negative and statistically significant at the 1 per cent level. The point estimate is -0.123, somewhat smaller than the MIRS estimate of -0.175, although not statistically different to it at even the 10 per cent level. The smaller coefficient estimate is likely in part due to measurement error. The SCF asks households to self-report the initial size of their mortgage; any error in these self-reports will cause misclassification between jumbo and non-jumbo mortgages, leading to attenuation bias in the estimated coefficient.

Column 2 includes all the right-hand size variables from Column 1, as well as a set of household characteristics not available in the MIRS, including ln(household income), household size, household leverage, a self-employment dummy, measures of credit constraints and two mobility variables (a full list of the variables included is provided at the bottom of Table 5). The intention is to see whether adding these variables has a significant effect on the jumbo dummy coefficient. If it did, this would suggest that the lack of household characteristics in MIRS imparts a significant bias in the conforming loan limit estimate. Fortunately, this is not the case. The coefficient in Column 2 is economically similar to column 1, -0.112 compared to -0.123, and certainly not statistically different from it.

Columns 3 and 4 repeat the same analysis using the RFS. Data is drawn from merging the two most recent RFS waves (1991 and 2001). The sample size is 6297, as before, a weighted probit is used. The results are similar to the SCF estimates. The coefficient on the jumbo dummy is -0.154 when controlling only for variables available in the MIRS dataset (Column 3). This coefficient is similar to the MIRS estimate, and significantly different from zero at the 1 per cent level. But the coefficient barely changes if additional household covariates are included, it ticks marginally downwards to -0.150 (Column 4).

Thus, the size of the RFS and SCF coefficients are consistent with the MIRS estimates presented earlier. Also, it appears from these results that the lack of borrower covariates in the MIRS likely induces only a small bias in those results, since the RFS and SCF estimates are almost invariant to the exclusion or inclusion of borrower controls. Both these pieces of evidence are consistent with a purely supply-side interpretation of the MIRS results.

The last column of Table 5 includes three additional variables available in the RFS that identify the receiver of loan payments on the mortgage. These estimates show directly that F&F disproportionately purchase FRMs relative to ARMs. A mortgage whose loan payments are received by a GSE (ie. F&F) is 15 percentage points more likely to involve a fixed interest rate. The 'Jumbo' dummy becomes much smaller, but is still negative and statistically significant, probably reflecting the competitive effects of F&F on the pricing of other non-jumbo mortgages.

4.7 Stocks versus flows

The evidence presented so far is based on mortgage originations, that is, the *flow* of new mortgages. It does not necessarily correspond to how the conforming loan limit affects the *stock* of outstanding ARMs and FRMs, because different types of mortgages prepay at different rates. To obtain a stock-based estimate, I re-estimate the SCF probit regression using a sample of all outstanding mortgages, not just mortgages originated in the past three years. The estimated jumbo coefficient is –0.140, with a z-statistic of 4.32. This implies that, controlling for loan size and borrower characteristics, loans whose original principal was above the conforming loan limit are 14 percentage points more likely to involve an adjustable interest rate. This is below the MIRS flow-based estimate, but above the SCF flow-based estimate. Thus, the stock estimate is quite close to the flow estimates presented earlier. The SCF estimates are likely to be somewhat attenuated because the original loan size is self-reported by the mortgageholder, as discused above.

5. Interest rate effects around the conforming loan threshold

The previous section established that ARMs are substantially more popular relative to FRMs just above the conforming loan threshold than just below it. This shift in market shares is large, discontinuous and occurs exactly at the conforming loan limit in each year of the sample, suggesting that it reflects a shift in mortgage supply due to the market presence of F&F in the non-jumbo sector. (Also consistent with this supply-side view, the shift in market shares is entirely robust to controlling for an exhaustive set of borrower and loan characteristics, as demonstrated in the SCF and RFS regressions presented in Table 5).

Under this supply-side interpretation, the observed shift in market shares at the conforming loan limit is due to households moving along their mortgage demand curve in response to a shift in relative interest rates on ARMs compared to FRMs. This section estimates the size of these interest rate effects. In terms of the econometric model in Section 3, our goal is to estimate the parameter Δ, the change in FRM rates at the conforming loan limit relative to the change in ARM rates. In the last part of the section, combining interest rate and market share estimates, I calculate β, the coefficient of substitution between FRMs and ARMs.

5.1 Estimates based on Bankrate data

Mortgage interest rate data comes from Bankrate, a private company that collects, aggregates and reports interest rate information on financial services products. Bankrate conducts a weekly national survey of quoted mortgage rates for most popular home mortgages in the conventional and jumbo markets. An important feature of the survey is that Bankrate stipulates in great detail the contractual details of the mortgage to be priced. For conventional mortgages, terms include the following: 0-2 point mortgage, a customer with whom the bank has no prior relationship, a loan size between \$165 000 – \$359 650, lock-in period of 30-60 days, loan-to-valuation ratio of 20 per cent, and FICO score in the range 650-719. Up-front points or administrative charges are amortized into the quoted interest rate assuming a loan life of 10 years. For jumbo mortgages, exactly the same putative contract terms are used, except that the loan size range is \$359 651 – \$650 000. Thus, the Bankrate interest rate is conditioned on several variables not available in the MIRS, most importantly the borrower's FICO rating (ie. a measure of borrower credit quality), and the extent of any prior bank-borrower relationship.

Interest rate data was collected from Bankrate's website (bankrate.com) for four popular mortgage contracts: 30 year FRMs, 15 year FRMs, 5/1 ARMs and 1/1 ARMs. Monthly observations were downloaded for a 12-month period between November 2004 – October 2005. Summary statistics are presented in Table 6.

[INSERT TABLE 6 HERE]

The table shows a monotonically declining relationship between the repricing interval of the mortgage, and the wedge between interest rates in the conforming and jumbo markets. For 30 year FRMs, the average difference between the two markets is 27 basis points. For 15 year FRMs it is 24 basis points. For 5/1 ARMs it is 11 basis points while for 1/1 ARMs it is only 9 basis points.

Weighting this data by the market shares of each contract, this data implies that the conforming loan limit shifts interest rates on FRMs by 26.5 basis points, and interest rates on ARMs by 9.7 basis points, a difference of 16.8 basis points. These results confirm the hypothesis that F&F do not simply subsidize all mortgages equally. Instead, the results show that these two institutions disproportionately act on the supply of FRMs, since interest rates on FRMs change disproportionately as the conforming loan limit is crossed.

5.2 Estimates based on the MIRS

The MIRS itself also includes mortgage interest rate data. Unlike the Bankrate data, the MIRS is not conditioned on borrower credit quality, bank-firm relationships, or most of the other loan terms listed in the Bankrate survey. The mortgage market share results were shown to be nearly invariant to the inclusion of borrower controls. However for modelling interest rates, the lack of borrower controls in the MIRS is likely to be much more significant, because mortgage interest rates are likely to be very sensitive to these omitted factors relative to the interest rate shock induced by the conforming loan limit.

With this caveat in mind, I estimate mortgage pricing regressions for each of the 9 mortgage categories from Table 3. The dependent variable in each regression is the effective mortgage interest rate on the loan. This effective interest rate amortizes any up-front fees or points into the mortgage interest rate over a 10 year period. I use the same set of right-hand side variables as in Equation 1, and results are estimated using the Fama and MacBeth (1973) approach as before. The estimates are presented in Table 5.

[INSERT TABLE 7 HERE]

As for the regressions in Section 3, the key coefficient is the difference between the coefficients on dummy90 and dummy100, which measures the effect of the conforming loan limit on mortgage interest rates. This estimated coefficient is positive in every case, and statistically different from zero for six of nine contracts, suggesting that F&F do shift out the supply curve of each of the nine contracts. More importantly, as with the Bankrate data, the shift in supply is larger for the FRM contracts than for either ARM contract. The difference [dummy100 – dummy90] is 19.0 basis points and 18.8 basis points for the 30 year and 15 year FRM contracts respectively (the two most popular FRM categories). For the three most popular ARM contracts (5/1 ARM, 1/1 ARM and ARM with initial repricing period of less than 1 year) the shift in interest rates is substantially smaller, 10.7, 13.7 and 0.18 basis points respectively. The weighted average effect of the conforming loan limit on FRM interest rates is 18.3 basis points, on ARM interest rates it is 9.9 basis points.

Thus, MIRS and Bankrate produce similar estimates for ARMs, but for FRMs the Bankrate estimates are about 10 basis points larger. The existing literature measuring the passthrough of F&Fs' implicit subsidy to mortgage consumers suggests a possible reason for this divergence. This literature essentially estimates the first column of table 5 (ie. they study the conforming-jumbo interest rate spread for 30 year FRMs). Using the MIRS, Passmore, Sherlund and Burgess (2005) estimate a coefficient of 15-17 basis points, quite similar to Table 5 (19.0 basis points). However, Sanders (2005) argues that this estimate is biased downwards because the MIRS does not allow controls for borrower credit quality. He cites Ambrose, LaCour-Little and Sanders (2004) who estimate a larger effect of the limit (28 basis points) based on a bank dataset that allows them to control for the borrower's FICO score.

This estimate is consistent with Blinder, Flannery and Kamihachi (2004), who conclude that the jumbo-conforming spread for 30 year FRMs is 26-29 basis points. Blinder, Flannery and Lockhart (2006) estimate the jumbo-conforming spread for 30 year FRMs to be 25 basis points using MIRS data, but applying a different empirical approach to Passmore, Sherlund and Burgess (2003). Since these estimates are very close to the Bankrate estimate of 27 basis points, I focus on the Bankrate estimates as the preferred measure of the jumbo-conforming spread.

5.3 *Implied coefficient of substitution between ARMs and FRMs*

The results so far are summarized in Figure 2, which plots the demand and supply for FRMs and ARMs in the jumbo and conforming markets. The identifying assumption is that the shift in mortgage interest rates at the conforming loan limit is due only to the supply-side effect of F&F. Under this assumption, the observed differences in mortgage interest rates and market shares observed at the conforming loan limit reflect consumers moving along their demand curves in response to a change in relative interest rates on FRMs and ARMs, as plotted in the diagram.

The Bankrate data implies that conforming loan limit shifts mortgage interest rates on FRMs by 26.5 basis points, and interest rates on ARMs by 9.7 basis points, a difference of 16.8 basis points (the difference between the two supply curves on the diagram). Based on the estimates in Section 4, this change in relative mortgage interest rates induces a 17.5 percentage point fall in the FRM share (shown on the x-axis on the diagram).

[INSERT FIGURE 2 HERE]

The ratio of these two numbers is the coefficient of substitution between ARMs and FRMs, defined as the percentage point change in the FRM market share for a one basis point increase in FRM interest rates relative to ARM interest rates. N.B. This is simply the parameter β from equation [1], expressed in terms of a marginal effect on the aggregate FRM market share.

$$\begin{aligned}\text{coefficient of substitution } (\beta) &= \left| \frac{\Delta \text{ FRM market share (per cent)}}{\Delta \text{ FRM interest rate - } \Delta \text{ ARM interest rate (basis points)}} \right| \\ &= \left| \frac{-17.5}{26.5-9.7} \right| \\ &= 1.04\end{aligned}$$

As shown above, the estimated coefficient is 1.04. That is, a 10 basis point increase in FRM relative interest rates ($m.rate_{FRM}$ – $m.rate_{ARM}$) implies a 10.4 percentage point decline in the FRM share.

5.4 Discussion

This estimated coefficient of substitution presented above appears large, given that movements in FRM mortgage interest rate spreads of 50-100 basis points or more are not uncommon in the data. However, it must be emphasized that these fluctuations mainly reflect changes in the term structure of interest rates, which in turn are driven by fluctuations in inflation risk premia, expectations about future interest rates and so on. The correct interpretation of the coefficient in this paper is that it reflects the sensitivity of mortgage choice to changes in retail mortgage interest rates conditional on the shape of the yield curve. Thus, this coefficient provides an appropriate estimate of how supply-side changes in the mortgage market, such as an increased willingness of lenders to originate FRMs, influence consumer choice. The estimates in this paper are thus quite complementary to Koijen, Van Hemert and Van Nieuwerburgh (2006), who study how macroeconomic factors influence the time-series share of FRMs.

It is also worth noting that, although the high estimated coefficient suggests many consumers are nearly indifferent between ARMs and FRMs, small interest rate differentials compounded over a long period of time are substantial in dollar terms. For a family who plans to borrow $300,000 using a 30 year FRM at a 6 per cent interest rate, an increase of 20 basis points in this rate increases their yearly repayment by $464. The net present value of this amount over 30 years is $6448. Put in these terms, it seems plausible that such amounts could be large enough to induce 20 per cent of households to switch between an ARM and FRM, consistent with the size of the estimated coefficient in this paper.

Although I am unaware of other estimates of the cofficient of substitution estimated in a similar way to this paper, some previous papers studying the determinants of individual FRM-ARM choice have included aggregate mortgage interest rate variables in the regression, and interpreted their statistical significance as being evidence of consumers substituting between the two mortgage types due to shifts in relative prices (Dhillon, Shilling and Sirmans, 1987; Brueckner and Follain, 1988). However, these papers rely on on time-series variation in mortgage interest rates, and thus are subject to the critique that their measure of interest rate differentials is correlated with many other factors that move through time not related to the true cost of mortgage finance (eg. movements in interest rates, expectations, consumer tastes etc.).

An obvious use of the coefficient in this paper would be in predicting how supply-side shocks to the mortgage market influence the share of different mortgage contracts. For example, Gabaix and Krishnamurthy (2005) show that the market value of prepayment risk fluctuates in response to the financial position of market-makers in the MBS market. This coefficient allows the effect of such changes to be mapped into contract shares in the primary mortgage market.

Secondly, the coefficient may be useful for evaluating structural models of mortgage choice, such as Campbell and Cocco (2003) and Van Hemert (2006). Namely, the interest rates on ARMs and FRMs relative to the risk free rate are parameters entered into their model, which is calibrated against US data. If the model is well specified, changing these parameters should yield predicted changes in the FRM share that are consistent with the coefficient of substitution estimated here.

Thirdly, this estimated coefficient may help provide insights into the cross-country differences in mortgage markets. In this vein, in the next section, I study differences differences between mortgages in the US (where FRMs predominate) and UK (where ARMs are most common). I show that the FRMs are comparatively more expensive in the UK, controlling for differences in contract features and the shape of the yield curve. Applying the coefficient estimated in this paper, I find that these differences in mortgage interest rates are large enough to explain most of the higher FRM share in the US compared to the UK.

6. Application: Comparing UK and US mortgage markets

The enduring popularity of long-term, prepayable FRMs in the US is quite striking by comparison to other advanced economies. Green and Wachter (2005) document the diversity of mortgage contracts across a sample of 13 industrialized countries. The US is one of only two countries where long-term FRMs without substantial prepayment penalties predominate. Campbell and Cocco (2003) note that: '*long-term nominal fixed-rate mortgages are almost unknown in the United Kingdom and Canada. An interesting area for future research will be to relate these international differences in prevailing mortgage contracts to differences in the risk management problem that households face*'.

This section applies the coefficient of substitution estimated above to shed further light on international differences in mortgage contracts. I focus on a comparison of the US and UK. The UK is used as a point of comparison because it is a large economy with a sophisticated financial system and a comparable mortgage debt to GDP ratio to the US, as well as readily available mortgage interest rate data. Also, UK policymakers have in recent years focused substantial policy attention on fixed rate mortgages, for example, the 'Miles Review' was commissioned in 2003 by the Blair government to provide policy suggestions for increasing the FRM share (Miles, 2004). High levels of adjustable rate debt in the UK are perceived to be a source of economic and housing market instability, and a significant impediment to joining the Euro, since fixed rate contracts and smaller mortgages are the norm in existing Euro-zone countries (UK Treasury, 2003).

I begin by estimating the extent to which differences in mortgage market shares between the US and UK are accounted for by differences in mortgage interest rates on ARMs and FRMs, rather than differences in consumer preferences (eg. because of differences in risk aversion or income volatility). I hand-collect data on UK FRM and ARM rates, and compare their pricing to bankrate.com data for the US. Using the estimated coefficient of substitution between these two mortgage types, this difference in relative interest rates can be translated into a predicted difference in FRM market shares. That is I calculate the predicted US FRM share if US mortgages were priced as in the UK. Any remaining difference in FRM shares *beyond* that predicted by interest rate differentials is then presumed to be due to differences in consumer preferences.

6.1 Calculation

The calculation involves the following steps:

Step 1. Calculate the difference between mortgage rates and a risk free rate of the same repricing period for ARMs and FRMs in the US and UK. Data on UK ARM and FRM interest margins is drawn from two sources. First, the Bank of England conducts a monthly survey of quoted mortgage interest rates for four popular ARM products (those with repricing intervals of 2, 3, 5 and 10 years). This data is then supplemented with mortgage quotes hand-collected directly from the websites of around 15 major UK mortgage lenders at two different times, November 2005 and February 2006. This hand-collected data allows comparison of a wider range of mortgage products than the Bank of England survey, namely mortgages with an initial repricing period of 15, 20 and 25 years, which are excluded from the BOE survey, most likely because their historical share of the UK mortgage market is very low. US data comes from Bankrate; I take daily averages of mortgage interest rates over a period from mid-November 2005 to mid-February 2006.

The spreads of these mortgage interest rates are then simply calculated by subtracting the yield of a government security with term equal to the repricing period of the mortgage. For the 'difference-in-differences' calculation, I use the average spreads on ARMs with 2, 3 and 5 year initial repricing periods in both countries to measure the average ARM spread, and averages of the 15, 20 and 25 year contracts to measure the FRM spread (I exclude the 30 year rate because 30 year FRMs are not offered in the UK). Bankrate does not provide data on 2/1 ARMs or 25 year FRMs for the US, so I approximate these respective spreads by taking a simple average on the spread of 1/1 ARMs and 3/1 ARMs, and the spread on 20 year FRMs and 30 year FRMs.

Step 2. Adjust UK mortgage rates for the value of the prepayment option on US FRMs. FRMs in the US are prepayable at little or no cost, allowing mortgageholders to strategically refinance during periods of low interest rates. This is not the case in the UK, where prepayment involves very high prepayment penalties, making such strategic refinancing unprofitable except in exceptional circumstances. Thus, for the FRM rates to be directly comparable, I must adjust the UK rates for the value of the prepayment option.

The prepayment option is valued using data on the option-adjusted-spread (OAS) of MBS pools. The OAS is estimated by estimating prepayment probability distributions using a prepayment model, then calculating the present value of those payments using a term structure model (Gabaix, Krishnamurthy and Vigneron, 2005, for more details). The OAS measures the component of the MBS spread that is not accounted for by the present value of the prepayment option, while the difference between the raw MBS spread and OAS spread measures the present value of the prepayment option itself, expressed in basis points. I use data from Bloomberg on the raw and option-adjusted spreads of new pools of MBS backed by 30 year FRMs and 15 year FRMs. This data was collected in January 2006. I then add the difference between these two spreads to the corresponding mortgage interest rates on UK FRMs (linearly interpolating to estimate the value of the prepayment option for 20 year and 25 year FRMs). The output from Steps 1 and 2 is presented in Table 8 below.

[INSERT TABLE 8 HERE]

Step 3. Calculate the FRM margin minus ARM margin in the UK. Subtract the corresponding differential in the US (ie. calculate [$m_{UK,\ FRM}$ - $m_{UK,\ ARM}$] – [$m_{US,\ FRM}$ - $m_{US,\ ARM}$]). Looking at Table 7, FRMs in the UK are priced on average 134 basis points above the risk free interest rate (taking the US prepayment option into account), while ARMs are priced 49 basis points above the risk free rate. The difference is 85 basis points. In the US, FRMs are priced 89 basis points above the risk free rate, compared to 62 basis points from ARMs, a difference of 27 basis points. The difference between these two FRM-ARM differentials is 85 – 27 = 58 basis points. In words, FRMs are 58 basis points more expensive than ARMs in the UK, compared to the corresponding FRM-ARM differential in the US.

Step 4. Multiply this 'difference in difference' estimate by the coefficient of substitution between ARMs and FRMs. How would the share of FRMs in the US change if mortgages were priced in the same way as in the UK? The coefficient of substitution between ARMs and FRMs estimated in Section 4 is 1.04. Thus, a change in FRM interest rates relative to ARM rates implies a 58 x 1.04 = 60 percentage point lower FRM share of mortgage originations in the US. The average FRM share in the MIRS is 76 percentage points, this implies a predicted US FRM share of 76 – 60 = 16 percent if the FRM rates compared to ARM rates were priced as in the UK. The actual UK FRM share is very close to zero. Thus, this calculation suggests that most, although not all, of the higher FRMs in the US compared to the UK is accounted for by interest rate differentials.

6.2 Discussion

The estimates presented above suggest that relative differences in the pricing of FRMs compared to ARMs in the US relative to the UK are large enough to explain around 80 per cent of the high US FRM share.

In turn, the estimates presented earlier in this paper suggest that about 25-30 per cent of the difference in mortgage interest rates can be ascribed directly to F&F. Namely, the US FRM-ARM interest rate differential is 17 basis points larger above the conforming loan limit, compared to an overall difference of 60 basis points between the US and UK.

The remaining 43 basis points (ie. 60 – 17) is likely due to other supply-side factors. Disentangling these factors is left to future research. However, one likely explanation is the less-active mortgage-backed securities market in the UK compared to the US. UK MBS represent only around 5 per cent of mortgage balances (UK Treasury, 2003), compared to 65 per cent of mortgages outstanding in the US (source: Flow of Funds, March 2006). In particular, there is no liquid market at all for securitizing FRMs in the UK.

An intriguing possibility is that there may be some path-dependence in the FRM share. If a country starts from an equilibrium in which FRMs are rare, then the secondary market for such mortgages is likely to be small and illiquid, and there will also be less product market competition for these instruments. These factors in turn make FRMs more expensive, keeping their market share low, and reinforcing the illiquidity of the secondary mortgage market.

7. Conclusions

For many consumers, the choice of home mortgage is likely to be the single most important factor determining the household's exposure to interest rate risk. This paper estimates that households' choice of mortgage is surprisingly price-sensitive: a 10 basis point increase in FRM interest rates increases the probability that the household will choose an ARM by 10.4 percentage points.

This high estimated coefficient of substitution implies that the aggregate share of FRMs and ARMs will be very sensitive to shifts in relative mortgage interest rates. In the second part of this paper, I show that FRMs are priced relatively cheaply in the US relative to the UK; using ARMs as a benchmark, FRM interest rates are 59 basis points lower in the US non-jumbo market than in the UK, after controlling for the yield curve and differences in contract features. Applying the coefficient of substitution estimated in the first part of the paper implies that if US mortgages were priced as in the UK, the US FRM share would fall from 76 per cent to only 16 per cent.

Around 30 per cent of this interest rate differential is directly accounted for by the lower FRM interest rates in the non-jumbo market, suggesting F&F do play a significant role in redistributing interest rate risk between borrowers and lenders in the US. However, F&F do not explain the bulk of the difference in contracts compared to the UK, since FRMs are still popular in the 'jumbo' market where the agencies do not operate. The other 70 per cent of the interest rate differential likely at least in part reflects the liquidity of the MBS market even for non-conforming FRMs. This allows financial institutions to diversify the prepayment risk and interest rate risk of these contracts, an option not available to mortgage originators in the UK.

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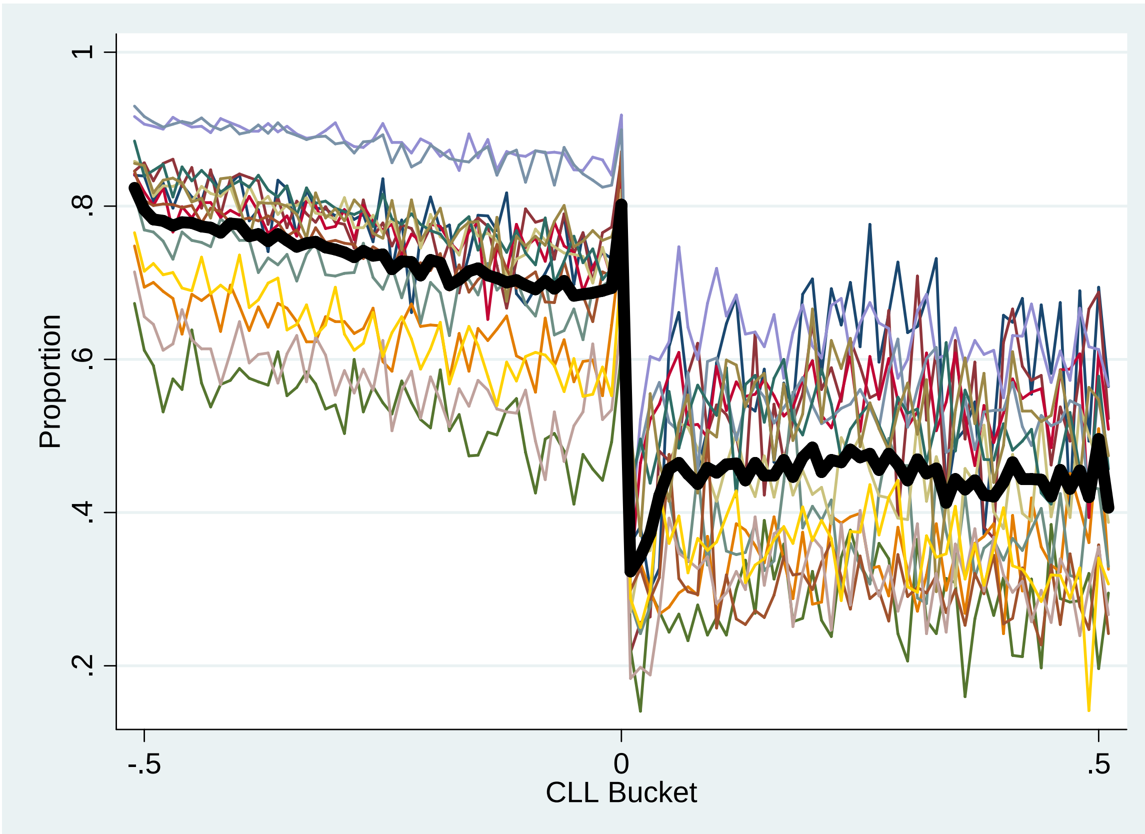
Figure 1: Effect of conforming loan limit on share of fixed rate mortages



Notes:

1. 'CLL Bucket' is defined in percentage terms relative to the conforming loan limit. For, example, CLL bucket = 0 refers to the proportion of fixed rate mortgages for loans between 99 and 100 per cent of the CLL in that given year. Thus, the graph covers loans between 50 and 150 per cent of the conforming loan limit.

2. Graph is based on MIRS data from 1986 to 2005.

Figure 2: Effect of conforming loan limit on interest rate and market share of ARMs and FRMs

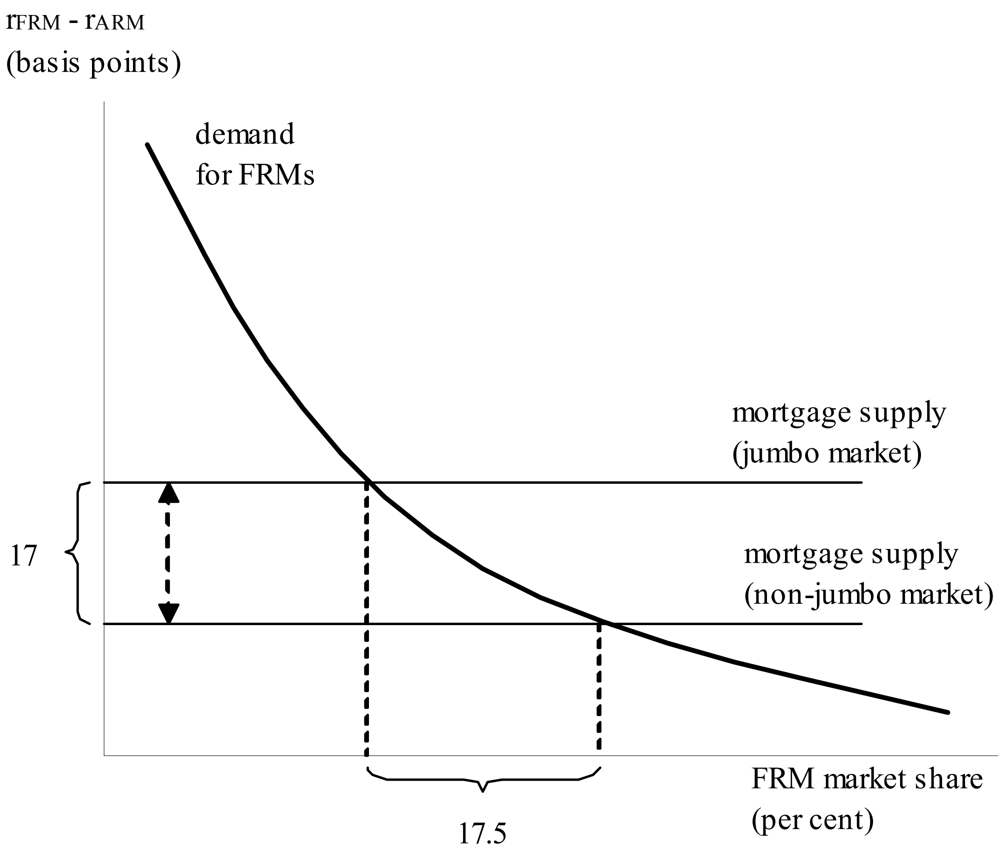


Table 1: MIRS Descriptive Statistics

A: Summary of Loans - All types

year	loan principal (nominal, 000s)	loan principal (real, 000s)	term	LTV	conforming loan limit (000s)	sample size	proportion jumbo loans	market share by lender type: mortgage co.	comm. bank	thrifts	share FRMs
1992	109.4	134.2	25.5	76.5	202.3	125098	7%	51%	22%	27%	80%
1993	107.9	128.5	25.6	77.3	203.2	141444	7%	51%	23%	26%	80%
1994	111.2	129.2	27.2	79.6	203.2	149831	8%	52%	26%	22%	60%
1995	111.6	126.1	27.5	79.8	203.2	125756	8%	52%	27%	21%	68%
1996	120.3	132.1	27.0	79.0	207.0	130001	10%	57%	24%	19%	73%
1997	128.3	137.5	27.6	79.2	214.6	179212	10%	55%	25%	20%	78%
1998	133.8	141.3	27.9	78.8	227.2	268640	9%	58%	17%	25%	88%
1999	141.1	146.0	28.3	78.8	240.0	248016	10%	58%	18%	24%	79%
2000	151.4	151.3	28.8	78.5	252.7	247612	10%	64%	16%	21%	75%
2001	160.3	155.9	27.8	77.1	275.0	291101	8%	64%	17%	20%	88%
2002	170.0	162.7	27.6	75.8	300.7	331679	8%	57%	22%	21%	82%
2003	177.4	166.1	27.4	75.2	322.7	384798	7%	54%	24%	22%	81%
2004	195.8	178.3	28.4	76.2	333.7	250398	11%	53%	24%	23%	63%
2005	218.1	192.9	28.8	75.0	359.7	172673	12%	52%	25%	24%	68%
Average	**145.5**	**148.7**	**27.5**	**77.6**	**253.2**	**217590**	**9%**	**56%**	**22%**	**23%**	**76%**

B: Summary of Loans - FRM only

year	loan principal (nominal, 000s)	loan principal (real, 000s)	term	LTV	conforming loan limit (000s)	sample size	proportion jumbo loans	market share by lender type: mortgage co.	comm. bank	thrifts
1992	105.1	128.9	24.5	76.5	202.3	90563	5%	59%	21%	21%
1993	102.7	122.3	24.8	77.4	203.2	105440	4%	59%	22%	19%
1994	97.6	113.6	25.8	79.3	203.2	74878	4%	63%	24%	13%
1995	100.7	113.7	26.5	79.4	203.2	75858	4%	61%	25%	14%
1996	108.6	119.4	26.2	78.7	207.0	85754	5%	67%	20%	13%
1997	120.5	129.1	27.0	79.2	214.6	133945	7%	62%	26%	13%
1998	127.0	134.1	27.6	79.0	227.2	236346	6%	62%	18%	20%
1999	128.4	133.0	27.9	79.1	240.0	193155	5%	67%	18%	15%
2000	132.4	132.2	28.4	78.9	252.7	175234	4%	74%	16%	10%
2001	148.5	144.4	27.5	77.2	275.0	246847	5%	67%	17%	16%
2002	155.5	148.7	27.1	75.7	300.7	252157	5%	60%	23%	17%
2003	165.5	155.0	26.8	74.9	322.7	301896	5%	56%	25%	20%
2004	169.7	154.6	27.6	75.3	333.7	143751	5%	56%	27%	17%
2005	190.3	168.2	28.2	74.4	359.7	110888	6%	54%	27%	19%
Average	**132.3**	**135.5**	**26.9**	**77.5**	**253.2**	**159051**	**5%**	**62%**	**22%**	**16%**

C: Summary of Loans - ARM only

year	loan principal (nominal, 000s)	loan principal (real, 000s)	term	LTV	conforming loan limit (000s)	sample size	proportion jumbo loans	market share by lender type: mortgage co.	comm. bank	thrifts
1992	126.4	154.9	29.2	76.5	202.3	34535	14%	19%	27%	53%
1993	128.8	153.4	29.0	76.9	203.2	36004	16%	21%	26%	53%
1994	131.7	152.7	29.3	80.0	203.2	74953	15%	35%	29%	36%
1995	134.6	152.4	29.4	80.6	203.2	49898	17%	33%	33%	34%
1996	152.0	166.7	29.1	80.0	207.0	44247	23%	31%	32%	37%
1997	156.6	168.0	29.5	79.5	214.6	45267	22%	33%	22%	45%
1998	182.1	192.4	29.7	77.7	227.2	32294	29%	25%	12%	63%
1999	188.8	194.9	29.8	77.7	240.0	54861	27%	25%	18%	58%
2000	209.4	209.5	29.9	77.1	252.7	72378	30%	31%	14%	55%
2001	244.0	237.2	29.8	76.1	275.0	44254	34%	39%	15%	46%
2002	237.3	227.1	29.8	76.3	300.7	79522	24%	38%	17%	44%
2003	228.4	213.7	29.7	76.8	322.7	82902	19%	49%	20%	32%
2004	240.4	218.8	29.9	77.7	333.7	106647	20%	48%	18%	34%
2005	277.2	245.2	30.0	76.1	359.7	61785	25%	46%	21%	33%
Average	**188.4**	**191.9**	**29.6**	**77.8**	**253.2**	**58539**	**22%**	**34%**	**22%**	**44%**

Table 2: ARM-FRM Mortgage Choice Results, MIRS

Dependent variable = 1 if fixed rate mortgage (FRM), =0 if adjustable rate mortgage (ARM). Regression estimated using a Fama-MacBeth (1973) two step procedure. In the first step, estimates are results from a cross sectional weighted probit regression, using the sample weights provided in the MIRS. Coefficients are normalized to reflect marginal effects. Omitted dummy variable categories: loan is less than 80% of CLL, lender is commercial bank. Regressions also include month-year dummies, FHLB sales district dummies, and state dummmies (coefficients not reported, available on request). Regression excludes loans between 98-104 per cent of the conforming loan limit.

Loan size relative to conforming loan limit (CLL):	
between 80-90% of CLL	-0.006***
	(0.001)
between 90-100% of CLL	-0.008*
	(0.003)
between 100-110% of CLL	-0.183***
	(0.021)
between 110-120% of CLL	-0.170***
	(0.020)
> 120% of CLL	-0.149***
	(0.021)
Effect of conforming loan limit:	-0.175***
100-110 minus 90-100	(0.019)
Loan to valuation ratio:	
LTV ratio	0.413**
	(0.119)
ln(1+LTV)	-0.328***
	(0.067)
Other loan covariates:	
Lender is mortgage company	0.114**
	(0.037)
Lender is savings bank	-0.179***
	(0.020)
Real loan principal (000s, $2001)	-0.002
	(0.015)
ln(Loan principal)	-0.109**
	(0.034)
New House dummy	0.004
	(0.007)
R^2	0.203

Table 3: Contract Shares, MIRS

Contract	% of sample
30 year FRM	57.6
FRM with term between 15-30 years	2.5
15 year FRM	12.3
FRMs with term less than 15 years	1.2
ARM, intial repricing period > 5 years	2.9
5/1 ARMs	4.9
ARM, initial repricing period >1 but <5 years	3.3
1/1 ARMs	9.7
ARMs with initial repricing period < 1 year	5.7

Table 4: Multinomial Choice Model, MIRS (9 contracts)

Dependent variable is dummy variable equal to one if the mortgage is of the type indicated. Regression estimated using a Fama-MacBeth (1973) two step procedure. Coefficients are normalized to reflect marginal effects. First step estimates based on a multinomial logit model. Omitted dummy variable categories: loan is less than 80% of CLL, lender is commercial bank. Regressions also include month-year dummies, FHLB sales district dummies, and state dummmies (coefficients not reported, available on request). Regression excludes loans between 98-104 per cent of the conforming loan limit.

	Fixed rate mortgages					Adjustable rate mortgages					
	30 year	15-30 year	15 year	<15 year	**SUM**	> 5 year	5/1	1-5 year	1/1	< 1 year	**SUM**
Loan size relative to conforming loan limit (CLL):											
between 80-90% of CLL	-0.004	-0.001	-0.001	0.001	**-0.005*****	-0.001	0.002	0.004	-0.001	0.001	**0.005*****
	(0.003)	(0.002)	(0.002)	(0.001)	**(0.002)**	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	**(0.002)**
between 90-100% of CLL	-0.008	-0.002	0.002*	0.002	**-0.006*****	0.001	0.001	0.004*	-0.002**	0.003**	**0.006*****
	(0.005)	(0.002)	(0.003)	(0.002)	**(0.003)**	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	**(0.003)**
between 100-110% of CLL	-0.112***	0.006	-0.027***	-0.012**	**-0.144*****	0.035***	0.036***	0.022***	0.031***	0.020***	**0.144*****
	(0.016)	(0.009)	(0.003)	(0.004)	**(0.013)**	(0.010)	(0.006)	(0.005)	(0.006)	(0.005)	**(0.013)**
between 110-120% of CLL	-0.099***	-0.004	-0.020	-0.012**	**-0.135*****	0.034***	0.034***	0.023**	0.026***	0.018***	**0.135*****
	(0.015)	(0.004)	(0.003)	(0.005)	**(0.014)**	(0.008)	(0.007)	(0.008)	(0.003)	(0.004)	**(0.014)**
> 120% of CLL	-0.100***	0.003	-0.007**	-0.015**	**-0.117*****	0.033***	0.036***	0.018**	0.021***	0.009**	**0.117*****
	(0.017)	(0.007)	(0.004)	(0.006)	**(0.015)**	(0.007)	(0.006)	(0.007)	(0.005)	(0.003)	**(0.015)**
100-100 minus 90-100	-0.104***	0.008	-0.029***	-0.013***	**-0.138*****	0.034***	0.035***	0.018***	0.034***	0.017***	**0.138*****
	(0.017)	(0.008)	(0.004)	(0.004)	**(0.012)**	(0.009)	(0.006)	(0.004)	(0.006)	(0.004)	**(0.012)**
Lender is mortgage company	0.091*	-0.003	0.000	-0.006	**0.082***	0.006	-0.035***	-0.034***	0.015	-0.035*	**-0.082***
	(0.044)	(0.004)	(0.005)	(0.004)	**(0.044)**	(0.007)	(0.008)	(0.008)	(0.026)	(0.017)	**(0.044)**
Lender is savings bank	-0.202***	0.001	-0.005	-0.019**	**-0.225*****	-0.014	-0.034*	0.005	0.154**	0.114***	**0.225*****
	(0.048)	(0.003)	(0.007)	(0.007)	**(0.035)**	(0.011)	(0.017)	(0.005)	(0.067)	(0.014)	**(0.035)**
Real loan principal (000s, $2000)	-0.020	-0.013	0.024***	0.006**	**-0.003**	-0.003	-0.004	0.004	0.004	0.002	**0.003**
	(0.014)	(0.009)	(0.006)	(0.003)	**(0.011)**	(0.003)	(0.005)	(0.002)	(0.004)	(0.003)	**(0.011)**
ln(Loan principal)	-0.025	-0.011**	-0.071***	-0.004	**-0.111*****	0.033***	0.041***	-0.003	0.034**	0.005	**0.111*****
	(0.030)	(0.004)	(0.008)	(0.003)	**(0.030)**	(0.008)	(0.010)	(0.005)	(0.013)	(0.006)	**(0.030)**
LTV ratio	0.784***	-0.131***	-0.484***	-0.003	**0.166**	0.013	0.058***	0.028***	0.056**	-0.321**	**-0.166**
	(0.039)	(0.037)	(0.099)	(0.009)	**(0.148)**	(0.013)	(0.019)	(0.005)	(0.021)	(0.130)	**(0.148)**
ln(1+LTV)	-0.404***	0.141	-0.042	-0.013**	**-0.319****	-0.014	-0.018	-0.026***	-0.042***	0.420***	**0.319****
	(0.021)	(0.087)	(0.031)	(0.005)	**(0.120)**	(0.013)	(0.015)	(0.004)	(0.008)	(0.117)	**(0.120)**
New House dummy	0.039***	-0.008*	-0.026***	-0.001	**0.004**	0.003	-0.005	0.002	0.019***	-0.023***	**-0.004**
	(0.009)	(0.004)	(0.005)	(0.002)	**(0.007)**	(0.002)	(0.006)	(0.003)	(0.009)	(0.003)	**(0.007)**
R^2	0.18										

Table 5: Estimates Using the RFS and SCF

Dep.variable = 1 if fixed rate mortgage, = 0 if adjustable rate mortgage. Weighted probit; coefficients normalized to display marginal effect of a change in the RHS variable at the point of sample means. Standard errors in parentheses are adjusted for heteroskedasticity.

Dependent variable: 1 if fixed rate mortgage, 0 otherwise

	Survey of Consumer Finances		Residential Finance Survey		
	[1]	[2]	[3]	[4]	[5]
	only MIRS variables	include household covariates	only MIRS variables	include household covariates	also include holder of loan
Jumbo mortgage dummy	-0.123***	-0.112**	-0.154***	-0.150***	-0.043**
	(0.047)	(0.045)	(0.031)	(0.031)	(0.022)
Loan payments received by:					
GSE					0.152***
					(0.010)
Unguaranteed conventional mortgage pool					0.049*
					(0.026)
State/Federal government program					0.057**
					(0.027)
Observations	2875	2875	6297	6297	6297
Pseudo R-squared	0.11	0.15	0.12	0.15	0.18

* significant at 10%; ** significant at 5%; *** significant at 1%

Additional regression sample / covariates information:

Survey of Consumer Finances: Pooled data from the 1989, 1992, 1995, 1998 and 2001 surveys. MIRS variables includes ln(amount borrowed), LTV, dummies for type of financial institution, region dummies and year of origination dummies. Other household covariates included in Column 2 are: ln(income), age, married dummy, non-white dummy, family size, household debt/household assets, self employment dummy, self-reported risk aversion, two dummies for past credit refusal, ln(years expected to stay in job), expectational measures of interest rates and income.

Residential Finance Survey: Pooled data from the 1991 and 2001 surveys. MIRS variables include ln(amount borrowed), LTV, dummies for type of financial institution, region dummies and year of origination dummies. Other household covariates included in Columns 4 and 5: business income as a share of total income, ln(real income), age, married dummy, non-white dummy, MSA dummy and two dummies for source of downpayment.

Table 6: Bankrate mortgage interest rates

Table gives summary statistics for end-of-month nominal mortgage rates as reported in Bankrate.com's daily survey of lending institutions. Sample period: November 30, 2004 - October 31, 2005 (N=12).

	Sample Average	Sample Deviation	Sample Average - 95% Conf. Int.	
30-year FRM				
jumbo	5.63			
conforming	5.36			
difference	0.27	0.04	0.25	0.30
15-year FRM				
jumbo	5.14			
conforming	4.91			
difference	0.24	0.05	0.21	0.26
5/1 ARM				
jumbo	4.85			
conforming	4.74			
difference	0.11	0.03	0.09	0.13
1/1 ARM				
jumbo	3.86			
conforming	3.77			
difference	0.09	0.07	0.05	0.13

Note.– The Bankrate.com survey controls for borrower risk characteristics in the following manner. Lending institutions are asked what loan rate they are willing to extend to a customer: having no prior relationship with the institution; of average income; with a FICO score between 650 and 719; on a one-unit, single-family, owner-occupied residence. With the exception of the FHA, all loans assume a 20% downpayment.

Table 7: Interest Rate Regressions, Monthly Interest Rate Survey

Dependent variable is effective mortgage interest rate. Sample is split according to whether mortgage is of the type indicated. Regression estimated using a Fama-MacBeth (1973) two step procedure. Coefficients are normalized to reflect marginal effects. First step estimates based on weighted least squares, using the sampling weights provided in the MIRS. Omitted dummy variable categories: loan is less than 80% of CLL, lender is commercial bank. Regressions also include month-year dummies, FHLB sales district dummies, and state dummmies (coefficients not reported, available on request). Regression excludes loans between 98-104 per cent of the conforming loan limit.

	Fixed rate mortgages					Adjustable rate mortgages					
	30 year	15-30 year	15 year	<15 year	**AVG**	> 5 year	5/1	1-5 year	1/1	< 1 year	**AVG**
Loan size relative to conforming loan limit (CLL):											
between 80-90% of CLL	0.007	-0.006	0.001	-0.021	**0.005**	0.000	0.017	0.031	0.063*	0.037**	**0.038****
	(0.003)	(0.017)	(0.007)	(0.034)	**(0.003)**	(0.011)	(0.013)	(0.020)	(0.027)	(0.010)	**(0.010)**
between 90-100% of CLL	0.006	0.014	0.022	0.045	**0.010***	0.030**	0.041*	0.012	0.039	0.018	**0.030****
	(0.006)	(0.029)	(0.012)	(0.049)	**(0.004)**	(0.010)	(0.015)	(0.030)	(0.020)	(0.012)	**(0.009)**
between 100-110% of CLL	0.196***	0.076	0.210***	0.126	**0.193*****	0.137***	0.121***	0.162*	0.176***	0.036	**0.129*****
	(0.017)	(0.057)	(0.038)	(0.151)	**(0.014)**	(0.030)	(0.027)	(0.058)	(0.039)	(0.024)	**(0.013)**
between 110-120% of CLL	0.191***	0.148***	0.217***	0.247	**0.195*****	0.147***	0.114**	0.110	0.203***	0.020	**0.129*****
	(0.033)	(0.030)	(0.017)	(0.270)	**(0.028)**	(0.021)	(0.030)	(0.064)	(0.047)	(0.017)	**(0.018)**
> 120% of CLL	0.175***	0.092	0.148***	0.041	**0.166*****	0.155***	0.119**	-0.003	0.183***	-0.019	**0.102*****
	(0.020)	(0.048)	(0.023)	(0.170)	**(0.018)**	(0.035)	(0.036)	(0.078)	(0.041)	(0.038)	**(0.015)**
100-100 minus 90-100	0.190***	0.061	0.188***	0.081	**0.183*****	0.107**	0.080**	0.150**	0.137**	0.018	**0.099*****
	(0.017)	(0.060)	(0.038)	(0.130)	**(0.014)**	(0.031)	(0.021)	(0.041)	(0.040)	(0.023)	**(0.015)**
Lender is mortgage company	0.091**	-0.009	-0.030	-0.468**	**0.059**	-0.002	0.032	-0.111	0.458*	-0.345	**0.085**
	(0.026)	(0.035)	(0.040)	(0.129)	**(0.028)**	(0.046)	(0.046)	(0.117)	(0.190)	(0.467)	**(0.126)**
Lender is savings bank	0.066*	0.080*	-0.060*	-0.363**	**0.039**	-0.111	-0.026	-0.172*	0.150	-0.562	**-0.105**
	(0.025)	(0.032)	(0.027)	(0.097)	**(0.022)**	(0.056)	(0.049)	(0.069)	(0.188)	(0.414)	**(0.140)**
Real loan principal (000s, $2000)	0.080***	0.133*	0.139***	0.148	**0.093*****	0.076**	0.040	0.164*	0.047	0.056	**0.065*****
	(0.012)	(0.047)	(0.020)	(0.089)	**(0.011)**	(0.021)	(0.024)	(0.056)	(0.037)	(0.038)	**(0.012)**
ln(Loan principal)	-0.281***	-0.304***	-0.367***	-0.398***	**-0.298*****	-0.307***	-0.251***	-0.501***	-0.356*	-0.257***	**-0.327*****
	(0.028)	(0.064)	(0.025)	(0.094)	**(0.024)**	(0.021)	(0.056)	(0.062)	(0.123)	(0.058)	**(0.034)**
LTV ratio	0.486*	0.491	0.971**	0.873*	**0.574***	1.009**	0.538	-0.972	0.977	5.303***	**1.592****
	(0.208)	(0.432)	(0.249)	(0.321)	**(0.207)**	(0.299)	(0.399)	(0.492)	(1.274)	(0.937)	**(0.505)**
ln(1+LTV)	-0.159	-0.177	-0.459*	-0.414	**-0.214**	-0.510*	-0.206	0.835*	-0.357	-2.972***	**-0.763***
	(0.103)	(0.253)	(0.153)	(0.242)	**(0.107)**	(0.175)	(0.221)	(0.289)	(0.722)	(0.542)	**(0.293)**
New House dummy	0.015	0.040	0.058***	0.009	**0.023**	-0.033	-0.054**	-0.041	0.064	0.124	**0.031**
	(0.016)	(0.029)	(0.012)	(0.028)	**(0.013)**	(0.017)	(0.015)	(0.023)	(0.066)	(0.058)	**(0.024)**

Table 8: Comparison of mortgage interest rates in US and UK

Column 1 shows the spread of different US mortgages relative to a Treasury rate with the same repricing period. Columns 2, 3 and 4 present data from the UK. Column 2 is based on a BOE survey of mortgage lenders. Column 3 is based on rates collected by the author from the websites of major UK mortgage lenders. Column 4 adjusts the estimates from column 3 for the value of the prepayment option implicit in US FRMs. The value of the prepayment option was calculated as the difference between the raw yield on a newly issued pool of Fannie Mae (FNMA) mortgage backed securities and the option adjusted spread (OAS) on that same pool of mortgages. The value of the prepayment option was then interpolated for shorter maturity US FRMs.

Fixed rate period (years)	**United States**	**United Kingdom**		
	Bankrate (conforming)	BOE data	Lender survey	Lender survey (including prepayment option)
	[1]	[2]	[3]	[4]
Hybrid ARMs				
2 years	0.361		0.358	
3 years	0.657		0.453	
5 years	0.855		0.529	
Average (2,3,5 years)	**0.624**		**0.491**	
FRMs				
15 years	0.726		0.724	1.214
20 years	0.907		0.741	1.324
25 years	1.025		0.813	1.489
30 years	1.143			
Average (15, 20, 25 years)	**0.886**			**1.343**

[1] FRM(US) - ARM(US) =	**0.262**	**[2] FRM(UK) - ARM(UK) =**	**0.852**
Difference [2] - [1] =	**0.590**		