Can “High Costs” Justify Weak Demand for the Home Equity Conversion Mortgage?

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Abstract

The Home Equity Conversion Mortgage (“HECM”), like other reverse mortgages, offers older homeowners price and longevity insurance and enhanced liquidity. The US government aims to price guarantees without subsidy, and weak demand is attributed to high fees and interest charges. I show that near the recent price cycle peak, strategically used HECM lines of credit were better than fairly priced to many borrowers, even under unfavorable assumptions. Benefits are large for borrowers impatient to spend home equity before death or expecting price declines. Revealed preference suggests these traits were rare, even in 2006, or that HECM is widely mistrusted or misunderstood.

1 Introduction

Reverse mortgages such as the US Home Equity Conversion Mortgage (“HECM”) offer older homeowners cash or a line of credit in exchange for repayment that may be deferred until the borrower dies or sells their home. At termination, the borrower’s liability is the lesser of: (a) accumulated fees, principal, and interest or (b) the resale value of the home, with no adverse credit event in the event that (b) is greater than (a). These products thus offer both enhanced liquidity and insurance against extreme longevity and home price declines.

Such a product would presumably appeal to older homeowners, many of whom are “house

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rich and cash poor.”¹ However, the overwhelming majority of older homeowners choose not to use reverse mortgages or conventional forward home equity mortgages. Fewer than 20% of US homeowners over age 75 in the 2007-2010 American Community Survey owe any mortgage debt. Consumer Financial Protection Bureau (2012) estimates that between 2% and 3% of eligible US homeowners are reverse mortgage borrowers.

Weak demand for reverse mortgages is commonly attributed to “high” fees and interest rates, with an implication that the credit terms are sufficiently worse than actuarially fair as to offset any benefits from smoothing consumption across time or states of nature. Redfoot et al. (2007) reports that high costs are by far the most important reason cited for not taking on HECM debt among surveyed retirees.²

This paper asks whether HECM really has offered actuarially unfavorable pricing to a large majority of borrowers, relative to the most common alternative of retaining 100% equity. The central question is whether the value of the implicit short position in the borrower’s home price and long positions in longevity and interest rates is greater than or less than the cost of fees and interest charges above riskless rates. I consider the net present value of a HECM line of credit to hypothetical risk neutral borrowers in different US metropolitan areas who believe that future changes in interest rates and prices will be drawn from their local historical joint distribution. A positive risk-neutral expected transfer to borrowers implies negative expected profits to the government as guarantor, because the government collects less than half of fees and interest charges but promises investors repayment of principal and interest. While a free market industry equilibrium might guarantee zero expected transfers to borrowers (somehow risk adjusted), government-imposed pricing that is invariant across markets and borrower gender or marital status almost guarantees that pricing will be better.

¹Venti and Wise (2000) among many others document the importance of home equity in retiree portfolios. Selling one’s home and moving to rental or cheaper owner housing is distasteful to most retirees, as indicated by survey results in Bayer and Harper (2000).
²See also Caplin (2002) and Nakajima and Telyukova (2011). In announcing the “HECM Saver” program in 2010 with lower loan to value ratios but also lower guarantee fees, Federal Housing Administration commissioner David Stevens said: “Despite the popularity of our HECM loan product, we have noted concerns that some senior citizens find that our fees are too high for them.”
or worse than fair for some set of borrowers.

A key insight is that a borrower who discounts at the riskless rate would not draw down the full HECM line of credit immediately, but would instead exploit a design feature and allow the available credit to grow at the higher loan interest rate. With linear utility over expenditures and no institutional or physical impediments to the timing of exercise, the line should only be drawn just before a move or death. The line of credit is thus akin to a put option with a stochastic exercise date and a strike price that grows at a spread over short term treasury or LIBOR rates. Accumulated principal and interest on credit draws come out of home equity whether or not the put expires in the money.

There are circumstances under which the borrower would not optimally allow the full line of credit to grow at the loan interest rate all the way until death or a move. These are evidently empirically relevant circumstances, because most HECM borrowers draw down most of their credit line within the first year. Borrowers may wish to draw the line because they have investment opportunities that pay greater returns than the loan interest rate. Council of Mortgage Lenders (2009) shows that most UK retirement home equity borrowers use loans to either pay off a higher rate mortgage or undertake a home improvement project; Stucki (2012) shows that most HECM borrowers plan to use the proceeds to pay down existing debt. Borrowers with concave utility over consumption while alive, weak bequest motives, and limited alternative sources of credit would likely wish to draw down some or all of the line before loan termination. This desire to smooth home equity consumption across time drives the value of home equity loans in the pioneering study of Artle and Varaiya (1978). Alternatively, the small fraction of the population who take HECM loans may be abnormally impatient. For such borrowers, discounting simple cash flows at the riskless rate will overstate the value of a strategy of waiting until loan termination to draw the credit line, but may understate the value of an optimally used HECM. To illustrate these effects, I consider borrowers with linear utility but no bequest motive or who finance up-front fees and some consumption each year in alternative simulations.
Even borrowers who discount all future cash flows at a rate lower than the loan interest rate might wish to draw down the line early. If the borrower may die or become incapacitated without sufficient warning to draw the line upon the health shock, then an in the money put option may go unexercised. Allowing for strategic failure and a relatively simple preemptive early withdrawal reaction reduces the value of HECM in examples below.

Whether loan pricing can justify weak demand for HECM is interesting for at least two sets of reasons. First, HECM is the dominant reverse mortgage product in the US. Given the seeming consumption smoothing benefits, a finding that HECM is actuarially favorably priced under “conservative” assumptions, combined with weak demand, would suggest that at least one of the following statements about older homeowners is false: (a) they have preferences that would generate demand for fairly priced reverse mortgages, (b) they understand and trust all significant and welfare improving financial products, (c) they believe future movements in real interest rates and home prices will be similar to past movements.

A failure of condition (a) would run counter to frequently used models of retirement finance. Absence of demand for annuities has been deemed a puzzle since at least e.g. Modigliani (1986), and reverse mortgages combine annuities’ transfers from short-lived to long-lived states of the world with transfers from high home price appreciation to low price appreciation states of the world and provide consumption smoothing benefits described by Artle and Varaiya (1978). If HECM is approximately fairly priced, low demand might be taken as evidence of utility that is nearly linear over wealth, as in Lockwood (2011). Demand for home equity as precautionary savings against long-term care needs (Skinner (1996), De Nardi et al. (2010), Davidoff (2010)) is unlikely to justify widespread absence of demand for HECM: I consider value for married couples, and nursing home expenditures are much higher for singles and for older retirees (see Lakdawalla and Philipson (2002)), thus HECM’s backloaded payouts should be positively correlated with the marginal utility of wealth for such precautionary savers.

Condition (c) is particularly interesting with respect to non-borrowers in “Sand State”
markets near the recent home price cycle peak. From an ex-post perspective, it seems clear that high long-run supply elasticity and low price growth should have made many people skeptical that jumps in the level of prices there between 2004 and 2006 would persist. However, for most households, taking a short position in housing prices is difficult: moving out of a home is burdensome, and securities such as Case-Shiller S&P home price index are thinly traded and involve exposure to considerable risk on top of capital gains on one’s own home. We thus do not have revealed preference data on whether most Sand State households believed prices were likely to crash. However, older homeowners who understood HECM design and believed that it was likely that prices would decline close to as far as they actually have should have found HECM to be welfare improving. That the large majority of homeowners in all markets rejected HECM even near the home price cycle peak near 2007 may be taken as evidence that there was not widespread skepticism about those price levels.

A second motivating consideration is that the US government (through the Federal Housing Administration, “FHA”) designed HECM and guarantees that lenders will be repaid principal and interest in exchange for fees. Expanding the use of home equity to enhance retirement financial security might satisfy government objectives, so it may be useful to understand whether actuarially unfair pricing is a plausible barrier to demand growth. Alternatively, condition (b) may apply: consumers may not be fully aware of the choices they face, which might motivate further consumer education efforts. Also, while the HECM loan guarantee business was meant to generate a non-negative value to the FHA, to date net transfers to borrowers and lenders have been considerable. The losses to FHA are in part attributable to geographic adverse selection described by Shan (2011) and others: while HECM market share has been small everywhere, a relatively large fraction of HECM originations went to “Sand State” (Arizona, California, Florida, and Nevada) borrowers near the recent cycle peak. Prices in these markets have fallen enough that outstanding balances (and credit lines) on many loans are worth considerably more than the underlying homes. This adverse selection is shown clearly in Figure 1.
Actuarial models of HECM performance generally assume that borrowers will continue to use credit lines early in the loan’s life.\textsuperscript{3} These models will require adaptation if consumer behavior changes and dynamic adverse selection on credit use emerges; that is, if borrowers adapt the strategy described below, under which loan spreads are almost never paid. Notably, in 2010, FHA increased regular interest charges with the intention of enhancing the profitability of their guarantee position. If credit line draws are sufficiently negatively correlated with price appreciation, this modification will increase expected losses to FHA, because the credit line grows faster with a larger loan spread. A better alternative may be to limit guarantees to HECM loans originated with fixed interest rates and which require the full loan amount to be withdrawn at closing. These fixed rate, lump-sum loans have become popular among borrowers since their recent adoption by FHA.

A finding that many borrowers would derive a positive expected net present value from HECM lines of credit is a departure from conventional wisdom. I thus aim to make modeling choices that understate, rather than overstate the value to borrowers. The methodology in Section 2 gives no credit to HECM for offering payments that are likely positively correlated with the marginal utility of wealth, except when borrowers with no bequest motive are considered. I also ignore some moral hazard and adverse selection considerations that have been identified in the contracting literature on reverse mortgages and should lead from transfers from FHA to borrowers. In particular, I ignore borrowers’ option to defer moving while alive when the loan balance is, or is likely to be, greater than the home value.\textsuperscript{4}

Adverse selection on mortality is a natural concern (witness the case of famously long-lived Jeanne Calment, who borrowed a French variant of a reverse mortgage), as there is evidence that this arises in the market for life annuities (e.g. Finkelstein and Poterba (2005)). I allow for this only in the sense that I consider the value of HECM to married couples, who receive loan terms identical to singles with the same age as that of the younger spouse. I do

\textsuperscript{3}e.g. IBM Global Business Services (2010).
\textsuperscript{4}Davidoff and Welke (2006) find increased termination probabilities when HECM borrowers have excess equity available, but we are more interested here in the latent behavior of non-borrowers.
not consider private information on mortality.

The borrower’s home’s value has the same joint distribution with interest rates as does the FHFA home price index, thus ruling out selection on price movements within markets and the option to under-maintain the home when it becomes likely that the credit available will exceed collateral value at loan termination.\(^5\) I ignore fluctuations of individual home values around FHFA market averages and thereby understate the volatility of individual borrowers’ home values and this reduces the embedded default options in HECM.\(^6\) I consider a variety of beliefs about home prices, including backward-looking expectations around 2006 that include periods of historically very high home price appreciation and low interest rates, conditions under which the put option is least likely to have value.

In the following section, I compute the value of HECM to borrowers under a variety of institutional arrangements and preference structures. Section 3 discusses how the results may affect our understanding of retiree beliefs and preferences.

2 The Value of a HECM Line of Credit

2.1 HECM Lines of Credit

Among other options, HECM borrowers can choose a line of credit with an adjustable interest rate. To be eligible, an individual, or both spouses in a couple, must be 62 or over. Costs and fees due at closing have varied across time and borrowers, but for a $200,000 home near the price cycle peak around 2006, 6% of the value of the home seems to have been slightly above average, inclusive of a 2% statutory insurance premium to FHA, origination fees capped at 2%, and reimbursable lender costs averaging roughly $3,400 according to Canadian Mortgage


\(^6\)I ignore individual home fluctuations because they would require a model of individual home dynamics missing from the FHFA methodology that generates estimates of these individual deviations: the nonlinear behavior of the volatility of individual home price deviations implies a complicated time series structure to these fluctuations, and taking a stand on these fluctuations and borrowers’ knowledge of them may be distracting.
and Housing Corporation (2012). I label these closing costs as a fraction of home value \( f \) below.

In a HECM line of credit, the “initial principal limit”, the maximum amount that can be drawn immediately, is the product of a “principal limit factor” and the “maximum claim amount.” The principal limit factor, \( l \) below, is increasing in borrower age and decreasing in the prevailing 10-year treasury or LIBOR rate. The age used in computing the principal limit factor is the age of the younger member of a couple if the borrower is a couple. The maximum claim amount is generally equal to the appraised value of the home, but is bounded above by time- and location-varying caps. Most eligible borrowers’ homes are worth less than these caps, so caps do not explain away low HECM market penetration and I assume they do not bind in the following analysis.\(^7\) HECM loans are commonly used to retire existing mortgage debt, but mortgage debt owed before closing must be less than the initial principal limit after closing.

Any draws on the line of credit, including the closing costs if financed, accumulate at a spread over an index that is the 1-year treasury or LIBOR rate. No repayment is due until loan termination. The most popular adjustable mortgage allows for adjustments capped only at a lifetime ceiling 10% above the initial rate. Through 2006, the 1-year treasury was the most common index and the margin was almost always 2%, reflecting a 1.5% margin to the lending institution and a .5% mortgage insurance premium to FHA. Between 2007 and 2010, the regular mortgage insurance premium rose to 1.25%, lenders’ margins rose, and principal limit factors formulas were modified. Unused credit available grows at the loan interest rate,\(^8\) and the lender may not call back the line of credit, even if the value of the home falls.

Denote by \( l \) the principal limit factor, \( b(t) \) the accumulated draws up to date \( t \), \( r \) the

\(^7\)Borrowers may be forced to set aside some loan proceeds for home improvements and the maximum initial draw allowed is reduced by a set-aside for expected servicing fees. However, the servicing fees are paid as part of the lender’s margin during the loan’s life, and I ignore the improvement requirement as fewer than 15% of borrowers to date have had such a requirement recorded in HECM loan data.

\(^8\)This credit growth formula was established in 1997 by FHA (Mortgagee Letter 97-15), replacing a growth formula that was typically more generous.
(variable) real index rate, \( s \) the lender’s margin plus the regular guarantee fee, and \( c \) the rate of consumer price inflation. With continuous compounding, the evolution of remaining credit available \( x(t) \) as a fraction of initial home value at date \( t \) would be:

\[
\begin{align*}
    x(0) &= l, \\
    \dot{x}(t) &= [x(t) - b(t)] [r(t) + c(t) + s] - \dot{b}(t), \\
    \dot{b}(t) &\leq x(t).
\end{align*}
\]

Upon the earliest of sale while alive, extended absence due to illness, or death of the borrower (both borrowers in the case of a couple), the borrower owes the lesser of the appraised value of the home net of selling costs or the accumulated principal and interest \( b(T) \). The lender has no claim on other borrower or estate assets and if the home is worth less than the balance due there is no adverse credit impact on the borrower.

### 2.2 Pure “Put” Strategy, No Strategic Failure

Suppose the borrower is able to manage the line of credit until just before death, that the borrower’s discount rate is at all dates \( t \) equal to the riskless index rate \( r(t) \), and that the borrower has linear utility over home equity proceeds consumed at any date. This linear utility for now includes wealth left to heirs, so that bequests are given the same weight as consumption while alive; this assumption will be dropped later. Under these conditions, the optimal strategy to maximize borrower NPV would be to pay closing costs and fees \( f \) out-of-pocket at closing and only draw the line just before loan termination. At that point, due to the non-recourse nature of HECM debt, home equity proceeds would equal the greater of the value of the home or available credit \( x(t) \).

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\(^9\)If the home is worth more than \( x(t) \), there is no cost or benefit to drawing the line under this strategy. FHA staff report no institutional limitations to this strategy (other than sudden death or incapacity, discussed below).
Under this strategy, assuming continuous compounding and assuming the borrower’s discount rate is always equal to the riskless rate $r(t)$, denoting by $g(t)$ the real growth rate of the home value at time $t$, and by $z$ brokerage and other selling costs, the net present value of home equity proceeds as a fraction of initial home value if the home is sold or the borrower dies at $T$ are:

$$W(T) = -f + e^{-\int_0^T [r(t) + c(t)] dt} \max \left( [1 - z] \int_0^T [g(t) + c(t)] dt, le^{\int_0^T [r(t) + c(t)] dt} \right).$$

(4)

The value $W(T)$ measures welfare in terms of the number of dollars (positive or negative) that would have to be invested at date 0 to achieve the same payout as $W(T)$, assuming savings were invested in rolled-over one-year treasuries.

An important feature of the design of the HECM line of credit is that for borrowers who discount future cash flows at a rate less than $r(t) + s$, drawing any of the line of credit is destructive of value. This is because drawing early is equivalent to borrowing at rate $r(t) + s$ and saving at rate $r(t)$. To see this, notice that if a fraction $b$ of initial value is withdrawn at date $M < T$, the payoff would be:

$$W(T)_{\text{early}} = -f + be^{-\int_0^M [r(t) + c(t)] dt} + e^{-\int_0^T [r(t) + c(t)] dt} \max \left( [1 - z] \int_0^T [g(t) + c(t)] dt - be^{\int_0^T [r(t) + c(t)] dt}, le^{\int_0^T [r(t) + c(t)] dt} - be^{\int_0^T [r(t) + c(t)] dt} \right).$$

(5)

The difference between not drawing early and drawing early is:

$$W(T)_{\text{early}} - W(T) = b \left[ e^{-\int_0^M [r(t) + c(t)] dt} - e^{\int_0^T [r(t) + c(t)] dt} e^{\int_M^T [r(t) + c(t)] dt} \right].$$

$$= be^{-\int_0^M [r(t) + c(t)] dt} \left[ 1 - e^{s[T-M]} \right] < 0.$$  

(6)

In the event of a shortfall claim, FHA permits the deduction of brokerage costs up to 6% of value, prorated real estate taxes, transfer taxes, attorney fees, probate fees and similar costs.
Notably, the strike price at which the HECM’s implicit put option becomes in the money at \( T \) does not change with credit use. Either way, a put option with an identical (stochastic and time \( T \) dependent) strike price is purchased for closing costs \( f \). Credit use is simply equivalent to borrowing at the loan interest rate.

With continuous compounding, we see that inflation terms \( e^{\int_0^T c_t \, dt} \) cancel in gross real home equity (4). In fact, compounding is monthly, but the remainder of the analysis considers discrete time (with annual compounding to speed calculations) and ignores any minor effects of inflation on real HECM value. Relative to retaining 100% equity and simply enjoying cumulative real price growth at \( T \), the discretized expected net present value of taking a HECM at date 0 and terminating at date \( T \) is:

\[
V_T = -f + \frac{\max\left(\Pi_{t=0}^T [1 + r_t + s] - [1 - z] \Pi_{t=0}^T [1 + g_t], 0\right)}{\Pi_{t=0}^T [1 + r_t]}. \tag{7}
\]

Two results follow immediately from equation (7). First, if the borrower uses this pure “put” strategy, increasing the loan margin \( s \) will reduce expected lender profits (FHA would absorb the loss above the 2% initial guarantee fee) and symmetrically increase the expected gain to the borrower, holding all else constant. That might not be the case if the borrower (like most HECM borrowers) uses some of the credit line before termination. Second, the benefit to the borrower in immediate dollars is bounded below at \(-f\), or roughly -6% of the value of the home. If potential borrowers understand HECM design and believe that they can follow this strategy, revealed preference indicates that the price hedging and longevity insurance associated with HECM are worth no more than this amount to the overwhelming majority of older homeowners who reject HECM. This strategy does not provide the intertemporal smoothing benefit described by Artle and Varaiya (1978).

In exchange for the fee \( f \), the strategic HECM borrower obtains future home equity proceeds that first order stochastic dominate those with no HECM in place. In this sense, HECM offers “insurance” with payouts linked to longevity, low price appreciation, and high real interest rate growth.
With no possibility of failure to draw the credit line just before termination, no liquidity considerations, and equal weighting of own consumption and bequests, computing the expected net present value of a HECM loan requires only integrating equation (7) over the joint probability distribution of termination dates $T$, real interest rates $r$, and home price growth $g$.

I consider the value of a HECM loan to a married couple. This value will be greater than the value that would be computed for single borrowers, but the market penetration rate for married couples is lower than for singles, so a finding for this majority group of retirees is no less interesting than would be results for singles. I consider couples with the wife aged 65 or 75 and husbands 68 or 78 respectively, reflecting a median of a three year gap among respondents in the Health and Retirement Study /AHEAD (“HRS”) panel data on older Americans.

HECM loans terminate with the earliest of (a) a refinance of the loan, (b) a move while alive, or (c) death of the longer-lived of the two borrowers. I ignore refinance, which leads to some understatement of the value of HECM; during the recent period of housing boom and low interest rates, a significant fraction of HECM loan terminations were via refinance. Borrowers will have a strategic incentive to adjust the timing of a move while alive. There is no financial reason to move if the home is worth less than the maximal credit line $x$ at a given date and the real loan interest rate is greater than the borrower’s discount rate. Exacerbating losses to FHA, HECM loan terminations have slowed considerably during the recent home price bust. However, because economists studying the general population (e.g. Venti and Wise (2000)) have identified such a critical role for health shocks and death of spouse in explaining sale of a home, and such a limited role for financial considerations, I assume that sale when alive is invariant to price and interest rate movements.\(^{11}\)

I take mortality probabilities for men and women from the US Social Security administration’s life tables. For the probabilities of exit while alive, I use panel data in HRS from

\(^{11}\)The borrowers’ objective can be thought of as involving infinite disutility if the move does not occur either at the stochastically arriving move while alive date or at death.
covering the years 1998 through 2010. I calculate the annual probability of a move while alive separately for singles (by age) and married couples (by age of the younger spouse in 5-year bins) and who were homeowners in all prior waves. Some age/sex cells become empty starting at age 98, and I assume the loan terminates with 100% probability conditional on at least one borrower remaining alive and in the home at age 98. The probabilities of a move while alive range from 2.4% to 4.4%. I ignore increases in mortality and mobility following death of a spouse and assume mortality and mobility for widows are the same for singles of each sex in general. Correlated mortality and mobility within couples would likely increase the right tail of loan duration, so ignoring this correlation presumably leads to downward bias in the duration of loans, and thus also the value of put options embedded in HECM. I also ignore the possibility of divorce or remarriage, effects that work in opposite directions.\textsuperscript{12}

With the probabilities of mortality and sale while alive in hand, the probabilities of terminating a loan, and of starting a given period after origination still in the home, by marital status, gender, and date of first arrival at that gender and marital status can be computed. These probabilities are independent of the path of the home value and interest rates as noted above. I find mean durations $T$ of approximately 20 years for couples with a 65-year-old wife and 16.5 years for couples with a 75-year-old wife.

I consider the expected value for HECM lines of credit given terms available around the first quarter of 2006, when the 5-year and 10-year real treasury (TIPS) yields were both approximately 2%, and so the borrower starts with a real discount rate of 2%. Given the prevailing 10-year nominal treasury rate, initial principal limit factors $l$ had medians of 60% for a 65-year-old, 70% for a 75-year-old, and 75% for an 85-year-old youngest borrower. I set closing costs $f$ at 6% and selling costs $z$ at 7%. I ignore non-financial costs, such as time spent thinking through optimal credit management and mandatory counseling imposed on borrowers. The rate spread above the one-year treasury rate, $s$ above, is set at 2%, except in Table 5.

\textsuperscript{12}Census data show that divorce is less than 20% as common as widowhood among Americans over 65.
Before turning to expectations that recognize the stochastic structure of home prices and interest rates, the top 4 rows of Table 1 present the value of HECM for a couple that believes real interest rates will remain at 2% and that the real value of their home will grow either at the real rate of growth of the FHFA repeated transaction US home price index between 1975 and 2006 (1.6%) or between 1982 and 2002 (0.97%). In the former case, with expectations of relatively high real price growth, HECM provides an NPV of approximately -3% of home value to a 65-year-old wife and her 68-year-old husband and -4% of home value to a or 75-year-old woman and her husband of 78. With the less optimistic price expectations, the value is approximately zero to the younger couple and -2% of home value to the older couple.

Given that the value of HECM is bounded below at -6% (f) of home value, we expect more positive valuations for homeowners who recognize that the real price appreciation and interest rates will not always be equal to current levels or historical averages. Moreover, some metropolitan areas have had historical average price growth less than that for the US as a whole. Because HECM market share is uniformly low across housing markets (with a mean of 2%, a 75th percentile of 3.3%, and a maximum of 10%, as documented in Figure 1), the higher end of the distribution of values may be of as much interest as the mean or median. The tabulation of results recognizes that metropolitan areas with longer available time series are larger and may have different price movement distributions than other housing markets. A large number of smaller metro areas have complete data for neither period.

To parameterize expectations about the future joint distribution of real home price growth $g$ and one-year real treasury rates $r$, for all available US metropolitan areas, I use backward looking expectations over different horizons characterized by start points $B$ and end points $E$. Data on home prices at the metropolitan level is sparse before 1978, so $B$ is either 1978 or 1983, first quarter. $E$ is either 2006 or 2002, first quarter. I use different starting and ending points to recognize that high real interest rates and low real price appreciation between 1978 and 1982 might have been unusually good draws for the put option value embedded in HECM, and that unusually low real treasury rates and high appreciation between 2002
and 2006 might have been unusually unfavorable for HECM put value. To explore the value of HECM to borrowers who put some probability on the observed home price crash, I also consider borrowers who believed that there would be a one-time crash in real values of 50% of the actual crash observed between 2007 and 2011. An immediate crash, followed by a reversion to historical growth patterns, is both simpler to characterize and typically less favorable to the HECM put option than a longer crash of the same magnitude that arrives later with some hazard rate.

To simulate the distribution of interest rates over time, because interest rates are persistent, I estimate a single factor regression with a trend for one-year real treasury rates with observations including all quarters over the different end points:

$$r_t - r_{t-4} = \alpha + \beta [r_{t-4} - \bar{r}] + \gamma t + u_t,$$

In regression (8), $r_t$ is computed as an \textit{ex-post} return: the nominal treasury yield (CMT, from the Federal Reserve Bank of St. Louis) available in quarter $t$ less the percentage growth of US C.P.I. (for all goods) between quarters $t$ and $t + 4$. $\bar{r}$ for regression purposes is also computed over that sample period. The borrower anticipates that interest rates will evolve with the parameter $\beta$ governing movements, and that the residuals $u_t$ will be drawn from the distribution observed between one endpoint and the other. The borrower assumes that going forward, there will be zero expected change in real interest rates from the initial level, and so sets $\alpha$ and $\gamma$ equal to zero rather than the estimates governed by historical data and sets $\bar{r} = .02$ to forecast rates forward. I calculate the value of HECM for each possible starting quarter, with the TIPS rate of 2% for 2006 as a starting point for the underlying treasury rate, and then drawing regression residuals starting in each quarter between the start and end years. After an initial quarter is randomly selected, I select the quarter four periods hence, cycling through. I put equal weight on each of the sequences of interest rate residual draws:

$$\{u_B,u_B+4,\ldots,u_E,u_B,\ldots\}, \{u_B+1,u_B+5,\ldots,u_E-3,u_B+1,\ldots\}, \ldots \{u_E-1,u_B+3,\ldots,u_E-1,u_B+3,\ldots\}.$$
\{u_E, u_{B+4}, \ldots , u_E, u_{B+4}, \ldots \}.

In the first sequence, the first year’s real interest rate drawn is the prevailing TIPS rate of 2\%. The second year’s real rate is 2\% plus the regression constant \( \alpha \) (.01) plus the regression \( \beta \) estimate times the regression residual \( u_B \) (plus \( r_0 - \bar{r} = 2\% - 2\% \)) for date \( B \), and so on.

I employ Monte Carlo sampling over sequences rather than simple one-by-one sampling of quarters between \( B \) and \( E \) with replacement (as in Poterba et al. (2010)) to recognize serial correlation in interest rates and home prices. This turns out to make little difference for simulated values of the HECM loan.

The time series patterns of home price growth are notoriously difficult to characterize (see e.g. Case and Shiller (1989)), and there is no simple time series relationship between real home price growth and real interest rates. The borrower thus anticipates that real home price growth will follow metropolitan-area specific real price growth realized between dates \( B \) and \( E \). That is, denote by \( g_t \) realized real price growth between dates \( t \) and \( t + 4 \), and the borrower puts equal probability weights on the joint real interest rate change and real percentage price growth paths: \( \{[g_B, u_B], [g_B+4, u_{B+4}], \ldots , [g_E, u_E], [g_E+4, u_{E+4}], \ldots \}\),
\( \{[g_{B+1}, u_{B+1}], [g_{B+5}, u_{B+5}], \ldots , [g_{E-3}, u_{E-3}], [g_{B+1}+4, u_{B+1}+4], \ldots \}\),
\( \ldots \{[g_{E-1}, u_{E-1}], [g_{B+3}, u_{B+3}], \ldots , [g_{E-1}, u_{E-1}], [g_{B+3}+4, u_{B+3}+4], \ldots \}\),
\( \{[g_E, u_E], [g_B+4, u_{B+4}], \ldots , [g_E, u_E], [g_B+4, u_{B+4}], \ldots \}\).

Assuming that individual homes grow at the FHFA metropolitan-specific price index growth rate will understate the value of the embedded put options in HECM for at least three reasons. First, changes to individual home values are more volatile than metropolitan area mean price changes. Second, borrowers may have information that their home value has lower expected price appreciation than the metropolitan area mean (both in the time series and cross-section). Third, borrowers have the option to under-maintain the home when it becomes likely that the credit available will exceed collateral value at loan termination.\(^{14}\)

\(^{13}\)The real yield curve happened to be flat in 2006 quarter 1.
\(^{14}\)See Miceli and Sirmans (1994) and Shiller and Weiss (2000).
For each sequence of interest rates and home prices, equation (7) is integrated over the probability distribution of termination dates \(T\). This distribution is arrived at as follows: in the first year of the loan, termination occurs with the probability that either both the husband and wife die, or that a married couple moves while alive. The probabilities that period two starts with a married couple, a single male, or a single female come from the sex-specific mortality probabilities and the probability of no move while alive for a couple in the first period. The probability of termination in period two is greatest conditional on starting with a single male, next with a single female, and least starting with a married couple. Termination is an absorbing state. The overall expected value puts equal weight on the expected value of \((7)\) for each sequence of the \(E - B\) starting quarters. The expected valuation for metropolitan area \(m\) is:

\[
\bar{V} = -f + \sum_{b=B}^{E} \sum_{T=T}^{98} \sum_{i=1}^{3} q_{TTi} P_{Ti} \frac{\max\left(\Pi_{t=T}^T [1 + r_T(b) + s] - [1 - z] \Pi_{t=T}^T [1 + g(b), 0]\right)}{\Pi_{T=T}^T [1 + r_T(b)]} \frac{\Pi_{T=T}^T [1 + g_T(b)]}{(E - B + 1)[98 - T + 1]}.
\]

(9)

\(q_{TTi}\) is the probability that a couple with a wife currently (i.e. at HECM loan closing) aged \(T\) and her three-years-older husband will evolve into status \(i\) (widower, widow, or couple) by the start of date \(T\), and \(p_{Ti}\) is the probability that a household of status \(i\) will exit ownership by (joint if a couple) death or a move while alive at age \(T\), conditional on survival to \(T\). For now, the history of status \(i\) does not matter for valuation, but will in later modifications that allow for strategic failure. In equation (9), interest rates and growth rates at different borrower ages depend on the path driven by the choice of start dates \(b\) between \(B\) and \(E\). For data reasons, widowers’ probability of a move while alive for ages 98-101 is assumed to be that for age 98.

The bottom rows of Table 1 presents the mean and 75th percentile of expected net present value results for different sets of metropolitan areas for couples with 65-year-old and 75-year-old wives. There is considerable variation in the value of HECM across metropolitan areas. The mean and 75th percentile of averaged valuations range from positive 1 to 10 percent.
of initial home value. In the absence of strategic failure, it does not appear that HECM is unfavorably priced for all or even most metropolitan areas.

The choice of endpoints for the backward-looking period from which the distribution of future prices matters: dropping the years of relatively high interest rates and low price appreciation 1978-1982 reduces HECM value and dropping the years with opposite features between 2002 and 2006 increases value. I present results for either 1978 to 2006 or 1982 to 2002, and these effects work in offsetting directions. The longer period exhibits somewhat higher valuations, despite being drawn from a set of metropolitan areas with higher than average price growth (and not too much greater volatility) and hence lower than average borrower values.

2.3 Strategic Failure

Realistically, the strategy of drawing down the line of credit only at the moment before death of a widowed spouse or sale while alive may fail if death arrives suddenly or if many years into a HECM loan, the credit line is forgotten. The fraction of terminations that would run into difficulty is hard to know, so in Table 2 I report results from an identical procedure to that outlined above, except that there is now a 50% probability that a single spouse will neglect to draw down the HECM line of credit just before termination, even if the credit available exceeds the value of the home. Recognizing this possible strategic failure, I allow the household to use the following rule for credit use: draw down the full line of credit if the credit available exceeds home value, and then only if an expected loss from failing to draw the line exceeds the approximate benefit of earning the loan spread \( s \) by waiting to draw the line. In particular, the line is drawn if:

\[
\text{Draw at date } t, \text{ status } i \text{ iff } .5 \left[ x(t) - \Pi_t^\infty [1 + g_t] \right] p_{ti} > \frac{x(t)s [1 - p_{ti}] (1 - .5)}{1 + r_t} \tag{10}
\]
The option to pull the line of credit is thus more likely to be exercised when the current home value is a small share of available credit and when the borrower is likely to terminate (\(p\) is close to one). There will be states of the world in which the “put option” is in the money, but the borrower fails to draw the line. I assume a couple never forgets to draw the line, naturally HECM’s value falls as the probability of a strategic failure rises.\(^{15}\)

Table 2 shows HECM borrower expected values under strategy 10 that are necessarily weakly less than the values shown with no strategic failure in Table 1. The range of mean to 75th percentile values across metropolitan areas is now -1 to 5 percent of the initial home value. Even recognizing a likelihood of strategic failure, it is difficult to characterize HECM as providing expensive insurance against longevity and home price declines.

### 2.4 Liquidity

Economists since Artle and Varaiya (1978) have emphasized the liquidity gain from reverse mortgage products at least as much as the protection against longevity and home price changes. Since a consumer who discounts at the riskless rate would have no demand for liquidity, and because the extent of liquidity obtained under a HECM line of credit is a matter of choice, there is no obviously best way to determine the actuarially fair value of HECM to such a borrower who for whatever reason chooses to draw on the line of credit early.

I offer two ways to value HECM with liquidity below. The first way is to assume an \textit{ad-hoc} draw strategy while preserving the risk-neutral valuation and assuming a full bequest motive. Casual empiricism suggests 1.25% of home value appears to be at the high end of

\(^{15}\)The absence of a simple functional form for loan termination or the evolution of interest rates or home prices makes it unlikely that there is a simple algorithm for identifying the optimal stopping time in expectation. That a single aging homeowner to use any such formula seems unlikely, indeed even the proposed formulation likely gives “too much credit” to the borrower. While a borrower can certainly observe a market index, the borrower would have to invest time or money to know the value of their individual home, so I choose not to simultaneously model strategic failure and deviations of individual home price growth from the market index. We will see that potential borrowers with no bequest motive place very high value on HECM, so absence of demand should be associated with bequest motives, and children will have incentives to help parents avoid in-the-money put options to expire without exercise.
property tax rates paid by homeowners in “Sand State” markets, and the politics around
California’s Proposition 13 makes it clear that retirees care about property tax levels. I thus
assume for illustrative purposes that the retiree draws 1.25% of initial home value per year.\textsuperscript{16}
To ensure that HECM is purely liquidity enhancing up to the date of move, I also assume
that the initial costs \( f \) of 6\% are borrowed rather than paid out of pocket. Because the loan
balance accrues at a spread of 2\% above the borrower’s discount rate, assuming a more rapid
draw would further reduce the estimated value of HECM. Table 3 shows that this early draw
strategy has a substantially negative effect on valuation. The expected value to the borrower
declines to a range of \(-14\) to \(-5\) percent of initial home value (with early draws, the lower
valuation bound of \(-f\) no longer applies). The mean internal rate of return to the lender is
close to 18\% across specifications and price paths. This high cost comes from the high share
of closing costs in total draws, since the spread of 2\% would generate much smaller IRRs.
In this sense, it is fair to say that HECM provides liquidity at high cost. While conventional
forward debt does not provide the same longevity and price insurance, is rarely used, and
may offer low loan amounts if pension income cannot be pledged, forward loans may provide
less costly liquidity than HECM.

An alternative, and arguably superior, way to treat liquidity is to provide a motivation
grounded in utility. Assuming a particular concave utility function would invite controversy,
particularly on the question of the extent of demand for liquidity for health expenditures
in advanced retirement. Moreover, the optimal consumption and draw path would be very
difficult to characterize in this stochastic setting featuring real options to move and to draw
on the credit line. Instead, I rationalize borrower liquidity demand in Table 4 with linear
utility over real discounted consumable wealth, but with no weight placed on wealth left to
heirs. Thus home equity proceeds at loan termination are only valued if the loan terminates
with a move while alive, and not with the simultaneous death of the couple or the death of a
widowed spouse. In this setting, I use a rough approximation of an optimal draw strategy as

\textsuperscript{16}California freezes property taxes at the initial purchase price (typically well before HECM origination),
rationalizing 1.25\% times initial value.
having a surviving spouse draw the full line of credit, whether or not this exceeds the value of the home, immediately upon the death of the other spouse.

With bequests not valued and the credit line drawn upon widowhood, there are two effects on HECM valuation. First, HECM becomes more valuable relative to retaining 100% equity, because it offers the couple the opportunity to guarantee that home equity will only be left to heirs (and hence effectively lost) if both spouses die simultaneously. This is likely to be a large effect, because at older ages, death is a much more common source of loan termination than moves while alive. Working in the opposite direction, HECM becomes more valuable with expected duration, and the “put option” is less likely to be in the money under the draw-upon-widowhood strategy than under the strategy in which the line is drawn only if both a spouse has died and the option is sufficiently deep in the money and termination sufficiently likely.

Table 4 shows that borrowers with no bequest motive who terminate upon widowhood obtain very large improvements on expected home equity proceeds while alive relative to not taking on any HECM debt, even with strategic failure still possible. The range of mean and 75th percentile values across metropolitan areas is from 29% to 36% of initial home value. In this specification, demand for liquidity makes the value of HECM relative to the value of retaining 100% equity until the earlier of death or sale of the home much larger than when bequests are equally weighted and there is no liquidity demand.

2.5 Increased Mortgage Insurance Premium After 2010

In the wake of substantial guarantee fee losses, the Federal Housing Administration has reduced principal limits and increased the regular mortgage insurance premium to 1.25% from .5% annually. Table 5 shows the effect of an insurance premium fee increase in isolation, holding the available loan to value ratios at 60% and 70% for 65- and 75-year-old younger borrowers. The parameters in the simulations summarized in Table 5 are identical to those in Table 2 but for the increased premium. We see that increasing the loan spread \( s \) has the
effect of increasing the value of the loan to the borrower, to a range between 1% and 10% of the initial home value, even though the borrower in some events may pull down the line of credit in cases when they should not if prices recover sufficiently quickly late in the loan’s life, and thereby pay the increased interest spread $s$ out of resale proceeds. This is consistent with the discussion above, and would likely not carry over to the case where the line is used for liquidity. It thus may be incorrect to say that FHA made a mistake by raising fees to increase guarantee profits.

### 2.6 Home Price Bust

Table 6 presents the results of simulations in which prices fall by an amount equal to 50% of the actual realized drop in the metropolitan area in question between 2007 and 2011. I assume that the full drop occurs immediately after loan closing, which tends to understate the effect of the current crisis. A prolonged price decline increases option value relative to an immediate decline if historical price growth was commonly greater than real interest rates, and loan termination is uncommon in the first few years of the loan in these simulations. We can thus take these simulations to approximate the value a borrower might have seen in a strategically used HECM line of credit expecting a decline in prices that was moderate relative to that actually observed. We find a range of mean to 75th percentile values from 2 to 9 percent, recognizing a 50% probability of strategic failure.

Most “Sand State” housing markets saw price declines considerably more severe than 30% after 2007, and the real declines have been prolonged, leading to considerable realized and expected future guarantee losses on HECM loans to FHA. At least from an *ex-post* perspective, it seems that home owners in these markets should have recognized that price declines of at least 30% would arrive with non-trivial probability. As discussed in Olesiuk and Kalser (2009), Glaeser et al. (2008), Davidoff (2012), and elsewhere, these markets saw rapid supply growth before and during the home price boom, in many cases no real price appreciation between the 1970s and early 2000s, and then prices in some cases more than

As shown in Figure 1, markets with the most severe crash saw far more originations per eligible homeowner than other markets, but the fraction of the eligible population over 2010 that ever took on HECM debt is everywhere below 10%. In the “baseline” case of a 65-year-old wife and her 68-year-old husband in Phoenix, purely expectations based entirely on the period 1978-2006 would have generated and expected value of HECM relative to no debt of -2% of home value; with a crash half as severe as actually experienced, the value of HECM would have been 7%. Drawing expectations from the period 1983-2002 would have generated a HECM value of 3% of home value with no crash, and 16% with a crash. We can thus say that a homeowner in Phoenix who thought that historical real price and interest rate movements would repeat themselves, but foresaw with 50% probability an immediate crash half as severe as the one actually observed, should have deemed HECM better than fairly priced. Similar figures apply to other “Sand State” markets such as Fresno and Miami.

Not surprisingly, interacting the recent .75% FHA increase in mortgage insurance with a price crash increases HECM value by somewhat more than the sum of the two effects. With the maintained 50% probability of strategic failure, the mean and 75th percentile of valuations looking backward between 1978 and 2006 for a 65-year-old wife and her husband are 9% and 15% of home value; increases of 9 and 10 percent above the baseline with neither a crash nor the insurance increase.

3 Conclusion

The simulations summarized in Tables 1 through 6 show that for many borrowers near the recent home price cycle peak, it would have been difficult to argue that the Home Equity Conversion Mortgage offered expensive insurance against longevity and home price declines. Comparing Tables 6 and 2, we see that the value of HECM relative to the most commonly chosen alternative of no home equity debt would have been considerably greater for those
who believed prices were likely to decline even half as far as they have.

In “Sand State” markets such as Phoenix, where prices exploded upward between 2002 and 2006, despite historically high supply growth and modest price growth, it is very difficult to think of preferences that would have made HECM unattractive for owners who both understood the product and believed there was a large chance of a price decline. Whether it was lack of skepticism about home prices or failure to understand design that led the overwhelming majority of older homeowners to turn down HECM is a question left to future research.

If older households near the cycle had strong demand for insuring against longevity or home price declines, then they likely did not fully understand or trust HECM design or their ability to use credit strategically. The last possibility is reflected in the comparison of borrower valuations between Tables 2 and 1. A 50% failure to draw the line of credit even when the loan terminates with more credit available than the value of the home leads to a considerable destruction of borrower value, even with a strategic early withdrawal policy that may be unrealistically sophisticated.

HECM’s provision of consumption smoothing across time is priced less favorably to borrowers than its provision of longevity and price insurance if borrowers discount at the index rate. The structure of the line of credit implies that drawing the line is equivalent to borrowing money at the loan rate’s spread above the index. In this way, standard home equity lines of credit, which require lower up-front fees but do not have explicit put options, may provide liquidity at a better price than HECM, to the extent they were available to retirees with limited income to pledge to required repayment, and to the extent that such loans’ shorter duration did not trouble older owners, many of whom want to remain in their homes as long as possible.

For most retirees, the most favored alternative to immediate use of HECM is no borrowing against home equity.\footnote{Small HECM market share suggests that waiting to exercise an option to take on HECM debt is not a relevant alternative for most.} While HECM’s provision of intertemporal consumption smoothing...
comes at a cost, a retiree who strongly prefers current to deferred consumption may find HECM to offer a large increase in utility relative to no debt. Table 4 shows that because a large fraction of retirees die before selling their homes, the ability to consume home equity before death implies that HECM offers an increase of approximately 30% of home value in real consumption while alive. Because this home equity consumption is back-loaded and deferred to states of widowhood, it is hard to believe that demand for cash in the event of extreme longevity or nursing home use would rationalize absence of demand for HECM for an older couple with no desire to leave wealth to heirs. Revealed preference thus suggests that most retirees either have very little understanding of HECM, or value bequests almost as strongly than own consumption. Adding in a desire to smooth the level of consumption while alive due to decreasing marginal utility of expenditures would further add to HECM valuation.

Given heightened awareness of home price volatility in the wake of the recent housing bust, HECM seems vulnerable to an expansion of demand for the pure put option use explored here. Should that demand materialize, the recently increased mortgage insurance premium may well reduce, rather than enhance, the profitability of the Federal Housing Administration’s guarantor position. The fact that borrowers have exhibited revealed preference for a lump-sum, fixed interest rate product suggests that a growing line of credit may not be part of optimal design.
References


Figure 1: Log real FHFA home price change 2007,q1 to 2011,a3 and the number of all HECM originations 1992-2011 divided by 2010 Census count of household heads over 62 who own a home.

Table 1: HECM Net Present Value under terms available in 2006: No Strategic Failure

<table>
<thead>
<tr>
<th>Age</th>
<th>Expectations</th>
<th>Metro Areas</th>
<th>ENPV % of initial home value</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td>constant 2% real treasury, real US FHFA growth 1975-2006 (1.62%) NA</td>
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Table 2: HECM Net Present Value under terms available in 2006 50% probability of “Strategic Failure” to exploit “put option”, HECM drawn early under rule (10).

<table>
<thead>
<tr>
<th>Age</th>
<th>Expectations</th>
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<td>1978+ -1 0</td>
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</table>

Table 3: HECM Net Present Value under terms available in 2006 50% probability of “Strategic Failure” to exploit “put option”, remaining HECM balance drawn early under rule (10). Liquidity enhancement: closing costs financed and 1.25% of initial value drawn each year.

<table>
<thead>
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<th>Age</th>
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<th>Metro Areas</th>
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Table 4: HECM Net Present Value under terms available in 2006 50% probability of “Strategic Failure” to exploit “put option”, HECM balance drawn upon widowhood. No value of money after both spouses have died.

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Table 5: HECM Net Present Value under terms available in 2006, modified to increase FHA guarantee fee from 0.5% to 1.25%. 50% probability of “Strategic Failure” to exploit “put option”, HECM drawn early under rule (10).

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Table 6: HECM Net Present Value under terms available in 2006. Instantaneous price drop of 50% of metropolitan-specific realized real decline 2007-2011 followed by reversion to backward-looking distribution of future price and interest rate changes. 50% probability of “Strategic Failure” to exploit “put option”, HECM drawn early under rule (10).

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