

# **How Do Financial Frictions Shape the Product Market?**

## **Evidence from Mortgage Originations**

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### **Abstract:**

I present evidence of specialization in residential mortgage debt contracting, driven by variation in the type of financial frictions facing the lender. I compare the lending practices of savings banks, commercial banks and finance companies. Due to institutional factors, these lenders face different ex-ante exposures to the major risks embedded in mortgages: credit risk, prepayment risk, interest rate risk and liquidity risk. I show that this variation in risk exposure significantly influences product market behavior. Institutions that are more exposed to risk ex-ante originate fewer risky contracts in the primary mortgage market, and price risky loan features more conservatively. For example, savings banks, which retain a large portfolio of mortgages on-balance-sheet, originate loans with comparatively low levels of credit risk, prepayment risk, and interest rate risk, while finance companies, which securitize nearly all originations, behave the opposite. I explore implications for the role of securitization in the recent subprime mortgage crisis.

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## **1. Introduction**

Firms face many risks that cannot be easily hedged. Examples include shocks to local economic conditions, shifts in consumer demand, changes in government regulations and taxes, and operational risks such as a labor strike. Innovations over the past several decades have substantially improved financial institutions' ability to hedge credit risk and market risk, although even in this setting, nontrivial frictions remain.

Froot and Stein (1998, hereafter FS), building on Froot, Scharfstein, and Stein (1993), argue that these frictions in hedging risk may have important effects on firms' non-financial decisions, such as how much to invest in new physical capital, or how to price the firm's output in the product market. FS present a simple model in which a firm chooses how much to invest in a new project. The return on this project is uncertain, and correlated with existing balance sheet risks that cannot be fully hedged. FS show that if external finance is costly, the higher the correlation of project returns with existing risks, the less the firm will invest. The intuition is that project cashflows will on average be low in states of nature where the firm is most credit constrained, making the project less valuable. For example, a bank exposed to significant credit risk from a particular industrial sector might invest fewer resources in attracting new loans to that industry, or price future loans more conservatively, reflecting its existing risk exposure.

This paper applies these ideas to understanding debt contracting in the residential mortgage market. Firms in the primary mortgage market consist of a range of types of financial institutions, who compete for the same pool of customers, but face different balance sheet exposures to the main risks embedded in mortgages; credit risk, interest rate risk, prepayment risk, and liquidity risk. I show that this variation in risk exposure has economically significant effects on the types of mortgages the firm originates in the primary mortgage market.

In particular, I compare the lending behavior of savings banks, commercial banks and finance companies, which together originate 93% of residential mortgages (2004 Survey of

Consumer Finances). These three firm types have strikingly different financial structures. Finance companies fund nearly all mortgage originations through securitization. In contrast, savings banks and commercial banks retain a significant portfolio of mortgages on balance sheet, funding many mortgages through deposits, rather than the secondary market. (Together, savings banks and commercial banks held \$2.9tr of whole loans on balance sheet in 2006, making up 30 percent of total residential mortgage debt outstanding; source: Flow of Funds). Mortgages as a fraction of total assets are particularly high for savings banks, which specialize in mortgage lending to a significantly greater degree than commercial banks. Whole mortgages are 54% of assets for savings banks, compared to 19% for commercial banks, and 28% for finance companies.

The high fraction of savings bank assets held in the form of mortgages implies that savings banks are more exposed to credit risk, prepayment risk and interest rate risk embedded in mortgages, at least under a ‘neutral’ scenario where all lenders originate and hold mortgages with the same average level of underlying risk. Consistent with the predictions of the FS framework, I find that savings banks originate loans with significantly less credit risk, interest rate risk and prepayment risk than either commercial banks or finance companies, based on loan level data on mortgage contracts from the Monthly Interest Rate Survey and the Survey of Consumer Finances. I measure the credit risk of the loan primarily by its loan-to-valuation (LTV) ratio, which indicates the amount of home equity in the dwelling. Interest rate risk and prepayment risk are measured by variables that measure the duration of the mortgage, such as an indicator variable for whether the loan is a fixed-rate mortgage (FRM).

Differences in contracting across lender types are economically as well as statistically significant. For example, the market share of savings banks is nearly three times larger for adjustable-rate mortgages (ARMs) as for FRMs. When I break mortgages into nine different contract types, I find that this difference is largest for the mortgages with the highest and lowest repricing periods, namely 30 year FRMs and 1 year ARMs, respectively.

Finance companies, which retain only a small mortgage inventory, are less exposed to credit risk and prepayment risk. However they are more exposed to liquidity risk, defined as fluctuations in the liquidity of the secondary mortgage market into which the loan is sold. Consequently, I test that finance companies originate a smaller fraction of loans with a high level of liquidity risk. I measure liquidity risk by whether the mortgage is larger than the conforming loan limit, which determines whether it can be sold to the housing GSEs Fannie Mae and Freddie Mac. Again consistent with the FS framework, I find that the risk-sensitive institution, in this case a finance company, originates a significantly smaller share of risky loans, which in this case are ‘jumbo’ loans larger than the conforming loan limit.

Important for the empirical strategy, I argue that observed differences in financial structure described above are driven by fixed differences in the regulatory environment faced by these three institution types, and can be considered plausibly exogenous for the purposes of the empirical analysis. The first factor, which only affects savings banks, is a portfolio restriction known as the Qualified Thrift Lender (QTL) test, which restricts savings banks to maintain at least 65 per cent of assets in a relatively narrow set of asset types, the most important of which are mortgages and mortgage-backed securities. The second factor is that savings banks and commercial banks must retain at least 10 per cent of assets in mortgages in order to gain access to the Federal Home Loan Bank system. Finally, savings and commercial banks are able to raise FDIC-insured deposits, while finance companies are not able to do so. Reliance on deposits generates both costs and benefits for banks, however one key benefit is that deposits provide a low-cost stream of finance to fund lending. Since finance companies have no access to this source of finance, they instead rely much more heavily on securitization to generate cash to fund new loans.

In the next section of the paper, I show that variation in exposure to risk exposure across lender types influences mortgage pricing, in addition to the quantities of different types of mortgage originated. An additional implication of the FS paradigm is that, as well as originating fewer fixed rate mortgages, risk-sensitive institutions such as savings banks will also price FRMs

most conservatively relative to ARMs. I find statistically significant evidence for these pricing effects, using data from two different sources: quoted interest rate data from Bankrate.com, and contract mortgage interest rate data from the Monthly Interest Rate Survey. I find that savings banks price fixed rate mortgages around 20 basis points more conservatively than commercial banks. These differences are relatively small, reflecting the competitive nature of the mortgage market, but the fact that they are non-zero appears to indicate the existence of search costs on the part of mortgage consumers.

The results in this paper add to a small but growing literature which tests how risk management concerns influence nonfinancial decisionmaking (see Bartram, Brown, and Minton, 2006, Pantzalis, Simkins, and Laux, 2001, and Petersen and Thiagarajan, 2000, for other contributions to this literature). The tests in this paper are also related to Carey, Post and Sharpe (1998), who study differences between lending by finance companies and banks amongst large commercial loans, and Loutskina and Strahan (2006), who study differences in the willingness of commercial banks to originate illiquid loans. In the final section of the paper, I discuss implications of the results for understanding the role of securitization in the increased risk-taking observed by mortgage originators in advance of the 2007 subprime lending crisis.

The remainder of this paper proceeds as follows. Section 2 provides background on the residential mortgage market, and discusses the institutional reasons why different types of financial institutions are differentially exposed to interest rate risk and prepayment risk. Section 3 presents empirical hypotheses to be tested. Section 4 presents empirical evidence on mortgage originations from the Monthly Interest Rate Survey. Section 5 presents evidence from the Survey of Consumer Finances. Section 6 presents evidence on interest rate differentials between savings banks and commercial banks. Section 7 discusses implications of the findings in this paper for the recent subprime mortgage crisis. Section 8 concludes.

## 2. Institutional background on the mortgage market

The empirical analysis in this paper compares the mortgage lending practices of finance companies, commercial banks and savings banks. Descriptive statistics on mortgage lending by these three institution types is presented in Table 1, using data drawn from the Flow of Funds, and the FHFB Monthly Interest Rate Survey (MIRS). (The MIRS is a large microeconomic database of mortgage terms, which is described in more detail in Section 4.)

[INSERT TABLE 1 HERE]

A first fact from Table 1 is that the size of the mortgage portfolio, as a fraction of total assets, is much larger for savings banks than for the other two institution types. Mortgage assets comprise 54% of savings bank assets, compared to 19% for commercial banks, and 28% for finance companies. Given these differences in portfolio size, other things equal, savings banks are more exposed to a decline in the value of mortgages than are other lenders. Consistent with these differences, Wright and Houpt (1996) show that the net interest margins of savings banks are strongly negatively correlated with the level of interest rates, reflecting the fact that rising interest rates reduce the present value of long-maturity fixed rate mortgages. Wright and Houpt find that commercial bank profits covary much less strongly with interest rates, given their more diversified balance sheet, and shorter duration assets.

Secondly, the table highlights a key difference in the way that mortgage originations are funded between banks and non-bank lenders. Although finance companies originate nearly half of all mortgages, they hold only \$517bn in mortgage assets on balance sheet in aggregate, compared to \$1871bn for commercial banks and \$1014bn for savings banks. The final line of the Table 1 calculates the share of total outstanding mortgages owned by each lender type scaled by their share of new originations. This is an approximate measure of the extent to which mortgages are retained on balance sheet rather than being securitized. This figure is 8 times larger for commercial banks and 4 times larger for savings banks than for finance companies. In other words, bank lenders are

more likely to retain originated mortgages on balance sheet, while finance companies are more likely to originate-and-securitize.

These two facts are very persistent; they are equally true in 2006, presented in the top half of the table, and 1989, presented in the lower half of the table. These differences are driven by two key institutional factors. First are portfolio restrictions, which induce savings banks in particular to retain a large mortgage portfolio. Second is access to insured deposit finance, which provide banks with a low-cost source of funding to support a retained mortgage portfolio, rather than relying on securitization to fund mortgage lending. These two institutional factors are described in more detail below:

**(i) Portfolio restrictions.** To retain a savings bank charter, a financial institution must comply with a regulation known as the Qualified Thrift Lender test (QTL), which places significant restrictions on the type of assets the bank can hold. In particular, the QTL dictates that at least 65 per cent of bank assets are held in a small number of asset classes, the most important of which is residential mortgages and mortgage-backed securities. The QTL was introduced in the late 1980s, and designed to ensure that savings banks focus on residential mortgage lending in the wake of excessive risk-taking by savings banks during the savings and loan crisis (Kwan, 1998). This regulation accounts for the much higher fraction of mortgage assets amongst savings banks than the other two lender types. Commercial banks are also subject to some mortgage-related portfolio restrictions, in particular they must hold at least 10% of assets in mortgages to qualify to access the Federal Home Loan Bank (FHLB) system. For most institutions, however, this constraint is sufficiently low so as to be non-binding.

**(ii) Access to insured deposits.** Unlike finance companies, savings banks and commercial banks fund a significant proportion of loans through deposits. (Deposits average 73 per cent of liabilities for savings banks, and 80 per cent of liabilities for commercial banks, based on Q1:2006 call reports data). Deposits provide an informationally-insensitive source of external finance. Stein (1998) presents a theoretical model in which insured deposits allow banks to make and hold

additional loans than would otherwise be possible, due to informational asymmetries in raising non-insured sources of external finance. Kashyap and Stein (1995, 2000) and Ashcraft (2004) present empirical evidence that variation in bank access to deposit finance induces changes in bank lending.

Since finance companies do not have access to FDIC-insured deposits, they instead rely to a significantly greater degree on securitization to fund mortgage originations. This is particularly true of monoline mortgage lenders such as New Century, who retain only a small inventory of mortgages, and sell most mortgage to secondary market underwriters as soon as they are originated. It is unlikely that such lenders could fund a large retained mortgage portfolio, simply because the cost of raising external finance to fund the portfolio would be too high, due to informational frictions.

Finally, Table 1 shows that the relative market shares of these three institution types, as measured in the Monthly Interest Rate Survey, have changed significantly over time. In 2006, finance companies originated 52 per cent of first-lien mortgages by value, compared to 37 percent in 1989, while the market share of commercial banks has increased from 10% to 24% over the same period. Conversely, the share of savings banks has declined from 53% in 1989 to 24% in 2006.<sup>1</sup>

### *2.1 Mortgage risks*

Retaining a large portfolio of whole mortgages on balance sheet exposes the lender to several different types of risk. The most important of these are credit risk, prepayment risk and interest rate risk.

Credit risk is the risk that the mortgage borrower will default on their promised payments. Default reduces the present value of the mortgage cashflows, and also changes the pattern of cashflows, since cash is not realized until the home is sold at a foreclosure auction or another time.

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<sup>1</sup> It should be noted that these figures are not entirely representative of the mortgage universe: the MIRS does not sample credit unions and other lender types, which together originate 7% of mortgage originations, and does not include data on second lien mortgages, home equity loans or HELOCs.

Credit risk is high for example for loans where the borrower has little home equity (i.e. a high loan-to-valuation ratio), where the borrower has a poor credit history (indicated for example by a low FICO score), or where the borrower has low income relative to repayments, or a high level of non-mortgage debt.

Interest rate risk relates to changes in mortgage value driven by movements in the term structure of interest rates. A mortgage originator is concerned with matching the duration of the mortgage portfolio with the liabilities used to fund that portfolio. Depository institutions on average have longer-duration assets than liabilities, because deposits are short term (see Wright and Houpt, 1996, and Sierra and Yeager, 2004 for empirical evidence on maturity mismatch for commercial banks and savings banks). Therefore, fixed rate mortgages (FRMs), which have long duration, generally embed more interest rate risk than hybrid and adjustable-rate mortgages (ARMs).

An additional complication in the measurement and hedging of interest rate risk for FRMs is the fact that mortgage prepayment is correlated with current and past interest rates, since consumers refinance their mortgages during periods when market interest rates fall significantly below the coupon rate on the mortgage. Thus, the duration of a portfolio of FRMs is time-varying. The sensitivity of prepayment rates to the term structure shifts in interest rates is in turn a function of household characteristics, the state of the housing market macroeconomic variables and so on.

In addition, 'pure' prepayment risk relates to uncertainty in mortgage prepayment that is orthogonal to the yield curve. Prepayment risk arises because borrowers also prepay their mortgages for a variety of reasons unrelated to interest rates, for example to gain access to home equity (Hurst and Stafford, 2004), or because the house has been sold. Gabaix, Krishnamurthy and Vigneron (2005) present evidence that prepayment risk is priced in mortgage backed securities (MBS) spreads, due to capital constraints amongst arbitrageurs in the MBS market. As with interest rate risk

Finally, a fourth source of risk, liquidity risk, relates to variation in the price at which a given portfolio of mortgages can be sold due to fluctuations in secondary market liquidity. Since finance companies securitize nearly all the mortgages they originate, they are less exposed to credit, prepayment and interest-rate risk, because they retain a smaller portfolio of loans on-balance-sheet. However, because finance companies are not able to fund mortgages through deposits, they rely more heavily than bank lenders on the presence of an active secondary market to fund lending.

Liquidity risk is higher for non-conforming loans that cannot be sold to the housing GSEs Fannie Mae and Freddie Mac. These institutions may not purchase jumbo loans larger than a dollar amount set by their regulator, OFHEO, known as the conforming loan limit, which in 2007 is \$417,000. They may not also purchase loans with a high level of credit risk, in particular loans with an LTV greater than 80% that are not

This discussion of mortgage risks is summarized in Table 2 below. Holding loan quality fixed, savings banks are most exposed to mortgage credit risk, prepayment risk and interest rate risk, because they hold a much larger mortgage portfolio scaled by assets than commercial banks and finance companies. On the other hand, finance companies are more exposed to liquidity risk than bank lenders, because they do not have access to insured deposits to fund mortgage lending, and thus are more dependent on the presence of a liquid secondary market for loans.

Table 2: Summary of mortgage risks

Type of risk	Type of mortgage for which risk is largest	Type of financial institution most exposed to risk
Credit risk	High LTV ratio Borrower has low FICO score, high debt-to-income ratio etc.	Savings bank
Prepayment risk	Fixed rate mortgage	Savings bank
Interest rate risk	Fixed rate mortgage	Savings bank
Liquidity risk	Non-conforming loan	Finance company

The exposure to mortgage risk described above would not have any real effects if lenders have an alternative frictionless way of hedging their exposure to risk. However, unless the loan is sold, the risks described above cannot be easily hedged. In recent years, a credit default swap (CDS) market has been developed for hedging the credit risk embedded in subprime mortgages, however it is based on an aggregate index, and thus will be imperfectly correlated with the credit risk faced by an individual lending institution. Similarly, although an interest rate swap can be used to hedge interest rate risk, it is more difficult to hedge the nonlinear exposure to interest rate risk induced by the prepayment option embedded in FRMs.

Finally, securitizing the loan itself also involves informational frictions. First, the mortgage originator has private information about loan quality, leading to a 'lemons' problem. Downing, Jaffee and Wallace (2005) present empirical evidence that information asymmetries influence securitization in the mortgage-backed-securities market. Second, positive spreads on mortgage-backed securities partially reflect the exposure of capital-constrained MBS arbitrageurs to prepayment risk (Gabaix, Krishnamurthy and Vigneron, 2005). One illustration of the frictions involved in securitizing mortgages is the simple fact that, despite the significant diversification benefits of securitization, around 40% of mortgage debt is not securitized, but instead is held on balance sheet by the mortgage originator (source: Flow of Funds).

### **3. Hypotheses and Empirical Strategy**

As described above, due primarily to the portfolio restrictions implicit in the qualified thrift lender test, savings banks hold a significantly higher fraction of mortgages on balance sheet than the other two lender types. Secondly, finance companies fund nearly all mortgage originations through securitization, while commercial and savings banks fund a significant fraction of originations through insured deposits.

Since mortgage originators in the US relatively rarely switch from one institutional charter type to another, I consider these differences in the institutional environment facing savings banks, commercial banks and finance companies to be plausibly exogenous for the purposes of the empirical analysis to follow.

In this section, I develop a number of hypotheses about how these differences in risk exposure influence contracting in the primary mortgage market. The primary theoretical papers on which these hypotheses are based is Froot and Stein (1998), which in turn is based on the framework of Froot, Scharfstein, and Stein (1993).

FS present a simple model in which a firm chooses how much to invest in a new project. The return on this project is uncertain, and correlated with existing balance sheet risks. If there are no costs of raising external finance, this ex-ante exposure to risk will have no effects on the firm investment decision, in line with the Modigliani and Miller theorem. However, if external finance is costly, FS show that the higher the correlation of project returns with this ex-ante risk, the less the firm will invest. The intuition of this finding is straightforward: if project cashflows are likely to be low in states of nature where the firm is most credit constrained, the project is less valuable to the firm.

In the Appendix, I present a simple model that applies the key FS insight to a mortgage lender. The main extension relative to FS is I show that when the lender has some pricing power, financial frictions will influence mortgage pricing. Namely, a lender which has a high ex-ante exposure to a particular risk embedded in the mortgage will charge a higher interest rate on high-risk loans, than a lender with no ex-ante exposure to risk.

Applying these ideas to the current context, I test the following three hypotheses:

***Hypothesis 1:*** *Savings banks originate mortgages with: (i) lower credit risk, (ii) lower prepayment risk, and (iii) lower interest rate risk, than will commercial banks or finance companies.*

As discussed in Section 2, savings banks hold a large portfolio of mortgages on balance sheet, and thus are more exposed to these risks, holding the product mix constant. Since they do not have a costless way to hedge these risks, FS predicts that savings banks should hedge their risks by originating a smaller share of risky mortgages in the primary market.

I measure credit risk primarily by the loan-to-valuation (LTV) ratio, although I also consider other borrower characteristics correlated with default for some of the empirical work. I measure prepayment risk and interest rate risk initially by identifying whether the loan is fixed or adjustable (i.e. whether the mortgage rate adjusts with market interest rates at any point during the life of the loan). I then break mortgage contracts down more finely into 9 different contract types, indexed by the duration of the loan.

***Hypothesis 2:*** *Finance companies will originate mortgages with lower liquidity risk than will commercial banks or savings banks.*

As discussed in Section 2, commercial banks and savings banks securitize a significantly smaller fraction of mortgage originations than do finance companies. Consequently, finance companies rely more heavily on the existence of a liquid secondary market to fund mortgage lending. As a measure for the secondary market liquidity of the loan, I include a dummy variable for whether the loan is larger than the conforming loan limit, which indicates an upper size bound on the mortgages that may be purchased by the housing GSEs Fannie Mae and Freddie Mac. The non-agency secondary market is significantly more sensitive to liquidity shocks. For example, during the LTCM crisis, and during the summer of 2007, the spread between interest rates on conforming loans, that may be sold to F&F, and non-jumbo loans, increased sharply, reflecting lower secondary market prices for non-agency mortgage backed securities. Closely related to this hypothesis, Loutskina and Strahan (2006) find that, comparing different commercial banks, institutions with a lower buffer stock of liquid assets are less likely to originate jumbo loans larger than the conforming loan limit.

**Hypothesis 3:** *Savings banks will set relatively higher interest rates in the primary market on mortgages with a high level of credit risk, interest rate risk and prepayment risk.*

The residential mortgage market is close to perfectly competitive, given that lenders compete over price rather than quantity, a la Bertrand, and do not face significant supply constraints relative to suppliers in most industries. Recent technological progress also improves the ability of individual households to compare across mortgage lenders, for example through comparison-shopping websites such as LendingTree.com. Under the assumption that the primary mortgage market is not perfectly competitive, the Appendix shows that frictions in hedging risk will influence pricing in the primary market, as well as the quantities of different types of mortgages originated. Thus, hypothesis 3 is a joint test of the prediction that frictions in hedging risk affect product market behavior, and the hypothesis that the mortgage market is not perfectly competitive.

I now turn to an empirical test of these three hypotheses, using loan level data from the Monthly Interest Rate Survey and the Survey of Consumer Finances. As well as a test of FS, these hypotheses can also be viewed as a test of a number of more specific theoretical papers on loan contract design. Arvan and Brueckner (1986) and Edelstein and Urosevic (2003) develop models of optimal loan contract design where both borrower and lender are assumed to be risk averse. They show that the share of interest rate risk borne by the borrower is increasing in the bank's degree of risk aversion, as well as the way that interest rates covary with bank profits. Santomero (1983) and Chang, Rhee and Wong (1995) model banks' optimal mix of fixed and adjustable rate lending from a mean-variance portfolio optimization perspective. Both papers generate the prediction that the share of fixed versus adjustable rate lending will depend on the bank's coefficient of risk aversion.

#### **4. Evidence on mortgage originations from the MIRS**

Data on mortgage originations is drawn from the Monthly Interest Rate Survey, a microeconomic survey of home mortgage terms collected and maintained by the Federal Home Financing Board

(FHFB). Each month, the FHFB surveys a sample of commercial banks, savings banks and finance companies, who report terms and conditions on 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 MIRS data is available from the 1970s onwards, the sample used here begins in 1986, when the survey begins to identify the difference between fixed- and adjustable-rate loans. Some of my analysis is limited to data from 1992 onwards, after the quality of the survey methodology was improved and the survey began reporting additional information on the repricing of ARMs. The survey reports 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 reprices, the frequency of subsequent adjustments, and the value of the property that secures the loan. Most important for this paper, the survey reports the lender institution type (ie. savings bank, commercial bank or mortgage company). Only the institution type is reported, the identity of the lender is not. One drawback of the dataset is that it reports no demographic information about the mortgageholder. For example, there is no explicit measure of credit history such as a FICO score.

The raw dataset for the main regressions consists of 3.8 million mortgage contracts collected monthly over a continuous period between January 1986 and December 2005. Summary statistics for the MIRS dataset are presented in Table 3. The upper part of the table summarizes the pooled sample of all mortgages. Mortgages in the sample have an average nominal principal of \$145.5 thousand. In 2005, the last year of the sample, the average nominal principal is \$218,000. The average LTV is 77.6 per cent, and the average loan term is 27.2 years.

[INSERT TABLE 3 HERE]

Fixed rate mortgage originations make up 76 per cent of the sample. The lower two parts of the table present separate summary statistics for the subsamples of fixed rate mortgages and adjustable rate mortgages. ARMs are substantially larger on average, \$188,000 compared to

\$132,000 for FRMs. Nearly all ARMs have 30-year terms (the average is 29.6 years). FRMs have an average term of 26.9 years.

On a weighted basis, finance companies originated 56 per cent of loans in the sample, commercial banks 22 per cent and savings banks 23 per cent. Comparing panels B and C of Table 1 highlights that finance companies originate a significantly higher share of FRMs than ARMs, while for savings banks, the reverse is true. For example, savings banks were responsible for 16 per cent of all FRM originations, but 44 per cent of ARM originations, a ratio of nearly 3 to 1. These differences are consistent with Hypothesis 1 outlined in the previous section.

I now turn to a formal regression analysis to determine which types of loans are associated with different types of financial institutions, controlling for loan characteristics.

#### 4.1 *Determinants of lender type*

Using the pooled MIRS dataset, I estimate a multivariate linear probability model of mortgage lender choice. The regression takes the following form:

$$\begin{aligned}
 P(\text{lender}) = \Phi[ & \delta_0 + b_1 \cdot \text{dummy for fixed rate loan} + b_2 \cdot \text{dummy for jumbo loan} + \\
 & b_3 \cdot \text{LTV} + b_4 \cdot \ln(1+\text{LTV}) + b_5 \cdot \text{dummy for LTV} > 0.8 + \\
 & \delta_1 \log(\text{loan size}) + \delta_2 \log(\text{loan size})^2 + \delta_3 \cdot \text{real loan size} + \\
 & \delta_4 \cdot \text{month x year dummies} + \delta_5 \cdot \text{state x MSA dummies} + e] \quad [1]
 \end{aligned}$$

The key variables of interest are listed in the first two rows of equation [1]. Their coefficients are indicated with a  $b$ , rather than a  $\delta$ . These are variables that relate to interest rate and prepayment risk (i.e. dummy for fixed rate loan); liquidity risk (i.e. dummy for whether is a ‘jumbo’ loan, larger than the conforming loan limit above which the loan cannot be sold to Fannie Mae and Freddie Mac) and credit risk (i.e. variables relating to the loan-to-valuation ratio, or LTV).

Controls in the regression include three continuous loan size variables (real loan size,  $\log[\text{real loan size}]$  and  $\log[\text{real loan size}]^2$ ), as well as a dummy for whether the mortgage relates to

a new dwelling, dummies for the month x year the loan was originated, and dummies for the state x MSA in which the loan was originated.

The model is estimated using Seemingly Unrelated Regression (SUR). To account for cross-sectional dependence in the standard errors, standard errors are clustered by month x year. Results from the regression are presented in Table 4 below.

[INSERT TABLE 4 HERE]

Hypothesis 1 is that savings banks originate loans with less credit risk, prepayment risk and interest rate risk than commercial banks or finance companies. Examining the results in Table 4, we find strong support for each of these hypotheses. First, switching from an ARM to an FRM (an indicator of higher prepayment risk and interest rate risk) is correlated with a 27% lower probability that the mortgage originator is a savings bank, and a 27% higher probability that the lender will be a commercial bank (both statistically significant at the 1% level). The conditional probability that the lender is a commercial bank is uncorrelated with whether the loan is fixed or adjustable. The magnitude of this result suggests very large differences in the interest rate sensitivity of loans originated by finance companies and savings banks.

Summarizing the credit risk results, Table 4 presents estimates of the marginal effect of LTV on lender choice at two different LTV levels, 80% and 100%. The marginal effect is quite similar at these two levels of loan leverage. In both cases, a higher LTV is associated with a lower probability of the mortgage originator being a savings bank, rather than a commercial bank or finance company. Quantitatively, an increase in LTV of 10 percentage points is associated with a reduction in the probability that the lender is a savings bank by 5.87 percentage points, significant at the 1% level. Thus, also consistent with Hypothesis 1, savings banks originate loans with lower credit risk, as measured by LTV, than either commercial banks or finance companies.

Interestingly, the ordering of commercial banks and finance companies, in terms of the riskiness of loans made, switches between interest rate and prepayment risk on one hand, and credit risk on the other. Commercial banks originate loans with higher credit risk than finance companies,

as measured by the marginal effect of LTV on the probability of matching with the lender type in question. On the other hand, commercial banks are less likely to originate loans with a high level of prepayment risk and interest rate risk, as measured by the FRM dummy.

A plausible reconciliation of these differences in risk-taking is that commercial banks are more concerned with holding loans that have a high level of prepayment and interest rate risk, because of their reliance on deposit finance. The large literature on the bank lending channel (Ashcraft, 2004; Kashyap and Stein, 2000; Stein, 1998) finds that commercial banks become more credit constrained during periods of rising interest rates, because the supply of deposits declines during such period, forcing banks to rely more intensively on other, less informationally insensitive, forms of external finance. This provides a potential explanation for why commercial banks are relatively conservative in originating loans with a high level of prepayment risk and interest rate risk, by comparison with finance companies.

Turning to liquidity risk, Hypothesis 2 is that finance companies originate loans with lower average liquidity risk than bank lenders, because they rely more heavily on securitization as a vehicle for funding originations. I measure liquidity risk by a dummy variable which indicates whether the loan is larger than the conforming loan limit. I find that, consistent with the Hypothesis, finance companies do indeed originate a smaller share of jumbo loans than do bank lenders. Conditional on other characteristics, switching from a non-jumbo to jumbo status reduces the probability that the loan is originated by a finance company by 6.3 percentage points. In contrast, the market shares of both commercial banks and savings banks increase by roughly equal amounts above the conforming loan limit.

To summarize this evidence, I find strong evidence of specialization in mortgage debt contracting. Furthermore, in each dimension of risk (credit risk, prepayment risk, interest rate risk and liquidity risk), the lender type with the largest ex-ante exposure to risk originates a smaller fraction of risky loans in the primary market. Differences in market share are economically as well

as statistically significant. For example, unconditionally, the market share of finance companies is nearly three times as large for ARMs as for FRMs.

#### 4.2 *Disaggregated estimates of interest rate and prepayment risk*

In the evidence presented so far, I identify exposure to prepayment risk and interest rate by a simple dummy variable indicating whether the loan is an FRM or ARM. Clearly this is a simplification, considering the diverse universe of mortgage contracts originated in the US.

Correspondingly, to consider a finer measure of prepayment and interest rate risk, I classify mortgage contracts into 9 different contract types: four different types of FRMs depending on the mortgage term, and five types of ARMs depending on the initial repricing period. The classification of mortgages, as well as the weighted share of mortgages within each mortgage category is presented in Table 5 below. [N.B. Table 3 uses the standard  $x / y$  nomenclature for ARMs, where  $x$  refers to the number of years until the mortgage first reprices, and  $y$  is the periodicity of subsequent repricings in years].

[INSERT TABLE 5 HERE]

Contracts in Table 5 are ordered in decreasing order of duration. The 30-year FRM is by far the most popular single contract, with nearly a 60 percent market share. This is followed by the 15 year FRM and 1/1 ARM.

According to Hypothesis 1, savings banks originate a smaller fraction of long-duration loans, minimizing their exposure to interest rate risk and prepayment risk. An additional implication of this hypothesis is that, if we break up the mortgage universe more finely as is done in Table 5, the market share of finance companies relative to savings banks will be most pronounced for contracts which are most 'extreme' in terms of exposure to interest rate risk and prepayment risk. That is, the market share of savings banks should be highest for the shortest duration contracts, namely a 1/1 ARM, which adjusts The differences in market share between

To investigate this hypothesis, I re-estimate equation [1] replacing the FRM dummy with nine different indicator variables, one for each of the mortgage types defined in Table 5. Results for each of these the dummy variables are presented in graphical form in Figure 1.

[INSERT FIGURE 1 HERE]

As the Figure shows, the high share of ARM originations by savings banks is concentrated exactly amongst the contract types with the shortest repricing periods, namely 1/1 ARMs and ARMs with a repricing period of less than a year. In addition, the lower share of FRM originations by savings banks is concentrated in the product with the greatest exposure to interest rate risk and prepayment risk, namely the 30-year fixed rate mortgage. Conversely, the high share of FRMs amongst mortgage company originations is particularly concentrated amongst 30 year FRMs. This provides further support for Hypothesis 1.

#### 4.3 *Time trends and other interaction terms*

It seems plausible that the product market specialization documented in the rest of section 4 has become smaller over time, as financial market integration, banking deregulation, and capital market deepening, reduce the importance of risk management frictions for product market behavior. To investigate this possibility, I re-estimate the regressions from Table 4 after including additional terms which interact the main risk variables (LTV, jumbo loan and fixed rate loan) with a time trend. [INSERT DISCUSSION OF BANKING REGULATORY REFORM DURING LATE 1980s, THAT REDUCED RISK-TAKING INCENTIVES BY DEPOSITORY INSTITUTIONS]. Results from this exercise are presented in Table 6.

[INSERT TABLE 6 HERE]

The results in Table 6 present mixed support for the proposition that the differences in lending behavior between financial institutions are narrowing over time. Results for interest rate risk and prepayment risk are consistent with the prediction that the differences between lender types are narrowing; namely that savings banks originate a higher fraction of FRMs over time compared to the other two financial institution types, perhaps reflecting a reduction in maturity mismatch

amongst savings banks. In contrast, differences in credit risk behavior in fact widen over time; savings banks are increasingly likely to originate loans with a low LTV ratio over the sample period. [INSERT DISCUSSION OF REGULATORY REFORM VARIABLES].

## **5. Evidence on mortgage originations from the Survey of Consumer Finances**

This section presents additional evidence on the relationship between lender type and mortgage characteristics, using data from the Survey of Consumer Finances (SCF). The main advantage of the SCF relative to the MIRS is that it includes a wide range of borrower covariates, such as debt, income, occupation, credit history and so on. This allows an investigation of whether the MIRS results suffer from any omitted variable bias due to the limited number of covariates included in the dataset. In addition, it is of direct interest to study additional measures of borrower credit risk other than the LTV, such as measures of overall borrower leverage.

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. Data is drawn from six SCF surveys conducted between 1989 and 2004. The underlying SCF consists of around four thousand households per survey year. I keep observations where the family reports a single-family mortgage originated within three years of the survey date. This yields a sample of 4,265 mortgages.

I estimate a regression model with the same structure as the MIRS lender choice regressions. Namely, I estimate a multinomial probit regression where the dependent variable equals 1 if the lender is of the institution type in question (i.e. in turn a finance company, commercial bank, and savings bank). Unlike the MIRS, the SCF also includes data on two other lender types, credit unions and other. To conserve space, I omit these two categories from the analysis.

The first set of mortgage risk variables in the regression are similar to the MIRS: a dummy for whether the loan is an FRM or ARM, a dummy for a jumbo loan, the LTV of the loan. I also include a number of borrower covariates that are also likely to be correlated with loan risk: total

household debt / assets, a dummy for whether the borrower has been denied credit in the past year, a dummy for whether the borrower did not apply for credit in the past year, expecting rejection (all of which are proxies for credit risk), and the log number of years the borrower expects to stay in their job (a proxy for prepayment risk).

In addition, I include a number of controls, including log(mortgage size), region dummies, dummies for the year of mortgage origination, and other household characteristics, including age, family size, self-reported risk aversion, a non-white dummy, and expectational measures of interest rates and income. Controls relating to the loan are similar to the loan controls included in the MIRS, using a more parsimonious specification reflecting the much smaller sample size.

Results for this regression model are presented in Table 7. In each case, I present two sets of results. In the first case, I estimate the lender choice regression including all the additional borrower covariates that are available in the SCF but not the MIRS. In the second specification I exclude these additional variables. A comparison of the coefficients on the main risk variables across these two specifications is intended to provide a robustness check on the extent of bias induced in the MIRS results due to the lack of borrower covariates.

[INSERT TABLE 7]

Results for the loan risk variables are consistent with the MIRS estimates presented earlier. I find that savings banks originate a significantly smaller share of FRMs than other lender types, . As before, the FRM share is particularly low by comparison with finance companies. One difference is that the magnitude of the coefficients is only around half as large as in the MIRS regressions. This may partially reflect attenuation bias due to misreporting by households of their mortgage type, or misreporting of the lender type that is correlated with unobserved borrower covariates.

Similarly, I find that finance companies issue fewer mortgages with high levels of liquidity risk, measured by whether the loan is larger than the conforming loan limit and therefore a jumbo loan that cannot be sold to the housing GSEs Fannie Mae and Freddie Mac. Finally, I find that the

credit risk, as measured by LTV, of loans originated by savings banks is significantly lower than for finance companies. However, in this case, there is no statistically significant difference between the LTV of loans issued by commercial banks and savings banks. This stands in contrast to the MIRS results, where commercial banks originate loans with higher LTV even than finance companies. The source of this difference is not immediately clear, but may reflect misreporting of savings bank loans as commercial bank loans by households.

Results for other borrower covariates also support the hypothesis that finance companies issue loans with a higher level of credit risk and prepayment risk than savings banks. First, conditional on the LTV of the loan, finance companies also originate a higher fraction of loans where the borrower's overall leverage ratio (including non-housing debt and assets) is higher. Second, relative to

Finally, for each of the three main variables of interest, the estimated coefficient is essentially invariant to the inclusion or exclusion of the additional borrower covariates not available in the MIRS. This suggests the lack of availability of those variables in the MIRS does not significantly bias the regression results presented in Table 4 and Table 6.

## **6. Mortgage pricing evidence from Bankrate interest rate quotes**

Hypothesis 3 advanced in Section 3 predicts that, as long as firms have some pricing power, ex-ante exposure to risk should affect the pricing of mortgages as well as the origination shares of different mortgages. The proposition that mortgage lenders indeed do face a demand curve that is not perfectly elastic is far from clear, given the market structure of the residential mortgage market. Mortgage lenders compete primarily over price (i.e. the interest rate, combined with other contract features such as mortgage points), and do not face significant supply constraints compared to firms in most industries. These features suggest a Bertrand model, rather than Cournot model, may be most appropriate for the industry. Furthermore, in recent years Internet sites such as LendingTree.com allow consumers to compare a wide range of mortgages online, and choose the

one with the lowest interest rate. This perhaps suggests that there will be no market demand for mortgages priced even a few basis points above the prevailing market interest rate.

Despite these factors, several pieces of evidence suggest that mortgage providers do indeed have some degree of pricing power. For example, bankrate.com data shows a surprising degree of dispersion in posted mortgage interest rates. Also, despite the large number of mortgage providers, a relatively high proportion of consumers fund their mortgage through a lender with whom they have a prior relationship [insert fact from the SCF here]. Pricing power likely stems from the relative complexity of mortgage contracts, which makes it difficult for consumers to compare a large number of mortgages. There may also be some transaction costs or informational asymmetries associated with borrowing from a mortgage lender with which the consumer has no prior relationship.

Assuming that some degree of pricing power does exist, I now test the hypothesis that savings banks price FRMs relatively more conservatively than other lender types.

I test this hypothesis using quoted mortgage interest rate data from Bankrate, a private data vendor which 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. Mortgage points and fees are amortized into the quoted interest rate assuming a loan life of 10 years. Thus, Bankrate's quoted interest rates are conditional on a significant number of borrower characteristics, as well as credit risk. Furthermore, by studying interest rate quotes, rather than contract rates, I avoid the selection bias associated with only observing.

The Bankrate data consists of 425 interest rate quotes, covering two different mortgage contracts, 1/1 ARMs and 30 year FRMs. Data is reported by savings banks and commercial banks across the 25 largest MSAs in the US. Quotes consist of effective rates averaged over the 2005 calendar year. Using this data, I estimate the following regression:

$$\text{effective rate} = a. \text{commbank} + b. \text{FRM} + c. \text{commbank} \times \text{FRM} + d. \text{MSA dummies} + e$$

commbank is a dummy equal to 1 if the quoting institution is a commercial bank, FRM is a dummy equal to 1 if the rate is quoted on an FRM rather than an ARM. MSA dummies includes a dummy variable for each of the 25 MSAs included in the dataset. As in the MIRS regressions, the key coefficient is the interaction term  $\text{comm.bank} * \text{FRM}$ , which measures whether savings banks price FRMs more conservatively than ARMs compared to commercial banks. A negative estimated coefficient on this interaction term would be consistent with the ‘pricing’ Hypothesis 3 stated above.

[INSERT TABLE 6 HERE].

Estimates from this regression are presented in Table 6 below. The baseline estimates are presented in Column 1. The coefficient on the interaction term (commercial bank x fixed rate mortgage) is negative as predicted. The estimated coefficient is -0.219, significant at the 5 per cent level.

To check that this estimate is not overly driven by outliers in the data, Table 6 also presents results using two alternative estimation techniques: median regression and OLS with winsorized data. Results are similar to Column 1. Thus, consistent with the MIRS results presented earlier, these Bankrate results suggest that savings banks do in fact actively price ARMs at a discount relative to FRMs, in order to increase their share of ARM originations.

## **7. Application to subprime mortgage crisis**

To write up. I find evidence that savings banks originated a significantly smaller share of risky subprime mortgages in recent years, while finance companies, especially those who are unaffiliated with a bank holding company originate the highest share of such loans. This is consistent with

[INSERT TABLE 9 HERE]

## **8. Conclusions**

I present evidence of specialization in debt contracting in the residential mortgage market. Savings banks, commercial banks and finance companies originate loans with very different exposures to the main risks embedded in mortgages; interest rate risk, prepayment risk, credit risk and liquidity risk. I argue that these differences in lending behavior can be understood as a product market response to the types of balance sheet risk the firm faces, given frictions in hedging those risks. For example, savings banks, which hold a large portfolio of mortgages, and are thus exposed to credit risk and prepayment risk of that portfolio, originate a smaller fraction of highly leveraged loans, and loans with longer duration such as FRMs. On the other hand, finance companies, which fund nearly all loans through the secondary market, originate a smaller fraction of loans with significant liquidity risk, measured by whether the loan is eligible to be purchased by Fannie Mae and Freddie Mac. Finally, these differences in risk exposure affect prices as well as quantities. Savings banks

The findings have implications for understanding the sources of the recent subprime mortgage crisis. Section 7 of the paper shows that a disproportionate share of subprime and Alt-A loans are originated by finance companies, particularly those which are unaffiliated with a bank holding company. This fits neatly with the argument made here. Since such firms are less likely to hold the mortgage, rather than securitizing it, they are less concerned with the credit risk of the loan. Consequently, it suggests that the rapid growth in nonagency secondary market volumes documented in Section 7 is an important explanation for the increased risktaking observed by mortgage originators in recent years.

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## Appendix A: Stylized model of mortgage lending under financial constraints

To fix ideas, it is useful to consider a simplified model of mortgage lending in the presence of financial constraints, which illustrates the key insights of FS.

Consider a two period model of a bank who provides two types of loans, labelled FRMs and ARMs. Repayments on both types of loans are linked to the realization of a risk-free interest rate  $i$ , which also determines depositors required rate of return on bank deposits. Repayments on ARMs are assumed to move 1 for 1 with  $i$ , while repayments on FRMs are assumed to move less than 1 for 1 with  $i$ .  $i$  is a random variable observed at the beginning of the second period. For simplicity, the mean of  $i$  is normalized to zero. In addition, the firm has a pre-existing exposure to interest rate risk. At the end of the second period, the firm must make a payment to a third party of  $\gamma \cdot i$  (where  $\gamma$  may be positive or negative). The timing in the model is as follows:

### Date 0:

1. The financial institution decides what interest rate to charge on the two products ( $m_{\text{ARM}}$  and  $m_{\text{FRM}}$ , where  $m$  refers to the margin on the product relative to the risk free rate). The firm faces a downward sloping demand curve for each type of loan:  $q = a - bm$ , so the choice of  $m$  for each loan type determines the demand for that type of loan.
2. To finance this lending, the financial institution borrows from depositors at interest rate  $i$ . As a simple way of introducing interest rate risk,  $i$  is assumed to be stochastic, realized at the beginning of date 1.

### Date 1:

1.  $i$  is realized, and borrowers repay the bank. There is no default, so repayments on the ARMs are  $R_{\text{ARM}} = \text{quantity} \times \text{interest rate} = q_{\text{arm}} \cdot (1 + i + m_{\text{arm}})$ . FRM repayments =  $q_{\text{frm}} \cdot (1 + \delta i + m_{\text{frm}})$ , where  $\delta$  indexes how interest-sensitive repayments on the FRM are ( $\delta < 1$ ).
2. The bank repays its depositors the amount borrowed plus interest:  $(1+i) \times (q_{\text{arm}} + q_{\text{frm}})$ . The bank also pays off its pre-existing exposure to interest rate risk  $\gamma \cdot i$ .

The firm's assumed objective is to choose  $m_{\text{arm}}$  and  $m_{\text{frm}}$  to maximize  $E[V(F_1)]$ , where  $F_1$  is the amount of funds the bank has at the end of date 1, and  $V(\cdot)$  is a concave function. That is, the value of the firm is assumed to be concave in the amount of internal funds. Froot, Scharfstein and Stein (1993) show how a simple costly state verification model can generate this kind of concave function.  $V(\cdot)$  is assumed to be exponential and  $i$  is assumed to be normally distributed.

The purpose of this model is to see how ARM and FRM originations depend on the firm's ex-ante interest rate risk exposure  $\gamma \cdot i$ . These relationships are summarized in Proposition 1 below.

### Proposition 1:

- (a) *The pricing and quantity of ARM lending ( $m_{\text{arm}}$  and  $q_{\text{arm}}$ ) are independent of  $\gamma$ .*
- (b) *The quantity of FRM lending ( $q_{\text{frm}}$ ) is decreasing in  $\gamma$ , and  $m_{\text{arm}}$  is increasing in  $\gamma$ .*
- (c) *Therefore, FRM loans as a share of total loans is decreasing in  $\gamma$ .*

### Proof:

Given the exponential-normal setup, the firm chooses  $m_{\text{arm}}$  and  $m_{\text{frm}}$  to maximize  $EF_1 - \lambda \text{var}(F_1)$ .  $F_1$  is given by

$$\begin{aligned} F_1 &= \text{net profit on FRMs} + \text{net profit on ARMs} - \text{payment to third party} \\ &= q_{\text{arm}} \cdot (1 + m_{\text{arm}}) + q_{\text{frm}} \cdot (1 + m_{\text{frm}} + (\delta - 1) \cdot i) - \gamma \cdot i \end{aligned}$$

The optimal quantity of loans extended is found by substituting the demand curves for FRMs and ARMs ( $q_i = a - b m_i$ ) into this equation for  $F_1$ , and differentiating  $EV(F_1)$  with respect to  $q_{arm}$  and  $q_{frm}$ . This yields  $q_{frm}^* = \frac{a}{2}$ . Inspecting these expressions,  $q_{arm}^*$  is independent of  $\gamma$ , while  $q_{frm}^*$  is decreasing in  $\gamma$  as long as  $\delta < 1$  and therefore  $(\delta - 1)$  is negative. ■

Proposition 1 shows that in this simple setting, a bank with an ex-ante exposure to rising interest rates (ie. a positive value of  $\gamma$ ) will originate a smaller share of FRMs, and correspondingly a higher share of ARMs, compared to a bank with no existing exposure to interest rate risk. The intuition for this result is simple: FRMs exacerbate the bank's pre-existing exposure to rising interest rates, because as interest rates increase, interest income from the FRM increases less quickly than the bank's marginal cost of funds. Put another way, the duration of the FRM is longer than the duration of the bank's liabilities, so issuing more FRMs increases the amount of maturity mismatch on the bank's balance sheet.

**Figure 1: Institution Type and Contract Type**  
**Nine contract model**

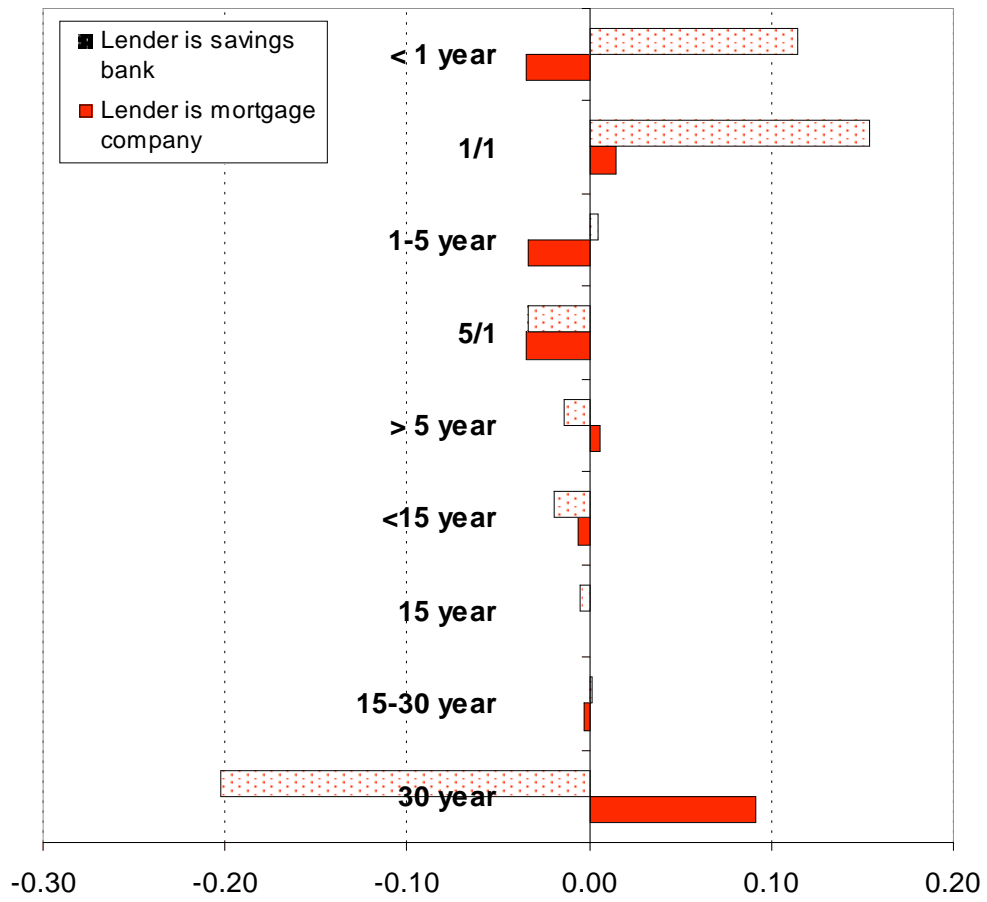


Table 1.

The table presents summary statistics on mortgage origination activity and holdings of mortgages across finance companies, commercial banks and savings banks.

	Finance companies	Commercial banks	Savings banks
2006 data			
[1] Deposits / assets	0	0.586	0.599
[2] Share of mortgage originations	0.523	0.241	0.236
Mortgages held on balance sheet:			
[3] Dollars (\$bn)	517	1871	1014
[4] Share of total mortgages outstanding	0.053	0.190	0.103
[5] Share of mortgage stock divided by share of mortgage originations ([5] = [4]/[2])	0.101	0.788	0.437
[6] Mortgage assets as fraction of total assets	0.280	0.191	0.542
1989 data			
[2] Share of mortgage originations	0.372	0.098	0.530
Mortgages held on balance sheet:			
[3] Dollars (\$bn)	75	373	631
[4] Share of total mortgages outstanding	0.032	0.157	0.265
[5] Share of mortgage stock divided by share of mortgage originations ([5] = [4]/[2])	0.085	1.606	0.501
[6] Mortgage assets as fraction of total assets	0.132	0.115	0.418

Data sources: Flow of funds, Q2:2006 and Q4:1989.

Table 3. Summary statistics, Monthly Interest Rate Survey  
 [TO DO: INSERT STATISTICS FROM 1986-1991]

A: Summary of Loans - All types

year	loan principal	loan principal	LTV	sample size	market share by lender type			FRMs
	(nominal, 000s)	(real, 000s)			finance company	finance company	finance company	
1992	109.4	134.2	76.5	125098	51%	22%	27%	80%
1993	107.9	128.5	77.3	141444	51%	23%	26%	80%
1994	111.2	129.2	79.6	149831	52%	26%	22%	60%
1995	111.6	126.1	79.8	125756	52%	27%	21%	68%
1996	120.3	132.1	79.0	130001	57%	24%	19%	73%
1997	128.3	137.5	79.2	179212	55%	25%	20%	78%
1998	133.8	141.3	78.8	268640	58%	17%	25%	88%
1999	141.1	146.0	78.8	248016	58%	18%	24%	79%
2000	151.4	151.3	78.5	247612	64%	16%	21%	75%
2001	160.3	155.9	77.1	291101	64%	17%	20%	88%
2002	170.0	162.7	75.8	331679	57%	22%	21%	82%
2003	177.4	166.1	75.2	384798	54%	24%	22%	81%
2004	195.8	178.3	76.2	250398	53%	24%	23%	63%
2005	218.1	192.9	75.0	172673	52%	25%	24%	68%
<b>Average</b>	<b>145.5</b>	<b>148.7</b>	<b>77.6</b>	<b>217590</b>	<b>56%</b>	<b>22%</b>	<b>23%</b>	<b>76%</b>

B: Summary of Loans - FRM only

year	loan principal	loan principal	LTV	sample size	market share by lender type		
	(nominal, 000s)	(real, 000s)			finance company	finance company	finance company
1992	105.1	128.9	76.5	90563	59%	21%	21%
1993	102.7	122.3	77.4	105440	59%	22%	19%
1994	97.6	113.6	79.3	74878	63%	24%	13%
1995	100.7	113.7	79.4	75858	61%	25%	14%
1996	108.6	119.4	78.7	85754	67%	20%	13%
1997	120.5	129.1	79.2	133945	62%	26%	13%
1998	127.0	134.1	79.0	236346	62%	18%	20%
1999	128.4	133.0	79.1	193155	67%	18%	15%
2000	132.4	132.2	78.9	175234	74%	16%	10%
2001	148.5	144.4	77.2	246847	67%	17%	16%
2002	155.5	148.7	75.7	252157	60%	23%	17%
2003	165.5	155.0	74.9	301896	56%	25%	20%
2004	169.7	154.6	75.3	143751	56%	27%	17%
2005	190.3	168.2	74.4	110888	54%	27%	19%
<b>Average</b>	<b>132.3</b>	<b>135.5</b>	<b>77.5</b>	<b>159051</b>	<b>62%</b>	<b>22%</b>	<b>16%</b>

Table 3. Summary statistics, monthly interest rate survey (cont...)

C: Summary of Loans - ARM only

year	loan principal (nominal, 000s)	loan principal (real, 000s)	LTV	sample size	market share by lender type		
					finance company	commercial bank	savings bank
1992	126.4	154.9	76.5	34535	19%	27%	53%
1993	128.8	153.4	76.9	36004	21%	26%	53%
1994	131.7	152.7	80.0	74953	35%	29%	36%
1995	134.6	152.4	80.6	49898	33%	33%	34%
1996	152.0	166.7	80.0	44247	31%	32%	37%
1997	156.6	168.0	79.5	45267	33%	22%	45%
1998	182.1	192.4	77.7	32294	25%	12%	63%
1999	188.8	194.9	77.7	54861	25%	18%	58%
2000	209.4	209.5	77.1	72378	31%	14%	55%
2001	244.0	237.2	76.1	44254	39%	15%	46%
2002	237.3	227.1	76.3	79522	38%	17%	44%
2003	228.4	213.7	76.8	82902	49%	20%	32%
2004	240.4	218.8	77.7	106647	48%	18%	34%
2005	277.2	245.2	76.1	61785	46%	21%	33%
<b>Average</b>	<b>188.4</b>	<b>191.9</b>	<b>77.8</b>	<b>58539</b>	<b>34%</b>	<b>22%</b>	<b>44%</b>

Table 4. Lender selection results, monthly interest rate survey

Dependent variable = 1 if the mortgage is originated by the lender type indicated (finance company, commercial bank or savings bank). Three equation system, estimated by seemingly unrelated regression (SUR). Regressions also include time dummies for each month x year a loan is observed, and dummies for each state x MSA (coefficients not reported). Robust standard errors are clustered by time period (month x year). Data from the Monthly Interest Rate Survey. Sample period 1986-2005. \*\*\*, \*\*, and \* denote statistical significance at the 1%, 5% and 10% levels, respectively.

Mortgage contract characteristic	Dependent variable = 1 if lender is of the type indicated			finance company - savings bank
	finance company	commercial bank	savings bank	
<i>Interest rate risk / prepayment risk</i>				
Dummy for fixed rate loan	0.272*** (23.75)	-0.002 (-0.43)	-0.270*** (-26.64)	0.542***
<i>Liquidity risk</i>				
Dummy for jumbo loan	-0.063*** (-12.45)	0.032*** (7.95)	0.031*** (6.97)	-0.094***
<i>Credit risk</i>				
Loan-to-valuation ratio (LTV)	0.101** (2.81)	0.702*** (13.45)	-0.803*** (-12.69)	
ln(1+LTV)	-0.039** (-2.18)	-0.351*** (-13.09)	0.389*** (16.07)	
LTV > 0.8	0.005 (1.22)	0.004 (0.98)	-0.009 (-1.44)	
Marginal effect at LTV = 0.8	0.079	0.507	-0.587	0.666***
Marginal effect at LTV = 1.0	0.087	0.531	-0.618	0.704***
<i>Loan size</i>				
Real loan principal	-0.017** (-2.09)	0.033*** (4.27)	-0.016** (-2.61)	
ln(loan principal)	0.130*** (11.88)	-0.085*** (-8.01)	-0.045*** (-6.11)	
ln(loan principal) <sup>2</sup>	0.003 (0.59)	0.014** (2.34)	-0.018*** (-5.42)	
Home is a newly constructed dwelling	0.020** (2.19)	-0.131*** (-20.12)	0.111*** (13.02)	
Number of observations (millions)	3.80	3.80	3.80	
R <sup>2</sup>	0.193	0.199	0.235	

Table 5. Market share of different loan types, monthly interest rate survey

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, initial 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

Source: Monthly Interest Rate Survey: 1992-2005.

Table 6. Additional lender selection results, monthly interest rate survey

Dependent variable = 1 if the mortgage is originated by the lender type indicated (finance company, commercial bank or savings bank). Regression includes the same covariates as Table 5, as well as the the additional interaction terms shown below. Three equation system, estimated by seemingly unrelated regression (SUR). Regressions also include time dummies for each month x year a loan is observed, and dummies for each state x MSA (coefficients not reported). Robust standard errors are clustered by time period (month x year). Data from the Monthly Interest Rate Survey. Sample period 1986-2006.

Mortgage contract characteristic	Dependent variable = 1 if lender is of the type indicated			finance company - savings bank
	finance company	commercial bank	savings bank	
<i>Time trend interacted with:</i>				
Dummy for fixed rate loan	-0.023*** (-14.24)	0.007*** (7.26)	0.016*** (10.07)	-0.039***
Dummy for jumbo loan	-0.004*** (-3.51)	0.002* (1.81)	0.002** (2.05)	-0.006***
Loan-to-valuation ratio (LTV)	0.014*** (5.49)	0.017*** (7.18)	-0.030*** (-10.84)	0.044***
<i>Regulatory reform dummy interacted with:</i>				
Dummy for fixed rate loan	0.212*** (8.52)	-0.105*** (-7.19)	-0.106*** (-4.83)	0.318***
Dummy for jumbo loan	0.085*** (5.11)	-0.025* (-1.91)	-0.060*** (-3.72)	0.145***
Loan-to-valuation ratio (LTV)	-0.348*** (-10.82)	-0.031 (-1.06)	0.379*** (11.35)	-0.727***
Number of observations (millions)	3.80	3.80	3.80	
R <sup>2</sup>	0.199	0.200	0.240	

Table 7: Determinants of lender selection, Survey of Consumer Finances

Dependent variable = 1 if the mortgage is originated by the lender type indicated (finance company, commercial bank or savings bank). Data from the 1989, 1992, 1995, 1998, 2001, and 2004 SCF surveys. Weighted probit estimated by repeat imputation regression. 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. Other household covariates in baseline model include: ln(amount borrowed), ln(income), age, married dummy, non-white dummy, family size, self-reported risk aversion, two dummies for past credit refusal, ln(years expected to stay in job), expectational measures of interest rates and income.

Mortgage contract characteristic	Dependent variable = 1 if lender is finance company		Dependent variable = 1 if lender is commercial bank		Dependent variable = 1 if lender is savings bank		Finance company - commercial bank	
	all controls	no borrower controls	all controls	no borrower controls	all controls	no borrower controls	all controls	no borrower controls
<i>Interest rate risk / prepayment risk</i>								
Dummy for fixed rate loan	0.101*** (0.020)	0.097*** (0.020)	-0.029 (0.020)	-0.025 (0.020)	-0.079*** (0.014)	-0.079*** (0.014)	0.18	0.176
<i>Liquidity risk</i>								
Dummy for jumbo loan	-0.139*** (0.026)	-0.152*** (0.025)	0.095*** (0.028)	0.111*** (0.027)	-0.020 (0.016)	-0.022 (0.016)	-0.119	-0.13
<i>Credit risk</i>								
Loan-to-valuation ratio (LTV)	0.061*** (0.013)	0.035*** (0.011)	-0.017 (0.013)	0.010 (0.011)	0.013* (0.008)	0.012* (0.006)	0.048	0.023
<i>Borrower risk covariates</i>								
Total debt / total assets	0.279*** (0.044)		-0.170*** (0.043)		-0.058** (0.026)			
Borrower denied credit	0.032 (0.022)		-0.026 (0.022)		-0.000 (0.013)			
Borrower did not apply for credit, fearing rejection	0.039 (0.032)		-0.086*** (0.030)		-0.049*** (0.015)			
Ln(years exp to stay at job)	-0.014** (0.006)		0.009 (0.006)		0.006 (0.004)			
Other borrower covariates	yes	no	yes	no	yes	no		
Year and region dummies	yes	Yes	yes	yes	yes	yes		
Number of observations	4265	4265	4265	4265	4265	4265		
R <sup>2</sup>	0.07	0.05	0.05	0.03	0.08	0.07		

Table 8. Relationship between lender type and quoted mortgage interest rates

<b>Dependent variable in all three columns: quoted mortgage interest rate.</b> Regression includes a dummy if lender is commercial bank, dummy for fixed rate mortgage, interaction dummy, and 25 MSA dummies.			
	[1]	[2]	[3]
	OLS	Median regression	OLS with winsorized data
Commercial bank * fixed rate mortgage	-0.219** (0.093)	-0.270*** (0.066)	-0.217*** (0.082)
Lender is commercial bank	0.202** (0.088)	0.240*** (0.053)	0.206*** (0.078)
Loan has fixed interest rate	1.245*** (0.074)	1.390*** (0.054)	1.176*** (0.068)
F-test, MSA dummies (p-value)	0.000***	0.000***	0.000***
R-squared	0.686		0.720
Number of observations	425	425	425

Table 9: Securitization rates for different types of mortgages

	2001	2006
Agency	76%	87%
Jumbo	33%	46%
Alt-A	19%	91%
Subprime	46%	75%

Source: Inside Mortgage Finance, 2007