How House Price Dynamics and Credit Constraints affect the Equity Extraction of Senior Homeowners

Stephanie Moulton, Samuel Dodini, Donald R. Haurin, and Maximilian D. Schmeiser

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Stephanie Moulton
John Glenn School Public Affairs
Ohio State University

Samuel Dodini
Federal Reserve Board*

Donald R. Haurin
Department of Economics
Ohio State University

Maximilian Schmeiser
Federal Reserve Board*

September 8, 2015

Abstract

Households can borrow against equity through different channels, including home equity lines of credit (HELOCs), second liens, cash-out refinancing, and—for senior homeowners—reverse mortgages. We use data from the New York Federal Reserve/Equifax Consumer Credit Panel, the U.S. Department of Housing and Urban Development, and other sources to jointly estimate the decision to extract equity through these different channels. Specifically, we identify the influence of credit constraints, house price dynamics, and their interactions on the proportion of seniors in a ZIP code extracting through a given channel each year from 2004 to 2012: the boom and bust period in the U.S. housing market. Prior research finds credit constrained households were more responsive to house price gains than non-constrained households. Our results suggest that this response varies depending on the borrowing channel. As house prices increased, cash-out refinancing increased in credit-constrained areas, but HELOCs increased in less-credit-constrained areas. Further, when house prices fell, reverse mortgage originations increased—particularly in credit-constrained areas. We also observe differential responses to credit constraints and house price changes in minority versus non-minority neighborhoods.

1. Introduction

Extracting home equity through borrowing allows households to smooth consumption and access liquidity without the substantial costs of selling the home (Hurst and Stafford 2004; Mian and Sufi 2010; Mian and Sufi 2011). During the first half of the 2000s, households in the United States extracted more than $1 trillion dollars in home equity (Bhutta and Keys 2014), with an increase of nearly 17 percent annually from 2000 to 2008 (LaCour-Little et al. 2014). For senior homeowners, home equity composes a substantial portion of wealth (Poterba et al. 2011; Joint Center for Housing Studies 2014), and thus decisions to extract equity can have a significant effect on a household's financial portfolio.[1] The decision to extract equity is complex, influenced by macro-level house price dynamics, interest rates, and credit conditions, as well as micro-level factors including household mobility and financial position.

In addition to the decision to extract equity, households make a choice about the channel through which to borrow. Options include cash-out refinancing of an existing mortgage, borrowing through closed-end home equity loans, or revolving home equity lines of credit (HELOCs), and for seniors, extracting equity through a reverse mortgage. The factors that lead borrowers to choose one particular channel over another are unclear. During the boom and bust in the U.S. housing market at the start of the 21st Century, the use of different extraction channels peaked at different times, with variation by geography and for particular subpopulations (Agarwal et al. 2006; Jagtiani and Lang 2011; Lee et al. 2012; Duca and Kumar 2014).

One reason for variation in product choice may be differences in observable house prices and credit conditions. The first purpose of our study is to estimate how shifting house price dynamics and credit conditions during the boom and bust period of the U.S. housing market contributed to differential rates of equity extraction by borrowing channel. Following Mian and Sufi (2011), we also consider interactions for which credit-constrained households may be more (or less) responsive to changes in house prices for particular borrowing channels.

Aside from variations in the absolute levels of particular explanatory factors, another reason for observed differences in channel use may be attributed to differential responses of homeowners residing in particular areas. Prior research finds higher rates of particular channels of equity borrowing—such as cash-out refinancing and HECMs—in lower-income and minority neighborhoods (Shan 2011; Do 2012; Davidoff 2015). A second purpose of our study is to estimate the proportion of the differences in origination channels in predominately black (minority) and predominately white (non-minority) neighborhoods that can be explained by changes in house prices and credit conditions (the endowment effect) and the proportion that can be attributed to differences in behavioral response to the same factors.

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[1]For more than half of households at retirement age (65–69), equity in the home is greater than the sum of all other assets, including assets in retirement accounts (Poterba et al. 2011), particularly for households with low incomes. Based on recent data from the Survey of Consumer Finance (SCF), home equity comprises more than 75 percent of total net wealth for senior homeowners with incomes in the lowest quartile of the income distribution (Joint Center for Housing Studies 2014).

While prior studies have explored the impact of house price dynamics and credit constraints on equity extraction generally, there is a lack of research that jointly estimates the decision to extract equity for each of the borrowing channels.[2] Joint consideration of equity extraction options is important, as unobserved factors that affect a household's probability of extracting equity may simultaneously affect all extraction channels. Households make the choice of a particular equity extraction option relative to other options, and thus explanatory factors that predict extraction through a particular channel should be interpreted relative to the effect of such factors on other extraction options.

We use data from the U.S. Department of Housing and Urban Development (HUD) on HECM loan originations from 2004 to 2012, combined with consumer credit data from the Federal Reserve Bank of New York/Equifax Consumer Credit Panel (CCP) and house price index (HPI) data from CoreLogic. We describe intertemporal and spatial differences in the relative proportion of the senior population extracting home equity through HELOCs, closed-end second liens, cash-out refinancing, and HECMs in a geographic area (ZIP codes) from 2004 to 2012.

We find that house price and credit dynamics affect the probability that a household extracts home equity, with substantial differences by channel. Use of both HELOCs and borrowing through cash-out refinancing increases as house prices increase, while the use of reverse mortgages increases when house prices are declining. Credit constraints are also differentially associated with borrowing channels. ZIP codes with relatively low average credit scores have lower use of HELOCs and greater use of cash-out refinancing, followed by second liens and then HECMs. Credit-constrained areas (with lower credit scores, higher credit utilization rates, and lower credit approval rates) are more likely to extract equity through cash-out refinancing in response to house price gains and through HECMs in response to house price declines. By contrast, areas that are less credit constrained are more likely to extract equity through HELOCs in response to house price gains. These results add new insights to prior research that finds that credit-constrained households were more likely to extract equity in response to house price increases (Mian and Sufi 2011), as our findings indicate that the effects of credit constraints and house price interactions vary by extraction channel. Previous studies that aggregated all forms of home equity extraction into a single measure missed interesting differences among the specific forms of extraction.

We find that geographical variation in household credit quality explains a substantial proportion of the differences in extraction channels in minority versus non-minority neighborhoods. We also find variation in responsiveness to house price dynamics and credit constraints by neighborhood. Holding credit constraints constant, homeowners in minority neighborhoods are more likely to borrow through cash-out refinancing in response to house price increases, while homeowners in non-minority neighborhoods are more likely to borrow through HELOCs. As house prices decrease, households in

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[2]The exception is an analysis of equity extraction at the household level by Do (2014) that estimates the probability of extraction through a HELOC or home equity loan a using multinomial logit specification. However, his analysis focuses on household demographics and does not include indicators for credit conditions or house price dynamics.

non-minority neighborhoods are more likely to borrow through HECMs, presumably as a hedge against further house price declines. By contrast, HECM originations in minority neighborhoods are not as responsive to house price declines.

2. Prior Literature on Equity Extraction

Most prior studies model equity withdrawals (e.g., the increase in mortgage balances during a particular time period) rather than the origination of a new equity extraction loan (Mian and Sufi 2011; Do 2012; Bhutta and Keys 2014; Duca and Kumar 2014). A few studies model the decision to extract equity through specific channels, including refinancing (Hurst and Stafford 2004) or home equity loans and lines of credit (LaCour-Little et al. 2014). A more limited body of literature models the decision for seniors to extract equity through a HECM, though not in conjunction with other forms of equity borrowing (Shan 2011; Davidoff 2015; Haurin et al. forthcoming).

The prevalence of home equity extraction tends to follow trends in the macroeconomy. Using data from the New York Federal Reserve Bank's Consumer Credit Panel from 1999 to 2010, Bhutta and Keys (2014) finds that 12.4 percent of households with a mortgage extract equity in a given year, spiking to nearly 20 percent in 2003 and declining to 6.2 percent by 2010. Equity extraction rates were slightly lower during the boom years for senior households; using data from the Health and Retirement Study (HRS), Duca and Kumar (2014) finds that 15.7 percent of households headed by someone over the age of 50 report a home equity withdrawal biennially between 2000 and 2006, equaling about 8 percent of seniors extracting equity in a given year. In terms of the channel of home equity extraction, Bhutta and Keys (2014) finds that from 1999 to 2010, 43 percent of equity was extracted through cash-out refinancing, 36 percent through HELOC draws, 10 percent through second mortgages, and 10 percent through some combination of the three. As one would expect, the proportion of new originations in a year are much lower than the proportion withdrawing equity. In an analysis of households over the age of 62 from 2000 to 2011, Haurin et al. (forthcoming) finds that, on average, 3 percent of seniors originate a new HELOC loan in a given year, while 0.24 percent originate a new HECM.

Across studies, house price dynamics are found to be an important explanatory factor influencing extraction, with some noted differences by extraction channel. Mian and Sufi (2011) analyzes a credit panel dataset of more than 74,000 U.S. homeowners from 1997 through 2008. It finds that homeowners extracted $25 per $100 in increased home value from 2002 to 2006. They do not explore equity extraction by channel, but rather model the dollar increase in equity loans. Analyzing credit panel data over a longer period (from 1999 to 2010), Bhutta and Keys (2014) finds that a one standard deviation increase in house price increases the probability of equity extraction by 38 percent, with the amount of equity extracted equal to $7 for each $100 increase in home value.

In an alternative specification, Bhutta and Keys (2014) models equity withdrawals structured as junior liens separately from equity withdrawals through cash-out refinancing. They find that cash-out refinancing is more sensitive to house price increases and interests rates than junior liens. They speculate that this is because cash-out refinancing resets the interest rate and loan amount for a longer period of time (typically 30 years), whereas junior liens typically have shorter duration and lower

transaction costs. Using Equifax credit panel data from 2000 to 2006, LaCour-Little et al. (2014) models the growth in the balance of HELOCs and closed-end second liens separately. They find that HELOC balances grow faster in ZIP codes with high house appreciation, while second lien balances are less responsive to house price changes.

With regard to HECMs and house price dynamics, Haurin et al. (forthcoming) use data aggregated to the state level to predict HECM originations as a proportion of senior households by state and year from 2000 to 2011. They find that intertemporal and spatial variations in take-up rates were higher in states with real house prices substantially above their long-term average and a history of large variations in house prices. The interpretation of this finding is that some seniors used HECMs as a means to insure against reductions in house prices. Using aggregate data, Shan (2011) estimates the total number of HECM originations from 1995 to 2010 in a ZIP code as a percentage of housing units with elderly owners in the year 2000. She finds that house-price growth accounts for approximately one-third of the growth in HECM originations from 2003 to 2007.

Aside from house price dynamics, prior research finds that credit conditions—both household credit conditions and supply side credit availability—influence equity extraction behaviors. In terms of household credit conditions, Bhutta and Keys (2014) finds that higher credit card utilization rates are associated with equity extraction, while credit score has a non-linear relationship. Equity extraction increases as credit scores increase up to 740, and then declines thereafter. This makes sense as lower credit score borrowers are most constrained and may be prevented from borrowing, while the highest credit score borrowers may have access to alternative forms of liquidity. Prior research also finds that credit-constrained borrowers—measured by lower credit scores and higher rates of credit card utilization—were more responsive to increases in house prices than less-constrained borrowers (Mian and Sufi 2011). This finding is similar to Hurst and Stafford (2004), which finds that households who experience income shocks or are otherwise borrowing constrained were more likely to extract equity through refinancing when house prices increase, regardless of interest rates.

Supply-side credit constraints have also been found to influence equity extraction. Bhutta and Keys (2014) includes an indicator for credit availability in a ZIP code, measured as the proportion of marginal credit applicants who applied for and were able to obtain credit in a given year. They find a significant and positive relationship between credit availability and equity extraction, in which a 10 percent increase in credit availability increases the probability of extracting equity 1 to 2 percentage points (depending on the control variables included).

There is some evidence of differential use of borrowing channels by borrower and neighborhood demographics, particularly minority status. In an analysis of HELOC and cash-out refinancing originations from 2001 to 2007, Do (2012) finds that while non-Hispanic black homeowners are less likely to extract equity in general, they are more likely to extract equity using cash-out refinancing relative to non-Hispanic white homeowners and are less likely to extract equity through HELOCs. He suggests that this may be due to lower levels of financial literacy and experience among minority borrowers. Using survey data from the HRS, Duca and Kumar (2014) finds that higher levels of financial literacy are associated with borrowing through a HELOC, while lower levels of financial literacy are

associated with extracting equity through closed-end loans.[3] Given data limitations, neither study includes indicators for credit conditions nor house price dynamics that might help unpack these effects. Mian and Sufi (2009) finds that latent demand for credit in particular areas may lead to an increase in equity extraction as house prices increase and borrowing constraints relax, particularly for products with limited underwriting. With regard to HECMs, Shan (2011) finds higher rates of originations in ZIP codes with higher percentages of black and Hispanic homeowners. In a recent analysis of HECM originations between 1989 and 2010, Davidoff (2015) confirms the positive relationship between minority share in a neighborhood and HECM originations, even after controlling for house price dynamics. However, neither study explains the use of HECMs relative to other equity extraction channels.

3. Theoretical Expectations

Homeowners optimize their decision to extract equity from their home in the current period based on the perceived utility derived from consuming equity in the current period relative to a future period, subject to constraints. Factors influencing equity borrowing include house price dynamics and credit conditions, but also borrowing costs and current and anticipated changes to income. Other household-level factors are also expected to influence extraction, such as household preferences and expectations, and financial position.

We expect to observe differences in explanatory factors by channel of equity extraction. Part of this variation may be due systematic differences in the *level* of explanatory factors, such as borrowing costs that vary systematically between borrowing channels. Part of this may also be due to differential *responses* to explanatory factors by channel, such as varying responses to changes in house prices depending on the borrowing channel.

Higher house values are expected to increase the probability of extracting equity across all channels due to a wealth effect; as a household's overall financial portfolio increases, it may stimulate a desire for consumption (Hurst and Stafford 2004; Mian and Sufi 2011). However, we expect that households may be motivated to utilize channels differently in response to changes in house prices. For example, if house prices are increasing, households may not want to lock themselves into a long-term mortgage with high upfront costs, such as through refinancing or a HECM. In these circumstances, households may prefer a shorter term HELOC or second lien that would be easier to adjust if house prices continued to increase in the future. On the other hand, HECMs are federally insured non-recourse mortgages for which the government bears the cost of the loan in a negative equity situation. Declining house prices may prompt seniors to originate a HECM to lock in equity before house prices decline further, providing a hedge against house price risk (Nakajima and Telyukova 2013; Haurin et al. forthcoming). While HELOCs also tend to have a shorter duration with low upfront costs, the credit line on a HELOC can be frozen in response to future house price declines (CFPB 2012) and thus may not be optimal when house prices are declining.

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[3] Financial literacy is measured in the HRS through a series of questions about financial knowledge. Correct responses to the financial diversification question are associated with decreases in closed-end home equity withdrawals.

Increases in house values can also relax a borrowing constraint by lowering the loan-to-value (LTV) ratio (Mian and Sufi 2011; Bhutta and Keys 2014). HELOCs tend to have lower LTV thresholds than second liens or cash-out refinancing; while closed-end first and second liens may allow for full leverage (e.g., 100 percent LTV), HELOCs typically cap LTVs at 80 percent, with some extending to 90 percent during the housing boom (CFPB 2012). The maximum LTV for a HECM is much lower, typically 50 to 80 percent of the home's value depending on the borrowers' ages and expected interest rate.[4]

Household decisions regarding equity extraction also account for borrowing costs. Borrowing costs, including the interest rate on the loan as well as upfront fees and transaction costs, may vary substantially between channels. Prime interest rates tend to be lower for refinanced first mortgages than second liens or HELOCs (Kalotay and Fu 2009); however, during the expansion of the subprime mortgage market in 2006, nearly twice as many refinanced mortgages were classified as "high cost" relative to second liens and home improvement loans (Avery et al. 2007; Mayer and Pence 2008).[5] The expected interest rate on HECMs is often similar to prime interest rates on forward mortgages.[6] While interest rates tend to be higher for HELOCs and second liens, closing costs tend to be negligible (CFPB 2012). On the other hand, closing costs associated with refinanced mortgages are estimated to be 1.5 to 2.5 percent of the household's mortgage balance (Mian and Sufi 2009). For HECMS, closing costs include a lender origination fee of up to 2 percent of the home's value and an upfront mortgage insurance premium that currently ranges from 0.5 percent to 2.5 percent, depending on the proportion of available funds extracted.[7] The perception of high upfront costs for reverse mortgages has been cited as a primary factor contributing to lack of demand (Redfoot et al. 2007; Davidoff 2015).

Supply-side credit standards can create a binding constraint, in which households otherwise desiring to extract equity but that cannot pass a given underwriting threshold are unable to borrow. Such thresholds differ between borrowing channels. Unlike refinanced first mortgages or closed-end second liens that are often securitized, HELOCs tend to be held in a lender's portfolio (Agarwal et al. 2006; Lee et al. 2012). HELOCs thus tend to have more stringent underwriting criteria, including higher minimum credit score requirements and lower combined LTV thresholds. Underwriting criteria for refinanced loans or second liens follows the appetite for risk in the secondary market. Risk-based pricing of securitized loans allows for relaxed underwriting requirements in exchange for higher interest rates. Thus, the prevalence of higher-priced loans from 2004 to 2007 allowed households that were previously constrained from borrowing due to credit standards to extract equity through securitized first or second liens. In contrast, underwriting for reverse mortgages has historically not been tied to income or credit

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[4] HUD sets the amount that can be borrowed, or principal limit factor (PLF), based on the expected growth of the HECM loan balance over the remaining expected life of the borrower.

[5] In 2006, nearly 30 percent of all refinance transactions in the United States were classified as "high cost" in the Home Mortgage Disclosure Act (HMDA) data, defined as loans with APRs 3 percentage points or more above Treasury securities. By contrast, only 17.3 percent of home improvement second loans were classified by HMDA as "high cost."

[6] As of April 2012, the fully indexed interest rate on an ARM HECM was 2.5 to 3.25 percent, compared to 4.5 to 5 percent for a fixed rate HECM. By contrast, the fully indexed interest rate for a HELOC during the same period was 4.25 to 5.25 percent (CFPB 2012).

[7] HUD sets a cap on the lender's origination fee, and sets the rate for the upfront mortgage insurance premium.

criteria.[8] Despite higher upfront costs, HECMs may be preferable for households constrained by the credit standards for other channel options.

Household-level factors may also influence the desired channel for equity extraction. To the extent that households extract equity to smooth consumption, levels of current and expected future income as well as overall borrowing liquidity may influence a household's desire to structure an equity withdrawal as a revolving line of credit (e.g., a HELOC or HECM) or a lump sum (e.g., cash-out refinance or a second lien). A line of credit allows households to extract equity as needed and retain funds on the line of credit for future shocks (Agarwal et al. 2006). This may be particularly true for households with low levels of liquid assets and liquidity constrained households who lack the ability to borrow through other channels (Hurst and Stafford 2004). Further, HELOCs often allow for interest-only payments, reducing the payment burden for income constrained households. Unlike forward mortgages, HECMs have no fixed maturity date and no monthly repayment, as the balance including equity withdrawn plus interest and fees grows in reverse. Thus, HECMs may be preferable for households extracting equity to smooth consumption due to income shortfalls.

Households with varying discount factors, levels of financial literacy, self-control, and motivations may have differing preferences for equity extraction channels (Laibson 1997; Bhutta and Keys 2014; Duca and Kumar 2014). More complex products like HECMs and HELOCs may be utilized by households with higher levels of financial literacy, while products that distribute funds up front may appeal to households with preferences for immediate consumption. Credit score may serve as a proxy for such differences, as prior debt behaviors may be correlated with underlying financial literacy and preferences (Mian and Sufi 2011). Such differences may be correlated with demographic characteristics, such as age, gender, or minority status. Senior households tend to decumulate housing equity at a much lower rate than would be expected from a life-cycle model of consumption (Mian and Sufi 2011), perhaps due to bequest motives, psychological attachment to the home and aversion to debt, and precautionary savings against future shocks including health shocks (Davidoff 2010; Poterba et al. 2011). Female and minority borrowers tend to have lower levels of financial literacy than borrowers who are male or white (Lusardi and Mitchell 2011), which may also lead to differential use of financial products.

Finally, we expect that there may be differential effects of explanatory factors in high- versus low-minority neighborhoods. On one hand, this may be due to different levels of explanatory factors in minority areas (e.g., higher house price volatility, lower borrower credit scores, or less credit availability) that are predictive of particular borrowing channels. For example, in early 2008, supply-side constraints to limit borrowing in "declining" or "distressed" markets may have disproportionately restricted access to forward mortgage options for equity extraction in minority neighborhoods, likely increasing the appeal of reverse mortgages in such areas (Avery et al. 2010; Immergluck 2011).[9] Controlling for factors (such as supply-side credit availability) should thus explain some of the observed differences in product

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[8] Changes to the program effective March 2015 require minimal underwriting to ensure a borrower's ability to pay property taxes and homeowners insurance (see Moulton et al. 2014).

[9] In 2008, certain lender servicers as well as Fannie Mae and Freddie Mac enacted stricter underwriting requirements, including lower loan to value ratios and higher fees, in geographic areas defined as areas where house prices were declining at a more rapid rate (Immergluck 2011; Avery et al. 2010).

selection for borrowers in high-minority areas. However, it is also possible that borrowers have differential responses to explanatory factors in high- versus low-minority areas. For example, borrowers in higher-minority areas may have less financial literacy or experience due to less exposure to or experience with complex financial products (Bucks and Pence 2008), and thus may not respond to volatility in house prices in the same manner as borrowers in areas with a higher level of financial sophistication.

4. Empirical Model

Our models estimate the extent to which changes in house prices and consumer credit conditions explain the proportion of the senior population extracting equity through the origination of HECMs, HELOCs, cash-out refinancing, and closed-end second liens within a ZIP code from 2004 to 2012. We exploit the panel structure of our ZIP-code level data and regress the percentage of the senior population originating through each channel on a vector of explanatory variables with MSA-level and year fixed effects. The result is a system of four equations, corresponding to each channel of equity extraction. By calculating our dependent variables for equity extraction channel as a share of the senior population in a ZIP code, we avoid omitting any groups from consideration and thus reduce concerns regarding selection. The "fifth" group includes all senior households in the ZIP code who are not homeowners or who do not extract equity. This group is fully defined by the other equations and is thus not modeled explicitly.

To test our hypotheses, we estimate our four reduced form equations using Seemingly Unrelated Regressions (SUR). In general, this approach also allows the error terms of our four equations to be correlated, which we expect because some unobserved factors that influence borrowers to select one particular equity extraction product (e.g., HELOC) may also influence borrowers when selecting a different equity extraction product (e.g., HECM). We allow for robust standard errors.[10]

The four equations are:

$$Y1_{zt} = \beta_0 + \beta_1 HP_{zt} + \beta_2 FC_{zt} + \beta_3 CC_{zt} + \beta_4 X_{zt} + \alpha_1 I_{HELOC,zt} + \gamma_m + \delta_t + u_{zt} \tag{1}$$

$$Y2_{zt} = \beta_0 + \beta_1 HP_{zt} + \beta_2 FC_{zt} + \beta_3 CC_{zt} + \beta_4 X_{zt} + \alpha_2 I_{First,zt} + \gamma_m + \delta_t + u_{zt} \tag{2}$$

$$Y3_{zt} = \beta_0 + \beta_1 HP_{zt} + \beta_2 FC_{zt} + \beta_3 CC_{zt} + \beta_4 X_{zt} + \alpha_3 I_{Second,zt} + \gamma_m + \delta_t + u_{zt} \tag{3}$$

$$Y4_{zt} = \beta_0 + \beta_1 HP_{zt} + \beta_2 FC_{zt} + \beta_3 CC_{zt} + \beta_4 X_{zt} + \alpha_4 I_{HECM,zt} + \gamma_m + \delta_t + u_{zt}, \tag{4}$$

where the subscripts indicate the ZIP code, z, MSA, m, and time, t. Y1 is HELOC originations as a percent of the population of seniors age 62 and older, Y2 is cash-out refinancing, Y3 is closed-end second lien originations, and Y4 is HECM originations. In each equation, *HP* corresponds to a vector of explanatory variables measuring house price dynamics, *FC* corresponds to a vector of explanatory variables measuring household financial characteristics, *CC* corresponds to a vector of explanatory variables measuring credit conditions (both borrower and supply side), X represents the racial/ethnic composition

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[10] The MYSUREG command in Stata is used.

of the ZIP code, γ_m corresponds to MSA fixed effects, and δ_t corresponds to year fixed effects. MSA fixed effects hold constant market-level variables that likely influence equity extraction, including the market share of lenders, supply constraints in the market, economic growth and unemployment in the market, and other aspects of current and expected housing market in the MSA. Year fixed effects absorb policy changes and macroeconomic shocks that are not directly observed in our model. In the various equations, I_{HELOC}, I_{First}, I_{Second}, and I_{HECM} each represent the interest rate applicable for that particular product in ZIP code z in time t. Including a unique interest rate variable in each equations gives further justification for our SUR framework.

In alternative specifications, we include interactions between the house price indicators and indicators for credit constraints (*HP*CC*) to explore the extent to which credit-constrained households are differentially responsive to house price changes. We also explore differences in equity extraction originations based on subsamples of ZIP codes with high levels of racial homogeneity. In particular, we apply our model to ZIP codes for which greater than 50 percent of the population is black (minority neighborhoods) and those for which 90 percent or more of the population is white (non-minority neighborhoods).

5. Data Sources and Descriptive Statistics

Our primary source of data is the Federal Reserve Bank of New York/Equifax Consumer Credit Panel (CCP), a 5 percent random sample of active credit files in the United States supplemented with the credit data for all other people who reside at the same street address as the primary individual. The CCP is a panel dataset that begins in the first quarter of 1999 and is updated quarterly to account for deaths, credit files becoming inactive, and newly created credit files. It contains approximately 40 million credit files in each quarter. The CCP data are used to construct equity extraction and credit measures from credit profiles for individuals ages 62 and above on an annual basis for our sample years 2004 through 2012, aggregated to the ZIP code level.[11] We supplement the CCP dataset with loan-level data on all HECM originations from the U.S. Department of Housing and Urban Development (HUD) for the same period (697,772 loans), aggregated to the ZIP code level.[12]

Indicators for home prices are drawn from the CoreLogic house price index (HPI) dataset. This includes CoreLogic's repeat sales house price index for non-distressed sales and the median sales price, both at the ZIP code level, for each year in our sample. Time-varying measures of household income are derived from IRS market segment data from the IRS Stakeholders, Partnerships, Education, and Communication (SPEC) unit, which we use to construct the median adjusted gross income (AGI) from senior tax returns by ZIP code for each year. Finally, to construct the number of seniors in a ZIP code and the minority share, we extract data from the U.S. Census Bureau's American Community Survey (ACS) for the years 2005 to 2012, using data from the 2000 U.S. Census to interpolate values for 2003 and 2004.

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[11] We limit our data to the period beginning in 2004, as the IRS dataset we used for income begins in 2004 and the CoreLogic house price data cover fewer geographic areas in earlier years (prior to 2004).

[12] These data are obtained under contract with HUD's Policy Development and Research (PDR) division. This is the same dataset that is used in the actuarial reports for the HECM program (IFE 2014).

We limit our data to ZIP codes for which we have at least 30 credit files for seniors and have CoreLogic HPI data. These restrictions result in a sample size of 5,495 ZIP codes of the approximately 30,000 ZIP codes in the United States. They cover about 45 percent of the senior population with credit files in the full population.[13] Our sample spans the period 2004 through 2012 and we have a total of 39,596 ZIP code/year observations.

Summary statistics for all model variables are presented in Table 1, and for high- and low-minority ZIP codes in Table 2.

[Tables 1 and 2 here]

The average yearly rate of new equity extraction loans among the senior population in our sample ZIP codes is 0.041, the largest portion of which are HELOC originations (0.024), followed by cash-out refinancing (0.008), closed-end second lien originations (0.007), and HECMs (0.002). However, there are substantial differences by geographic subsamples. For example, in high-minority ZIP codes, the share of HECM originations is twice that of low-minority ZIP codes.

In addition to differences in the relative share of each type of equity extraction origination by ZIP code at a point in time, there is also substantial variation in the relative share of each origination type over time within a ZIP code. Figure 1 plots the rate of equity extraction loans by type during our sample period, and HECMs as a share of all equity extractions over time. For senior households, the prevalence of HELOCs declined substantially from 2004 to 2009, followed by a slower rate of decline thereafter. The largest decline in closed-end seconds was from 2007 to 2009, stabilizing thereafter. Cash-out refinancing slowly declined throughout the sample period. HECM originations increased from 2004 to a peak in 2009, declining and then flattening thereafter. HECMs also increased as a share of all originations beginning in 2005, and peaked as a share in 2009—a time when there was a substantial reduction in other types of home equity loan originations.

[Figure 1 here]

Our first set of explanatory variables measure house price dynamics in a ZIP code. To measure the absolute value of homes in a given ZIP code, we include the median of the repeat sales price (in thousands, logged), calculated by CoreLogic using non-distressed sales for each of our sample years. In addition to the median sales price, we separately measure the annual rate of positive and negative house price changes in a ZIP code as we expect that the relationship between house price change and equity extraction is not symmetric.

Our second set of explanatory variables measure consumer credit conditions in a ZIP code. Using the CCP data, we construct measures of household credit conditions as well as supply-side credit constraints. It is important to note that our household measures are constructed using credit file data for seniors age 62 and over, and seniors tend to have higher credit scores and fewer defaults than

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[13] This is based on the 2004 population of seniors with credit files in the CCP dataset. In 2004, there were 2.49 million credit records for seniors in the CCP. Our sample ZIP codes include approximately 1.1 million senior primary individuals in 2004, representing about 45 percent of the population.

consumers in the general population. First, to measure overall credit constraints, we include the median credit score for senior households in a ZIP code, with a sample average of 783.[14] We control for measures of severe credit distress, including the proportion of seniors with a mortgage past due (0.016), prior bankruptcy (0.009), and prior foreclosure (0.003). To capture non-housing credit liquidity, we construct a measure of seniors' median revolving credit balance to the revolving high credit limit (0.08), following Gross and Souleles (2002) and Bhutta and Keys (2014).

To measure supply-side credit constraints that vary over time and ZIP code, we use the CCP data to calculate the fraction of senior credit profiles that have at least one credit inquiry during the year who were able to open at least one new credit account during the year; in other words, the number of individuals who applied for and were approved for credit divided by the number of individuals who applied for credit.[15] This measure approximates the ease of borrowing through all available credit channels, not limited to mortgage lending. In our sample, the average credit approval rate is 0.67. As a point of reference, Bhutta and Keys (2014) estimate an approval rate of 0.57 for marginal consumers (scores between 550 and 600).

As demonstrated in Figure 2, there is substantial variation in credit availability during our sample period, especially for low-credit-score seniors. The time pattern corresponds to the loosening and tightening of the credit market, with a peak approval rate of 0.70 in 2006 and a low of 0.63 in 2009. For seniors with credit scores below 660, the approval rate peaked at 0.60 in 2007, dropping 0.20 points to 0.40 in 2009 and 2010.

[Figure 2 here]

We control for other household characteristics that may influence their choice of borrowing channel. Equity extraction should be related to the amount of home equity held by households in a ZIP code. To develop a proxy measure for home equity, we construct the ratio of the median mortgage debt for seniors with a mortgage in a ZIP code to the median house sales price (lagged one year) in the ZIP code. In our sample, this ratio equals 0.37. This value, when combined with the fact that only 34 percent of our seniors have mortgages, suggests that there is a substantial amount of home equity among the senior population. We further include a measure of the median monthly mortgage payment amount (lagged one year) for seniors with a mortgage in a ZIP code in a given year. This variable is related to both the total amount of home equity and the cash outflow associated with current mortgage obligations. We also include a measure of household income. From the IRS data, we obtain the median monthly Adjusted Gross Income (AGI) from taxable wages, pensions, and social security for households

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[14] The Equifax Risk Score included in the CCP is similar to the FICO score, but is based on a different algorithm. It predicts the likelihood of severe delinquency over the next 24 months as does the FICO score. The CCP credit score ranges from 280 to 850. In alternative specifications, we test for nonlinearities resulting from differences in the distribution of borrowers with high and low credit scores (e.g., Bhutta and Keys 2014). We include the percentage of credit profiles whose Equifax score falls into one of three categories: below 620 (8 percent of the sample), between 621 and 660 (4.6 percent), and from 661 to 720 (10 percent), with over 720 being the omitted category.
[15] Bhutta and Keys (2014) construct this measure for marginal credit applicants only, defined as consumers with credit risk scores between 550 and 600. Given the relatively higher average credit score of seniors, there is not sufficient sample size in all ZIP codes to construct our measure using such a narrow range of risk scores.

age 65 or older filing tax returns in a given ZIP code and year (in thousands). Regarding demographics, we measure the average age of seniors in the ZIP code (72), the share of the entire population that is black (0.098) and the share of the population that is Hispanic (0.13).

In Table 2, the samples are based on 247 unique minority ZIP codes (predominately black) and 1,584 unique non-minority ZIP codes (predominately white). The combined rate of equity extraction in minority areas is nearly as high as in non-minority areas, but there is notably less reliance on HELOCs. In minority areas, income is lower and the percentage of the senior population with a mortgage is slightly lower, but house price variation is greater. Credit scores are notably lower in non-minority areas, with the average ZIP code median credit score of 731 3 standard deviations below the average ZIP code median credit score of 791 in low-minority areas. Credit utilization is higher in minority areas, as are bankruptcy, foreclosure, and past-due mortgages, while the credit approval rate is lower.

6. Results

6.1 Estimation Results: Full Sample

Results for the estimation of equations (1)-(4) are presented in Table 3. Given the widely differing rates of origination for HELOCs, cash-out refinancing, closed-end second liens, and HECMs, we present normalized coefficients in Table 3 by dividing the estimated coefficient by the average incidence of the relevant home equity extraction channel. The effects of explanatory variables can thus be compared across extraction channels. Changes in explanatory variables could affect total extraction, and thus raise or lower all channels of extraction. In addition, changes in an explanatory variable may increase (or decrease) extraction through a particular channel, relative to a decrease (or increase) in another channel.

[Table 3 here]

We first consider the effects of house-price dynamics on equity extraction. As expected, the log of median house price in a ZIP code is positively associated with most types of equity originations, with the greatest effect on HELOC originations and the smallest effect on HECM originations.[16] Closed-end second liens are the only type of equity extraction that is negatively correlated with higher house prices. Separately from the house price level, positive house price growth within a ZIP code is associated with increased use of HELOCs and cash-out refinancing and a reduction in HECMs. Positive house price growth has no statistically significant effect on the origination of closed-end second liens. On the other hand, negative house price growth within a ZIP code is positively associated with HECM originations— with a 1 percentage point decrease increasing HECM originations by 1.02 percent—and negatively associated with cash-out refinances. Given the high upfront costs of originating an HECM, borrowers may be reluctant to lock in their house values with an HECM when house prices are rising, but may be

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[16] The single exception to our reporting coefficients relative to the baseline rate of equity extraction is for the log of median house price given one can easily report percentage responses for logged variables.

motivated to originate an HECM when house prices decrease to insure against further house price declines as suggested by Haurin et al. (forthcoming).

Next, we turn to the effect of credit conditions. The credit approval rate in a ZIP code, a supply-side measure of credit availability, is positively and significantly associated with HELOC originations, cash-out refinancing, and closed-end second liens, but only weakly associated with HECM originations. A 1 percentage point increase in the credit approval rate increases HELOC origination 0.73 percent, cash-out refinancing 1.10 percent, closed-end second lien origination 0.60 percent, and HECM originations 0.14 percent. The relatively limited response of HECMs to the credit availability measure is consistent with HECMs requiring little underwriting, making their origination largely independent of credit conditions.

With regard to household credit conditions, we first examine the effect of the ZIP code median credit score on originations. HELOCs are the only origination type for which we observe an increase in originations as the median credit score increases. Here, a 10 point increase in median credit score increases originations by a modest 0.02 percent. By contrast, a 10 point increase in median credit score is associated with a 0.06 percent decrease in cash-out refinancing originations. Similarly, for second liens and HECMS, a 10 point increase in median credit scores decreases originations by 0.02 and 0.05 percent, respectively. These results suggest that as credit scores in a ZIP code increase, more homeowners extract equity through the relatively desirable HELOC channel and away from other forms of equity extraction.

We further examine the effect of household credit conditions on extraction using the median revolving credit utilization rate in a ZIP code. Of the four extraction channels, credit utilization only affects the incidence of HELOCs and HECMs, with a 1 percentage point increase in the utilization rate increasing HELOC originations by 1.1 percent and HECM originations by 0.6 percent. Given that many HECMs are structured at least in part as a revolving credit line, this suggests that borrowers may be using lower-cost home equity secured revolving credit as a substitute for higher-cost unsecured revolving credit.

Overall, our results suggest that areas that are credit constrained have lower shares of HELOC originations and instead have higher shares of cash-out refinance and HECM originations and, to a lesser extent, second liens. As supply-side credit availability increases, we find that cash-out refinances increase the most, with the least effect on HECM originations. An increase in cash-out refinances in areas with lower credit scores and rising credit availability is consistent with the concentration of subprime originations in areas with latent demand for credit, and the relatively large proportion of subprime originations that included cash-back at closing (Mayer and Pence 2008; Mian and Sufi 2009). The preference for HELOCs among more financially secure borrowers is further supported by the coefficient on median IRS monthly AGI, which shows that HELOC originations increase with ZIP code mean income, while the cash-out refinancing, closed-end second lien originations, and especially HECM originations decline as ZIP code mean income increases. For HECMs, income appears to be a much larger factor driving originations than it is for other channels of extraction. While an increase in AGI is negatively associated with cash-out refinancing, second liens, and HECMs, the size of the coefficient is nearly three times as large for HECM originations.

Our models control for a variety of other credit and demographic indicators, finding sensible effects on equity extraction. Indicators of poor credit quality—such as the share of seniors past due on their mortgage, share with prior foreclosure, or share with bankruptcy—generally reduces the share of all types of equity extraction. Indicators of indebtedness—such as total debt to income or the share of seniors with mortgage debt—are generally associated with an increase in most types of equity extraction, perhaps suggestive of a greater willingness to borrow in these areas. However, a higher amount of existing mortgage debt as measured by higher median debt to median sales price ratios is associated with a relatively consistent reduction in equity extraction originations across channels, as this is likely indicative of having limited additional equity from which to borrow. Similarly, a higher median monthly mortgage payment is associated with a reduction in all origination types except cash-out refinances. In terms of demographic characteristics, an increase in the share of older seniors tends to be associated with reduced equity extraction, with the exception of HECM originations that increase in areas with relatively older populations. This makes sense, as the amount of equity that can be accessed through an HECM increases with age. As the share of minorities (Hispanic or black) increases in a ZIP code, the use of HELOCs declines and cash-out refinancing and HECM use increases. We explore this effect in more detail in our subsample regressions.

Finally, our models control for macroeconomic conditions through the inclusion of interest rate variables specific to each extraction channel and through the inclusion of year and MSA fixed effects. The coefficients on the year dummies (not shown) are consistent with the broader trends in originations observed for each channel over time. The coefficients on forward mortgages, and HELOCs in particular, are negative and increasing in magnitude through our sample period. In contrast, the year coefficients for HECM originations are positive but peak in magnitude in 2009.

Tests for independence reveal that choice of SUR is appropriate. The Breusch-Pagan test for independence reveals a P-value near zero, meaning there is certainly correlation between the errors of our four equations and the SUR framework is an improvement on separate estimation.

[Table 4 here]

6.2 Estimation Results- Minority and Non-Minority Geographic Areas

Next, we turn to our regression analyses by geographic subsamples. Table 4 includes the results of panel estimations with the sample restricted to minority and non-minority ZIP codes. Here we allow the probability of each channel to be affected differently by the set of explanatory variables depending on the racial composition of the ZIP code. Given that our inclusion criteria for being a part of a subsample are fairly wide (e.g., 50 percent to 100 percent of black ZIP codes are in the same group), we continue to include the share of the population that is black in the analysis.

Positive and negative house price growth is significantly associated with HELOC originations in non-minority neighborhoods, with no significant effect on HELOC originations in minority neighborhoods. For HECM originations, negative house price growth is associated with an increase in originations in non-minority neighborhoods, but has no significant effect in minority neighborhoods. This finding is

consistent with individuals in predominately white areas pursuing a more sophisticated strategy of using HECMs to lock in their house price gains.

With regard to supply-side credit availability, when overall credit approval rates for a ZIP code increase, the originations of HELOCs, seconds, and cash-out refinancing rise in all areas, although the responses are greater in magnitude in minority neighborhoods. Moreover, in non-minority neighborhoods, we see HECM originations decline by 0.21 percent when credit approval rates increase by 1 percentage point, whereas credit approval rates do not have a statistically significant effect on HECM originations in minority neighborhoods. This finding suggests that borrowers in non-minority neighborhoods primarily use HECMs when alternative home equity extraction mechanisms—particularly HELOCs—are unavailable, while borrowers in minority neighborhoods select HECMs for reasons unrelated to credit availability.

Turning to household-level credit conditions, credit utilization rates are not significantly associated with any type of extraction in minority neighborhoods, while an increase in utilization rates is associated with a significant increase in HELOC origination rates and decrease in cash-out refinancing in non-minority areas. Median credit scores appear largely unrelated to originations in minority neighborhoods, while higher credit scores are associated with reductions in cash-out refinancing and second liens in non-minority neighborhoods and an increase in HECM originations. This is consistent with more sophisticated borrowers (with higher credit scores) accessing HECMs in non-minority areas, as mentioned earlier.

Differential use of extraction channels in minority and non-minority neighborhoods may be due to differences in the absolute level of explanatory variables, as well as differential responses to explanatory variables. HELOC origination rates are about 50 percent lower in minority neighborhoods relative to non-minority neighborhoods, while cash-out refinancing rates are 37 percent higher, second lien rates are 16 percent higher, and HECM rates are 54 percent higher (see summary statistics in Table 2). We use the estimated coefficients from our subsample regressions to decompose endowment and behavioral effects that may contribute to these differences.

We first consider how predicted channel rates would differ based on shifting the endowment in the typical minority neighborhood to equal the endowment of the typical non-minority neighborhood. The ratio of this difference to the mean extraction rate for the j-th channel (E_{ij}) is: $(\sum b_{1j}*x_{2j}-)-(\sum b_{1j}*x_{1j})/E_{1j}$, where b_{1j} represents the coefficients for the j-th channel in minority areas and b_2j represents the coefficients in non-minority areas, and x_{1j} represents the variable means for the j-th channel in minority areas and x_{2j} represents the variable means in non-minority areas.[17] If minority areas had the same endowments as non-minority areas, our experiment suggests that HELOC rates would increase by 68 percent, while all other extraction channels would decrease, with cash-out refinancing decreasing 41 percent, second liens decreasing by 22 percent, and HECMs dropping to a predicted origination rate near 0. These changes would more than explain the observed differences in channel usage in minority

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[17] The exception is that we keep the spatial distribution of minority and non-minority households the same among ZIP codes; thus, the b does not include the coefficients of the set of ZIP code dummy variables.

neighborhoods. We next assign minority areas only the credit attributes of non-minority areas. With this experiment, we find that HELOC rates would increase by 24 percent, while all other channels would stay virtually the same. Thus, differences in credit conditions only explain a portion of the observed differences for lower HELOC use, but do not explain the higher use of other channels.

Next, we consider the predicted differences in borrowing channels if households in minority areas had the same behavioral responses as households in non-minority areas, calculated as $((\sum b_{2j}*x_{1j})-(\sum b_{1j}*x_{1j})/E_{1j}$, where b_{2j} represents the coefficients in non-minority areas for the j-th extraction channel. Here, we find that the use of cash-out refinancing would decrease an estimated 42 percent, while all other extraction channels would increase, with HELOC rates increasing 80 percent, and second lien and HECM rates increasing about 50 percent. This indicates that extraction rates in general would rise in minority areas if households in minority areas had the same responses to the explanatory variables as households in non-minority areas. This growth would occur across all channels, with the exception of cash-out refinancing, which would decline to a similar rate observed in non-minority areas. Interestingly, HECM rates would also increase further, suggesting that higher rates of HECM use in minority areas are not due to differences in behavioral responses, but rather differences in endowments between the two areas.

6.3 House Price Dynamics and Credit Constraint Interactions

As an additional test, we interact the indicators for positive and negative house price growth with the three alternative indicators for credit constraints (median credit score, credit utilization rate, and credit approval rate) in three separate specifications. To interpret the interactions, we estimate the effect of a 1 percentage point change in house price growth (positive or negative), setting the credit constraint indicators at their mean values and one standard deviation above and below their mean. As with the base specification, we normalize the coefficients by the mean value of extraction for a given channel (the coefficients for the interactions and their components are reported in Appendix B). Table 5 presents the results of the interactions for house price changes and credit scores (Panel A), credit utilization rates (Panel B), and credit approval rates (Panel C).

[Table 5 here]

First, we determine the change in the total equity extraction rate (summed across all extraction channels) as predicted by the interactions. Credit-constrained areas with lower credit scores (Panel A), higher utilization rates (Panel B), and lower approval rates (Panel C) have a lower rate of net equity originations in response to house-price increases. For example, in areas at the mean credit score, a 1 percentage point increase in the HPI rate is associated with a 0.49 percent increase in originations. In areas where the median credit score is one standard deviation (20 points) below the mean, a 1 percentage point increase in the HPI rate is associated with a 0.15 percent increase in equity loan originations—less than one-third of the extraction rate increase for average credit score areas. This is the opposite of Mian and Sufi's (2011) finding that credit-constrained borrowers were most responsive to equity extraction in response to house price increases but is consistent with more recent results

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presented in Adelino et al. (2015) that show the growth in equity extraction prior to the Great Recession was driven by higher income and higher-credit-score borrowers.

By contrast, the extraction rate for cash-out refinances in response to HPI increases is greater in lower credit score areas or areas with higher utilization, in line with Mian and Sufi (2011). But the extraction rates for other channels of extraction are lower in credit-constrained areas. The extraction rate for HELOCs in response to HPI increases is greater in areas with higher credit scores and lower rates of credit utilization. For HECM originations, credit-constrained areas with lower credit scores or higher utilization rates are more responsive to house price declines. This may indicate a greater need for liquidity among borrowing-constrained households, who originate HECMs to lock in equity as house prices fall. Credit approval rates (Panel C) have a greater effect on equity originations than the other credit constraints. Areas with lower credit approval rates (one standard deviation below the mean) are not responsive at all to increases in house prices for equity extraction (the sum of the coefficients is negative). In areas with low approval rates, the only type of extraction that increases in response to HPI increases is cash-out refinances. This is likely indicative of the relaxed underwriting for cash-out refinances prior to the crisis. On the opposite end, areas with high approval rates see higher rate of equity extraction in response to HPI increases: three times higher than areas with average approval rates. In areas with higher approval rates, an increase in house prices is more than twice as likely to result in a HELOC origination than it is in areas with average approval rates. Areas with low credit approval rates are less likely to lock in equity through HECMs as house prices decline, perhaps indicative of lower financial sophistication in areas with lower credit approval rates.

As a final exercise, we include the same set of interactions in our geographic subsamples to test for differences in behavioral responses in minority and non-minority neighborhoods. For simplicity, we report the results of the credit score interactions (Table 6); the interaction results for the other credit constraints (credit utilization and credit approval rates) are substantively similar.

[Table 6 here]

Overall, non-minority neighborhoods are more likely to extract equity in response to house-price increases than minority neighborhoods. However, when credit score is held at the mean sample value (784) in both areas, the total origination rate is the same, where a 1 percentage point increase in the HPI rate is associated with a 0.32 percent increase in originations. However, there are substantial differences in the channel of extraction in response to house prices and credit constraints in minority versus non-minority neighborhoods.

As credit constraints increase (credit scores one standard deviation below the mean), HELOC originations are lower and cash-out refinances are higher in response to increases in HPI. However, minority areas that have lower credit scores respond to an HPI increase through cash-out refinancing at a much greater rate than in non-minority areas (with lower credit scores). Even at the same median credit score (784), minority areas are much more likely to cash-out refinance in response to HPI increases than non-minority areas.

Interestingly, homeowners in minority areas do not respond to HPI declines by originating HECMs, even at the same mean credit score. Holding credit score in the area at 784, predominantly white areas have HECM origination rates that are three times greater in response to house price declines than minority areas. If an area has lower credit scores, it is more likely to respond to HPI decline by originating a HECM, but much more so in non-minority compared with minority areas.[18]

These results suggest that credit constraints or lack thereof play an important role in the decision to extract equity in the face of house price changes. Less constrained borrowers utilize relatively more desirable extraction channels when prices increase. Furthermore, when examining ZIP codes with comparable credit scores, minority and non-minority ZIP codes respond differently to changes in house prices, with non-minority neighborhoods utilizing more sophisticated strategies to capitalize on home equity gains, or to protect against loss of equity.

7. Conclusion

Our results add new insights to the literature on equity extraction. While prior studies have found house price dynamics and credit constraints to be important factors for predicting equity extraction generally, our study finds that the relationships differ considerably depending on the choice of extraction channels. Our innovations include separately considering the rate of use for a particular extraction channel, while allowing unobserved factors to jointly affect all choices. Using credit panel data from both the period of the housing boom and subsequent housing bust, as well as data on HECM originations during the same period, ours is the first known study to model the choice of reverse mortgages alongside other modes of equity extraction.

We find that while the use of forward mortgage channels increases as house prices increase, the use of HECMs increases in areas where house prices are declining. This makes sense, as HECMs can be originated as a hedge against future house-price declines. Despite concerns that HECMs may be adversely selected by borrowers with the highest credit risk, our findings suggest that cash-out refinances were much more likely to be utilized in areas with a higher share of lower credit score individuals. On the other hand, HECM usage is the least sensitive of the extraction channels to credit availability, likely due to lack of risk-based underwriting criteria for HECM loans. The greater incidence of HELOCs in areas with relatively higher credit score borrowers is consistent with HELOCs being a preferred method of home equity extraction given their flexibility as revolving credit, but also with HELOCs being more heavily underwritten by financial institutions, thus limiting their availability to low credit score borrowers.

Differences in house-price dynamics and credit conditions also help explain observed differences in extraction channels in minority areas. Descriptively, in minority areas where blacks comprise at least 50 percent of the population, there exists a different pattern of selecting the channel of equity extraction than in non-minority areas (90+ percent white), although the total rate of originations for the two types of areas is very similar (0.040 versus 0.042 annually). Residents in minority neighborhoods rely much

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[18] The coefficients used to calculate the percent changes reported in Table 5 and 6 are included as Appendix Tables A and B.

less on HELOCs and rely more on cash-out refinancing and HECMs. A question is whether these differences are explained by the differences in the characteristics of the resident households. Our initial regression pools all areas and finds that neither differences in household characteristics (credit, demographic, economic) nor differences in credit availability explain all of the observed differences in use of extraction channels. Specifically, the coefficient for the share of the population that is black is significantly negative in the HELOC equation and significantly positive in the cash-out refinance and HECM equations. We then estimate separate regressions for the two types of geographic areas, allowing the behavioral responses to influential factors to differ by racial composition of the area.

We find that credit conditions in a ZIP code can explain about half of the minority/non-minority variation in HELOC originations. Other differences in endowments between minority and non-minority can more than explain the remaining differences in borrowing channel in minority and non-minority areas. The differing pattern of results across minority and non-minority areas is consistent with borrowers in low-minority areas using HECMs in a more sophisticated way, such as to lock in house price gains or as an alternative to other home equity extraction products when credit availability declines. Similarly, HELOCs are primarily used by borrowers in low-minority areas, suggesting that they are either unavailable to borrowers in high-minority areas or that demand is relatively weak.

Prior research on equity extraction finds that credit-constrained borrowers were most responsive to increases in house prices during the housing boom, where individuals with lower credit scores and higher revolving account utilization rates were more likely to borrow against home equity in response to house price increases (Mian and Sufi 2011). Our interaction results suggest that this effect depends on the channel of extraction. For cash-out refinancing, areas with greater credit constraints are more responsive to house price increases. However, the opposite is true for HELOCs; increases in credit constraints are associated with reduced responsiveness to house price increases. HECMs fall in between. Thus, credit-constrained senior homeowners respond to house price increases through cash-out refinancing, while less constrained homeowners respond to increases in house prices through HELOCs.

Overall, there are no uniform responses to changes in house price or credit constraints applicable to all areas or all extraction types. Equity extraction is the result of a more complicated decision process that responds to the interplay between house price dynamics, racial makeup, credit availability, financial understanding, and institutional policy.

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Figure 1: Mean Equity Extraction Origination Rate as Proportion of Population 62 and Older, by Year

**Mean Equity Extraction Origination Rate
as a Proportion of the Population 62 and older, by Year**

Legend: HELOC · · · · ·   Cashout Refinance ——   Closed-End Second – – –   •HECM ——   •HECM Share – · –
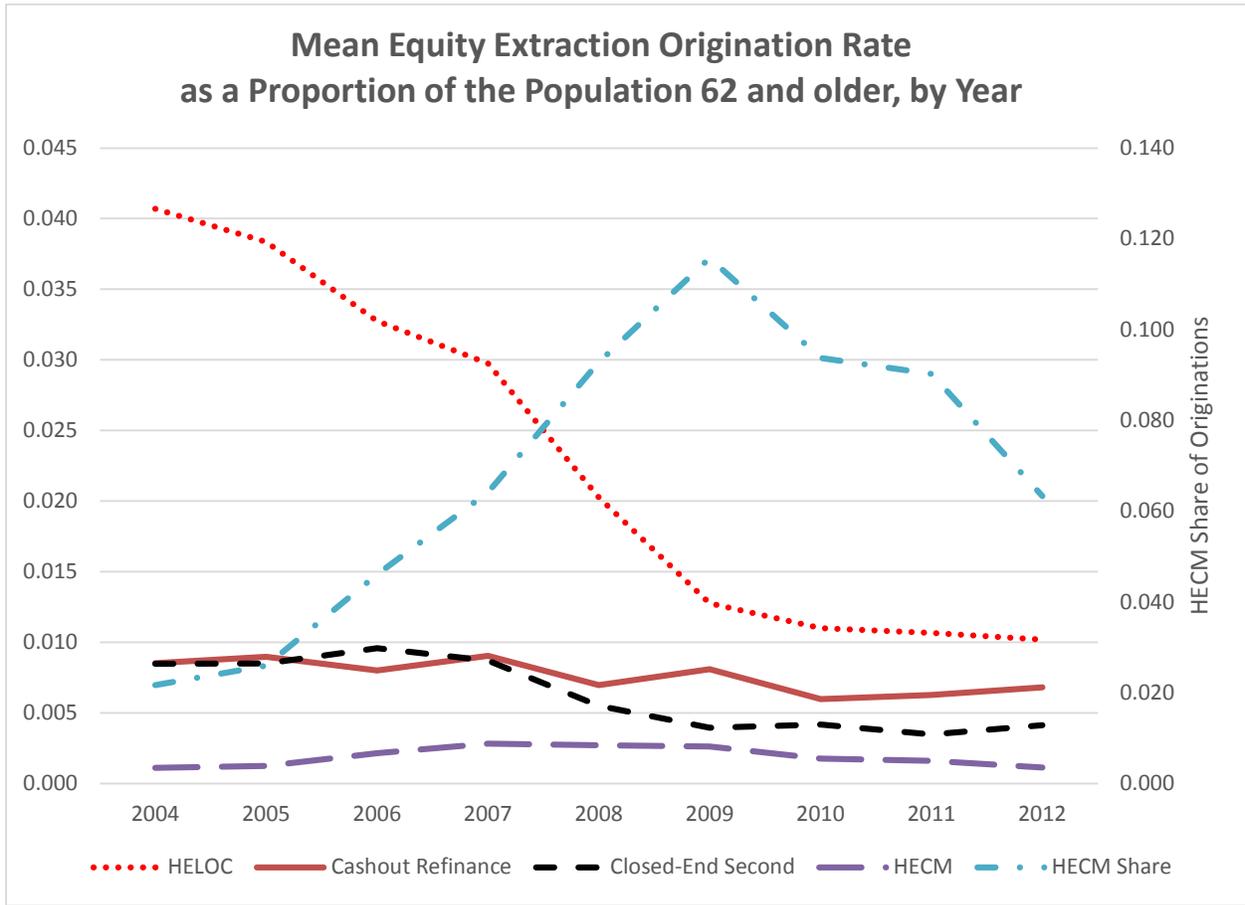
Figure 2 Credit Approval Rate: 2004–13

Credit Approval Rate

Legend:
— Credit Approval Rate (All)
– – Credit Approval Rate (credit below 660)
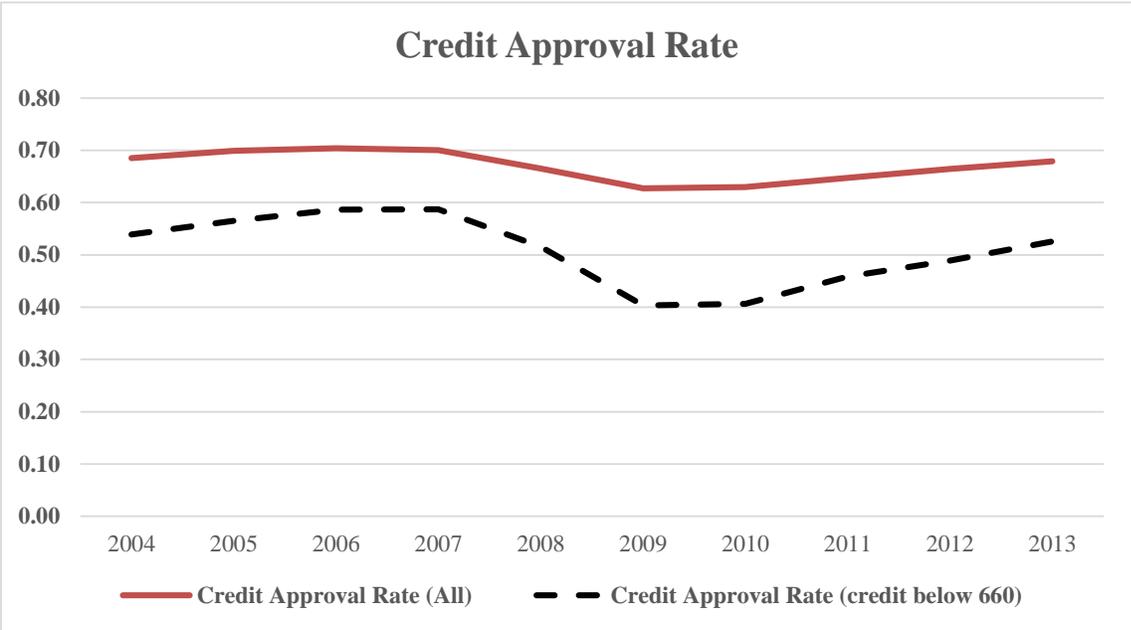
Table 1: Descriptive Statistics for Model Variables, Full Sample (N=39,596)

	Mean	SD	Min	Max
Equity Extraction Share				
HELOC Origination Rate	0.0244	0.0209	0.0008	0.2670
Cash-out Refinance Origination Rate	0.0078	0.0079	0	0.1470
Closed-End Second Origination Rate	0.0066	0.0073	0	0.0771
HECM Origination Rate	0.0019	0.0020	0	0.0293
Housing Market Conditions				
Median Repeat Sales Price (ln)	12.480	0.5600	10.280	14.970
HPI Growth Rate, Positive	0.0460	0.0762	0	0.7840
HPI Growth Rate, Negative	0.0367	0.0568	0	0.5690
HELOC ZIP-level Interest Rate	0.0579	0.0126	0.0200	0.1225
First Mortgage ZIP-level Interest Rate	0.0538	0.0088	0.0250	0.0825
Closed-end Second ZIP-level Interest Rate	0.0668	0.0102	0.0206	0.1161
Average HECM MSA-level Interest Rate	0.0561	0.0004	0.0425	0.0657
Consumer Credit Conditions				
Credit Approval Rate (All)	0.6720	0.0836	0.2310	1.0000
Credit Approval Rate (Under 660)	0.5120	0.1830	0	1.0000
Median Credit Score	783.58	20.18	634	820
Median Revolving Credit Utilization Rate	0.0793	0.0478	0.0152	0.5760
Past Due Mortgage Rate	0.0165	0.0198	0	0.2310
Bankruptcy Rate	0.0090	0.0090	0	0.1360
Foreclosure Rate	0.0027	0.0047	0	0.0760
Revolving Debt to Income Ratio (1 yr lag)	0.0204	0.0136	0	0.5670
Household Characteristics				
Share of Population with Mortgage (1 yr lag)	0.3370	0.1090	0.0502	1.0000
Median Mortgage Debt to Median Sales Price (1 yr lag)	0.3720	0.1560	0	2.4420
Median Monthly Mortgage Payment (1 yr lag)	0.8840	0.3380	0.1360	3.5630
Median IRS AGI (Monthly)	3.5520	1.3520	0.4170	8.3330
Median Age of Seniors with Credit Files	72.4600	2.3100	65	84
Black (share of population)	0.0980	0.1460	0	0.9810
Hispanic (share of population)	0.1300	0.1510	0	0.9750

Note: All dollar amounts in thousands. 5,495 unique ZIP codes.

Table 2: Descriptive Statistics for Model Variables, Geographic Subsamples

	Minority (>50% Black, N=1,483)				Non-Minority (>90% White, N=12,167)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Equity Extraction Share								
HELOC Origination Rate	0.0176	0.0153	0.0014	0.1770	0.0262	0.0210	0.0008	0.2080
Cash-out Refinance Origination Rate	0.0106	0.0097	0	0.0651	0.0067	0.0072	0	0.0947
Closed-End Second Origination Rate	0.0083	0.0082	0	0.0608	0.0070	0.0077	0	0.0733
HECM Origination Rate	0.0035	0.0039	0	0.0292	0.0016	0.0015	0	0.0168
Housing Market Conditions								
Median Repeat Sales Price (ln)	12.1700	0.5300	10.6300	13.7200	12.3800	0.5000	10.2800	14.9700
HPI Growth Rate, Positive	0.0509	0.0762	0	0.4200	0.0390	0.0672	0	0.4930
HPI Growth Rate, Negative	0.0358	0.0581	0	0.4840	0.0331	0.0493	0	0.3190
HELOC ZIP-level Interest Rate	0.0006	0.0130	0.0240	0.1099	0.0573	0.0124	0.0200	0.1225
First Mortgage ZIP-level Interest Rate	0.0564	0.0084	0.0300	0.0788	0.0534	0.0089	0.0250	0.0806
Closed-end Second ZIP-level Interest Rate	0.0640	0.0099	0.0263	0.1049	0.0667	0.0098	0.0208	0.1161
Average HECM MSA-level Interest Rate	0.0568	0.0032	0.0474	0.0618	0.0560	0.0036	0.0455	0.0625
Consumer Credit Conditions								
Credit Approval Rate (All)	0.5920	0.0840	0.2420	0.8640	0.7030	0.0779	0.2860	1.0000
Credit Approval Rate (Under 660)	0.4850	0.1110	0	1.0000	0.5340	0.2100	0	1.0000
Median Credit Score	731.20	34.00	634	805	791.61	10.43	699	820
Median Revolving Credit Utilization Rate	0.1980	0.0913	0.0253	0.5680	0.0628	0.0245	0.0173	0.3090
Past Due Mortgage Rate	0.0322	0.0256	0	0.1900	0.0135	0.0169	0	0.1430
Bankruptcy Rate	0.0159	0.0124	0	0.0824	0.0078	0.0079	0	0.0707
Foreclosure Rate	0.0050	0.0058	0	0.0408	0.0021	0.0040	0	0.0458
Revolving Debt to Income Ratio (1 yr lag)	0.0400	0.0261	0.0035	0.3920	0.0184	0.0097	0.0016	0.4000
Household Characteristics								
Share of Population with Mortgage (1 yr lag)	0.3260	0.1090	0.0969	0.7180	0.3410	0.1040	0.0543	0.9530
Median Mortgage Debt to Median Sales Price (1 yr lag)	0.4080	0.1630	0.0845	1.6220	0.3670	0.1560	0	1.7410
Median Monthly Mortgage Payment (1 yr lag)	0.7860	0.2960	0.2350	2.0690	0.8010	0.3070	0.1480	2.9220
Median IRS AGI (Monthly)	2.5720	0.9710	0.4170	7.2920	3.6500	1.3390	0.4170	8.3330
Median Age of Seniors with Credit Files	71.8500	2.1900	67	80	72.7300	2.3500	65	82
Black (share of population)	0.6720	0.1540	0.3190	0.9810	0.0215	0.0185	0	0.1480
Hispanic (share of population)	0.0750	0.0796	0.0039	0.4320	0.0568	0.0921	0.0010	0.9590

Note: all dollar amounts in thousands   247 unique ZIP codes   1,584 unique ZIP codes

Table 3: SUR Estimates, % Population 62 + Equity Extraction Method, 2004-2012

Values = regression coefficient divided by the mean percentage of originations	HELOC			Cash-out Refinance			Closed-End Second			HECM		
Variable	b/ȳ		SE	b/ȳ		SE	b/ȳ		SE	b/ȳ		SE
Median Real Repeat Sales Price (ln)	0.0064	***	0.0003	0.0014	***	0.0002	-0.0009	***	0.0002	0.0005	***	3.69E-05
HPI Growth Rate, Positive	0.5984	***	0.0811	0.4077	***	0.1099	-0.1447		0.1170	-2.2895	***	0.0958
HPI Growth Rate, Negative	-0.0182		0.0664	-0.2949	**	0.1169	0.1682		0.1120	1.0158	***	0.1358
HELOC Interest Rate	1.1800	***	0.4500									
First Mortgage Interest Rate				-4.0100	*	2.2200						
Closed-End Second Interest Rate							0.4200		0.6100			
MSA Level HECM Interest Rate										9.0500		6.2600
Credit Approval Rate (All)	0.7336	***	0.0508	1.0962	***	0.0771	0.5985	***	0.0864	0.1437	**	0.0611
Median Credit Score	0.0021	***	0.0004	-0.0057	***	0.0007	-0.0023	***	0.0007	-0.0048	***	0.0008
Median Revolving Credit Utilization Rate	1.1148	***	0.1434	-0.1449		0.2474	0.1438		0.2470	0.6211	**	0.2537
Past Due Mortgage Rate	-0.5943	***	0.1680	-0.8423	***	0.3167	0.2000		0.3106	-1.4316	***	0.2642
Bankruptcy Rate	-3.0246	***	0.4631	-0.9974		0.7590	1.0439		0.7909	-8.5789	***	0.5789
Foreclosure Rate	-7.8689	***	0.7787	-5.4231	***	1.5000	-0.1758		1.4030	-1.0263		1.2632
Debt to Income Ratio	0.8402	**	0.3496	-1.4103	***	0.4872	-0.4000		0.5227	3.7684	***	0.9579
Share of Population over 62 with Mortgage	1.8525	***	0.0611	3.3590	***	0.1003	2.4848	***	0.0956	2.0158	***	0.0726
Median Mortgage to Median Sales Price	0.0762	***	0.0287	-0.2410	***	0.0459	-0.2833		0.0488	-0.8316	***	0.0398
Median Monthly Mortgage Payment	-0.1283	***	0.0209	0.2154	***	0.0295	-0.0427	***	0.0314	-0.2989	***	0.0242
Median IRS AGI (Monthly)	0.0697	***	0.0054	-0.0758	***	0.0074	-0.0589	***	0.0080	-0.1763	***	0.0064
Median Age of Seniors with Credit Files	-0.0186	***	0.0019	-0.0050	*	0.0029	-0.0131		0.0032	0.0393	***	0.0026
Black (Share of Population)	-0.3283	***	0.0352	0.7077	***	0.0629	0.0402		0.0656	1.3053	***	0.0668
Hispanic (Share of Population)	-0.1709	***	0.0334	0.4103	***	0.0550	-0.0427		0.0542	0.0753		0.0584
Year & CBSA Fixed Effects	Y			Y			Y			Y		
R-Squared	0.5421			0.2389			0.2153			0.4669		
Dependent Variable Mean	0.0244			0.0078			0.0067			0.0019		
Observations	39,596			39,596			39,596			39,596		
Number of ZIP Codes	5,495			5,495			5,495			5,495		

*** p<0.01, ** p<0.05, * p<0.1

Table 4: SUR Estimates, % Population 62 + Equity Extraction Method, 2004-2012, by Geographic Subsamples

Variable	HELOC Minority b/ȳ		SE	HELOC Non-Minority b/ȳ		SE	Cash-out Refinance Minority b/ȳ		SE	Cash-out Refinance Non-Minority b/ȳ		SE
Median Real Repeat Sales Price (ln)	0.0043	***	0.0012	0.0066	***	0.0006	0.0005		0.0008	0.0003		0.0003
HPI Growth Rate, Positive	0.0201		0.4375	0.6374	***	0.1389	0.4472		0.4623	0.0407		0.2239
HPI Growth Rate, Negative	-0.1108		0.3199	-0.5420	***	0.1332	-0.8264	**	0.3821	0.0912		0.2567
HELOC Interest Rate	-4.8000		2.5700	0.3000	***	0.7300						
First Mortgage Interest Rate							-5.8500		6.7100	-1.7900		4.7500
Closed-End Second Interest Rate												
MSA Level HECM Interest Rate												
Credit Approval Rate (All)	0.7898	**	0.3119	0.6183	***	0.0901	1.2264	***	0.3660	0.6299	***	0.1522
Median Credit Score	0.0023	*	0.0014	0.0007		0.0013	-0.0005		0.0016	-0.0100	***	0.0022
Median Revolving Credit Utilization Rate	0.4574		0.3744	2.0000	***	0.3855	0.5943		0.4858	-1.8806	***	0.6806
Past Due Mortgage Rate	0.0448		0.7443	-1.3206	***	0.3450	-1.0566		0.8462	-0.6299		0.6955
Bankruptcy Rate	-4.2102	*	2.3352	-1.5763	*	0.9580	2.5472		2.2925	-3.6418	**	1.6119
Foreclosure Rate	-9.2045	***	3.1477	-8.8168	***	1.4885	-1.1509		4.3208	-7.9701	**	3.1045
Debt to Income Ratio	-0.3619		0.7898	1.2710		1.0420	-1.8962	**	0.8651	0.3388		1.3060
Share of Population over 62 with Mortgage	1.7102	***	0.3068	1.8397	***	0.1134	3.3491	***	0.3755	2.8358	***	0.1925
Median Mortgage Debt to Median Sales Price	-0.3795	**	0.1744	-0.0151		0.0489	-0.3500	*	0.1840	-0.0515		0.0921
Median Monthly Mortgage Payment	-0.0385		0.2006	-0.1580	***	0.0385	0.1368		0.1651	0.2791	***	0.0688
Median IRS AGI (Monthly)	0.1199	**	0.0493	0.0718	***	0.0098	-0.1198	**	0.0497	-0.0299	*	0.0157
Median Age of Seniors with Credit Files	-0.0430	***	0.0125	-0.0168	***	0.0038	-0.0051		0.0128	-0.0222	***	0.0065
Black (Share of Population)	-0.5648	**	0.2557	0.3420		0.3492	0.5613	**	0.2547	-0.0867		0.5851
Hispanic (Share of Population)	-0.8409	**	0.3534	0.0863		0.1416	0.1594		0.3792	0.2821		0.2791
Year & CBSA Fixed Effects	Y			Y			Y			Y		
R-Squared	0.4846			0.5241			0.4081			0.1794		
Dependent Variable Mean	0.0176			0.0262			0.0106			0.0067		
Observations	1,483			12,167			1,483			12,167		
Number of ZIP Codes	247			1,584			247			1,584		

*** p<0.01, ** p<0.05, * p<0.1

(Cont) Table 4: SUR Estimates, % Population 62 + Equity Extraction Method, 2004-2012, by Geographic Subsamples

Variable	Closed-End Second Minority b/ȳ		SE	Closed-End Second Non-Minority b/ȳ		SE	HECM Minority b/ȳ		SE	HECM Non-Minority b/ȳ		SE
Median Real Repeat Sales Price (ln)	-0.0004		0.0008	-0.0005	*	0.0003	0.0016	***	0.0003	0.0002	***	4.74E-05
HPI Growth Rate, Positive	-0.4783		0.5084	0.0887		0.2100	-3.9143	***	0.4114	-2.1688	***	0.1481
HPI Growth Rate, Negative	-0.2602		0.4458	0.4471	**	0.2229	0.0697		0.5686	2.5938	***	0.2300
HELOC Interest Rate												
First Mortgage Interest Rate												
Closed-End Second Interest Rate	0.1600		3.3500	3.8000		1.2000						
MSA Level HECM Interest Rate							18.170		41.710	-18.060	*	10.310
Credit Approval Rate (All)	0.7386	*	0.4482	0.4457	***	0.1614	0.3429		0.2971	-0.2075	**	0.1006
Median Credit Score	-0.0013		0.0019	-0.0059	***	0.0021	-0.0001		0.0014	0.0027	*	0.0016
Median Revolving Credit Utilization Rate	-0.2819		0.5566	0.8614		0.7157	0.2500		0.4943	-0.0617		0.5538
Past Due Mortgage Rate	0.9783		1.1048	-0.7086		0.6743	-2.2629	***	0.7600	-0.2588		0.4038
Bankruptcy Rate	0.3458		2.7108	-0.2443		1.6000	-5.1429	***	1.7943	-3.7938	***	0.9438
Foreclosure Rate	0.1892		4.8072	-0.1929		2.6857	1.1971		3.2857	5.2938	**	2.5813
Debt to Income Ratio	1.1614		1.0506	0.9000		1.3029	2.5657	**	1.2714	6.5625	**	2.6750
Share Population over 62 with Mortgage	2.7711	***	0.4301	1.8857	***	0.1786	1.8286	***	0.3029	1.1125	***	0.1294
Median Mortgage to Median Sales Price	-0.5108	**	0.2313	-0.1111		0.0861	-1.0143	***	0.1971	-0.4938	***	0.0614
Median Monthly Mortgage Payment	0.1482		0.2072	0.0207		0.0663	-0.4514	***	0.1700	0.0981	**	0.0471
Median IRS AGI (Monthly)	-0.0348		0.0633	-0.0471	***	0.0154	-0.3257	***	0.0449	-0.1888	***	0.0122
Median Age of Seniors with Credit Files	-0.0154		0.0159	-0.0030		0.0065	0.0477	***	0.0137	0.0226	***	0.0046
Black (Share of Population)	0.1843		0.3205	-0.0493		0.6229	1.5657	***	0.2234	-0.1494		0.4019
Hispanic (Share of Population)	0.2265		0.4434	-0.3114		0.2286	0.0691		0.4514	1.3813	***	0.2900
CBSA Fixed Effects	Y			Y			Y			Y		
R-Squared	0.2957			0.2075			0.617			0.5166		
Dependent Variable Mean	0.0083			0.007			0.0035			0.0016		

	1,483	12,167	1,483	12,167
Observations	1,483	12,167	1,483	12,167
Number of ZIP Codes	247	1,584	247	1,584

*** p<0.01, ** p<0.05, * p<0.1

Table 5: Credit Constraint Interactions with Positive and Negative HPI Growth Rate

Panel A: Credit Score Interactions

	% Δ HELOC	% Δ Cash-out	% Δ Second	% Δ HECM	% Δ Extraction Rate
At mean credit score (784)					
0.01 Increase in HPI Rate	0.9257	0.2285	-0.0763	-2.1108	0.493
0.01 Decrease in HPI Rate	-0.1375	-0.2538	0.2379	0.6427	-0.065
One standard deviation (20 points) below the mean credit score (763)					
0.01 Increase in HPI Rate	0.2821	0.5881	-0.2253	-2.3539	0.150
0.01 Decrease in HPI Rate	0.0819	-0.3088	0.0110	1.6224	0.063
One standard deviation (20 points) above the mean credit score (803)					
0.01 Increase in HPI Rate	1.5331	-0.1110	0.0644	-1.8814	0.836
0.01 Decrease in HPI Rate	-0.3446	-0.2020	0.4520	-0.2821	-0.192

Panel B: Credit Utilization Ratio Interactions

	% Δ HELOC	% Δ Cash-out	% Δ Second	% Δ HECM	% Δ Extraction Rate
At mean utilization (0.0793)					
0.01 Increase in HPI Rate	0.6592	0.3288	-0.1299	-2.1702	0.334
0.01 Decrease in HPI Rate	-0.0721	-0.1998	0.2654	0.8602	0.002
At one standard deviation (.0482) above mean utilization (0.1275)-more credit constrained					
0.01 Increase in HPI Rate	0.3649	0.7169	-0.1846	-2.5823	0.203
0.01 Decrease in HPI Rate	-0.0111	-0.3348	0.0409	1.0807	-0.013
At one standard deviation (.0482) below mean utilization (0.0311)- less credit constrained					
0.01 Increase in HPI Rate	0.9535	-0.0593	-0.0752	-1.7581	0.465
0.01 Decrease in HPI Rate	-0.1332	-0.0649	0.4899	0.6397	0.017

Panel C: Credit Approval Ratio Interactions

	% Δ HELOC	% Δ Cash-out	% Δ Second	% Δ HECM	% Δ Extraction Rate
At mean approval (0.672)					
0.01 Increase in HPI Rate	0.5174	0.4032	-0.1550	-2.2613	0.255
0.01 Decrease in HPI Rate	-0.1406	-0.0950	0.2272	1.2388	-0.007

At one standard deviation (.08) below the mean approval (0.5882)- more constrained					
0.01 Increase in HPI Rate	-0.3138	0.1502	-0.3502	-2.5240	-0.336
0.01 Decrease in HPI Rate	0.0297	-0.6302	0.0460	0.6352	-0.065
At one standard deviation (.08) above mean approval (0.7558)- less constrained					
0.01 Increase in HPI Rate	1.3485	0.6562	0.0401	-1.9987	0.845
0.01 Decrease in HPI Rate	-0.3110	0.4403	0.4083	1.8423	0.051

Table 6: Minority Subsample Credit Score Interactions with HPI Growth Rate

Panel A: Minority Areas

	% Δ HELOC	% Δ Cash-out Refinance	% Δ Second Lien	% Δ HECM	% Δ Extraction Rate
At mean credit score (792)					
0.01 Increase in HPI Rate	0.8272	-0.0955	0.2091	-1.8955	0.463
0.01 Decrease in HPI Rate	-0.5863	0.1073	0.4366	2.3350	-0.187
One standard deviation (10 points) below the mean credit score (782)					
0.01 Increase in HPI Rate	0.5348	0.1582	0.0063	-2.0618	0.281
0.01 Decrease in HPI Rate	-0.4126	0.0400	0.1966	4.1600	-0.060
One standard deviation (10 points) above the mean credit score (802)					
0.01 Increase in HPI Rate	1.1195	-0.3493	0.4120	-1.7293	0.645
0.01 Decrease in HPI Rate	-0.7599	0.1747	0.6766	0.5100	-0.314
At mean for full sample (784)					
0.01 Increase in HPI Rate	0.5933	0.1075	0.0469	-2.0285	0.318
0.01 Decrease in HPI Rate	-0.4473	0.0535	0.2446	3.7950	-0.085

Panel B: Non-Minority Areas

	% Δ HELOC	% Δ Cash-out Refinance	% Δ Second Lien	% Δ HECM	% Δ Extraction Rate
At mean credit score (731)					
0.01 Increase in HPI Rate	0.0785	0.4710	-0.4461	-3.8711	-0.272
0.01 Decrease in HPI Rate	-0.2879	-0.8148	-0.2641	-0.0946	-0.406
One standard deviation (34 points) below the mean credit score (697)					
0.01 Increase in HPI Rate	-0.5435	0.3052	-0.6030	-4.2412	-0.655
0.01 Decrease in HPI Rate	0.5949	-1.0024	-0.9523	0.8866	-0.124
One standard deviation (34 points) above the mean credit score (765)					
0.01 Increase in HPI Rate	0.7006	0.6368	-0.2892	-3.5010	0.111
0.01 Decrease in HPI Rate	-1.1707	-0.6271	0.4241	-1.0757	-0.687
At mean for full sample (784)					
0.01 Increase in HPI Rate	1.0482	0.7295	-0.2015	-3.2942	0.324
0.01 Decrease in HPI Rate	-1.6641	-0.5223	0.8087	-1.6240	-0.845

Appendix A. Variable Descriptions

Variable Label		Source
HELOC Origination Rate	Number of new HELOC originations divided by the total population of those 62 and older	CCP/EQUIFAX
Cash-out Refinance Origination Rate	Number of new cash-out refinancing originations divided by the total population of those 62 and older	CCP/EQUIFAX
Second Lien Origination Rate	Number of new closed-end second mortgage originations divided by the total population of those 62 and older	CCP/EQUIFAX
HECM Origination Rate	Number of new HECM originations divided by the total population of those 62 and older	HUD
Median Real Repeat Sales Price (ln)	Natural log of the median home sales price in a ZIP in real (2014) dollars	CoreLogic
HPI Growth Rate, Positive	Annual percent change in the CoreLogic ZIP code level house price index when the change is positive; zero if the change is negative	CoreLogic
HPI Growth Rate, Negative	Annual percent change in the CoreLogic ZIP code level house price index when the change is negative; zero if the change is positive	CoreLogic
Share of Population with Mortgage (1 yr lag)	One year lagged number of credit profiles over age 62 with a mortgage divided by total population of those 62 and older	CCP/EQUIFAX
Median Mortgage Debt to Median Sales Price (1 yr lag)	One year lagged ratio of median mortgage debt for those 62 and older with a mortgage in a ZIP to median home sales price in that ZIP	CCP/EQUIFAX
Median Monthly Mortgage Payment (1 yr lag)	One year lagged median monthly mortgage payment for those 62 and older who have a mortgage	CCP/EQUIFAX
Median IRS AGI (Monthly)	Median monthly gross adjusted income for seniors in a ZIP; expressed in thousands	IRS
Median Age of Seniors with Credit Files	Median age of seniors age 62 and over with a credit profile in the ZIP	CCP/EQUIFAX
Black (Share of Population)	Percentage of the ZIP population that is black	ACS
Hispanic (Share of Population)	Percentage of the ZIP population that is Hispanic	ACS
Past Due Mortgage Share	Percentage of credit profiles for those age 62 and over with a mortgage who have past due mortgage debt	CCP/EQUIFAX
Bankruptcy Share	Percentage of population 62 and older who have bankruptcy on their record	CCP/EQUIFAX
Foreclosure Share	Percentage of population 62 and older who have foreclosure on their record	CCP/EQUIFAX
Median Revolving Credit Utilization Rate	The median of ratio of revolving debt to revolving credit limit for credit profiles age 62 and over in the ZIP	CCP/EQUIFAX

Credit Approval Rate	The number of credit profiles age 62 and over who were approved for credit divided by the number of credit profiles age 62 and over who applied for credit.	CCP/EQUIFAX
Credit Approval Rate (Under 660)	For those with credit scores below 660: the number of credit profiles age 62 and over who were approved for credit divided by the number of credit profiles age 62 and over who applied for credit	CCP/EQUIFAX
Median Credit Score	Median Equifax 3.0 credit score among credit profiles age 62 and over in the ZIP	CCP/EQUIFAX

Appendix B: Credit Constraint Interactions with Positive and Negative HPI

Panel A: Credit Score Interactions with Positive and Negative HPI

	HELOC	Cash-out Refinance	Second Lien	HECM
HPI Negative * Median Credit Score	-0.0003***	2.07e-05	0.0001***	-0.0001***
	(0.0001)	(3.16e-05)	(2.5e-05)	(1.76e-05)
HPI Positive * Median Credit Score	0.0008***	-0.0001***	0.0001**	2.28e-05*
	(0.0001)	(3.16e-05)	(2.16e-05)	(1.20e-05)
HPI Negative	0.2005***	-0.0182	-0.0552***	0.0732***
	(0.0388)	(0.0246)	(0.0195)	(0.0138)
HPI Positive	-0.5753***	0.1079***	-0.0378**	-0.0219**
	(0.0404)	(0.0247)	(0.0167)	(0.0094)
Median Credit Score	3.25e-06	-3.52e-05***	-2.13e-05***	-7.37e-06***
	(1.13e-05)	(6.36e-06)	(5.45e-06)	(1.78e-06)

Panel B: Credit Utilization Ratio Interactions with Positive and Negative HPI

	HELOC	Cash-out Refinance	Second Lien	HECM
HPI Negative * Median Revolving Credit Utilization Rate	0.0309	-0.0217*	-0.0306***	0.0088
	(0.0196)	(0.0127)	(0.0094)	(0.0059)
HPI Positive * Median Revolving Credit Utilization Rate	-0.1490***	0.0624***	-0.0075	-0.0165***
	(0.0246)	(0.0146)	(0.0101)	(0.0043)
HPI Negative	-0.0042*	0.0002	0.0042***	0.0010*
	(0.0026)	(0.0015)	(0.0012)	(0.0005)
HPI Positive	0.0279***	-0.0024*	-0.0003	-0.0029***
	(0.0028)	(0.0014)	(0.0012)	(0.0003)
Median Revolving Credit Utilization Rate	0.0329***	-0.0030	0.0029	0.0015**
	(0.0037)	(0.0022)	(0.0018)	(0.0007)

Panel C: Credit Approval Rate Interactions with Positive and Negative HPI

	HELOC	Cash-out Refinance	Second Lien	HECM
HPI Negative * Credit Approval Rate	-0.0496***	0.0495***	0.0142**	0.0139***
	(0.0154)	(0.0086)	(0.0068)	(0.0025)
HPI Positive *Credit Approval Rate	0.2420***	0.0234***	0.0153**	0.0061***
	(0.0205)	(0.0083)	(0.0070)	(0.0019)
HPI Negative	0.0299***	-0.0340***	-0.00805*	-0.0070***
	(0.0098)	(0.0055)	(0.0043)	(0.0017)
HPI Positive	-0.1500***	-0.0126**	-0.0113**	-0.0084***
	(0.0135)	(0.0056)	(0.0047)	(0.0014)
Credit Approval Rate	0.0088***	0.0056***	0.0027***	-0.0005***
	(0.0017)	(0.0008)	(0.0008)	(0.0002)

Appendix C: Credit Constraint Interactions with Positive and Negative HPI

Panel A: Credit Score Interactions with Positive and Negative HPI, Minority ZIP Codes

	HELOC	Cash-out Refinance	Second Lien	HECM
HPI Negative * Median Credit Score	-0.0005***	5.85e-05	0.0002**	-0.0001*
	(0.0002)	(0.0001)	(8.56e-05)	(5.21e-05)
HPI Positive * Median Credit Score	0.0003*	5.17e-05	3.83e-05	3.81e-05
	(0.0002)	(0.0001)	(9.20e-05)	(2.63e-05)
HPI Negative	0.3290***	-0.0514	-0.1250**	0.0735*
	(0.1120)	(0.0779)	(0.0620)	(0.0389)
HPI Positive	-0.2340*	-0.0328	-0.0317	-0.0414**
	(0.1230)	(0.0747)	(0.0666)	(0.0193)
Median Credit Score	3.67e-05	-9.94e-06	-1.73e-05	3.06e-07
	(2.93e-05)	(1.79e-05)	(1.73e-05)	(5.02e-06)

Panel B: Credit Score Interactions with Positive and Negative HPI, Non-Minority ZIP Codes

	HELOC	Cash-out Refinance	Second Lien	HECM
HPI Negative * Median Credit Score	-0.0005*	4.51e-05	0.0002	-0.0003***
	(0.0003)	(0.0001)	(0.0001)	(5.64e-05)
HPI Positive * Median Credit Score	0.0008***	-0.0002	0.0001	2.66e-05
	(0.0003)	(0.0001)	(9.05e-05)	(1.92e-05)
HPI Negative	0.3450*	-0.0350	-0.1300	0.2350***
	(0.2010)	(0.0945)	(0.0841)	(0.0447)
HPI Positive	-0.5850***	0.1340	-0.1110	-0.0241
	(0.2090)	(0.0840)	(0.0714)	(0.0151)
Median Credit Score	-1.08e-05	-5.91e-05***	-5.53e-05***	1.28e-05***
	(3.75e-05)	(1.63e-05)	(1.72e-05)	(2.91e-06)