An Analysis of Default Risk in the Home Equity Conversion Mortgage (HECM) Program

Stephanie Moulton
John Glenn School Public Affairs
Ohio State University

Donald R. Haurin
Department of Economics
Ohio State University

Wei Shi
Department of Economics
Ohio State University

July 18, 2014

Keywords Reverse Mortgages, Mortgage Default, Senior Housing, Property Taxes

JEL Classification R21, R31, G21

Funding is from two sources: MacArthur Foundation: "Aging in Place: Analyzing the Use of Reverse Mortgages to Preserve Independent Living," 2012-14, Stephanie Moulton, PI. Also the Department of Housing and Urban Development: "Aging in Place: Managing the Use of Reverse Mortgages to Enable Housing Stability," 2013-2015, Stephanie Moulton, PI.

Abstract

While reverse mortgages are intended as a tool to enable financial security for older homeowners, in 2012, nearly 10 percent of reverse mortgage borrowers in the federally insured Home Equity Conversion Mortgage (HECM) program were in default on their property taxes or homeowners insurance. A variety of policy responses were implemented in 2013, including establishing underwriting guidelines for the first time in the program's history. However, there is a lack of data and analysis to inform such criteria. Our analysis follows 30,000 seniors counseled for reverse mortgages between 2006 and 2011. The data includes comprehensive financial and credit report attributes, not typically available in analyses of reverse mortgage borrowers. Using a truncated bivariate probit model, we estimate the likelihood of tax and insurance default. Financial characteristics that increase default risk include the percentage of funds withdrawn in the first month of the loan, a lower credit score, higher property tax to income ratio, low or no unused revolving credit, and history of being past due on mortgage payments or having a tax lien on the property. We simulate the effects of alternative underwriting criteria and policy changes on the probability of take-up and default. While a simple limit on the initial withdrawal percentage substantially reduces default, it also substantially reduces participation in the program. A greater reduction in the default rate with less effect on participation can be achieved by setting thresholds based on credit score or derogatory credit indicators. Further reductions in the default rate with a minimal effect on participation can be achieved by requiring that participants with low credit scores to set aside some of their HECM funds for future property tax and insurance payments, a form of escrowing.

1. Introduction

Home equity is an illiquid asset that can typically only be extracted through home sale or mortgaging the property. However, reverse mortgages provide a mechanism for senior households to withdraw equity from their home without home sale or monthly mortgage payments. The most prevalent form of reverse mortgage, comprising more than 95 percent of the market since the mid-2000s, is the U.S. Department of Housing and Urban Development's (HUD) federally insured Home Equity Conversion Mortgage (HECM). The objective of the HECM program is to provide seniors with a vehicle to "supplement social security, meet unexpected medical expenses and make home improvements" (U.S. Department of Housing and Urban Development 2006). The primary obligations for the homeowner are upkeep of the home, and paying property taxes and homeowner's insurance. As of February, 2012, 9.4 percent of all active HECM loans were in default for not paying property taxes or homeowner's insurance (Consumer Financial Protection Bureau, CFPB, 2012), placing more than 54,000 senior homeowners at risk of foreclosure.

This issue has prompted, for the first time in the reverse mortgage market, a requirement for lenders to underwrite HECMs taking into account borrower financial and credit risk characteristics (Mortgagee Letter 2013-28). While these sorts of underwriting guidelines are a standard component of forward mortgage lending, the introduction of such criteria for HECMs is new. Previously, homeowners over the age of 62 could qualify for a HECM as long as they could pay off existing mortgages, other property liens, and cover closing costs and fees with the proceeds of the HECM (or pay the difference in cash). Because a reverse mortgage does not require a monthly mortgage payment, "ability to pay" was not considered a qualifying factor.

A significant challenge for the reverse mortgage market will be to establish the appropriate criteria to reduce default risk while not unnecessarily excluding households from the market. Unfortunately, there is a lack of prior empirical data and research on reverse mortgage default to inform these criteria. Research is needed that systematically evaluates the relative importance of different factors, and the likely impact of particular underwriting thresholds or other policy restrictions. Several factors have been anecdotally associated with higher rates of default; however, there has been no systematic analysis to date of borrower attributes and program characteristics that contribute to tax and insurance default among reverse mortgage borrowers due to the lack of comprehensive data. For example, it is unknown the extent to which factors such as credit scores, debt, or income are significant predictors of tax and insurance default among reverse mortgage borrowers, as credit and income data were not collected. One of the primary theoretical determinants of default in the forward mortgage market, negative equity, is not applicable for reverse mortgages. Rather, lack of financial resources, liquidity constraints, and poor financial management are likely more important. Further, the way in which borrowers structure their withdrawals of equity from reverse mortgages, principally the proportion of funds distributed as a lump sum at closing, may exacerbate or reduce default risk.

Our analysis directly informs this research need, with a unique dataset of more than 30,000 seniors counseled for reverse mortgages between 2006 and 2011, 58 percent of whom took out HECM loans. The data includes comprehensive financial and credit report attributes not typically available for reverse mortgage borrowers. In partnership with HUD, we link these data to loan-level HECM data containing information on originations, withdrawals, and tax and insurance default outcomes. Our analysis builds on a small body of existing literature modeling reverse mortgage take-up (e.g. Davidoff and Welke 2007; Davidoff 2013; Shan 2011; Haurin et al. 2014) and terminations (e.g. Szymanoski et al. 2007; Bishop and Shan 2008; Davidoff 2013). However, with the exception of the actuarial report prepared for HUD (Integrated Financial Engineering (IFE) 2011; 2012; 2013), the previous literature does not model the probability of tax or insurance default, as data on these variables are not publicly available and have only recently been collected by HUD. Further, previous analyses including the actuarial report lack many important characteristics of borrowers, including income, debt, and credit report attributes that we include in our analysis. To inform our expectations about how these characteristics may influence tax and insurance default for reverse mortgage borrowers, we draw from the extensive literature on mortgage default in the forward market. Our analysis allows us to isolate the effects of explanatory factors at the time of closing that predict tax and insurance default, including indicators of financial resources, liquidity, and historical credit performance. We also account for decisions made regarding the initial withdrawal of HECM funds that may contribute to default risk.

Our model recognizes that the initial decisions of a senior include whether to obtain a HECM and if yes, the initial withdrawal percentage. The next decision is whether to default or not, which is observed for borrowers up to the end of the sample period or termination of the loan. These three decisions are modeled as a truncated bivariate probit, where the initial withdrawal percentage is treated as an endogenous variable. We conclude our analysis with a series of simulations to evaluate the potential impact of credit-based underwriting criteria, in conjunction with limits to initial withdrawals and lifetime set-asides for taxes and insurance.

Our results suggest a statistically significant relationship between future default and certain credit report indicators, including credit score, prior delinquency on mortgage debt, the property tax burden, and prior tax liens. Even after controlling for risk characteristics, the initial withdrawal percentage is an important factor predicting default. Other factors currently proposed as part of the financial assessment, such as installment and revolving debt burdens, are not significant predictors of default. We conclude with a discussion of policy implications and caveats. The simulations indicate that default risk can be reduced with minimal effect on program participation by establishing a minimum credit score criterion. They further suggest that additional reductions in default can be achieved by requiring selected households to set aside HECM funds received at the time of origination, these dedicated to paying future property tax and insurance costs.

2. Policy Background

Reverse mortgages are financial products that allow senior homeowners to borrow against the equity in their home without making a monthly mortgage payment. The balance of the loan grows over time "in reverse" as a function of withdrawals, fees and accrued interest. Amounts owed are not repaid until the borrowers die, move out, sell the home, or a foreclosure occurs. The federal government's HECM program was initiated in the National Housing Act of 1987, with a total of 862,499HECM reverse mortgages originated since the program's inception as of February 28, 2014 (National Reverse Mortgage Lenders Association 2014). While only a small proportion- about 2 percent- of eligible seniors in the U.S. have reverse mortgages, the volume of HECMs has increased substantially in the past decade; 80 percent of HECM loans have been originated since 2006 (CFPB 2012).

HECMs are insured by the Federal Housing Administration (FHA) through the mutual mortgage insurance (MMI) fund, which guarantees borrowers that they will have access to their loan funds in the future, and it guarantees lenders that their loan will be fully repaid to the lender when the home is sold or foreclosed, regardless of the future market value of the home. Further, HECMs are non-recourse loans. At the termination of the reverse mortgage, borrowers (or their heirs) are responsible to pay the lesser of the current balance of the HECM or 95 percent of the appraised value at the time of termination. After repaying the HECM balance, any proceeds from the sale of the home belong to the borrowers or their heirs. The borrowers retain title to the property throughout their residence and are responsible for property taxes, homeowners insurance, and other assessments on the property.

If a borrower fails to pay property taxes or homeowner's insurance, the lender is notified (as a lien holder) and the lender can make the payments out of available HECM loan funds on behalf of the borrower. However, if the borrower has exhausted all available HECM funds, the borrower is considered in "technical default" on the HECM.[1] Default on taxes and insurance is not a terminal outcome for the loan. The lender can make a "corporate advance" of funds to pay the past due obligations for up to two years, adding the amount advanced to the borrower's HECM loan balance and working with the borrower to repay the funds. However, in the absence of repayment or a workout plan, the lender is required to request permission from HUD to accelerate the loan, thereby making it "due and payable," which could lead to eventual foreclosure.[2] As of February 2012, 9.4 percent of active HECMs were in technical default due to failure to pay property taxes and homeowner's insurance (CFPB 2012).

Technical defaults in HECM program can lead to increased risks and costs for the lender, the federal government and the homeowner. The lender servicing the mortgage incurs costs as they seek to work out a solution with the borrower; if they fail to work out a solution or accelerate the property in a timely manner, they may lose the HUD insurance for the loan and be required to assume the debt. To the extent that the default causes the foreclosure of a property in a negative equity position, the federal MMI fund assumes the loss, which likely would have been less severe had the termination of the mortgage occurred through an arms-length sales transaction rather than a foreclosure. This loss can be exacerbated if the timing of the termination is forced to an earlier period than the loan would have otherwise terminated and housing values are relatively low. Finally, for the borrower, foreclosure is antithetical to the underlying policy intent of the program- to enable senior homeowners to have increased financial stability while remaining in their homes.

---

[1]This amount is not based on the current value of the property, but rather the initial loan amount adjusted for growth, less any prior withdrawals. Subsequent changes in property values are not accounted for in this determination. Thus, loan proceeds may be available even if the current property value is less than the current loan balance. In contrast, loan proceeds may not be available even if the current property value greatly exceeds the loan balance due to house price appreciation.

[2]HUD will not assume a HECM from the lender if the property taxes and insurance are not up to date. To maintain the loan in good standing with HUD, and thus available for assignment, the lender must follow HUD guidelines regarding payment of property taxes and insurance, and request permission from HUD to call the loan due and payment (acceleration) when such obligations are not met. Once the loan is approved for acceleration, the servicer will issue a due and payable notice to the borrower. The issuance of this notice may motivate the borrower to cure the default in tax or insurance through a repayment plan or alternative financing. If the borrower does not work to solve the issue within the required time frames, then a notice of intent to foreclose will be issued and, after six months, legal action of foreclosure must be taken.

Under the authority of Congress, HUD is permitted to establish rules that structure HECM product options for borrowers in line with the policy intent, while maintaining the solvency of the program (for example, see Mortgagee Letters 2013-27; 2013-28; 2013-33). These rules can be described as those targeting eligibility, including borrower and property eligibility criteria, and those targeting the use of HECM proceeds, including maximum loan amounts, fees, and withdrawal limits. Both of these sets of rules act as levers that HUD can adjust in response to changing market conditions, borrower needs, and projected losses (or gains) to the MMI fund. Changes to these rules affect homeowners' decisions to take out a HECM and decisions about withdrawing funds, both of which are expected to influence the probability of tax and insurance default. However, the impact of the different levers on program outcomes is currently unclear. Our paper addresses this deficiency by modeling the relative impact of rules restricting eligibility criteria and the use of HECM funds. Below we provide a brief background of the different sets of rules and how they have changed over time.

The first set of rules includes those that affect borrower eligibility. To be eligible for a HECM, the youngest borrower must be at least 62 years of age and live in the home as their principal residence.[3] If the borrower has an existing mortgage or lien on the property, the proceeds from the HECM must be sufficient to pay off that mortgage or the borrower must be willing to bring extra cash to pay off the loan(s), as the HECM can be the only lien on the home. Because of the complexities of the mortgage product, potential HECM borrowers must receive counseling from a HUD approved agency prior to application for a loan. Historically, HUD has not imposed any additional underwriting criteria (e.g., related to credit score, debt or income). However, beginning in 2014, HUD requires lenders to assess and document a borrower's "ability to pay" before originating a loan, following minimum credit, debt and affordability standards (Mortgagee Letter 2013-28). Borrowers failing to meet the new underwriting criteria can be denied a HECM, or can be required to set aside a portion of their available principal in a lender managed escrow account to cover future property tax and insurance obligations, called a life expectancy set-aside (LESA).

Thus, in addition to having sufficient funds available through the HECM to pay off existing mortgage debt, borrowers failing to meet the underwriting criteria also need to have sufficient money available through the HECM or in cash to fund the tax and insurance LESA. The implications of these policy changes are unclear. On the one hand, the overall default rate for the program should fall. On the other hand, it is unclear what proportion of borrowers falling below the underwriting thresholds will

[3] Additional details are in Haurin et al. (2014) and Moulton et al. (2014).

have sufficient equity to fund the set aside, in addition to paying off their mortgage debt and other obligations. Thus the proportion of seniors who are eligible to obtain a HECM will fall. To understand this tradeoff, our analysis explores the impact of different credit thresholds and LESA requirements on both take-up and default rates.

The second set of policy rules include those that affect the use of HECM proceeds. The amount of money that a borrower can access from a HECM, or principal limit, is the product of HUD's principal limit factor multiplied by the maximum claim amount (MCA). The MCA is the lesser of the appraised value on the home or the HECM loan limit. The HECM loan limit has increased over time, to a nationwide limit of $625,000 in February, 2009. HUD sets the principal limit factor as a function of the borrower's age and the expected interest rate. For adjustable rate HECMS, the expected interest rate is calculated based on the 10 year interest rate index (LIBOR swap rate or the 10-year Constant Maturity Treasury), plus the lender's margin. For fixed rate HECMs, the expected interest rate is equal to the actual rate on the mortgage. The principal limit factor is set based on the estimated growth of the balance on a HECM (principal plus accrued interest) over the expected lifetime of the loan. The balance is expected to grow up to but not in excess of the MCA, as HUD assumes liability for HECMs with loan balances greater than 98 percent of the MCA and must pay for any shortfalls out of the MMI fund.

The amount of money that a borrower can receive from a HECM, or the net principal limit, is calculated by subtracting from the initial principal limit any mandatory obligations, including mortgages that must be paid off, as well as up-front closing costs and mortgage insurance premiums if the borrower chooses to finance them in the mortgage. The proceeds from a HECM loan can be distributed to borrowers through a variety of different payment structures: a lump-sum at origination, a line of credit, "tenure" payments (a lifetime annuity), and "term" payments (an annuity for a specified number of years), or some combination of these options. Borrowers taking out a fixed rate HECM are forced to take all money as a lump sum at closing. However, drawing all funds at closing may increase default risk to borrowers, who have no available funds in the HECM to draw from if needed, and may increase the "crossover risk" to the program-- that the balance will grow to exceed the value of the home at a rate faster than projected. Due in part to this increased risk, HUD placed a moratorium on the standard fixed rate-full draw HECM product in 2013 (Mortgagee Letter 2013-1). This was a substantial policy change, as this option had come to dominate the market, growing from less than 10 percent in early 2009 to 70 percent of the market by 2012 (CFPB 2012).[4] Further, in 2013, HUD issued a new rule restricting the withdrawal amount in the first year to 60 percent of the initial principal limit, with a provision for higher amounts if needed to payoff mandatory obligations, primarily existing mortgages (Mortgagee Letter 2013-27. 2013). The initial withdrawal restriction is intended to reduce default risk; however, the actual impact of the initial withdrawal amount on tax and insurance default is unknown. Our analysis allows us to assess the impact of the initial withdrawal amount on default, holding constant other risk characteristics that are also likely associated with the initial withdrawal amount. We also simulate the expected impact of initial withdrawal restrictions on both take-up and default, expecting that some households will no longer be motivated to take-out a HECM if they cannot have immediate access to the full amount of their available equity.

3. Existing Literature

No known published research examines the causes of tax and insurance default for reverse mortgage borrowers, with the exception of the actuarial report on the HECM program prepared for HUD (IFE 2011; 2012; 2013). However, even this report is based on limited data, lacking borrower financial and credit characteristics. There are two bodies of related literature on reverse mortgages that have some relevance for tax and insurance default outcomes. First, there is a small body of research that considers factors associated with the take-up of reverse mortgages. These studies are relevant in that a household can default on a HECM only if it has previously obtained a HECM, and observed and unobserved factors that lead a household to take a HECM may also be associated with default. Using HUD loan level data on reverse mortgage borrowers from 1995-2005 and U.S. Census data from 2000, Shan (2011) estimates the take-up rate for reverse mortgages at the zip-code level. She finds that zip-codes with lower incomes, higher home values, higher owner costs relative to income, higher levels of education, higher proportion of minority residents and lower average credit scores are associated with a higher reverse mortgage take-up rate.

[4] Prior to 2008, only adjustable rate HECMs were available in the market. However, the exit of Fannie Mae from the HECM market in 2008, combined with rule clarification from HUD allowing a closed-end full draw HECM, led to the creation of a fixed rate product (Mortgagee Letter 2008-08). Typically, fixed interest rates tend to be higher than the expected rate on an adjustable HECM. However, an increase in investor demand for fixed rate HECM securities combined with record low interest rates led the fixed rate to be lower than the expected ARM rate for a period of time from April 2009 to June 2010, and at different point in time during 2011 (CFPB 2012). Due to the lower fixed rate during these periods, borrowers could access more of their equity up-front by taking a fixed rate, full draw HECM.

Recent work by Haurin et. al (2014) finds that house price dynamics are also an important factor; a higher proportion of homeowners take-out reverse mortgages in states where house prices are high relative to the long term average and where house prices are more volatile, suggesting that seniors may take reverse mortgages to lock-in home equity. This finding extends prior work by Nakajima and Telyukova (2013), who estimate the demand for reverse mortgages will be greater when there is house price uncertainty, as reverse mortgages can serve as a hedge against house price risk. Nakajima and Telyukova also estimate that homeowners with higher health care costs will be more likely to take out reverse mortgages to help cover medical expenditures. Davidoff (2014) finds that neighborhoods with a higher minority concentration also tend to have higher rates of HECM borrowing; however, he notes that there is a correlation between neighborhoods with volatile house prices and a high proportion of minority residents. Taken together, these studies suggest that reverse mortgage borrowers are more likely to be financially constrained, with lower incomes and non-housing assets.

Second, there are several empirical studies that examine termination and assignment outcomes in the HECM program. These outcomes are relevant for tax and insurance default for several reasons. Terminations typically occur when the borrower sells the home or refinances, or upon the death of the last borrower. However, terminations also result from foreclosures when the borrower fails to maintain the property or pay taxes and insurance. From the perspective of the lender and secondary market investors, loan assignment is a terminal outcome. A unique feature of the HECM program is that a loan can be assigned by the lender to HUD when the loan balance is equal to 98 percent or more of the initial maximum claim amount. However, loans where borrowers are in technical default for failure to pay property taxes or insurance cannot be assigned to HUD; the lender must accelerate the loan if the default cannot be remedied before assigning to HUD, potentially resulting in foreclosure.

While tax and insurance default is not a terminal outcome, it can lead to termination and prevent loan assignment. Thus, previous studies of termination may be picking up factors related to tax and insurance defaults. Therefore understanding factors associated with these outcomes indirectly informs tax and insurance default. In an early study, Rodda et al. (2004) model terminations using 1990-2000 HECM data and find that significant explanatory variables include borrower age, income at the time of origination, gender, presence of a co-borrower, house price growth, and the spread between 30 year and one-year Treasury bills. Not significant are the amount of borrower assets or home equity at the time of origination. Szymanoski et al. (2007) report the hazard rates of termination by borrower, and type of borrower (couple or gender if single). They found that the average duration of a reverse mortgage was seven years, with a 10 year survival rate of only 22 percent. Couples tend to terminate more quickly, followed by single males. In their study of terminations, Bishop and Shan (2008) find similar differences by marital status and gender. Shan (2011) extends the empirical model and finds that an increase in initial house value and the house price appreciation rate in the locality are positively associated with termination, suggesting that HECM borrowers may sell their homes or refinance to tap additional equity when housing values increase.

Using data from the American Community Survey and HUD's reverse mortgage database, Davidoff and Welke (2007) find that HECM borrowers tend to terminate their mortgages and exit their homes more quickly than otherwise similar non-HECM senior homeowners. They suggest that reverse mortgage borrowers may be heavy discounters who have a stronger desire to extract home equity, both through a reverse mortgage and through sale when housing values increase. This runs counter to expectations of adverse selection in the HECM program, where borrowers who expect to stay in their homes longer enter into reverse mortgages, taking advantage of the insurance feature of the product that kicks in when the balance on the mortgage exceeds the house value (Shiller and Weiss 2000; Miceli and Sirmans 1994). In subsequent work, Davidoff (2013) also finds that HECM borrowers do not appear to behave ruthlessly by exercising their "put option," allowing credit line funds to grow at a rate that is higher than their home appreciation and then drawing the remaining funds immediately prior to termination.

The only empirical analysis of tax and insurance default in the HECM program is that by IFE in their actuarial reports prepared for HUD (IFE 2011; 2012; 2013). The reports find that defaults are more likely the greater the initial withdrawal, the younger the borrower, for single borrowers, for property located in Florida, Texas, and California, and for a longer time since origination.[5] They also find that default likelihood is lower if the dwelling's value is above the area median home value and if the borrower selects a fixed rate, full draw loan (IFE 2012). While the IFE analysis provides some information about characteristics associated with technical default, the data set is limited and important borrower characteristics such income, assets, and credit score were not collected. This omission not only reduces an understanding of important factors that could be the target of policy tools, but the estimated effects of variables included in the analysis suffer from omitted variable bias. Further, the IFE analysis does not take into account the selectivity of the HECM population and thus the IFE study is subject to sample

[5] The average default occurs in the 3rd year after origination (IFE 2013).

selection bias.[6] Finally, the IFE study treats the initial withdrawal amount as exogenous; however, unobserved factors that are associated with higher draw amounts may also be associated with tax and insurance defaults. Our analysis helps address these deficiencies by including a broader array of borrower characteristics likely associated with default, and by accounting for the selection process into a HECM and the resulting partial observability of the initial withdrawal and default.

4. Theoretical Expectations and Model

4.1 Theoretical Expectations

We form our expectations about property tax and insurance default for reverse mortgages by drawing from prior literature on mortgage default in the forward market, adapting our expectations to fit the unique structural features of the HECM product and the irregularity of property tax and insurance payments. In the forward mortgage market, default is typically framed through an options theoretic model, where households optimally exercise their options embedded in a mortgage to put (default) or call (prepay) their mortgage, based in large part on the value of the home and balance of the mortgage. Borrowers are more likely to ruthlessly default under conditions of negative home equity (Vandell 1995; Deng et al. 2000). Prior empirical studies have found negative equity to be a significant, although not perfect predictor of mortgage default (Foote et al. 2008; Mayer et al. 2009; Elul et al. 2010). However, the insurance feature of the HECM program covers any shortfall between home value and the balance on the mortgage; therefore, a reverse mortgage borrower behaving ruthlessly may actually have an incentive to stay in the home longer under conditions of negative equity (Shiller and Weiss 2000; Miceli and Sirmans 1994). While there is a lack of evidence for reduced mobility in the HECM program to date (Davidoff 2013), there is little reason to expect HECM borrowers to ruthlessly default under conditions of negative equity.

A complimentary perspective on mortgage default is the trigger events model (Vandell 1995; Ambrose and Capone 1998; Elmer and Seelig 1999), where default occurs because of a negative shock to the household post-origination, such as loss of income or increased medical expenses. Even for post-origination shocks, observable characteristics at the time of origination may describe a household's ability to endure an economic shock, and thus characteristics at the time of origination are often used in underwriting decisions for forward mortgages. They include measures of debt payments to income, the amount of net wealth, earnings ability, and credit history, which may reflect a borrower's capacity to

[6] A similar problem was identified in the forward mortgage market by Ross (2000), who was estimating default probabilities.

recover from financial shocks. Negative equity can compound the default probability in the presence of a triggering event, as a household facing a triggering event might otherwise be able to extract equity (e.g., through sale) to help compensate for the loss.

The financial position of a household, including cash flow deficiencies, liquidity constraints and poor credit management, have been found to be important predictors of default in the forward market (Avery et al 1996; Pennington-Cross 2003; Foote, Gerardi and Willen 2008; Elul et al. 2010; Demyanyk and Van Hemert 2011). These factors are important for HECM borrowers, not only because they may be associated with vulnerability to future trigger events, but because they may indicate households that lack the capacity or willingness to pay property taxes and insurance even from the time of origination of the HECM. While traditional underwriting in the forward mortgage market evaluates the borrower's ability to pay the mortgage obligations at the time of origination, this has not been the case in the HECM program, as there was no monthly mortgage payment. However, property taxes and insurance are reoccurring expenses that borrowers must maintain in order to prevent default.

Through 2013, HECM borrowers could be in default on property taxes and insurance at the time of origination, as long as the proceeds from the HECM were sufficient to bring any past due amounts current. There were no additional underwriting requirements to ensure that borrowers had the ability to pay their ongoing taxes and insurance after origination of the HECM. It is thus expected that lower incomes and higher debt burdens at the time of origination will be associated with increased risk of default on property tax and insurance payments for HECM borrowers, as has been documented in the forward market. A parallel can be made to the default risk associated with lax underwriting for subprime mortgage borrowers. Researchers found that many subprime borrowers were unable to afford mortgage payments from the time of origination, with mortgage payments exceeding 50 percent of household income (Mayer et al. 2009).

Household financial constraints can also increase vulnerability to trigger events. In the presence of a negative income shock or trigger event, households often can, at least temporarily, finance consumption and mandatory obligations from savings, borrowing, or other forms of wealth (Elmer and Seelig 1999). Households with lower levels of non-housing wealth have fewer resources to draw from in the presence of a shock. Liquidity indicates the ability of a household to borrow to finance consumption (Agarwal et al. 2007). Households that are both wealth constrained and liquidity constrained are more likely to experience default in the forward mortgage market (Elul et al. 2010). In general, we expect that HECM borrowers are more illiquid and have fewer non-housing assets than other senior households (Shan 2011; Nakajima and Telyukova 2013). Home equity is often the primary asset and source of capital for seniors, motivating equity extraction through HECM borrowing in the first place (Mayer and Simmons 1994; Hurst and Stafford 2004). Thus, we expect that HECM borrowers with relatively high non-housing wealth and revolving credit availability at the time of origination to be less likely to default on property taxes and insurance.

Further, the lumpy nature of property tax and insurance payments-- infrequent installment amounts due once or twice per year-- may increase default risk for HECM borrowers. Property tax and insurance payments for HECM borrowers are not escrowed as part of a monthly mortgage payment as in the forward market, as there is no monthly payment. The lumpy property tax or insurance payment may create a liquidity problem for households with little wealth and credit availability. A study by Anderson and Dokko (2011) finds that subprime borrowers, who lacked escrows for property taxes and homeowners insurance, were more likely to experience early delinquency on their mortgage immediately following their property tax due dates.

The infrequent, lumpy nature of property tax and insurance payments may also create default risk for households who are poor financial planners. Some households may simply neglect to make their payments if they are not a predictable, regular part of monthly expenses. There is some evidence of lower property delinquency rates in taxing jurisdictions that bill more frequently and in smaller increments (Waldhart and Reschovsky 2012).

Prior research suggests that senior households with lower levels of financial literacy and planning may have difficulty making financial decisions (Lusardi and Mitchell 2007; 2011). In the default literature, prior credit payment histories and credit scores at the time of origination have been a persistent predictor of mortgage default even after accounting for negative equity, financial resources, and exposure to trigger events (Avery et al. 1996; Pennington-Cross 2003). We expect that households in the HECM program who exhibit prior histories of poor financial planning (e.g., missed payments) are more likely to default on their property taxes and insurance.

A final unique aspect of the HECM program that may be associated with default risk is the borrower's management of HECM funds, and specifically the amount of available proceeds withdrawn near the time of origination. To the extent that borrowers consume equity when it is extracted, it is no longer available to cover future property tax and insurance payments. Even if the extracted equity is used to pay down debt and therefore increase monthly cash flow, the additional monthly liquidity may not be sufficient to cover large, irregular property tax and insurance installments. Prior research on income tax rebates suggests that liquidity constrained households may be more likely to increase consumption in response to a lumpy infusion of cash rather than save the funds for later use (Agarwal et al. 2007). A large initial withdrawal of equity in the HECM program may increase consumption in the short term, at the expense of being available to cover longer term financial needs. We thus expect that an increase in the initial withdrawal amount to be positively associated with increased default risk, above and beyond the risk associated with illiquidity and poor financial planning.

4.2 Empirical Model

The purpose of our empirical analysis is to identify factors at the time of origination that are associated with future property tax and insurance default, conditioned on a household having obtaining a HECM and the amount of funds withdrawn up-front (withdrawal percentage). The decision to obtain a HECM and default are binary outcomes, while the withdrawal percentage is a continuous outcome.[7] Whether a household defaults and the withdrawal percentage is observed only if the household obtains a HECM.

Unobserved characteristics that contribute to obtaining a HECM and the withdrawal percentage may potentially be correlated with default propensity. For example, consider a household with significant financial constraints at the time when a decision is made regarding whether to obtain a HECM. Further assume that there is a positive correlation between obtaining a HECM, high withdrawal percentages and subsequent default. Part of this correlation may be explained by observable variables such as the amount of non-housing assets, property tax burden relative to income, or payments that would be mandatory at the time of origination such as for existing mortgages or home equity loans on the property. However, other factors may be unobservable such as the household having a tendency to quickly spend all liquid assets in its possession or other poor credit management behaviors. Thus, we allow the error terms in the three equations to be correlated.

We use a truncated bivariate probit model to model default, accounting for sample selection, given that households have a choice to select into a HECM. We estimate three equations simultaneously.

---

[7]We treat technical default due to non-payment of property taxes and homeowner's insurance as a binary outcome, rather than modeling it as a competing risk with prepayment as default is typically modeled in the forward mortgage literature. This is because we do not view technical default in the HECM program as a competing risk with prepayment. It is unlikely that a household would sell the home and move to avoid a technical default, given the transaction costs of moving, the fact that a move would terminate the HECM and forfeit the insurance aspect of the HECM loan, and the fact that a technical default is not a foreclosure and can be cured through a workout with the lender. However, we recognize that households who terminate their loans have a shorter exposure time for technical default (sample truncation). We therefore include an exposure term that is equal to the time of counseling until termination or the last date observed in the data. Further, we are unable to measure default using a proportional hazards model due to data constraints; we only observe the time of default for about half of the observations in our sample.

- HECM selection

$$y_{i1}^{*} = x_{i1}'\beta_1 + z_i'\alpha_1 + \epsilon_{i1} \tag{1}$$

The household selects a HECM ($y_{i1} = 1$) if $y_{i1}^{*} > 0$ and does not take up HECM otherwise.

- Default

$$y_{i2}^{*} = x_{i2}'\beta_2 + z_i'\alpha_2 + w_i\gamma + \epsilon_{i2} \tag{2}$$

The household defaults on tax or insurance ($y_{i2} = 1$) if $y_{i2}^{*} > 0$ and $y_{i1} = 1$. w_i is the initial withdrawal variable.

- Withdrawal

$$w_i = x_{i3}'\beta_3 + z_i'\alpha_3 + \epsilon_{i3} \tag{3}$$

In (1)-(3), z_i are the common regressors and x_{i1}, x_{i2}, x_{i3} are the regressors unique in the respective equation. The identification is achieved from variables x_{13} which are unique to the withdrawal equation. The unobservables $[\epsilon_{i1} \quad \epsilon_{i2} \quad \epsilon_{i3}]$ are jointly normal with mean 0 and variance

$$\Sigma = \begin{bmatrix} 1 & \rho_{12} & \rho_{13}\sigma \\ \rho_{12} & 1 & \rho_{23}\sigma \\ \rho_{13}\sigma & \rho_{23}\sigma & \sigma^2 \end{bmatrix}. \tag{4}$$

The unobservables are assumed to be independently and identically distributed between individuals and independent from the regressors x_{i1}, x_{i2}, x_{i3}, z_i. The initial withdrawal is endogenous if $\rho_{13} \neq 0$ or $\rho_{23} \neq 0$.

There are 3 cases.

		case 1	case 2	case 3
y_{i1}	HECM take-up	1	1	0
y_{i2}	default	1	0	·
w_i	initial draw	observed	observed	·

- Case 1: the household selects a HECM, $y_{i1} = 1$, withdraws w_i, and defaults, $y_{i2} = 1$. The joint density is

$$
\begin{aligned}
l_{i1}(\theta) &= f(\mathrm{y}_{i1}=1,\mathrm{y}_{i2}=1,\mathrm{w}_i=\mathrm{w}|\mathrm{x}_{i1},\mathrm{x}_{i2},\mathrm{x}_{i3},\mathrm{z}_i) \\
&= \int_{-x_{i1}'\beta_1-z_i'\alpha_1} \int_{-x_{i2}'\beta_2-z_i'\alpha_2-w_i\gamma} \phi_3(\epsilon_1,\epsilon_2,w-x_{i3}'\beta_3-\mathrm{z}_i'\alpha_3)\,d\epsilon_2\,d\epsilon_1 \\
&= \int_{-x_{i1}'\beta_1-z_i'\alpha_1} \int_{-x_{i2}'\beta_2-z_i'\alpha_2-w_i\gamma} \phi_{\epsilon_1,\epsilon_2|\epsilon_3=w-x_{i3}'\beta_3-z_i'\alpha_3}(\epsilon_1,\epsilon_2)\, f(\mathrm{w}\,|\,x_{i3},\mathrm{z}_i)\,d\epsilon_2\,d\epsilon_1 \\
&= f(\mathrm{w}\,|\,x_{i3},\mathrm{z}_i)\int_{-x_{i1}'\beta_1-z_i'\alpha_1} \int_{-x_{i2}'\beta_2-z_i'\alpha_2-w_i\gamma} \phi_{\epsilon_1,\epsilon_2|\epsilon_3=w-x_{i3}'\beta_3-z_i'\alpha_3}(\epsilon_1,\epsilon_2)\,d\epsilon_2\,d\epsilon_1 \\
&= f(\mathrm{w}|\mathrm{x}_{i3},\mathrm{z}_i)\mathrm{P}(\mathrm{y}_{i1}=1,\mathrm{y}_{i2}=1|\mathrm{x}_{i1},\mathrm{x}_{i2},\mathrm{x}_{i3},\mathrm{z}_i,\mathrm{w}_i=\mathrm{w})
\end{aligned}
$$

Here, ϕ_3 is the density of trivariate normal distribution with mean $\begin{bmatrix}0 & 0 & 0\end{bmatrix}$ and variance Σ as in Eq. (4). Then the trivariate normal density is written as a product of the marginal density of ϵ_{i3} and the conditional density of ϵ_{i1}, ϵ_{i2} on $\epsilon_{i3} = w - x_{i3}'\beta_3 - z_i'\alpha_3$. The terms in the last equation are

$$
\log f(w_i = w\,|\,x_{i3},\mathrm{z}_i) \propto -\frac{1}{2}\log\sigma^2 - \frac{1}{2\sigma^2}(w - x_{i3}'\beta_3 - \mathrm{z}_i'\alpha_3)^2,
$$

$$
\log P(y_{i1}=1, y_{i2}=1\,|\,x_{i1},x_{i2},x_{i3},\mathrm{z}_i,w_i=w) = \log\Phi_2(x_{i1}'\beta_1, x_{i2}'\beta_2 + \mathrm{z}_i'\alpha_2 + w_i\gamma_2; \bar{\mu}_{i,1}, \bar{\Sigma}_1)
$$

where $\phi_2(\cdot,\cdot;\bar{\mu}_{i,1},\bar{\Sigma}_1)$ is the cdf of a bivariate normal $(\bar{\mu}_{i,1},\bar{\Sigma}_1)$. Using the properties of a multivariate normal distribution,

$$
\bar{\mu}_{i,1} = \begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}\Sigma_{12}\Sigma_{22}^{-1}(\mathrm{w}_i - x_{i3}'\beta_3) = \begin{pmatrix} -\dfrac{\rho_{13}}{\sigma} \\ -\dfrac{\rho_{23}}{\sigma} \end{pmatrix}(\mathrm{w}_i - \mathrm{x}_{i3}'\beta_3 - \mathrm{z}_i'\alpha_3)
$$

$$
\bar{\Sigma}_1 = \Sigma_{11} - \Sigma_{12}\Sigma_{22}^{-1}\Sigma_{21} = \begin{pmatrix} 1-\rho_{13}^2 & \rho_{12}-\rho_{13}\rho_{23} \\ \rho_{12}-\rho_{13}\rho_{23} & 1-\rho_{23}^2 \end{pmatrix}
$$

where $\Sigma_{11} = \begin{pmatrix} 1 & \rho_{12} \\ \rho_{12} & 1 \end{pmatrix}$, $\Sigma_{22} = \sigma^2$, and $\Sigma_{12} = \begin{pmatrix} \rho_{13}\sigma \\ \rho_{23}\sigma \end{pmatrix}$.

- Case 2: the household selects a HECM, $y_{i1} = 1$, withdraws w_i and does not default, $y_{i2} = 1$. The derivation of the likelihood is similar to that in Case 1.

$$
\begin{aligned}
l_{i2}(\theta) &= \mathrm{P}(\mathrm{y}_{i1}=1, y_{i2}=0, w_i = w\,|\,x_{i1},x_{i2},\mathrm{x}_{i3},\mathrm{z}_i) \\
&= f(\mathrm{w}_i = \mathrm{w}\,|\,\mathrm{x}_{i3},\mathrm{z}_i)\,\mathrm{P}(\mathrm{y}_{i1}=1, y_{i2}=0\,|\,x_{i1},x_{i2},x_{i3},\mathrm{z}_i,\mathrm{w}_i = w)
\end{aligned}
$$

with

$$
\log f(\mathrm{w}_i = w\,|\,x_{i3},\mathrm{z}_i) \propto -\frac{1}{2}\log\sigma^2 - \frac{1}{2\sigma^2}(\mathrm{w}_i - x_{i3}'\beta_3 - \mathrm{z}_i'\alpha_3)^2
$$

$$
\log P(\mathrm{y}_{i1}=1,\mathrm{y}_{i2}=0\,|\,x_{i1},x_{i2},x_{i3},\mathrm{z}_i,\mathrm{w}_i = w) = \log\Phi_2(\mathrm{x}_{i1}'\beta_1, -x_{i2}'\beta_2 - \mathrm{z}_i'\alpha_2 - w_i\gamma; \bar{\mu}_{i,2}, \bar{\Sigma}_2)
$$

where as in Case 1,

$$\bar{\mu}_{i,2} = \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} \Sigma_{12}\Sigma_{22}^{-1}(\mathrm{w}_i - x_{i3}'\beta_3 - \mathrm{z}_i'\alpha_3) = \begin{pmatrix} -\dfrac{\rho_{13}}{\sigma} \\ \dfrac{\rho_{23}}{\sigma} \end{pmatrix} (\mathrm{w}_i - x_{i3}'\beta_3 - \mathrm{z}_i'\alpha_3),$$

$$\bar{\Sigma}_2 = \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} (\Sigma_{11} - \Sigma_{12}\Sigma_{22}^{-1}\Sigma_{21}) \begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} = \begin{pmatrix} 1-\rho_{13}^2 & -\rho_{12}+\rho_{13}\rho_{23} \\ -\rho_{12}+\rho_{13}\rho_{23} & 1-\rho_{23}^2 \end{pmatrix}.$$

- Case 3: the household does not take up HECM, $y_{i1} = 0$.

$l_{i3}(\theta) = \mathrm{P}(\mathrm{y}_{i1} = 0 \mid x_{i1}, \mathrm{z}_i) = \Phi_1(-x_{i1}'\beta_1 - \mathrm{z}_i'\alpha_1; 0,1)$,

where $\Phi_1(\cdot; 0,1)$ is the cdf of standard normal distribution.

The full likelihood function is:

$$\log L_n(\theta) = \sum_{i=1}^{n} \left\{ I(\mathrm{y}_{i1}=1, y_{i2}=1)\log \mathrm{l}_{i1}(\theta) + \mathrm{I}(\mathrm{y}_{i1}=1, y_{i2}=0)\log \mathrm{l}_{i2}(\theta) + \mathrm{I}(\mathrm{y}_{i1}=0)\log \mathrm{l}_{i3}(\theta) \right\}.$$

In the maximum likelihood estimation, ρ_{12}, ρ_{13}, ρ_{23} and σ are not directly estimated. Directly estimated is a transformation of these parameters, $\log\sigma$ for σ and $\mathrm{atanh}\rho = \frac{1}{2}\log\left(\frac{1+\rho}{1-\rho}\right)$ for ρ. Thus $\rho = \frac{-1+\exp(2\mathrm{atanh}\rho)}{1+\exp(2\mathrm{atanh}\rho)}$. The parameter space of the transformed variable is therefore unrestricted.

The set of explanatory variables included in the regressions is based on our expectations described above, with specific variables described in the next section. We include state fixed effects in each equation. In the take-up equation, they capture differences in variations in state laws or the average distance to counselors or lenders' offices. State fixed effects in the default equations capture differences in state laws regarding defaults and geographically based lender practices. We also include year dummies in the take up and withdrawal equations to capture the effect of common macro factors.

5. Data and Descriptive Statistics

To estimate the system of equations described above, we employ a unique dataset that combines borrower demographic, financial and credit report data with HECM loan data. Our primary dataset consists of confidential reverse mortgage counseling data on households counseled by a large nonprofit housing counseling organization (CredAbility, dba ClearPoint Credit Counseling Services) for the years 2006 to 2011. These data include demographic and socio-economic characteristics of the counseled household. The counseling data also contains Equifax credit report attribute data at the time of counseling, obtained by the nonprofit agency with client consent for counseling and evaluation purposes. The credit report data includes credit score, outstanding balances and payment histories on revolving and installment debts, and public records such as tax liens and bankruptcies.

In addition to data at the time of counseling, our analysis includes detailed data on HECM loan transactions. Household level data is linked to HECM loan data, including details on origination, withdrawals, terminations and tax and insurance defaults. Importantly, this allows us to account for selection by modeling the take-up of HECMs among counseled households, and subsequently whether they default on their mortgages.[8] Finally, to account for macroeconomic characteristics, we include variables describing state-level economic growth and house price volatility and deviations from the historical mean house price, derived from state-level FHFA and Freddie Mac data.

Our complete sample includes 30,268 senior households the majority (94 percent) of whom were counseled between 2008 and 2011. Of those counseled, 64 percent are linked to HUD data using confidential personal identifiers, indicating that they applied for a HECM. Of those applying for a HECM, 85 percent went on to originate a HECM within two years of counseling. For our regression analysis, we limit our sample to 28,129 seniors with complete data on variables necessary to compute the amount of funds available through the HECM loan, including geographic location, home value and borrower age.[9] In the regression sample, 57.9 percent of the observations originate a HECM.

The primary outcome of interest in our analysis is whether or not a HECM borrower enters into technical default on their mortgage, as indicated by the lender making a corporate advance to cover property taxes or homeowner's insurance payments. Corporate advances occur when borrowers default on their property taxes or homeowners insurance and have exhausted all of the available proceeds in their HECM loan. Lenders are required to report corporate advances to HUD; however, the detail of reporting has varied over time. While all corporate advances, including amount and any borrower repayments are reported in the HUD data, the dates of advances and payments are only known for a

---

[8]We recognize that counseled households may not represent a random sample of the population, thereby limiting the generalizability of the findings to counseled households. However, as a robustness check (discussed in section 6.3), we also estimate the take-up of HECMs from the general population using Health and Retirement Study (HRS) survey data and find that our results are substantively similar. The use of the HRS data results in a more restricted set of variables and sample period and is thus not our preferred specification.

[9]For other variables with missing values, we preserve all observations and create missing data binary indicators that are reported on the summary tables and included in the regression analyses. For any given variable, approximately 5 percent of observations have missing values.

subset of borrowers in our sample.[10] Therefore, in this analysis, we measure technical default with a dummy variable indicator, coded "1" if the lender has ever made a corporate advance on behalf of the borrower, regardless of date or borrower repayment. Our indicator for technical default does not indicate that the borrower has entered or will enter into foreclosure. For the regression sample, of the 16,283 borrowers originating a HECM, 7.2 percent ever entered into technical default as of June 30, 2012. This is lower than the overall technical default rate of 9.4 percent in the entire population of HECM loans, likely due to the shorter duration of exposure for loans our sample. To account for loan duration and loans that have terminated, we include a variable measuring the exposure time for each observation, as the date of origination until the date of termination or July 1, 2012, the last day we observe technical defaults in our dataset.

Tables 1-3 present descriptive statistics for our model variables. Summary statistics for the entire regression sample of counseled households (N=28,129) are included in the descriptive tables, in addition to sample means and proportions for those borrowers with a HECM mortgage (N=16,283), and borrowers ever in technical default (N=1,173). Complete variable definitions are included in the Appendix. Our first set of explanatory variables includes those measuring the household's financial position at the time of counseling. These variables are included in models of all three outcomes, as they are expected to be associated with the decisions to take out a HECM, the amount of the initial withdrawal and technical default. Monthly income is self-reported as the total of all retirement, wage and supplemental household income.[11] Non-housing assets include the self-reported total of money in checking, savings and retirements accounts, as well as the net value of property such as cars or boats.[12] As expected, those experiencing technical default have lower incomes and fewer non-housing assets. We include a measure of liquidity from the credit report data, constructed as the amount of available revolving credit, in line with prior literature (Agarwal et al. 2007; Elul et al. 2010).[13] In line with our expectations, lower liquidity is observed among those who experience technical default. We also include debt to income ratios conventionally used in analyses of mortgage default (Archer et al. 1996),

[10]Missing data on the date of the corporate advance for more than half of our observations prevents us from employing a hazard model to measure time until default.
[11]In our data, we cap income at $30,000 per month (coding those with values in excess of $30,000 as missing).
[12]Non-housing assets are not reported at the time of counseling for about half of the observations in our sample. We thus include a dummy variable for no reported non-housing assets.
[13]In alternative specifications, we measure liquidity as the ratio of the outstanding revolving balance to the revolving credit limit instead of and in addition to the dollar amount of available revolving credit; however, in both cases, the ratio measure of liquidity is not significantly associated with our model outcomes.

calculated as the ratio of the revolving balance to annual income, and the installment balance to annual income.

Of particular interest for this analysis is the ability of households to afford their property tax and insurance payments. We expect that those for whom property taxes comprise a greater proportion of their income may be more constrained; therefore, we include a variable indicating property tax burden, defined as the expected annual property taxes calculated using county average property tax rates, multiplied by the property value at the time of counseling, divided by annual income.[14] Among those in technical default, the average property tax burden is very high at 11.2 percent; data from the Survey of Consumer Finances indicates that only thirteen percent of senior homeowners spend more than 10 percent of their income on property taxes, and only six percent of non-senior homeowners have a greater than 10 percent property tax to income burden (Shan 2010).

[Insert Table 1 Here]

We also include indicators of prior debt payment histories, measuring financial management and potential vulnerability to trigger events. The FICO credit score of the primary borrower at the time of counseling provides an aggregate measure of credit risk, incorporating both payment histories (e.g. missed payments) and account liquidity (balances relative to account limits). Credit score has been found to be a substantial predictor of mortgage default in prior literature, even after controlling for a robust array of explanatory variables (Avery et al. 1996). We also include indicators for payment delinquencies at the time of counseling from the credit report file, including indicators for whether or not the existing mortgage was two months or more past due and an indicator for “foreclosure started”, coded 1 if the borrower had a foreclosure in process when they completed counseling for the HECM. Aside from the mortgage, we include an indicator for any prior bankruptcy on the credit record in the 12 months prior to counseling. Finally, we include an indicator for whether or not the household had any tax liens or judgments on their credit file, potentially signaling a prior property tax delinquency. As might be expected, nearly 17 percent of HECM borrowers in technical default had a prior tax lien or judgment on their credit file, compared with less than 8 percent of all HECM borrowers in the sample.

Our second set of explanatory variables includes those measuring the management of HECM funds, and specifically, the proportion of funds withdrawn up-front. The forward mortgage default literature typically includes loan to value (LTV) ratio, as higher LTVs decrease borrower equity and may increase the incentives for strategic default (Foote et al. 2008). In some ways, the proportion of HECM

[14]To construct a measure for property tax burden, we merge in data at the county level on property tax rates from The Tax Foundation (2013). We use the three year average of property tax rates (2008-2010) and are missing property tax data for about six percent of the observations in our sample.

proceeds withdrawn up-front is similar to LTV, in that the outstanding balance owed on the HECM increases with the amount of funds drawn. However, the HECM loan is structured in a way that there is a cap on the amount that can be drawn (initial principal limit) to prevent negative equity from occurring, and if it occurs, the mortgage insurance picks up the difference. Increased default risk associated with high initial withdrawals in the HECM program may occur because when equity is extracted as a large lump sum amount, it may be more likely to be consumed and thus not available to cover future expenditures, similar to literature on the expenditure of lumpy income tax rebates (Agarwal et al. 2007).

The initial withdrawal percent is calculated as the amount of funds withdrawn by the borrower in the first month (typically at closing) divided by the total amount of funds available. As reported in Table 2, the overall average *initial withdrawal %* is large, at 77 percent. The average initial withdrawal is more than 10 percentage points higher among those experiencing technical default. We include the initial withdrawal percentage in the default equation, but treat it as endogenous.

Depending on the outcome being modeled, we also include an array of variables that capture the equity available to the borrower. We indicate which variables are unique to each equation following the exclusion restrictions described in Section 4.2. To predict HECM take-up, we include the estimated amount of funds available to the household through the HECM, less mandatory obligations, or the *estimated net initial principal limit (IPL)*.[15] Unique to the take-up equation is a variable measuring the amount of monthly mortgage payments at the time of counseling, an indicator for whether or not the household had a home equity line of credit (HELOC) at the time of counseling, and an indicator for *excess value*. *Excess value* is the difference between the self-reported home value at the time of counseling and the county specific FHA loan limit, coded "0" if the difference is negative. This excess portion of equity is not available to the borrower through the HECM loan, and higher amounts of excess value may make a household less likely to take out a HECM loan. We expect that the amount of monthly mortgage payments at the time of counseling and whether or not the household had a HELOC at the time of counseling may be associated with the probability of taking out a HECM, as both may indicate willingness to extract equity. We also merge in three macro-economic variables at the state level that may affect demand for HECMs, derived from state-level FHFA and Freddie Mac data. These macro variables include the state's real GDP growth rate, a measure of house price volatility calculated

---

[15]This measure is based on the lesser of the self-reported home value at the time of counseling or the county specific FHA loan limit, the principal limit factor at the time of counseling adjusted for the borrower's age, and mortgage debt as reported in the credit file. For the principal limit, we use the greater of the principal limit factor calculated using the average adjustable expected interest rate or the principal limit factor using the average fixed interest rate as of the day of counseling.

based on the nine years prior to the survey year, and a measure of the deviation of the current real house price from the average real house price for the 1980 to 1999 period.[16] Following Haurin et al. (2014), we also include an interaction between state house price volatility and deviation.

In the equation that develops an instrument for the initial withdrawal amount, we replace the *estimated net IPL* variable with the *actual IPL*, based on the appraised value of the property and the actual expected interest rate on the loan as reported by HUD. Unique to the withdrawal equation, we include a variable for total outstanding mortgage debt at the time of counseling, measured as total mortgage debt as a percentage of the actual IPL. We expect this to be positively associated with the initial withdrawal amount, as mortgage debt is considered a mandatory obligation that must be paid in full from the HECM proceeds or in cash. The withdrawal equation also includes a policy variable indicating whether or not the counseling occurred after April 1, 2009, when the fixed rate, full-draw HECM product became available. We expect this policy variable to be strongly associated with higher initial withdrawals, as full draws up-front are required for borrowers who elect to take a fixed rate loan. After April 1, 2009, we also include the spread between the average fixed and adjustable interest rates as of the month of HECM application. While typically one would expect adjustable rates to be lower than fixed rates, market conditions drove the fixed rate to be lower than the adjustable rate for a substantial portion of the study period. We expect a negative spread to be associated with increased take-up of the fixed rate, full-draw product. The fixed rate policy change provides a clear identification strategy, as we only expect the policy change to directly affect the withdrawal amount—not the take-up of HECMs or technical default.[17]

Finally, for the model predicting technical default, we include the initial withdrawal percent as we expect that higher initial withdrawals will increase default risk. We also include the *actual net IPL* to capture the total amount of HECM funds available to the household based on the appraised value and mandatory obligations. The actual net IPL measures HECM funds available to the household, regardless of the timing of the withdrawals. We also include an exposure variable to control for the number of days since the time of HECM origination and July 1, 2012 or the date of termination on the loan, whichever comes first.

[Insert Table 2 Here]

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

[17] The percentage of loans that were nearly full draws (90 percent or more of IPL) increased from 43 to 68 comparing the period before to that after the policy change.

All of our models include control variables for an array of demographic characteristics at the time of counseling, including race, ethnicity, marital status, gender, age of youngest senior household member and highest level of education completed (summarized in Table 3). All of the explanatory variables in our model are known at the time of origination. The limitation of variables to the time of origination is appropriate for policy analysis because this is the set of information available to lenders (and HUD) when a HECM application is received.

[Insert Table 3 Here]

6. Results

6.1 Estimation Results

The results of the truncated bivariate probit regression for HECM default with an endogenous initial withdrawal amount are presented in Table 4. Column (1) reports the marginal effects for the probability of selection of a HECM, corresponding to Equation (1). We do not discuss the results of this equation in detail, as HECM take-up is not the focus of this analysis (see Moulton 2014). Column (2) reports the marginal effects for the probability of default, conditioned on a household obtaining a HECM, corresponding to Equation (2).[18] This is the focal equation for our analysis. Column (3) reports the coefficients for Equation (3), the OLS regression predicting the initial withdrawal amount.

The first set of focal variables includes those describing the household's financial position. Liquidity at the time of counseling is statistically associated with future default, where a $10,000 increase in available revolving credit is associated with a 0.3 percentage point decrease in the default rate. Not having access to revolving credit significantly increases default risk by 1.57 percentage points. Given the sample's default rate is 7.2 percent, this increase equals nearly 22 percent. Measures of revolving and installment debt to income at the time of counseling are not significantly associated with future default, a non-finding that is similar to analyses including debt to income ratios in the forward market. This result is potentially important because some of the changes to underwriting screen for eligibility based on debt to income thresholds. By contrast, the property tax burden is significantly associated with default, where a 10 percent increase in the tax burden is associated with a 0.3 percentage point increase in the default rate. Neither monthly income nor non-housing assets are

[18] The marginal effects for the default equation are the response of default to a one unit change in the explanatory variable, holding constant other explanatory variables, including the initial withdrawal. For example, while a change in income changes the withdrawal percentage, which affects the likelihood of default, we do not account for this in the reported marginal effects of income on default. Instead, we hold the initial withdrawal constant when reporting the marginal effect of income.

significantly associated with technical default. For non-housing assets, this may be due to the self-reported nature of our measure and the large amount of missing data on this indicator. Further, our measures are at the time of counseling; it is possible that (unobserved) shocks to income or assets occurring after the receipt of a HECM may trigger default.

Next, we consider measures of credit management. The credit score is statistically and economically associated with future default, where a 100 point increase in credit score at the time of counseling is associated with a 2.3 percentage point decrease in the default rate. Other indicators from credit report histories at the time of counseling are associated with increased default. Specifically, households who are past due two or more months on their forward mortgages at the time of counseling have default rates that are 1.55 percentage points higher than other households. Those with a prior tax liens or judgments on their credit histories have default rates that are 1.11 percentage points higher. Credit indicators for foreclosure or prior bankruptcy are not significantly associated with default.

We next consider households' management of HECM funds and measures of available equity. Borrowers manage their HECM loans by choosing the timing and amount of withdrawals, including the proportion of available funds to withdraw at the time of origination. Borrowers taking a fixed rate HECM must withdraw all funds at the time of origination, while borrowers taking an adjustable rate HECM can take as much or little of the funds at the time of origination as desired. HECM funds not withdrawn at origination are available to the borrower for future withdrawals.[19] Even after controlling for other risk factors and accounting for endogeneity, the proportion of funds taken as an initial withdrawal (e.g., within the first month after origination) is significantly associated with increased default. A 10 percentage point increase in the initial withdrawal is associated with a 0.62 percentage point increase in the default rate. By contrast, the net initial principal limit is not significantly associated with default, suggesting that default risk is more directly tied to the timing of the withdrawal than the total funds available through the HECM. A longer duration of exposure is also associated with increased default.

All of our models also include control variables for household demographic characteristics. Default rates are greater for blacks (1.9 percentage points), Hispanics (2.5 percentage points), and for single male borrowers (2.7 percentage points). Other demographic characteristics including level of education are not significantly associated with default. Our explanatory variables explain the spatial distribution of defaults as only three of the state dummy variables are statistically different than zero.

While the focus of this analysis is on technical default, we review the impact of the variables that are unique to the withdrawal equation. Specifically, the policy variable corresponding to the time

[19] The closest analogy in the forward market is the choice to prepay part of the loan.

period when fixed rate, full-draw loans were available is associated with a 5.5 percentage point increase in the initial withdrawal amount. However, the interest rate spread after the fixed rate period is not significantly associated with higher withdrawals. Higher initial principal limit amounts are associated with lower initial withdrawal percentages. This is expected if the borrower's desired initial withdrawal is a specific amount. As expected, an increase in the mortgage debt as a percentage of the initial principal limit is significantly associated with a higher initial withdrawal, as borrowers must pay-off existing mortgage debt from available funds or in cash upon origination of the HECM.

Finally, we consider the correlations of errors (rho) between the three equations, representing unobserved characteristics associated with HECM take-up, default and the initial withdrawal. The correlation of errors between the take-up and withdrawal equations is statistically significant and positive (0.45), but that between the other equations is not significantly different from zero.

[Insert Table 4 Here]

6.2 Robustness Checks

The findings presented above are robust to a variety of alternative specifications. First, while our empirical specification accounts for selection into a HECM by modeling HECM take-up, the generalizability of our findings are limited to those who seek counseling for a reverse mortgage because our primary sample data includes only those who sought counseling for a reverse mortgage. We expect that households who seek counseling may differ from households in the general population of seniors. It is possible that unmeasured characteristics associated with seeking counseling and subsequently obtaining a reverse mortgage are also associated with technical default. In an alternative specification, we merge our sample data with Health and Retirement Study (HRS) data, this being a sample of the general population of senior households. We limit the years of the data in our CredAbility sample to households counseled in 2009-2011, corresponding to the 2010 wave of the HRS. Next, we re-estimate the system of equations but use the full HRS and CredAbility samples in equation (1), following the strategy described in Moulton et al (2014). Our set of explanatory variables included in (1) is much more limited, as the HRS data lacks information on property tax payment burden and credit report indicators. However, key variables measuring income, non-housing assets, expected net principal limit and mortgage delinquency are included in the HRS survey data and are used for this analysis. Our full set of explanatory variables is still included in the default and withdrawal equations. We find that our primary variables are robust to the alternative specification. Specifically, after accounting for selection into a HECM from the general population, liquidity, credit risk indicators and the initial withdrawal remain significantly associated with mortgage default, with economically similar effects.

Second, data constraints limit our measure for technical default as a binary indicator coded ”1” if a corporate advance was ever made on behalf of a borrower to pay for past due property taxes or homeowner’s insurance. An alternative specification is to consider the severity of the default, similar to models of default for forward mortgages. While we do not have the date of the corporate advance for more than half of our observations, we do have an indicator for whether or not the borrower “cured” the default by repaying the amount of the corporate advance. In our sample data, 21.6 percent of households experiencing technical default had cured as of June 30, 2012. We re-estimated the system of equations, re-coding technical default in equation (2) as borrowers who experienced default and had not yet cured.   We again find that our results are statistically and economically similar. In particular, less unused credit, a lower credit score, and higher initial withdrawal are still significantly associated with this definition of technical default.

We also estimate our models with a variety of alternative specifications for our explanatory variables, checking for nonlinear relationships and interactions. For example, the IFE (2013) analysis of technical default in the HECM program includes a nonlinear term for the initial withdrawal amount, specifically including a spline at 90 percent. Their analysis finds that the slope for default risk decreases significantly for draws above 90 percent. However, in addition to lacking controls for credit risk and household financial position, their analysis does not account for the endogeneity of the initial withdrawal and may be picking up on other factors associated with households electing to take higher withdrawal amounts. To check for nonlinearities in the initial withdrawal in our analysis, we divide the initial withdrawal amount into four equal groups corresponding to the distribution, allowing the slope to differ for each group, at less than 60 percent, 60 to 90 percent, 90 to 95 percent and greater than 95 percent. We find no statistically significant differences between these groups, suggesting that the linear specification employed in our primary model is appropriate. Similarly, we test for nonlinearities on credit score, dividing it into buckets. We find that the coefficients for the credit score categories decrease monotonically, suggesting that the linear specification for credit score is appropriate.

Finally, we estimate a series of interactions between model variables, including interactions between credit score and the initial withdrawal amount and liquidity and the initial withdrawal amount based on the expectation that there could be a layering effect of risk characteristics, where higher initial withdrawals present greater default risk for illiquid households or households with poor credit management, similar to risk layering with LTV in the forward mortgage literature (Mayer, Pence and Sherlund 2009). We do not find evidence of risk layering for HECM default, as the interactions with the initial withdrawal amounts are not statistically significant.

6.3 Simulation Results

As a final exercise, we use the estimates from the regression model to simulate the effect of imposing various underwriting criteria on the predicted take-up of HECMs and the probability of technical default. This is particularly informative given that risk-based underwriting criteria have not previously been implemented for reverse mortgages. Using the estimated regression coefficients, we explore changes in take-up and default probabilities based on certain risk thresholds. We also simulate the additional effects of initial withdrawal restrictions in addition to credit risk thresholds and required life expectancy set asides (LESAs) for property taxes and homeowner's insurance for those failing given thresholds. Unlike the marginal effects presented earlier, our simulations allow for feedback within the system of equations. For example, the initial withdrawal is treated as endogenous to the take-up and default equations, and thus a forced change to the initial withdrawal affects the simulated probability that a borrower will take out a HECM.

Our simulation results are presented in Table 5. First, we impose the new initial withdraw restrictions for all households in our sample. Following HUD's guidelines, we restrict households without existing mortgage debt at the time of origination to the lesser of a 60 percent withdrawal of IPL or the actual amount drawn up-front. Households with mortgages are limited to the initial withdrawal percentage necessary to pay-off their existing mortgages, an up-front mortgage insurance premium of 2.5 percent if the mortgage is over 60 percent of IPL and 0.5 percent otherwise, $3,400 in closing costs plus (1) any additional actual initial withdrawal amount, up to 60 percent of IPL (for those whose mortgages are less than 60 percent of IPL), or (2) up to 10 percent additional IPL (for those whose mortgages are greater than 60 percent of IPL). This simulation assumes that if the observed initial withdrawal percentage for a household in our data exceeds the policy limit, the household withdraws the policy limit. We also allow the forced reduction of the initial withdraw amount to affect the probability that a borrower will take-up a HECM. Based on our models, we estimate that the initial withdrawal restriction would result in a 19.9 percent reduction in predicted HECM volume, and a 21.3 percent reduction in the probability of technical default, had the restriction been in place with our sample of HECM borrowers. Thus, the decline in predicted default associated with the initial withdrawal restriction corresponds to a significant expected decline in HECM volume.

[Insert Table 5 Here]

Next, we simulate the impact of specific credit risk-based underwriting thresholds on the probability of HECM take-up and default, had such thresholds been in place for our sample of HECM borrowers. We begin by imposing credit score thresholds at FICO scores of 500 and 580, and alternatively impose a threshold for "bad credit," defined as occurring when a borrower has any credit history of a delinquent mortgage, foreclosure, tax lien or judgment, delinquent installment debt or delinquent revolving debt. First, we treat the credit risk thresholds as a hard cut-off, dropping households from the HECM program that fail the specific thresholds. Second, we impose a life expectancy set-aside (LESA) requirement for borrowers failing the credit risk thresholds. If a borrower fails the credit risk threshold, but can afford the LESA plus all other mandatory obligations, we retain them in the HECM sample and force their default probability to zero, given that they have set aside funds to cover their property taxes and insurance for their expected lifetime. If the borrower fails the credit risk threshold but cannot afford the LESA, we exclude them from the HECM program. Finally, we combine the specific credit risk threshold, LESA requirement and initial withdrawal restrictions to simulate the maximum policy impact on HECM take-up and default.

In order to identify which borrowers can afford the LESA, we estimate LESA for each HECM borrower in our sample. To do this, we use the formula for LESAs provided by HUD (Mortgagee Letter 2013-27):

$$\text{LESA} = (\text{PC} \div 12) \times \{(1 + c)^{\text{m}+1} - (1 + c)\} \div \{c \times (1 + c)^{\text{m}}\}$$

In the above formula, PC is equal to the annual property charges for taxes and homeowner's insurance. To estimate total property charges for HECM borrowers in our sample, we use our county level estimate of property taxes plus an annual homeowner's insurance rate of 3.5 percent multiplied by the home value/1,000.[20] Following HUD's guidelines, we multiply the estimated annual property tax and insurance amount by 1.2 to get the total annual property charge; this represents their adjustment factor for future tax increases.[21] For the monthly compounding rate, c, we divide the sum of the HECM expected rate and the annual mortgage insurance premium of 1.25 percent by 12. Finally, m is the life expectancy for a given borrower, in months, as derived from the life expectancy table provided in the mortgagee letter. We consider a household is able to "afford a LESA" if the amount of the LESA is less than or equal to the initial principal limit on the HECM minus any outstanding mortgage debt, closing costs and up-front MIP at the time of origination.

[20]Our rate of 3.5 for homeowner's insurance is derived from a general rule of thumb published in an online consumer education resource from the Federal Reserve: http://www.federalreserve.gov/pubs/settlement/. This does not account for regional variations in insurance rates (e.g., flood insurance required in particular areas), but provides a rough estimate of average insurance costs.

[21]Based on our assumptions about property tax and insurance rates, the average annual property charge for a borrower in our sample is $3,210*1.2 = $3,852. In comparison, total average self-reported property charges (homeowner's insurance and property taxes) for households in our sample is $3,375.

For households who fail the threshold but can afford LESA, we assume that the net IPL (HECM proceeds available) will be reduced by the amount of the LESA, which may affect a household's decision to obtain a HECM. Even if they are able to afford a LESA, the net proceeds (net IPL) available from a HECM will be reduced substantially by the LESA amount, and they may decide to no longer obtain a HECM. To simulate this, we estimate the probability of technical default, conditional on the (post LESA) probability of taking out a HECM given the estimated lower net IPL (less LESA amount) for those failing a given risk threshold. Then the average default probability is reported.

In our sample of HECM borrowers, we estimate that imposing a hard credit score threshold at a FICO of 500 would reduce the predicted HECM volume by 3.2 percent, and reduce predicted default rate in the full sample by 12.4 percent. If a LESA was required, rather than a hard cut-off, we predict that HECM volume would decline by less than 1 percent and the default rate would decline by nearly 15 percent. A credit score threshold of 580 has a much greater expected impact on the default rate, with a reduction of 36.7 percent and corresponding reduction in HECM volume of 13.8 percent. However, if a LESA requirement was imposed rather than a hard cut-off, the threshold of 580 would only reduce predicted HECM volume by about 4 percent, and reduce the predicted default rate by 44.5 percent. Alternatively, credit risk thresholds could be applied based on derogatory credit histories instead of credit scores. In our simulations, imposing a hard cut-off for indicators of bad credit has a very similar impact on the predicted default rate as a credit score cut-off at 580, but results in a greater predicted decline in HECM volume, making it less efficient. Finally, imposing the initial withdrawal restrictions on top of the credit risk thresholds has an additional impact on reducing the predicted default rate for all thresholds. However, the initial withdrawal threshold is also predicted to substantially reduce HECM volume. For example, an initial withdrawal restriction plus a LESA requirement for households with credit scores below 580 reduces the predicted default rate by an additional 13 percent, but reduces the predicted HECM volume by an additional 20 percent.

It is important to caution that our simulations of the initial withdrawal restriction does not account for strategic behavior of borrowers to withdraw additional funds after the withdraw restriction is lifted in the first year. Our simulations assume that borrowers will continue to withdraw at the same rate over the lifetime of the HECM that they did prior to the policy change. An increase in the rate of withdrawals after the first year could affect the probability of take-up and the probability of default. If borrowers simply postpone their desired withdraw amount to the second year, they may still be willing to take out a HECM after the policy restrictions and our estimates of the decline in take-up may be overstated. Further, if borrowers withdraw at a higher rate after the first year restriction, the rate of default may be reduced in the first year but revert when the limit expires. Thus, our estimates should be viewed as the maximum estimated effect of the initial withdrawal restriction on both take-up and default; the actual impact is likely somewhere between zero (if borrowers are completely strategic and simply postpone withdrawals) and our estimated impact.

7. Conclusions

Federally insured HECMs have the potential to play an important role in enabling financial security for senior homeowners. However, the near 10 percent default rate on property taxes and homeowners insurance among HECM borrowers raises significant concerns. A variety of policy responses have been put into effect, including establishing risk-based underwriting guidelines for the first time in the program's history. This is a significant challenge for the industry, as data on borrower risk characteristics was not previously collected as part of the origination process. Further, it is not appropriate to assume that risk characteristics associated with mortgage default in the forward mortgage market will be the same factors associated with technical default in the reverse mortgage market. Unlike forward mortgages, there is no monthly payment for reverse mortgages. Default does not occur due to failure to pay monthly payments, but rather failure to pay property taxes and homeowner's insurance. Negative equity, a primary theoretical factor contributing to default for forward mortgages, is not expected to be associated with technical default for reverse mortgage borrowers given the structure of the program. And, unique aspects of the reverse mortgage, specifically the timing and amount of withdrawals from HECM proceeds, may be associated with default risk.

Given the lack of prior data and empirical analysis, the first objective of this study is to identify the factors contributing to default risk for reverse mortgage borrowers. We accomplish this objective using a comprehensive dataset of households who sought counseling for a reverse mortgage, linked to loan level data indicating whether or not the household obtained a reverse mortgage and characteristics of the reverse mortgage. Our resulting dataset includes large set of demographic, financial and credit characteristics at the time of counseling, as well as information about the reverse mortgage transaction including the initial withdrawal percentage and whether or not the borrower was ever in technical default on their loan. We expect that unobserved characteristics associated with a borrower's decision to take out a HECM may also be associated with technical default. We therefore use a truncated bivariate probit model to analyze a household's decision whether to obtain a HECM, and conditional on origination, whether to default. Given the unique structure of reverse mortgages, a key explanatory variable in our model is the percentage of HECM funds withdrawn during the first month. We treat the initial withdrawal as endogenous, recognizing that unobserved risk characteristics may be associated with both the withdrawal and technical default.

We find a statistically significant relationship between default and multiple risk characteristics including credit score, delinquency on mortgage debt, the property tax burden, and prior tax liens. Having a delinquent mortgage or prior tax lien on the household's credit report raises the probability of default by 15.4 and 21.5 percent, respectively. The elasticity of default with respect to the FICO score is large, 2.21. The elasticity of the property tax burden (property taxes divided by income) is 0.42.[22] Household liquidity is also important; the probability of default is reduced by 22 percent if a household has access to revolving credit and it also falls the greater percentage of unused revolving credit (elasticity of -0.11). Controlling for risk characteristics, the initial withdrawal is an important factor predicting default. An increase in the initial withdrawal of 10 percentage points is associated with an 8.6 percent increase in the probability of default, corresponding to an elasticity of 0.66.

A second objective of our analysis is to identify the impact of various policy changes and underwriting criteria. The simulation estimates take into account the feedback between our system of equations, allowing for the identification of the effect of a particular change on both the probability of default and participation in the HECM program. In this way, criteria can be identified that reduce the default rate without significantly reducing program participation. We find that a simple limitation on the initial withdrawal of funds is effective in reducing default, but also substantially reduces participation. A greater reduction in the default rate and smaller reduction in program participation can be achieved either by setting minimum FICO scores or requiring households that have derogatory credit risk characteristics to set aside funds at the time of HECM origination (designated as a LESA) that will be used to pay the cost of future property taxes and house insurance. Currently, no escrowing of funds for these purposes is required. Selecting among the various policies would require applying social welfare weights to default and participation. However, a comparison of policy options finds that requiring a LESA for households with credit scores less than 580 would reduce participation by less than five percent while reducing default by about 45 percent.

Finally, it is important to consider the broader implications of tax and insurance default for the HECM program. Borrowers defaulting on taxes and insurance are not necessarily underwater on their HECM (balance exceeds the home value), as is often the case in the forward mortgage market. On one hand, this suggests that tax and insurance defaults may not have as significant an impact on the financial

[22] Both elasticities are evaluated at the means for the sample of HECM borrowers.

viability of the program as other risks, such as crossover risks (e.g., when the balance of the HECM grows to exceed the value of the home). To the extent that there is still equity left on the subject property, borrowers defaulting on taxes and insurance may not require claims against the MMI fund. In the post 2006 period when nominal house prices fell after origination, default and foreclosure were costly to the MMI fund. However in the future, if house prices return to grow at the rate of inflation, these costs will be much less.

On the other hand, the viability of the HECM program depends not only on fiscal solvency (the MMI fund), but also on the perceived public value of the program. If large numbers of senior homeowners with HECMs are being foreclosed upon for failure to pay property taxes and insurance, there is significant risk to the program. The fact that seniors in tax and insurance default may have equity remaining in the property may exacerbate public concerns about the program's purpose and policy effectiveness. Foreclosing on senior homeowners for a relatively small tax bill in comparison to the amount of equity in their properties has been perceived negatively by senior advocacy groups and the general public. However, putting in place underwriting requirements to stem future defaults that overly restrict access to the product could also be perceived as antithetical to the public mission of the HECM program. Addressing the tax and insurance default problem without compromising the mission to serve the needs of senior homeowners is thus a significant issue for the policy viability of the HECM program. While our analysis does not address broader implications related to the fiscal solvency of the program and the MMI fund, it does offer insights that can inform policy design-- and market innovations—to address the viability of the HECM program over the longer term.

References

Agarwal, Sumit, Chunlin Liu, and Nicholas S. Souleles. 2007. The reaction of consumer spending and debt to tax rebates—Evidence from consumer credit data. Journal of Political Economy 115 (6), 986-1019.

Ambrose, Brent W., and Charles A. Capone. 1998. Modeling the conditional probability of foreclosure in the context of single-family mortgage default resolutions. Real Estate Economics 26 (3), 391-429.

Anderson, Nathan B. and Jane Dokko. 2011. Liquidity problems and early payment default among subprime mortgages. FEDS Working Paper No. 2011-09. Available at SSRN: http://ssrn.com/abstract=1810079.

Archer, Wayne R., David C. Ling, and Gary A. McGill. 1996. The effect of income and collateral constraints on residential mortgage terminations. Regional Science and Urban Economics 26 (3), 235-261.

Avery, Robert B., Raphael W. Bostic, Paul S. Calem, and Glenn B. Canner. 1996. Credit risk, credit scoring, and the performance of home mortgages. Federal Reserve Bulletin 82, 621-648.

Bishop, T. B. and H. Shan. 2008. Reverse mortgages: A closer look at HECM loans. Working paper 08-Q2. Cambridge: National Bureau of Economic Research.

Consumer Financial Protection Bureau. 2012. Reverse mortgages: report to Congress. Consumer Financial Protection Bureau.

Davidoff, Thomas. 2013. Can "High Costs" Justify Weak Demand for the Home Equity Conversion Mortgage? Working Paper, Sauder School of Business, University of British Columbia. Available at SSRN: http://ssrn.com/abstract=2146988

Davidoff, Thomas. 2014. Reverse mortgage demographics and collateral performance. Working Paper, Sauder School of Business, University of British Columbia. Available at SSRN: http://ssrn.com/abstract=2399942

Davidoff, Thomas and Gerd Welke. 2007. Selection and moral hazard in the reverse mortgage market. Working Paper, Haas School of Business, UC Berkeley.

Demyanyk, Yuliya and Otto Van Hemert. 2011. Understanding the subprime mortgage crisis." Review of Financial Studies 24 (6), 1848-1880.

Deng, Yongheng, John M. Quigley, and Robert van Order. 2000. Mortgage terminations, heterogeneity, and the exercise of mortgage options. Econometrica 68 (2), 275–307.

Department of Housing and Urban Development.2006. HUD strategic plan FY 2006 - FY 2011. Washington.

Elul, Ronel, Nicholas S. Souleles, Souphala Chomsisengphet, Dennis Glennon, and Robert Hunt. 2010. What" triggers" mortgage default? The American Economic Review 100 (2), 490-494.

Foote, Christopher L., Kristopher Gerardi, and Paul S. Willen. 2008. Negative equity and foreclosure: Theory and evidence. Journal of Urban Economics 64 (2), 234-245.

Elmer, Peter J. and Steven A. Seelig. 1999. Insolvency, trigger events, and consumer risk posture in the theory of single-family mortgage default. Journal of Housing Research 10 (1), 1-25.

Haurin, Donald R., Chao Ma, Stephanie Moulton, Maximilian Schmeiser, Jason Seligman, and Wei Shi. 2014. Spatial variation in reverse mortgages usage: House price dynamics and consumer selection. Journal of Real Estate Finance and Economics. Forthcoming.

Hurst, E. and F. Stafford. 2004. Home is where the equity is: Liquidity constraints, mortgage refinancing and consumption. Journal of Money, Credit and Banking. 36, 985–1014.

Integrated Financial Engineering. 2011. An Actuarial Analysis of FHA Home Equity Conversion Mortgage Loans in the Mutual Mortgage Insurance Fund: Fiscal Year 2011. Washington: U.S. Department of Housing and Urban Development.

Integrated Financial Engineering. 2012. Actuarial Review of the Federal Housing Administration Mutual Mortgage Insurance Fund HECM Loans For Fiscal Year 2012. Washington: U.S. Department of Housing and Urban Development.

Integrated Financial Engineering. 2013. Actuarial Review of the Federal Housing Administration Mutual Mortgage Insurance Fund HECM Loans For Fiscal Year 2013. Washington: U.S. Department of Housing and Urban Development.

Lusardi, Annamaria and Olivia S. Mitchell. 2007. Baby boomer retirement security: The roles of planning, financial literacy, and housing wealth. Journal of Monetary Economics 54 (1), 205-224.

Lusardi, Annamaria and Olivia S. Mitchell. 2011. Financial literacy and planning: Implications for retirement wellbeing. Working Paper w17078. National Bureau of Economic Research.

Mayer, Christopher J. and Katerina V. Simons. 1994. Reverse mortgages and the liquidity of housing wealth. Journal of the American Real Estate and Urban Economics Association 22 (2), 235-255.

Mayer, Christopher J., Karen Pence, and Shane M. Sherlund. 2009. The rise in mortgage defaults." Journal of Economic Perspectives 23 (1), 27-50.

Miceli, Thomas J., and C. F. Sirmans.1994. Reverse mortgages and borrower maintenance risk. Real Estate Economics 22 (2), 433-450.

Mortgagee Letter 2008-08. 2013. Department of Housing and Urban Development.

Mortgagee Letter 2013-1. 2013. Department of Housing and Urban Development.

Mortgagee Letter 2013-27. 2013. Department of Housing and Urban Development.

Mortgagee Letter 2013-28. 2013. Department of Housing and Urban Development.

Mortgagee Letter 2013-33. 2013. Department of Housing and Urban Development.

Moulton, Stephanie, Donald R. Haurin, and Wei Shi. 2014. Who gets a reverse mortgage? Identifying household level determinants of reverse mortgage choice and the influence of counseling. Working Paper. Ohio State University.

Nakajima, M., & Telyukovaz, I. A. 2013. Reverse mortgage loans: A quantitative analysis. Working Paper No. 13-27. Federal Reserve Bank of Philadelphia.

National Reverse Mortgage Lenders Association. 2014. Industry statistics. Published online at: http://nrmlaonline.org/rms/statistics/default.aspx?article_id=601. Last accessed June 12, 2014.

Pennington-Cross, A. 2003. Credit history and the performance of prime and nonprime mortgages. Journal of Real Estate Finance and Economics 27, 279–301.

Rodda, David T., Ken Lam, and Andrew Youn.2004. Stochastic modeling of Federal Housing Administration Home Equity Conversion Mortgages with low-cost refinancing. Real Estate Economics 32 (4), 589–617.

Ross, Stephen. 2000. Mortgage Lending, Sample selection and default. Real Estate Economics 28 (4), 581–621.

Shan, Hui. 2010. Property taxes and elderly mobility. Journal of Urban Economics, 67(2), 194-205.

Shan, Hui. 2011. Reversing the trend: The recent expansion of the reverse mortgage market. Real Estate Economics 39(4), 743-768.

Shiller, Robert J., and Allan N. Weiss. 2000. Moral hazard in home equity conversion. Real Estate Economics 28 (1), 1-31.

Szymanoski, E. J., Enriquez, J.C., & DiVenti, T.R. 2007. Home Equity Conversion Mortgage terminations: Information to enhance the developing secondary market. Cityscape: A Journal of Policy Development and Research 9 (1), 5-46.

Tax Foundation. 2013. http://taxfoundation.org/article_ns/median-effective-property-tax-rates-county-ranked-total-taxes-paid-3-year-average-2008-2010.

Vandell, Kerry D. 1995. How ruthless is mortgage default? A review and synthesis of the evidence. Journal of Housing Research 6(2), 245-264.

Waldhart, Paul and Andrew Reschovsky. 2012. Property tax delinquency and the number of payment installments. Public Finance & Management 12 (4), 316-330.

Table 1, Summary Statistics for Household Financial Characteristics

	Counseled (N=28,129)		HECM (N=16,283)		Default (N=1,173)	
	mean	sd	mean	sd	mean	sd
Monthly income	2,311	1,717	2,337	1,660	1,849	1,204
Monthly income, missing	0.054	0.225	0.064	0.245	0.110	0.313
Non-housing assets	42,260	179,408	41,945	174,284	22,465	138,547
Non-housing assets are zero	0.509	0.500	0.513	0.500	0.664	0.473
Tax burden, property taxes/income	0.091	0.095	0.096	0.098	0.112	0.105
Tax burden, missing	0.060	0.238	0.068	0.252	0.115	0.319
FICO credit score	678	102	693	98	597	90
FICO credit score, missing	0.067	0.249	0.064	0.245	0.090	0.286
Revolving balance/income	0.231	0.453	0.252	0.475	0.161	0.411
Installment balance/income	0.236	0.496	0.221	0.479	0.291	0.583
Foreclosure started	0.021	0.143	0.011	0.105	0.033	0.180
Bankruptcy in last 12 months	0.011	0.105	0.007	0.083	0.013	0.114
Available revolving credit	22,556	37,411	25,754	38,308	8,411	19,746
No revolving credit	0.118	0.323	0.084	0.278	0.130	0.337
Mortgage past due, 2+ months	0.062	0.241	0.039	0.192	0.121	0.326
Tax lien or judgment	0.102	0.302	0.079	0.269	0.169	0.375
Missing credit report data	0.084	0.277	0.098	0.297	0.159	0.365

Note: Summary statistics are reported excluding missing observations. For the regression analysis, the missing dummy indicator is included for each respective variable (or set of variables for missing credit report data) and missing observations are coded as "0".

Table 2, Summary Statistics for Mortgage Characteristics

	Counseled (N=28,129)		HECM (N=16,283)		Default (N=1,173)	
-	mean	sd	mean	sd	mean	sd
Initial withdrawal %			0.771	0.292	0.883	0.152
HECM Take-Up Equation						
Estimated net IPL	84,555	82,014	93,186	81,251		
Excess home value amount	18,006	94,544	17,220	82,550		
Monthly mortgage payments	498	766	462	717		
HELOC indicator	0.130	0.337	0.140	0.347		
State house price deviation	0.215	0.222	0.245	0.240		
State house price volatility	19.176	13.280	19.815	13.306		
State house price deviation*volatility	5.452	7.635	6.351	8.625		
State GDP growth	0.006	0.030	0.006	0.030		
Initial Withdrawal Equation						
Actual IPL			139,977	88,012	129,410	78,943
Home debt/IPL			0.387	0.350	0.470	0.346
Fixed rate policy indicator			0.736	0.441	0.477	0.500
Fixed rate policy*spread			-0.069	0.350	-0.110	0.317
Technical Default Equation						
Actual net IPL			83,147	75,391	63,851	59,713
Exposure days			799	483	1,118	466

Table 3, Summary Statistics for Demographic Characteristics

	Counseled (N=28,129)		HECM (N=16,283)		DEFAULT (N=1,173)	
	mean	sd	mean	sd	Mean	sd
Hispanic	0.110	0.314	0.094	0.292	0.188	0.391
Hispanic - missing	0.021	0.142	0.027	0.163	0.036	0.186
Race - white	0.633	0.482	0.681	0.466	0.424	0.494
Race - black	0.166	0.372	0.127	0.333	0.263	0.440
Race - Asian	0.009	0.096	0.009	0.092	0.007	0.082
Race - missing	0.068	0.252	0.073	0.261	0.117	0.321
First language - not English	0.072	0.259	0.056	0.229	0.130	0.337
Unmarried Male	0.161	0.368	0.157	0.364	0.205	0.404
Unmarried Female	0.362	0.481	0.393	0.488	0.421	0.494
Age - youngest household member	72	8.101	72	7.957	71	7.659
Education - bachelors degree	0.110	0.314	0.111	0.314	0.075	0.264
Education - high school diploma	0.329	0.470	0.310	0.462	0.283	0.451
Education – missing	0.185	0.388	0.218	0.413	0.356	0.479
Education - advanced degree	0.048	0.215	0.046	0.210	0.030	0.170
Education - some college	0.198	0.399	0.197	0.398	0.131	0.338

Table 4, Truncated Bivariate Probit Results, Endogenous Withdrawal

	HECM		Default		Withdrawal	
Monthly income	0.0358	***	-0.0027		0.0108	***
	(0.0042)		(0.0019)		(0.0033)	
Monthly income (squared)	-0.0019	***	0.0000		-0.0004	*
	(0.0003)		(0.0002)		(0.0002)	
Monthly income, missing	0.1720	***	-0.0056		0.0680	***
	(0.0385)		(0.0156)		(0.0268)	
Non-housing assets	0.0000	*	0.0000		0.0000	
	(0.0000)		(0.0000)		(0.0000)	
Non-housing assets are zero	0.0000		0.0003		0.0003	
	(0.0062)		(0.0024)		(0.0044)	
Property taxes/income	0.1214	***	0.0337	***	-0.2036	***
	(0.0441)		(0.0133)		(0.0343)	
Property taxes/income, missing	-0.0806	*	0.0036		-0.0613	***
	(0.0358)		(0.0150)		(0.0248)	
FICO credit score	0.0005	***	-0.0002	***	-0.0002	***
	(0.0000)		(0.0000)		(0.0000)	
FICO credit score. Missing	0.2981	***	-0.1539	***	-0.1674	***
	(0.0272)		(0.0107)		(0.0189)	
Revolving balance/income	0.0492	***	-0.0058	*	0.0409	***
	(0.0071)		(0.0030)		(0.0045)	
Installment balance/income	-0.0015		0.0012		0.0136	***
	(0.0059)		(0.0022)		(0.0039)	
Foreclosure started	-0.0757	***	-0.0037		-0.0100	
	(0.0236)		(0.0083)		(0.0167)	
Bankruptcy in last 12 months	-0.0949	***	-0.0025		-0.0454	**
	(0.0274)		(0.0114)		(0.0189)	
Available revolving credit	-0.0001		-0.0003	***	-0.0003	***
	(0.0001)		(0.0001)		(0.0001)	
No revolving credit	-0.0423	***	0.0157	***	-0.0044	
	(0.0099)		(0.0037)		(0.0076)	
Mortgage past due, 2+ months	-0.0373	***	0.0155	***	-0.0283	***
	(0.0143)		(0.0044)		(0.0077)	
Tax lien or judgment	-0.0335	***	0.0111	***	0.0143	**
	(0.0096)		(0.0033)		(0.0064)	
Missing credit report data	-0.0632	***	0.0029		-0.0027	
	(0.0163)		(0.0050)		(0.0129)	

*** p<0.01, ** p<0.05, * p<0.1
Probit estimates reported as conditional marginal effects (default) and selection marginal effects (HECM). Robust standard errors in parentheses.

Table 4 (cont), Truncated Bivariate Probit Results, Endogenous Withdrawal

	HECM		Default		Withdrawal	
Hispanic, missing	0.1592	***	-0.0004		0.0191	
	(0.0243)		(0.0068)		(0.0147)	
Hispanic	-0.0119		0.0149	***	0.0238	***
	(0.0141)		(0.0049)		(0.0096)	
Race, missing	0.0621	***	-0.0043		0.0048	
	(0.0176)		(0.0051)		(0.0115)	
Race, white	0.0602	***	-0.0069	*	0.0053	
	(0.0112)		(0.0039)		(0.0080)	
Race, black	-0.0644	***	0.0114	***	0.0391	***
	(0.0130)		(0.0044)		(0.0090)	
Race, Asian	-0.0234		0.0072		0.0221	
	(0.0315)		(0.0122)		(0.0235)	
Unmarrried male	0.0623	***	0.0158	***	0.0353	***
	(0.0083)		(0.0032)		(0.0061)	
Unmarried female	0.1271	***	0.0047	*	0.0162	***
	(0.0069)		(0.0026)		(0.0053)	
Age, youngest household member	0.0193	***	-0.0014		0.0084	**
	(0.0039)		(0.0019)		(0.0037)	
Age, squared	-0.0001	***	0.0000		-0.0001	***
	(0.0000)		(0.0000)		(0.0000)	
First language, not English	-0.0481	***	-0.0023		0.0564	***
	(0.0185)		(0.0061)		(0.0122)	
Education, bachelors degree	0.0003		0.0077		-0.0307	***
	(0.0116)		(0.0049)		(0.0087)	
Education, high school	-0.0008		0.0052		-0.0069	
	(0.0090)		(0.0037)		(0.0067)	
Education, missing	0.0110		0.0089	**	-0.0044	
	(0.0137)		(0.0043)		(0.0091)	
Education, advanced degree	-0.0317	**	0.0113	*	-0.0341	***
	(0.0153)		(0.0066)		(0.0113)	
Education, some college	0.0040		0.0064		-0.0087	
	(0.0099)		(0.0042)		(0.0072)	
Initial withdrawal %			0.0620	***		
			(0.0158)			

*** p<0.01, ** p<0.05, * p<0.1
Probit estimates reported as conditional marginal effects (default) and selection marginal effects (HECM). Robust standard errors in parentheses.

Table 4 (cont), Truncated Bivariate Probit Results, Endogenous Withdrawal

	HECM		Default		Withdrawal	
Estimated net IPL	0.0005	***				
	(0.0001)					
Excess home value amount	-0.0003	***				
	(0.0000)					
Monthly mortgage payments	-0.0221	***				
	(0.0050)					
HELOC indicator	0.0140					
	(0.0087)					
Price deviation*volatility	-0.0004					
	(0.0023)					
State house price deviation	0.2130	**				
	(0.1019)					
State house price volatility	0.0008					
	(0.0016)					
State GDP growth	-0.1713					
	(0.2719)					
Actual net IPL			0.0000			
			(0.0000)			
Exposure days			0.0001	***		
			(0.0000)			
Exposure days, squared			0.0000	***		
			(0.0000)			
Actual IPL					-0.0001	***
					(0.0000)	
Home debt/IPL					0.3270	***
					(0.0056)	
Fixed rate policy indicator					0.0554	***
					(0.0109)	
Fixed rate policy*spread					-0.0072	
					(0.0064)	
Constant	-3.6216	***	-0.4787		0.4805	**
	(0.4173)		(1.2011)		(0.1373)	
State Fixed Effects	Y		Y		Y	
Year Fixed Effects	Y		N		Y	
Rho (HECM, Default)	0.0313					
Rho (HECM, Withdrawal)	0.4486	***				
Rho (Default, Withdrawal)	0.0492					

log_sigma	-1.3670	***
Wald chi2	3273.6	***
Log pseudolikelihood	-5522.5	

*** p<0.01, ** p<0.05, * p<0.1
Probit estimates reported as conditional marginal effects (default) and selection marginal effects (HECM). Robust standard errors in parentheses.

Table 5, Policy Simulations

Policy Simulations	%Δ in Predicted HECM volume	Δ in T&I Default Rate	% Δ in T&I Default Rate[3]
Initial Withdrawal Limit			
Initial withdrawal limit[1]	-19.92%	-1.49	-21.32%
Credit Score Thresholds			
Initial draw limit[1]	-19.92%	-1.49	-21.32%
Hard limit: credit score >= 500	-3.18%	-0.87	-12.37%
LESA for credit score less than 500[2]	-0.93%	-1.04	-14.82%
LESA for credit score less than 500 + initial draw limit	-20.76%	-2.37	-33.83%
Hard limit: credit score >= 580	-13.80%	-2.57	-36.69%
LESA for credit score less than 580	-4.01%	-3.11	-44.49%
LESA for credit score less than 580 + initial draw limit	-23.65%	-4.05	-57.88%
Credit Risk Thresholds			
Initial draw limit	-21.34%	-1.48	-21.94%
Hard limit: drop observations with bad credit	-18.84%	-2.31	-34.40%
LESA for bad credit[4]	-5.42%	-3.05	-45.31%
LESA for bad credit + initial draw limit	-26.48%	-3.95	-58.68%

For the initial withdrawal limit and credit score thresholds simulations, we limit the simulations to observations with credit scores (N=14,900). For the credit criteria threshold simulations, we limit the sample and to observations with full credit reports (N=14,366).

[1]This exercise simulates the effect of the policy
1) If mortgage is over 60% of IPL, 2.5% upfront MIP is charged. Otherwise, initial MIP is 0.5%.
2) If mandatory obligation is less than 60% of IPL, initial withdrawal is limited up to 60% of IPL.
3) If mandatory obligation is more than 60% of IPL, initial withdrawal is limited up to an additional 10% of IPL, after paying off the mandatory obligation.
Other assumptions
1) Origination cost = $3400.
2) Household withdraws the same amount if policy (2) and (3) can be satisfied.

[2]The change in T&I default rate after LESA is calculated by assuming 0% default for those borrowers falling below the threshold who can afford the LESA, and otherwise dropping borrowers from the HECM pool who fall below the threshold and cannot afford LESA. This assumes that all borrowers who fall below the threshold and can afford LESA will behave the same as before which is modeled by the bivariate probit model. Those who pass the threshold are also assumed to have the same behavior.

[3]The % change in T&I default rate is the change in the default rate from imposing the percent draw limit or the threshold (if applicable), divided by the baseline default rate.

[4]Any record of delinquent mortgage, in foreclosure, tax lien, delinquent installment debt or delinquent revolving debt.

Appendix, Variable Definitions

Variable Name	Definition
Monthly income	Self-reported monthly household income at the time of counseling
Non-housing assets	Self-reported household non-housing assets at the time of counseling, including the value in checking and savings accounts, retirement accounts and the value of non-housing property
Property taxes/income	Three-year average (2008-2010) of county level on property tax rates from The Tax Foundation, divided by annual household income
FICO credit score	FICO credit score as reported in Equifax credit data; ranges from 300 to 850
Revolving balance/income	From credit attribute file, outstanding balance on revolving debt at the time of counseling, divided by annual household income
Installment balance/income	From credit attribute file, outstanding balance on installment debt at the time of counseling, divided by annual household income
Foreclosure started	From credit attribute file, coded 1 if the borrower had a foreclosure in process when they completed counseling
Bankruptcy in last 12 months	From credit attribute file, coded 1 if the borrower had a foreclosure in process when they completed counseling
Available revolving credit	From credit attribute file, constructed as the revolving credit limit less the outstanding revolving balance
No revolving credit	From credit attribute file, coded 1 if the borrower had no revolving credit accounts on his/her credit file
Mortgage past due, 2+ months	From credit attribute file, coded 1 if the amount of the past due mortgage is equal to or greater than 2 times the monthly mortgage payment amount
Tax lien or judgment	From credit attribute file, coded 1 if the borrower had a tax lien or judgment on their credit report file at the time of counseling.
Hispanic	Indicator for ethnicity, Hispanic
Race, white	Indicator for race, white
Race, black	Indicator for race, black
Race, Asian	Indicator for race, Asian
Unmarrried male	Indicator for single male household; includes never married, divorced, widowed and separated
Unmarried female	Indicator for single female household; includes never married, divorced, widowed and separated
Age, youngest household member	Age of the youngest household member at the time of counseling; if single, age of counselee
First language, not English	Indicator for the first language of the client as other than English
Education, bachelors degree	Indicator for highest level of education completed, 4 year college
Education, high school	Indicator for highest level of education completed, high school or GED
Education, advanced degree	Indicator for highest level of education completed, graduate degree

Appendix (cont.), Variable Definitions

Variable Name	Definition
Education, some college	Indicator for highest level of education completed, 2 year degree or some college
Initial withdrawal %	From HUD data, the proportion of the actual IPL withdrawn within the first month after origination
Estimated net IPL	Estimated initial principal limit (IPL) calculated based on the lesser of the self-reported home value at the time of counseling or the county specific FHA loan limit, the principal limit factor at the time of counseling adjusted for the borrower's age, and mortgage debt as reported in the credit file. For the principal limit, we use the greater of the principal limit factor calculated using the average adjustable expected interest rate or the principal limit factor using the average fixed interest rate as of the day of counseling
Excess home value amount	Calculated as the difference between the self-reported home value at the time of counseling and the county specific FHA loan limit, coded "0" if the difference is negative
Monthly mortgage payments	From credit attributes file, calculated as the total of all minimum monthly mortgage payments (first and second liens and HELOCs)
HELOC indicator	From credit attributes file, coded 1 if the borrower had a HELOC on the credit file at the time of counseling
State house price deviation	From state level FHFA data, deviation of the current real house price from the average real house price for the 1980 to 1999 period
State house price volatility	From state level FHFA data, house price volatility calculated based on the nine years prior to 2011
State GDP growth	From the state level FHFA data, state's real GDP growth rate
Actual net IPL	Calculated as the initial principal limit at the time of origination from HUD data, less outstanding mortgage debt as reported on the credit attributes file at the time of origination
Exposure days	Calculated as the number of days since the time of HECM origination and July 1, 2012 or the date of termination on the loan, whichever comes first.
Actual IPL	From HUD, the actual initial principal limit at the time of origination
Home debt/IPL	Calculated as the total amount of mortgage debt at the time of origination from the credit attributes file, divided by the actual IPL from HUD
Fixed rate policy indicator	Coded 1 if origination occurred on or after April 1, 2009, when the fixed rate, full-draw HECM product became readily available in the market
Fixed rate policy*spread	Calculated as the spread between the average fixed and adjustable interest rates as of the month of HECM application, multiplied by the fixed rate policy indicator