Impediments to Post-Great Recession Recovery of Homeowner Mobility [1]

Hamilton Fout
Fannie Mae
Kansas State University

Ozge Savascin[2]
Fannie Mae

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Abstract:

We introduce a novel data set of Fannie Mae proprietary loan and market transaction observations to document the current experience and historical context of homeowner mobility. We find that homeowner mobility, measured as a move within five years of purchase loan origination, declined during the housing crisis and while it has recovered recently, it has not reached its pre-crisis level, still approximately 30 percent below its Pre-Crisis value. Furthermore, we find underwater homeowners who experienced rapid home price depreciation during the first five years of their home ownership to be least mobile across all periods. Post-crisis we observe a significant decline in the homeowner mobility of high equity homeowners relative to low equity borrowers. Other impediments to recent mobility include borrowers aging in place (older borrowers have increased in share and moved less frequently) and increases in the level and sensitivity of homeowner moves to a household's debt relative to income. Based on our empirical model, we estimate that 25 percent of the observed decline in mobility rates can be explained by changes in recent buyer profile, while the remaining drop in mobility appears to reflect a change in homeowner preference for moving.

Keywords: Homeowner Mobility, Equity, Mortgage Finance

JEL Codes: R21, R23, R31, D15, D12, G51, J62

1. Introduction

Earlier in the 2000s, repeat buyers, the focus of this paper, constituted two thirds of the conventional owner-occupied Fannie Mae purchases. More recently, however, their share dropped to less than 50 percent in 2019 (Figure 1). Repeat home buyers are five years older at the time of mortgage origination compared to their peers from the early 2000s suggesting a delay in their move to the next home (Figure 2). [3,4]

As shown in Figure 3a mobility measures based on the American Community Survey (ACS) have declined sharply during the Financial Crisis but have been recovering in recent years, especially between 2015 and 2017.[5] As it is based on the status of the household at the time of survey response, ACS-based mobility measures include renter households moving into owner households as well as owner households buying and moving into another owned residence. Once we split the ACS mobility estimates by homeowner age as in Figure 3b, we see that homeowner mobility has fully recovered for the youngest cohorts (< 30 years old), surpassing its pre-crisis level, while older cohorts have not recovered to their pre-crisis level.[6,7] As we document in this paper, this recovery is driven largely by the influx of recent first-time home buyers transitioning from renting to owning and does not represent a meaningful rebound in homeowner transitions.[8]

In this paper, we aim to understand the drivers behind repeat-buying activity (i.e. existing homeowner mobility) using a novel dataset created from proprietary loan and purchase transaction information from Fannie Mae. We build an empirical model of repeat buyers for three time periods (Pre-Crisis, Home Price Decline and Recovery) to understand how the drivers of repeat-buying have changed over time. We use our estimates to quantify the decline in repeat buying activity, finding that repeat buyers have declined by 29 percent from the Pre-Crisis period to the Home Price Recovery period, with about 25 percent of the decline coming from changes in repeat buyer profile and situation. In particular, we find that homeowners in the current period are older and have moderate levels of equity (less

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[3] Our definition for first-time home buyer follows the Internal Revenue Service's definition where a loan is classified as being made to a first-time home buyer if any borrower meets either of the following criteria: 1) Had no homeownership interest during the 3 years prior to the purchase date, or 2) Is a displaced homeowner or single parent who had no homeownership interest other than a joint ownership with a spouse.

[4] This was previously documented in Savascin (2015), which identified the decline in repeat buyers as the primary driver for the reduction of Mid-Tier FICO acquisitions, even after controlling for underwriting standard differences.

[5] See, for instance, Masnick (2013) for another example of mobility analysis based on the ACS.

[6] In this paper, the term "crisis" refers to the Financial Crisis and Great Recession period that occurred between 2007 and 2009.

[7] In 2018 three out of six age groups have recovered to levels to their corresponding 2000 level. Homeowners younger than 30, in their 30s and 40s have passed their corresponding mobility rates of 2000 by 1.6 percentage-points (pp), 0.2 pp and 0.2 pp respectively. These group of households likely represent first time home buyers or in other words renter to owner moves. However middle aged and older homeowners who are more likely be repeat buyers have not recovered. Householders in their 50s, 60s and over 70 have fallen short of their corresponding 2000 levels by 08pp, 1.1pp and 1.1pp respectively.

[8] The highly mobile younger home buyers constitute approximately 25 percent of all homeowners with mortgages (Fout and Savascin 2020).

extreme) and smaller debt-to-income ratios. After controlling for these differences, however, we find that 75 percent of the decline in repeat-buying activity is not explained by these drivers and represents a potential fundamental shift in preferences.

One of the biggest contributions of this paper to the mobility literature is our unique nationwide data set that allows us to systematically isolate and track existing homeowner moves. Standard mobility measures are developed from either survey-based methods (e.g. ACS) and or loan-level data sets that are often limited to selected states. In this paper, we propose a unique way of measuring existing homeowner moves that relies on loan and transaction data. In particular, we match Fannie Mae owner-occupied borrowers from 2000 through 2014 to a subsequent sale of their property using Fannie Mae's property transaction database that contains sale records over the same period. We measure moves by matching the original purchase mortgage to an arms-length, voluntary sale of the underlying property and identify repeat buyers as those who sold their properties within five years of the original mortgage purchase date. We construct our mobility measure as the percentage of Fannie Mae homeowners who moved within five years of the initial purchase date. We are interested in the voluntary act of moving hence we exclude defaults and distressed sales from our sample. We show that existing homeowner mobility measured this way declined sharply during the Great Recession and recovered to some extent after the crisis but has not reached its pre-crisis levels. The recovery has been comparatively stronger for younger existing homeowners who have been turning over more frequently in recent years.

In an aim to empirically investigate the potential impediments to mobility we model individual owner-occupants' selling and moving decisions within five years after mortgage origination controlling for borrower characteristics such as age, loan attributes such as equity levels, basic economic conditions such as unemployment rate, location and time. Using our empirical model, we investigate the potential drivers behind the lower post-crisis mobility rates including equity-lock in, life-cycle changes, increased household debt and relocation issues of multiple earners. We estimate the model over three separate time periods: the pre-crisis years of 2000 to 2002 during which homeowners experienced a positive change to their property value in the following five years, the housing price decline period between 2005 to 2007 when home buyers incurred significant property value losses over the subsequent five years and lastly the recovery years of post-2011 (2011-2014) with recovering home prices over much of the period. Estimated this way, we apply the model to investigate whether the fundamental drivers of mobility have changed across time.

We join the group of studies that find evidence of an equity lock-in effect on voluntary mobility (Andersson and Mayock 2014, Bricker and Bucks 2013, Ferreira et al. 2010, 2011). In particular, we find underwater homeowners who experienced rapid home price depreciation during the first five years of home ownership to be least mobile (those who purchased between 2005 and 2007). One advantage we have over the previous literature is that we can compare the sensitivity of homeowner mobility to changes in equity position across time periods. On this dimension we find that in the Home Price Decline period the equity lock-in effect became more prominent for homeowners with small but positive equity levels. For the home-price decline and recovery years (2005 to 2007 and 2011 to 2014, respectively), the odds of a move with close to no equity drops by 40 percent relative to a homeowner with 20 percent of equity. This is up from the four percent drop for the Pre-Crisis period between the

same groups. Another interesting difference with the Recovery period is the relatively slower moves at higher equity levels, where the marginal move odds ratios are much lower in the Recovery period than the previous two periods, indicating a fundamental shift in those high equity homeowners in the recent time period.

In order to investigate potential changes to life-cycle dynamics (e.g. raising a family and needing to move to a larger home or to a preferred school district), we use age of the borrower and co-borrower as a proxy for family-related decisions. In all periods, homeowner mobility follows a U-shaped pattern, with the youngest (i.e. move-ups) and oldest (i.e. downsizing) homeowners on average being the most mobile. If homeowners are for instance opting to age (or grow their families) in place and renovate instead of moving, we should see a significant shift in mobility patterns across age groups in the years following the crisis. Here we find several interesting changes in moving patterns across age groups. For instance, during the recovery years of 2011 and 2014 we find older homeowners to be substantially less mobile compared to their peers from the early 2000s (over 65 years old) even after controlling for major loan, borrower, regional and economic characteristics suggesting a behavioral shift among the elderly. Relative to middle-aged borrowers (50s) retirees at the age of 65 are 17 percent less likely to move post-2011 while prior to the crisis they had the same likelihood to move. These findings are consistent with retirees aging in place as they are the least likely group to move post-2011.

Our empirical results further indicate higher household debt relative to income (DTI) was an additional constraining factor in homeowner mobility during the crisis period and recovery periods. In all periods, homeowners with DTI ratio above 45 were less mobile, especially in the period of home price decline when the relative odds of a move significantly declined for homeowners with DTI ratio in excess of 36 (versus DTI less than or equal to 36) relative to the Pre-Crisis and Recovery periods. More recently, the negative impact of high DTI levels subsided, but this group is still relatively less mobile compared to their early 2000 counterparts.

We also find that homeowners who took out loans with currently ineligible features (see Fout et al. 2018 for more details), including loans with lower than 620 credit score, higher than 97 original loan-to-value, more than 50 percent DTI ratio and ineligible products such as negatively amortizing loans, 40-year terms, and interest-only loans, were more likely to move in the five years after origination in time periods prior to 2011. This is consistent with the idea that the easier (but riskier) access to credit enabled increased mobility among homeowners of 2000s.

Finally, using the number of borrowers as a proxy for multiple earners in the household we show that single borrowers are generally more likely to move within five years of initial purchase compared to multiple borrowers. However, the effect has been relatively stable across the periods we analyze, suggesting that relocation issues have not been any more prevalent in recent years than in the Pre-Crisis years.

Comparing the distribution of age across time periods, we find that in the recent period the share of homebuyers older than 50 has increased, a potential reason why the overall mobility rate has declined. In order to quantify how the change in age of recent buyers, as well as other aspects of the profile, have affected mobility, we estimate expected mobility rates using the profile of post-crisis

Recovery buyers using coefficients from the Pre-Crisis period and compare with observed mobility rates.[9] Here we find that mobility rates should have been expected to have returned closer to Pre-Crisis levels given the profile of recent buyers. This implies that mobility rates are approximately 30 percent lower than expected (30 percent actual versus 39 percent expected). We conduct the expected mobility analysis to account for how the change in composition of homeowner profile have impacted the mobility rates. The observed changes in borrower profile corresponds to a four percentage-point (pp) decrease in homeowner mobility from 42% in the Pre-Crisis years (2000-2001) to an expected mobility rate of 39% in the Recovery period (2011-2014). In other words, we find that 25 percent (or three pp) of the total drop of 12 pp in observed mobility (from 42% in Pre-Crisis to 30% in Recovery) is explained by profile changes between the Pre-Crisis and Recovery periods. The remainder of the difference, 75 percent or nine pp, between the observed mobility of 30 percent in the Recovery period versus the 42 percent observed in the Pre-Crisis period is due to a fundamental shift in homeowner behavior.

While our empirical work is most similar to Andersson and Mayock (2014), our paper advances the literature on repeat-buyer mobility in several ways.[10] First is the geographic and time period coverage of our data, which contains over 13 million owner-occupied loans Fannie Mae has acquired and spans almost two decades and the entire U.S. market. To our knowledge, creating a matching dataset of this size and scope is unique to the mobility literature. Second, utilizing this data set, we are able to document and investigate changes in homeowner mobility (as opposed to household mobility which conflates existing homeowner and first-time homebuyer mobility) as well as drivers of these changes across a number of time periods, for instance comparing mobility patterns and drivers in the Pre-Crisis and Recovery time periods. Finally, we are able to provide an estimate of the role of changes in homebuyer profile in explaining the continued lower observed mobility rates relative to historical rates in the most recent time period.

In the next section we further discuss the relevant literature for our current research and provide more detail behind the potential impediments to mobility. In section 3 we lay out the data, our empirical approach to identify homeowner moves and present our results in section 4. Section 5 concludes.

2. Potential Impediments to Mobility

In a seminal paper in the mobility literature, Molloy et. al. (2011) study the internal inter-state and inter-county mobility in the United States and show that mobility rates in the U.S. have been falling for the past several decades, not just in after the wake of the Great Recession. Hence the most recent

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[9] We place this analysis into the context of the Oaxaca-Blinder decomposition (Oaxaca 1973, Blinder 1973) approach later in the paper.

[10] Andersson and Mayock (2014) use parcel identification from tax rolls to merge transaction data with property valuation data from Florida. They create a fuzzy matching technique using property location, origination date and mortgage balance at origination to bring borrower characteristics such as age and credit score from a randomized sample of credit bureau data into their sample. As our data contains property address as well as latitude and longitude, we rely on a strict match of property data in our analysis. Other studies including Molloy et al. (2011), Ferreira et al. (2008, 2011), Bricker and Bucks (2013) and Coulson and Grieco (2012) rely on survey data such as ACS to study household mobility.

cyclical downturn's effect on labor or housing market conditions was not the sole driver behind the decline in observed mobility.

One of the potential drivers of mobility declines, widely debated in the literature, is negative equity.[11] The general idea is that under rapid price depreciation as homeowners owe more than the values of their houses, they will be less likely to sell their properties and move. Being underwater, however, could increase mobility because of increased likelihood of default. Isolating voluntary moves from involuntary defaults (as we also do in our analysis), Andersson and Mayock (2014) find voluntary household mobility declined by around 25 percent due to reductions in equity between 2006 and 2010. Coulson and Grieco (2012) used the Panel Study of Income Dynamics (PSID) from 1999 to 2009 and estimated households' move probability to investigate the lock-in effects of equity loss. They argued that there is no lock-in effect and instead mobility increases with MTMLTV, a result partly stemming from the fact that they could not distinguish voluntary moves from foreclosures and other distressed sales, given limitations in the underlying data set. Bricker and Bucks (2013) found that negative equity alone did not correlate with higher or lower mobility rates unless it was combined with other economic shocks such as a job loss. Analogous to the double-trigger theory of default, underwater borrowers moved involuntarily in the presence of negative economic shocks. However underwater homeowners who did not suffer from negative economic shocks were found to have similar mobility compared to homeowners with positive equity during the 2007-2009 period.[12] It is also possible that pessimistic equity perceptions by households may also limit mobility despite recent continued increases in home prices and equity levels nationwide.[13] In this context, low levels of positive equity may be insufficient to induce voluntary moves.

Another potential limiting factor for mobility is the lock-in effect created by the low interest rate environment in the 2010s. In particular, existing homeowners with mortgage rates much lower than the prevailing market rate may be reluctant to give up their current rates and bear the cost of buying and moving with the additional burden of paying a higher rate of interest. Identifying this effect empirically is difficult and requires disentangling homeowner mobility from the financial strength of the homeowner which is correlated with both increased mobility and lower interest rates relative to the market. In other words, while an interest rate lock-in effect may be intuitively appealing, it is difficult to isolate given that homeowners with lower interest rates are often financially strong and thus more likely to move.

Affordability issues may represent the biggest impediment to homeowner mobility, especially when coupled with pessimistic valuations by households of their currently occupied units. Limited housing supply and fast price appreciation put pressure on prospective move-up buyers and make it harder for those looking for the specific home that fits their needs and preferences at any given price point. If available housing supply does not suit the exact needs of the potential mover, postponing the move or simply renovating-in-place as an alternative to moving are other possible options.

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[11] See Gupta (2019) for an extensive discussion of the effect of negative equity on household mobility.
[12] Other papers that looked at the relationship of negative equity and homeowner mobility include Bloze and Skak (2016), Steegmans and Hassink (2018), and van Veldhuzien et al. (2018). These studies use Dutch administrative data which is a large sample of homeowners with personal characteristics.
[13] See, for instance, Deggendorf and Wilcox (2015).

Growing household debt burdens also represent an impediment to mobility. In particular, household debt and credit, total debt balance has been steadily growing since 2013, with mortgage debt making up almost 70 percent of total debt (Federal Reserve Bank of New York 2020). Following the Great Recession there has also been growing attention to the longer-run increase of household debt (see Mian and Sufi 2011). Moving-up in most cases will increase household debt holdings due to the increased home price and required mortgage balance. Current DTI ratios as well as prospective increases in household DTI ratios post-move can limit or delay homeowner moves. A homeowner with high debt-to-income, for instance, can find themselves unable to move without sufficient savings especially when there are not many affordable options around.

Relocation difficulties among two-earner households is another potential impediment to mobility. Coordinating a relocation of both jobs can be difficult for two-earner household decreasing the likelihood of moving across areas especially for out-of-area moves.

A final set of factors relate to life cycle issues and changes in housing needs brought on by changes in family size. Housing relocation decisions are often related to life cycle events in the household (e.g. marriage, children, death) which creates an imbalance between a household's current housing consumption and its updated housing demand. This imbalance typically culminates in the physical act of moving. This framework is commonly known as the housing life-cycle model where changes in the size, composition and housing preferences of households are associated with different stages of household formation, expansion and contraction or dissolution[14] With households having fewer kids and older homeowners potentially delaying downsizing due to factors such as adult children living at home and higher life expectancy, traditional patterns of household mobility may be shifting.

There are several consequences of reduced homeowner mobility. Reductions in mobility can create labor market frictions by inhibiting the homeowner from fully adjusting to labor market conditions. Loss of significant home equity could cause workers to decline job offers that would require them to move. This creates immobility and reduces the supply of available homes for sales, potentially driving home prices up further (Sterk 2015).[15] Repeat buyers play a unique role in the housing market by not only creating demand in housing but also creating the supply of existing properties for sale. First-time home buyers often buy existing homes and tend to take out smaller sized loans (Patrabansh 2013, 2015). [16,17] Based on the data set we use for our empirical analysis (discussed further below), first-time home buyers typically purchase in the low to middle price tiers of the market, while repeat buyers typically purchase in the higher price tiers of the market, regardless of time period (Figure 4). This cycle of buying and selling and sorting of the existing housing stock is an important mechanism for

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[14] See Hendershott et al. (2015) and Morrow-Jones and Wenning (2005) for an extensive literature review on housing mobility and the housing life-cycle model.

[15] Molloy et al. (2017) provides another perspective on the relationship between mobility and labor markets, presenting evidence that long-term observed declines in interstate mobility have been driven by declining rates of job changing.

[16] In 2018, 93% of first-time home buyers purchased an existing home based on numbers gathered from National Association of Relators' Home Buyer and Generational Trends report, NAR's existing and Census's new home sales records.

[17] For detailed illustrations of LTV, credit score and income comparisons between first-time homebuyers and repeat buyers please refer to "A Study of First-Time Homebuyers" FHFA Mortgage Market Note 2013.

churning existing supply and freeing up the appropriately priced and located housing stock for the next wave of first-time homebuyers. In general, first-time home buyers traditionally move and sell their existing homes to the next set of prospective first-time home buyers while becoming repeat buyers themselves.[18] Reaching a certain age these repeat buyers traditionally move or downsize. A collective break in this cycle potentially leads to a shortage of supply in the first-time homebuyer segment, pushing up home prices and undermining affordability.

3. An Empirical Model of Repeat Buying

In order to understand the decline in the repeat buyer activity we rely on a unique data set that allows us to identify homebuyer moves. In this section, we discuss in depth the data set we use in our empirical analysis. This data set combines Fannie Mae's loan level database with a comprehensive property transaction database to get information on a homebuyer's subsequent home selling activity. We begin with all Fannie owner-occupied purchase loans and investigate whether these homebuyers moved within a specified time window. We measure moves in our set as voluntary, arms-length sales of the underlying property within five years of the original purchase mortgage origination date.

In order to empirically study the drivers of mobility, we use a logistic model to predict a homeowner's probability of selling and moving within five years of origination, controlling for borrower characteristics such as age, loan attributes such as updated equity levels, the local unemployment rate and state and time fixed effects. In the following sections we lay out details on our identification methodology, model variables and present results.

3.1 Data Description

We take owner-occupied purchase mortgage loans from Fannie Mae's acquisitions database from 2000 through the end of 2014. The loan-level dataset contains loan attributes as well as the underlying property's geographical location. We then search for these properties in Fannie Mae's property transaction database (PTD) made up of an extensive collection of several property transaction data sources including the Uniform Appraisal Data set (see Eriksen et al. 2019 for a description of this data), real estate owned properties by the government sponsored enterprises (GSEs, i.e. Fannie Mae and Freddie Mac), data from GSE loan records, data from the Multiple Listing Service (MLS) and deed data.[19] The loan records contain a standardized street address and zip code enabling a merge with the

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[18] This is different from but related to the filtering of older housing stock to lower income buyers, as existing homeowners who become repeat buyers are more likely to buy more expensive properties. See Rosenthal (2014) for recent research on this particular filtering mechanism.

[19] We compare the coverage of the PTD to existing and new home sales calculated by National Association of Realtors. While PTD's coverage of all sales can fluctuate across time, we estimate on average the transaction database covers 70 percent of market transactions. We weight our mobility measures and empirical observations to account for changes in PTD coverage.

property transaction data. We remove any distressed property transactions as well as loan defaults to focus on voluntary moves. Here, we assume this group of homeowners who sell their property in a foreclosure or other distressed sale is small enough that mobility rates are not meaningfully affected by removing them or otherwise would have had comparable mobility rates to similar homeowners (i.e. similar controls, including past delinquencies) that remained in the population.

Our focus is on dynamics of homeowner mobility where an owner household decides to move from their current home. Thus, we exclude purchase mortgages associated with investor properties or second homes. It is possible for a household to purchase multiple properties, but those properties not occupied by the owner (i.e. investor or second homes) in Fannie Mae's acquisition database would be labeled as non-owner. If a household sells their owner-occupied property, they could be buying another property or renting, hence our mobility measure captures both owner-to-owner and owner-to-renter moves (in other words those existing homeownership).[20]

In creating our left-hand side variable, we are interested in the first move after origination of the initial purchase loan and set a time window for subsequent sale to create comparable measures across time. In particular, the focus of our analysis in this paper is Fannie Mae homeowners who move within five years after their initial home purchase. Our results are robust to various moving timelines, including moves within three, five and seven years after initial loan origination. We do not have a way of tracking all of the borrowers after the sale of their property hence the mobility measure constructed this way not only includes owner to owner moves but also contains households exiting homeownership. A big part of our motivation in looking at existing homeowner mobility is the selling of existing stock for other buyers to acquire the stock and thus release inventory in potentially more supply-constrained portions of the market. Moves out of homeownership would serve to relieve supply pressures, and at least along this dimension, represent a source of mobility we are interested in capturing.

One of the drawbacks of this approach that should be noted here is that by restricting moves to sales we are assuming those who did not sell stayed in their properties. However, no record of sale does not necessarily mean the homeowner did not move. Some households buy another home without selling their existing one, for instance, by converting their existing property into an investment property. This could mean our mobility rate is underestimated. To enhance our matching algorithm for those did not sell but still moved we search for the same borrowers within Fannie Mae's acquisition database using a unique borrower identification number. This way we can identify at least some portion of those who did not sell the property underlying their initial purchase mortgage but appeared on a new owner-occupied mortgage underwritten by Fannie Mae. Our matching methodology is summarized schematically in Figure 5.

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[20] The investor share of overall Fannie Mae's purchase acquisitions is six percent in the 2000-2002 time period, nine percent in the 2005-2007 time period and 11 percent in the 2011-2014 time period.

3.2 Summary Statistics

Using our matched dataset, we create an indicator variable that takes the value of one when there is a sale within five years and the value of zero if there is no sale in this time period. Figure 6 presents the percentage of Fannie Mae homeowners who moved within five years of the initial purchase date.[21] We find that mobility measured this way declined sharply during the economic downturn and recovered to some extent after the crisis. Only about 30 percent of owners with a Fannie Mae mortgage who bought their home in 2014 moved through 2019, a drop from the approximate 42 percent of those who originated loans between 2000 and 2002. This approximate 30 percent decline relative to the Pre-crisis mobility rate has corresponded with an uptick in the share of residential fixed investment devoted to home improvement, indicating renovation may be serving as a potential substitute for trading up in recent years. Figure 7 presents mobility rates by age cohort and shows that the youngest homeowners typically are the most mobile and that their mobility rates have recovered the fastest in the Home Price Recovery period. Still, mobility rates remain below the Pre-Crisis levels for all age cohorts.[22]

Figure 8 plots home price against our mobility measure, indicating an inverse relationship between future home prices and our five-year mobility measure.[23] To make inferences about mobility drivers and observe their effect across different housing environments in our empirical modeling approach presented in the next section, we split the sample into separate time periods that represent three distinct periods of national home price movements. Homeowners who purchased their homes between 2000 and 2002 were subject to home price appreciation in advance of the home price declines that began circa 2007, so we label this group as Pre-Crisis. Those who purchased homes between 2005 and 2007 were hit by rapid price depreciation and are labeled Home Price Decline. Lastly, we group 2011 and 2014 together as the Recovery period.

Our estimation sample contains several loan-level and property-level attributes, including the mark-to-market loan-to-value ratio (or MTMLTV) which is the updated ratio of the current loan balance to the current property value. Given that homeowners do not necessarily sell at the same point in time after origination, in order to generate a measure of equity levels consistent across our sample, we derive MTMLTV five years after loan origination (as opposed to using MTMLTV at the time of liquidation).[24] To do this, we take origination loan amount and calculate the remaining balance on the loan in five years based on the amortization schedule for a 30-year fixed rate mortgage.[25] The new

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[21] For the five-year conditional mobility measure, December 2014 is the last cohort with five years of observations.

[22] If there is more than one borrower, age is defined as the youngest of the two.

[23] The absolute value of the correlation coefficient between five-year mobility and the home price index is over 85 percent.

[24] Liquidations does not necessarily represent a sale, for instance it could be a refinance liquidation.

[25] In our sample across years, the vast majority of owner-occupied purchase loans have a 30-year amortization period, these include 30-year fixed loans as well as ARM loans that amortize over 30 years. In the Pre-Crisis period this share is 84 percent, it rises to 92 percent in the Crisis period and falls to 89 percent in the Recovery period. The loans that do not amortize over 30 years include fixed rate products with longer (e.g. 40-year) and shorter (e.g. 15- and 20-year) terms, ARMs with longer and shorter amortization periods and other historical products (e.g. negatively amortizing loans). The most common of these across time periods was the 15-year product, which was

value of the underlying property is calculated using original property value and realized five-year-ahead zip-level home price growth rates.[26]

Table 1 presents summary statistics describing the overall sample used in the estimation of our mobility model (described in the next section).[27] This table shows that 31 percent of our sample of approximately 14 million owner-occupied purchase loans have moved within five years. Those who moved are two years younger on average than those who stayed (38 years old versus 40 years old) and have smaller MTMLTV ratios (higher equity), with only four percent of movers underwater (i.e. owe more than the property value, versus eight percent for those who stayed). Furthermore, 84 percent of the movers have 20 percent or more equity compared to 75 percent for those who stayed. Among the movers the share of income above area median income is also higher (60 percent versus 56 percent) and they have slightly lower high-DTI shares (DTI over 45 percent).[28] First-time home buyer share is highest among non-movers. Not surprisingly, movers have lower delinquency rates and were more mobile prior to the crisis.

Table 2 looks at mobility rates across four important dimensions; namely MTMLTV, age, DTI and number of borrowers, and Table 3 presents their corresponding distribution across the three time periods. We observe that homeowners with less equity and middle-aged buyers tend to be less mobile across time. Homeowners in their 40s and 60s generally have the lowest mobility rates across time periods. Importantly, the age distribution in recent years has skewed older with a greater share in their 50 and 60s, indicating a potential reason behind slower mobility. Prior to the crisis between 2000 and 2002 as well as during the most recent period only a small fraction of homeowners were underwater after five years (with a share of only 0.03 percent or less) hence any equity lock-in inference for these time periods would be estimated over a very small sample. However, 26 percent of homeowners who purchased between 2005 and 2007 were underwater after five years, allowing us to make more accurate inferences on this segment of our sample. These group of underwater homeowners had the smallest mobility rate of the period (16 percent) suggesting lock-in effects of negative equity as a result of the housing crisis. Generally, higher equity corresponds to higher mobility rates, where mobility rates for homeowners with MTMLTV between 60 percent and 80 percent is greater than those with higher MTMLTV levels across all time periods. However, in recent years homeowners with the highest equity levels (MTMLTV<=40 percent) have become less mobile than homeowners with incrementally lower equity levels. This may suggest a behavioral change for homeowners who have paid down enough of their mortgage and are choosing to age in place rather than change residence.

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less common in the Crisis period, thus the somewhat counterintuitive higher share of 30-year amortization term loans in the Crisis period.

[26] To calculate MTMLTV in this way, we use the interest rate at origination from our loan-level database and zip-level home price indices created internally by Fannie Mae.

[27] All of our summary statistic tables, as well as those shown in Tables A1 – A4, are based on the weighted sample scaled up to account for coverage of the transaction database. In our calculations of the mobility rates and in our empirical model of mobility we use the same weights.

[28] Area median incomes is calculated at the county level based on ACS data and used for the GSE's affordable Housing Goal reporting (see for instance Lam, Schultz and Raman 2018).

Tables A1 – A3 break down the sample by our time periods of interest and present the summary statistics for each. Table A4 focuses only on homeowners that moved within five years of the initial loan origination. We observe that movers in the recovery years are generally younger (less than 30 years old) or older (between 50 and 70 years old) shifting the age distribution older. Likewise, in recent years we see more concentration at higher equity levels, especially between the 40 to 60 percent MTMLTV group, which is expected given the strong home price appreciation post-2012. Another notable difference is that homeowners who moved are more likely to be single borrowers relative to homeowners in prior periods. Furthermore, the average DTI of movers has gone down from 36 percent in the 2000 to 2002 period to 33 percent in the 2011 to 2014 period.

4. Estimation Results

To provide a view into the changing patterns and underlying drivers of mobility and investigate why mobility has remained lower in recent years, we estimate a logit model with our five-year mobility measure as the dependent variable. Our regressors include most of the borrower and loan characteristics presented in the summary statistics of the previous section. Our focus is on the major impediments to mobility, including equity lock-in, household debt, relocation issues of multiple earners and aging in place/life-cycle considerations. We use MTMLTV, DTI ratios, the number of borrowers on the loan and age of the borrower/co-borrower, respectively, to gauge the effect on mobility of these potential drivers.

In our predictive model we use indicator variables to define first-time home buyer, multiple borrowers, delinquency (a measure indicating whether a loan was 90 days delinquent within the first five-year period after origination) and subordinate financing status. We also create buckets of various levels for property type, loan type (fixed rate versus adjustable-rate mortgages), and third-party originator type (whether the loan was originated by a third-party or through a retail channel). We include borrower age, MTMTLV, loan amount relative to the national conforming limit and credit score (FICO) as additive splines. [29,30]

Regarding economic controls, MTMLTV already considers home price changes in property value, so we do not control for home prices separately. We include changes in the county-level unemployment rate over the five-year period calculated from Bureau of Labor Statistics unemployment data. We

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[29] High-cost areas have local conforming limits above the national conforming limit, hence the GSEs can acquire these high balance conforming loans with loan amounts greater than the national conforming limit. We use limits specific to contiguous states and non-contiguous states (Alaska, Guam, Hawaii, and Puerto Rico) separately and account for number of units in the property in applying this limit. For instance, in 2020 the national loan limit for a one-unit property in contiguous states is $510,000. However, for properties located in the Washington DC metro area, the limit is $765,000. Without loss of generality, any loan over 100 percent of the national limit represents a high-cost area loan.

[30] We have also tested each of the splined variables with buckets in the model. While the results were robust for each specification, creating additive splines increased the fit of the model.

additionally control for state and eligibility of loans that were originated prior to 2014.[31] All of our variables are interacted with the time period (Pre-Crisis, Home Price Decline and Home Price Recovery) in our empirical model.

Tables 4 and 5 present our regression coefficients and odd ratios, respectively. In general, we find a hump-shaped pattern between equity and mobility. Prior to the crisis, high to moderate levels of equity (MTMLTV between 40 and 60 percent) are generally associated with the highest odds of moving, and mobility starts to decline as homeowners have less equity than 40 percent (MTMLTV over 60 percent) as suggested by Figure 9. This relationship notably has changed during the period of home price decline and has shifted further after home prices started to recover. In particular, mobility starts to decline in the recovery years when equity levels start falling below 20 percent (MTMLTV over 80 percent, Figure 9). During this time period, the odds of a move with no equity drops by 40 percent relative to a homeowner with 20 percent of equity. This is up from the four percent drop observed between the same groups for the Pre-Crisis period (shown more clearly in Figure A1 in the Appendix).

We also find that underwater homeowners (MTMLTV over 100 percent) who purchased their homes between 2005 and 2007 were least likely to move, consistent with the negative equity lock-in effect on homeowner mobility triggered by home price depreciation found by others in the literature (see for instance Andersson and Mayock 2014). During this time period, the greatest decline in odds of moving happens between 90 percent to 100 percent MTMLTV. Negative equity still reduces the mobility but only slightly relative to the no equity group. Unfortunately, we cannot make a similar comparison for the other two time periods as the Pre-Crisis and Recovery periods' shares of underwater borrowers are very small, limiting reliable inferences about the equity lock-in effects. Prior to the crisis we observe that homeowners who had no equity after five years of initial home purchase were more likely to move compared to those buyers with at least ten percent of equity (MTMLTV equal to 100 versus MTMLTV equal to 90, Figure 9). However, shares were very small in these MTMLTV buckets as illustrated in Table 3.

In the early 2000s, higher equity levels did not reduce the likelihood of moving, but for the recovery years of 2011 and 2014, mobility at high equity levels has been much lower than at lower equity levels, suggesting a behavioral shift for these low MTMLTV borrowers in the most recent period.[32] Homeowners with the highest level of equity (over 60 percent) who purchased during recovery years are over 20 percent less likely to move compared to homeowners with lower equity (20 percent). Prior to the crisis the effect was flipped, where the highest equity homeowners were three percent more likely to move relative to low equity homeowners. These findings are consistent with a recent slowdown in the downsizing behavior of older borrowers with higher equity levels.

There is some potential sensitivity of our results to how we control for the relationship between origination LTV (OLTV) and MTMLTV. To address this, we estimated an alternative specification using

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[31] See Fout et.al (2018) for more details on the ineligible population. Lower than 620 credit score, higher than 97 original loan-to-value, higher than 50 percent DTI ratio and non-traditional products that are no longer eligible for GSE underwriting such as negatively amortizing loans, 40-year terms, and interest-only loans are among the excluded group.

[32] This change is shown clearly in Figure A1 where we present the percentage change in odds ratios across various levels of MTMLTV relative to 80 percent MTMLTV.

bucketed MTMLTV interacted with bucketed OLTV to track how differences in the starting equity position (i.e. OLTV) affect mobility for a given current equity position (i.e. MTMLTV) with individual specifications for each time period.[33],[34] As in our baseline specification, we find (in results not shown) that small or negative equity positions are associated with less mobility. We further find in this alternative specification that those buyers who experienced more home price decline to arrive at a given updated equity position (i.e. lower OLTV for a given MTMLTV) have lower mobility rates. Similarly, at lower MTMLTVs, we find that those buyers who arrive at a given updated equity position based on more price appreciation (i.e. higher OLTV for a given MTMLTV) have higher mobility rates.

The effect of borrower age on mobility has the expected U-shaped pattern also found in many other household mobility studies (Andersson and Mayock 2014, Coulson and Grieco 2012, Ferreira et al. 2010). Younger homeowners move more, up until age 40, with mobility steady until approximately age 70 before picking up again, as seen in Figure 10. We find this to be true regardless of time period, consistent with the life-cycle framework discussed earlier. Mobility is at its highest for the youngest and oldest homeowners, as expected. We find further evidence that retirees are aging in place as they are less likely to move relative to all other homeowners within the same time cohort after the crisis. In the Pre-Crisis years of 2000 to 20002, the odds of a move dips at age 40 and starts to increase for older ages, while the odds of a move are smallest for those around age 65 during the Recovery and Home Price Decline periods. Relative to those in their 40s, 65-year-olds are three percent less likely to move post-2011, while prior to the crisis they were seven percent more likely to move.

Our findings suggest that not only retirees, but most homeowners are delaying moving decisions once we make comparisons across time periods. In the recovery years, we find the youngest households' (aged 25) odds of move to be similar to their Pre-Crisis counterparts. However, this is not the case for older homeowners aged 30 or older. They are substantially less mobile compared to their peers from the 2000s. The percentage reduction in mobility odds for all ages relative to 25 is greater in recent times than those from the Pre-Crisis period. For example, a 35-year-old homeowner is now 52 percent less likely to move in five years relative to a homeowner aged 25, while their peers from the early 2000s were 42 percent less mobile relative to the corresponding 25-year-old category.[35]

We find that higher household DTI has suppressed borrower mobility the most during the housing price decline period. While in all periods having higher DTI result in less mobility, mobility odds across DTIs have been relatively stable prior to the crisis with only a slightly negative impact of high DTI on the odds of moving relative to low levels of DTI. The odds of moving for buyers with the highest DTI ratios over 45 percent (relative to less than 36 percent) declined by four percentage-points for the Recovery period and by nine percentage-points for those Home Price Decline-period buyers. This

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[33] The updated MTMLTV will differ from the OLTV because of amortization of the loan balance and accrued home price changes to the underlying property value.

[34] In Table A5 in the Appendix, we show that in the Pre-Crisis and Recovery periods, less than one percent of loans saw an increase in their MTMLTV versus OLTV over the five-year period, with similar distributions of the type of MTMLTV declines observed. For instance, in both periods, approximately 30 percent of loans experienced a decline in MTMLTV relative to OLTV of 10 to 20 percentage points. In the Home Price Decline period, on the other hand, 61 percent of homeowners saw an increase in their MTMLTVs relative to their OLTVs.

[35] Similar comparisons follow for all age groups relative to age 25, as depicted in Figure A2 in the Appendix.

suggests that household debt relative to income was a greater contributing factor in mobility reduction during the home price decline period compared to the Recovery period. While the effect was reduced (three percent versus nine percent), high household DTI ratios is still one of the constraints to mobility post-2011 (Figure 11).

We use the number of borrowers as a proxy for multiple earners in the household. Figure 12 presents mobility odds for multiple borrowers with respect to the case of one borrower. Relocation for a household with more than one job requires both earners to find a viable alternative job especially for out-of-area moves. Even though we do not control for whether a homeowner moves out of the area, we do find a significant negative effect of having more than one borrower on mobility. Homeowners who obtained their mortgages alone are more likely to move compared to homeowners who have a cosigner on the mortgage present. In particular, having multiple borrowers/earners decreases the odds of a move by 15 to 19 percentage-points. The effect has been relatively stable pre-2007 and post-2011 (within a few percentage-points of one another), suggesting that relocation issues might not be any more prevalent in recent years than in the Pre-Crisis period.[36]

In our data if borrowers are seriously delinquent within five years after origination but sold their properties in arm's length transactions, it would be identified as a move. Borrowers can reperform after being three-months delinquent and in our sample all the borrowers with 90-day delinquencies within five years have reperformed and the time from serious delinquency to sale on average was approximately 10 months. We present the share of borrowers who were three months delinquent in Table 1 and subsequently in the Appendix tables A1 – A3. While the Pre-Crisis and Home Price Recovery periods overall had only one percent of borrowers with 90-day delinquencies, that share was seven percent for the Home Price Decline period (2005-2007). Our model controls for this serious delinquency rate and suggests that borrowers who were 90-day delinquent are less likely to move regardless of time period. As expected, the likelihood of moving when the homeowner has experienced a 90-day delinquency relative to staying drops the most during the Home Price decline period (2005-2007), by almost 70 percent. The magnitude of the effect of delinquency on mobility while lower to some extent in the Home Price Recovery period, stayed higher than Pre-Crisis. Since we have removed defaults (foreclosed loans) from our sample these borrowers that went through a period of distress which reflected upon their mortgage payment were able reperform at some point but were less likely to sell the property upon recovery. These borrowers are likely to delay their move as they work to gain a stronger financial position.

We also control for whether or not a loan would be eligible for delivery to Fannie under the tighter underwriting requirements in the Recovery time period. Prior to the crisis, certain loan products such as interest-only, products with greater than 30-year amortization terms, loans with features such as low credit scores (less than 620) or high DTIs (over 50%) were eligible for delivery to the GSEs. These relaxed underwriting criteria might have played a role in getting certain segment of borrowers into homeownership as well as affecting the future ability to move. In our sample we label these loans as ineligible for purchase based on current underwriting standards. Across three selected time periods

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[36] These finding are in line with the survey-based findings of Fout and Savascin (2020) where delayed move up buyers, defined as first-time homeowners who lived in their home more than five years, are found to be more likely to agree that both earners of the household have to find a job for moves out of their current area.

ineligible loans account for 31 percent of Pre-Crisis loans, 45 percent for the Home Price Decline period loans and close to zero percent for the Recovery period. Based on our model coefficients, homeowners who took out loans with ineligible features were more likely to move in the five years after origination prior to 2011. This is consistent with the idea that the easier (but riskier) access to credit enabled increased mobility among homeowners of 2000s.

Additionally, from our model we find that households with relatively larger loan amounts compared with the national conforming limits and first-time homebuyers are less likely to move in the recent period even after controlling for loan characteristics and time and state-fixed effects. We also control for the presence of second liens in our model with an indicator variable to capture some of the additional information from the presence of subordinate financing.[37] Interestingly, in the results shown in Table 4, the presence of subordinate financing led to greater mobility in the Pre-Crisis period and slower mobility in the Home Price Decline and Home Price Recovery periods. Subordinate financing likely has two off-setting effects. The first is a selection effect, with higher credit quality and thus potentially more mobile buyers, which is consistent with the results in Fout et al. (2018) that shows subordinate financing across similar time periods results in less delinquency. The second effect lower mobility, as subordinate financing decreases the equity position of the buyer relative to the MTMLTV calculated based only on the first lien.

In Figure 13, we apply our model to the question of how much the observed decline in the mobility rate between the Pre-Crisis and Recovery periods is driven by shifts in explainable factors such as age, DTI, MTMLTV and other determinants. In particular, we use the prediction sensitivities from the Pre-Crisis period and apply them to the crisis and recovery buyer profiles to generate an expected value of buyer mobility in these periods. Here we find that the expected mobility rate is 39 percent (total purchase transaction weighted) during the 2011-2014 period compared to an observed rate of 30 percent. This implies that mobility rates should have recovered closer to Pre-Crisis levels given the observed profile of recent buyers. Hence the change in composition of homeowner profile have caused mobility rates to drop from 42 percent in the Pre-crisis period (2000-2002) to 39 percent in the Home Price Recovery period (2011-2014). This corresponds to a three percentage-points drop or only 25 percent of the total drop in mobility explained by changes in homebuyer or loan profile. The observed total drop between the two time periods is 12 percentage-points (42 versus 30 percent). Hence approximately 75 percent (9 percentage-points of the 12 percentage-points drop) of the observed drop is unexplained by changes in borrower profile from the early 2000s to the early 2010s, for instance due to a fundamental shift in homeowner behavior (measured by the coefficients in our model). We can place this analysis into the context of the Oaxaca-Blinder approach to decompose regression results (Oaxaca 1973, Blinder 1973). We first take the Pre-Crisis (2000-2002) and Home Price Recovery (2011-2013) time periods as the two groups in comparing mean differences across moving decisions in five years after origination. We summarize the decomposition equation between these two time periods as follows:

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[37] The shares of subordinate financing measured this way among our sample are very close across the Pre-Crisis and Home Price Recovery periods as shown in Tables A1 – A3 in the Appendix. During the Home Price decline period the instances of mortgages with seconds rose to 24 percent from six percent in the Pre-Crisis period and fell back to five percent in the Recovery period.

$$Mean(Move_{Pre-Crisis}) - Mean(Move_{Recovery})$$

$$= \beta_{Pre-Crisis}\left(\bar{X}_{Pre-Crisis} - \bar{X}_{Recovery}\right) + \bar{X}_{Recovery}(\beta_{Pre-Crisis} - \beta_{Recovery})$$

$$= Explained + Unexplained$$

The average height of the solid line in Figure 13 between the Pre-Crisis and Recovery periods represents the left-hand side of this equation, which we calculate as 12.1 percent (total purchase transaction weighted) or 29.1 percent of the Pre-Crisis average mobility rate. The difference between the solid line in the Pre-Crisis period and the dashed line in the Recovery period in this figure represents the explained portion of the differences in mobility driven by changes in loan and property characteristics while holding the coefficients constant at their Pre-Crisis estimated values, which we calculate as 3.0 percent or 25.1 percent of the 12.1 percentage-point difference in average mobility rates across the two periods. Finally, the unexplained portion is calculated as the difference between the dashed line and the solid line for the Recovery period, which we calculate as 9.1 percent or 75.0 percent of the 12.1 percent difference in average mobility rates across the two periods.

As Tables A1 – A2 indicate, the credit profile of borrowers has noticeably changed from the Pre-Crisis to Recovery periods. Importantly, the average credit score was 708 in the Pre-Crisis period, 725 in the Recovery period and 754 in the Recovery Period. The percent of loans that are currently ineligible for delivery (e.g. FICO less than 620) also made up a significant portion of volume in the Pre-Crisis and Home Price Decline period, accounting for 31 and 45 percent of volume, respectively, compared with zero percent in the Recovery period. As Figure 14 illustrates, over the same time period Fannie's share (and the GSE share) of MDO changed dramatically, losing share to the non-agency segment in the early 2000s and gaining share as part of the entire agency market relative to the non-agency market in the Recovery period.[38] This indicates the potential for sample selection as a driving reason for the decline in mobility observed in the Fannie sample in the Recovery period. To investigate the role of the changing composition of borrower profile in Fannie relative to the entire market of purchase originations, we include analysis from two additional data sets that cover the entire market, namely the American Housing Survey (AHS) and the CoreLogic Loan Level Market Analytics (LLMA). In particular, the AHS is a nationwide longitudinal survey at the housing unit level and includes household responses related to the housing unit and household characteristics. This survey allows us to track general mobility patterns for homeowners across the entire market and compare the observed patterns with those observed in our set of Fannie purchase mortgages. Importantly, the survey includes information on the tenure of the unit (i.e. owner versus renter) and the date the household moved into the unit. We can thus track a given unit through time and identify when the unit changes hands to a new owner occupant. We can then create a metric by vintage of original purchase date of the fraction of homebuyers who move within five years to compare this to the mobility metric

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[38] Here agency refers to the GSEs and Ginnie Mae, and non-agency refers to private label securitizations (PLS) and bank portfolio loans (or book loans in Figure 14).

we use in this paper based on the Fannie data.[39] Unfortunately, due to a change in sample in the AHS in 2015 as well as the infrequency of the AHS survey (every two years), we are unable to get a full read on the Recovery period. We are limited to presenting five-year mobility rates for AHS through the 2007 purchase vintage and three-year mobility rates through the 2010 purchase vintage, as shown in Figure 15a.

With the five-year mobility rates, we find that the AHS and Fannie mobility rates follow the same general pattern through 2007, with the AHS mobility rate consistently lower. Thus, we view the Pre-Crisis and Home Price Decline period patterns observed in both the Fannie and AHS data as consistent with declining mobility over these time periods and not a feature unique to the GSE sample. To gain some insights into the comparatively higher Fannie mobility rates we turn to LLMA, a loan-level data set that allows us to track over time the relative credit profile of Fannie owner-occupied purchase loans versus the market as a whole.

As the AHS covers the entire market, it includes GSE purchases (we assume these are representative of Fannie purchases), as well as government loan purchases (including Federal Housing Agency (FHA) and Veteran Affairs (VA) typically securitized by Ginnie Mae) and non-agency purchases. As shown Figures 16a and 16b, government loans have higher OLTVs and lower credit scores across time periods versus GSE loans, while non-agency had a worse credit profile in the Pre-Crisis and Home Price Decline periods (lower credit score and higher OLTVs) and a better credit profile in the Recovery period (lower credit score and higher OLTVs) versus GSE loans. Our empirical findings suggest lower mobility when credit scores are extremely low and extremely high based on the Fannie sample and when MTMLTVs are high (consistent with a combination of higher OLTVs and weaker home prices) and to a lesser extent when they are extremely low. Thus, we interpret the lower mobility rates observed in AHS as consistent with the empirical findings we discuss above as well as the observation that GSE loans typically fall comparatively in the middle of the distribution (i.e. the most mobile part of the distribution) relative to the entire market which includes government loans and non-agency loans).

In order to gain additional understanding from the AHS into whether there is sample selection in the more recent time period, we restrict the mobility measure to three years to look more closely at the patterns in more recent years (Figure 15b). Here, again the patterns are generally consistent across the two data sets, with the AHS mobility rates typically falling below the Fannie mobility rates (except for 2001 and 2002), mobility rates declining over the Pre-Crisis and Home Price Decline periods and leveling off prior to the Recovery period. Given the observations that the Fannie (and GSE) credit scores and OLTVS (and by extension the MTMLTV) are less extreme than the market, it is likely that the mobility rates observed in the Fannie data are higher than those that would be observed in the

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[39] We also use the AHS to also identify the fraction of all households that have moved within the last year to create a view similar to the ACS-based metric we discuss in the introduction. Figures A3 and A4 in the Appendix present this analysis and show that this AHS view of mobility is similar to ACS, with declining mobility in the Crisis period and recovering mobility in the Recovery period. The AHS data also provides similar trends across different age groups, with some minor differences compared with ACS. In particular, relative to the ACS mobility series, the youngest group of homeowners (aged less than 30) did not experience the strong pick up in the AHS view. The other age group that shows some difference with ACS is the group of homebuyers in their 40s. Here we see a full recovery to pre-crisis levels in the ACS mobility series, however, the AHS series suggests a continued decline in mobility for this age group.

market. Thus, it is not likely that the decline in mobility observed in the Recovery period in the Fannie sample is being meaningfully driven by sample selection.

5. Conclusion

Existing homeowner mobility is traditionally a mechanism that encourages supply as repeat buyers release inventories to prospective first-time homebuyers who are transitioning to homeownership. This mechanism has faced challenges in recent years as the additional supply from new homes has been limited and repeat buyers have held on to the existing stock longer.

In this paper we utilize a novel dataset that matches Fannie Mae owner-occupied borrowers with a potential subsequent sale of their properties. We use this sale information to derive a measure of mobility and define mobility as the percentage of Fannie Mae homeowners who move within five years of the initial purchase date. We find that mobility measured this way declined sharply during the economic downturn and recovered to some extent after the crisis, driven mostly by younger existing homeowners turning over more frequently. However, existing homeowner mobility, while improving, has not reached its pre-crisis levels. We find that mobility rates remain approximately 30 percent lower than in the Pre-Crisis period covering 2000 to 2002. Our sensitivity analysis using borrower profile from the Recovery period reveals that approximately 25 percent of the observed drop in mobility is explained by changes in age and other observable factors for homeowners between the Pre-Crisis and Recovery periods. The majority of the drop is thus due to a fundamental shift in borrower behavior.

In an aim to empirically investigate the potential drivers of mobility we have estimated a predictive model of an owner-occupant borrower's moving decision within five years after mortgage origination controlling for borrower characteristics such as age, loan attributes such as equity levels, basic economic conditions as captured by the unemployment rate, and location and time period.

Our main findings are as follows: First, we found that underwater homeowners who originated between 2005 and 2007 were least likely to move consistent with a lock-in effect of negative equity triggered by home price depreciation. Moreover, post-crisis high equity homeowners have become relatively less mobile and are delaying moves. We also observe that higher household DTI ratios suppress borrower mobility especially during the housing price decline period but that the impact got smaller for homebuyers during the recovery years. We also tested for relocation difficulties of multiple earner household by using the number of borrowers as a proxy. We find that borrowers who obtained their mortgage alone are generally more likely to move compared to borrowers with cosigners. The effect has been relatively stable pre-2007 and post-2011, suggesting that the relocation issue might not be any more prevalent in recent years than in the pre-crisis period. Finally, we find that mobility is generally concentrated in the youngest and oldest age groups and that observed household moving decisions continue to be consistent with the timing of major life events. However, once we compare time periods, we find evidence that homeowners at a usual retirement age of 65 are among the least likely to move in the recent Recovery period, a pattern not observed in the Pre-Crisis period.

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Figures and Tables

Figure 1: Conventional Owner-Occupied Purchase Acquisitions
Eligible Loans (Thousands, Labels Show % Repeat Buyers)*

Source: Fannie Mae

Repeat *FTHB*
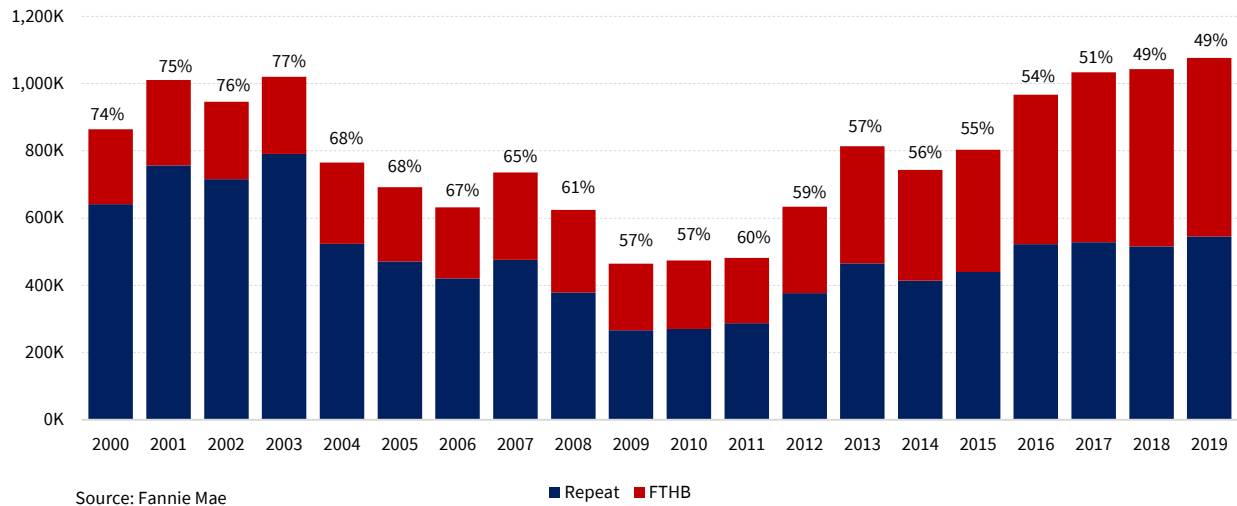
* Volume in thousands, labels show percent repeat buyers. Loans with lower than 620 credit score, higher than 97 loan to value and more than 50 percent pre-crisis acquisitions.

Figure 2: Age of Borrower
Conventional Owner-Occupied Purchase Acquisitions

Source: Fannie Mae

Repeat *FTHB*
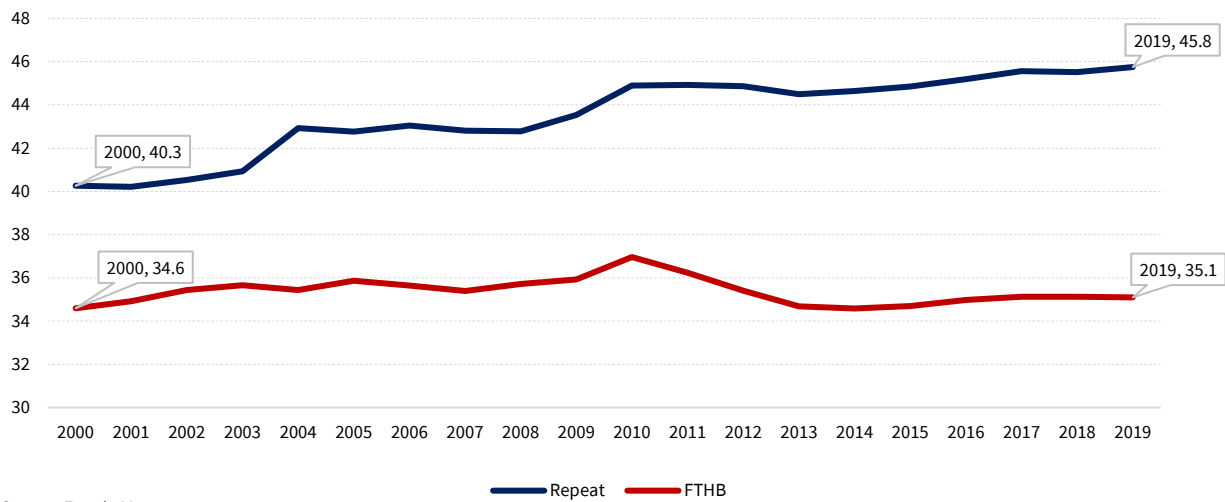
*Fannie Mae owner occupied purchase acquisitions. Loans with lower than 620 credit score, higher than 97 loan to value and more than 50 percent debt to income ratio and products such as negatively amortizing loans, 40-yr FRM and interest only loans are removed from pre-crisis acquisitions. When there is more than one borrower the age of the youngest borrower and co-borrower is used.

Figure 3.a: Mobility Series for Homeowners and Mortgaged Homeowners
American Community Survey
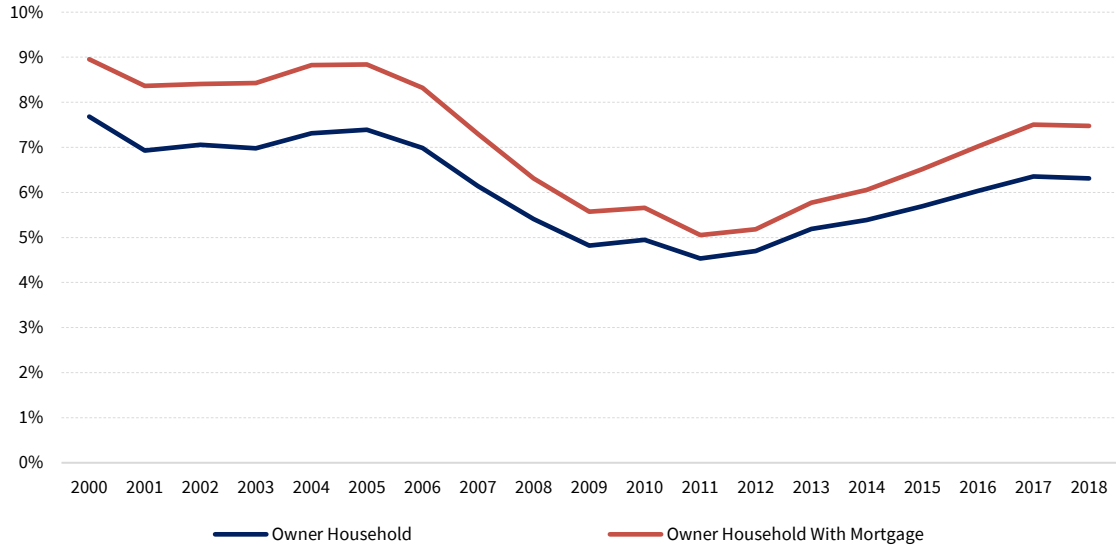
Source: ACS PUMS. Shows percentage of homeowners who moved since the previous year.

Figure 3.b: Mortgaged Homeowner Mobility by Age Cohorts
American Community Survey
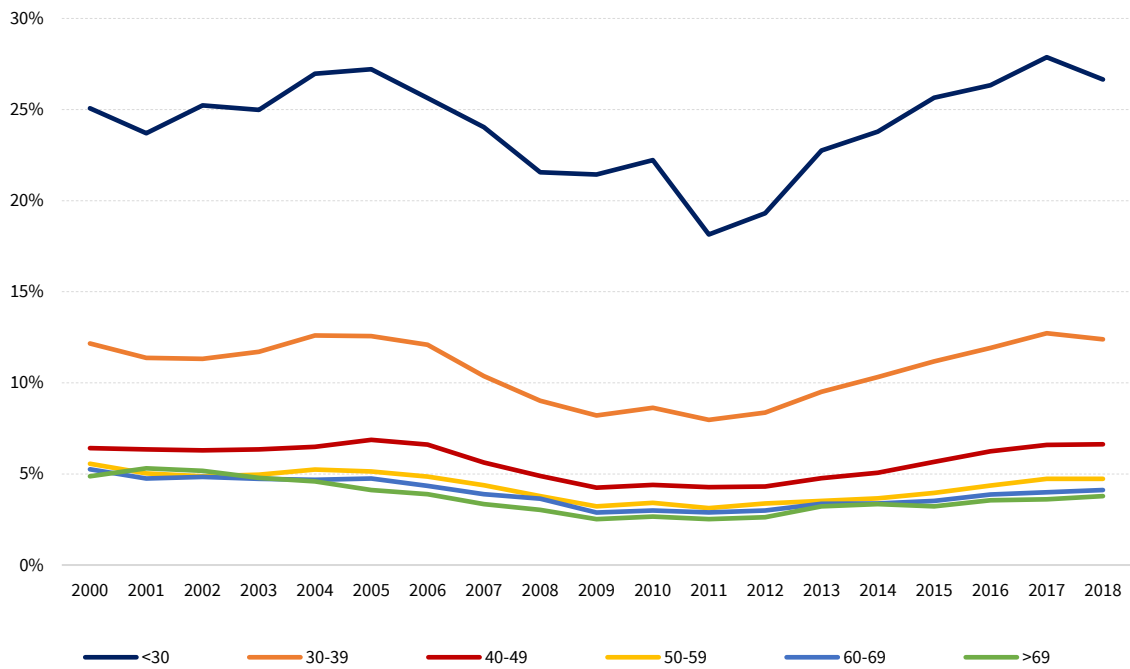
Source: ACS PUMS. Shows percentage of homeowners with mortgages who moved since the previous year.

Figure 4: Repeat and First Time Homebuyer Share of Owner-Occupied Purchase Loans
Across Price Tiers*

First Time Homebuyers

Repeat Buyers

Low Price Tier Share	Mid Price Tier Share	High Price Tier Share
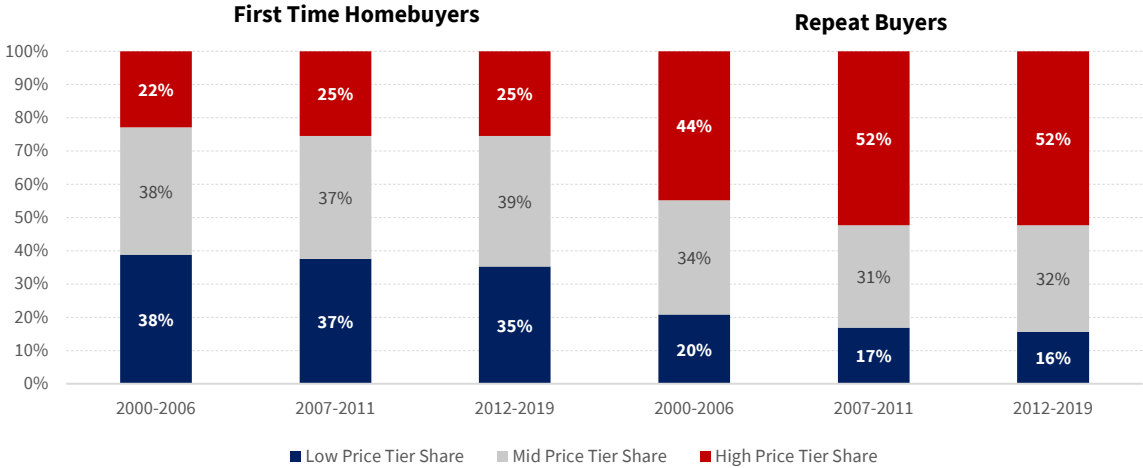
Owner occupied Fannie Mae purchase acquisitions. Price tiers are calculated at county level. Loans with lower than 620 credit score, higher than 97 loan to value and more than 50 percent debt to income ratio and products such as negatively amortizing loans, 40yr FRM, and interest-only loans are removed from pre-crisis acquisitions.

Figure 5: Existing Homeowner Mobility Approximation Methodology

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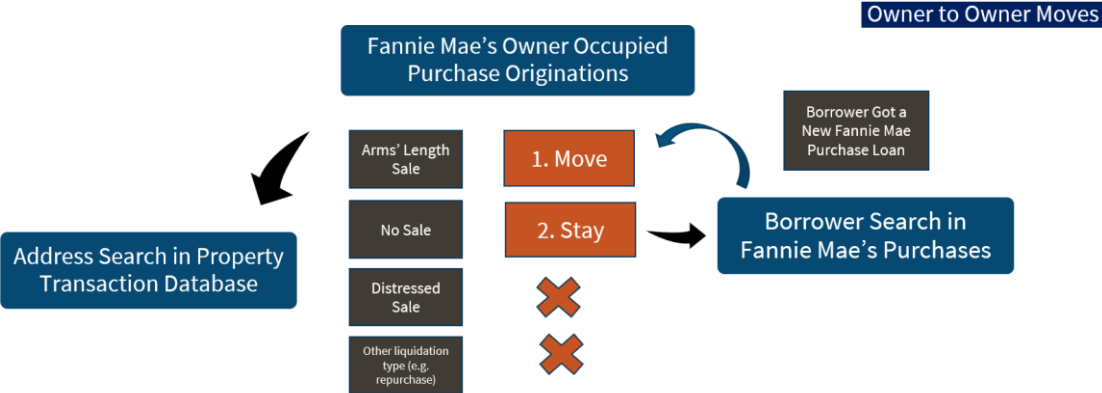
Figure 6: Five-Year Homeowner Mobility Rate (Sell Property within Five Years) versus Share of Residential Fixed Investments Dedicated to Improvements

Last cohort with 5 years of observations (Dec 2014)

— Fannie Mae's Homeowner Mobility Rate   — Improvements % of Residential Investment (excluding Multi-Family)
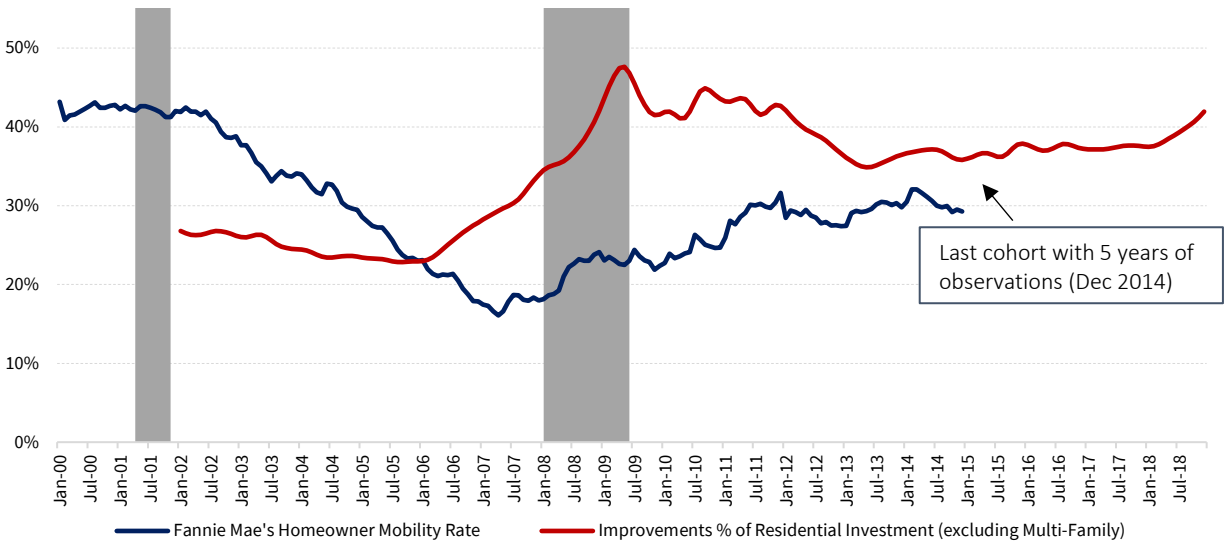
Source: Fannie Mae and U.S. Bureau of Economic Analysis (BEA) National Income and Product Accouts (NIPA)

Shared areas represent NBER recessions. Approximated mobility measure is collected from Fannie Mae property transactions database. Shows share of Fannie Mae owner occupied borrowers who sold their house in an arm's length transaction (i.e. not distressed sale) within five years of the original purchase. Improvement monthly series is derived from "Real private fixed investment in structures - Residential - Other structures - Improvements" and "Private fixed investment - Residential - Structures".

Figure 7: Five-Year Homeowner Mobility Rate (Sell Property within Five Years) by Age
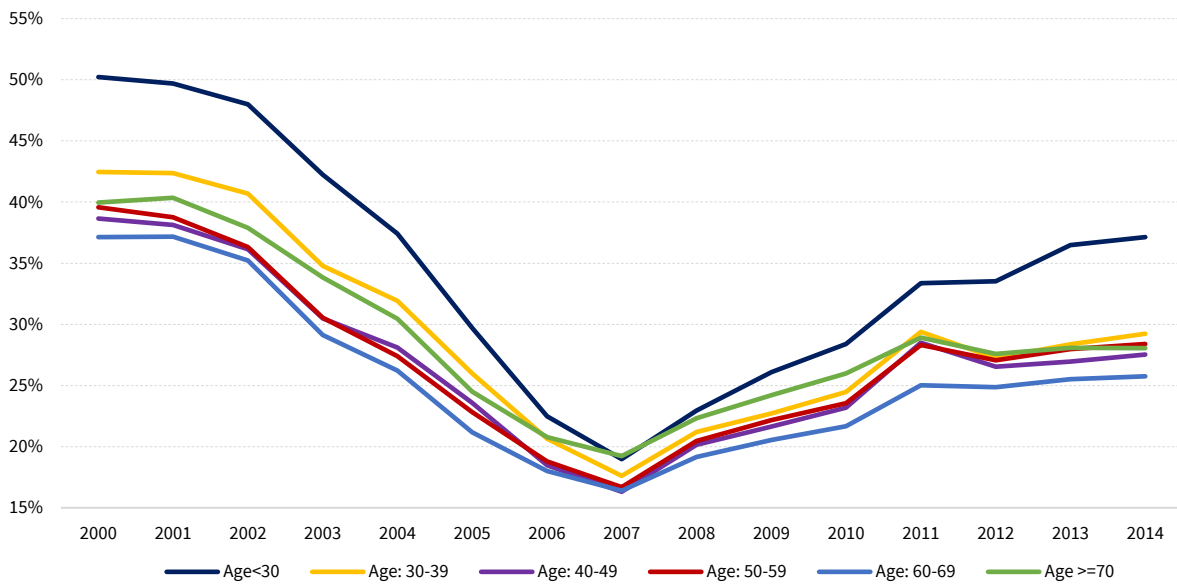
— Age<30   — Age: 30-39   — Age: 40-49   — Age: 50-59   — Age: 60-69   — Age >=70

Source: Fannie Mae

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Approximated mobility measure is collected from Fannie Mae property transactions database. Shows share of Fannie Mae owner occupied borrowers who sold their house in an arm's length transaction (i.e. not distressed sale) within five years of the original purchase. When there is both borrower and co-borrower on the loan, we assume the youngest age for the household.

Figure 8: Five-Year Owner Mobility Rate (Sell Property within Five Years) versus Home Price Index
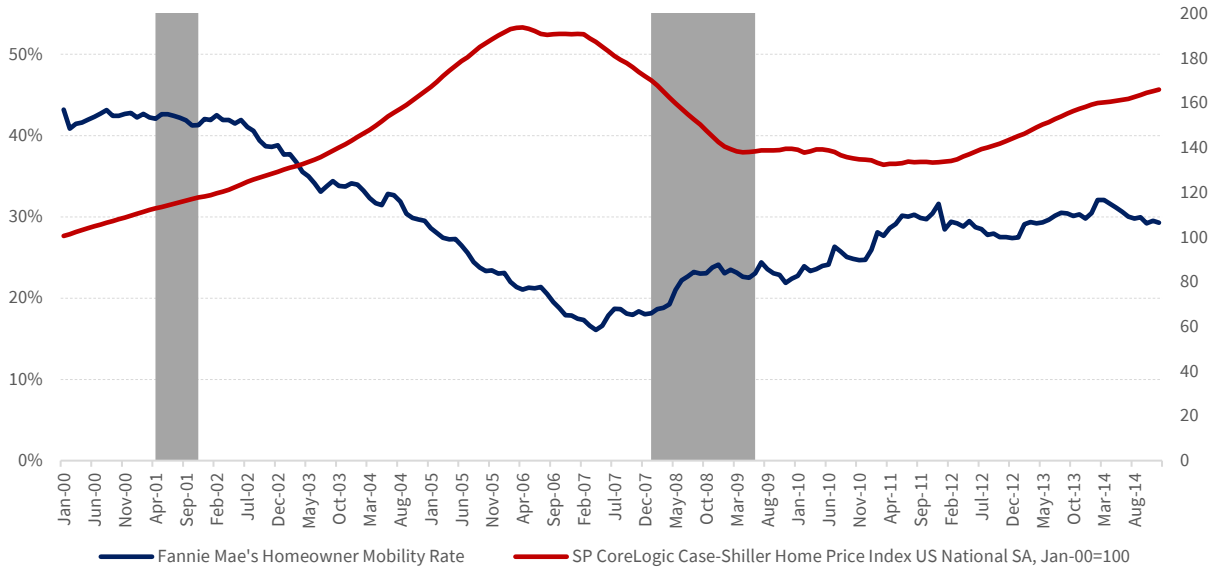
Source: Fannie Mae, CoreLogic

Shared areas represent NBER recessions. Approximated mobility measure is collected from Fannie Mae property transactions database. Shows share of Fannie Mae owner occupied borrowers who sold their house in an arm's length transaction (i.e. not distressed sale) within five years of the original purchase. Home price index is seasonally adjusted.

Figure 9: Incremental Odds of Move at Different Levels of MTMLTV
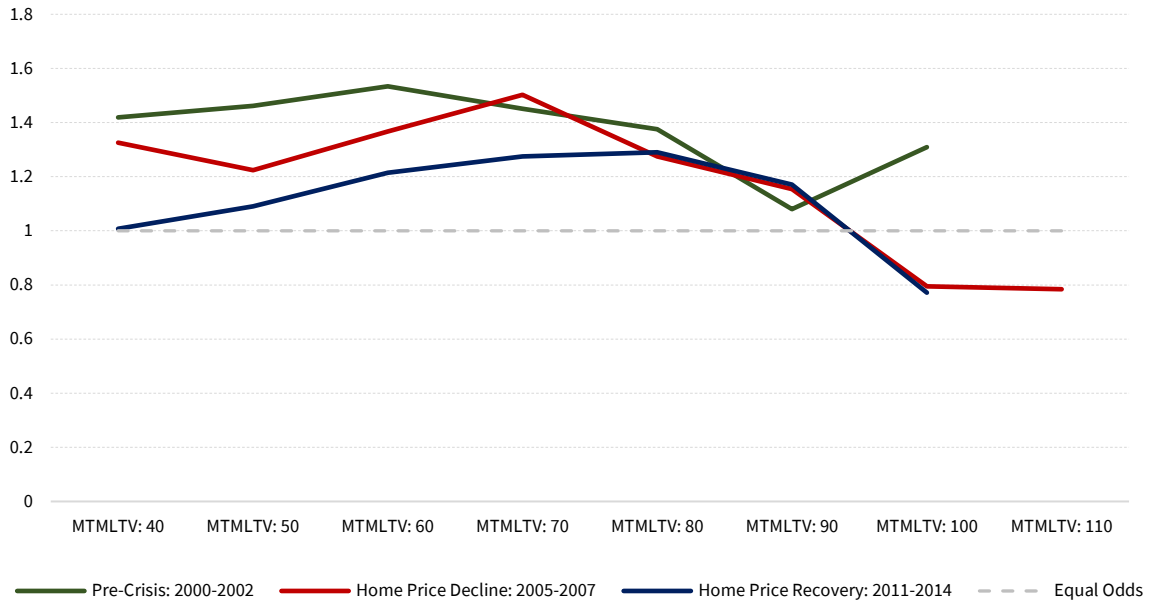
Figure represents incremental odds ratios for homeowners with MTMLTV from 40 to 110 everything else being constant. Effects of over 100 MTMLTV is not shown for Pre-Crisis and Home Price Recovery periods due to extremely small sample.

Figure 10: Incremental Odds Of Move by Age Cohorts
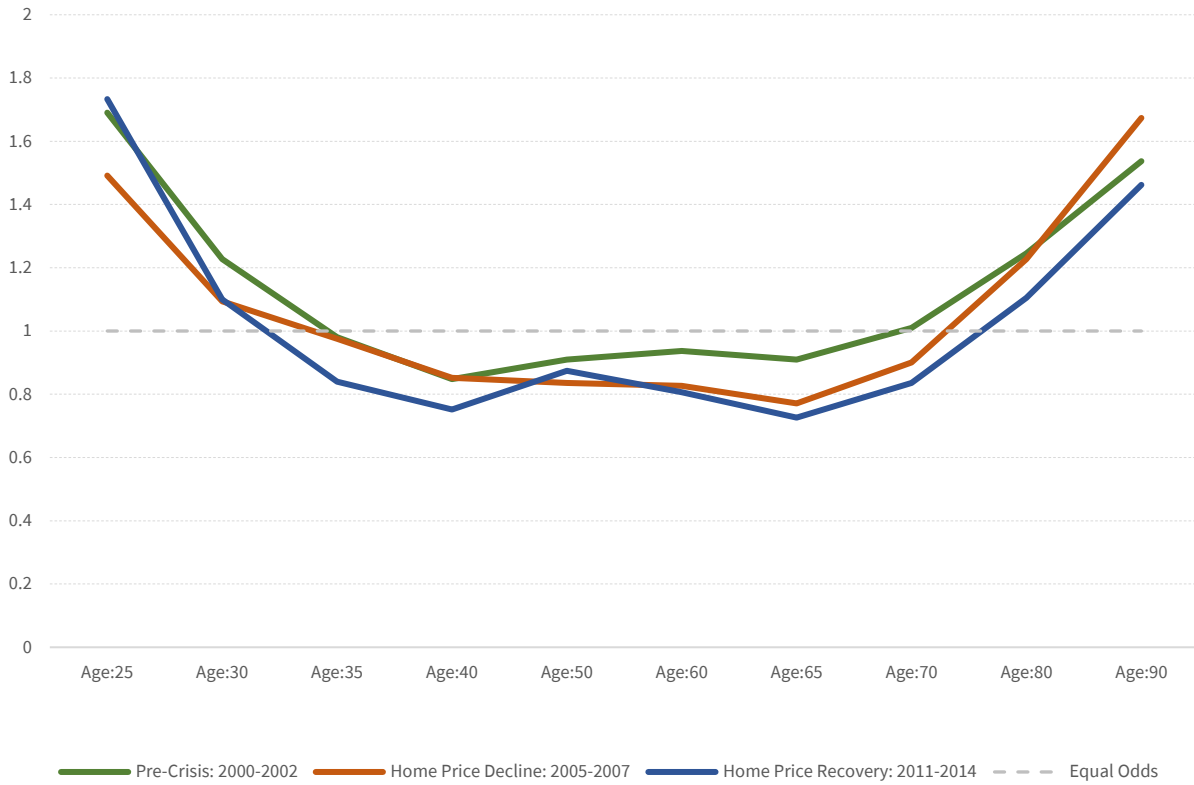
Figure represents incremental odds ratios for homeowners aged 25 to aged 90 everything else being constant.

Figure 11: Odds of Move Relative to DTI<36%
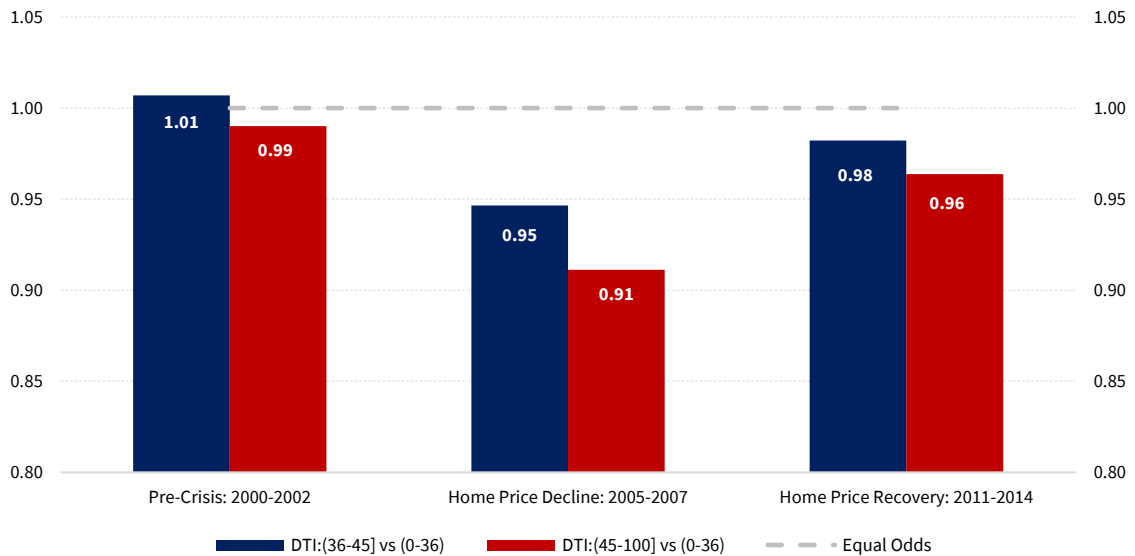
Figure 12: Odds of Move for Multiple Borrowers Relative to Single Borrowers
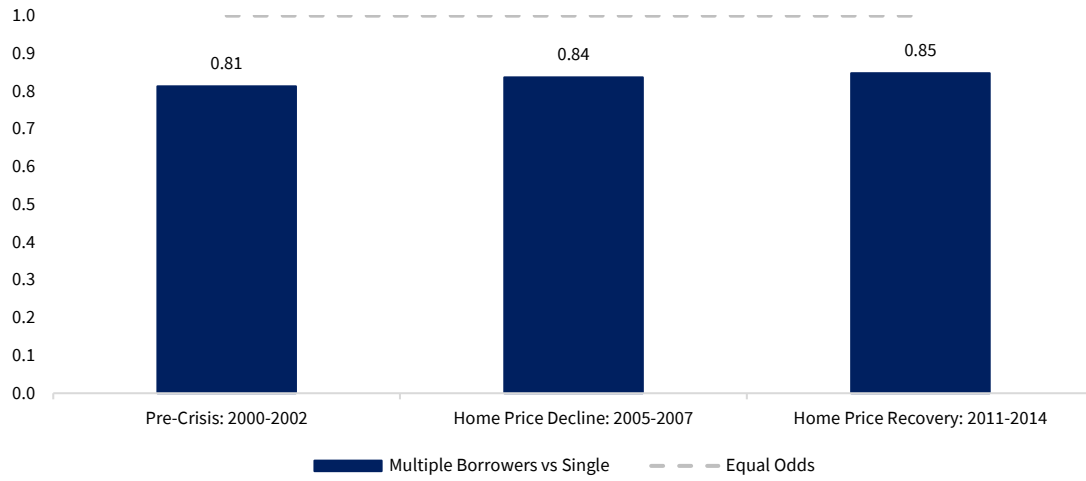
Figure 13: Predicted Mobility with 2000-2002 Profile

Fannie Mae's Homeowner Mobility Rate

Predicted Mobility with 2000-2002 Parameters
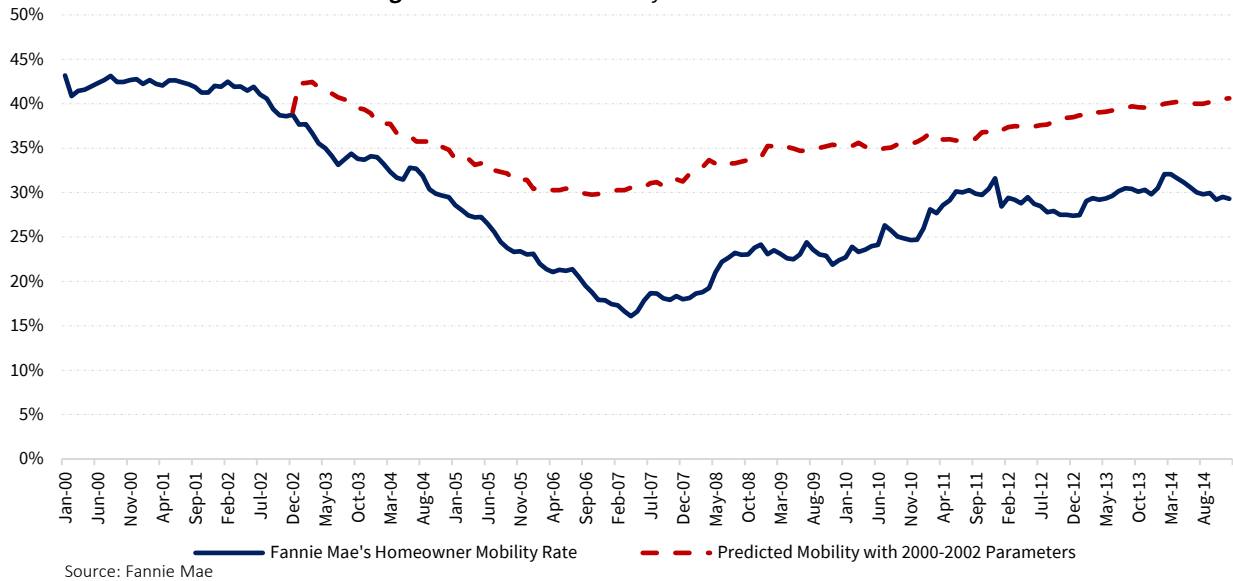
Source: Fannie Mae

Figure 14: Market Share of Single Family First-Lien Mortgage Debt Outstanding

Held-on-Book   Fannie Mae   Freddie Mac   Private Label Securities   Ginnie Mae
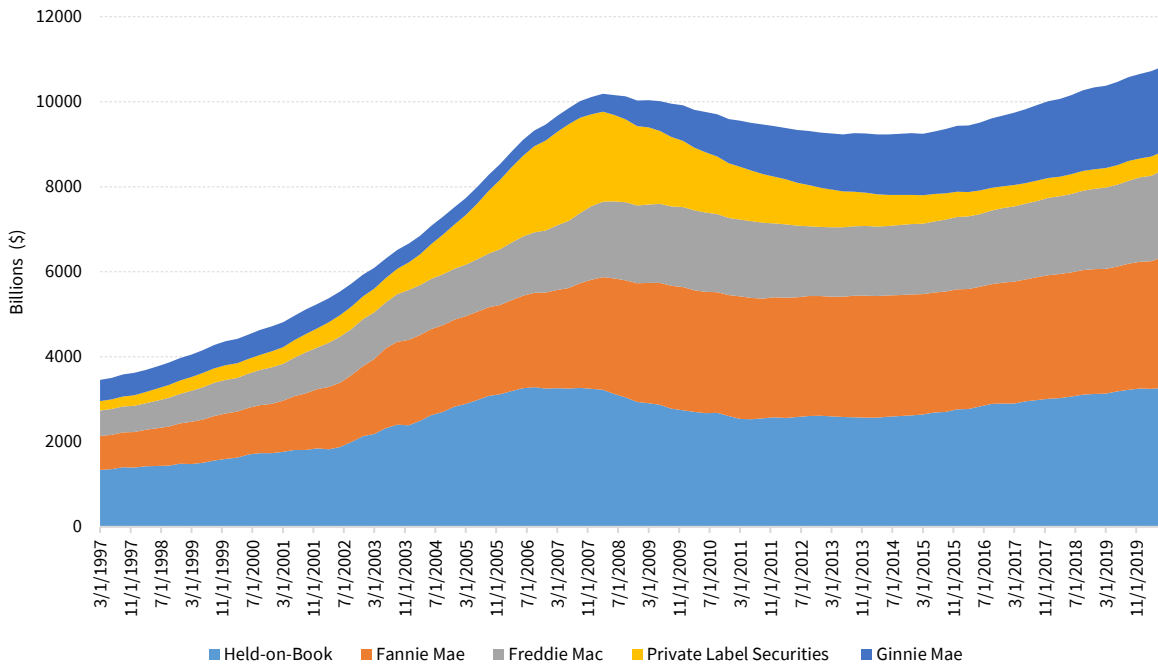
Source: Federal Reserve Board

Figure 15.a: Fannie Mae Versus AHS Five-Year Mobility Rates
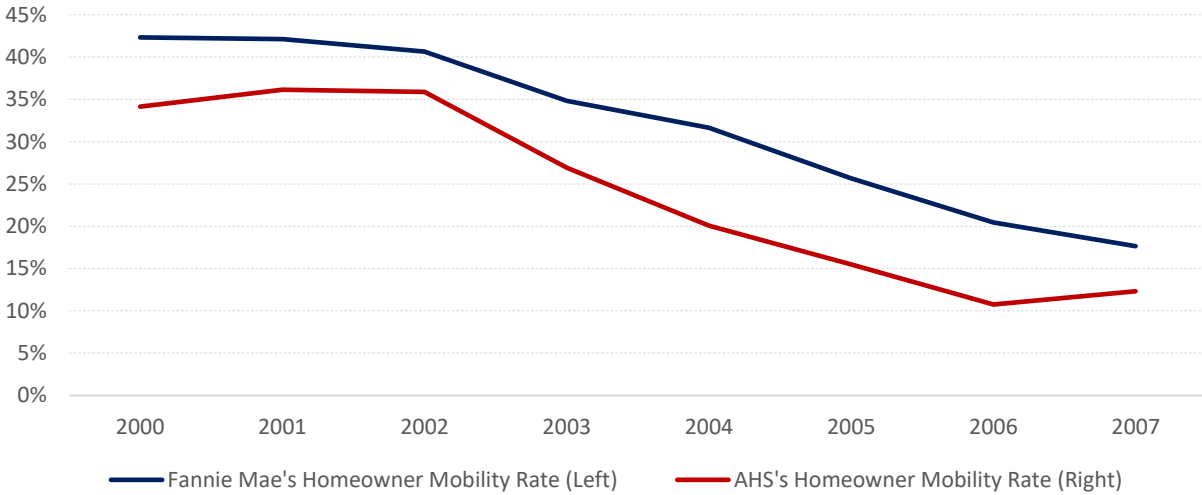
Note: Mobility measures move within five years of getting the property. We put AHS database by the year the household bought the unit and not by the survey year.

Figure 15.b: Fannie Mae Versus AHS Three-Year Mobility Rates
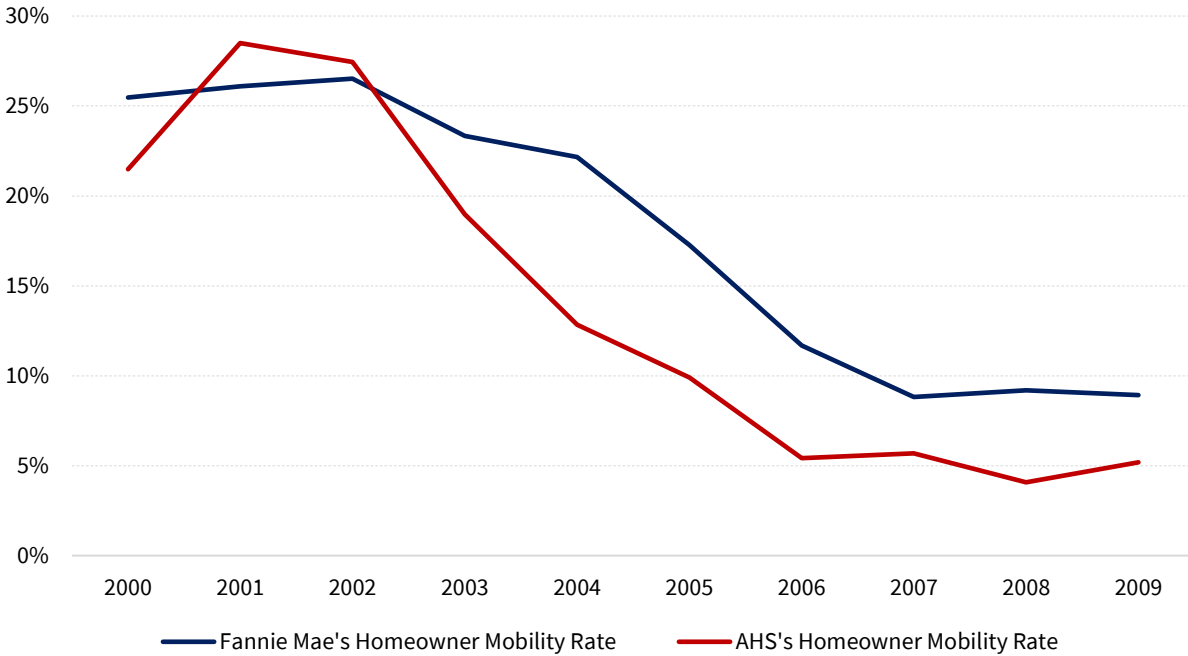
Note: Mobility measures move within three years of getting the property. We put AHS database by the year the household bought the unit and not by the survey year.

Figure 16.a. Average FICO Scores by Secondary Market Execution Channel
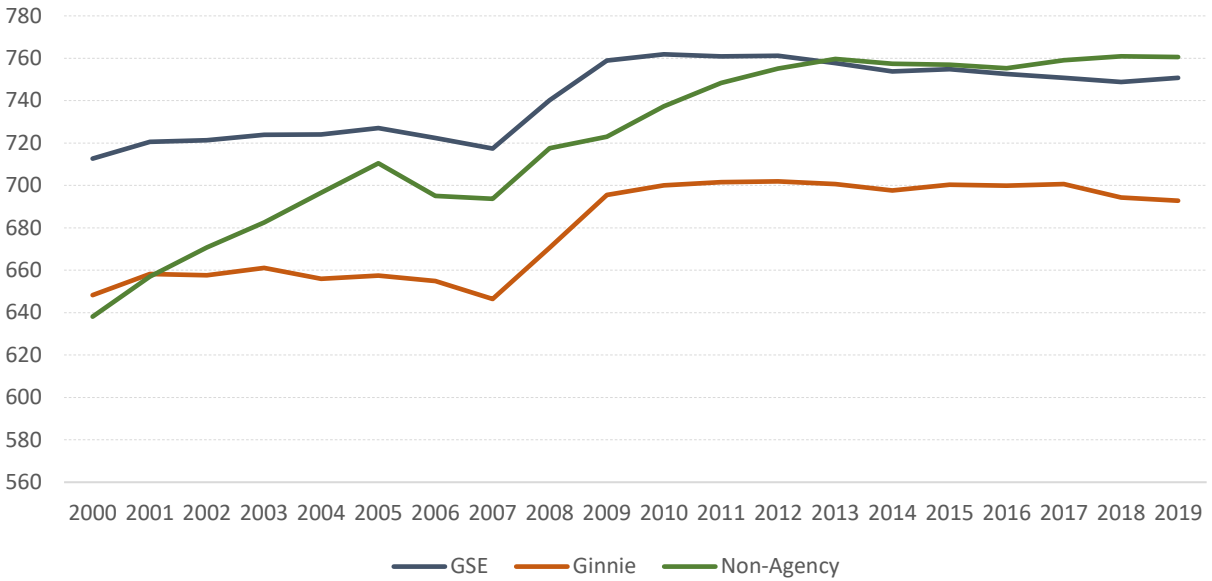
Source: Core Logic Loan Level Market Analytics Data Set. Purchase Owner-Occupied Loans.

Figure 16.b. Average Origination Loan-to-Value Ratios by Secondary Market Execution Channel
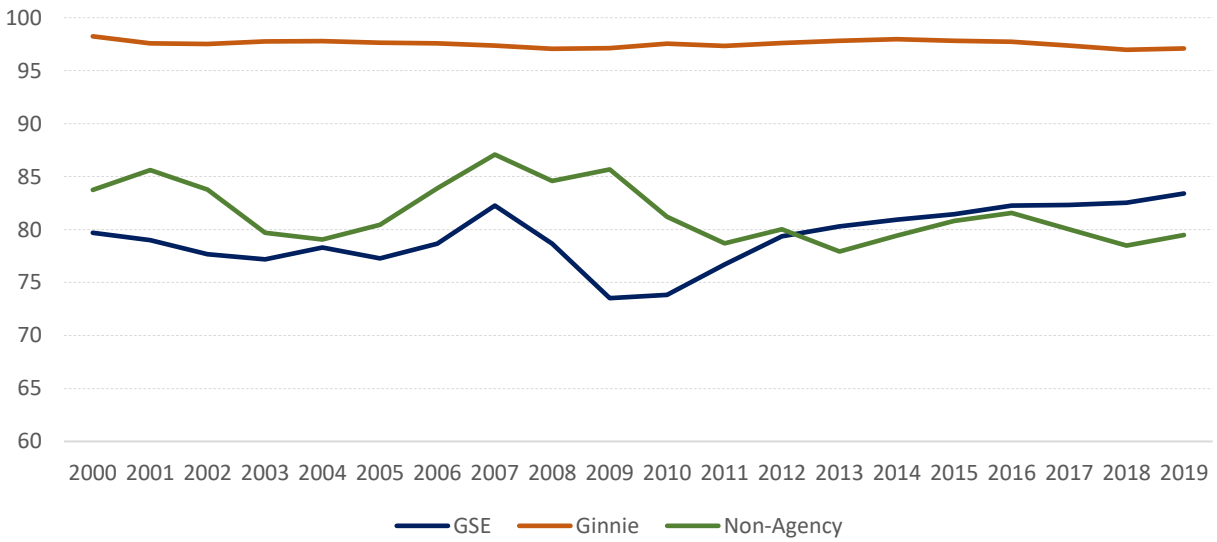
Source: Core Logic Loan Level Market Analytics Data Set. Purchase Owner-Occupied Loans.

Table 1: Summary Statistics

				Overall		Stay		Move
Observations				14,112,070		9,738,403		4,373,667
Share				100%		69%		31%
Origination Amount			$	183,635	$	184,335	$	182,077
Income			$	82,900	$	82,204	$	84,460
Origination Rate				5.88%		5.83%		5.99%
Debt to Income Ratio				36%		36%		36%
MTMLTV				66%		68%		63%
FICO				729		731		724
Age				39		40		38
Origination Amount relative to Conforming Limits				51%		50%		53%
Single Borrower (Not Marital Status) %				51%		51%		51%
First-Time Home Buyer %				34%		35%		30%
90 Day delinquent loans %*				4%		4%		1%
Ineligible Loan %**				27%		27%		27%
Subordinate Finance %				11%		11%		10%
Property Type								
		Condo		13%		13%		11%
		PUD		20%		19%		22%
		Single Family Attached Unit		2%		2%		2%
		Single Family Detached Unit		66%		66%		65%
Product Type								
		30 Year Fixed Rate		81%		81%		79%
		Other Type		19%		19%		21%
Third Party Originator Type								
		Retail		51%		51%		52%
		Broker		17%		17%		17%
		Correspondent		32%		33%		32%
Time Periods								
		Pre-Crisis: 2000-2002		27%		25%		36%
		Home Price Decline: 2005-2007		22%		24%		14%
		Home Price Recovery: 2011-2014		20%		19%		21%
		Rest: 2003-2004 & 2008-2010		31%		32%		29%
MTMTLV Buckets								
		MTMLTV: [0-0.4]		11%		10%		12%
		MTMLTV:(0.4-0.6]		29%		27%		33%
		MTMLTV:(0.6-0.8]		38%		38%		39%
		MTMLTV:(0.8-0.9]		10%		10%		8%
		MTMLTV:(0.9-1]		6%		6%		4%
		MTMLTV:(1+]		7%		8%		4%
Age Buckets								
		<30		21%		20%		25%
		30-39		30%		30%		30%
		40-49		19%		20%		18%
		50-59		12%		12%		11%
		60-69		5%		5%		4%
		>70		2%		2%		2%
		Missing		11%		11%		11%
DTI Buckets								
		0-36%		48%		48%		49%
		36-45%		28%		28%		28%
		45-50%		19%		19%		18%
		Missing		5%		5%		6%
Income Relative to Area Median Income								
		<50%		7%		7%		5%
		50% - 80%		19%		20%		18%
		80% - 100%		14%		14%		14%
		100% - 120%		13%		13%		13%
		>120%		44%		44%		47%
		Missing		3%		3%		3%

*90-Day delinquency status within 5 years after origination. **Ineligible definition includes loans lower than 620 credit score, higher than 97 original loan-to-value, more than 50 percent DTI ratio and non-traditional (no longer eligible for GSE underwriting) products such as negatively amortizing loans, 40-year terms, and interest-only loans.

Table 2: Five-Year Mobility rates (Weighted)

	Overall: 2000-2014	Pre-Crisis: 2000-2002	Home Price Decline: 2005-2007	Home Price Recovery: 2012-2014
Overall	31%	42%	21%	30%
MTMTLV Buckets				
MTMLTV: [0-0.4]	35%	43%	20%	26%
MTMLTV:(0.4-0.6]	35%	44%	23%	29%
MTMLTV:(0.6-0.8]	32%	39%	25%	31%
MTMLTV:(0.8-0.9]	27%	36%	23%	29%
MTMLTV:(0.9-1]	22%	37%	20%	13%
MTMLTV:(1+]	19%	41%	16%	9%
Age Buckets				
<30	36%	49%	23%	36%
30-39	31%	42%	21%	29%
40-49	28%	38%	19%	27%
50-59	28%	38%	19%	28%
60-69	26%	36%	18%	25%
>70	30%	39%	22%	28%
Missing	31%	40%	23%	30%
DTI Buckets				
0-36%	31%	40%	22%	29%
36-45%	31%	43%	21%	30%
45-50%	30%	43%	20%	28%
Missing	36%	41%	25%	37%
Number of Borrowers				
One	31%	42%	21%	30%
Two or More	31%	41%	22%	29%

Table 3: Distribution (Weighted)

	Overall: 2000-2014	Pre-Crisis: 2000-2002	Home Price Decline: 2005-2007	Home Price Recovery: 2012-2014
MTMTLV Buckets				
MTMLTV: [0-0.4]	11%	23%	4%	10%
MTMLTV:(0.4-0.6]	29%	39%	7%	46%
MTMLTV:(0.6-0.8]	38%	34%	28%	42%
MTMLTV:(0.8-0.9]	10%	3%	20%	2%
MTMLTV:(0.9-1]	6%	0.3%	17%	0.1%
MTMLTV:(1+]	7%	0.03%	26%	0.02%
Age Buckets				
<30	21%	20%	23%	21%
30-39	30%	32%	27%	31%
40-49	19%	20%	18%	19%
50-59	12%	11%	12%	14%
60-69	5%	4%	5%	7%
>70	2%	1%	1%	2%
Missing	11%	12%	13%	6%
DTI Buckets				
0-36%	48%	49%	40%	56%
36-45%	28%	23%	27%	39%
45-50%	19%	19%	28%	5%
Missing	5%	9%	6%	0%
Number of Borrowers				
One	51%	48%	53%	53%
Two or More	49%	52%	47%	47%

Table 4: Regression Estimates – Coefficients / Dependent Variable Five-year Mobility (Move within Five Years = 1)

	Pre-Crisis: 2000-2002	Home Price Decline: 2005-2007	Home Price Recovery: 2011-2014
Intercept	-1.434***	-3.15***	-1.075***
Multiple Borrower	-0.207***	-0.178***	-0.165***
First Time Home Buyer	-0.162***	-0.288***	-0.373***
Property Type			
Property: SF Attached vs SF Detached	0.263***	0.104***	0.268***
Property: Condo vs SF Detached	-0.48***	-0.58***	-0.577***
Property: PUD vs SF Detached	0.13***	0.029***	0.187***
Product Type			
Loan: ARM/Other vs 30FRM	0.142***	0.311***	0.164***
DTI Buckets			
DTI:(36-45] vs (0-36)	0.007***	-0.055***	-0.018***
DTI:(45-100] vs (0-36)	-0.01***	-0.093***	-0.037***
DTI: Miss vs (0-36)	-0.03***	0.137***	0.156
MTMLTV Splines			
MTMLTV:(0-0.4]	0.875***	0.705***	0.019
MTMLTV:(0.4-0.5]	0.298***	-0.801***	0.786***
MTMLTV:(0.5-0.6]	0.48***	1.108***	1.081***
MTMLTV:(0.6-0.7]	-0.554***	0.945***	0.487***
MTMLTV:(0.7-0.8]	-0.539***	-1.643***	0.118
MTMLTV:(0.8-0.9]	-2.414***	-0.995***	-0.975***
MTMLTV:(0.9-1.0]	1.925***	-3.738***	-4.167***
MTMLTV:(1.0+)	-2.57**	-0.128***	1.549*
Age Splines			
Age: 18-25	0.021***	0.016***	0.022***
Age: 26-30	-0.064***	-0.062***	-0.091***
Age: 31-35	-0.045***	-0.023***	-0.054***
Age: 36-40	-0.029***	-0.027***	-0.022***
Age: 41-50	0.007***	-0.002**	0.015***
Age: 51-60	0.003***	-0.001	-0.008***
Age: 61-65	-0.006***	-0.014***	-0.021***
Age: 66-98	0.021***	0.031***	0.028***
Origination Amount relative to Conforming Limit Splines			
Loan Amount to Conforming Limit: <25%	1.857***	2.98***	2.221***
Loan Amount to Conforming Limit: 25%- 50%	1.325***	0.802***	0.289***
Loan Amount to Conforming Limit: 50%- 100%	-0.166***	0.223***	-0.009
Loan Amount to Conforming Limit: >100%	-2.839***	-1.59***	0.081***
FICO Splines			
FICO: 300-680	0***	0*	-0.001***
FICO: 680-720	0***	0.001***	0.001***
FICO: 720-760	-0.002***	0**	-0.001***
FICO: 760-800	-0.007***	-0.004***	-0.004***
FICO: 800+	-0.008***	-0.009***	-0.005***
Third Party Origination Type			
TPO: Broker	0.012***	-0.08***	-0.087***
TPO: Correspondent	0.035***	-0.063***	-0.037***
3 Month DLQ in 5 Years vs Non-DLQ	-0.109***	-1.178***	-0.483***
Unemployment Change in 5 Years	-0.214***	0.089***	-0.107***
Subordinate Financing vs No Subordinate	0.063***	-0.026***	-0.023***
Ineligible Loan vs Eligible	0.072***	0.091***	-0.195***

Additional Controls: STATE

***, ** and * denote significance at 1%, 5% and 10%. The model is based on Fannie data from 2000-2014 matched with subsequent selling behavior from transaction data. The dependent variable is whether the owner occupant borrower sold the house (=1) or not (=0) in an arm's length transaction (i.e. not distressed sale) within five years of the original purchase.

Table 5: Regression Estimates – Odds Ratios / Dependent Variable Five-year Mobility (Move within Five Years = 1)

	Pre-Crisis: 2000-2002	Home Price Decline: 2005-2007	Home Price Recovery: 2011-2014
Intercept	0.24	0.04	0.34
Multiple Borrower	0.81	0.84	0.85
First Time Home Buyer	0.85	0.75	0.69
Property Type			
Property: SF Attached vs SF Detached	1.30	1.11	1.31
Property: Condo vs SF Detached	0.62	0.56	0.56
Property: PUD vs SF Detached	1.14	1.03	1.21
Product Type			
Loan: ARM/Other vs 30FRM	1.23	1.18	1.17
DTI Buckets			
DTI:(36-45] vs (0-36)	1.01	0.95	0.98
DTI:(45-100] vs (0-36)	0.99	0.91	0.96
DTI: Miss vs (0-36)	0.97	1.15	1.17
MTMLTV Splines			
MTMLTV:(0-0.4]	2.40	2.02	1.02
MTMLTV:(0.4-0.5]	1.35	0.45	2.19
MTMLTV:(0.5-0.6]	1.62	3.03	2.95
MTMLTV:(0.6-0.7]	0.57	2.57	1.63
MTMLTV:(0.7-0.8]	0.58	0.19	1.13
MTMLTV:(0.8-0.9]	0.09	0.37	0.38
MTMLTV:(0.9-1.0]	6.86	0.02	0.02
MTMLTV:(1.0+)	0.08	0.88	4.71
Age Splines			
Age: 18-25	1.02	1.02	1.02
Age: 26-30	0.94	0.94	0.91
Age: 31-35	0.96	0.98	0.95
Age: 36-40	0.97	0.97	0.98
Age: 41-50	1.01	1.00	1.02
Age: 51-60	1.00	1.00	0.99
Age: 61-65	0.99	0.99	0.98
Age: 66-98	1.02	1.03	1.03
Origination Amount relative to Conforming Limit Splines			
Loan Amount to Conforming Limit: <25%	6.40	19.69	9.22
Loan Amount to Conforming Limit: 25%- 50%	3.76	2.23	1.34
Loan Amount to Conforming Limit: 50%- 100%	0.85	1.25	0.99
Loan Amount to Conforming Limit: >100%	0.06	0.20	1.08
FICO Splines			
FICO: 300-680	1.00	1.00	1.00
FICO: 680-720	1.00	1.00	1.00
FICO: 720-760	1.00	1.00	1.00
FICO: 760-800	0.99	1.00	1.00
FICO: 800+	0.99	0.99	1.00
Third Party Origination Type			
TPO: Broker	1.01	0.92	0.92
TPO: Correspondent	1.04	0.94	0.96
3 Month DLQ in 5 Years vs Non-DLQ	0.90	0.31	0.62
Unemployment Change in 5 Years	0.81	1.09	0.90
Subordinate Financing vs No Subordinate	1.06	0.97	0.98
Ineligible Loan vs Eligible	1.07	1.10	0.82

Additional Controls: STATE

The model is based on Fannie data from 2000-2014 matched with subsequent selling behavior from transaction data. The dependent variable is whether the owner occupant borrower sold the house (=1) or not (=0) in an arm's length transaction (i.e. not distressed sale) within five years of the original purchase.

Appendix

A.1 Additional Figures and Tables

Figure A1: Percent Change in Odds Ratios relative to 80% MTMLTV

Pre-Crisis: 2000-2002   Home Price Recovery: 2011-2014
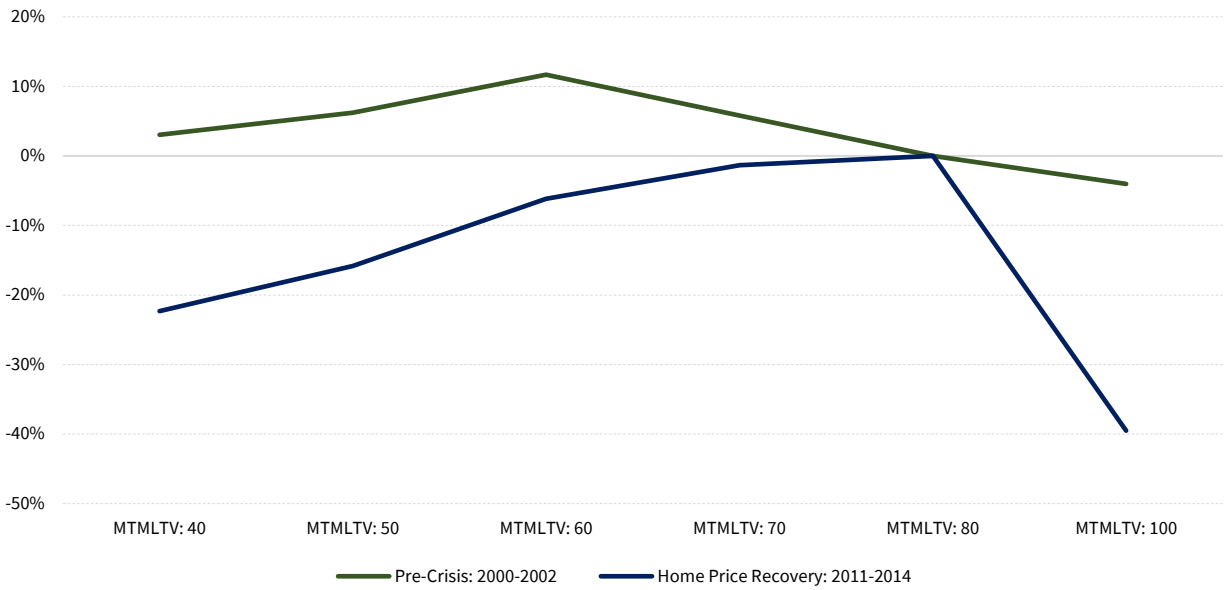
Figure A2: % Change in Odds Ratios relative to Age:25

Pre-Crisis: 2000-2002   Home Price Recovery: 2011-2014
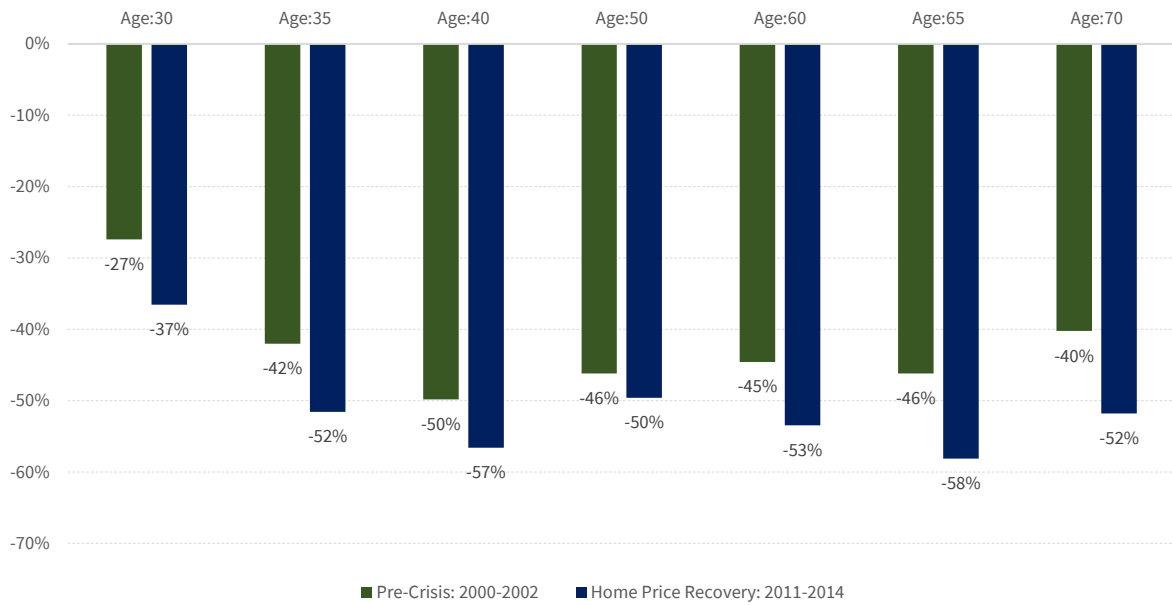
Figure A3: Mobility Series for Homeowners and Mortgaged Homeowners
American Housing Survey
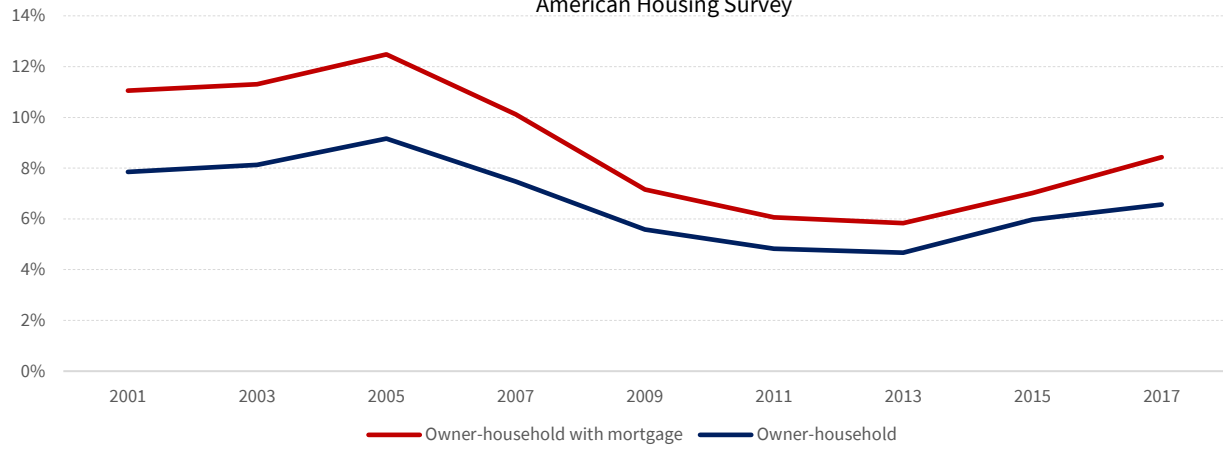
Owner-household with mortgage — Owner-household

Source: AHS. Shows percentage of homeowners with mortgages who moved since the previous year.

Figure A4: Mortgaged Homeowner Mobility by Age Cohorts (AHS)
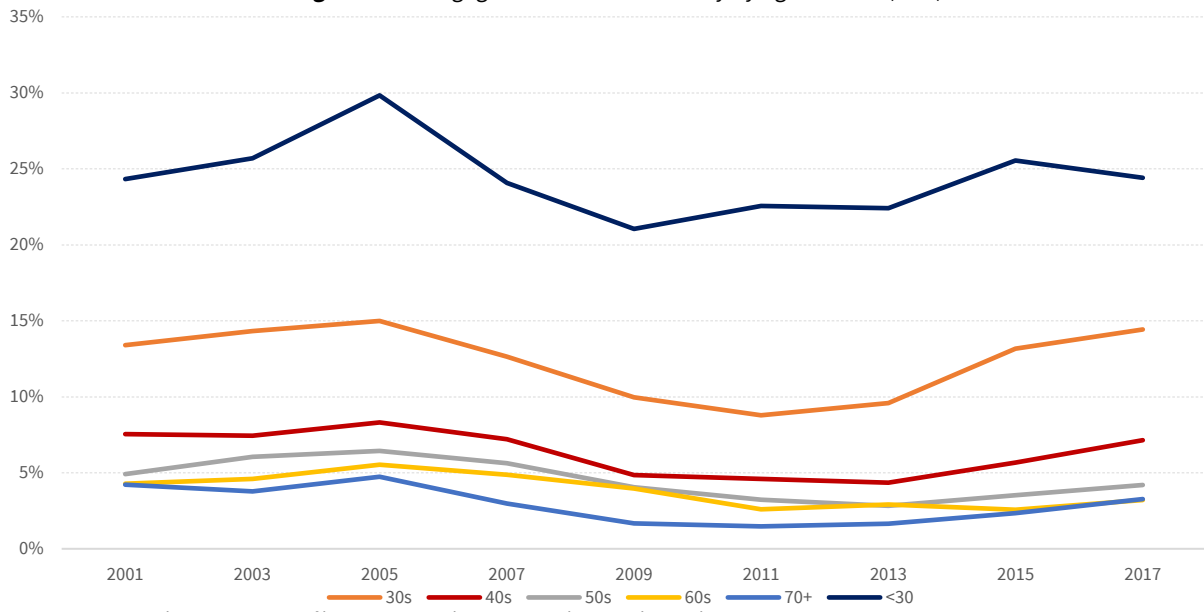
30s — 40s — 50s — 60s — 70+ — <30

Source: AHS. Shows percentage of homeowners with mortgages who moved since the previous year.

Table A1: Summary Statistics - Pre-Crisis Period: 2000-2002

		Overall	Stay	Move
Observations		3,816,858	2,227,226	1,589,633
Share		100%	58%	42%
Origination Amount		$ 143,989	$ 140,197	$ 149,302
Income		$ 72,017	$ 70,548	$ 74,061
Origination Rate		7.19%	7.18%	7.21%
Debt to Income Ratio		35.7%	35.4%	36.1%
MTMLTV		52%	53%	52%
FICO		708	709	706
Age		39	40	38
Origination Amount relative to Conforming Limits		51%	50%	54%
Single Borrower (Not Marital Status) %		48%	47%	49%
First-Time Home Buyer %		25%	25%	24%
90 Day delinquent loans %*		2%	3%	1%
Ineligible Loan %**		31%	30%	32%
Subordinate Finance %		6%	5%	6%
Property Type				
	Condo	12%	12%	12%
	PUD	12%	11%	14%
	Single Family Attached Unit	2%	2%	2%
	Single Family Detached Unit	74%	75%	72%
Product Type				
	30 Year Fixed Rate	79%	79%	79%
	Other Type	21%	21%	21%
Third Party Originator Type				
	Retail	53%	53%	51%
	Broker	21%	20%	21%
	Correspondent	27%	27%	27%
MTMTLV Buckets				
	MTMLTV: [0-0.4]	23%	22%	24%
	MTMLTV:(0.4-0.6]	39%	38%	42%
	MTMLTV:(0.6-0.8]	34%	35%	31%
	MTMLTV:(0.8-0.9]	3%	4%	3%
	MTMLTV:(0.9-1]	0.3%	0.3%	0.2%
	MTMLTV:(1+]	0.0%	0.0%	0.0%
Age Buckets				
	<30	20%	18%	24%
	30-39	32%	32%	31%
	40-49	20%	21%	18%
	50-59	11%	11%	10%
	60-69	4%	4%	3%
	>70	1%	1%	1%
	Missing	12%	12%	12%
DTI Buckets				
	0-36%	49%	50%	48%
	36-45%	23%	23%	24%
	45-50%	19%	19%	20%
	Missing	9%	9%	9%
Income Relative to Area Median Income				
	<50%	6%	7%	5%
	50% - 80%	19%	19%	18%
	80% - 100%	14%	14%	14%
	100% - 120%	13%	13%	14%
	>120%	41%	41%	43%
	Missing	6%	6%	6%

Sample is from Fannie Mae's owner-occupied purchase mortgage loans that originated between 2000 and 2014. "Move" shows the portion of the sample who sold their house in an arm's length transaction (i.e. not distressed sale) within five years of the original purchase. "Stay" shows those who did not. If a homeowner sold the house in more than 5 years, they would be included in the "Stay" population.

Table A2: Summary Statistics - Home Price Decline Period: 2005-2007

	Overall	Stay	Move
Observations	3,038,834	2,390,335	648,499
Share	100%	79%	21%

		Overall	Stay	Move
Origination Amount		$ 185,559	$ 184,118	$ 190,867
Income		$ 81,684	$ 80,125	$ 87,475
Origination Rate		6.27%	6.29%	6.19%
Debt to Income Ratio		38.7%	38.8%	38.2%
MTMLTV		89%	89%	85%
FICO		725	725	728
Age		39	39	38
Origination Amount relative to Conforming Limits		47%	46%	48%
Single Borrower (Not Marital Status) %		53%	53%	52%
First-Time Home Buyer %		38%	39%	33%
90 Day delinquent loans %*		7%	8%	2%
Ineligible Loan %**		45%	45%	43%
Subordinate Finance %		24%	24%	26%
Property Type				
	Condo	12%	12%	12%
	PUD	20%	20%	22%
	Single Family Attached Unit	2%	2%	2%
	Single Family Detached Unit	65%	66%	64%
Product Type				
	30 Year Fixed Rate	82%	83%	78%
	Other Type	18%	17%	22%
Third Party Originator Type				
	Retail	46%	46%	49%
	Broker	18%	18%	17%
	Correspondent	36%	36%	35%
MTMTLV Buckets				
	MTMLTV: [0-0.4]	4%	4%	3%
	MTMLTV:(0.4-0.6]	7%	7%	7%
	MTMLTV:(0.6-0.8]	28%	27%	33%
	MTMLTV:(0.8-0.9]	20%	19%	21%
	MTMLTV:(0.9-1]	17%	17%	16%
	MTMLTV:(1+]	26%	27%	20%
Age Buckets				
	<30	23%	22%	25%
	30-39	27%	27%	27%
	40-49	18%	19%	17%
	50-59	12%	12%	11%
	60-69	5%	5%	4%
	>70	1%	1%	1%
	Missing	13%	13%	14%
DTI Buckets				
	0-36%	40%	39%	41%
	36-45%	27%	27%	26%
	45-50%	28%	28%	26%
	Missing	6%	6%	7%
Income Relative to Area Median Income				
	<50%	6%	6%	5%
	50% - 80%	20%	20%	17%
	80% - 100%	14%	14%	13%
	100% - 120%	13%	13%	12%
	>120%	45%	44%	50%
	Missing	3%	3%	4%

Sample is from Fannie Mae's owner-occupied purchase mortgage loans that originated between 2000 and 2014. "Move" shows the portion of the sample who sold their house in an arm's length transaction (i.e. not distressed sale) within five years of the original purchase. "Stay" shows those who did not. If a homeowner sold the house in more than five years, they would be included in the "Stay" population.

Table A3: Summary Statistics - Home Price Recovery Period: 2011-2014

	Overall	Stay	Move
Observations	2,829,572	1,993,729	835,843
Share	100%	70%	30%

Origination Amount	$	225,509	$	224,838	$	227,107
Income	$	98,449	$	96,913	$	102,116
Origination Rate		4.13%		4.13%		4.13%
Debt to Income Ratio		33.2%		33.2%		33.2%
MTMLTV		57%		57%		58%
FICO		754		755		752
Age		40		41		39
Origination Amount relative to Conforming Limits		54%		54%		54%
Single Borrower (Not Marital Status) %		53%		52%		53%
First-Time Home Buyer %		42%		43%		39%
90 Day delinquent loans %*		1%		1%		1%
Ineligible Loan %**		0%		0%		0%
Subordinate Finance %		5%		5%		5%

Property Type

Condo	13%	14%	9%
PUD	31%	29%	36%
Single Family Attached Unit	1.5%	1.4%	2%
Single Family Detached Unit	55%	56%	53%

Product Type

30 Year Fixed Rate	86%	86%	85%
Other Type	14%	14%	15%

Third Party Originator Type

Retail	53%	53%	54%
Broker	9%	9%	8%
Correspondent	38%	38%	38%

MTMTLV Buckets

MTMLTV:[0-0.4]	10%	10%	9%
MTMLTV:(0.4-0.6]	46%	47%	46%
MTMLTV:(0.6-0.8]	42%	41%	44%
MTMLTV:(0.8-0.9]	2%	2%	2%
MTMLTV:(0.9-1]	0.1%	0.1%	0.0%
MTMLTV:(1+]	0.0%	0.0%	0.0%

Age Buckets

<30	21%	19%	26%
30-39	31%	32%	30%
40-49	19%	20%	18%
50-59	14%	14%	13%
60-69	7%	8%	6%
>70	2%	2%	2%
Missing	6%	6%	6%

DTI Buckets

0-36%	56%	57%	56%
36-45%	39%	38%	39%
45-50%	5%	5%	5%
Missing	0%	0%	0%

Income Relative to Area Median Income

<50%	6%	7%	5%
50% - 80%	18%	19%	16%
80% - 100%	13%	13%	12%
100% - 120%	12%	12%	12%
>120%	51%	50%	54%
Missing	0%	0%	0%

Sample is from Fannie Mae's owner-occupied purchase mortgage loans that originated between 2000 and 2014. "Move" shows the portion of the sample who sold their house in an arm's length transaction (i.e. not distressed sale) within five years of the original purchase. "Stay" shows those who did not. If a homeowner sold the house in more than 5 years, they would be included in the "Stay" population.

Table A4: Summary Statistics - Movers Across Time Periods (Fannie Owner-Occupied Purchases Moved within Five Years)

	Pre-Crisis: 2000-2002	Home Price Decline: 2005-2007	Home Price Recovery: 2012-2014
Observations	1,589,633	648,499	835,843

Share			42%		21%	30%
Origination Amount	$		149,302	$	190,867	$	227,107
		$		$	87,475	$	102,116
Income			74,061			
Origination Rate			7.21%		6.19%	4.13%
Debt to Income Ratio			36.1%		38.2%	33.2%
MTMLTV			52%		85%	58%
FICO			706		728	752
Age			38		38	39
Origination Amount relative to Conforming Limits			54%		48%	54%
Single Borrower (Not Marital Status) %			49%		52%	53%
First-Time Home Buyer %			24%		33%	39%
90 Day delinquent loans %*			1%		2%	1%
Ineligible Loan %**			32%		43%	0%
Subordinate Finance %			6%		26%	5%

Property Type

Condo	12%	12%	9%
PUD	14%	22%	36%
Single Family Attached Unit	2%	2%	2%
Single Family Detached Unit	72%	64%	53%

Product Type

30 Year Fixed Rate	79%	78%	85%
Other Type	21%	22%	15%

Third Party Originator Type

Retail	51%	49%	54%
Broker	21%	17%	8%
Correspondent	27%	35%	38%

MTMTLV Buckets

MTMLTV: [0-0.4]	24%	3%	9%
MTMLTV:(0.4-0.6]	42%	7%	46%
MTMLTV:(0.6-0.8]	31%	33%	44%
MTMLTV:(0.8-0.9]	3%	21%	2%
MTMLTV:(0.9-1]	0.2%	15.7%	0.0%
MTMLTV:(1+]	0.0%	19.5%	0.0%

Age Buckets

<30	24%	25%	26%
30-39	31%	27%	30%
40-49	18%	17%	18%
50-59	10%	11%	13%
60-69	3%	4%	6%
>70	1%	1%	2%
Missing	12%	14%	6%

DTI Buckets

0-36%	48%	41%	56%
36-45%	24%	26%	39%
45-50%	20%	26%	5%
Missing	9%	7%	0%

Income Relative to Area Median Income

<50%	5%	5%	5%
50% - 80%	18%	17%	16%
80% - 100%	14%	13%	12%
100% - 120%	14%	12%	12%
>120%	43%	50%	54%
Missing	6%	4%	0%

Table A5. MTMLTV After Five Years Versus Origination LTV, Loan Averages

Percentage-Point Difference: MTMLTV - LTV	Pre-Crisis: 2000-2002	Home Price Decline: 2005-2007	Home Price Recovery: 2011-2014
Zero to 10 pp	0.3%	27.2%	0.2%
10 to 20 pp	0.0%	14.2%	0.0%
>20 pp	0.0%	19.3%	0.0%
> Zero pp	**0.3%**	**60.7%**	**0.2%**
%Difference: (-10,0 pp]	7.1%	30.9%	4.5%
%Difference: (-20,-10 pp]	28.2%	7.8%	31.1%
%Difference: <=-20 pp	64.4%	0.5%	64.3%
<= Zero pp	**99.7%**	**39.3%**	**99.8%**

Table A5: Summary Statistics - Loan Amount Relative to National Conforming Limit Distribution across States

STATE	Pre-Crisis: 2000-2002				Home Price Decline: 2005-2007				Home Price Recovery: 2011-2014			
	[0%-25%]	(25%-50%]	(50%-100%]	(100%-150%]	[0%-25%]	(25%-50%]	(50%-100%]	(100%-150%]	[0%-25%]	(25%-50%]	(50%-100%]	(100%-150%]
CA	5%	6%	18%	34%	1%	2%	9%	21%	3%	7%	15%	56%
NY	5%	3%	6%	7%	4%	3%	6%	11%	4%	3%	4%	10%
VA	2%	2%	3%	5%	1%	2%	4%	6%	1%	2%	3%	8%
NJ	2%	3%	5%	4%	1%	2%	5%	7%	1%	2%	4%	7%
WA	2%	2%	3%	3%	1%	2%	5%	5%	2%	3%	4%	6%
MD	1%	2%	3%	3%	1%	1%	3%	6%	1%	1%	2%	5%
MA	1%	1%	3%	3%	0%	1%	4%	4%	1%	2%	4%	3%
DC	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	2%
CT	1%	1%	2%	1%	1%	1%	2%	2%	1%	1%	1%	1%
UT	0%	1%	1%	0%	1%	2%	1%	1%	1%	2%	2%	1%
HI	1%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%
CO	1%	2%	4%	3%	1%	2%	3%	2%	1%	3%	5%	0%
FL	13%	11%	6%	5%	4%	6%	6%	5%	8%	6%	5%	0%
NH	0%	1%	1%	0%	0%	0%	1%	0%	0%	0%	0%	0%
WY	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
ID	1%	1%	0%	0%	1%	1%	0%	0%	1%	1%	1%	0%
RI	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
AZ	2%	4%	3%	2%	1%	2%	3%	2%	3%	3%	3%	0%
MN	1%	2%	2%	1%	1%	2%	2%	1%	3%	3%	2%	0%
OR	1%	2%	2%	1%	1%	2%	2%	1%	1%	2%	2%	0%
PR	1%	1%	0%	1%	1%	1%	0%	1%	0%	0%	0%	0%
TN	2%	2%	1%	1%	3%	3%	2%	1%	2%	2%	2%	0%
AK	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
AL	2%	1%	1%	0%	3%	2%	1%	0%	1%	1%	1%	0%
AR	1%	1%	0%	0%	2%	1%	0%	0%	1%	1%	0%	0%
DE	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%
GA	2%	4%	4%	3%	3%	4%	3%	2%	3%	3%	3%	0%
GU	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
IA	2%	1%	0%	0%	3%	1%	0%	0%	3%	2%	1%	0%
IL	4%	4%	5%	4%	4%	4%	6%	4%	7%	5%	4%	0%
IN	3%	2%	1%	1%	5%	3%	1%	1%	3%	2%	1%	0%
KS	1%	1%	1%	0%	2%	1%	1%	0%	1%	1%	1%	0%
KY	1%	1%	1%	0%	2%	1%	1%	0%	1%	1%	1%	0%
LA	2%	2%	1%	0%	2%	2%	1%	0%	1%	1%	1%	0%
ME	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
MI	3%	4%	3%	2%	3%	3%	2%	1%	6%	4%	2%	0%
MO	3%	2%	1%	1%	4%	3%	1%	1%	3%	2%	1%	0%
MS	1%	1%	0%	0%	1%	1%	0%	0%	1%	1%	0%	0%
MT	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%
NC	2%	3%	2%	2%	4%	4%	3%	1%	2%	3%	3%	0%
ND	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
NE	1%	1%	0%	0%	2%	1%	0%	0%	1%	1%	0%	0%
NM	1%	1%	0%	0%	1%	1%	1%	0%	1%	1%	0%	0%
NV	1%	1%	2%	1%	0%	0%	1%	1%	1%	1%	1%	0%
OH	5%	4%	3%	2%	7%	5%	2%	2%	6%	4%	2%	0%
OK	2%	1%	0%	0%	3%	1%	0%	0%	2%	2%	1%	0%
PA	6%	4%	3%	2%	6%	4%	4%	2%	4%	4%	3%	0%
SC	1%	2%	1%	1%	2%	2%	1%	1%	2%	2%	1%	0%
SD	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	0%
TX	10%	8%	6%	5%	13%	12%	6%	3%	8%	11%	10%	0%
VI	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
VT	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
WI	2%	2%	1%	0%	2%	2%	1%	0%	5%	3%	1%	0%
WV	1%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%