Housing Busts and Household Mobility*

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Abstract

Using two decades of *American Housing Survey* data from 1985-2005, we estimate the impact on household mobility of owners having negative equity in their homes and of rising mortgage interest rates. We find that both lead to lower, not higher, mobility rates over time. The impacts are economically large, with mobility being almost 50 percent lower for owners with negative equity in their homes. This does not imply that current worries about defaults and owners having to move from their homes are entirely misplaced. It does indicate that, in the past, the lock-in effects of these two factors were dominant over time. Our results cannot simply be extrapolated to the future, but policy makers should begin to consider the consequences of lock-in and reduced household mobility because they are quite different from those associated with default and higher mobility.

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I. Introduction

How do housing busts affect residential mobility? The current market downturn has raised fears that local communities will suffer as social capital is depleted due to foreclosures forcing defaulting homeowners to move. One recent media report indicates that 220,000 homes were lost to foreclosure just during the second quarter of 2008, which is nearly triple the number over the same time period in 2007.[1] Default-induced moves always are the first mobility-related impact observed during a downturn, but they need not be the last or the most importantly economically. In fact, much previous research indicates that factors such as falling home prices or rising interest rates that typically are associated with housing market declines can 'lock-in' people to their homes—reducing, not raising mobility (Quigley (1987), Stein (1995), Genesove and Mayer (1997, 2001), Chan (2001), Engelhardt (2003)).

Whether negative equity or higher rates raises or lowers mobility is an empirical question that depends upon whether the default or lock-in effect dominates over time. The homeowner's default option is well studied in the real estate finance literature[2], and the exercise of that option clearly has been increasing recently. However, the potential for the lock-in effect to dominate has been known at least since Stein (1995), who argued that downpayment constaints arising from falling house prices that reduce the mobility of repeat buyers could help account for the positive correlation between house prices and transactions volumes over the cycle.

Empirical work has confirmed large negative impacts on mobility, although researchers posit different mechanisms by which mobility is reduced. Housing finance researchers tend to focus on financial constraints that are created when low or negative housing equity and rising

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[1] There were nearly 740,000 foreclosure filings over this same period according to the July 25, 2008, story written by Les Christie that was posted on CNNMoney.com's web site. The underlying data are from RealtyTrac, an online marketer of foreclosed properties. This highlights the fact that just because one enters the foreclosure process does not necessarily mean that a foreclosure or move will occur, as many defaults are cured. Also, see Gerardi, et. al. (2008) for a recent study of the rise in defaults and foreclosures among subprime borrowers in Massachusetts.

[2] See Quigley, et. al. (2000) for more on homeowner default.

interest rates require the owner to put up additional cash beyond standard closing costs (which typically are 6%-8% of house value) to be able to move. Given both the high transactions costs involved in purchasing a home and that lenders generally impose maximum leverage ratios below one, households without access to sufficient liquid financial resources could become constrained even if home equity does not turn strictly negative (Stein (1995), Chan (2001)). However, falling house prices are not necessary to generate a financial lock-in, as Quigley (1987) has shown. Because home mortgages generally are not assumable, if interest rates rise, the household may not be able to afford the debt service payments on a new loan that would be used to finance the purchase of the new residence, even if the new home is no more expensive.

Behavioral economists rely on prospect theory's claim that reference points are important, and that individuals will react differently to a housing bust based on their degree of loss aversion. In this framework, a household without any financial constraint can become less mobile if nominal loss aversion leads it not to sell the home after its price has fallen. Some of this research focuses on impacts on time on the market conditional on the decision to sell, not on longer-run mobility *per se* (e.g., Genesove and Mayer (1997, 2001)). However, Engelhardt (2003) concludes that loss aversion leads to reduced mobility based on analysis of a sample of younger households.

Our interpretation of this research is that there is solid evidence that both the financial constraint and loss aversion mechanisms are operative in affecting household mobility. We do not attempt to distinguish between these mechanisms in this paper, focusing instead on the overall impact on mobility. It is useful to revisit this issue for a number of reasons. How one should think about possible policy responses is dramatically different depending upon whether negative equity or higher rates lowers, rather than raises, mobility because the social and economic consequences are markedly different if lower mobility results. Instead of dislocation from post-foreclosure moves, reduced mobility leads to inefficient labor market matching. It also results in lower utility from not being able to access desired levels of housing or of local public services if household size changes or children move into or out of school attendance age while locked-in to one's home.

A new, more general, empirical analysis also is useful in gauging the size of the impacts on mobility. While previous empirical work suggests that the net effect of both negative equity and higher mortgage interest rates on household mobility is both negative and economically large, much of that research works with special samples that are restrictive in terms of geographic, temporal, or demographic coverage.[3] To ascertain whether we can reliably generalize from those results, a new analysis is conducted using national data from the biannual *American Housing Survey* (*AHS*) that covers metropolitan areas across the United States from 1985-2005. We also estimate interest rate and negative equity effects in the same specification, as well as control for a host of other factors thought to influence household mobility, in order to deal with likely omitted variable biases that could affect more narrowly defined studies that focus on one particular mechanism by which mobility might be affected or a single market or demographic group.[4]

Our analysis begins by specifying a baseline empirical model of the household relocation decision that relies on the foundation established by Hanushek and Quigley (1979) and Venti and Wise (1984). The estimated impacts of lock-in on mobility are as large or larger than those reported previously. For example, having negative equity reduces the two-year mobility rate by 5.6 percentage points (*ceteris paribus*), which is nearly 50 percent of baseline mobility. A $1,000

[3] For example, Quigley's (1987) analysis of mortgage interest rate lock-in effects, which found that a 200 basis point increase in rates was associated with about a one-third lower probability of moving over an 8-year horizon, worked with data from the 1979-1981 *Panel Survey of Income Dynamics*. Chan's (2001) study, which concluded that mobility was from one-quarter to one-third lower when equity constraints were present, was restricted to observations from the New York City metropolitan area. Engelhardt's (2003) study focused on younger owners from the *National Longitudinal Survey of Youth* between 1985-1996 who were most likely to be constrained.

[4] That said, we do not claim that our work is immune to all such criticism, only that it is more general in its scope and set of controls. See below for more on this.

higher real annual mortgage interest cost is estimated to reduce mobility by 2.8 percentage points, or by about one quarter of the baseline rate.

That the *net* impact of negative equity in particular has been to reduce, not raise, mobility may surprise some given the high number of defaults and foreclosures in the current environment. It is important to recognize that, by definition, lower mobility only can be observed over time, so it will take a few years to know how the impact of negative equity will play out in this cycle. It also should be emphasized that these findings cannot simply be extrapolated to the future because housing market conditions are not the same over time. For example, the subprime market was much smaller over most of our sample period, so the underlying riskiness of borrowers probably was lower in the past. In addition, our sample is restricted to owner-occupied homes and excludes investors and second homes, both of which may respond differently to negative equity situations (Haughwout, Peach and Tracy (2008)).

The plan of the paper is as follows. The next section documents that market conditions have dramatically changed recently, and that lock-in effects could become economically important once again. This is followed in Section III with the specification of our econometric model of household mobility. The data use in the estimation are described in Section IV, with the empirical results reported and discussed in Section V. The penultimate section then outlines the implications of reduced mobility. There is a brief conclusion.

II. Housing Market Conditions and Implications for Mobility

There certainly have been some pronounced shifts over time in house values, leverage, and mobility rates. For example, the span of years from 1985-1997 saw a substantial boom and bust in California housing markets. Data from the biannual *American Housing Survey* (*AHS*) for metropolitan areas in that state show a peak in mean nominal house prices of $253,617 in 1989, with an average loan-to-value (LTV) ratio of 67 percent, and a two-year mobility rate of just over 15 percent.[5] Prices in California then began to fall around 1991, but did not bottom out until 1997 when they reached $201,693, with an average LTV of 78 percent, and a two-year mobility rate of only 11.7 percent. From peak to trough, nominal prices fell by just over 20 percent, with the mean loan-to-value ratio increasing by 16 percent. It was not until the 1998-99 period that mobility returned to the pre-1989 peak levels (at 15.8 percent). Other markets such as Boston that also experienced sharp swings in prices and loan-to-value ratios over time show similar mobility patterns.

While past variation such as this obviously is necessary for the estimation of mobility effects, perhaps more interesting is that current conditions in various markets appear ripe for lock-in effects to become economically important once again. The potential scope of the negative equity problem in particular is well illustrated with recent data from the San Francisco Bay Area housing market. Figure 1 depicts the evolution of mean and median house real prices (in January 2007 dollars) in this market since the recent housing boom began in 1997.[6] The typical sales price rose fourfold from about $200,000 to $800,000 between 1997 and 2007. More recent price information just released by our data vendor (but not yet obtained by us) indicates about a 12 percent decline in house prices in the Bay Area since their peak in the summer of 2007.[7] Many analysts are predicting that prices will continue to fall. In fact, futures contracts on the S&P/Case-Shiller Home Price Index for this market (as of May 2008) imply further drops in values at least

[5] Prices and LTVs were calculated from a sample of recent movers who had occupied their homes for less than two years. Mobility rates use the full sample of homeowners.
[6] These data represent all housing transactions from the first quarter of 1997 through the third quarter of 2007 that were recorded in the six county region that comprises the heart of the Bay Area: Alameda, Contra Costa, Marin, San Francisco, San Mateo, and Santa Clara counties. The data were purchased from DataQuick, an industry data provider. No adjustments are made to control for quality shifts in the homes that sell in any particular quarter. The total number of transactions follows a similar pattern, as shown in Appendix Figure 1.
[7] See the article in the Wall Street Journal on March 14, 2008, "California Home Price Plunge in Big Counties". This story reports on price data released by DataQuick for February 2008.

through early 2009. Together, existing data and the only available futures market suggest the potential for a 25 percent or more drop in Bay Area house prices from their peak.[8]

Of course, the extent to which a steep decline in housing prices would trigger the lock-in effect also depends on high levels of housing debt. Figure 2 documents the very high loan-to-value ratios (LTVs) that became common in the Bay Area market. Mean and median LTVs are plotted for the same six county region from 1997-2007. The typical LTV on a home purchase was fairly stable around 80 percent until the end of 2002.[9] Beginning in 2003, there was a sharp increase with the median LTV hitting 90 percent in 2004. Loan-to-value ratios stayed at that high level for a few years, but have come down since then, returning to the 80 percent level in the most recent data we have. Essentially, the typical new home buyer in the Bay Area bought a house for $800,000 in 2006 using a $720,000 mortgage. If prices really do decline by 25 percent from their peak, the underlying house value will be around $600,000, which is much lower than the typical mortgage balance taken out that year.

Since further declines in home prices obviously would increase the number of homeowners affected by the negative equity problem, Figure 3 reports information on the proportion of homeowners with different leverage amounts. We computed four categories of LTVs: 0%-75%, 75%-85%, 85%-95%, and more than 95%. In the late 1990s, barely 10 percent of Bay Area borrowers had LTVs above 95%. That number then rose significantly from 2002-2006, ultimately reaching about 35 percent of buyers. Calendar year 2007 saw a fairly sharp decline, but 1-in-5

[8] These futures contracts are very thinly traded, so their information content is suspect. Our point is not to posit some precise number by which prices will fall, but simply to note that any relevant market data we can find is predicting fairly large prices declines.
[9] Information is available on up to three loans used to finance the home purchase. Our LTV figures are based on all reported mortgage debt, not just the first loan.

purchasers still bought a home with less than a 5 percent equity downpayment that year. Over 50 percent of home buyers in the Bay Area in 2006 had leverage levels above 85 percent.[10]

Of course, owners also may be locked into their existing homes if mortgage interest rates rise. This may have been an important constraint recently for borrowers who needed a jumbo mortgage to finance a trade-up purchase. Over the period from 2003 to 2006, the average spread between prime jumbo and prime conforming mortgage rates was 26 basis points. As financing dried up in the jumbo market in the fall of 2007, the interest rate spread between prime jumbo and prime conforming mortgages widened significantly, reaching 150 basis points in late March of 2008.[11]

We will not know how mobility in the Bay Area and other markets will change for some time. We can, however, determine what happened in past cycles and what factors drove any changes. It is to that effort that we now turn.

III. Econometric Model of Household Mobility

We begin by specifying a baseline empirical model for household relocation decisions. For each household, we assume that the decision to move between survey periods is based on comparing the indirect utility associated with staying in the current residence with that of moving to a new residence. This new residence could be in the same metropolitan area or involve a longer distance move. A move takes place if the monetized value of the gain in indirect utility exceeds the transactions costs involved with the move.[12]

[10] A large fraction of mortgages in 2005 and 2006 actually have LTVs of 1. This was possible because of very lax lending standards, where banks based their lending on assessed values rather than on selling prices. Given the high expectations about price appreciation, assessed values were usually higher than transaction prices in those years.
[11] We computed these spreads with data obtained from a Bloomberg screen. The underlying data source is BankRate.
[12] See Hanushek and Quigley (1979) and Venti and Wise (1984) for early expositions of this well-known framework.

Motivations for moving can include a wide variety of "quality-of-life" reasons, as well as job-related reasons. Examples of the former include the desire for a different amount or type of housing, a different set of neighborhood amenities, or a different set of natural/cultural amenities. Job-related moves can reflect factors such as reducing the commute time to work, as well as taking a new job in a different labor market. Factors such as having negative equity or higher interest rates can change the cost-benefit calculus of moving.

We summarize these numerous factors involved in a household's mobility decision by a latent index, I^*_{it}. This index captures the monetized net change in indirect utilities less the transactions costs of a move. We normalize this index so that a household is assumed to move between periods when this index is positive, and remain in its current residence otherwise. Equation (1) represents a simple linear specification for this latent index,

(1) $I^*_{it} = X_{it}\beta + \varepsilon_{it}$

where X_{it} captures observed factors that affect household mobility and ε_{it} is a random error term.

For each household and time period, there is an observed indicator, I_{it}, which takes a value of 1 if the household moves over the coming time period and 0 otherwise. Thus,

(2) $I_{it} = \begin{matrix} 1 \text{ if } I^*_{it} > 0, \text{ household moves} \\ 0 \text{ otherwise, household stays} \end{matrix}$.

We assume that the random error term has a normal distribution.

Further, let P_{it} denote the probability that the household moves between period *t* and period *t*+1. This probability of moving is characterized as follows:

(3) $\mathrm{P}_{it} = \Pr(I^*_{it} > 0) = \Pr(X_{it}\beta + \varepsilon_{it} > 0)$.

Using data on I_{it} and X_{it}, we will estimate β using a Probit model.

An alternative estimation approach is to focus on the current years of tenure of the household rather than on the mobility probability, P_{it} (e.g., Wasi and White (2005)). To contrast approaches, assume for the moment that a house only experiences transitions from one owner to another owner with no intervening periods of renting. By way of illustration, consider a house that was built five periods ago. The probability that we currently observe a housing tenure (T) of 5 periods is given by

$$(4)\ \Pr(T_i = 5) = \prod_{n=1}^{5}(1 - P_{it-n}) .$$

That is, observing a current tenure of five periods given the initial condition on when the house was built implies that the household that initially moves into the new house does not move over the next five periods. Similarly, the probability that we currently observe a housing tenure of 4 periods is given by

$$(5)\ \Pr(T_i = 4) = P_{jt-5}\prod_{n=1}^{4}(1 - P_{it-n}) .$$

In this case, after residing in the house for one period, household j sells the house to household i, after which household i then stays in the house for the next four periods.

The important thing to note about these two simple examples is that the likelihood associated with the current years of tenure in the house is a product of a set of current and historical mobility probabilities. If we model each mobility probability as in (1), then the current tenure is a function of current *and* past values of the explanatory variables for the current and possibly previous households. However, the typical empirical specification applied to cross-section data relates current tenure only to current values for the explanatory variables. We can see, though, that for time-varying explanatory variables such as the potential lock-in effects that are the focus of this study, the current tenure specification will not produce coefficients that have a ready interpretation. For this reason, we choose to directly model the mobility probabilities.

IV. Data

The *American Household Survey* (*AHS*) is the primary data source for our estimation of tenure mobility probabilities. Since 1985, the *AHS* has been conducted every two years on a continuous panel of houses. The *AHS* contains a unique identifier for each house, an indicator for whether the house is currently owned or rented, and the year in which the house was purchased if the unit is owned. We restrict our analysis to owned houses. It is noteworthy that our sample likely is devoid of speculators. The survey process itself is such that the responding household itself is the primary resident of the home, and questions are clearly asked to identify tenure status.[13]

For this subsample, the house identifier and purchase year allow us to follow a household over time. If a household continues to reside in the house over the two year period between surveys, we observe this as the same purchase year associated with that house. If a household moves residences over the two year period between surveys, we observe this as a new purchase year associated with that house.[14] Since the *AHS* is a house-based, not a household-based panel, we can not follow the household to its new residence, nor do we observe any information about the location of this new residence.

We restrict the sample to single detached homes owned by a household head between 21 and 59 in age. The timing convention is as follows. The mobility indicator captures moves

[13] Consider an investor who misrepresents his occupancy status as owner-occupied to a lender. If the house is rented and part of the overall *AHS* sample, the tenants would respond to the survey that they rent. If the house is vacant and listed to be sold, it would not be included in our sample. Mortgage-based data, in contrast, would list the property as owner-occupied.

[14] We use demographic information on the household to help edit the panel structure of the data in order to eliminate false moves that would be generated by measurement problems with the purchase year. Information on all data cleaning and sample preparation procedures are available upon request.

between the survey conducted in year *t* and the subsequent survey conducted in year *t*+2. Changes in household or neighborhood characteristics refer to changes between the survey conducted in year *t* and the prior survey conducted in year *t-2*.

We are particularly interested in the roles of negative equity and increasing interest rates which tend to vary significantly over the cycle and help characterize housing busts. To measure negative equity, we first construct the homeowner's current LTV ratio using the value of the mortgage balance and the owner's self-reported current value of the house. We code an indicator that takes a value of one when the current LTV exceeds 1. To deal with likely measurement error, an instrument for this indicator is constructed by replacing the current self-reported house value with the implied current house value based on the purchase price and the house price appreciation based on a repeat-sales house price index for that SMSA.

We follow Schwartz (2006) to determine mortgage rates, assuming that for fixed rate loans the first reported interest rate, term and mortgage balance are the most accurate.[15] We use the annual average mortgage rate on 30-year fixed-rate mortgages as the measure for what rate the household would receive on a new mortgage. The annual payment difference is computed assuming that the new mortgage would match the existing mortgage's balance and duration. We control for the real annual difference in mortgage payments, where we set any negative payment differences to zero.[16] We also use an instrument to deal with measurement error for this financial friction. Specifically, the real annual difference in mortgage payments is recalculated using the average mortgage rate on 30-year fixed rate mortgages for the year the mortgage was originated in place of the self-reported mortgage interest rate. Again, we recode all negative values as a zero payment difference.

[15] For these mortgages, we hold the mortgage balance constant at this initial reported value when calculating the current LTV discussed earlier.
[16] Quigley (1987) also included a measure of the present value of this difference in mortgage payments over the remaining life of the mortgage.

The *AHS* also can be used to investigate another monetary friction akin to the one created by higher mortgage interest rates. This one arises from California's Proposition 13, which has been recently studied by Wasi and White (2005) and Ferreira (2007). The *AHS* provides information on the homeowners' self-reported house value as well as their current annual property taxes. For residents of California, we create a tax subsidy variable which is equal to the difference between one percent of the self-reported house value and the reported annual property taxes.[17] Given that the tax subsidy variable is constructed from two self-reported variables, it is likely measured with error. To help address this, we create an instrument which is the difference between the growth in the SMSA repeat-sales house price index and the maximum allowed growth in the property tax over the same period multiplied by the fully assessed property tax on the purchase value of the house. We also compute the same tax subsidy variable for residents outside of California. If the tax subsidy is correctly picking up the incentives that are unique to California, it should have no impact on mobility decisions for non-California residents.

Since the Proposition 13 lock-in variable is measured in real dollars, it provides a natural benchmark for judging the magnitude of the interest rate lock-in variable, which is also measured in real dollars. A natural test will be that the different variables have a similar impact on household mobility decisions for a given dollar change in their worth.

Because this tax subsidy measure is our most important robustness test regarding the magnitude of our estimates, some of its properties are examined here. We focus exclusively on positive subsidies and set all negative values of the variable equal to zero. Since the property tax wedge is a function of the degree of house price appreciation, it is useful to get a picture of the different housing markets in California over our estimation period. Figure 4 shows the distribution of cumulative growth in house prices as measured by SMSA level repeat-sales price

[17] If the house is sold, the property taxes are reassessed at one percent of the sale price of the house.

indices. For each SMSA, we measure the cumulative growth in the house price index from 1978. The line represents the weighted average cumulative price growth, where the weights are the share of observations from each SMSA in our estimation sample. The figure makes clear that there is considerable cross-sectional heterogeneity in the rate of price appreciation. This heterogeneity in house price appreciation is reflected in the implied property tax subsidies. Figure 5 then displays different percentiles of the tax subsidy for California residents over time. This heterogeneity will allow us to include California-specific year effects in our mobility specification to sweep out any omitted time effects that might be specific to that state.

Finally, the AHS's rich set of detailed demographic information about each owner-occupied household also is useful in helping control for the many other forces which influence mobility. For these variables, we start with the set used by Quigley (1987). Family size, as well as changes in family size, can impact household mobility. Family size may proxy for a variety of costs of moving, while changes in family size may trigger a move as households attempt to optimize their housing space per capita. Other standard controls include a set of characteristics of the household head such as age, race, and education.[18] In addition to these characteristics, we include the sex of the household head, marital status and the change in marital status of the household head. Holding constant the change in family size, the nature of the change in family size as captured by changes in marital status may have important mobility implications. Quigley (1987) also controlled for family income. In addition to the level of family income, we allow for changes in family income to affect mobility. In particular, we allow for asymmetric effects between gains and losses in family income.

[18] We allow for nonlinear effects, where Quigley assumed linear age and education effects. We enter age as a 3rd order polynomial, and we include indicators for graduating from high school, attending some college, graduating from college, and post-graduate education.

We further expand on Quigley's specification using some additional information provided in the *AHS*. The *AHS* identifies first-time homebuyers, so we include an indicator for a first-time buyer to capture any systematic differences in their mobility relative to trade-up purchasers. Because the *AHS* provides the year the household bought the house, we are able to calculate the length of time that the household has lived in the current residence. We control for duration dependence in the mobility decision by including a 3rd order polynomial in the current duration. The *AHS* also asks households to rate the quality of their neighborhoods. We code two indicator variables capturing whether the household reported a significant improvement or a significant decline in the neighborhood between surveys in order to ascertain whether changes in the local area affect mobility.

V. Empirical Results

Descriptive statistics for our sample are provided in Table 1. The average two-year mobility rate for the estimation sample is 12 percent. The data indicate that only 2.6 percent of our observations involve a household in a negative equity situation. Prior to the current housing crisis, few households would be expected to find themselves in this situation, although this fraction varies widely across markets and time, as discussed above. Table 2 then provides our estimates of the determinants of residential mobility. The coefficients can be interpreted as changes in the two-year mobility rate.

Two specifications are reported in Table 2. Our baseline model is reported in column one.[19] The results reported in the second column provide a robustness check on the Proposition 13

[19] As explained in Section III, another estimation method from this literature uses current years of tenure as the dependent variable instead of mobility probabilities. Since this alternative method only relates current tenure with current values of the independent variables, its estimates could greatly differ from what we believe is a more appropriate model. Indeed, treating our data as cross-sectional, we find that such a method generates estimates for several demographic variables that have counterintuitive and opposite signs to the ones found in this paper.

variable by restricting the sample to households residing outside of California and are discussed more fully below. In each specification, instruments to address potential measurement error in the three lock-in variables were created as discussed above and in the notes to the table.[20] In addition to a range of covariates, each specification also controls for region-specific time effects as well as California-specific time effects.

The results reported in the first row of column one of Table 2 indicate that households who currently have a negative equity position in their house have 2-year mobility rates that are 5.6 percentage points lower than similar households with positive equity in their house. This represents a decline of 47 percent relative to the average mobility rate. This net decline on household mobility implies that over the past two decades the lock-in effect for owner-occupied borrowers dominated the impact of foreclosures induced by negative equity.

We also experimented with an alternative specification (not reported in Table 2) that, in addition to our negative equity indicator, included a variable that measures continuously any nominal loss implied by the self-reported house values over the two years since the last survey. To deal with likely measurement error, we instrument the continuous nominal loss measure with a variable that measures the losses implied by the SMSA repeat-sales house price index.[21] Two findings emerge from this alternative specification. Controlling for any mobility effect from negative equity, the results indicate that each $10,000 in nominal losses reduces mobility by 1.7 percentage points, so there is evidence that recent losses are associated with lower mobility.[22]

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[20] Attenuation bias from measurement error appears to be large. The results using the unadjusted variables, in lieu of their measurement error-related instruments, always have the same sign, but are smaller in magnitude and never statistically significant at conventional confidence levels.

[21] Note that households may report a nominal loss since the last survey but still have positive equity, and households can be in a negative equity situation and still report no nominal loss on their house since the last survey. In our data, just over 15 percent of households with positive equity report a nominal loss since the last survey. Conversely, nearly 77 percent of households with a negative equity position report no nominal loss since the last survey.

[22] We checked for evidence of a nonlinear response to this nominal loss by estimating a two-piece linear spline. We set the break point at a loss of $20,000, which is between the median and 75th percentile, conditional on a loss being reported. The results did not indicate any change in the response of mobility as the magnitude of the loss increases.

However, controlling for recent nominal losses only slightly lowers the coefficient on the negative equity indicator. Thus, households in a negative equity situation still have substantially lower mobility even after controlling for any impact arising from recent reported losses on the house.

For those households with fixed rate mortgages, we find that a $1,000 annual real mortgage interest difference is associated with a 2.8 percentage point reduction in the mobility rate (row 2 the first column of Table 2). The comparison of this effect with the one estimated from the Proposition 13 financial friction in the next row finds a very similar result. A $1,000 annual real property tax difference for California residents generated by Proposition 13 lowers household mobility by 2.9 percentage points. The data can not reject the hypothesis that the fixed rate mortgage lock-in effect and the Proposition 13 lock-in effect are of the same magnitude.

The second specification reported in column 2 tests the validity of the Proposition 13 lock-in variable by checking to see if it is significant in a sample of households residing outside of California. If the Proposition 13 variable is capturing some other unmeasured effects and not the impact of the legislation, then we should see a similar impact in the non-California sample. This does not appear to be the case, as the results show that the Proposition 13 variable is both economically and statistically insignificant in the non-California sample (row 4, column 2).

Thus, we find negative equity and mortgage lock-in effects at least as large as those reported in previous studies. Our national sample over a two-decade long period indicates these sizable impacts are not peculiar to more narrowly-defined samples of people or time spans. While our estimates are reduced form in nature, our more general specification that includes both negative equity and mortgage interest rate effects simultaneously as well as a host of other demographic and economic controls, increases confidence that the effects are not driven by omitted variable bias.[23]

Returning to our baseline specification in column one finds the estimated impacts of the other demographic and economic variables broadly consistent with Quigley (1987) whose estimates were derived from hazard analysis using data from the 1979-81 *PSID*. For example, the results in row 5 show that first-time homebuyers have a lower mobility rate than other households. Duration in the unit also is important, as illustrated by Figure 6's plot of the marginal effect of years living in a house on the likelihood of a move. Mobility increases with years of tenure up to 9, and then decreases with years of tenure. This is consistent with a life-cycle pattern of housing choices where households go through several trade-up purchases before owning a home that they will live in for an extended period of time.[24]

Various demographic characteristics of the household are also important determinants of mobility. Being married is not a statistically significant predictor of mobility in the national sample (row 6 of column 1), but divorce is. Transitions out of marriage are associated with much higher mobility, with the point estimate being more than double that for transitions into marriage (compare rows 7 and 8 of column 1). The next few rows show that household mobility increases with the education of the household head. A household headed by someone with at least some graduate education has a 2-year mobility rate that is 4.2 percentage points higher than a household headed by someone without a high school education (the omitted category). Whites are more

[23] While we control for changes in household income as well as region and year effects, the most worrisome potential confounder of our interpretation of the results arises from an economic shock that differentially affects high loan-to-value owners. Consider a change that reduced house prices and employment simultaneously, but harmed the job prospects of highly leveraged borrowers more. If our income, time, and location variables do not fully control for this, it is possible that part of our estimated mobility effect could be due to the reduced employment opportunities of highly leverage borrowers, not a housing lock-in mechanism. Future work should focus on accessing the magnitude of this potential confounder, as the literature to date has not properly addressed this issue.

[24] Not coincidently, this same pattern is exhibited by the typical sequence of job durations over a worker's career.

likely to move than non-whites, while male-headed households are less likely to move than female-headed households (see rows 13 and 14 of column 1).

Figure 7 depicts the marginal effect for the age of the household head on household mobility. Each additional year of age reduces household mobility until the household head reaches the early fifties. After this point, aging raises the likelihood of a move. Finally, larger households tend to move less frequently, as indicated by the significantly negative coefficients on the household size control (see row 15 near the bottom of the first page of the table). This is consistent with the hypothesis that kids increase the transactions costs involved in moving. However, the results in the next two rows show that, controlling for family size, mobility is higher in response to increases in family size, but is not significantly impacted by decreases in family size.[25]

Household income and its dynamics also impact household mobility. Households with higher income are more likely to move all else the same (bottom row of the first page of Table 2). Given a household's income level, declines in household income are associated with higher mobility. Finally, changes in neighborhood quality, whether positive or negative, are not significantly associated with changes in mobility.

VI. Implications of Reduced Household Mobility

Because market conditions differ over time and the mobility impacts play out over a period of years, one cannot simply use our point estimates to precisely gauge mobility effects associated with the current housing market. However, it is clear that the consequences of lock-in and reduced mobility are very different from those associated with foreclosure and increased mobility. For example, lower mobility is likely to result in more inefficient matching in the labor market, as

[25] Quigley (1987) finds this same asymmetry in the effects of changes in family size.

some households will not be able to move to access better jobs in alternative labor markets. Utility also will be lower to the extent households are not able to move as readily as they would like in order to access different amenities or public services (e.g., good schools), or just a differently-sized home if family size changes.

Recent research also suggests that owners with negative equity behave more like renters and reinvest less in their residences (Gyourko and Saiz, 2004). Harding et al. (2007) document the important role of maintenance expenditures at reducing the depreciation rate on housing. It also is possible that the reduced mobility associated with mortgage lock-in can have local public finance effects. Previous research has shown that even households without children often support investments to improve school quality because these improvements are capitalized into house values (Hilber and Mayer (2004)). However, for households with negative equity in their home, that linkage is broken because it is the lender, not the owner, who would benefit from any initial increase in property values resulting from the improved public services.

Research is urgently needed to examine these potential consequences and assess their importance. More thought and analysis also is necessary to determine whether there is a case for public policy to intervene in response to mortgage lock-in. For example, it seems likely that lenders would internalize the home maintenance/reinvestment externality. However, it is not at all clear they would do so with respect to the inefficiencies in labor market matching and housing market matching (in terms of accessing local services or amenities). Whether such costs would justify government intervention is not obvious, but a clear accounting of the potential benefits of such action is needed to weigh against the typical costs (e.g., moral hazard) that economists rightly associate with such policies. Whatever the correct answer, the calculus is sure to be very different from that associated with worries exclusively focused on the externalities associated with foreclosure.

VII. Conclusion

The end of the recent housing boom and the weakness in many local housing markets raise new questions about an old issue in housing research—namely, lock-in effects. We use a panel data set from the *American Housing Survey* over a two-decade period predating the current housing downturn to estimate the influence of negative equity and rising mortgage rates on household mobility, controlling for a host of other factors known to influence mobility. Higher interest rates are shown to lower mobility substantially, and we are able to confirm the magnitude of this result using data on a comparable financial friction generated by property tax differentials associated with California's Proposition 13.

Having negative equity in one's home reduces mobility rates by even more—by nearly 50 percent from its baseline level according to our estimates. That the net impact of negative equity is to reduce, not raise, mobility certainly does not mean that defaults and foreclosures are insignificant consequences of this condition. However, it does signify that the preponderant effect is for owners to remain in their homes for longer periods of time, not to default and move to another residence.

Finally, reduced mobility has its own unique set of consequences which have not been clearly identified or discussed in the debate about the current housing crisis. Substantially lower household mobility is likely to have various social costs including poorer labor market matches, diminished support for local public goods, and lesser maintenance and reinvestment in the home. Whether these costs are sufficient to warrant government intervention is unclear, with research urgently needed to address this and other issues pertaining to the financial frictions associated with potential mortgage lock-in.

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Table 1. Descriptive Statistics

	Mean	Standard Deviation
Move	0.12	0.32
First-time homebuyer	0.50	0.50
Duration in house	8.21	7.38
Married	0.72	0.45
Single to married	0.02	0.13
Married to single	0.02	0.13
High school graduate	0.27	0.44
Some college	0.26	0.44
College graduate	0.23	0.42
Some graduate school+	0.17	0.38
White	0.84	0.37
Male	0.73	0.44
Age	42.30	8.94
Household size	3.24	1.52
Positive change in household size	0.11	0.40
Negative change in household size	0.12	0.46
Log real household income	10.51	0.78
Positive change in log real household income	0.14	0.41
Negative change in log real household income	0.15	0.51
Positive change in neighborhood quality	0.08	0.27
Negative change in neighborhood quality	0.11	0.31
Negative home equity (indicator)	0.03	0.16
Fixed rate mortgage lockin ($000)	0.08	0.25
Proposition 13 property tax subsidy ($000)	0.21	0.43

Notes: Income, fixed-rate mortgage subsidy, and property tax subsidy are measured in real 1982-84 dollars.

Table 2. Household mobility

Variable	(1)	(2)
Negative home equity (indicator)[1]	-0.056^{**} (0.021)	-0.052^{**} (0.024)
Fixed-rate mortgage lock-in ($1,000)[2]	-0.028^{**} (0.009)	-0.020^{*} (0.011)
Proposition 13 lock-in ($1,000) – California	-0.029^{**} (0.014)	
Proposition 13 lock-in ($1,000) – Non-California		0.011 (0.037)
First-time Homebuyer	-0.010^{**} (0.003)	-0.009^{**} (0.003)
Married	0.005 (0.004)	0.007^{**} (0.004)
Single to married	0.013 (0.010)	0.013 (0.011)
Married to single	0.042^{**} (0.011)	0.047^{**} (0.012)
High school graduate	0.015^{**} (0.006)	0.010 (0.007)
Some college	0.022^{**} (0.007)	0.017^{**} (0.007)
College graduate	0.033^{**} (0.007)	0.027^{**} (0.008)
Some graduate school +	0.042^{**} (0.007)	0.036^{**} (0.008)
White	0.028^{**} (0.004)	0.035^{**} (0.004)
Male	-0.013^{**} (0.003)	-0.017^{**} (0.004)
Household size	-0.009^{**} (0.001)	-0.010^{**} (0.001)
Positive change in household size	0.016^{**} (0.003)	0.015^{**} (0.004)
Negative change in household size	−0.000 (0.003)	−0.001 (0.004)
Log real household income	0.009^{**} (0.002)	0.009^{**} (0.003)

Table 2. Household mobility – continued

Variable	(1)	(2)
Positive change in log real household income	0.002 (0.003)	0.002 (0.004)
Negative change in log real household income	0.009** (0.003)	0.007** (0.004)
Positive change in neighborhood quality	0.000 (0.005)	0.001 (0.005)
Negative change in neighborhood quality	0.003 (0.004)	0.004 (0.005)
Observations	58,363	47,700[4]

Notes: Probit marginal effects with standard errors given in parentheses. Specifications contain a cubic in years in the current house, a cubic in the age of the household head, and region-specific year effects as well as CA-specific year effects in specification (1). Income, fixed-rate mortgage subsidy, and property tax subsidy are measured in real 1982-84 dollars.

* significant at the 5 percent level ** significant at the 10 percent level.

[1] Instrument for negative current LTV uses an estimate for the current house value based on the value of the house at purchase and the appreciation of the value based on a repeat-sale house price index for that SMSA.

[2] Instrument for mortgage lock-in is the implied increase in mortgage payments assuming that the current mortgage interest rate is the average rate for fixed-rate mortgages for the year the mortgage was originated.

[3] Instrument for the property tax subsidy is the implied subsidy calculated using the metro-area repeat-sale house price appreciation.

[4] Excludes observations from California.

Figure 1. Mean and Median Quarterly Sales Prices, SF Bay Area

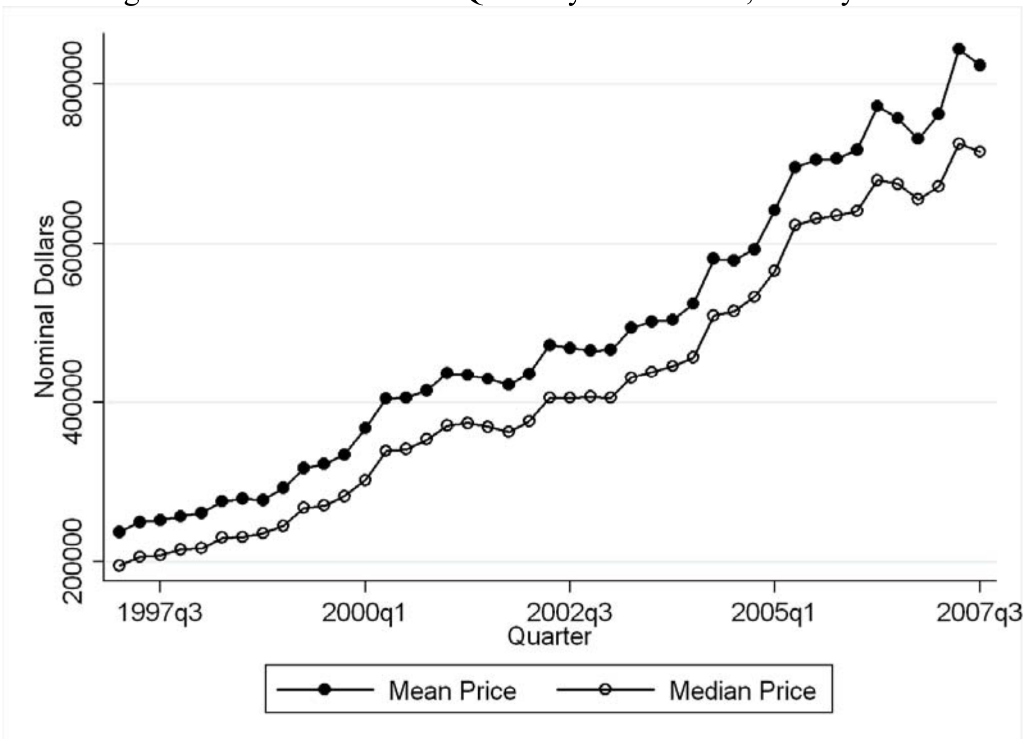


Figure 2. Mean and Median LTVs, SF Bay Area

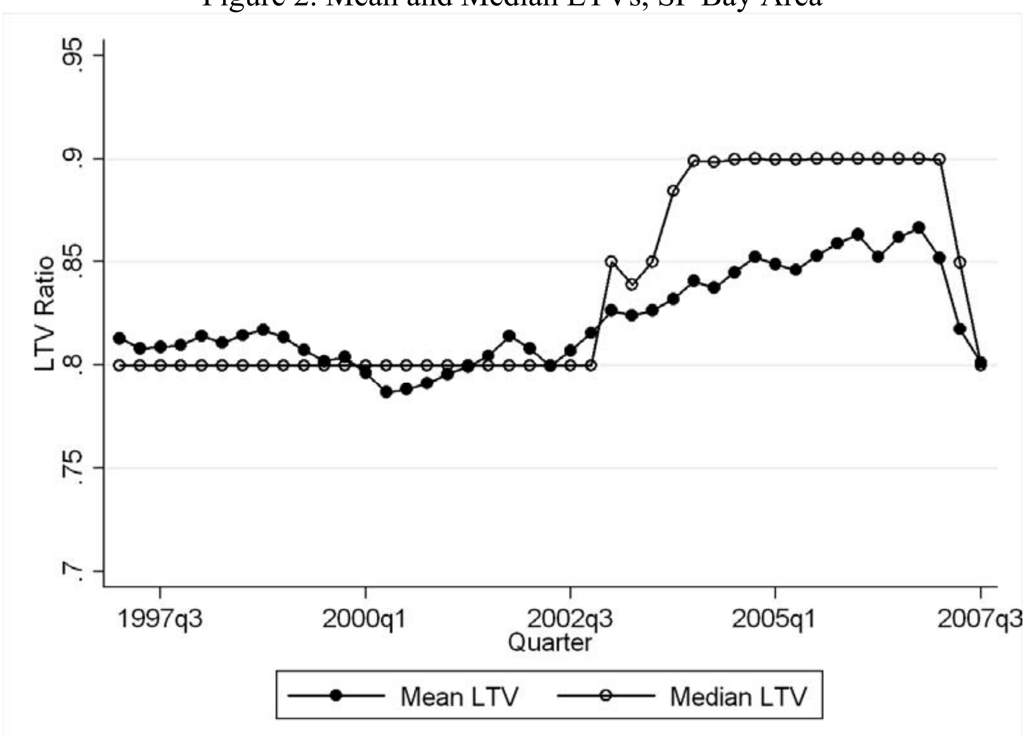


Figure 3. Distribution of LTVs Over Time, SF Bay Area

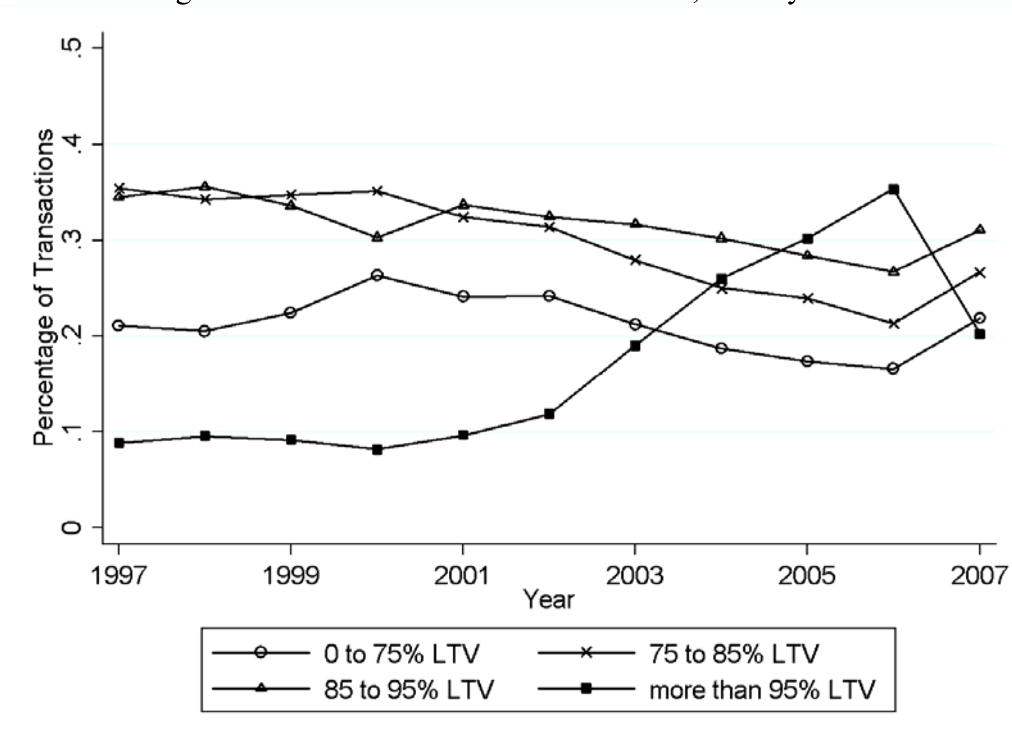


Figure 4. Cumulative House Price Appreciation in California Since 1978

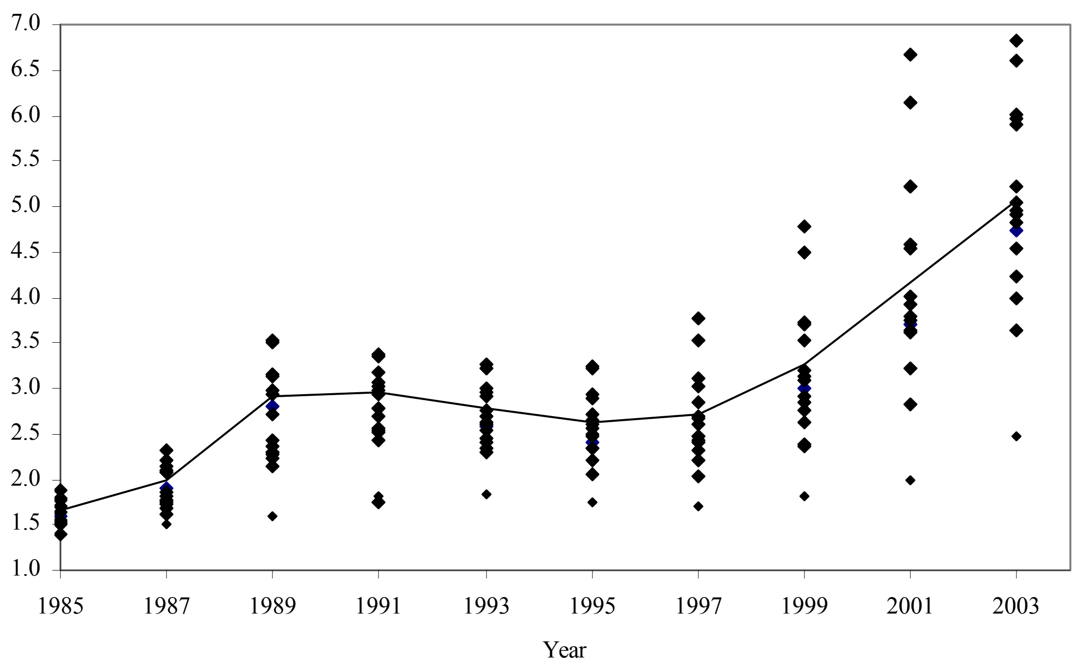


Figure 5. Distribution of Property Tax Subsidies in California Over Time

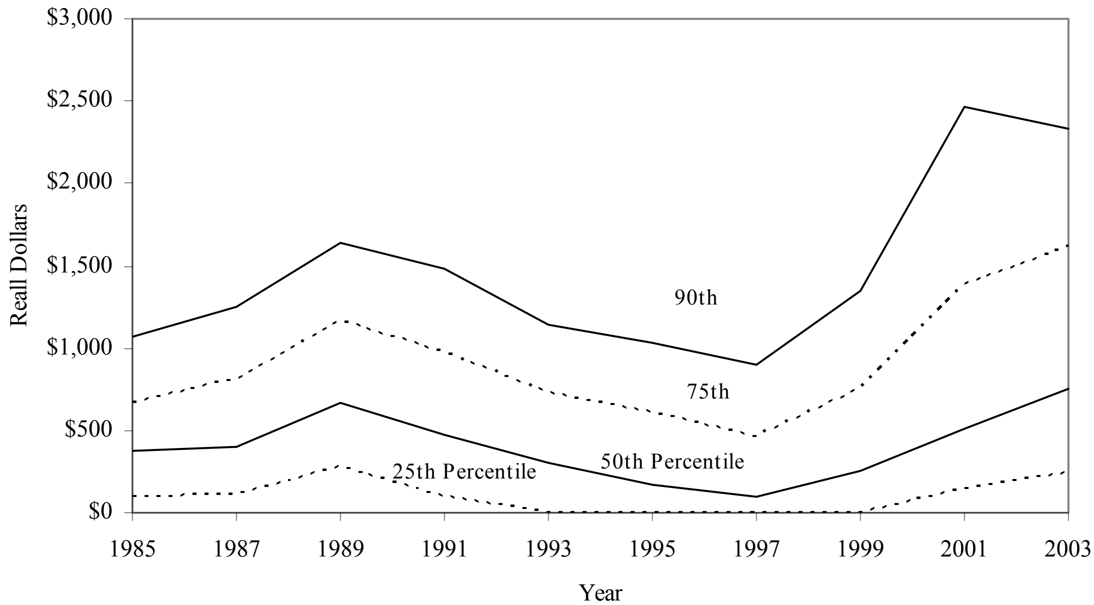


Figure 6. Marginal Effect of Year in Current House on Mobility

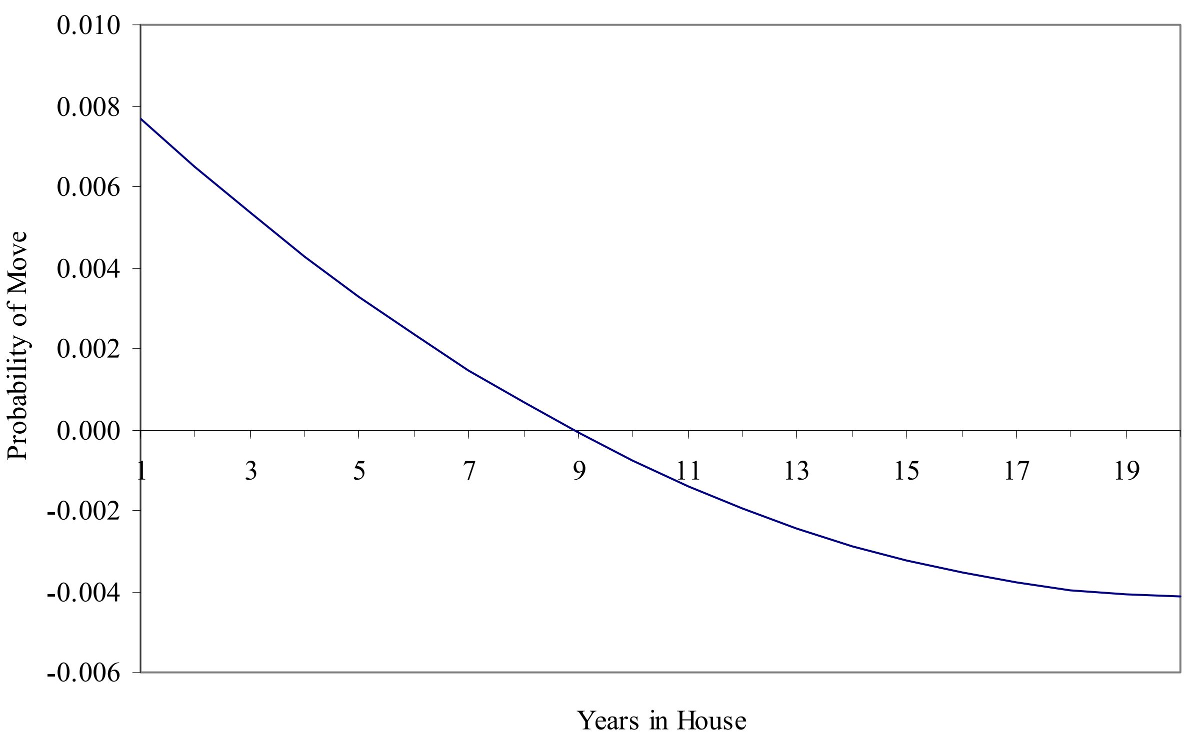
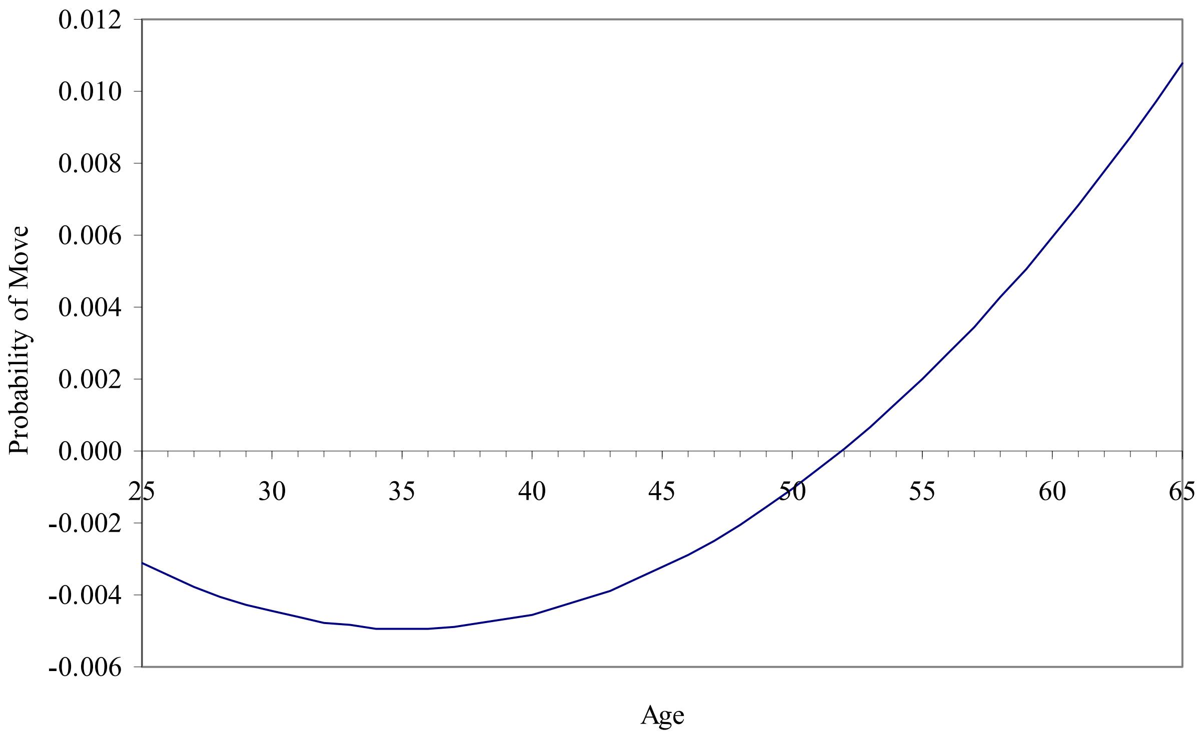


Figure 7. Marginal Effect of Age of Household Head on Mobility



Appendix Figure 1. Housing Transactions Volume Over Time, SF Bay Area