

# Spatial Variation in Reverse Mortgages Usage: House Price Dynamics and Consumer Selection

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**Abstract** Reverse mortgages have been obtained by nearly one million senior households. In the future, the number of eligible households will grow substantially, about 80 % are homeowners, and many of them have substantial equity in their home. We study state-level variations in rate of originations of HUD's Home Equity Conversion Mortgage (HECM) product. Our focus is on the impact of house prices on the origination rate. We test the hypothesis that in states where real house prices are volatile and the current level is above the long term norm, seniors rationally anticipate future reductions in house prices and lock-in their housing equity gains by obtaining a reverse mortgage. We test alternative hypotheses, the first being that seniors living in states with high rates of house price appreciation increase their use of HECMs as a means to convert an illiquid wealth capital gain into a more liquid asset. A second alternative hypothesis is that the intertemporal changes in originations of HECMs were a result of changes in the supply of mortgage originators. Our empirical work supports the hypothesis that seniors used HECMs to insure against house price declines, but we find no evidence in support of the alternative hypotheses.

**Keywords** Reverse mortgages · Mortgage choice · Senior housing

**JEL Classification** R21 · R31 · J14 · G21

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## Introduction

Equity in a home can serve as a source of supplemental income, particularly in retirement. However, homeowners may not be willing to sell their homes to access the equity, and may be unwilling or unable to make additional mortgage payments typically required to extract equity from a home. Reverse mortgages provide a mechanism for senior households to withdraw equity from their home without monthly mortgage payments. The most prevalent form of reverse mortgage, comprising more than 95 % of the market since the mid-2000s, is the federally insured Home Equity Conversion Mortgage (HECM) available to borrower(s) at least 62 years of age with sufficient equity in their current home (Consumer Finance Protection Bureau 2012).

The number of households eligible to obtain a reverse mortgage is relatively large. Approximately 80 % of households age 62 or over own a home (Poterba et al. 2011) and equity in owner-occupied homes comprises the primary source of wealth for most seniors (Sinai and Souleles 2013; Consumer Finance Protection Bureau 2012). Survey of Consumer Finance (SCF) data from 2010 indicate that only 40.5 % of households headed by a person age 65–74 have mortgage debt and 24.2 % of households age 75 or older have mortgage debt (Bricker et al. 2012). Thus, a large proportion of senior homeowners have substantial equity in their homes. Further, nearly ten million households with heads age 65 or older had annual household incomes below \$25,000 in 2009 (U.S. Census Bureau, Table 692, 2012), suggesting that they may have a desire to convert home equity into a more liquid form. However, rather than sell their home to extract equity, survey research finds that 78 to 92 % of homeowners age 65 and older report that they would like to stay in their current residence “as long as possible” (Keenan 2010; Bayer and Harper 2000). Substantial equity, combined with financial need and a strong desire to stay in the home throughout the retirement years may thus create demand for a home equity extraction product.

While the overall rate that the senior population holds reverse mortgages is relatively low (less than two percent), the past decade has witnessed an increase in the demand for HECMs. For example, the number of HECMs originated per year increased from 6,640 in 2000 to a peak of 114,692 in 2009. A variety of factors have been proposed that may explain this increase, including changing demographics of the senior population and dynamics of the macroeconomy. In this paper, we focus on the role of house prices in explaining variations in the rate that seniors choose a reverse mortgage.

We argue that the link between house price variations and the take-up rate of reverse mortgages is more complex than previously assumed. Specifically, we test whether the take-up rate is related to an area’s house price level relative to its long-term norm and the volatility of house prices. Our primary hypothesis is that intertemporal changes in the take-up rate of HECMs is due to seniors rationally insuring their housing capital gains against future declines in house prices. This occurs because HECMs are structured as nonrecourse loans, with an amount that can be borrowed based on the initial value of the home and a growth rate on the unused loan balance that is tied to the interest rate on the loan, not changes in home values. Once the loan is originated, the senior may draw on the initially authorized loan amount at any time, subject to the requirements of living in and maintaining the property, paying property taxes, and having home insurance. Even if the price of the house declines below the loan balance, the borrower can continue to draw unused funds, and his or her heirs have no obligation

to repay any balance in excess of the home's value at the time of loan termination. We argue that the take-up rate should be relatively high in states where house prices have a history of high volatility and at a point in time when prices were substantially above their long term norm. In this case it would be rational to insure against a future decline in house prices; HECM reverse mortgages are a vehicle that effectively creates this insurance.

We also test two alternative hypotheses that might explain the observed relationship between house prices and HECM origination rates. First, increases in the supply of forward mortgage lending in a state might also be positively correlated with increases in house prices, and might result in an increase in HECM lending if information costs for obtaining a HECM are reduced due to a higher presence of mortgage originators in their locality.<sup>1</sup> An increase in HECM take-up rates may thus be due to a spillover of supply from the forward mortgage market that led to increased information about HECM loans, rather than as a rational response to house price dynamics. Second, increased home equity in localities with relatively high house prices may lead households to obtain reverse mortgages simply to increase their current consumption, regardless of anticipated changes to future house prices. If this hypothesis is true, there is no reason that HECMs should be different than other alternatives to extract equity from a home such as home equity loans. Thus, this hypothesis suggests we will observe the same spatial and intertemporal variations in seniors' originations of home equity loans in response to changing house prices as for HECMs.

To conduct our analysis, we combine HECM data from the U.S. Department of Housing and Urban Development (HUD), the 2000 Census, the 2005–2011 American Community Surveys (ACS), the Federal Housing Finance Agency (FHFA), and the Federal Reserve Bank of New York / Equifax Consumer Credit Panel. In addition to information on house prices, our analysis controls for a large set of descriptors of seniors' socio-economic characteristics, including credit characteristics that might be associated with mortgage demand.

We find an increase in HECM origination rates in states where house prices have a history of volatility and are currently high compared to their historical average. We do not find evidence that reverse mortgages were used primarily for equity extraction; however, our evidence suggests that seniors may have used home equity lines of credit to extract housing capital gains. Overall, our results suggest that the 2000–2011 changes in the national take-up rate of HECMs was largely driven by house price changes that occurred in states with a history of volatile house prices. We find little evidence that the take-up rate of HECMs was affected by either seniors' demographic or credit quality characteristics. Nor is there any evidence to suggest that supply side factors caused the increase in HECM originations.

This paper proceeds as follows. First, we provide background on HECMs, including program logistics and structural options. We then provide a review of related literature, followed by a description of our data and models. After presenting our results, we conclude with possible implications for future HECM demand.

<sup>1</sup> We refer to the standard mortgage as a forward mortgage, in contrast to reverse mortgages.

## Background

HECMs are reverse mortgages insured by the federal government and originated in the private market. The HECM program was authorized in 1988, continued as a small pilot for the next decade, and then grew to dominate the reverse mortgage market (Consumer Finance Protection Bureau 2012). The loans are insured by the Federal Housing Administration (FHA) through the mutual mortgage insurance (MMI) fund, which guarantees borrowers that they will have access to their loan funds in the future, allows borrowers to stay in the home even if the loan balance exceeds the value of the home, and guarantees lenders that their loan will be fully repaid when the home is sold regardless of the future value of the home. HECMs are nonrecourse loans. At the termination of the reverse mortgage, borrowers (or their heirs) are only responsible to pay the lesser of the current balance of the reverse mortgage or 95 % of the current appraised value of the home. A HECM loan is due if one of multiple circumstances occurs including the death of all listed borrower(s), the borrowers reside in some other residence for a 12 month period, failure to maintain the property, or failure to pay property taxes, homeowners insurance, or homeowner association fees.<sup>2</sup>

To be eligible for a HECM, a borrower must be at least 62 years of age and live in the home as their principal residence.<sup>3</sup> Eligible properties must be in relatively good condition and include single-family, 1-to 4- unit residences, and HUD approved condominiums.<sup>4</sup> If the borrower has an existing mortgage or lien on the property, the proceeds from the HECM must be sufficient to pay off that mortgage or the borrower must be willing to bring extra cash to the closing to pay off any loans, as the HECM can be the only lien on the home. The borrower retains title to the property throughout their residence and is responsible for property taxes, homeowners insurance, and other assessments on the property. Notably, during the period of the data in this study (through the end of 2012), HUD did not impose any additional underwriting criteria (e.g., related to credit score, debt or income); however, private lenders may choose to add their own financial eligibility criteria, although this occurs rarely. Private lenders do not currently price risk into the HECM mortgage product; interest rates and fees are not tied to the risk profile of the borrower or the loan.<sup>5</sup> Potential HECM borrowers must receive counseling from a HUD approved agency prior to the origination of the loan.

There are a variety of different options for accessing funds under the HECM program. HUD sets the parameters regarding the maximum loan amount, the loan type and the method of distribution. There have been significant changes in HUD policies over time. The amount of money that a borrower can receive

<sup>2</sup> There are a set of detailed requirements that a lender must follow in case the borrower fails to pay taxes, insurance, or association fees. Default is not immediate in these cases. Lenders usually have the option to pay overdue taxes and insurance, increasing the loan balance if it is less than the net principal limit.

<sup>3</sup> Thus, if a household consists of a couple aged 59 and 62, only the person age 62 can be listed on the reverse mortgage loan. At a later date the younger person (upon turning 62) can be added to the mortgage. However, through 2012, adding a younger person required refinancing the HECM, with the associated origination fees. If only one person of a couple is the borrower, then other household members do not have the right to remain in the home as long as they live; only the borrower(s) have that right.

<sup>4</sup> HUD may allow a poor quality unit to qualify if the borrower sets aside funds from the HECM to undertake required repairs on the dwelling.

<sup>5</sup> There is some variation in interest rates among lenders; however, it is not related to households' risk characteristics.

from a HECM (“principal limit”) is determined by a factor (“principal limit factor”) based on the borrower’s age, the expected average interest rate during the period of the loan, and the maximum claim amount (MCA), which is the lesser of the appraised property value or the HECM FHA loan-limit). Beginning in 2009, the HECM loan limit was raised to \$625,000, representing a substantial increase from the previous limit of \$417,000 (set in 2008), and \$200,160–\$363,790 initially.<sup>6</sup> The increase in the loan limit allowed borrowers with higher value homes to leverage more of their equity through the reverse mortgage, increasing the average HECM maximum claim amount over time. During the same period HUD made adjustments to the principal limit factor that reduced the proportion of the MCA that can be borrowed in order to offset some of the risk to the FHA HECM insurance fund.<sup>7</sup>

The proceeds from a HECM loan can be distributed to borrowers through a variety of different payment structures: a lump-sum at origination, a line of credit, “tenure” (a lifetime annuity), and “term” (an annuity for a specified number of years), or some combination of these options.<sup>8</sup> With a line of credit, the borrower accrues interest only on the amount borrowed and the unused balance in the line of credit earns interest at the same rate as charged by the lender plus 0.5 percentage points. When a borrower withdraws all of their money up-front, they pay interest and fees on the full amount for the lifetime of the loan. The selection of a payment structure (e.g. lump-sum versus credit line or monthly payments) can have significant implications for means-tested benefits, such as Medicaid and Supplemental Security Income (SSI). Money distributed to a borrower through a reverse mortgage can make the borrower ineligible for means-tested benefits when realized proceeds are not used in the month they are taken.<sup>9</sup>

Market conditions and HUD policy changes affect the costs of reverse mortgages to borrowers (e.g., the interest rate on the loan, origination and servicing fees, and mortgage insurance premiums), thereby affecting the relative costs of different loan types and payment structures. Interest rates and origination fees on HECM loans are set by the HECM lender and are affected by general market factors similar to those that affect forward mortgages’ interest rates and fees. Initially, borrowers only could obtain HECMs with an adjustable interest rate, but due to changes in the secondary market, fixed rate loans became widely available beginning in 2009. Because of lenders’ (and the

<sup>6</sup> The differences in the loan limit were spatial, depending on whether a locality was judged to be a high housing cost area.

<sup>7</sup> For example, prior to October 2009 a 62-year-old homeowner could borrow about 62 % of their home value, but this was reduced to 56 % in 2009 and then further reduced in October 2010.

<sup>8</sup> The lifetime annuity yields monthly payments for as long as the household remains in the property. It is based on assuming the youngest borrower lives to be age 100. Under the line of credit option, the principal limit changes over time as the borrower receives interest on unused balances.

<sup>9</sup> On the other hand, a HECM could be used by a Medicaid recipient to spend the equity in the home without risking the loss of the equity through an estate recovery program. While Medicaid rules vary by state, generally the principle residence is exempt from home Medicaid asset level tests while the individual is alive. However, all states have “estate recovery” programs that can tap funds from the probate estate of a person over 55 if their Medicaid benefits were paid by the state. This recovery will include the equity in the person’s home, thus in practice, the equity is not sheltered permanently. However, if a household obtained a reverse mortgage, then the net principal limit of the HECM is made available to the senior and Medicaid does not consider the distribution of funds from a reverse mortgage to be income (as long as they are spent in the same month they are received). Thus, a reverse mortgage distributed as a line of credit would allow the net principal limit to increase over time, be tapped as needed, and not affect the likelihood of receiving Medicaid funds. Assuming the line of credit is fully spent by the time of death of the last surviving borrower, the state will find there are no funds left to recover from the property. The impact of state recovery funds on senior homeownership rates, housing equity, and the use of trusts is studied by Greenhalgh-Stanley (2012).

secondary market's) difficulty in forecasting the cost of HECMs when the withdrawal pattern is not specified, all HECM fixed rate loans require proceeds to be withdrawn in a lump-sum at closing, contributing to a significant increase in the proportion of borrowers withdrawing all of their money up-front rather than taking a credit line structure.<sup>10</sup> Since 2000, the average HECM interest rate first fell, then rose, then declined.<sup>11</sup> During this period the HECM loan interest rate tracked that of conventional ARM loans up to 2011; thereafter the average HECM loan rate followed fixed rate loans.

In addition to accrued interest over the life of the loan, borrower costs at the time of origination (most often rolled into the loan) include lender origination fees, an upfront HUD mortgage insurance premium, and other closing costs.<sup>12</sup> Monthly fees that accrue over the lifetime of the HECM include a servicing fee and a monthly HUD mortgage insurance premium.<sup>13</sup> In response to complaints about the high closing costs associated with HECMs, HUD introduced the "HECM Saver" in October, 2010. Compared with the original form ("HECM Standard"), Saver loans had significantly lower upfront HUD mortgage insurance premiums (0.01 % compared with 2 % for Standard HECMs), but also have substantially lower principal limits (generally 10 % to 18 % lower), resulting in less money available under any of the payment structures. We present stylized examples of HECM loans in Appendix Table 3, varying the age of the youngest borrower, whether a Saver or Standard loan, and the method of withdrawal.

HECM borrower composition, payment structures, and withdrawal patterns have changed significantly over the past decade. Based on a review of publicly available HECM data from the U.S. Department of Housing and Urban Development (HUD) we find that the average borrower age has fallen from near 76 to less than 72 since 2000 and the percentage of borrowers taking out HECMs at the minimum age threshold has risen from three percent in 2000 to nine percent in 2011. The gender of the typical borrower also has changed over the last decade. Specifically, the percentage of female borrowers has fallen by 15 percentage points, while the percentage of couples and male borrowers has increased about equally. These changes are consistent with the decreasing age of the youngest borrower.

## Literature

Due in large part to lack of data, little previous research has studied a household's decision to obtain a reverse mortgage. Early studies estimated the potential demand for reverse mortgages, and potential benefits for increasing income and reducing

<sup>10</sup> As of April 1, 2013, HUD eliminated the fixed rate Standard loan because of the large proportion of borrowers withdrawing all of their equity up front. HUD retained the fixed rate Saver option for the remainder of 2013, which also requires a full draw at closing, but it has a lower principal limit.

<sup>11</sup> Adjustable rate HECM loans may be adjusted monthly or annually. Before October 2007, adjustable rate loans were tied to the one-year constant maturity treasury rate. Thereafter, they could be tied to the LIBOR, this being the dominant form of adjustable rate HECMs in 2013. The rate may change by no more than two percentage points per year or five over the life of the loan.

<sup>12</sup> HUD limits the amount of origination fees. For homes with an appraised value of \$125,000 or less, the maximal fee is \$2,500. It rises at 2 % up to a \$200,000 home value, then 1 % thereafter. The maximal fee for any home is \$6,000. Closing costs are similar to those for a forward mortgage. For the Standard HECM, the mortgage insurance premium is 2 % of the maximal loan amount at closing and a 50 basis point interest rate premium.

<sup>13</sup> At times, competitive pressures lead lenders to forego either servicing or origination fees.

household debt (Mayer and Simmons 1994; Venti and Wise 1991). There is substantially more literature about termination decisions related to reverse mortgages (Bishop and Shan 2008; Szymanoski et al. 2007), as historical HECM loan-level data is publicly available (HUD 2012). However, identifying the factors associated with HECM selection is a prerequisite to understanding longer term outcomes. Here, we limit our review to those descriptive and empirical studies that discuss HECM selection decisions.

A few descriptive studies examine the differences between seniors obtaining reverse mortgages and seniors in the general population (Case and Schnare 1994; DeNavas-Walt et al. 2006; Redfoot et al. 2007). They find that those seeking reverse mortgages tend to be older and are more likely to be female-headed households. They also tend to be better educated than the general population but have lower incomes—about 40 % lower than the median income for other seniors (DeNavas-Walt et al. 2006). At the same time, reverse mortgage borrowers tend to have more equity than non-borrowers. Case and Schnare (1994) study loan choice in a sample of HECM loans, finding that borrowers tended to be house rich (higher valued properties) but cash poor (low income) and single females.<sup>14</sup> In an AARP study of reverse mortgage borrowers (Redfoot et al. 2007), when asked about their potential uses for reverse mortgage funds, 78 % of seniors reported unexpected emergencies, 73 % noted improving their quality of life, 50 % indicated covering everyday expenses, 47 % indicated facilitating home repairs or maintenance, and 40 % indicated paying off an existing mortgage. About 25 % of respondents mentioned health or disability or paying off non-mortgage debt, property taxes, and insurance as a motive. Only 13 % reported purchasing investments, annuities, or long term care insurance as a motive. The primary rationale cited for not taking a reverse mortgage was the high costs associated with the product. A secondary rationale was the desire to retain the home debt free.

Shan (2011) uses HUD's loan-level HECM data from 1989–2007 and conducts multiple descriptive analyses. First, Shan regresses zip code level annual take-up rates of HECMs from 1995–2005 on time invariant zip code level demographic, income, and house value data from the 2000 Census, and on 2005 zip code level credit scores. This spatially detailed level of analysis resulted in a very low level of take-up values per observation, with 30 % of zip codes having no HECMs originated and the median number of originations being only two. Also, the explanatory variables are the values for the entire population of the zip code, not just for senior households. Thus, substantial measurement error may be introduced to the extent that seniors' characteristics differ from the general population in a locality.<sup>15</sup> Shan finds that take-up rates are higher in zip codes where there are higher percentages of Blacks, Hispanics, educational attainment, and house values. Take-up rates are higher the lower are median incomes or credit scores. Shan next used about one-third of U.S. counties to study the growth of originations from 1993 to 2007.<sup>16</sup> In the basic model, explanatory variables were limited three: the most recent one-year house price inflation rate and the changes in a

<sup>14</sup> Fratantoni (1999) develops a stochastic dynamic programming model of a borrower's choice between an annuity for the duration of stay in the home and a line of credit mortgage, which is assumed to be withdrawn as a lump-sum at the time of origination. His empirical work studies households' choice of loan type but data limitations prevented him from studying households' choice of whether to obtain a HECM. See also Davidoff and Welke (2004).

<sup>15</sup> While some localities are fairly homogeneous across household heads' ages in terms of socio-economics characteristics, other neighborhoods are characterized by seniors aging in place and either gentrification or deterioration, resulting in substantial differences in characteristics of seniors and nearby households.

<sup>16</sup> Most of the observations were from 2003–2007; a period with a strong growth in both house prices and HECM originations.

county's per capita income and unemployment rate. While the results depend on the specification, in all cases house price increases had a positive impact on the change in originations (county and year fixed effects were included). Causal linkages were not discussed.

Davidoff (2013) examines the general belief that senior homeowners do not select reverse mortgages because of their relatively high origination fees. In contrast, he argues that it is plausible that married households would benefit from a line of credit reverse mortgage if the household does not withdraw any of the loan at origination, but instead allows the credit line grow at a rate that is typically above the reverse mortgage's interest rate. However, he notes that borrowers may have a particularly high demand for expenditures prior to termination such as for medical costs or paying off high interest credit loans. The result for these households is that they use all of the line of credit early in the lifecycle of the loan. His theoretical calculations demonstrate that given the growth feature of the line of credit, the net present value of a HECM declines with borrower's age and thus his model predicts households near the minimum age limit may be more likely to select a HECM and use the line of credit option than would older households.

Nakajima and Telyukova (2013) develop a calibrated theoretical model that replicates observed rates of seniors' demand for reverse mortgages.<sup>17</sup> They argue that an important reason for obtaining a reverse mortgage is to tap home equity in a manner different from a typical forward mortgage. This suggests that households with high home equity but low levels of liquid assets would be more likely to select a reverse mortgage (similar to Case and Schnare's 1994 finding). Of particular relevance to our analysis, they assert that reverse mortgages provide a form of insurance against house price risk as they are nonrecourse loans, suggesting that households in areas with volatile house prices would be more likely to seek reverse mortgages. However, they note that house price shocks also increase the likelihood of moving, which reduces the probability of selecting a reverse mortgage. In their calibrated model, the net effect of increased price volatility was a reduced rate of selecting reverse mortgages. We note that house price volatility has systematically varied across regions and states (Liu, 2009) and thus if expectations about future volatility are related to past volatility, their prediction is testable. Aside from house price volatility, Nakajima and Telyukova also consider income, health, medical expenses, and bequest motives. They find that households with lower incomes, better health, higher medical expenses, and without bequest motives are theoretically more likely to select a reverse mortgage.<sup>18</sup>

## Data Sources and Sample Characteristics

To conduct our analysis of house price dynamics and reverse mortgage take-up rates, we combine data from HUD, the 2000 Census, the 2005–2011 American Community Surveys (ACS), the Federal Housing Finance Agency (FHFA), and the Federal Reserve Bank of New York / Equifax Consumer Credit Panel. State-level annual take-up rates for

<sup>17</sup> Their model "is estimated to match life-cycle profiles of net worth, housing and nonhousing assets, homeownership rate, and home equity debt." They include shocks to health and house prices.

<sup>18</sup> Their model does not include any discussion of the interaction of potential medical expenses, reverse mortgages, and Medicaid eligibility for low-income households.

HECMs among the eligible population are computed by combining aggregate HUD loan-level data with data from the 2000 Census and the 2005–2011 American Community Surveys. HUD reports the number of originations of HECMs by state and year. The take-up rate is computed as the ratio of the number of originations in a state divided by the number of eligible households. Our definition of an eligible household is that the head must be age 62 or older and not already have a HECM.<sup>19</sup> Given that this population is determined by age, selection is not an issue in this sample. In general, homeownership is a choice variable, which could introduce selection issues if we limited the sample to senior homeowners. However, given that about 80 % of the senior population owns their home, any sample selection is not likely to significantly bias the results. Overall, we find few differences in the estimation results if we limit our analysis to the owner sample.<sup>20</sup>

While our empirical estimation includes all states, Fig. 1 displays the time series of take-up rates in eight geographically diverse states, demonstrating variations in the take-up rates among the states and over time. Nationally, the average of states' take-up rates is 0.24 % annually. Over a 10 year period, the implication is that over two percent of the senior population will have held a reverse mortgage at some time.<sup>21</sup>

While the take-up rates for HECMs follow the same general trend across states (increasing then decreasing), the magnitude and timing of differences in trends strongly suggests varying state level dynamics. Distinct and large peaks occurred in California (2006) and Nevada (2007), indicative of the HECM take-up rates in many western states. There is a clear positive correlation with these states' one-year lagged house price changes. Florida also exhibits a large peak, which occurs in 2008, again a one-year lag from its peak in house prices. More modest peaks occurred in Virginia (2008), Texas (2009), New York (2009), and Illinois (2009). These peaks lagged the peak in the states' house prices by one to two years. There was very little HECM activity in Ohio, this being a characteristic of many Midwestern states where house prices varied relatively little over the period.

State-level measures of senior households' economic and demographic characteristics were computed from the 2000 Census and 2005–11 annual ACS PUMS data.<sup>22</sup> Variables describing house price inflation, volatility, and deviations from the historical mean house price were derived from state-level FHFA and Freddie Mac data.<sup>23</sup> Data on the credit characteristics of households with a head age 62 or greater were obtained from the Federal Reserve Bank of New York / Equifax Consumer Credit Panel. Table 1 displays the means and standard deviations for the variables used in the analysis.

The explanatory variables reflect the socio-economic characteristics of the senior population (age 62 and greater) of a state in a specific year. All variables in the analysis are time varying. Aggregation to a smaller geographic area such as MSAs would prohibit our use of time varying explanatory variables that reflect the socio-economic characteristics of the senior population.

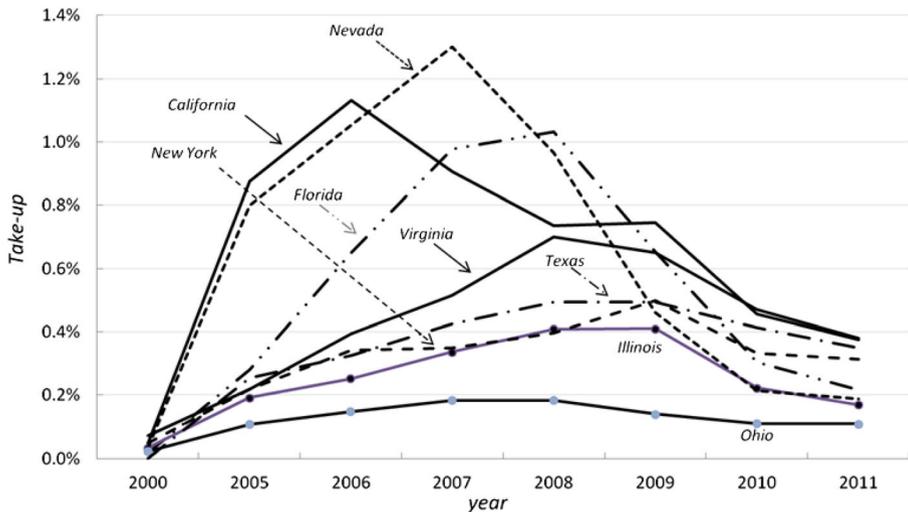
<sup>19</sup> We used the 1989–2010 history of state-level HECM loan originations and terminations to calculate the number of households without a HECM in each year.

<sup>20</sup> We are not aware of any studies that directly address selection issues in a sample of aggregated data. It is clear that the standard approaches cannot be applied to aggregate data.

<sup>21</sup> Our analysis is based on nearly one million originations of reverse mortgages. Reasons that the overall take-up rate is low likely include the lack of seniors' familiarity with and misinformation about reverse mortgages, the perception that origination fees are high, and the lack of home equity.

<sup>22</sup> ACS PUMS data are not available for 2001–2004.

<sup>23</sup> The FHFA series is for purchases only.



**Fig. 1** Examples of state level take-up rates. Source: Home equity conversion mortgage data (2012)

In general, the set of control variables is similar to those used when explaining variations in forward mortgage originations. State-level variables are either the mean value for the population of seniors or the percentage distribution of the variable in this population. The characteristics of the head of household include work status (full-time employed, not in labor force, unemployed, or part-time employed (omitted)); whether a U.S. citizen; whether Black, Hispanic, Asian, or another race; a spline in age; years of education; and marital status (single male, single female, or married (omitted)). Financial characteristics include the credit score, percent 30 days past due on credit cards, installment loans, or any mortgage, the percent bankrupt in the last 24 months, the percent with a tax lien on their house, and the percent with a first mortgage 120 days past due.

Household characteristics include total real income, the number of children present in the household, whether a recent mover (within the last 4 years), an indicator for receipt of Supplemental Social Security income, and a Census indicator for being in poverty. Other household characteristics include the average monthly mortgage payment (conditional on having a mortgage), the percentage of households with no mortgage payment and the percentage with a second mortgage, households' self-assessed value of the property, and the average ratio of annual property taxes to property value.<sup>24</sup> Property characteristics include the percentage of dwellings built before 1950 and built after 1990, and the percentage that are condominiums.

Characteristics of the resident state include the real GDP growth rate, a measure of house price volatility calculated based on the 9 years prior to the survey year and a measure of the deviation of the current real house price from the average

<sup>24</sup> The Census mortgage payment variable includes everything paid to the lender (principal and interest payments, real estate taxes, fire, hazard, and flood insurance payments, and mortgage insurance premiums).

**Table 1** Means and standard deviations of state-level variables

	Mean	Standard Deviation
Annual Take-up Rate HECM	0.0024	0.0020
Annual Take-up Rate HELOC	0.0306	0.0202
Characteristics of Household Heads		
Citizen	0.9876	0.0112
Disabled	0.4333	0.0512
Fully Employed	0.1556	0.0337
Not Employed	0.6136	0.0501
Unemployed	0.0111	0.0063
Hispanic	0.0349	0.0538
Black	0.0712	0.0716
Asian	0.0227	0.0762
Other Race	0.0303	0.0363
Age 62–65	0.2271	0.0260
Age 66–69	0.1836	0.0151
Age 70–73	0.1574	0.0110
Age 74–77	0.1374	0.0135
Age 78–81	0.1190	0.0127
Unmarried Male	0.1542	0.0169
Unmarried Female	0.3838	0.0281
Education (years)	12.584	0.5807
Credit Score	752.90	12.865
Percent Past Due—Credit Card	0.0053	0.0019
Percent Past Due—Installment Loan	0.0054	0.0025
Percent any Mortgage Past Due	0.0042	0.0024
Percent Bankrupt in Last 24 Months	0.0109	0.0041
Percent with a Tax Lien	0.0201	0.0095
Percent with First Mortgage 120 Days Past Due	0.0014	0.0017
Characteristics of Households		
Linguistically Isolated	0.0269	0.0278
Income (annual \$000)	46.466	7.9618
Recent Mover	0.2011	0.0421
SSI Indicator	0.0424	0.0147
Poverty Indicator	0.1096	0.0276
# of Children in Household	0.0648	0.0321
Monthly Mortgage Payment	0.7123	0.1738
No Mortgage	0.7279	0.0557
Second Mortgage	0.1896	0.0436
Characteristics of the Property		
Condominium	0.0631	0.0437
House Value (\$000)	179.93	82.459
Built Before 1950	0.2130	0.0959

**Table 1** (continued)

	Mean	Standard Deviation
Built 1950–1989	0.5920	0.0654
Built After 1989	0.1949	0.0818
Property Tax/Property Value	0.0092	0.0041
Characteristics of the State		
State GDP Growth Rate	0.0151	0.0308
House Price Volatility	13.512	9.6823
House Price Deviation from the Norm	0.3002	0.2613
Forward Originations (000)	32.008	15.788
Top 50 HECM Originators' Originations (000)	4.7001	2.3023

The sources of the data include the HUD HECM reports, 2000 Census, 2005–11 American Community Surveys, and the Federal Housing Finance Agency. The following variables were deflated using the national CPI: Income, Mortgage Payment, House Value, GDP Growth Rate, House Price Growth Rate, House Price Deviation, and the House Price Std. Dev. The Census states that “Linguistic isolation is a measure of English-speaking ability in a household. A linguistically isolated household is one in which no person age 14 or over speaks English at least ‘very well’.” The house price growth rate and price deviation are in the same units. The house price standard deviation reflects the variation of the FHFA price index, thus its units are not directly comparable. The means of house value, mortgage payment, and property taxes are for only homeowners

real house price for the 1980 to 1999 period.<sup>25</sup> During the study period, the average deviation was about 30 % above the long term norm.<sup>26</sup> Our focal test is of the impact of the interaction of house price volatility with the house price deviation variable. In Fig. 2 we map the average value of this variable across states. The highest values are in Northeastern and Western states (CA, MD, FL, RI), with the lowest values in the Midwest (MI, OH, IN, NE).

## Hypotheses and Estimation Model

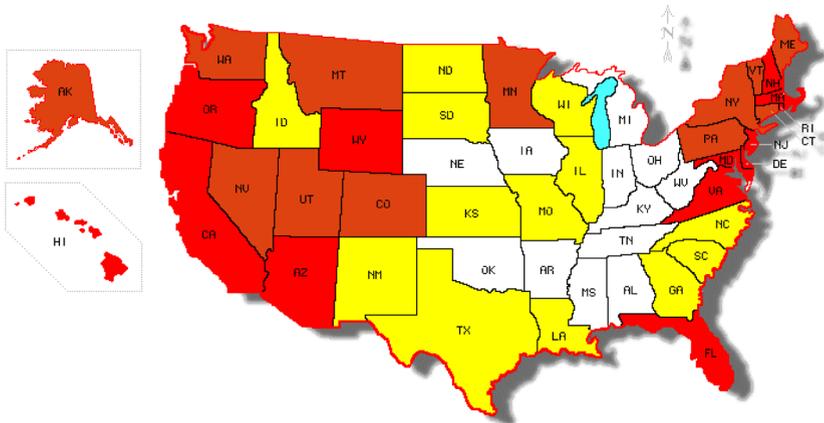
Whether a household obtains a reverse mortgage depends on both supply and demand factors. The focus of our analysis is on the demand side of the market. We assume there is a distribution of seniors' likelihood of selecting a HECM. Changes in a variable that affects the benefits or costs of a HECM will thus affect the set of households at the margin, resulting in a change in a marginal change in the take-up rate. We first discuss the demand side and then the supply side factors.

<sup>25</sup> The selection of a nine year period to measure house price volatility is ad hoc. The number of observations of house prices must be sufficiently long to compute a measure of volatility, but not so long that it exceeds a reasonable period of recollection of price movements. We assume there is continuous updating of the volatility measure over time.

<sup>26</sup> The measure of real house price deviation from the norm is computed in an ad hoc manner. We use the twenty year period prior to the 2000 survey to establish the expected house price level. As noted by Shiller (2013), at the national level real house prices were nearly identical in 1980 and 1999. We assume this twenty year period established the expected house price level (norm) for seniors. Given the strong house price boom after 1999, the average deviation from the norm in our sample is positive, generally growing through 2006, then declining.

House Price Deviation  $\times$  Volatility

- - 1st Quartile
- - 2nd Quartile
- - 3rd Quartile



**Fig. 2** The spatial variation of the value of the interaction of house price volatility and the deviation from the long-term value of house prices (drawn with the use of: [http://diymaps.net/us\\_12.htm#bestuse](http://diymaps.net/us_12.htm#bestuse))

Demand Side

Reverse mortgages have two important characteristics relevant for seniors' decisions. First, they are a means to extract equity from a home.<sup>27</sup> Alternative methods to quickly extract equity while remaining in the home include first and second mortgages, home equity loans and lines of credit. Second, HECMs are a means to insure the owner against the risk of future decreases in house prices. The amount of home equity available over the life of the loan (the principal limit) is based on the value of the home at the time of origination plus a growth rate applied to the unused balance where the growth rate is slightly greater than the mortgage interest rate. Even if house prices decline, the amount of equity available is based on the initial home value and the growth rate, where neither is tied to the rate of change in home values. And, unlike most home equity loans or lines of credit, HECMs are nonrecourse loans. Even if house value falls to be lower than the initial principal limit, the owner can continue to draw funds and the owner and his or her heirs will not be held liable for more than the then current value of the home at the time of termination. Note that it does not matter whether the owner withdraws the funds at the time of origination or later, the right to withdraw the initial principal limit remains unchanged. While there are equity extraction alternatives, there is no comparable means to insure against house price decreases. Thus, our primary hypothesis is that the take-up rates of HECMs will increase when there is a perceived need to insure home equity against house price risk.

<sup>27</sup> The literature testing the relationship between home equity gains due to house price inflation and current consumption is large and generally finds a positive relationship with about 25 % of increased equity converted to current consumption (Mian and Sufi 2011). We do not have a direct measure of home equity as the Census does not report measures of wealth or mortgage debt. Instead, we include senior owners' estimates of their dwelling's value and three cost of housing measures: (1) the percentage of senior owners with no mortgage, (2) the ratio of property taxes to house value, and (3) the real monthly mortgage payment.

Both equity extraction and insurance motivations suggest that senior homeowners will be more likely to seek a reverse mortgage when their house price is relatively high compared to their state's historical average. We measure the price deviation as the difference between the current deflated constant quality price and their state's 1980–1999 average real house price. However, we isolate the insurance motivation by including an interaction between house price volatility and the deviation of house prices from the long term norm. Seniors living in states with a history of volatile real house prices should anticipate that any price deviation is temporary.<sup>28</sup> Thus, if the current deviation of house prices from the long term norm is positive and the state's house price volatility measure is large, the likelihood of using a reverse mortgage to lock-in the gains in home equity should be greater.<sup>29</sup> Thus, the insurance hypothesis predicts that the coefficient of the interaction of the price deviation variable with the volatility measure will be positive, while the equity extraction hypothesis suggests that seniors in all states with currently high price deviations will be more likely to obtain HECMs.<sup>30</sup>

Our second method to distinguish between these two motivations is to consider seniors' use of home equity loans. The equity extraction hypothesis suggests that other mechanisms for converting home equity into a more liquid form of assets will also be employed by seniors, such as the use of home equity loans and lines of credit (HELOC). Thus, the use of HELOCs by seniors should increase relatively more in states with high values of the deviation of house prices from the norm. We would therefore expect a positive coefficient on the price deviation variable in a regression where the dependent variable is the number of HELOC originations per senior household. Whether an interaction variable between house price deviation and the volatility of house prices is significant depends on whether households also view HELOCs as providing some insurance against house price risk, even though they are often recourse loans and they do not guarantee a set amount of credit.<sup>31</sup> If households view HELOCs as insurance against house price risk, then the argument is similar to that for HECM originations and the interaction variable would be positive in a regression explaining

<sup>28</sup> Previous research suggests that homeowner expectations regarding future house prices are largely dependent on previous experience (e.g. Case et al. 2012). Malmendier and Nagel (2012) study the formation of inflation expectations and find that “The experience of younger individuals is dominated by recent observations, while older individuals draw on a more extended historical data set in forming their expectations.”

<sup>29</sup> Note that if house prices rise, the owner (or heirs) fully benefits from the capital gain at the termination of the reverse mortgage.

<sup>30</sup> If not the homeowner, lenders or financial planners could make the argument that a HECM provides insurance against future house price declines. A financial planning website for a reverse mortgage lender provides an example: “At age 62, Tom purchased a conversion mortgage as a way to protect his home's value against possible market decline. Tom utilized the Income Optionality strategy, and since his line-of-credit was set at loan initiation and did not fluctuate with his home's value, he was able to protect the equity in his home, even during the down years between 2007 and 2012.” (Available from <https://www.nu62.com/>, accessed December 12, 2013). Other market participants may be influential on seniors' take-up decisions. For example, anticipation of future house price declines and the push to lock-in equity through a reverse mortgage could originate with local mortgage brokers who have a significant financial interest in the transaction. Not only does high home equity make the feasibility of a reverse mortgage deal more likely, it also results in a higher net principal limit thus increasing the potential loan amount and brokerage fee.

<sup>31</sup> Following the downturn in house prices, the difference between HELOCs and HECMs became more apparent as major U.S. banks froze, restricted, and reduced lines of credit, this not feasible with HECMs.

HELOC originations by seniors. If not, then we expect the interaction to not be significantly different from zero.

### Supply Side

Unlike standard forward mortgages, the supply of reverse mortgages is not affected by lenders' credit standards as HUD did not impose credit requirements and lenders did not reject applicants because of a poor credit history in our sample period. However, the supply side of the market is relevant in that HUD has introduced new HECM options and modified existing options over the study period. We do not directly model these changes; instead, we include year-fixed effects in regressions to control for policy changes. We also include state level fixed effects to capture regulatory variations between states that may affect the supply of HECM mortgages. Also relevant are origination fees, but they are only recorded if they are not rolled in to the mortgage and thus we do not have an accurate measure.

Another supply side factor is the cost of obtaining information about a HECM. HECMs are advertised through various media, and the amount of advertising may vary by state and year; however, no measure of advertising expenditures is available. Arguably, the cost of obtaining information about a HECM depends, in part, on the spatial distance to a reverse mortgage lender. The number of HECM lenders in a state is clearly simultaneously determined with the state's take-up rate, thus it cannot be used as an indicator of supply. Instead, we test for the effect of changes in the amount of forward mortgage market lending in a state on the HECM take-up rate—a "spillover hypothesis." The argument is that increases in the aggregate forward mortgage lending are exogenous to HECM decision making; however, the existence of increased forward mortgage lending (and more lenders) may spillover into the reverse mortgage market through reduced costs to seniors of information about HECMs. A simple test of this idea is to include the number of forward mortgages originated by year and state in the HECM take-up regression. A more sophisticated test is based on the observation that not all forward lenders also originated reverse mortgages, and not all reverse mortgage lenders originated forward mortgages. Specifically, we test whether changes in the amount of forward mortgage lending by lenders who were a top 50 HECM originator is correlated with the amount of HECM originations.<sup>32</sup> This version of the test of information spillovers is more direct in that the information about reverse mortgages would have to be supplied by firms engaged in forward mortgage lending.

We also test our spillover hypothesis in the market for HELOCs. Because HELOCs are a closer line of business to forward mortgages, we expect that increased penetration of forward mortgage lending in a market may also increase information about HELOCs, thus increasing HELOC take-up rates.

### Other Hypotheses and Control Variables

Nakajima and Telyukova's (2013) model suggests that the probability of a senior household selecting a reverse mortgage falls with increased income. Our explanatory variables include

<sup>32</sup> We use Home Mortgage Disclosure Act (HMDA) data to identify the number of forward mortgage originations by state and year and HUD HECM data to identify the top 50 HECM lenders.

seniors' median real income, the percentage of the senior homeownership population living in poverty (a Census measure), and the percentage reporting they receive SSI. As previously discussed, obtaining certain types of HECMs may affect a senior's eligibility for Medicaid and SSI.<sup>33</sup> We expect that the larger the SSI percentage in a state (holding household income constant), the lower the take-up rate of HECMs because of the possible negative impact on SSI eligibility. The potential to earn income may be reflected in the senior population's current labor force status. We include the percentages of heads that are fully employed, not employed, and unemployed (omitting part-time employment).

We include indicators of dwelling age. Older dwellings require greater maintenance expenditures and thus households may not demand HECMs because they expect to move relatively soon. In contrast, a household in an older dwelling who wishes to age in place may seek a HECM to increase liquidity and be able to fund the expected repair needs. Seniors in newer housing should expect lower future maintenance expenses, thus may plan to reside in the dwelling a longer time. We also include a dummy variable indicating whether senior homeowners live in condominiums, as HECM regulations for condominiums differ slightly from those covering single family dwellings.

The effect of homeowner age on the likelihood of obtaining a reverse mortgage is not clear. The Principal Limit Factor increases with the borrower's age, allowing homeowners to borrow a greater proportion of their home equity. However, this increase occurs because the expected duration of living in the home without repaying the loan falls with the borrower's age. We include six categories of the age distribution of the eligible senior population, with ages greater than 82 comprising the omitted category.<sup>34</sup> The benefits of a reverse mortgage depend on the expected time a household is geographically stable, which likely depends on marital status (we include indicators for unmarried female heads and unmarried male heads), the history of relocating, and on whether the head is disabled.<sup>35</sup> The disability variable also may indicate that a household has a relatively high demand for medical care and the associated expenses, increasing its demand for cash. A recent move may predict a future move is more likely, making obtaining a reverse mortgage less likely.

We include a set of variables measuring the credit characteristics of senior households including states' average credit score, the percentages 30 days past due on their credit card debt, installment debt, and any mortgage debt. We also include the percentage of seniors with a reported bankruptcy in the last 2 years, a reported tax lien on their property, and the percentage who have a first mortgage payment 120 days past due. Credit scores reflect the history of financial preparedness as well as current financial well-being. The other credit variables are measures of current financial distress. There are opposing factors related to these variables; for example, obtaining a reverse mortgage may be part of a long run planning process for a senior that has a demonstrated history of financial preparedness, measured by a high credit score. Or, obtaining a HECM may be a senior's solution to financial distress, and thus may be associated with households with lower credit scores and higher incidences of past due debts. Also, lower credit score households have less access to

<sup>33</sup> We do not have measures of participation in Medicaid.

<sup>34</sup> We do not consider age variations within a household. Expected lifetimes vary among states, but only a time invariant measure was available, thus we omit it.

<sup>35</sup> The reference group is married couples. The disability could be cognitive, ambulatory, or being unable to provide self-care.

alternative methods of withdrawing home equity such as home equity loans, due to supply-side underwriting criteria, which may lead to increased demand for HECMs. .

We regress state-level HECM take-up rates using OLS, with year and state fixed effects (the omitted year dummy is 2000). Analyzing aggregated dichotomous variables produces heteroscedasticity, which we address by calculating robust standard errors.<sup>36</sup> All of the explanatory variables vary over both time and states. These variations result from three sources: changes in the characteristics of new old households in a state's sample through immigration or turning age 62 compared with the resident senior population, differences in the characteristics of households exiting a state's sample through death or emigration compared with the resident senior population, and changes in the characteristics of the senior residents in a state.

## Results

Estimation results are presented in Table 2. The focal variables are the measures of house price deviation from the norm and its interaction with price volatility.<sup>37</sup> As background, when the interaction variable is omitted, the price deviation variable is positive and significantly different from zero at the 1 % level, lending support to the equity extraction hypothesis (see appendix Table 4). However, as reported in the first column of Table 2, when the interaction variable is included, the price deviation variable becomes slightly negative with a t-statistic of only 0.2 (results are available from the authors).<sup>38</sup> As hypothesized, the interaction of the price deviation and price volatility is positive with a t-statistic of 3.1. Thus, seniors in states with a high current deviation of house prices from the long term norm and a history of volatile house prices originate reverse mortgages at a relative high rate compared with those living either in states with relatively little house price appreciation or living in states with a history of stable house prices. At the mean level of volatility, the elasticity of the take-up rate with respect to the price deviation is 0.12.<sup>39</sup> In summary, the significance of the interaction variable and lack of significance of the price deviation variable is consistent with seniors using reverse mortgages as house price insurance.<sup>40</sup> The lack of significance of the price deviation variable lends no support for the equity extraction hypothesis.

<sup>36</sup> See Kmenta (1986) for an early discussion of the problems generated by aggregating dichotomous variables.

<sup>37</sup> Shan included house price changes in her take-up rate estimation. We tested both measures of positive house price change (lagged one year) and negative house price change (also lagged); however, neither was significantly different from zero.

<sup>38</sup> The measure of price volatility is not significantly different than zero.

<sup>39</sup> This calculation includes both the direct effect of the price deviation and the effect through the interaction term. The elasticity is 0.16 if only the interaction effect is considered. One question is why the elasticity is not greater. Case et al. (2012) find that house price expectations vary among households at a point in time within a metro area. Presumably there are similar distributions of house price expectations among the senior population, explaining why there are only marginal changes in the take-up rate.

<sup>40</sup> We also tested the effect of including an interaction of price volatility with the square of the price deviation. The interaction of price volatility and deviation remains positive (coefficient is 2.7 times larger) and statistically significant ( $t=4.4$ ). The coefficient of the new interaction of volatility with the square of the deviation is negative ( $-0.00012$ ), and statistically significant ( $t=3.9$ ). Thus the effect attenuates as the price deviation becomes large. Evaluated at the mean of volatility and price deviation, the combined effect of these variables on the origination rate is about 50 % larger, while it is about 50 % smaller at one standard deviation above the mean of the price deviation variable.

**Table 2** OLS estimation of state-level take-up rates of HECMs and HELOCs

	HECM Originations per Senior Household		HELOC Originations per Senior Household	
	Coefficient	t-statistic	Coefficient	t-statistic
Intercept	-0.08	0.25	1.34	0.46
House Price Deviation from the Norm	-0.00	0.23	0.25***	2.90
Deviation * Volatility	0.93***	3.11	6.55**	2.44
House Price Volatility	0.02	0.07	-4.13**	2.56
Forward Originations	-0.22*	1.94	6.39***	6.89
Citizen	0.10	0.54	-0.64	0.60
Disabled	-0.02	0.46	-0.20	0.59
SSI Indicator	0.06	0.88	0.10	0.14
Fully Employed	-0.06	1.57	-0.00	0.01
Not Employed	-0.06*	1.87	0.39	1.38
Hispanic	0.28**	2.09	1.57	1.49
Black	0.05	0.49	-0.44	0.50
Asian	0.12	1.20	-1.90**	2.30
Other Race	0.09	0.83	-0.84	0.98
Age 62–65	-0.04	0.73	-0.00	0.00
Age 66–69	-0.06	0.79	0.01	0.01
Age 70–73	-0.11	1.44	0.28	0.46
Age 74–77	-0.02	0.28	-0.43	0.69
Age 78–81	-0.04	0.64	-0.78*	1.82
Unmarried Male	0.05	0.78	0.41	0.81
Unmarried Female	0.04	0.78	0.55	1.05
Condominium	0.03	0.47	0.68	1.31
Poverty Indicator	-0.09**	2.15	0.12	0.27
Education	-0.01*	1.89	-0.03	0.71
Property Tax/Property Value	1.08	1.39	-2.73	0.27
# of Children in Household	0.03	0.99	0.46	1.52
Income (annual \$000)	0.07	0.29	0.67	0.27
Mortgage Payment (monthly \$000)	0.03*	1.74	-0.32*	1.74
House Value (\$000)	0.128**	2.34	0.04	0.07
Linguistically Isolated	-0.14	1.12	1.64	1.53
Recent Mover	-0.05	1.16	-1.11***	2.78
Unemployed	-0.07	0.51	-2.03	1.64
State GDP Growth Rate	0.01	0.40	-0.08	0.38
Built Before 1950	0.04	0.82	-0.35	0.94
Built After 1989	0.10***	3.25	0.49*	1.80
No Mortgage	-0.08*	1.89	0.13	0.34
Second Mortgage	0.01	0.29	0.07	0.31
Credit Score	0.25	0.77	-0.06	0.16
Percent Past Due—Credit Card	-0.42	0.93	-3.44	0.90
Percent Past Due—Installment Loan	-0.11	0.26	3.83	0.67
Percent any Mortgage Past Due	-1.48**	2.10	-0.20	0.04
Percent Bankrupt in Last 24 Months	0.07	0.23	5.10*	1.92
Percent with a Tax Lien	0.33*	1.76	-2.03	1.05
Percent with First Mortgage 120 Days Past Due	-0.83	1.20	-6.15	0.96

**Table 2** (continued)

	HECM Originations per Senior Household		HELOC Originations per Senior Household	
	Coefficient	t-statistic	Coefficient	t-statistic
Sample size	400	400	400	400
R <sup>2</sup>	0.85		0.91	

All coefficients are  $\times 10^{-1}$  except Price Volatility, Forward Originations, Credit Score, House Value, and Income, which are  $10^{-4}$ . Robust standard errors are estimated. The regression includes state and year fixed effects. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$

With regard to self-assessed house values, the coefficient is positive and significantly different than zero at the 5 % level. The elasticity of a state's take-up rate with respect to house value is relatively large, 0.96, suggesting seniors' demand for reverse mortgages is quite responsive to changes in self-assessed house values.

The relative impact of house price variations can be seen in two simple examples. First consider the reactions to a house price cycle in a state where previous price volatility was very low. We assume that house prices initially equal the long term norm, then rise by 10 % for 2 years, and then fall back to normal where they remain. Because volatility is low in this state we can focus solely on the responses implied by the coefficient of house value. We assume that seniors' recognize (and report) rising house values quickly during a boom, but report falling house values with a one-year lag during a downturn.<sup>41</sup> In the period when house prices first change, the HECM take-up rate rises by ten percent, given that the house value elasticity is approximately 1.0. In the next period, house prices are stable and the take-up rate remains elevated. In the third period house prices decrease but there is no additional change in the take-up rate because of the assumed lagged reaction to decreases in home values. In the fourth period the take-up rate returns to its long term norm.

In a state with a high level of house price volatility, there is an additional effect due to the significance of the interaction between house price deviations from the norm and price volatility. Recall that price volatility is measured as the standard deviation of an index of real house prices (calculated based on the 9 years prior to the survey year)—a state with a volatility measure of 20 is about two standard deviations above the mean. Continuing the above example, the deviation of prices from the long term norm is 10 % in the first period. The effect of the interaction variable implies an additional jump in the first period take-up rate by 7 %, presumably reflecting a relatively strong rush to lock-in home equity. Thus the total increase in take-up rate in the first period is 17 %, much larger than the 10 % in a state with no history of price volatility. In the example, the origination rate remains high in the second year, tapers off in the third year, and again returns to its norm in the fourth year. This result suggests that the 2000–2011 changes in the national take-up rate of HECMs was largely driven by changes in take-up rates that occurred in states with a history of volatile house prices due to seniors seeking to insure their home values.

The second test of the equity extraction hypothesis is to regress seniors' origination of home equity lines of credit on the same set of explanatory variables used in the

<sup>41</sup> Case et al. (2012) state "We conclude that over the cycle, buyers in boom cities were very much aware of contemporaneous changes in house prices." They do not test for asymmetries in knowledge of house price trends comparing boom and bust periods.

HECM take-up equation. We expect that HELOCs will be used to extract home equity for consumption and thus the price deviation variable should have a positive coefficient. In a regression without the price deviation-volatility interaction, the price deviation variable has a positive coefficient (0.44) with t-statistic of 5.4 (see appendix Table 4). However, in contrast to the results for HECM originations, the price deviation variable remains statistically significant at the 1 % level when the price deviation-volatility interaction variable is added to the HELOC regression. Thus, we find strong support for the argument that HELOCs are used by seniors for equity extraction.

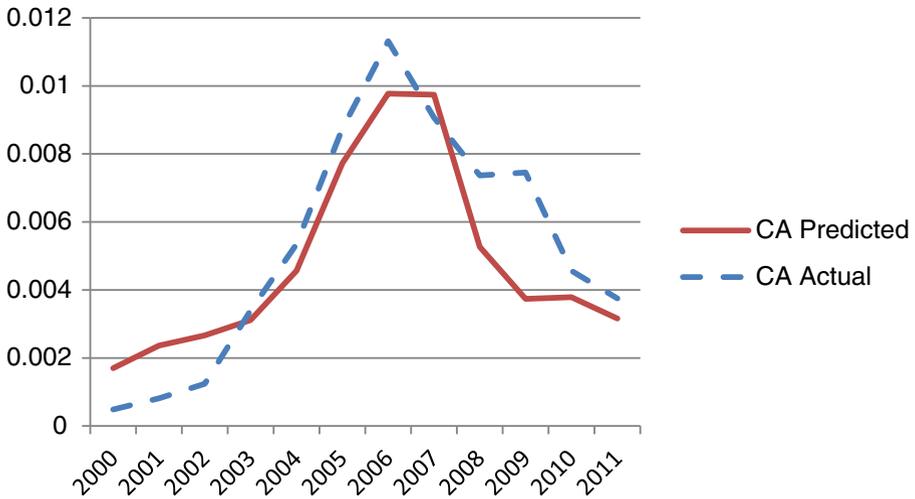
As with the HECM origination regression, the interaction variable in the HELOC regression is positive and statistically significant. At the mean level of volatility, the elasticity of HELOC originations with respect to the price deviation is 0.33. Thus seniors also appear to be using HELOCs to insure against house price declines, perhaps erroneously believing that HELOCs are nonrecourse loans and their available credit will not be reduced or frozen should prices decline. Alternatively, seniors may be applying for HELOCs anticipating that their availability would decline when house prices declined in their state. We further find substantial evidence of co-movements in the number of forward mortgage originations and HELOC originations, as the coefficient of the number of origination is positive with a t-statistic of 6.9.

In the HECM regression, we tested the other competing hypothesis—there is a spillover from the forward mortgage market's intensity of originations to the HECM market—but found no support as the coefficient of this measure for forward originations is unexpectedly negative, with a t-statistic of 1.9. Regarding other explanatory variables, we expected the rate of HECM originations to be greater if home equity is larger. The significant positive coefficient of home value is supportive; however, neither the amount of a first mortgage payment, the presence of a second mortgage, nor the percentage of seniors with no mortgage payment is significant at the 5 % level. The ratio of the property tax to house value is positive effect as expected but is not statistically significant. The poverty indicator has a negative coefficient and t-statistic of 2.1, and thus the greater the share of low income seniors in a state, the lower the take-up rate. The average credit score of seniors in a state does not affect the take-up rate of HECMs. Among the other credit characteristics, the only one that is statistically significant at the 5 % level is the percentage past due on any mortgage on seniors' homes, it being negative as expected.

The theoretical direction of the effect of many of the other socio-economic variables is ambiguous. This could explain their lack of significance. Among the demographic variables, only the percentage of senior Hispanics affects the HECM origination rate (positive coefficient). We find no effect of education, language isolation, being disabled, or recent relocation.

We tested for the effects of two home attributes, dwelling age and whether it is a condominium. Variations in the percentage of condominiums have no effect; however, the greater the percentage of dwellings built after 1990 the greater the take-up rate. The impact of dwelling age is theoretically ambiguous, depending on the tradeoff of building age, expected maintenance expenditures, and expected duration in the dwelling. It is possible that very new homes (built after 1990) are more likely to be accessible for aging in place and thus more appropriate for HECMs.

As displayed in Fig. 1, the intertemporal variation in selected states' HECM origination rates is substantial. Can the estimation results explain this variation? We use the observed changes in California's house prices, our set of behavioral assumptions regarding lags, and



**Fig. 3** Predicted and observed HECM take-up rates in California—the effect of variations in house prices. Note: Authors' calculations

the estimation results to predict changes in California's take-up rate over the sample period.<sup>42</sup> To isolate the impact of house price changes, we use only the sample period's average values of all other variables in the regression, thus they cannot contribute to variations in the predicted take-up rate. Figure 3 displays a comparison of the predicted and actual rates. Overall, the model closely tracks the large rise and substantial decline in California's take-up rate. The predictions are slightly too high during the early part of the house price boom and too low during the bust.<sup>43</sup> However, it is clear that the variation in house prices alone are sufficient to have caused the intertemporal variation in the HECM take-up rate.

## Conclusion

The demand for federally insured Home Equity Conversion Mortgages (HECMs) has risen sharply since 2000, with annual volume growing more than 20-fold through 2009, followed by an approximate 50% decline. The dynamics of HECM demand have been fueled by a confluence of factors during this period, possibly including policy changes that made the program more attractive, the aging of the U.S. population, house price changes, and shocks to income and debt among the eligible population. Parsing out the effects of house price dynamics on HECM take-up rates, holding constant other factors, is critical, particularly given the large increase in the population age 62 or greater in coming decades and planned policy changes to the HECM program.

Our results suggest that the relationship between house prices and HECM demand is more complex than a simple linear relationship (i.e., increase in house prices leads to an increase in demand). We find evidence consistent with the argument that senior households anticipate future reductions in house prices and lock-in their equity gains by

<sup>42</sup> The variables allowed to change are house value, the deviation of house price from its long term norm, house price volatility, and the interaction of the deviation and volatility.

<sup>43</sup> The state fixed effects results in the average prediction over the period being correct.

obtaining reverse mortgages.<sup>44</sup> Specifically, we find that senior households living in states where house prices have a history of volatility and are currently high compared to their historical average are more likely to take out a reverse mortgage. Our interpretation is that senior households used HECM loans to extract home equity before house prices returned to normal, thus insuring their house price gain. We find that this “insurance motive” explains a relatively large share of the annual percentage change in HECM originations.<sup>45</sup> Thus, our results suggests that the 2000–2011 changes in the national take-up rate of HECMs were largely driven by house price changes that occurred in states with a history of volatile house prices. It is important to stress that responsiveness to house prices does not depend on the assumption of borrowers having perfect foresight; for example, local market participants (e.g., reverse mortgage brokers) also have a financial interest in originating reverse mortgages when equity is at its peak.

An alternative hypothesis for the increase and subsequent decrease in the rate of origination of HECMs is that there was a spillover from the forward mortgage market. However, our test finds no supportive evidence, although there is evidence in support of this hypothesis when the dependent variable is seniors’ origination rate of HELOCs. We find that seniors used HECMs and HELOCs to extract home equity, but the equity extraction motive appears to be stronger for seniors’ origination of HELOCs.

We find that demographic differences in state-level senior homeownership populations are relatively unimportant to the explanation of variations in the take-up rate. It is possible that household level demand for HECMs depends on each household’s particular circumstances; however, this not observable using aggregate data. Other omitted variables at the household level, not observed in our data, such as non-housing wealth and debt may also provide additional explanatory power. A goal for future research is to use detailed household level data to analyze the decision of whether to obtain a reverse mortgage, the terms selected, and withdrawal behaviors.

As the baby boomer generation retires, it has been projected that demand for reverse mortgages, and federally insured HECMs, will continue to grow. Our research suggests that the future demand for HECMs is likely to be affected by not only changes in house values, but also by house price volatility and its interaction with house prices. If house prices are stable, our results suggest that the take-up of HECMs will tend to be stable. Thus, in a stable housing market the growth in HECMs will likely be primarily driven by the growth of the senior population, home equity dynamics, and policy changes that alter the costs and benefits of the HECM product for consumers.

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<sup>44</sup> A study by Sevak and Schmidt (2011) uses data from the Health and Retirement Survey to compare seniors’ expectations of future economic conditions with observed future values. One conclusion is very relevant for our study. “Our results also suggest that an increase in stock prices is significantly associated with a decreased expectation of a future stock price increase, which could be consistent with beliefs in some degree of mean reversion in stock prices.”

<sup>45</sup> We note that more than 95 % of the total population of senior homeowners rejected taking out the reverse mortgage even when house prices were relatively high. A survey by Munnell et al. (2007) indicates that 77 % of seniors ages 60–65 do not plan on using home equity for ordinary living expenses during retirement while only six percent plan to use it, perhaps explaining the low take-up rate.

Appendix

**Table 3** Examples of HECM loans, varying by borrower age and loan type

Loan Type (ARM is 1 month LIBOR)	Standard ARM	Standard FRM	Saver ARM	Saver FRM
Borrower Age=62				
Property value	200,000	200,000	200,000	200,000
Principal limit	123,800	123,800	104,600	91,200
Lender's margin	2.50 %	–	2.75 %	–
Interest rate index	0.204 %	–	0.204 %	–
Total interest Rate	2.704 %	4.75 %	2.954 %	5.50 %
Mortgage insurance (MIP)	1.25 %	1.25 %	1.25 %	1.25 %
HECM expected interest rate	4.48 %	4.75 %	4.730 %	5.50 %
Origination fee	3,000	0	4,000	3,000
Upfront Mortgage insurance fee	4,000	4,000	20	20
Closing costs	2,976	2,976	2,976	2,976
Net principal limit	113,824	116,824	97,604	85,204
Monthly payment (lifetime)	610	NA	540	NA
Max lump-sum payment	113,800	116,824	97,604	85,204
Line of credit growth rate	4.026 %	NA	4.286	NA
Max line of credit after 10 years	170,097	NA	149,718	NA
Borrower Age=72				
Property value	200,000	200,000	200,000	200,000
Principal limit	135,400	135,400	110,800	99,600
Lender's margin	2.50 %	–	2.75 %	–
Interest rate index	0.204 %	–	0.204 %	–
Total interest Rate	2.704 %	4.75 %	2.954 %	5.50 %
Mortgage insurance (MIP)	1.25 %	1.25 %	1.25 %	1.25 %
HECM expected interest rate	4.48 %	4.75 %	4.730 %	5.50 %
Origination fee	3,000	0	4,000	3,000
Upfront Mortgage insurance fee	4,000	4,000	20	20
Closing costs	2,976	2,976	2,976	2,976
Net principal limit	125,424	128,424	97,604	93,604
Monthly payment (lifetime)	747	NA	634	NA
Max lump-sum payment	125,424	128,424	103,804	93,604
Line of credit growth rate	4.026 %	NA	4.286	NA
Max line of credit after 10 years	187,471	NA	159,229	NA
Borrower Age=82				
Property value	200,000	200,000	200,000	200,000
Principal limit	146,000	146,000	116,600	107,600
Lender's margin	2.50 %	–	2.75 %	–
Interest rate index	0.204 %	–	0.204 %	–
Total interest Rate	2.704 %	4.75 %	2.954 %	5.50 %
Mortgage insurance (MIP)	1.25 %	1.25 %	1.25 %	1.25 %
HECM expected interest rate	4.48 %	4.75 %	4.730 %	5.50 %
Origination fee	3,000	0	4,000	3,000

**Table 3** (continued)

Loan Type (ARM is 1 month LIBOR)	Standard ARM	Standard FRM	Saver ARM	Saver FRM
Upfront Mortgage insurance fee	4,000	4,000	20	20
Closing costs	2,976	2,976	2,976	2,976
Net principal limit	136,024	139,024	109,604	101,604
Monthly payment (lifetime)	1,006	NA	826	NA
Max lump-sum payment	136,024	139,024	109,604	101,604
Line of credit growth rate	4.026 %	NA	4.286 %	NA
Max line of credit after 10 years	203,315	NA	168,125	NA

**Table 4** OLS estimation of state-level take-up rates of HECMs and HELOCs—No interaction variables

	HECM Originations per Senior Household		HELOC Originations per Senior Household	
	Coefficient	t-statistic	Coefficient	t-statistic
Intercept	-0.10	0.31	1.17	0.40
House Price Deviation from the Norm	0.02**	2.50	0.43***	5.42
House Price Volatility	0.27	1.43	-2.32*	1.84
Forward Originations	-0.33***	2.71	5.66***	6.57
Citizen	0.09	0.47	-0.70	0.63
Disabled	-0.01	0.13	-0.10	0.30
SSI Indicator	0.07	0.89	0.13	0.19
Fully Employed	-0.07*	1.95	-0.10	0.36
Not Employed	-0.05	1.60	0.44	1.60
Hispanic	0.26*	2.01	1.36	1.30
Black	0.01	0.13	-0.71	0.75
Asian	0.06	0.60	-2.32**	2.77
Other Race	0.12	1.13	-0.58	0.67
Age 62–65	-0.04	0.65	0.04	0.06
Age 66–69	-0.05	0.65	0.06	0.08
Age 70–73	-0.10	1.17	0.39	0.61
Age 74–77	-0.02	0.23	-0.40	0.62
Age 78–81	-0.05	0.66	-0.79*	1.75
Unmarried Male	0.06	0.85	0.43	0.81
Unmarried Female	0.04	0.71	0.54	0.99
Condominium	0.03	0.44	0.67	1.24
Poverty Indicator	-0.10**	2.31	0.04	0.10
Education	-0.01*	1.92	-0.03	0.82
Property Tax/Property Value	1.46*	1.99	-0.08	0.08
# of Children in Household	0.03	0.80	0.42	1.52
Income (annual \$000)	0.05	0.20	0.18	0.07

**Table 4** (continued)

	HECM Originations per Senior Household		HELOC Originations per Senior Household	
	Coefficient	t-statistic	Coefficient	t-statistic
Mortgage Payment (monthly \$000)	0.04*	1.94	-0.29	1.53
House Value (\$000)	0.14**	2.40	0.14	0.20
Linguistically Isolated	-0.11	0.79	1.88	1.61
Recent Mover	-0.05	1.28	-1.15***	2.84
Unemployed	-0.04	0.30	-1.81	1.43
State GDP Growth Rate	0.00	0.17	-0.12	0.56
Built Before 1950	0.03	0.70	-0.40	1.02
Built After 1989	0.09***	3.07	0.43	1.58
No Mortgage	-0.08*	1.99	0.07	0.18
Second Mortgage	0.02	0.81	0.14	0.59
Credit Score	0.30	0.82	-0.22	0.06
Percent Past Due—Credit Card	-0.54	1.18	-4.31	1.10
Percent Past Due—Installment Loan	-0.11	0.24	3.84	0.67
Percent any Mortgage Past Due	-1.71**	2.40	-1.79	0.36
Percent Bankrupt in Last 24 Months	0.07	0.23	5.10*	1.94
Percent with a Tax Lien	0.45**	2.31	-1.15	0.60
Percent with First Mortgage 120 Days Past Due	-1.49*	1.97	-10.83*	1.70
Sample size	400	400	400	400
R <sup>2</sup>	0.84		0.91	

All coefficients are  $\times 10^{-1}$  except Price Volatility, Forward Originations, Credit Score, House Value, and Income, which are  $10^{-4}$ . Robust standard errors are estimated. The regression includes state and year fixed effects. \*\*\* $p < 0.01$ , \*\* $p < 0.05$ , \* $p < 0.1$

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