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Abstract

The real estate finance literature provides rich insights into circumstances that expose mortgage borrowers to risk. However, there is no characterization of how mortgage contracts might play a role in helping households manage their portfolio risks. This paper provides a framework for evaluating the implications of mortgage choice for the risk management of households. Starting with an empirical characterization of the assets and liabilities of a representative household, we build a framework to determine how they manage the duration and convexity of household-equity at various stages of the life cycle.

Our risk management framework takes into account the relationship between the most important asset of the household – their human capital – and their most important liability – the mortgage. The embedded call and put options of the mortgage contract are well known. Households also have implicit call and put options on the asset side of the balance sheet in the form of their human capital. The puts and calls of the mortgages and human capital to some extent help households reduce the net duration and convexity of their equity.

We find strong evidence that human capital does matter in the mortgage choice, at least with respect to the variability of employment by sector, whether the borrower is self-employed, or a young college graduate. We also find that total indebtedness and leverage play an important role in mortgage choice.

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1. Introduction

The value of the housing stock in the United States, at the end of 2004, stood at $18 trillion. This was financed with roughly $8 trillion in mortgage debt and $10 trillion in equity. The fact that households finance 44 percent of house value with debt contrasts with corporations that use 32 percent debt finance. As households refinance more, draw more on their built up home equity, and use home equity to find a low-cost source of financing, they are increasingly changing the form of the mortgage contracts they use to finance their homes. This highlights the fact that the magnitude of mortgage debt and the manner in which this debt is financed is likely to be of importance for individual households and the economy at large.

The literature has given substantial attention to the choice of mortgage contracts and the risks associated with such contracts. Examples of mortgage choice include the choice between fixed-rate and adjustable-rate mortgages, the choice between long-term and short-term mortgages, and the choice between mortgages with discount points and relatively low coupons and those with no discount points and relatively high coupons.[1] However, there is little work that has addressed the macroeconomic implications of these choices.

There are four studies, nonetheless, that examine the role of housing in the household portfolios and its macroeconomic implications.

The first two studies address a set of questions on the issue of housing in the setting of an individual's portfolio formation. This approach is the approach taken by Flavin and Yamashita (2002) and Brueckner (1997). Flavin and Yamashita use a mean-variance efficiency framework to evaluate a household's optimal portfolio when owner-occupied housing is included in the list of available assets. An important observation they make is that the demand for housing is "overdetermined" since the optimal consumption of housing services will most likely differ from optimal housing from a portfolio perspective. Yet, a number of frictions in the market for housing force households to include the optimal level of consumption of housing services in their

[1] See, for example, Brueckner and Follain (1988), Campbell and Coco (2003), and Stanton and Wallace (1998).

portfolios. They then address the question of "the impact of the portfolio constraint imposed by consumption demand for housing on the households optimal holding of financial assets."

Brueckner's findings are similar to Flavin and Yamashita, in that he finds that when the investment constraint (introduced in a study by Henderson and Ioannides,1983) is binding, the homeowner's optimal portfolio is inefficient in a mean-variance sense. Thus, portfolio inefficiency is not an indication that consumers are irrational or careless in their financial decisions. Instead, inefficiency can be seen as the result of a rational balancing of the consumption benefits and portfolio distortion associated with housing investment.

The third and fourth studies look at a second set of questions focused specifically on the factors that drive the choice of mortgage contracts. Campbell and Coco (2003) study the choice between a fixed-rate mortgage (FRM) and an adjustable-rate (ARM) mortgage. Using a numerical life-cycle model where labor income is risky and when consumers face borrowing constraints, they find ARMs to be an attractive contract. However, when households are highly risk averse, face significant costs of default and when they do not expect to move, they are less likely to prefer an ARM. One of the significant findings of this paper is that inflation-indexed fixed-rate mortgages that remove the wealth risk of a nominal fixed-rate mortgage without the income-risk accompanying ARMs would effectively help households manage their risks.

Szerb (1996) examines the borrowers choice between a FRM and an ARM in the face of real and nominal (inflation) shocks to income, house prices and mortgage rates. He finds that more exposure to nominal shocks will decrease the probability of choosing an ARM if the amount of the adjustable mortgage payment exceeds expected real income growth. Expected real and nominal income growth increases the likelihood of ARM choice by counterbalancing the risk of higher future payments.

The third approach examined in the fifth paper uses an asset pricing methodology to characterize the manner in which volatility in house prices impinge on the cross-section variation of asset returns. The critical variable through which shocks to house prices get funneled to risk premia is one that Lustig and Nieuwerburgh (2005) refer to as a collateral ratio, the ratio of housing wealth to human wealth. There are two paths through which shocks to housing are funneled through to the market price of risk. The first path is one where a low collateral ratio leaves households more exposed to "idiosyncratic labor income risk," which in turn contributes to the stochastic discount factor. And since nondurable consumption and housing services may

be complements, the second path describes households requiring a higher risk premium, if returns and rental price growth are positively correlated. Through these two paths, the collateral effect impinges on asset returns.

In all three approaches highlighted so far, implicit in the characterization of risks, is the critical role played by human capital and where they are situated in the life-cycle. For example, Flavin and Yamashita (2002) point out "young households, which typically have large holdings of real estate relative to their net worth are highly leveraged and therefore are forced into a situation of high risk."[2] Additionally, Campbell and Coco (2003) make the case that "if markets were complete such that labor income can be capitalized, and its risk insured, then labor income characteristics play no role in the mortgage decisions."[3] However, they go on to state "markets are seriously incomplete because moral hazard issues prevent investors from borrowing against future labor income, and insurance markets for labor income risk are well developed."[4] Finally, in the approach taken by Lustig and Nieuwerburgh (2005), a critical variable in their explication of risks is that of the collateral ratio: the proportion of housing wealth to human capital wealth. The collateral variable insulates households from labor income shocks when it is high and fails to provide such protection when it is low.

However, in all three approaches, the form of the labor contract and the role it plays in exacerbating or mitigating risk is not clearly laid out. Further, there is no way in which to determine how risky labor income might play a role, from the perspective of risk management, in determining the choice of mortgage contracts. This paper addresses these two issues.

The framework we build is one where a household, regardless of where it is in the life cycle, would satisfy a balance sheet. The risks of the balance sheet would be managed to ensure that risks to equity capital are minimized. To provide a simple characterization of the issue, the household has a physical asset, the home, some financial assets, and its human capital, on the asset side of the balance sheet. On the liability side of the balance sheet, the household has a mortgage contract, whose characteristics we will consider shortly. Further, the household might have some other short and long-term liabilities as well. In Table 1, we provide the aggregate value of the elements of the balance sheet for U.S. households other than their holdings of human capital.

[2] Flavin and Yahamshita (2002), p. 345.
[3] Campbell and Coco (2003), p.2.
[4] Ibid.

Taking a closer look at the asset side of the balance sheet, two issues need to be highlighted. The first, the home, is a physical asset and has a large duration. It is best to think of the duration as the interest rate sensitivity in the current context.[5] The second asset, human capital, is the dimension we characterize in a manner that is different. We see the market value of human capital as being captured using the framework of a labor contract that takes the form of a swap. The individual provides labor services, whose productivity is variable, in return for a payment or a wage that is fixed.[6] The additional features of this swap are the two embedded options: a call that permits the employee to call his human capital should another more attractive alternative become available to her, and a put that given the employer the right to terminate the contract for firm-specific or performance-related reasons. Given the durations and convexities for the asset side of the balance sheet, the household has to determine the manner in which she will choose liabilities to balance or mitigate interest rate risk subject to current income and credit constraints. Beginning with the situation that we have just described, the household is likely to be seriously long-duration on the asset side of the balance sheet. The question then is how might the liabilities be adjusted to ensure that some of this long duration exposure on the asset side of the balance sheet is matched or neutralized? This is the central question this paper addresses.

Section 2 of this paper describes a simple framework of the household's balance sheet. It lays out all of the elements of the asset side and provides a detailed description of the labor contract. This is followed by a description of the implications of choosing different types of contracts to manage the risks inherent in the asset side of the household's balance sheet. Once again we lay out in the detail the structure of the liability side of the balance sheet, especially that of the mortgage contract. The paper then provides a description of the hypothesis along with a detailed description of the data in Section 3. This is followed by a presentation of the empirical results in Section 4. Section 5 concludes with a set of questions to be pursued as part of this research agenda.

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[5] The research by Deutsche Bank in Table 1 estimates the duration by regressing the log of asset prices, P_t against the yield rates on the 10-year constant maturity U.S. Treasury securities, r_t. Duration is the β coefficient in the equation $\ln(P_t) = \alpha + \beta r_t + \varepsilon_t$

[6] This the labor contract described in Lazear's (1995) seminal work, *Personnel Economics*.

2. The Household Financial Statement

2.1 The Balance Sheet

The model presented is one that begins with a balance sheet of a household. At this point, we will not highlight the stage of the lifecycle of the family. For illustration we refer again to Table 1 to show the aggregated values for all households – individual households have a similar structure to their balance sheets.

Real estate is the single largest asset for households, followed by the sum of equities held in household liquid holdings and pensions, which are generally illiquid. The home is also a high duration asset, where duration is defined as the changes in the asset prices relative to changes in the 10-year constant maturity U.S. Treasury securities, or the β in the regression model $\ln(P_t) = \alpha + \beta r_t + \varepsilon_t$. The estimated duration of home prices is 11, beaten only by the duration of stock equities at 23. The mortgage is the largest liability, and is the highest duration of the liability side of the balance sheet, estimated at a duration of 3.4. However, human capital is also a household asset, and the most important one since it limits both current consumption and saving behavior and represents an expected stream of payments over the worker's life – in this context we think of the head of the household as representative of the household for human capital. We examined the variation in returns to human capital in a method similar to that of the Deutsche Bank analysis to estimate duration or Betas for employment. These are shown in Table 2 for the Northeast Region for the period 1978 through 2000, and the data are growth rates in regional sectoral employment relative to national employment growth.[7]

In what follows, we describe each of the elements in the balance sheet in detail, paying particular attention to the interplay between the mortgage contract, the home value, and the value of human capital.

2.2 Valuing the Elements of the Balance Sheet

The valuation of the physical asset, the home, is characterized using a simple dividend growth model. In this framework, the mortgage rate paid by the household is r_m, the market

[7] We estimated betas for all regions and they are similar across the different regions in the rank ordering of the sectors. The other three regional regression tables are in the Appendix.

mortgage rate,[8] and the rate of growth in home prices is g_m. The rate of growth of home prices in this setting is the expected long-term equilibrium rate of growth. The value of the housing asset P^h is represented by the present value of the stream of dividends, D^h, enjoyed by the household. The valuation of the home according to the constant dividend growth model is:

$$P^h = \frac{D^h}{(r_m - g_m)} = \frac{D_0^h(1-g_0)}{(r_m - g_m)} \qquad (1)$$

where the zero subscript denotes the value of the growth rate at the decision point for the household.

The financial assets held by the household are held partly in liquid near-cash form and as longer-term illiquid assets that are typically in various pension vehicles. An important point worth noting is that this asset is not easily used to risk manage the balance sheet of the household. We characterize the present value of the financial assets of the household as:

$$FA^h = N^h + PA^h = \sum_{j=1}^{J} N_j^h + PA_j^h, \qquad (2)$$

which is the sum over all financial assets of various types j, $j = 1,...,J$, including cash, CDs, mutual stock and bond funds and annuities, individual equities and corporate and government bonds.

For now we make the simplifying assumption that younger households hold all of their pension assets in a basket of equities, and change this composition as they grow older. As households near retirement, the mix of financial assets is tilted decidedly towards bonds.

The human capital of the household is described in this framework on a period-by-period basis. To characterize human capital, we use the insight of Lazear (1995) that labor contracts are ones where the payment received by labor is fixed, whereas what they give back to the firm or the employers is variable, as their productivity varies. We build on this insight and outline a one-period labor contract. The contract, renewed every period, is a labor-swap. In this contractual arrangement the individual exchanges his labor services, which are variable, for a fixed payment. This payment received is like the coupon on a fixed-rate bond. The firm on the

[8]This is a simplification–a risk premium should be added to the mortgage rate to get the weighted average cost of capital for housing.

other hand has a position that resembles being invested in a variable-rate bond. We realize that is an oversimplification of what is inherently a complex contractual relationship.

We add two dimensions to the human capital involved in the labor swap. We recognize that this labor swap has two embedded options. The first is a call written by the firm and it permits the employee to call his labor services away during the life of the swap, with appropriate notice to the employer. The second embedded option is a put that the employee has written for the firm. This permits the firm to put the employees' services back to him or her for reasons of the firms' performance, or the performance of the employee. The description of the labor swap from the perspective of the employee is:

$$V^{swap} = LS^{fix} - LS^{Var} \tag{3}$$

where LS^{fix} is valued in the manner one might a simple bond with twelve or twenty four coupons depending on whether wages are received once or twice every month. The value of the variable component is similar to that of a bond for which the coupon is variable, depending on labor productivity, which is uncertain. However, there are two factors that complicate the valuation of the swap. First, the part of the swap relating to the employee contains an embedded call option. The employee, should he find an opportunity that is distinctly advantageous to him, could call his employment swap back if it is in the money. Consequently, we express the value to the employee of his portion of the labor swap as:

$$LS^{fix} = LS_0^{fix} + Call^{fix} \tag{4}$$

Where $Call^{fix}$ is the value of the call option in which the employee maintains a long position, and LS_0^{fix} is the wage and benefit payments to the employee with his current employer. The value of this call option can be written as,

$$Call^{fix} = \max(0,\ LS^{fix*} - LS_0^{fix}), \tag{5}$$

where LS^{fix*} is the net value of a new opportunity relative to the current net payment for labor services, LS_0^{fix}.

However, the employee has also written a put option for the employer. As the employer finds the value of his labor services VLS_0 not contributing a benchmark minimum VLS^*, a separation can take place and the employer puts the labor swap back to the employee, or

$$\text{Put}^{\text{var}} = \max(\text{VLS}^* - \text{VLS}_0, 0). \quad (6)$$

If we think of this as the marginal revenue product of labor, then VLS_0 can drop below the threshold either because the worker becomes unproductive through shirking or the value of the product (marginal revenue) in the market place falls. The value to the employer of his portion of the labor swap is expressed as,

$$\text{LS}^{\text{var}} = \text{LS}_0^{\text{var}} + \text{Put}^{\text{var}}. \quad (7)$$

The full expression for the value to the employee of the labor swap is:

$$\text{V}^{\text{swap}} = \text{LS}_0^{\text{fix}} + \text{Call}^{\text{fix}} - (\text{LS}_0^{\text{var}} + \text{Put}^{\text{var}}). \quad (8)$$

Note that the value of the labor swap is equal to zero if the employee is matched to his best job at the prevailing market wage (meaning the call option is at zero) and is meeting expectations (meaning that the put option is at zero). In reality, the thresholds for the labor contract call and put options will not be zero, but instead will include some transactions costs, due to search, training, liability, and measurement.

From the point of view of the household, the current mortgage liability is

$$\text{Mortgage}_0^{\text{h}} = \sum_{t=1}^{T} \frac{m_t^{\text{mort}}}{(1+d_t)^t} - \text{Call}^{\text{mort}} - \text{Put}^{\text{mort}} \quad (9)$$

where T is the number of remaining scheduled payments, m_t^{mort} is the mortgage payment (principal and interest) in period t, d_t is the expected discount rate at time t, $\text{Call}^{\text{mort}}$ is the value of the prepayment option and Put^{mort} is the value of the default option. Foster and Van Order (1984) and Deng, Quigley and Van Order (2001) discuss the valuation of the two embedded options and we think of them in those terms. However, we will not specify these options in more mathematical detail for our purposes here. Similarly, the household has put and call options on its other debt, but usually has very little choice in the structure of the instrument – almost always a variable-rate consumer loan (credit cards) or a short-term, fixed-rate loan (auto loans, for example), and usually the default option does not require the household to give up the

rights to their home.[9] We can define the present value of the sum over the household's K types of short- and long-term debt liabilities as

$$\text{Debt}_0^h = \sum_{k=1}^{K}\sum_{t=1}^{T}\frac{m_{k,t}^{debt}}{(1+d_t)^t} - \text{Call}^{\text{debt}_k} - \text{Put}^{\text{debt}_k} \qquad (10)$$

Collecting terms, we can express the net present value of the equity of the household as:

$$E_0 = \frac{D^h(1+g_0)}{(r_m - g_m)} + N^h + PA^h + LS_0^{fix} + \text{Call}^{fix} - \left(LS_0^{var} + \text{Put}^{var}\right)$$

$$- \text{mortgage}_0^h - \text{Debt}_0^h \qquad (11)$$

The value of the household's equity is the sum of the physical asset, the home, the short and long-term financial assets, and the value of human capital (valued as a short-term swap for the head of the household) net of the mortgage obligation and debt (short and long).

Seen from the perspective of a household, the expression provides insight into the financial choices made and their impact on the balance sheet, especially with regard to interest-rate risk. It is useful to first consider the net duration of this balance sheet where the household balance sheet has a significant amount of duration in its physical asset, the home. While the short-term and long-term financial assets do add duration, it is likely that their impact is dependent on where in the life-cycle the household is situated. Lastly, human capital, which is described as a labor swap on the left hand side of the balance sheet, might sometimes have quite a lot of duration (in the case of tenured professors, for example), but will often not have much duration; and the embedded optionality is likely to change duration dramatically as rates change.

Fluctuations in human capital returns are important because they can explain why households might not maximize risk-adjusted returns by investing in a market portfolio and adjusting their risk position through borrowing and lending at the risk-free rate. For example, a manufacturing worker is, *per se*, heavily "invested" in the manufacturing sector. If the prospects for his firm are good, he has a long position in manufacturing; as the prospects for the firm diminish, the position becomes shorter and shorter. Using the traditional mean variance framework, we can think about workers seeking to maximize:

[9] The national bankruptcy laws have recently changed, making the bankruptcy default option less appealing since most households must now pay back some of the debt. Homesteading laws vary by state, and in many cases protect the family home up to some value limit from seizure under bankruptcy. See Cutts and Green (2005) for a listing of states as of December 2002 that allow for deficiency judgments against other assets when the proceeds from the sale of the home through foreclosure do not cover the unpaid principal balance.

$$E_0 = \frac{D^h(1+g_0)}{(r_m - g_m)} + N^h + PA^h + LS_0^{fix} + Call^{fix} - \left(LS_0^{var} + Put^{var} \right)$$

$$- mortgage_0^h - Debt_0^h$$

$$\text{s.t.} \quad \sigma_E^2 \leq Risk^*, \qquad (12)$$

where $Risk^*$ is the maximum level of risk tolerance the household wants to bear.

The right hand side of the balance sheet includes the mortgage contract, the choice of which is likely to determine the volume of duration that is available to the household. Longer fixed-rate contracts on their face will provide a large amount of duration while ARMs are likely to provide very little duration. Both types of these contracts also contain default options, the values of which might vary because of how they interact with duration. Finally, there are other liabilities (short and long-term) that are likely to bring some measure of duration counterbalancing to the balance sheet.

However, the important point for this analysis is that while there is a significant amount of duration on the asset side of the balance sheet, the ability to counterbalance it depends critically on the choice of mortgage contracts. Should the household decide to choose a fixed-rate, long-term contract, it will provide itself with a distinct amount of protection against interest rate moves. In the instance of the household choosing an ARM, the ability to obtain this protection is not available and the balance sheet is long duration and consequently open to large swings in value with interest rate changes – an unlikely choice for generally risk-averse people. On the other hand, for certain types of borrowers, it may be the case that an ARM better hedges labor-market risk, in part because of the default option and in part because interest rates and macroeconomic conditions tend to move together (interest rates generally fall in periods of economic slowdown.)

This has important implications about the relationship between household characteristics and the use of mortgage debt. It suggests that the type of employer or occupation will influence mortgage choice, because some occupations have longer expected durations than others. It suggests that age and marital status should matter, because expected duration in the house will be influenced by these characteristics and because the former provides information about the realization of human capital while the second signals greater risk aversion. It suggests that both

the level and expected volatility of permanent income should matter. And of course, it suggests that investments in financial assets and the net worth of the household should matter.

Complicating this, however, is a borrowing or "affordability" constraint. Until recently, the principal determinant of the maximum prime mortgage balance a household could obtain was the payment to income ratio. Generally speaking, throughout the 1980s and 1990s, for Fannie Mae and Freddie Mac to consider purchasing a mortgage, they required the borrower's mortgage debt service payment to be less than 28 percent of gross income, and the total household debt service to be less than 36 percent. This constraint has been far less binding since the Government Sponsored Enterprises began underwriting mortgages using Fair Isaac credit bureau scores in 1993 and using automated underwriting systems in 1995, but it did influence mortgage choice before then, and continues to do so, because ARMs have lower monthly payments than fixed-rate mortgages.[10] Consequently, any study of mortgage choice must also include and examination of payment-to-income ratios.[11]

2.3 Implications of interactions between labor and mortgage markets

Let us consider the interaction between labor markets, capital markets, and the two basic types of mortgage contracts in more detail. We then will discuss the relationship between observed household characteristics and the predilection for using ARMs.

Suppose households face two potential types of shocks: productivity shocks and interest-rate shocks. Let us consider the types of hedge each mortgage provides under each potential scenario: upward movements in interest rates and productivity, an upward movement in productivity and a downward movement in interest rates, a downward movement in productivity and an upward movement in interest rates, and downward movements in both productivity and interest rates.

When both productivity and interest rates rise, the household is to some degree hedged against volatility, regardless of the type of mortgage it chooses. This is because the rising rate will cause the house value to fall, but the productivity gain will cause the value of human capital to rise. With an adjustable-rate mortgage, the present value of the mortgage obligation (the present value of future payments) remains at par, which in turn means equity would fall; with the

[10] The recent rise in the popularity of interest-only and option-payment ARMs is due to affordability issues in many high-cost markets. An interest only mortgage usually has a lower interest rate than a similar

[11] See Brueckner and Follain (1988) for a discussion of mortgage choice under constraints.

fixed-rate mortgage, the present value of the mortgage would fall, which would mean that the household would be insulated against a substantial reduction in equity. On the other hand, because the ARM borrower loses equity, the value of its default option becomes more valuable. Depending on how levered the household is, it is possible that the ARM borrower is better off under this scenario than the fixed-rate borrower.[12]

When productivity rises and interest rates fall, the FRM borrower is clearly better off than the ARM borrower. The value of human capital and the house both rise, the value of the default option gets smaller, and the value of the FRM falls while the value of the ARM remains at par. Both types of borrowers will have the value of the call option increase.

When productivity falls and interest rates rise, the value of the FRM versus the ARM will again be a function of how the household's leveraged. Once again, the value of the mortgage balance remains at par from the standpoint of households holding ARMs, while the present value of the obligation falls for those with the FRM. But now, the ARM household is also facing payment shock–a shock that could create the sort of trigger event described in Deng, Quigley and Van Order (2001) and that could also lead to exercise of the default option. Highly levered households whose employers exercise the labor put would then exercise the housing put embedded in the ARM contract.[13] This would suggest that households that are vulnerable to changes in the broader economy and who are highly leveraged will prefer ARMs.

Finally, when both productivity falls and interest rates fall, the ARM gives the benefit of reducing payments without incurring the transactions costs of refinance. But for both mortgage types there will be an increase in the value of the call option, with the net effect of marking both mortgages at approximately par. The ability to freely prepay the mortgage subject to transactions cost constraints limits the balance-sheet risk induced by higher risk of being fired regardless of the mortgage contract chosen.

Based on this line of reasoning, we would expect to see more-highly leveraged borrowers take out ARMs, since they will have little equity to protect with the mortgage contract. We cannot fully determine which types of employers or occupations will lead to which mortgage

[12] Implicitly this assumes that there is no emotional or transactions cost to default (meaning loss of the home through foreclosure). If these costs are significant, then the household may always be worse off in this scenario with an ARM.

[13] These households could have significant financial assets, but it is rare to have households take mortgages with less than 20% down if they can scrape together the funds to meet this threshold and avoid the cost of mortgage insurance. Hence, we posit this scenario on the household having few other assets to fall back on, and thus being forced to give up the home in the event of job loss.

contract because it will depend on whether the household is duration hedging or simply risk averse – but we would expect that households employed high employment duration sectors from Table 2 to behave very differently than those with smaller durations. Lastly, we would expect that those with less binding budget constraints and better revelation of human capital (higher income, older, more educated households) will have more options when choosing the mortgage contract.

3. Data and the Empirical Model

3.1 The Survey of Consumer Finances

The data we use is the Survey of Consumer Finances (SCF), which is a triennial interview survey of U.S households sponsored by the Board of Governors of the Federal Reserve System with the cooperation of the U.S. Department of the Treasury. Since 1992, the SCF data have been collected by NORC, a University of Chicago research organization, between May and December of each survey year. The data collected look at U.S. households' balance sheets, their use of financial services including the types of mortgages held, the number of mortgages and the pertinent mortgage rates on the households' residential real estate. The SCF also provides detailed information on labor force participation as well as demographic characteristics for each survey year.

The SCF is intended to provide an accurate and comprehensive snapshot of U.S. households. Its sample design consists of two parts: a standard, geographically-based random sample and a special over-sample of relatively wealthy families. Weights are then generated to combine information from the two samples to make estimates for the full population.

We pooled the data from the five survey years (1989 through 2001) and convert all the nominal financial information to real dollars by using the Bureau of Labor Statistics' current methods version of the consumer price index (CPI) and treating 2001 as the base year.

The sample is limited to those households who have one or more mortgages on their primary residence. We further limited the sample by a 1% trim on the top and bottom incomes to eliminate those with no recorded incomes and those whose incomes, while most likely true, are so far from the median income that they are not representative of the general population of

interest to us.[14] We also deleted observations for which the mortgage balance was reported as zero or for whom the current loan-to-value ratio was greater than 3, the mortgage-debt-to-income ratio was greater than 10, the head of household was younger than 18 at the time the mortgage was originated, or the year the mortgage was originated was prior to 1985. And of course, if any of the relevant variables of interest were missing.

We should also note that the SCF contains substantial imputation. As Kennickell (1998), one of the authors of the survey, notes:

> The Survey of Consumer Finances (SCF) focuses intensely on the details of households' finances. Owing to the perceived sensitivity of this topic to some people, unit and item nonresponse rates in the SCF are substantial. In addition, many of the assets and liabilities treated in the survey may have values that are not always precisely defined—for example, a closely held business may have a distribution of possible values and the market value might not be knowable without actually selling the business. Such assets can have relatively high rates of missing information. Multiple imputation (MI) has provided a means of providing a public dataset that is more informative overall than anything that could be constructed with the data available to the public. At the same time, the variability in imputations allows us to give a more honest picture of the limits of our knowledge about the missing data.
>
> MI also plays a key role in the SCF in disclosure limitation. Fairly unusual observations in the population are relatively common in the SCF, and this aspect of the survey complicates the creation of public versions of the data. MI used as a data simulation tool has been a key part of a larger strategy to protect the identity of respondents while avoiding distortions in the data made available to the public.

These imputations have implications for the estimation of coefficient standard errors—we use the techniques specified in the SCF documentation for doing such estimation.

3.2 Variables

The dependent variable is whether the household has chosen an adjustable-rate mortgage (ARM = 1) for their first lien mortgage or a fixed-rate or balloon mortgage (ARM = 0). The independent variables are chosen to represent borrower constraints and demographic and financial characteristics that may influence the choice of the mortgage contract. The model is logistic regression.

[14] The highest real income in our untrimmed sample was $126 million. The range of incomes in our trimmed sample was $5,330 to $456,335 in 1991 dollars.

Employment Sector of the Head of Household

This is our key variable of interest. The SCF reports high-level industry sectors for the head of the household if employed. They are: agriculture; construction or mining; manufacturing; wholesale or retail sales; finance, insurance or real estate; public utilities, transportation or services; and government. The default category is that the household head is not in the labor force. Of interest is whether the households in the highest risk or most volatile sectors from an employment or earnings standpoint prefer ARMs (thus matching the asset volatility of the labor contract) or prefer FRMs (thus hedging the asset volatility from the labor contract). Using the methodology in Seyfried (1998), we estimated employment betas for ten sectors as shown in Table 2. By these estimates, we would expect to find households that work in sectors in which the estimated durations are significantly greater than 1 will choose between ARMs and FRMs differently than those that work in sectors with Betas well below a value of 1.

Real Household Income

This is the total household money income from all sources at the time of the survey (not at origination) in 2001 dollars. The variable has been scaled by dividing it by 100,000. This variable has an indeterminate prior – those with higher incomes would be able to bear greater income shocks and thus could better weather interest-rate adjustments but they also would have greater choices among available homes and would not be as constrained by affordability issues that might cause lower-income households to choose adjustable-rate mortgages.

Real Total Financial Assets

This is the total sum of all financial assets from all sources at the time of the survey (not at origination) in 2001 dollars, including pensions, cash and liquid short- and long-term assets but excluding holdings in real estate. The variable has been scaled by dividing it by 10,000. We expect households with greater financial assets to have a greater cushion for the interest-rate risk associated with an adjustable-rate mortgage, but also have more to risk losing when rates rise and a fixed-rate mortgage would protect these assets when rates rise. [15]

[15] We can divide out pension assets from other financial assets and may do so in a later version to see what if any impact the liquidity aspect of these assets may have on the household's decisions.

Real Household Debt

This is the total household debt from all sources at the time of the survey (not at origination) in 2001 dollars. The variable has been scaled by dividing it by 10,000. We would expect households that have greater outstanding debts to have a greater tolerance for interest-rate risk since they have less equity to protect, all-else equal.

Age of the Head of Household

We use the age of the head of household in the year the reported mortgage was originated and break the variable into six age classifications: younger than 25, 25 to 34, 35 to 44, 45 to 54, 55 to 65 and older than 65. We would generally expect older households to reject ARMs in favor of FRMs due to impending retirement and a near certain curtailment of income as well as increasing risk aversion since they have little time to recover from a financial shock.

Marital Status

This is a dummy variable indicating that the head of the household is married as of the survey year. Our prior is that married households are more risk averse and thus would seek FRMs more often than unmarried heads of households.

Education Level of Head of Household

We use dummy variables to indicate the education level achieved by the household head as of the survey year. The default is that the head did not complete high school and we have indicators for whether the head was a high school graduate, attended college, completed college or went on to graduate school. It is our prior that better educated households will have a higher risk tolerance and greater knowledge of their permanent income, and thus would be more likely to choose an ARM.

Current Loan-to-Value Ratio

The SCF does not report the LTV at origination but does report current loan balance and estimated property value. We use four LTV categories in our regression: LTV below 50% (the default category), between 50 and 80%, between 80 and 90% and greater than 90%. Our prior is that households with less home equity will be more likely to choose an ARM due to the fact that they have no equity to protect when confronted with a default option trigger. They will also be

more constrained than households with more equity at origination, and thus it is also an indicator of affordability constraints.

Mortgage Debt Ratio

The SCF does not report the mortgage debt ratio, the mortgage balance divided by the household's income, at origination but does report current loan balance and current income. The general rule of thumb is that the mortgage balance at origination should be between 3 and 4 times income. Households with higher ratios will be more capacity constrained than households with lower ratios, and thus this is an indicator of affordability that might influence the household to choose an ARM rather than a FRM.

Self-Employed Head of Household

We include this variable because entrepreneurs are thought to be less risk-averse than those households who are either retired or who work for someone else. We expect these households to prefer ARMs.

Age and Education Interaction

We include an age-education group of variables to test the impact of a college degree on age. We expect that college educated household heads will choose ARMs more often than household heads who are of similar age but who do not have a college degree.

Age and Income Interaction

We include an age-income group of variables to test whether there is any additional information in knowing that someone is 25 and making $30,000 relative to someone who is 55 and making $30,000. Our prior is that income at older ages is more telling of permanent income and thus it is more likely that older household heads with higher incomes will choose ARMs.

Year the Mortgage Was Originated

The SCF reports the year the current mortgage was originated, and we use dummy variables for each year and set the default year as 1985. The choice between ARM and FRM at origination will also depend greatly on the slope of the yield curve. If the discount for ARMs relative to FRMs is high, families that might otherwise prefer a FRM may choose an ARM due to the large monthly savings on their mortgage payments. Figure 1 shows the weekly mortgage

rates as reported in the Primary Mortgage Market Survey[SM] from Freddie Mac. In 1993, FRMs dipped below 7 percent for the first time in the Survey, which started in 1971 for FRMs. Mortgage rates were generally low over the period of our sample, but fixed mortgage rates were trending down, while ARM rates went up and down, ending in 2000 with an inverted yield curve and the difference between the Survey's FRM and ARM averages closing to just 15 basis points in December of that year. We expect households to choose FRMs when ARMs are relatively expensive or when FRMs are absolutely cheap.

4. Results

We find that six factors are consistently important across the five model specifications that we tried: employment sector, total household debt, current LTV, whether the household head is self-employed, and whether the household head is a young college graduate. The results are presented in Table 3. Income is only important when the mortgage debt ratio is not included.

The results for our key variable of interest, sectoral employment, are particularly striking – households employed in three sectors of the economy seem to have particular antipathy toward ARMs. The sectors are manufacturing, whose workers like ARMs the least; the government sector, whose workers follow only manufacturing workers for disdaining ARMs; and the public utility, transportation and services sector. As Table 2 shows, these happen to be the three sectors where the employment Betas are lowest, meaning that employment in these sectors is less volatile than employment in other sectors. One might think that this would lead workers in these sectors to be more likely to choose ARMs, because their expected income is stable. On the other hand, it is possible if not likely that workers with high levels of risk aversion self-select into these relatively stable sectors, and thus also self-select into fixed-rate mortgages. If these workers' mortgage choices reflect their general personal conservatism, they also may be less likely to "stretch" when purchasing a house, which means that they will be less payment constrained than other borrowers.

Our models indicate that the higher the household's debt, the more likely they are to choose an ARM. The coefficients remain within a narrow band for all five models; a $10,000 increase in total debt outstanding leads to a roughly three percent greater likelihood of taking on an ARM. This could reflect a capacity constraint issue (people with more debt are more payment constrained and bound to find the ARM more appealing), or a relatively high personal discount rate. The result is not consistent with a duration matching story, as large amounts of

short-term, adjustable-rate debt could leave households vulnerable to labor-market and interest-rate shocks.

The importance of the payment constraint becomes particularly obvious when one looks at the coefficients on either payment-to-income ratios or loan-to-value ratios—one of the two is significant in all five specifications. This reflects that fact that some borrowers are forced into an ARM in order to qualify for the house they wish to purchase given their income and financial assets.

Self-employment is also a strong predictor of ARM choice—those who are self-employed are more likely to choose ARMs. We speculate that this reflects the borrower's personal discount rate: entrepreneurs are more risk loving than the general population, and may therefore have a greater predilection toward ARMs.

Finally, young college graduates prefer ARMs relative to other education-age classes. This could reflect the fact that these graduates use ARMs to overcome tilt—they wish to buy a house consistent with their permanent income, which will be high relative to current income. They can therefore more easily qualify for the amount of housing they wish to consume out of lifetime income using an ARM than they can with a FRM. They, as a group, may also have the most confidence that its income will rise, and therefore the ARM matches up well with the group's labor market position.

The results on the year of mortgage origination are consistent with our priors: when FRM's are relatively cheap or absolutely cheap, households are less likely to choose ARMs.

5. Conclusions

In the past, mortgage-choice papers have just looked at the financial aspects, either through affordability or pricing on household behavior. We set out to incorporate the labor contract into the household's choice of mortgage, and establish theoretically the framework under which the labor contract, the housing asset, and the mortgage contract can be correlated and increase or decrease the risk to household equity. We also find empirical evidence of large differences in the variability of different asset prices and household liabilities, and large differences in the employment growth characteristics across industry sectors that would suggest a benefit to households of choosing a mortgage contract that can either match their risk aversion preferences or hedge the risk in the household balance sheet. Empirically, we find that households employed in lower employment volatility sectors such as government and

transportation, prefer FRMs, while those in higher employment volatility sectors generally prefer ARMs.

We are surprised that households seem to reveal aspects of their risk preference or a duration match rather than use the mortgage contract as a hedge against interest-rate volatility. People whose jobs seem safest may be in a better position to take on interest-rate risk, yet our regression results imply that they are less likely to do so with respect to the liability side of their balance sheet. However, from our relatively simple variable representing the broadly defined employment sector, rather than say occupation and detailed industry sector, it is hard to gauge whether there could be hedging occurring. For example, a manufacturing worker in a durable goods factory (say, making washing machines) will have greater interest-rate risk on his labor contract than would a worker manufacturing pharmaceuticals. In a hedging scenario, we might expect these two workers to make different choices than if they were simply expressing risk aversion.

The recent rise in the variety of ARMs available, including regular hybrids (fixed mortgage rates for 3, 5, 7 or 10 years and then variable annually thereafter) and the more exotic interest-only and option-payment ARMs (mortgages that specify four payment options each month: a minimum payment, usually implying negative amortization, an interest only payment, a 30-year amortization payment or a 15-year amortization payment) gives households a greater ability to duration match and meet current budget constraints. The option payment and interest only ARM mortgages also allow households with variable incomes, such as those with a significant amount of income from commissions or bonuses, to better match their payments to their income in each period but pose much greater potential payment shocks in later periods than do regular hybrid ARMs. The 2004 SCF may help to shed more light on these mortgage choices in the context of the labor contract and employment volatility.

References

Brueckner, Jan K. 1997. "Consumption and Investment Motives and the Portfolio Choices of Homeowners," *Journal of Real Estate Finance and Economics*, vol. 15(2): 159-80

Brueckner, Jan K and James R. Follain. 1988. "The Rise And Fall Of The Arm: An Econometric Analysis Of Mortgage Choice," *Review of Economics & Statistics*, vol. 70(1): 93-103

Campbell, John Y and Joao Coco. 2003. "Household Risk Management and Optimal Mortgage Choice," Working Paper, NBER Working Paper 9759, June.

Cutts, Amy Crews and Richard K. Green. 2005. "Innovative Servicing Technology: Smart Enough to Keep People in Their Houses?" in *Building Assets, Building Credit: Creating Wealth in Low-Income Communities*, Nicolas P. Retsinas and Eric S. Belsky, eds. 2005, Washington, DC: JCHS/Brookings Press.

Deng, Yongheng, John M. Quigley and Robert Van Order. 2000. "Mortgage Terminations, Heterogeneity and the Exercise of Mortgage Options," *Econometrica,* vol. 68(2): 275-307.

Edward P. Lazear. 1995. *Personnel Economics*. Cambridge: MIT press.

Flavin, Marjorie and Takashi Yamashita. 2002. "Owner-Occupied Housing and the Composition of the Household Portfolio," *American Economic Review*, vol. 92(1): 345-362.

Foster, C. and Robert Van Order. 1984. "An Option-Based Model of Mortgage Default," *Housing Finance Review,* vol. 3: 351-372.

Henderson, J. Vernon and Yannis M. Ioannides. 1983. "A Model of Housing Tenure Choice," *American Economic Review*, vol. 73(1): 98-124.

Lustig, Hanno N., Stijn G. Van Nieuwerburgh. 2005. "Housing Collateral, Consumption Insurance, and Risk Premia: An Empirical Perspective," *Journal of Finance*, vol. 60(3): 1167-1219.

Seyfried, William L. 1998. "Quantifying And Comparing Regional And National Employment Trends," *B>Quest Journal of Applied Topics in Business and Economics,* http://www.westga.edu/~bquest/1998/employ.html, accessed December 29, 2005.

Stanton, Richard and Nancy Wallace. 1998. "Mortgage Choice: What's the Point?" *Real Estate Economics,* 26(2): 173-205.

Szerb, Laszlo. 1996. "The borrower's Choice of Fixed and Adjustable rate Mortgages in the Presence of Nominal and Real Shocks," *Real Estate Economics*, 24(1): 43-54.

Table 1: Aggregated Household Balance Sheet with Durations

Assets	Size ($T)	Duration	***Liabilities***	Size ($T)	Duration
Real Estate	17.1	11	Mortgages	7.1	3.4
Durable Goods	3.6	2	Consumer Credit	2	1
Equities	15.7	23	Other Liabilities	1	2
Short Term Deposits	5.5	0			
Fixed Income Instruments	6.2	2			
Equity in non-Corporate Businesses	5.9	11			
Other Assets	2	2			
Total Assets	56	11.4	Total Liabilities	10.1	2.8
Human Capital	na	na	Equity	45.9	13.3

Notes: Data on assets, liabilities and equity from Deutsche Bank, US Fixed Income Weekly, Dec 10, 2004.

Table 2: Employment Betas for the Northeast Region, 1978-2000

Industry	α P-Value	β P-Value	Adj R^2	DW	White Test
Farm	-10.761	6.728	0.191	2.284	0.177
	0.000	(<0.0001)			
Construction	-1.007	1.020	0.131	1.020	0.272
	-0.058	0.000			
Mining	-5.277	2.900	0.087	1.993	0.200
	-0.005	0.003			
Manufacturing	-1.590	0.928	0.421	1.975	0.340
	(<0.0001)	(<0.0001)			
Wholesale	-1.408	1.18	0.407	2.055	0.003
	(<0.0001)	(<0.0001)			
Retail	-0.380	0.460	0.102	1.174	0.913
	-0.161	0.001			
Transportation and Public Utilities	-0.252	0.375	0.042	2.221	0.158
	-0.448	0.028			
Services	0.246	0.528	0.216	1.455	0.126
	-0.230	(<0.0001)			
Government and Military	0.550	-0.102	0.000	2.183	0.646
	-0.008	-0.323			
Finance, Insurance and Real Estate	-3.483	3.020	0.253	2.453	0.003
	-1.000	(<0.0001)			

Notes: Data on assets, liabilities and equity from Deutsche Bank, US Fixed Income Weekly, Dec 10, 2004; Labor data based on authors calculations using methodology described in "Quantifying And Comparing Regional And National Employment Trends" by William L. Seyfried accessed at www.westga.edu/~bquest/1998/employ.html on December 20, 2005 and are for the Northeast region only. Data cover the period from 1978 Q1 to 2000Q4 and are from the BEA series on employment.

P-values for betas are misspecified as written above -- they should be for H0: $\beta = 1$, rather than H0: $\beta = 0$; this correction will be made in the future

Table 3: Logistic Regression Results for Likelihood that Household Chooses an Adjustable Rate Mortgage versus Fixed Rate or Balloon Mortgage

Independent Variables	Model 1		Model 2		Model 3		Model 4		Model 5	
	Parameter Estimate	P-Value	Parameter Estimate	P-Value	Parameter Estimate	P-Value	Parameter Estimate	P-Value	Parameter Estimate	P-Value
Intercept[1]	**-1.200**	0.00	**-0.764**	0.01	**-1.024**	0.00	**-0.659**	0.03	**-0.899**	0.00
Real total HH income in $100,000s	0.082	0.22	**-0.107**	0.08	**-0.103**	0.09	-0.220	0.26	-0.280	0.17
Real total HH financial assets in $10,000s	0.000	0.19	0.000	0.12	0.000	0.13	0.000	0.13	0.000	0.13
Real total HH debt in $10,000s	**0.009**	0.01	**0.016**	0.00	**0.016**	0.00	**0.016**	0.00	**0.017**	0.00
Head of HH is younger than 25 years old[2]	-0.123	0.65	-0.194	0.48	-0.260	0.46	-0.343	0.40	-0.344	0.44
Head of HH is 25 to 34 years old[2]	-0.025	0.90	-0.044	0.83	0.042	0.88	-0.154	0.57	-0.075	0.81
Head of HH is 35 to 44 years old[2]	-0.251	0.22	-0.259	0.20	-0.098	0.72	-0.341	0.20	-0.215	0.48
Head of HH is 45 to 54 years old[2]	-0.100	0.62	-0.102	0.61	0.087	0.76	-0.160	0.56	-0.016	0.96
Head of HH is 55 to 64 years old[2]	-0.017	0.94	-0.006	0.98	0.156	0.58	-0.212	0.45	-0.051	0.87
Head HH is employed in the Agriculture Sector	-0.137	0.63	-0.210	0.46	-0.182	0.52	-0.212	0.45	-0.183	0.52
Head of HH works in the construction or mining sectors	-0.197	0.27	-0.250	0.16	-0.246	0.17	-0.259	0.15	-0.252	0.16
Head of HH works in the manufacturing sector	**-0.413**	0.01	**-0.498**	0.00	**-0.512**	0.00	**-0.507**	0.00	**-0.517**	0.00
Head of HH works in the wholesale or retail sales sectors	-0.166	0.32	-0.197	0.23	-0.210	0.20	-0.205	0.21	-0.216	0.19
Head of HH works in the finance, insurance or real estate sectors	-0.206	0.19	-0.246	0.11	**-0.262**	0.09	**-0.255**	0.10	**-0.268**	0.08
Head of HH works in the public utility, transportation or services sectors	**-0.250**	0.08	**-0.319**	0.03	**-0.324**	0.02	**-0.327**	0.02	**-0.329**	0.02
Head of HH works in the government sector	**-0.399**	0.05	**-0.483**	0.02	**-0.500**	0.02	**-0.496**	0.02	**-0.510**	0.01
Head of HH is married	-0.060	0.53	-0.128	0.16	-0.121	0.19	-0.127	0.17	-0.117	0.21
Mortgage originated in 1986	-0.290	0.19	-0.299	0.18	-0.312	0.16	-0.297	0.18	-0.309	0.17
Mortgage originated in 1987	0.186	0.37	0.196	0.34	0.191	0.35	0.195	0.34	0.188	0.36
Mortgage originated in 1988	0.326	0.12	**0.338**	0.10	0.343	0.10	0.344	0.10	**0.346**	0.09
Mortgage originated in 1989	-0.254	0.24	-0.250	0.25	-0.262	0.23	-0.246	0.26	-0.258	0.23
Mortgage originated in 1990	-0.318	0.16	-0.291	0.19	-0.298	0.18	-0.291	0.19	-0.298	0.18
Mortgage originated in 1991	**-0.769**	0.00	**-0.752**	0.00	**-0.765**	0.00	**-0.753**	0.00	**-0.769**	0.00
Mortgage originated in 1992	**-0.769**	0.00	**-0.730**	0.00	**-0.744**	0.00	**-0.733**	0.00	**-0.746**	0.00
Mortgage originated in 1993	**-0.951**	0.00	**-0.942**	0.00	**-0.952**	0.00	**-0.941**	0.00	**-0.951**	0.00
Mortgage originated in 1994	**-0.396**	0.05	**-0.369**	0.07	**-0.386**	0.06	**-0.370**	0.07	**-0.391**	0.05
Mortgage originated in 1995	**-0.553**	0.01	**-0.516**	0.02	**-0.533**	0.01	**-0.519**	0.02	**-0.537**	0.01
Mortgage originated in 1996	**-0.676**	0.00	**-0.630**	0.01	**-0.654**	0.00	**-0.633**	0.01	**-0.656**	0.00
Mortgage originated in 1997	**-0.929**	0.00	**-0.909**	0.00	**-0.919**	0.00	**-0.909**	0.00	**-0.920**	0.00
Mortgage originated in 1998	**-1.302**	0.00	**-1.250**	0.00	**-1.264**	0.00	**-1.250**	0.00	**-1.265**	0.00

Table 3: Logistic Regression Results for Likelihood that Household Chooses an Adjustable Rate Mortgage versus Fixed Rate or Balloon Mortgage, cont.

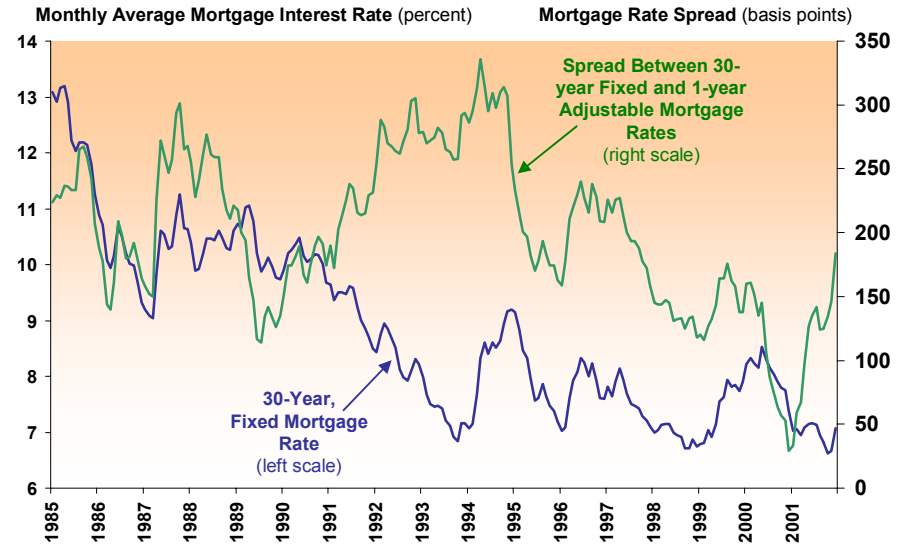
	Model 1		Model 2		Model 3		Model 4		Model 5	
Independent Variables	Parameter Estimate	P-Value	Parameter Estimate	P-Value	Parameter Estimate	P-Value	Parameter Estimate	P-Value	Parameter Estimate	P-Value
Mortgage originated in 1999	**-0.995**	0.00	**-0.923**	0.00	**-0.941**	0.00	**-0.926**	0.00	**-0.943**	0.00
Mortgage originated in 2000	**-0.551**	0.04	**-0.472**	0.08	**-0.475**	0.08	**-0.478**	0.07	**-0.474**	0.08
Mortgage originated in 2001	**-1.403**	0.00	**-1.282**	0.00	**-1.293**	0.00	**-1.286**	0.00	**-1.295**	0.00
Head of HH is high school graduate	-0.128	0.43	-0.170	0.29			-0.172	0.28		
Head of HH went to college	-0.126	0.45	-0.153	0.35			-0.153	0.35		
Head of HH is collge graduate	0.008	0.96	0.009	0.96			0.005	0.98		
Head of HH went to graduate school	0.027	0.88	0.027	0.88			0.021	0.90		
Current LTV ratio is 51% to 80%	0.001	0.99	0.112	0.21	0.111	0.21	0.110	0.22	0.107	0.23
Current LTV ratio is 81% to 90%	0.161	0.24	**0.329**	0.01	**0.328**	0.01	**0.329**	0.01	**0.325**	0.02
Current LTV ratio is greater than 90%	0.132	0.35	**0.343**	0.01	**0.355**	0.01	**0.342**	0.01	**0.352**	0.01
Mortgage debt ratio (UPB/Income)	**0.231**	0.00								
Head of HH is self employed	0.112	0.22	**0.195**	0.03	**0.200**	0.03	**0.193**	0.04	**0.194**	0.04
Head of HH is younger than 25 years old and is college graduate[2]					**0.876**	0.04			**0.890**	0.04
Head of HH is 25 to 34 years old and is college graduate[2]					0.234	0.10			0.236	0.12
Head of HH is 35 to 44 years old and is college graduate[2]					0.087	0.53			0.089	0.54
Head of HH is 45 to 54 years old and is college graduate[2]					0.047	0.77			0.060	0.72
Head of HH is 55 to 64 years old and is college graduate[2]					0.096	0.67			-0.020	0.94
Head of HH is 65 years old or older and is college graduate[2]					0.457	0.19			0.533	0.13
Income if head of HH is younger than 25 years old[2]							0.238	0.70	0.085	0.90
Income if head of HH is 25 to 34 years old[2]							0.134	0.55	0.172	0.46
Income if head of HH is 35 to 44 years old[2]							0.100	0.62	0.173	0.42
Income is head of HH is 45 to 54 years old[2]							0.081	0.69	0.155	0.47
Income if head of HH is 55 to 64 years old[2]							0.209	0.32	0.301	0.18
Number of Observations										

[1] Default category is households (HHs) where head is not married, is retired or otherwise not in the labor force, is 65 years old or older, and did not complete high school (Models 1 and 2 only) or did not graduate college (Models 3 and 5 only) and mortgage was originated in 1985 and has a current LTV of less than 50%

[2] Age adjusted to be age of household head in mortgage origination year; all other variables are as of survey year

Source: Authors' calculations on Survey of Consumer Finances 1992-2001

Figure 1: Fixed and Adjustable Mortgage Rates 1985-2001



Source: Freddie Mac's Primary Mortgage Market Survey℠

Appendix – Employment Beta Regressions By Region

Table A1: Employment Betas By Region, 1978-2000

Region:	North Central					South					West				
Industry	α P-Value	β P-Value	Adj R^2	DW	White Test	α P-Value	β P-Value	Adj R^2	DW	White Test	α P-Value	β P-Value	Adj R^2	DW	White Test
Farm	-46.483	14.866	0.041	2.200	0.238	-11.158	7.317	0.101	2.295	0.349	-3.701	2.335	0.035	2.379	0.135
	0.217	0.03				0.011	0.001				0.098	0.041			
Construction	-0.877	0.778	0.070	1.116	0.406	-0.914	0.912	0.175	1.046	0.124	-1.136	1.122	0.165	1.367	0.388
	0.111	0.006				0.024	<0.0001				0.027	<0.0001			
Mining	-4.440	2.466	0.130	2.061	0.443	-3.332	2.238	0.160	1.802	0.456	-2.517	1.552	0.149	1.409	0.970
	0.001	0.000				0.002	<0.0001				0.001	<0.0001			
Manufacturing	-1.889	1.146	0.315	1.244	0.693	-1.127	0.878	0.499	1.317	0.803	-1.460	1.210	0.411	2.119	0.483
	<0.0001	<0.0001				<0.0001	<0.0001				<0.0001	<0.0001			
Wholesale	-1.293	1.05	0.426	1.198	0.186	-0.957	1.05	0.486	1.396	0.053	-1.033	1.10	0.435	1.847	0.010
	<0.0001	<0.0001				<0.0001	<0.0001				0	<0.0001			
Retail	-0.350	0.361	0.072	1.214	0.895	-0.160	0.452	0.128	1.469	0.985	-0.136	0.458	0.110	1.728	0.781
	0.166	0.006				0.496	0.000				0.600	0.001			
Transportation and Public Utilities	-0.481	0.490	0.125	1.839	0.042	-0.219	0.627	0.212	2.031	0.177	0.003	0.443	0.068	2.576	0.070
	0.066	0.000				0.374	<0.0001				0.994	0.007			
Services	0.499	0.324	0.115	1.845	0.266	0.607	0.477	0.237	2.032	0.153	0.292	0.647	0.281	1.930	0.044
	0.006	0.001				0.001	<0.0001				0.170	<0.0001			
Government and Military	0.732	-0.170	0.026	2.218	0.113	0.607	-0.016	-0.011	2.327	0.077	0.634	-0.064	-0.008	2.267	0.072
	0.000	0.068				0.003	0.870				0.007	0.585			
Finance, Insurance and Real Estate	-1.967	1.792	0.270	2.226	0.044	-1.443	1.642	0.256	2.112	0.016	-1.753	1.852	0.238	1.907	0.013
	0.002	<0.0001				0.013	<0.0001				0.011	<0.0001			

Notes: Data on assets, liabilities and equity from Deutsche Bank, US Fixed Income Weekly, Dec 10, 2004; Labor data based on authors calculations using methodology described in "Quantifying And Comparing Regional And National Employment Trends" by William L. Seyfried accessed at www.westga.edu/~bquest/1998/employ.html on December 20, 2005 and are for the Northeast region only. Data cover the period from 1978 Q1 to 2000Q4 and are from the BEA series on employment.
P-values for betas are misspecified as written above -- they should be for H0: $\beta = 1$, rather than H0: $\beta = 0$; this correction will be made in the future