Evaluating the Appreciation Rate of Homes with a HECM Reverse Mortgage[1]

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Among FHA mortgage programs, the Home Equity Conversion Mortgage (HECM) program is relatively small. In 2017, about 1.2 million loans were endorsed by the FHA, out of which HECMs only accounts for only 4.4% (based on the number of endorsements in 2017). However, HECM loan performance has led to substantial variability in the FHA's Mutual Mortgage Insurance (MMI) Fund. One of the main drivers of HECM loan performance is the value of the properties underlying HECM loans. There have been reports and some statistical evidence[2] indicating HECM properties tend to underperform relative to non-HECM properties, sometimes by a substantial margin. A traditional explanation is that HECM borrowers have either lower incentive or insufficient capability to properly maintain their properties and that inadequate maintenance leads to lower property values. Using HECM loan data, public deeds records by CoreLogic, home price indexes from Zillow, and personal financial information provided by Equifax, this report investigates determinants of HECM property performance from 2003 to 2017.

This report finds that the property values of homes with a HECM reverse mortgage depreciated faster than other homes in the same Zip code, both because of inflated appraisals prior to 2009 and also for loans that were outstanding for a longer time period. The rate of depreciation bottoms out around 10 years after origination with about 10% excess depreciation. Beyond loan age, financial factors also play a role, with relatively stronger appreciation for borrowers with higher FICO scores and more available principal limit to draw from. Low home values, especially those below $150,000, have substantially greater rates of depreciation. These results suggest that he types of reforms that the FHA has implemented to stabilize the finances of the HECM program in the last decade, including appraisal independence, limits on up-front draws at 60 percent of the principal limit, and Financial Assessment will result in improved sale prices for homes in the HECM program.

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[1] The work that provided the basis for this publication was supported by funding under a Grant with the U.S. Department of Housing and Urban Development, Office of Policy Development and Research, Research Partnership Project "Understanding the Market for Reverse Mortgages". The authors thank Stephanie Moulton and Josh Miller for helpful comments. The authors are solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the Government. This is the final version of Report 1 presented to HUD, with minor changes for clarity. Mayer is CEO of Longbridge Financial, a reverse mortgage lender.

[2] See citations and the literature summary in section 1.

1. Literature Review: Moral Hazard, Home Maintenance, and Price Appreciation

There is a small literature of papers that explore the determinants or home maintenance, both for all homes as well as specifically for reverse mortgage borrowers. Of particular relevance, is the question of whether reverse mortgage borrowers might have less incentive to maintain their home as such borrowers might be more likely to suffer from a foreclosure in which the lender becomes the residual claimant (moral hazard). As well, reverse mortgage borrowers might also have less incentive to maintain their home if such borrowers were less concerned about the impact of liquidation values as they are more likely to die prior to the home sale.

The issue of home maintenance decisions has long been examined in urban economics literature. In one of the earliest papers on home maintenance, Mendelsohn (1977) analyzes factors that determines homeowners' maintenance decisions. He found income plays a significant role in the resources that are put into maintenance, but also in how maintenance work is performed (by owners themselves or by hired labors). Homeowners with high income tend to spend more on maintenance and to rely on hire labors. In addition to income, age of homeowners seems to affect the maintenance decisions; older homeowners are less likely to start maintenance projects, but if they do, they are more likely to hire someone else for the project.

Baker and Kaul (2002) differentiate home improvement activities into those of a discretionary or non-discretionary nature. The latter includes replacement projects such as a roof repair while the former includes activities like a room addition, kitchen and bathroom remodeling, or structural alterations that are driven by changes in homeowners' preferences. The authors take advantage of expanded categories in home improvement of American Housing Surveys (AHS) and map categories of maintenance to changes in household characteristics. In particular, they argue that discretionary home improvement projects would be planned and performed over longer periods, and interpret their findings of persistency in the likelihood of improvement efforts over time as evidence for discretionary nature of housing maintenance. Their analysis also shows that the duration of residence negatively affects the likelihood of home improvement projects, suggesting that recent movers have a greater incentive to modify their homes based on preferences (e.g., recent home buyers have a longer expected time in the home to justify specific investments). They also find old homeowners tend to engage less on home improvement, interpreting the evidence as due to the fact that the household composition of older homeowners is unlikely to change.

Ioannides (2002) examines the effect of neighborhood on housing maintenance decisions. Similar to Galster (1987) who emphasizes neighborhood cohesion and identification of homeowners themselves with the neighborhood in the upkeep decisions, Ionnides (2002) provides evidence that neighborhood interaction effects are important in households' maintenance decisions even after controlling for traditional demographic and neighborhood information. Estimated coefficients of social interactions are not only significant, but substantially larger than the coefficients on lagged maintenance variables.

Other research links home maintenance to the corporate finance literature. Economists argue that corporate investment decisions depend on Q-ratio, the ratio of market value of the firm over its replacement cost. Applying this idea to housing investment, Gyourko and Saiz (2004) examine how construction costs relative to market value in housing maintenance decision. Similar to firms with lower Q-ratios, homeowners should be less inclined to engage in housing maintenance/renovation efforts when the market value of the house is lower than its replacement cost. Using American Housing Survey (AHS) supplemented by proprietary datasets, they find that housing renovation/reinvestment expenditures by homeowners fall sharply (around 50 percent) when market value to cost ratio of the house is below one.

Gyourko and Tracy (2006) investigate the link between consumption and home maintenance decisions. They propose that variability in housing maintenance expenditures can be used to offset unexpected income shortfalls as homeowners might temporarily defer maintenance when transitory income is low. Their empirical analysis provides support for the role of housing maintenance as a temporary buffer for income fluctuations. The elasticity of maintenance and repair spending with respect to transitory income is 0.41. In dollar terms, a dollar of maintenance deferred offsets 1 to 7 cents of transitory income change. As supporting evidence, they suggest that this impact should be larger for liquidity constrained borrowers. Their analysis on homeowners aged 20 to 30 who purchased their first house within last five years show that these homeowners have a much higher elasticity of housing maintenance with respect to transitory income compared with similar age homeowners of that are not liquidity constrained.

Melzer (2017) examines the effect of debt overhang on home maintenance. He investigates whether homeowners with negative home equity would spend less on maintenance projects compared to those with positive equity. He finds that those with negative equity spend $200 or 30% less per quarter on maintenance and pay down less on their mortgage balances. He also finds that homeowners with high income and large financial assets spend less on housing maintenance when they have negative equity on their houses. Melzer interprets this as evidence that lower maintenance spending is driven by negative equity but not by liquidity constraints. He also finds that homeowners with negative equity do not reduce spending on durables which are not at the risk of foreclosure, such as entertainment related durables, jewelry and vehicles.

As noted above, the reverse mortgage contract might impact the incentive of a borrower to maintain the home. Miceli and Sirmans (1994) develop a theoretical model that looks into moral hazard as potential risk for reverse mortgage contracts. They point out that, due to decreasing housing equity and the limited liability feature, reverse mortgage borrowers have less incentive to appropriately maintain their homes over time in the property. The longer the time in the home, the greater the likelihood of a default since the reverse mortgage balance grows rapidly due to negative amortization.

Capone, Chang and Cushman (2010) measure the size of moral hazard (they refer to this as “basis risk”) by comparing a market-level property appreciation rate and the average appreciation rate of properties secured for reverse mortgage contracts, separately for those with long expected tenure and for those with short tenure. They find that the market-level property appreciation rate is higher than the average appreciation rate of properties held by HECM borrowers with long tenure (10 years or longer) by 160 basis points, which appears consistent with the moral hazard problem. However, for HECM borrowers with short tenures (2 years or shorter), the average property value appreciates faster than the market level appreciation rate by 825 basis points. They attribute the difference to divergent incentives between the borrowers with short tenures and those with long tenure. Borrowers with short expected tenure might have stronger incentives for home maintenance to achieve net positive equity in their houses at loan termination.

Other researchers suggest that lack of incentive to perform home maintenance by borrowers might not be the most significant risk factor for reverse mortgages and that the price discount of houses secured for reverse mortgages are not consistent with moral hazard in home maintenance in that discounts do not increase with the length of tenure. Davidoff and Welk (2007), noting the high early termination rates for reverse mortgages, suggest that elderly homeowners have heterogeneous time preferences and that homeowners with relatively large time discount factor might be more likely to choose reverse mortgages as a mean to quickly spend down their home equity. These homeowners would terminate reverse mortgage contracts more quickly with positive remaining home equity, leading to advantageous selection, not adverse selection. Park (2017) finds that average price of houses secured by reverse mortgages at foreclosure is less than that of houses by forward mortgages by 2-4 percent, but the discount appears to be time-invariant. He posits that the main driver behind the time-invariant depreciation of properties secured for reverse mortgages is more likely appraisal inflation of the house at loan origination. He finds that appraised values of properties secured for reverse mortgages are higher than those for purchase loans by 16%, even higher than those for refinance loans which are higher by 11%.

Finally, there is a substantial amount of research showing that appraisal bias was prevalent during the period leading to the crisis in early 2000s. In particular, overappraisal of properties in mortgage applications appears to be correlated with loan performance. Agarwal, Ben-David and Yao (2015) find similar evidence for over-appraisals for refinance loans of GSE forward mortgage loans. They find that the evidence is stronger for refinance loans with cash-out as well as for those originated in non-recourse states. Krueger and Maturana (2017) compare appraisals with AVM valuations and finds that appraisals exceed AVM valuations 60% of the time. Based on New Century loans, they find that appraised values of properties were higher than AVM based values by 5%. They also find some evidence that the overappraisals were intentional in that past appraisal bias tend to predict future overappraisals.

Of course, lower financial resources among reverse mortgage borrowers compared to other home owners might lead borrowers to under maintain their properties. For example, Davidoff (2014) suggests that HECM demand is larger among those with low wealth, showing that HECM loans are more common, more responsive to price appreciation, and more intensively used in neighborhoods where incomes and property values are below metropolitan average and where larger fractions of homeowners are black and Hispanic. Moulton, et. al. (2017) show the reverse mortgage borrowers and those who seek counseling to get a reverse mortgage have lower incomes, very little non-housing assets, substantial equity in their homes, and much higher levels of mortgage debt. Similarly, Nakajima and Telukova (2017) suggest a threefold increase in RML demand for lowest income and oldest households during the Great Recession.[3]

As well, Davidoff (2015) shows that reverse mortgage borrowers are not “strategic” in that demand does not rise when the “put” option is strongly in the money, that is, when prices are abnormally high and the potential for home prices to fall is above-normal. By contrast, Haurin et. al. 2014 find that seniors used HECMs to insure against house price declines.

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[3] Not surprisingly, periods of increased home values are also associated with greater take-up of HECM loans (Davidoff 2014, Haurin, et. al. 2016, and Shan 2011). Mayer and Simons (1994) and Goodman and Kaul (2017) argue that the lack of non-housing wealth for many elderly homeowners could increase demand for reverse mortgages.

2. Data

2.1 Initial Data Merge Process

The analysis starts with the data set of 878,960 loan records sent by HUD covering all HECMs originated prior to 6/30/2014. The HECM data were matched with deeds records from DataQuick by property address and borrower name. Only deed property records that indicated a reverse mortgage through a lien to HUD were included in the match. We were able match 377,805 properties with the HECM loan records. DataQuick property ids were attached to the corresponding loan records. The subsample of matched loan records was sent back to HUD.

HUD sent us the full loan servicing records for the loans in the matched subsample with all identifying information dropped except for the DataQuick property ids. The property ids allowed us to match the full loan servicing records with the deeds records. This left us with a dataset that included full loan servicing records from 2000-2014 and deed property historical records for each corresponding property from 2000-2013. This was our original sample.

2.2 Deed Record Expansion Using More Recent CoreLogic data

CoreLogic data was later added to expand deed record coverage. We were sent an incomplete dataset of deeds records up through March 2017 along with a crosswalk between CoreLogic's property id system and DataQuick's property ids. We were able to match property histories in CoreLogic's dataset with the corresponding records in the HECM matched DataQuick deed record subsample using the crosswalk. Unfortunately, the crosswalk did not have full coverage, so we matched the remaining properties using property address and owner name variables. We were able to find matches for 367,549 of the 377,805 properties in the DataQuick subsample.

Due to the incomplete nature of the dataset sent to us by CoreLogic, we kept the DataQuick records for 2000-2012 and only used CoreLogic records from 2013-2017. The CoreLogic records provided us with an additional 252,997 deed records with which to expand our sample. The CoreLogic records were reformatted to match the DataQuick records and then attached to the DataQuick records, expanding our deed record coverage from 2000-2017. Once this new, expanded deed record sample was created we merged it with the HECM full loan servicing records. However, the analysis only includes information from loan origination, although future research for the second project will include subsequent information on loan performance, measuring information like defaults on property taxes and insurance.

2.3 Termination Identification & Sale Records

Once the HECM loan servicing records were combined with the historical property deed records we began identifying loans which had terminated and tagging their termination type, i.e. sale vs. foreclosure vs. refinance using information in the deeds records. This was done by noting changes in the buyer and seller and whether the buyer or seller was a financial entity, government entity, HUD, or an individual/family member. We identified 123,776 loans that had originated between 2000 and 2012 and terminated by 2017.

We further identified the terminated loans with valid sale prices in order to assess housing appreciation of HECM loans. Of the approximately 100,000 properties with sale prices, about 80,000 properties had zip code information and could match with Zillow's house price index for regional housing appreciation comparison purposes. Throughout this process, we noted several outliers, such as properties appreciating by several hundred percent over a few years, which, we believe is due to data entry errors such as non-arms-length transactions or mismatched properties. To address this concern, we dropped the top and bottom 3% of the sample, by appreciation. This left us with a sample of about 76,000 loans.

2.4 Zip Code Price Indexes from Zillow

To measure predicted price changes at the Zip code level, we use Zillow data on the median home values that are estimated on the universe of properties in its coverage universe using the All Homes series.[4] Zillow calculates an estimated home value ("Zestimate") for each property on a monthly basis using data on all transactions in their database, and then takes the median within the Zip code. In theory, this approach should control for biases associated with variation in the types of properties selling over time. However, we do not have access to Zillow's proprietary model, and thus cannot examine the possibility that estimation errors that

[4] Authors conducted the same analysis using MSA-level indexes for FHFA and Zillow data. The sample is smaller than the Zillow data, but the results are generally similar to each other and also to the results here. However, the MSA data are less precise and in the case of FHFA data, only available at quarterly frequency. FHFA zip code data are only available annually, which is not frequently enough for this analysis.

might be systematically biased.[5] Zillow provides data at the metropolitan area as well as the Zip code.

2.5 Data Description

Table 1 provides sample statistics for the observations in the final sample. Overall, the properties underlying HECM loans lost about 25% value. In particular, properties which terminated in non-foreclosure lost only 12% while those which terminated in foreclosure lost close to half of their original value (47.6%). In contrast, the average price depreciation in those zip codes where HECM properties are located is smaller (8%). HECM properties that terminated in non-foreclosure are located in zip codes which experienced much smaller price depreciation (1.7%) than those terminated in foreclosure (21%). The average tenure of HECM loans is relatively short, 5.5 years, even though a majority of loans (72%) were originated before 2009, which implies relatively quick sales for HECM loans.

The average FICO score at origination is 711. Approximately 95.7 percent of FICO scores were missing. We have no FICO scores for properties originated before 2005. The number of available FICO scores peaks for loans originating from 2006-2008 before decreasing through 2012.[6] Somewhat surprisingly, the average FICO score at origination is higher for borrowers whose loans terminated in foreclosure (726 vs. 686). Regardless of whether loans were terminated with foreclosure or not, HECM borrowers experienced a drop in FICO scores, from 711 to 691 on average. For the borrowers whose loans were foreclosed, FICO score dropped by 88 while FICO scores of the borrowers who were not foreclosed have increased by 8 instead. While declining credit scores among HECM borrowers might seem unusual and suggest that such borrowers are having financial difficulties, Moulton, et. al. (2016) find that seniors extracting equity through reverse mortgages have greater reductions in consumer debt, and are less likely to become delinquent or suffer a foreclosure three years post origination relative to otherwise similar extractors and nonextractors.

Other variables suggest similarities. The average amounts set aside for home repair at origination are similar between foreclosed loans and non-foreclosed loans ($961 vs. $845) considering large standard deviation ($3861 for all loans), which indicates structural conditions

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[5] Zillow data are commonly used in many research projects due to their easy availability and perceived accuracy. Zillow reports a median error rate of 4.3% as of August 2017, meaning that half of all homes sell for a price within 4.3% of the current Zestimates. For more information, see https://www.zillow.com/zestimate/.

[6] FICO data were collected by HUD for a subset of HECM borrowers and merged into the data with personal identifiers removed.

of properties had been similar between properties which were later foreclosed and those which were not. The average maximum claim amount (MCA) for non-foreclosed properties is slightly higher, either because they are more expensive or are located in areas with relatively high housing costs.

Overall, prices of HECM properties at sale are lower than area- average price, either by zip code (87%) or by metro areas (89%). About 40% of borrowers are male and less than 30% of those borrowers are married. 70% of loans are disbursed through line of credit. About 12% of loans were disbursed in a one-time lump sum, and the rest were disbursed in pension type plans: term plan (7%) and tenure plan (8%). For age at origination, borrowers who were foreclosed were only slightly older (76.33) than those who were not (76.17). The average amount of withdrawal in the first month is much higher for borrowers whose properties were foreclosed (71%) than those whose properties were not foreclosed (55%).

3. Empirical Models and Results

3.1 What determines HECM haircuts?

To understand the determinants of home price changes for HECM homes relative to what would be expected based on attributes of the home, the borrower, the time period, the type of HECM mortgage, and various borrowing choices, we estimate the following

$$\frac{\Delta \ln p_{i,j,t,\tau}}{\Delta \ln P_{j,t,\tau}} = \beta_0 + \beta_{YEAR} YEAR_{i,j,\tau} + \beta_{AGE} AGE_{i,j,t,\tau} + \beta_{LOAN} LOAN_{i,j,t,\tau} + \varepsilon_{i,j,t,\tau} \quad (1)$$

The dependent variable is the change in home price appreciation for HECM property i from τ (origination) to t (sales) relative to the change in the price index of the Zip code j over the same period. The Zip code index is computed based on matching HECM properties to data from Zillow based on the month the HECM was obtained and the date the property was subsequently sold. The actual appreciation rate and the predicted appreciation rate are measured in percent difference, so if the median home in the Zip code appreciated 21% and the HECM home appreciated 18% over the same time period, the dependent variable would be -3.0(%). In other regressions, not reported here, we included the percent Zip code change as an independent variable. The coefficient on the Zip code price change was very close to 1.0 in the base specification (e.g., coefficient= 1.0094, t-stat= 299.4).

The independent variables include $YEAR_{i,j,\tau}$, the set of indicator variables for origination year with 2003 as default year and $AGE_{i,j,t,\tau}$, the set of indicator variables for loan age at sale for property i. We also add $LOAN_{i,j,t,\tau}$, the set of information on the HECM loan including FICO scores, marriage, sex, maximum claim amount, loan type, borrower age at origination, amount of withdrawals at origination and the property appraised value relative to the area's median house value.

The sample is based on all properties where there is a valid (arms-length) sale of the property following a HECM purchase. In the case of a sale by owner (non-foreclosure) we include the actual purchase price. If the next sale of a property is a foreclosure, we include the sale only if the property (REO) was purchased by an unrelated third-party. In foreclosure sales, the transaction price associated with the foreclosure is not a "market" price, but instead represents the bid made by the servicer on behalf of HUD to acquire title and then subsequently market the property. In a few cases, a third-party purchases the property at the foreclosure sale, in which case we include that sale. Estate or trust sales also count as third-party sales as long as there was no foreclosure.[7]

Of course, this analysis does not consider other reasons that HECM loans might terminate, such as refinancing with another HECM or a traditional mortgage or prepaying a loan with other resources. Thus, the high ratio of foreclosures in this database should not suggest that the bulk of loans terminate in foreclosure, a subject we will return to in future research on HECM terminations. See Rodda et. al. (2004), Szymanowski (2007), and Moulton, et. al. (2015) for a further discussion of this issue.

We start with Table 2 with regressions for the entire sample of sales (All Loans). The first set of covariates are dummy variables for the year of origination. The sample includes HECM loans originated between 2003 and 2012, so 2003 loans are the excluded category. The dummy variables show that properties originated in 2003 perform somewhat better than loans in other years, somewhat counter-intuitively. The "worst" origination years were 2007 and 2008, years where appraisal quality appears to be especially low, with excess depreciation rates of as much as 8.6 percent relative to the best years. More recent vintages showed better performance.

Next, we include various controls for age, all of which are highly statistically significantly different than zero. A primary purpose of the analysis is to examine whether HECM properties depreciate faster than other homes in the same Zip code. The initial analysis shows that such concerns are valid. The coefficient on loan age is -1.7% per year, which suggests quite severe depreciation. However, subsequent regressions that split foreclosure and non-foreclosure sales show that about one-half of that excess depreciation is due to an increased probability of foreclosure for older loans. The quadratic coefficient is positive, suggesting that the rate of excess depreciation falls over time (Figure 1A and 1B). Looking at year dummies in column (3), the flattening out of depreciation in later years is apparent, although the sample size of loans terminating after 10-years is markedly smaller.

One of the new variables that are included in this sample is the FICO score at origination and the change in FICO between origination and sale. FICO is observed for a subset of borrowers (7,519 or 10.3% of the sample), but is an important addition to the study as a part of this grant. The coefficients show that higher FICO borrowers have better home price

[7] Note that this analysis does not take into account any money that the servicer might have spent making HUD-required repairs to the property prior to the subsequent sale and thus does not represent the total net recovery to HUD. Of course, repairs and maintenance expenditures made by owners of non-HECM properties and owners of HECM properties prior to foreclosure are not included, so it is difficult to understand the impact of such exclusions.

appreciation, although the effect is moderate. Eliminating especially low FICO borrowers (say a borrower with a 200 point lower FICO), as likely happened with the new HECM program due to required financial assessment, would increase home price appreciation by 0.32%. One possibility is that higher FICO borrowers have resources to maintain the property, which is consistent with the findings in Moulton et. al. (2015), who find that HECM borrowers with higher FICO scores at origination are much less likely to suffer a default due to non-payment of property taxes or insurance. Interestingly, changes in FICO from origination do not predict change in appreciation.

Borrower demographics and loan characteristics matter quite a bit. Married borrowers have homes that appreciate much faster (5.5% above single females), whereas single men have the lowest rate of appreciation (1.7% less than single females). Borrowers with a repair set-aside have lower-appreciating homes, although the effect is modest (having a $10,000 set aside is associated with 0.9% higher total depreciation).[8] This is not surprising, given that having a required repair set-aside is indicative of a home that is not fully maintained at origination. Properties with term and tenure loans (column 9) also perform quite a bit better (4.2% to 5.2% less depreciation) than homes that have loans without payment plans. This finding also makes intuitive sense; such loans pay out proceeds at a fixed rate over time and thus provide borrowers with continuing resources to maintain the home. Older borrowers also have homes that depreciate at a slightly above average rate (column 10), with an additional 10 years of age adding 0.5% excess depreciation.

Maybe the most striking covariate is the maximum claim amount (MCA), measure in 000's, in Column 8 (Panel A), which equals the home value for all homes below the FHA lending limit (e.g., the maximum home value that the FHA will use in computing the loan amount) and the maximum home value for homes worth more than the FHA maximum. The coefficient on MCA is 0.044, suggesting that a $100,000 increase in home value would increase the predicted rate of appreciation by 4.4% relative to the zip code. Since the MCA in the sample is as high as $625,000, this implies that excess depreciation is concentrated in lower priced homes and that the highest prices homes may not suffer any excess depreciation relative to the zip code. The inclusion of this variable doubles the R-squared of the regression. Adding MCA also changes the year-dummies, suggesting that better performance of homes in the 2008-2010 vintages might have been due to recent loans increasingly being secured by more expensive homes.

[8] About 17.3% of mortgages have a repair set-aside, with the amount averaging $5,700.

To further investigate what is driving the MCA effect, we split the effect several different ways and report the results in Panel B. In column 12 (Panel B), we include a spline at $150,000, and allow for a separate slope above and below $150,000. The results show that lower value homes have a large fixed effect (-22%), but also a large slope (0.15%), so a home worth $50,000 will depreciate by 14.5% more than homes worth $151,000, but that a $100,000 home depreciates by 7% more. This suggests substantial underperformance for homes at the lowest end of the value spectrum. For homes worth more than $150,000, the slope coefficient falls to 0.025, suggesting that a $250,000 home appreciates 2.5% faster relative to less expensive HECM properties.[9]

In column 11 (Panel B), the regressions add another interaction for mortgages originated before and after 2008. The results suggest that the low home value effect is more pronounced in early than later time periods. The post-2008 dummy variable for MCA<$150,000 falls by 1.4%, and the slope coefficients drop to 0.11 for lower home values and to only 0.14 for homes worth more than $150k at origination. It appears that pre-crisis homes with low appraisal values performed the worst of all properties. Interestingly, with these MCA controls, the individual dummy variables for 2006-2008 increase in size and are highly statistically significant, suggesting that appraisals in these years may have been especially bad. The coefficient on loan age remains nearly unchanged, suggesting that these effects of appraisal and value are unrelated to excess appreciation associated with more highly aged loans.

Next the regressions explore changes in the HECM program that led to a great increase in the number and percentage of fixed-rate (FRM), full draw loans. The results show that homes with full draw FRMs perform much worse than other homes, with 8.8% excess depreciation. We also include a spline for adjustable-rate, line of credit loans (ARMs) interacted with draw percentage (share of initial principal limit) and get the same coefficients before and after 2008, suggesting that a property with a fully-drawn ARM has depreciation of 8.5%[10]. These results are consistent with the hypothesis that homes with loans that have a higher initial draw, whether a FMR or an ARM, appreciate at substantially lower rates. Along with the earlier findings about improved performance of homes with term or tenure payment plan loans, these results suggest

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[9] In other regressions, we also included a spline at $300,000. The spline was much smaller and the impacts above and below $300,000 were much lower, suggesting that much of the higher depreciation is concentrated in especially low-value homes.

[10] The vast majority of ARMs that do not take a 100% draw up-front have an available line of credit that allows the borrower to draw the remaining proceeds over time. The amount available to the borrower grows at the underlying rate of interest on the loan.

that lowering available proceeds up-front should result in improved collateral performance over time.[11]

We also examine the hypothesis that homes whose value is high relative to the zip code (or MSA) have higher rates of appreciation. This variable is measured by comparing the appraised value relative to the median home value in the Zip code or MSA as estimated by Zillow. The initial results in columns 14 (Zip code) and 16 (MSA) suggest initial support for the hypothesis. However, in columns 15 and 17 (Panel B) we add the MCA of the property. Once the MCA is included, the coefficient on relative home value turns negative, suggesting that homes that are above the median in their location perform less well. However, the coefficient on home value relative to median is small (a home that is 200% of the Zip code median will only fall in relative value by 1.4%, holding MCA constant). When both Zip and metro area controls are included, the relative price versus the metro area matters more than that in the Zip code.

Finally, columns 19 and 20 (Panel B) combine these results together in a single specification. Even with all variables together, the results remain roughly similar to those with the inclusion of MCA controls. The age dummies remain remarkably constant across the regressions, changing little even as many additional variables are added. The age dummies seem to level-off at about 15%-17% excess depreciation for homes that sell more than 10 years after origination. Homes with HECMs originated in 2006-2008 performed much worse than homes with HECMs originated in later years. Excess depreciation is as much as 12.5% worse for HECMs originated in 2008 versus 2012, which is almost as much as the entire age effect.

Other variables change size in important ways. The impact of FICO increases to 0.39% per 100 FICO points (from 0.16%) and the change in FICO becomes statistically significant and of similar order of magnitude as initial FICO (a 100-point increase in borrower FICO is associated with a 0.4% increase in home value).[12] The impact of a term/tenure loan drops substantially with the inclusion of variables for ARM draw percent and full-draw FMS, which is not surprising given that term/tenure loans are ARMs with very low initial draws.

The remaining variables generally become smaller in magnitude, but retain statistical significance. MCA interactions are most important and remain little-changed.

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[11] In 2014, the HECM program began to limit the portion of the principal limit (PL) available for a borrower to draw in the first 12 months. These findings suggest that this program modification should result in better collateral performance, as long as borrowers do not take all the remaining proceeds near the 13^{th} month.

[12] HECM loans without a FICO score are included in the specification but with a zero value for FICO.

Table 3 and Table 4 report the results based on the sample split into foreclosure and non-foreclosure sales. This is a key distinction. After all, there are two possible interpretations of our results: all homes have a similar rate of estimated depreciation, or homes that suffer foreclosure depreciate faster over time than other homes. On Panel A, the coefficient on loan age drops from 1.7% to 0.85% (column 1). Vintage year effects are also much more pronounced in the foreclosure sample (column 3). For simplicity, while the full set of regressions are reported, the remainder of this analysis focuses on the last two columns that contain all covariates.

In a few cases, like age, covariates appear to be associated with much larger depreciation rates for homes with a direct third-party sale than foreclosed homes. The loan age effect (when taking into account the quadratic effect) is more muted. Depreciation rates level off at 9-12% after 10 years for non-foreclosed homes, whereas depreciation is higher for foreclosed homes (17%-19%). However, in both cases, HECM houses that are owned for longer periods of time appear to fall in value relative to other homes in the same Zip code.

However, the impact of many other variables appears to become smaller or even insignificant when the sample is split. Coefficients on FICO and change in FICO drop in magnitude and are sometimes insignificant as do coefficients on demographic variables like married, male, and borrower age. Term/tenure loans and higher draw loans also have much less predictive power for change in price for BOTH foreclosed and non-foreclosed loans.

The impact of MCA (home value) on depreciation varies appreciably across the two different populations of properties. For non-foreclosed homes, higher and lower MCA homes perform a lot more similarly, whereas for foreclosed homes, once again, low home value homes suffer from much higher depreciation rates. As above, the weighted average of the coefficients on foreclosed and non-foreclosed homes is much smaller than the size of coefficients for the entire sample reported in Table 2.

3.2 Estimating the Impact of Covariates on Foreclosure Probability

Previous results show the importance of foreclosure on HECM haircuts, we investigate the determinants of the extensive margin; that is, what factors explain HECM property being foreclosed in the first place.[13] We estimate the following linear probability model of the determinants of property foreclosure.

$$Foreclosure_{i,j,t,\tau} = \beta_0 + \beta_{YEAR}YEAR_{i,j,\tau} + \beta_{AGE}AGE_{i,j,t,\tau} + \beta_{LOAN}LOAN_{i,j,t,\tau} + \varepsilon_{i,j,t,\tau} \quad (2)$$

The dependent variable is a dummy variable equal to 1 if the home was sold at foreclosure (to a third-party) and 0 if the property was sold by the owner. Approximately 35.8% (26,102/72,835) of the sales were via foreclosure.

The impact of covariates on depreciation can either happen by predicting higher rates of depreciation or a higher likelihood of foreclosure.[14] Of course, foreclosed homes often face excess depreciation either because they are under-maintained during the foreclosure process or because the foreclosure sale process may not obtain the best prices for vacant homes.

Table 5 presents the estimation results from Equation (2), with the same specification and covariates as in the previous regressions.[15] In general, many of the same variables that impact depreciation also impact the likelihood of foreclosure. These estimates also help explain why the coefficients on individual variables are smaller in both foreclosure and non-foreclosure regressions than in the regression sample that include both types of sales.

First, the results show that loan age is an appreciable determinant of foreclosure; every year of age increases the probability by 5.8%. However, loan age impacts foreclosure at a diminishing rate, as the quadratic term is negative and significant. Foreclosure probability appears to peak around the 10th year and actually fall a bit afterwards.

Loan vintage (origination year) also has a large impact on the likelihood of default. Properties with HECMs originated in 2006 – 2008 have about a 30-percentage point higher foreclosure rate than homes with loans originated in 2011 or 2012. It is important to understand that reverse mortgage borrowers, unlike forward mortgage borrowers have little incentive to strategically default. After all, HECM owners do not have to make mortgage payments on an underwater home; they only have to pay property taxes and insurance and

[13] See also HUD actuarial reports for estimation of default likelihood.

[14] Homes with a higher rate of depreciation also face a higher foreclosure rate, although we do not consider that interaction in these preliminary estimates.

[15] A linear probability model obtains similar estimates as a logit model for large samples, and is easier to interpret. Future drafts will incorporate a more sophisticated estimation as necessary.

maintain the home to continue to live in it. These payments are typically lower than rent would cost on an equivalent home, so walking away and losing the home doesn't make sense for a borrower if he/she has the money to continue paying taxes and insurance. Thus, loans originated in these years are likely at risk of foreclosure because they are underwater at the time that the borrower died or needed to move.

Overappraisal may well be one reason that these homes were foreclosed and thus generated a loss to the FHA. Earlier regressions showed that homes with HECMs originated in 2006-2008 underperformed the Zip code property index at a much higher degree than homes with mortgages originated in other years, especially in 2011 and 2012 when appraisal practices were much more restrained and the FHA had additional guidelines established to better protect the integrity of appraisals.

Demographic factors like borrower age, marital status, and gender have the same directional impact on foreclosure likelihood as on home price appreciation. As well, high FICO borrower and borrowers with a larger negative change in FICO also have higher foreclosure probabilities. It is hard to disentangle the impact of these variables on maintenance/depreciation versus ability to pay T&I. The coefficient on demographic variables is quite large, though in magnitude and it might be worth exploring how these variables impact program underwriting.

Other variables such as term/tenure and, full draw FRMs, and draw percent for ARMs appear to have a much bigger impact on the probability of foreclosure than on home price appreciation. The fact that these variables have such a relatively large impact the likelihood of foreclosure, but not the appreciation rate on either foreclosed or non-foreclosed homes suggests that having additional capital may allow borrowers to make investments that reduce the likelihood of foreclosure, possibly including paying property taxes and insurance (T&I). Avoiding early default with these financial resources seems to protect the FHA by avoiding costly foreclosures. This evidence supports the positive impact of recent program changes that underwrite borrower's ability to pay T&I and also reducing initial draws to preserve resources.

Similarly, low MCA homes (< $150,000) have a much higher likelihood of default than other homes, which can help explain why the depreciation rate on these homes is much lower than estimated separately for either foreclosed or non-foreclosed homes. One unusual finding is that post-2008, low-MCA homes have a much higher foreclosure probability than pre-2008 low-MCA homes. This is opposite what we find for home price appreciation, where low home values are associated with better relative appreciation rates after 2008. One way to reconcile this finding is that low-priced homes were located in Zip codes where home prices had a slower recovery. As well, it is likely that borrowers in low-value homes have fewer financial resources during and after the recession and thus were at greater risk of failing to pay T&I. This is a hypothesis worthy of future exploration.

4. Conclusion

The evidence in this report shows that prices for properties secured by a HECM mortgage appear to appreciate at moderately lower rates than properties in the same Zip code. This is driven by two factors: a) property appraisals appear biased upwards for loans originated in 2007 and 2008, driving down relative appreciation several percentage points versus those originated in 2010-2012 and b) HECM properties appear to depreciate over time by about 1% per year, leveling off at a 10-percent depreciation after 10 years (homes owned beyond 10 years do not appear to depreciate further).

These findings support the previous literature that finds appreciable appraisal bias in the years leading up to the financial crisis and that such bias continues to some extent post-crisis. In 2009, the Home Valuation Code of Conduct (HVCC) as was adopted as part of a joint agreement between Fannie Mae, Freddie Mac, the Federal Housing Finance Agency, and the New York State Attorney General and was codified as part of the Dodd-Frank Act in 2010. The HVCC worked to separate the financial incentives for loan origination from the independence of appraisers. Research suggests that this resulted in an immediate, but small, immediate reduction in estimated appraisal bias. (Eriksen, et. al. 2016, Shi and Zhang 2015, and Ding and Nakamura 2016). It is likely that HECM loans originated prior to 2009 will perform worse than would be predicted based on changes in home values alone and worse than loans originated in subsequent years. However, subsequent research suggests that some appraisal bias remains (Ding and Nakamura 2016, Eriksen, et. al. 2016, and Calem, et. al. 2017). Solutions include relying more heavily on automated valuation models, which are often more informative than appraisals (Calem, et. al. 2017).

By contrast, these findings do not support the hypothesis that moral hazard is a problem with the HECM program. Moral hazard would predict that under-maintenance would grow over time as owners of homes get closer to being underwater as their HECM mortgage balance grows. The findings in this paper are the opposite. Instead, these results appear consistent with the hypothesis that homes are under-maintained to a smaller extent, but that HECM homes do not suffer from major maintenance problems that would badly impair value beyond a 10 percent relative depreciation.

Of course, prices of foreclosed properties are significantly lower than prices of non-foreclosed properties. Interestingly, the extent to which time leads to greater depreciation is not different for foreclosed versus non-foreclosed sales (Figures 2A and 2B). This suggests that under-maintenance over time is not the dominant factor leading to foreclosure. Instead, other factors may be larger contributors to the likelihood of foreclosure. In fact, origination year and time in the property are dominant factors in predicting a foreclosure sale in Table 4, both of which are also likely correlated with negative equity. These are factors that will be considered in more detail in future research.

Having financial resources and good credit also appear to be important factors in predicting relative HECM appreciation. Good credit scores, having available principal limit to draw from, and term/tenure loans are all associated with better price performance, whereas having a required repair set-aside predicts lower relative appreciation.

Finally, these data also suggest that low-priced homes exhibit much bigger haircuts relative to high priced homes. These results are not driven by owning a lower-than-average priced home in a Zip code or metro area; in fact, HECM homes that are below median have slightly better home price appreciation. Instead, homes valued under $150,000 appear to exhibit strong relative depreciation. Low-value homes are also much more likely to suffer a foreclosure. It is possible that borrowers in such homes do not have the financial resources to respond to a financial shock or those homes may already be in poorer-than-average condition and thus more likely to suffer serious depreciation.

Putting these findings together, these results support the types of reforms that the FHA has implemented to stabilize the finances of the HECM program in the last decade, including appraisal independence, limits on up-front draws at 60 percent of the principal limit, and Financial Assessment. That said, further exploration would be possible to understand the factors that lead to foreclosures and the potential of foreclosure mitigation techniques to reduce the likelihood of a foreclosure sale and thus reduce depreciation. For example, this study cannot determine the extent to which the foreclosure sale itself leads to greater physical depreciation or whether foreclosure sales garner less money due to less seller bargaining power or reduced marketability to mainstream home buyers. Finally, the FHA has continued to implement reforms to improve the appraisal process such as requiring appraisals to be uploaded through the Electronic Appraisal Delivery (EAD) system. The goal is to “promote quality up-front appraisal data.” Improved data allows the FHA to track and manage the quality of appraisals.

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Figure 1A- Plot of HECM Haircut by Linear and Quadratic Age Variables for Non-Foreclosed Homes

This Figure plots the age variables from HECM Haircuts for non-foreclosed homes with all control variables (Table 3B, Column 19). HECM properties appear to depreciate at a higher rate than other properties for the first 10-years after receiving a HECM, leveling off at about a 10-percent relative depreciation.

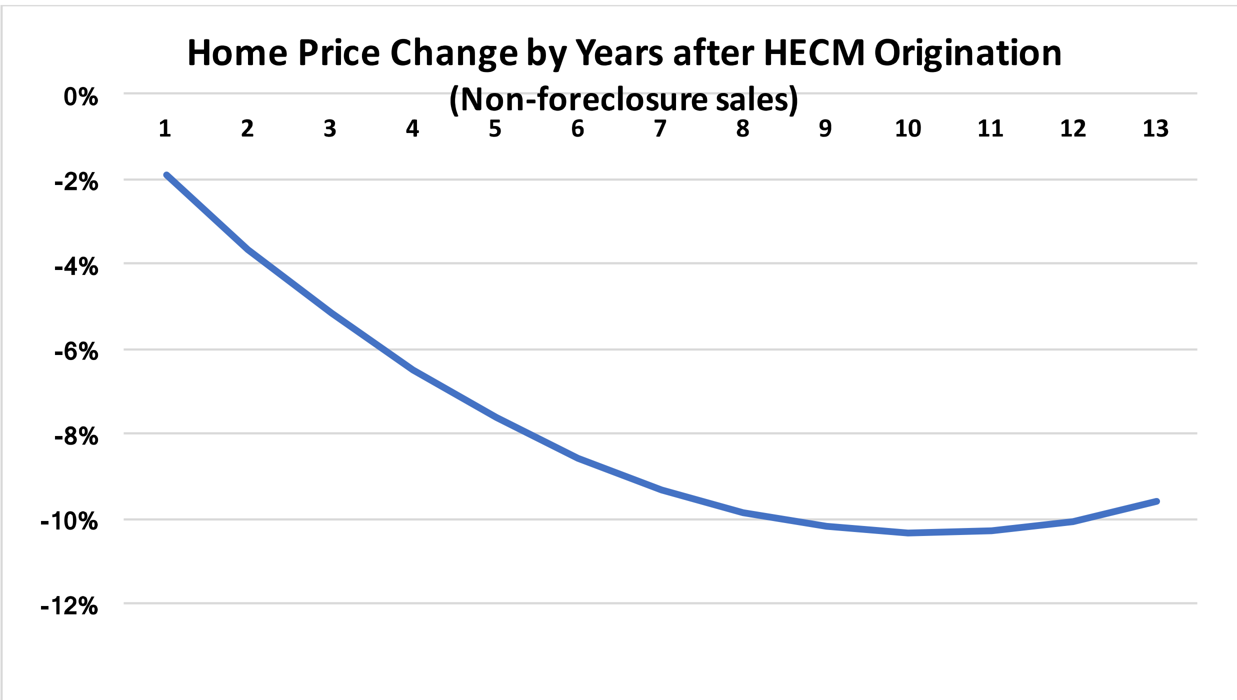

Figure 1B- Plot of HECM Haircut by Linear and Quadratic Age Variables for Foreclosed Homes

This Figure plots the age variables from HECM Haircuts for non-foreclosed homes with all control variables (Table 4B, Column 19). HECM properties appear to depreciate at a higher rate than other properties for the first 10-years after receiving a HECM, leveling off at about a 10-percent relative depreciation. These relative depreciation rates are quite similar to those for non-foreclosure sales.

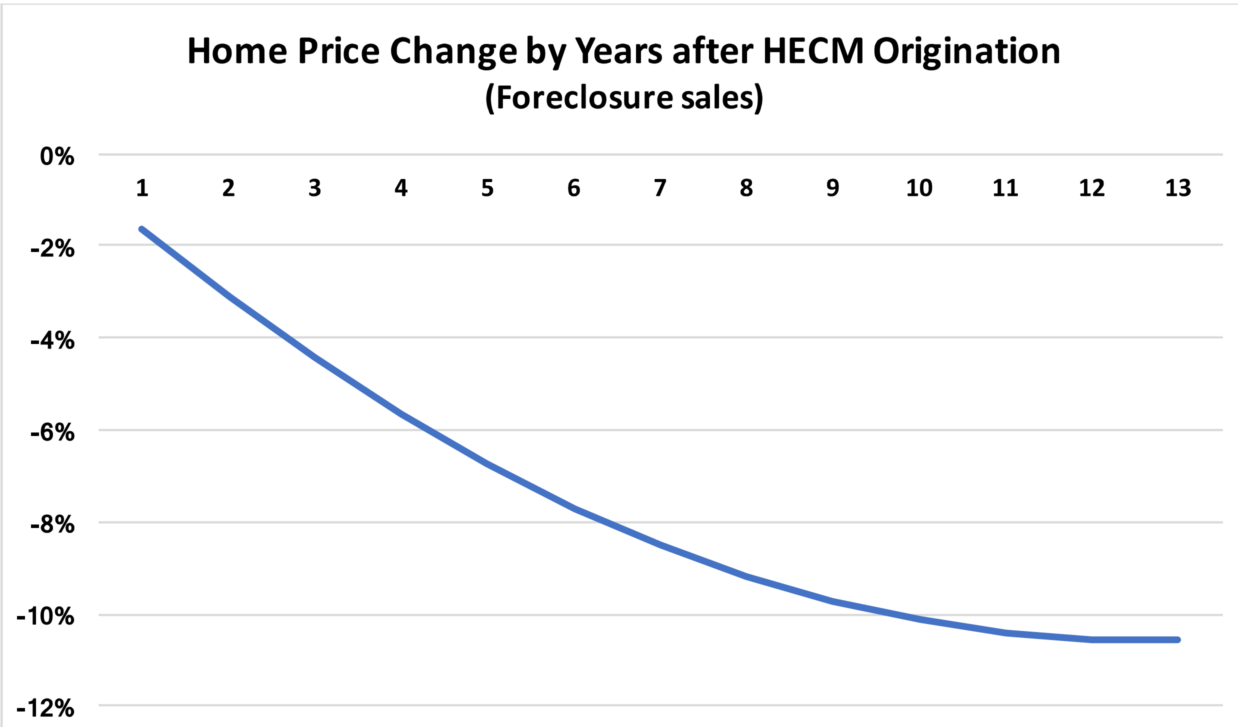

Table 1. Data Description

A. All Loans

This table provides summary statistics for variables used in empirical analysis of this paper. Panel A reports statistics for the variables based on the whole sample

	Mean	Std. Dev.	Min	Max
Change in HECM property value	-24.64	33.75	-99.97	147.273
Change in zip code level property index	-8.51	26.39	-75.93	166.891
Difference between HECM property value change and zip code level index change	-16.13	19.66	-73.86	39.192
Loan age	5.48	2.72	0.093	13.488
FICO at origination	710.77	97.50	232	818
FICO at sales	680.90	134.00	235	817
FICO change between origination and sales	-48.65	179.28	-818	429
Indicator for married borrower	0.28	0.45	0	1
Indicator for male borrower	0.42	0.49	0	1
Amount for repair set aside at origination	886.44	3860.67	-13650	114477
Maximum Claim Amount ($000)	246.88	119.87	17.5	625.5
Indicator for Term Loans	0.07	0.26	0	1
Indicator for Tenure Loans	0.08	0.27	0	1
Age of Borrower	76.23	7.91	62	105
Indicator for MCA < 150K	0.22	0.42	0	1
Indicator for loans originated post 2008	0.28	0.45	0	1
Indicator for loans with fixed interest rate (FRM)	0.12	0.33	0	1
Indicator for loans with FRM and originated post 2008	0.12	0.32	0	1
Percentage of draw in the first month	0.61	0.32	0	1
Appraised value at origination	280821	184542	17500	10000000
Median house value by zip code	279528	187243	14675	16000000
Median house vale by metro area	294954	145338	56300	795400
HECM property value as % of median value by zipcode	0.87	0.61	0	27.43
HECM property value as % of median value by metro area	0.89	0.64	0	26.91

B. Non-foreclosed Loans

This table provides summary statistics for variables used in empirical analysis of this paper. Panel B reports statistics for the variables based on the non-foreclosure property sales.

	Non-Foreclosure			
	Mean	Std. Dev.	Min	Max
Change in HECM property value	-11.872	31.22	-99.972	147.273
Change in zip code level property index	-1.694	26.12	-74.775	166.891
Difference between HECM property value change and zip code level index change	-10.178	17.52	-73.865	39.192
Loan age	4.788	2.739	0.093	13.49
FICO at origination	685.74	103.77	232	818
FICO at sales	693.649	130.304	235	817
FICO change between origination and sales	-42.93	170.35	-818	429
Indicator for married borrower	0.30	0.46	0	1
Indicator for male borrower	0.41	0.49	0	1
Amount for repair set aside at origination	844.78	3861.72	-13650	114477
Maxium Claim Amount ($000)	269.52	126.68	20	625.5
Indicator for Term Loans	0.09	0.29	0	1
Indicator for Tenure Loans	0.10	0.31	0	1
Age of Borrower	76.17	8.10	62	105
Indicator for MCA < 150K	0.17	0.37	0	1
Indicator for loans originated post 2008	0.33	0.47	0	1
Indicator for loans with fixed interest rate (FRM)	0.13	0.34	0	1
Indicator for loans with FRM and originated post 2008	0.13	0.34	0	1
Percentage of draw in the first month	0.55	0.33	0	1
Appraised value at origination	316527	201409	20000	7200000
Median house value by zipcode	251607	220714	0	16000000
Median house vale by metroarea	271871	175704	0	795400
HECM property value as % of median value by zipcode	0.91	0.65	0	23.81
HECM property value as % of median value by metroarea	0.96	0.72	0	25.94

C. Foreclosed Loans

This table provides summary statistics for variables used in empirical analysis of this paper. Panel B reports statistics for the variables based on the non-foreclosure property sales.

	Foreclosure			
	Mean	Std. Dev.	Min	Max
Change in HECM property value	-47.512	24.87	-99.97	123.53
Change in zip code level property index	-20.716	22.12	-75.93	115.30
Difference between HECM property value change and zip code level index change	-26.796	18.74	-73.78	35.18
Loan age	6.730	2.20	0.15	13.41
FICO at origination	725.65	90.35	308	818
FICO at sales	637.527	137.376	256.5	817
FICO change between origination and sales	-58.90	193.83	-818	392.5
Indicator for married borrower	0.24	0.43	0	1
Indicator for male borrower	0.42	0.49	0	1
Amount for repair set aside at origination	961.02	3857.74	-8550	93556
Maximum Claim Amount ($000)	206.33	93.83	17.50	625.50
Indicator for Term Loans	0.04	0.21	0	1
Indicator for Tenure Loans	0.03	0.18	0	1
Age of Borrower	76.33	7.56	62	103
Indicator for MCA < 150K	0.68	0.47	0	1
Indicator for loans originated post 2008	0.17	0.38	0	1
Indicator for loans with fixed interest rate (FRM)	0.10	0.30	0	1
Indicator for loans with FRM and originated post 2008	0.09	0.29	0	1
Percentage of draw in the first month	0.71	0.28	0	1
Appraised value at origination	216892	126615	17500	10000000
Median house value by zipcode	194820	150999	0	8098135
Median house vale by metroarea	246164	143045	0	794400
HECM property value as % of median value by zipcode	0.81	0.52	0	27.43
HECM property value as % of median value by metroarea	0.77	0.45	0	26.91

Table 2. HECM Haircuts: All Loans

This table provides the results of the following regressions of HECM haircuts based on the whole sample;

$$\frac{\Delta \ln p_{i,j,t,\tau}}{\Delta \ln P_{j,t,\tau}} = \beta_0 + \beta_{YEAR} YEAR_{i,j,\tau} + \beta_{AGE} AGE_{i,j,t,\tau} + \beta_{LOAN} LOAN_{i,j,t,\tau} + \varepsilon_{i,j,t,\tau}$$

The dependent variable is the change in home price appreciation for HECM property i from τ (origination) to t (sales) relative to the change in the price index of the zip code j over the same period. The Zip code index is computed based on matching HECM properties to data from Zillow based on the month the HECM was obtained and the date the property was subsequently sold. The independent variables include $YEAR_{i,j,\tau}$, the set of indicator variables for origination year with 2003 as default year, $AGE_{i,j,t,\tau}$, the set of indicator variables for loan age at sales of the property i and $LOAN_{i,j,t,\tau}$the set of information on the HECM loan including FICO scores, marriage, sex, maximum claim amount, loan type, borrower age at origination, amount of withdrawals at origination and the property value relative to the area's median house value. Panel A provides the basis results while Panel B provides results from interaction effects and nonlinear effects measured by splines.

A. Without Interaction Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
origin_yr=2004	-1.8	-1.4	-1.5	-1.4	-1.4	-1.3	-1.4	-1.9	-1.3	-1.4
	(-4.45)	(-3.44)	(-3.69)	(-3.44)	(-3.44)	(-3.17)	(-3.39)	(-4.77)	(-3.27)	(-3.42)
origin_yr=2005	-1.1	-0.3	-0.7	-0.4	-0.3	-0.2	-0.3	-2.0	-0.1	-0.3
	(-3.01)	(-0.88)	(-1.82)	(-0.98)	(-0.87)	(-0.65)	(-0.83)	(-5.40)	(-0.38)	(-0.90)
origin_yr=2006	-2.2	-0.9	-1.3	-1.0	-0.8	-0.7	-0.9	-3.4	-0.6	-0.8
	(-6.11)	(-2.40)	(-3.48)	(-2.80)	(-2.33)	(-2.02)	(-2.52)	(-9.72)	(-1.61)	(-2.32)
origin_yr=2007	-5.7	-4.0	-4.4	-4.2	-4.0	-3.7	-4.1	-5.8	-3.6	-4.0
	(-16.09)	(-10.99)	(-11.83)	(-11.37)	(-10.89)	(-10.20)	(-11.22)	(-16.40)	(-9.74)	(-10.98)
origin_yr=2008	-8.6	-6.7	-7.0	-6.8	-6.6	-6.3	-6.8	-8.0	-6.1	-6.7
	(-23.60)	(-17.65)	(-18.16)	(-18.00)	(-17.54)	(-16.73)	(-17.88)	(-21.99)	(-16.14)	(-17.66)
origin_yr=2009	-7.1	-5.2	-5.3	-5.3	-5.2	-4.9	-5.3	-9.8	-4.6	-5.2
	(-18.72)	(-13.31)	(-13.51)	(-13.65)	(-13.21)	(-12.79)	(-13.58)	(-25.72)	(-11.82)	(-13.32)
origin_yr=2010	-6.1	-4.4	-4.4	-4.5	-4.4	-4.1	-4.5	-8.1	-3.6	-4.4
	(-14.48)	(-10.30)	(-10.36)	(-10.63)	(-10.22)	(-9.79)	(-10.54)	(-19.59)	(-8.56)	(-10.33)
origin_yr=2011	-5.0	-3.7	-3.8	-3.8	-3.7	-3.6	-3.8	-6.8	-2.9	-3.7
	(-11.20)	(-8.21)	(-8.28)	(-8.53)	(-8.13)	(-7.99)	(-8.45)	(-15.74)	(-6.49)	(-8.30)

origin_yr=2012	-5.2	-4.4	-4.6	-4.6	-4.4	-4.3	-4.6	-7.3	-3.6	-4.5
	(-10.02)	(-8.53)	(-8.74)	(-8.81)	(-8.45)	(-8.37)	(-8.74)	(-14.46)	(-6.93)	(-8.66)
loan_age	-1.7	-3.7		-3.7	-3.7	-3.8	-3.7	-3.4	-3.6	-3.7
	(-59.58)	(-34.31)		(-34.36)	(-34.24)	(-35.67)	(-34.34)	(-32.30)	(-33.59)	(-34.53)
loan_age_squared		0.2		0.2	0.2	0.2	0.2	0.2	0.2	0.2
		(19.25)		(19.29)	(19.22)	(19.71)	(19.24)	(18.03)	(18.90)	(19.30)
loan_age_yr=2			-2.1							
			(-4.54)							
loan_age_yr=3			-5.3							
			(-11.87)							
loan_age_yr=4			-8.7							
			(-19.71)							
loan_age_yr=5			-10.9							
			(-24.79)							
loan_age_yr=6			-12.6							
			(-28.53)							
loan_age_yr=7			-13.8							
			(-31.28)							
loan_age_yr=8			-14.7							
			(-32.93)							
loan_age_yr=9			-15.3							
			(-33.30)							
loan_age_yr=10			-15.9							
			(-32.35)							
loan_age_yr=11			-16.4							
			(-28.53)							
loan_age_yr=12			-18.5							
			(-24.71)							
loan_age_yr=13			-17.8							
			(-15.96)							
loan_age_yr=14			-16.9							
			(-6.46)							

fico_@orig				0.00164						
				(5.01)						
fico_change-orig-to-sale					0.00044					
					(1.12)					
married						5.5				
						(32.31)				
male						-1.7				
						(-10.72)				
Amt_repair_set_aside							-0.00009			
							(-5.02)			
max_claim_amount								0.044		
								(75.59)		
term_loan									4.2	
									(15.44)	
tenure_loan									5.2	
									(19.67)	
borrower_age										-0.050
										(-5.57)
max claim amount<150k										
MCA<150k*MCA										
MCA>150k*MCA										
MCA<150*post2008										
MCA<150k*MCA*post2008										
MCA>150k*MCA*post2008										
frm_post_2008										

arm_draw%*post_2008										
draw%*pre_2009										
zip_price_diff										
metro_price_diff										
Constant	-2.21	0.72	-1.67	0.74	0.70	0.23	0.89	-9.22	-0.77	4.67
	(-6.11)	(1.84)	(-3.33)	(1.88)	(1.80)	(0.58)	(2.25)	(-23.10)	(-1.95)	(5.76)
Observations	72,835	72,835	72,835	72,835	72,835	72,835	72,835	72,835	72,835	72,835
Adjusted R-squared	0.060	0.065	0.065	0.065	0.065	0.078	0.065	0.133	0.072	0.065

B. With Interaction Effects

	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
origin_yr=2004	-2.1	-1.9	-1.4	-1.4	-1.9	-1.2	-2.0	-2.0	-2.0	-2.2
	(-5.35)	(-4.85)	(-3.42)	(-3.38)	(-4.83)	(-3.00)	(-5.08)	(-5.07)	(-5.25)	(-5.59)
origin_yr=2005	-2.9	-2.2	-0.1	-0.3	-2.0	-0.2	-2.2	-2.2	-2.7	-3.1
	(-7.90)	(-6.07)	(-0.24)	(-0.82)	(-5.53)	(-0.40)	(-5.91)	(-5.90)	(-7.43)	(-8.38)
origin_yr=2006	-4.6	-3.5	-0.5	-0.8	-3.5	-0.7	-3.7	-3.7	-4.4	-4.9
	(-13.27)	(-10.13)	(-1.34)	(-2.27)	(-9.95)	(-1.83)	(-10.41)	(-10.43)	(-12.69)	(-13.78)
origin_yr=2007	-6.6	-5.8	-3.4	-3.9	-5.9	-3.8	-6.0	-6.0	-6.1	-6.6
	(-18.78)	(-16.70)	(-9.33)	(-10.68)	(-16.67)	(-10.41)	(-16.98)	(-17.02)	(-17.64)	(-18.68)
origin_yr=2008	-8.3	-7.7	-5.7	-6.4	-8.2	-6.6	-8.1	-8.2	-7.6	-8.0
	(-23.14)	(-21.41)	(-15.14)	(-16.90)	(-22.42)	(-17.40)	(-22.35)	(-22.46)	(-21.32)	(-22.06)
origin_yr=2009	1.3	-8.3	-3.7	-5.0	-9.9	-5.6	-9.8	-9.9	2.3	2.1
	(2.13)	(-21.95)	(-7.14)	(-12.88)	(-26.14)	(-14.48)	(-25.77)	(-25.88)	(3.40)	(3.16)
origin_yr=2010	2.9	-6.4	-2.2	-4.3	-8.2	-4.7	-8.1	-8.2	4.3	4.2
	(4.67)	(-15.63)	(-4.26)	(-10.15)	(-19.85)	(-11.10)	(-19.68)	(-19.76)	(6.27)	(6.14)
origin_yr=2011	3.9	-5.2	-1.5	-3.6	-7.0	-4.1	-6.8	-6.9	5.2	5.2
	(6.28)	(-12.09)	(-2.83)	(-7.99)	(-16.00)	(-9.08)	(-15.69)	(-15.79)	(7.60)	(7.48)
origin_yr=2012	3.4	-5.6	-2.1	-4.4	-7.4	-4.9	-7.2	-7.2	4.9	4.8
	(5.09)	(-11.30)	(-3.38)	(-8.36)	(-14.66)	(-9.44)	(-14.29)	(-14.38)	(6.70)	(6.47)
loan_age	-3.5	-3.4	-3.4	-3.7	-3.4	-3.7	-3.4	-3.4	-3.4	
	(-33.98)	(-32.91)	(-32.18)	(-34.14)	(-32.35)	(-34.15)	(-32.27)	(-32.29)	(-33.37)	
loan_age_squared	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
	(19.72)	(18.44)	(17.80)	(19.13)	(18.07)	(19.18)	(18.00)	(18.02)	(18.75)	
loan_age_yr=2										-2.4
										(-5.58)
loan_age_yr=3										-5.6
										(-13.36)
loan_age_yr=4										-8.5
										(-20.73)
loan_age_yr=5										-10.5

										(-25.62)
loan_age_yr=6										-12.0
										(-29.07)
loan_age_yr=7										-13.0
										(-31.52)
loan_age_yr=8										-13.7
										(-32.87)
loan_age_yr=9										-14.3
										(-33.18)
loan_age_yr=10										-15.1
										(-32.60)
loan_age_yr=11										-15.7
										(-29.16)
loan_age_yr=12										-17.8
										(-25.35)
loan_age_yr=13										-17.2
										(-16.51)
loan_age_yr=14										-17.2
										(-7.08)
fico_@orig									0.0038	0.0039
									(7.47)	(7.62)
fico_change-orig-to-sale									0.0041	0.0042
									(6.69)	(6.90)
married									3.8	3.8
									(23.02)	(22.89)
male									-1.3	-1.3
									(-9.20)	(-9.17)
Amt_repair_set_aside									-0.00013	-0.00013
									(-7.76)	(-7.73)
max_claim_amount					0.045		0.047	0.047		
					(74.91)		(73.51)	(73.50)		
term_loan									0.6	0.6

									(2.15)	(2.19)
tenure_loan									0.7	0.7
									(2.46)	(2.50)
borrower_age									-0.091	-0.090
									(-10.47)	(-10.38)
max claim amount<150k	-20.1	-22.4							-18.8	-18.7
	(-24.61)	(-34.86)							(-23.12)	(-22.96)
MCA<150k*MCA	0.18	0.15							0.18	0.18
	(28.87)	(30.04)							(27.89)	(27.82)
MCA>150k*MCA	0.053	0.025							0.053	0.053
	(41.35)	(33.75)							(41.99)	(42.22)
MCA<150*post2008	1.4								2.6	2.6
	(1.06)								(1.96)	(1.95)
MCA<150k*MCA*post2008	-0.065								-0.069	-0.070
	(-6.02)								(-6.48)	(-6.52)
MCA>150k*MCA*post2008	-0.039								-0.037	-0.037
	(-24.59)								(-23.31)	(-23.55)
frm_post_2008			-8.8						-7.1	-7.0
			(-22.92)						(-18.75)	(-18.56)
arm_draw%*post_2008			-8.5						-7.3	-7.3
			(-15.18)						(-13.61)	(-13.56)
draw%*pre_2009			-8.5						-6.3	-6.3
			(-32.15)						(-23.14)	(-23.39)
zip_price_diff				1.34	-0.72			-0.30	-0.60	-0.60
				(11.58)	(-6.30)			(-2.35)	(-4.86)	(-4.90)
metro_price_diff						2.19	-1.15	-1.02	-0.83	-0.82
						(19.64)	(-9.82)	(-7.89)	(-6.54)	(-6.49)
Constant	-9.22	-3.15	4.24	-0.63	-8.70	-1.35	-8.68	-8.53	1.40	-0.30
	(-18.88)	(-7.45)	(10.45)	(-1.54)	(-21.34)	(-3.34)	(-21.56)	(-20.90)	(1.60)	(-0.33)
Observations	72,835	72,835	72,835	72,835	72,835	72,835	72,835	72,835	72,835	72,835
Adjusted R-squared	0.164	0.154	0.084	0.066	0.133	0.070	0.134	0.134	0.187	0.187

Table 3. HECM Haircuts: Non-foreclosed Loans

This table provides the results of the following regressions of HECM haircuts based on the sample of non-foreclosure sales;

$$\frac{\Delta \ln p_{i,j,t,\tau}}{\Delta \ln P_{j,t,\tau}} = \beta_0 + \beta_{YEAR} YEAR_{i,j,\tau} + \beta_{AGE} AGE_{i,j,t,\tau} + \beta_{LOAN} LOAN_{i,j,t,\tau} + \varepsilon_{i,j,t,\tau}$$

The dependent variable is the change in home price appreciation for HECM property i from τ (origination) to t (sales) relative to the change in the price index of the Zip code j over the same period. The Zip code index is computed based on matching HECM properties to data from Zillow based on the month the HECM was obtained and the date the property was subsequently sold. The independent variables include $YEAR_{i,j,\tau}$, the set of indicator variables for origination year with 2003 as default year, $AGE_{i,j,t,\tau}$, the set of indicator variables for loan age at sales of the property i and $LOAN_{i,j,t,\tau}$the set of information on the HECM loan including FICO scores, marriage, sex, maximum claim amount, loan type, borrower age at origination, amount of withdrawals at origination and the property value relative to the area's median house value. Panel A provides the basis results while Panel B provides results from interaction effects and nonlinear effects measured by splines.

A. Without Interaction Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
origin_yr=2004	-0.4	-0.3	-0.4	-0.3	-0.3	-0.2	-0.2	-0.5	-0.2	-0.3
	(-1.00)	(-0.60)	(-0.97)	(-0.60)	(-0.60)	(-0.37)	(-0.57)	(-1.21)	(-0.57)	(-0.59)
origin_yr=2005	0.4	0.7	0.4	0.6	0.7	0.7	0.7	0.0	0.7	0.7
	(0.93)	(1.64)	(0.85)	(1.56)	(1.64)	(1.84)	(1.68)	(-0.07)	(1.70)	(1.62)
origin_yr=2006	-0.9	-0.4	-0.7	-0.5	-0.4	-0.3	-0.4	-1.5	-0.3	-0.4
	(-2.34)	(-1.02)	(-1.76)	(-1.35)	(-1.00)	(-0.70)	(-1.08)	(-3.90)	(-0.86)	(-0.96)
origin_yr=2007	-3.0	-2.3	-2.6	-2.4	-2.3	-2.1	-2.3	-3.1	-2.2	-2.3
	(-7.69)	(-5.80)	(-6.41)	(-6.13)	(-5.76)	(-5.28)	(-5.92)	(-8.00)	(-5.52)	(-5.79)
origin_yr=2008	-3.6	-2.9	-3.1	-3.0	-2.8	-2.6	-2.9	-3.7	-2.7	-2.9
	(-9.29)	(-7.07)	(-7.62)	(-7.39)	(-7.04)	(-6.56)	(-7.19)	(-9.22)	(-6.68)	(-7.10)
origin_yr=2009	-2.1	-1.3	-1.5	-1.5	-1.3	-1.2	-1.4	-3.6	-1.2	-1.3
	(-5.45)	(-3.33)	(-3.80)	(-3.65)	(-3.31)	(-2.97)	(-3.48)	(-8.90)	(-2.92)	(-3.35)
origin_yr=2010	-1.7	-0.9	-1.1	-1.1	-0.9	-0.8	-1.0	-2.9	-0.7	-1.0
	(-3.92)	(-2.18)	(-2.40)	(-2.49)	(-2.15)	(-1.82)	(-2.31)	(-6.51)	(-1.65)	(-2.22)
origin_yr=2011	-1.6	-1.0	-1.1	-1.2	-1.0	-0.9	-1.1	-2.6	-0.8	-1.1
	(-3.67)	(-2.31)	(-2.39)	(-2.61)	(-2.29)	(-2.09)	(-2.44)	(-5.79)	(-1.77)	(-2.38)
origin_yr=2012	-2.1	-1.7	-1.8	-1.8	-1.7	-1.6	-1.7	-3.1	-1.4	-1.7

	(-4.03)	(-3.27)	(-3.41)	(-3.54)	(-3.24)	(-3.13)	(-3.39)	(-6.06)	(-2.75)	(-3.39)
loan_age	-0.85	-1.77		-1.77	-1.77	-1.91	-1.77	-1.78	-1.77	-1.80
	(-27.27)	(-15.57)		(-15.62)	(-15.54)	(-16.82)	(-15.61)	(-15.80)	(-15.57)	(-15.81)
loan_age_squared		0.085		0.086	0.085	0.091	0.086	0.086	0.086	0.086
		(8.38)		(8.41)	(8.37)	(8.98)	(8.40)	(8.51)	(8.44)	(8.46)
loan_age_yr=2			-1.6							
			(-3.80)							
loan_age_yr=3			-3.2							
			(-7.66)							
loan_age_yr=4			-4.8							
			(-11.47)							
loan_age_yr=5			-5.9							
			(-13.94)							
loan_age_yr=6			-6.3							
			(-14.46)							
loan_age_yr=7			-6.6							
			(-15.02)							
loan_age_yr=8			-7.6							
			(-16.64)							
loan_age_yr=9			-7.8							
			(-16.09)							
loan_age_yr=10			-8							
			(-14.80)							
loan_age_yr=11			-7.8							
			(-12.08)							
loan_age_yr=12			-9.6							
			(-11.05)							
loan_age_yr=13			-10.4							
			(-8.35)							
loan_age_yr=14			-10.3							
			(-3.61)							
fico_@orig				0.0014						

				(3.92)						
fico_change-orig-to-sale					0.00016					
					(0.35)					
married						3.7				
						(18.90)				
male						-1.3				
						(-7.42)				
Amt_repair_set_aside							-0.00006			
							(-2.65)			
max_claim_amount								0.018		
								(26.26)		
term_loan									1.6	
									(5.65)	
tenure_loan									1.4	
									(5.32)	
borrower_age										-0.043
										(-4.25)
max claim amount<150k										
MCA<150k*MCA										
MCA>150k*MCA										
MCA<150*post2008										
MCA<150k*MCA*post2008										
MCA>150k*MCA*post2008										
frm_post_2008										
arm_draw%*post_2008										

draw%*pre_2009										
zip_price_diff										
metro_price_diff										
Constant	-4.43	-3.19	-3.76	-3.18	-3.20	-3.39	-3.10	-6.68	-3.63	0.17
	(-12.14)	(-8.11)	(-7.83)	(-8.07)	(-8.12)	(-8.53)	(-7.83)	(-16.18)	(-9.12)	(0.20)
Observations	46,733	46,733	46,733	46,733	46,733	46,733	46,733	46,733	46,733	46,733
Adjusted R-squared	0.021	0.022	0.022	0.023	0.022	0.030	0.022	0.036	0.023	0.023

B. With Interaction Effects

	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
origin_yr=2004	-0.8	-0.6	-0.3	-0.3	-0.5	-0.2	-0.6	-0.6	-0.8	-1.0
	(-2.02)	(-1.41)	(-0.64)	(-0.61)	(-1.30)	(-0.57)	(-1.52)	(-1.49)	(-1.99)	(-2.41)
origin_yr=2005	-0.9	-0.2	0.7	0.7	-0.1	0.7	-0.2	-0.2	-0.9	-1.3
	(-2.20)	(-0.44)	(1.70)	(1.62)	(-0.25)	(1.67)	(-0.54)	(-0.53)	(-2.35)	(-3.18)
origin_yr=2006	-2.8	-1.6	-0.3	-0.4	-1.6	-0.4	-1.8	-1.8	-3.0	-3.4
	(-7.26)	(-4.15)	(-0.86)	(-1.04)	(-4.21)	(-0.98)	(-4.54)	(-4.57)	(-7.64)	(-8.45)
origin_yr=2007	-4.2	-3.2	-2.1	-2.3	-3.3	-2.3	-3.4	-3.4	-4.2	-4.6
	(-10.56)	(-8.22)	(-5.46)	(-5.87)	(-8.41)	(-5.76)	(-8.56)	(-8.68)	(-10.75)	(-11.52)
origin_yr=2008	-4.7	-3.7	-2.5	-2.9	-4.0	-2.8	-3.8	-4.0	-4.7	-5.0
	(-11.67)	(-9.29)	(-6.28)	(-7.21)	(-9.87)	(-7.07)	(-9.56)	(-9.90)	(-11.59)	(-12.25)
origin_yr=2009	4.4	-3.2	-1.9	-1.4	-3.9	-1.4	-3.7	-3.9	3.5	3.3
	(6.71)	(-7.86)	(-3.60)	(-3.41)	(-9.59)	(-3.43)	(-8.99)	(-9.42)	(4.83)	(4.46)
origin_yr=2010	5.0	-2.4	-1.3	-1.0	-3.0	-1.0	-2.9	-3.0	4.3	4.2
	(7.43)	(-5.44)	(-2.36)	(-2.20)	(-6.90)	(-2.25)	(-6.60)	(-6.84)	(5.88)	(5.67)
origin_yr=2011	5.0	-2.1	-1.3	-1.1	-2.8	-1.1	-2.6	-2.7	4.4	4.3
	(7.44)	(-4.74)	(-2.44)	(-2.34)	(-6.17)	(-2.38)	(-5.77)	(-6.03)	(5.91)	(5.78)
origin_yr=2012	4.4	-2.6	-1.9	-1.7	-3.3	-1.7	-3.0	-3.2	3.8	3.7
	(6.16)	(-5.15)	(-3.13)	(-3.29)	(-6.35)	(-3.34)	(-5.89)	(-6.14)	(4.90)	(4.71)
loan_age	-1.87	-1.80	-1.77	-1.77	-1.78	-1.77	-1.77	-1.78	-2.02	
	(-16.68)	(-16.01)	(-15.60)	(-15.58)	(-15.84)	(-15.58)	(-15.75)	(-15.79)	(-18.02)	
loan_age_squared	0.092	0.086	0.087	0.085	0.086	0.085	0.086	0.086	0.098	
	(9.12)	(8.55)	(8.53)	(8.38)	(8.53)	(8.38)	(8.48)	(8.51)	(9.84)	
loan_age_yr=2										-1.9
										(-4.52)
loan_age_yr=3										-3.8
										(-9.28)
loan_age_yr=4										-5.5
										(-13.48)
loan_age_yr=5										-6.8

										(-16.33)
loan_age_yr=6										-7.3
										(-17.03)
loan_age_yr=7										-7.6
										(-17.49)
loan_age_yr=8										-8.5
										(-18.90)
loan_age_yr=9										-8.7
										(-18.19)
loan_age_yr=10										-9.1
										(-17.01)
loan_age_yr=11										-9.3
										(-14.61)
loan_age_yr=12										-10.9
										(-12.88)
loan_age_yr=13										-11.7
										(-9.58)
loan_age_yr=14										-12.2
										(-4.37)
fico_@orig									0.003	0.003
									(5.45)	(5.55)
fico_change-orig-to-sale									0.0029	0.003
									(4.15)	(4.31)
married									3.2	3.2
									(16.51)	(16.44)
male									-1.2	-1.2
									(-6.79)	(-6.80)
Amt_repair_set_aside									-0.00009	-0.00009
									(-4.37)	(-4.35)
max_claim_amount					0.019		0.02	0.02		
					(27.63)		(27.79)	(28.09)		
term_loan									0.36	0.36

									(1.23)	(1.24)
tenure_loan									-0.2	-0.2
									(-0.70)	(-0.71)
borrower_age									-0.068	-0.068
									(-6.54)	(-6.53)
max claim amount<150k	-7.4	-8							-6.7	-6.6
	(-5.81)	(-8.55)							(-5.26)	(-5.22)
MCA<150k*MCA	0.086	0.053							0.083	0.083
	(8.61)	(6.96)							(8.36)	(8.33)
MCA>150k*MCA	0.035	0.011							0.036	0.036
	(22.84)	(14.07)							(24.07)	(24.10)
MCA<150*post2008	2.8								3	3
	(1.47)								(1.60)	(1.60)
MCA<150k*MCA*post2008	-0.063								-0.063	-0.063
	(-4.16)								(-4.13)	(-4.14)
MCA>150k*MCA*post2008	-0.031								-0.03	-0.03
	(-17.12)								(-16.40)	(-16.44)
frm_post_2008			-2.3						-2.3	-2.3
			(-5.91)						(-5.74)	(-5.71)
arm_draw%*post_2008			-2						-2.3	-2.3
			(-3.41)						(-3.95)	(-3.98)
draw%*pre_2009			-3.8						-3.5	-3.6
			(-12.41)						(-10.51)	(-10.79)
zip_price_diff				-0.33	-1.1			-0.77	-0.95	-0.95
				(-2.65)	(-8.91)			(-5.52)	(-6.91)	(-6.88)
metro_price_diff						0.15	-1.11	-0.79	-0.64	-0.64
						(1.36)	(-9.10)	(-5.83)	(-4.76)	(-4.75)
Constant	-9.58	-4.54	-1.40	-2.88	-5.87	-3.33	-6.17	-5.76	-1.60	-2.11
	(-17.81)	(-10.21)	(-3.33)	(-6.99)	(-13.89)	(-8.19)	(-14.82)	(-13.63)	(-1.56)	(-2.01)
Observations	46,733	46,733	46,733	46,733	46,733	46,733	46,733	46,733	46,733	46,733
Adjusted R-squared	0.048	0.040	0.026	0.022	0.038	0.022	0.038	0.039	0.061	0.061

Table 4. HECM Haircuts: Foreclosed Loans

This table provides the results of the following regressions of HECM haircuts based on the sample of foreclosure sales;

$$\frac{\Delta \ln p_{i,j,t,\tau}}{\Delta \ln P_{j,t,\tau}} = \beta_0 + \beta_{YEAR} YEAR_{i,j,\tau} + \beta_{AGE} AGE_{i,j,t,\tau} + \beta_{LOAN} LOAN_{i,j,t,\tau} + \varepsilon_{i,j,t,\tau}$$

The dependent variable is the change in home price appreciation for HECM property i from τ (origination) to t (sales) relative to the change in the price index of the Zip code j over the same period. The Zip code index is computed based on matching HECM properties to data from Zillow based on the month the HECM was obtained and the date the property was subsequently sold. The independent variables include $YEAR_{i,j,\tau}$, the set of indicator variables for origination year with 2003 as default year, $AGE_{i,j,t,\tau}$, the set of indicator variables for loan age at sales of the property i and $LOAN_{i,j,t,\tau}$the set of information on the HECM loan including FICO scores, marriage, sex, maximum claim amount, loan type, borrower age at origination, amount of withdrawals at origination and the property value relative to the area's median house value. Panel A provides the basis results while Panel B provides results from interaction effects and nonlinear effects measured by splines.

A. Without Interaction Effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
origin_yr=2004	-1.3	-1.2	-1.2	-1.2	-1.2	-1.3	-1.2	-1.5	-1.2	-1.2
	(-1.69)	(-1.52)	(-1.48)	(-1.52)	(-1.52)	(-1.66)	(-1.53)	(-2.03)	(-1.55)	(-1.53)
origin_yr=2005	2.4	2.7	2.4	2.6	2.6	2.4	2.6	0.1	2.7	2.7
	(3.32)	(3.59)	(3.05)	(3.56)	(3.57)	(3.28)	(3.56)	(0.09)	(3.69)	(3.66)
origin_yr=2006	3.5	3.8	3.4	3.7	3.7	3.5	3.7	0.1	3.8	3.8
	(4.95)	(5.25)	(4.47)	(5.14)	(5.17)	(4.92)	(5.17)	(0.12)	(5.34)	(5.24)
origin_yr=2007	-0.5	-0.1	-0.5	-0.2	-0.2	-0.3	-0.2	-2.6	0.0	-0.1
	(-0.71)	(-0.20)	(-0.69)	(-0.29)	(-0.27)	(-0.39)	(-0.32)	(-3.75)	(0.02)	(-0.13)
origin_yr=2008	-6.0	-5.6	-5.8	-5.7	-5.7	-5.6	-5.7	-6.3	-5.4	-5.5
	(-8.23)	(-7.45)	(-7.54)	(-7.52)	(-7.50)	(-7.52)	(-7.56)	(-9.04)	(-7.15)	(-7.38)
origin_yr=2009	-10.4	-10.0	-10.1	-10.1	-10.1	-10.1	-10.1	-12.5	-9.8	-10.0
	(-13.37)	(-12.56)	(-12.43)	(-12.63)	(-12.60)	(-12.68)	(-12.66)	(-16.71)	(-12.25)	(-12.51)
origin_yr=2010	-12.0	-11.7	-11.9	-11.8	-11.8	-11.7	-11.8	-11.7	-11.4	-11.7
	(-13.45)	(-12.97)	(-12.97)	(-13.03)	(-13.01)	(-13.03)	(-13.06)	(-13.82)	(-12.65)	(-12.95)
origin_yr=2011	-13.6	-13.4	-13.6	-13.5	-13.4	-13.5	-13.5	-12.0	-13.1	-13.2
	(-12.96)	(-12.74)	(-12.79)	(-12.79)	(-12.78)	(-12.89)	(-12.83)	(-12.25)	(-12.46)	(-12.60)

origin_yr=2012	-14.9	-15.0	-15.2	-15.0	-15.0	-15.0	-15.1	-13.1	-14.7	-14.8
	(-10.97)	(-10.98)	(-11.01)	(-11.02)	(-11.01)	(-11.03)	(-11.05)	(-10.29)	(-10.79)	(-10.91)
loan_age	-0.89	-1.40		-1.40	-1.40	-1.53	-1.40	-1.30	-1.39	-1.32
	(-14.63)	(-5.10)		(-5.12)	(-5.11)	(-5.59)	(-5.10)	(-5.08)	(-5.08)	(-4.81)
loan_age_squared		0.04		0.04	0.04	0.04	0.04	0.04	0.04	0.04
		(1.91)		(1.93)	(1.92)	(2.07)	(1.90)	(2.37)	(1.80)	(1.83)
loan_age_yr=2			-4.7							
			(-1.12)							
loan_age_yr=3			-9.1							
			(-2.22)							
loan_age_yr=4			-10.2							
			(-2.49)							
loan_age_yr=5			-10.7							
			(-2.62)							
loan_age_yr=6			-12.1							
			(-2.98)							
loan_age_yr=7			-13.5							
			(-3.33)							
loan_age_yr=8			-13.4							
			(-3.29)							
loan_age_yr=9			-14.0							
			(-3.43)							
loan_age_yr=10			-14.6							
			(-3.59)							
loan_age_yr=11			-16.1							
			(-3.92)							
loan_age_yr=12			-18.2							
			(-4.36)							
loan_age_yr=13			-17.8							
			(-4.03)							
loan_age_yr=14			-16.8							
			(-2.79)							

fico_@orig				0.00076						
				(1.44)						
fico_change-orig-to-sale					-0.00062					
					(-1.06)					
married						3.5				
						(12.32)				
male						-0.52				
						(-2.12)				
Amt_repair_set_aside							-0.00006			
							(-1.91)			
max_claim_amount								0.07		
								(61.81)		
term_loan									3.2	
									(5.85)	
tenure_loan									4.5	
									(6.98)	
borrower_age										0.1
										(6.80)
max claim amount<150k										
MCA<150k*MCA										
MCA>150k*MCA										
MCA<150*post2008										
MCA<150k*MCA*post2008										

MCA>150k*MCA*post2008										
frm_post_2008										
arm_draw%*post_2008										
draw%*pre_2009										
zip_price_diff										
metro_price_diff										
Constant	-18.6	-17.4	-11.7	-17.4	-17.4	-17.2	-17.3	-31.0	-17.8	-25.7
	(-21.84)	(-16.50)	(-2.85)	(-16.48)	(-16.48)	(-16.26)	(-16.33)	(-30.66)	(-16.86)	(-15.96)
Observations	26,102	26,102	26,102	26,102	26,102	26,102	26,102	26,102	26,102	26,102
Adjusted R-squared	0.063	0.063	0.063	0.063	0.063	0.069	0.063	0.183	0.066	0.065

B. With Interaction Effects

	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
origin_yr=2004	-1.5	-1.5	-1.2	-1.2	-1.5	-1.0	-1.6	-1.6	-1.7	-1.7
	(-2.09)	(-2.01)	(-1.55)	(-1.46)	(-2.03)	(-1.28)	(-2.16)	(-2.16)	(-2.38)	(-2.31)
origin_yr=2005	-0.7	-0.2	2.7	2.7	0.1	2.8	-0.1	-0.1	-0.9	-1.2
	(-1.08)	(-0.28)	(3.72)	(3.61)	(0.08)	(3.83)	(-0.18)	(-0.19)	(-1.39)	(-1.73)
origin_yr=2006	-0.9	-0.1	3.9	3.9	0.1	4.0	-0.2	-0.2	-1.3	-1.7
	(-1.30)	(-0.11)	(5.43)	(5.38)	(0.10)	(5.63)	(-0.29)	(-0.27)	(-1.91)	(-2.40)
origin_yr=2007	-3.3	-2.8	0.1	0.1	-2.6	0.1	-2.8	-2.7	-3.5	-3.8
	(-4.88)	(-4.09)	(0.12)	(0.07)	(-3.77)	(0.13)	(-4.05)	(-4.01)	(-5.17)	(-5.55)
origin_yr=2008	-6.5	-6.3	-5.2	-5.0	-6.4	-5.4	-6.5	-6.4	-6.4	-6.6
	(-9.40)	(-9.09)	(-6.93)	(-6.63)	(-9.06)	(-7.21)	(-9.21)	(-9.04)	(-9.25)	(-9.39)
origin_yr=2009	-4.2	-11.6	-8.2	-9.5	-12.5	-10.4	-12.4	-12.3	-3.1	-3.2
	(-3.51)	(-15.61)	(-6.18)	(-11.95)	(-16.72)	(-13.13)	(-16.63)	(-16.40)	(-2.05)	(-2.06)
origin_yr=2010	-4.4	-10.5	-10.3	-11.3	-11.7	-11.7	-11.7	-11.6	-3.7	-3.8
	(-3.49)	(-12.57)	(-7.33)	(-12.57)	(-13.83)	(-12.98)	(-13.85)	(-13.76)	(-2.35)	(-2.39)
origin_yr=2011	-5.4	-10.8	-12.0	-12.7	-12.0	-13.4	-11.9	-11.8	-4.5	-4.7
	(-3.95)	(-11.12)	(-7.98)	(-12.10)	(-12.26)	(-12.85)	(-12.17)	(-12.01)	(-2.74)	(-2.80)
origin_yr=2012	-6.5	-11.6	-13.6	-14.2	-13.1	-14.8	-13.1	-13.0	-5.8	-6.0
	(-4.13)	(-9.16)	(-7.87)	(-10.47)	(-10.31)	(-10.89)	(-10.30)	(-10.20)	(-3.15)	(-3.23)
loan_age	-1.63	-1.55	-1.46	-1.39	-1.30	-1.42	-1.29	-1.29	-1.68	
	(-6.49)	(-6.11)	(-5.32)	(-5.10)	(-5.08)	(-5.20)	(-5.04)	(-5.03)	(-6.71)	
loan_age_squared	0.07	0.06	0.04	0.04	0.05	0.04	0.04	0.04	0.07	
	(3.63)	(3.18)	(1.95)	(1.90)	(2.37)	(2.07)	(2.31)	(2.30)	(3.60)	
loan_age_yr=2										-6.5
										(-1.68)
loan_age_yr=3										-10.8
										(-2.87)
loan_age_yr=4										-12.6
										(-3.37)
loan_age_yr=5										-12.9

										(-3.48)
loan_age_yr=6										-14.3
										(-3.85)
loan_age_yr=7										-15.5
										(-4.16)
loan_age_yr=8										-15.4
										(-4.14)
loan_age_yr=9										-15.9
										(-4.27)
loan_age_yr=10										-16.5
										(-4.43)
loan_age_yr=11										-17.2
										(-4.60)
loan_age_yr=12										-19.4
										(-5.09)
loan_age_yr=13										-18.2
										(-4.53)
loan_age_yr=14										-17.4
										(-3.16)
fico_@orig									0.0013	0.001
									(1.27)	(1.37)
fico_change-orig-to-sale									0.0014	0.0015
									(1.19)	(1.29)
married									2.2	2.2
									(8.38)	(8.30)
male									-0.78	-0.77
									(-3.44)	(-3.42)
Amt_repair_set_aside									-0.00011	-0.00011
									(-4.13)	(-4.11)
max_claim_amount					0.071		0.074	0.073		
					(60.32)		(59.93)	(59.62)		
term_loan									-0.0088	0.0086

									(-0.02)	(0.02)
tenure_loan									0.27	0.25
									(0.45)	(0.42)
borrower_age									0.077	0.078
									(5.52)	(5.60)
max claim amount<150k	-19.2	-17.0							-19.1	-19.1
	(-19.06)	(-20.03)							(-18.90)	(-18.82)
MCA<150k*MCA	0.18	0.14							0.18	0.18
	(23.73)	(21.30)							(23.81)	(23.80)
MCA>150k*MCA	0.060	0.043							0.062	0.063
	(29.36)	(26.26)							(30.22)	(30.35)
MCA<150*post2008	10.3								10.3	10.1
	(5.54)								(5.55)	(5.48)
MCA<150k*MCA*post2008	-0.12								-0.12	-0.12
	(-8.27)								(-8.15)	(-8.10)
MCA>150k*MCA*post2008	-0.040								-0.038	-0.038
	(-11.69)								(-10.94)	(-11.02)
frm_post_2008			-4.6						-3.8	-3.8
			(-4.06)						(-3.61)	(-3.61)
arm_draw%*post_2008			-6.6						-5.4	-5.4
			(-4.69)						(-4.19)	(-4.18)
draw%*pre_2009			-4.5						-3.5	-3.5
			(-10.04)						(-8.05)	(-8.01)
zip_price_diff				2.7	-0.14			0.54	0.29	0.27
				(12.63)	(-0.65)			(2.34)	(1.30)	(1.21)
metro_price_diff						3.9	-1.7	-2.0	-1.9	-1.9
						(15.70)	(-6.75)	(-7.11)	(-7.00)	(-7.01)
Constant	-25.4	-22.3	-14.2	-19.9	-30.9	-20.6	-30.2	-30.4	-27.6	-20.6
	(-23.07)	(-20.79)	(-12.84)	(-18.61)	(-30.28)	(-19.26)	(-29.70)	(-29.79)	(-16.85)	(-5.20)
Observations	26,102	26,102	26,102	26,102	26,102	26,102	26,102	26,102	26,102	26,102
Adjusted R-squared	0.212	0.199	0.067	0.069	0.183	0.072	0.184	0.184	0.22	0.221

Table 5. HECM Foreclosure

This table provides the results of the following regressions of HECM foreclosure based on the whole sample;

$$Foreclosure_{i,j,t,\tau} = \beta_0 + \beta_{YEAR} YEAR_{i,j,\tau} + \beta_{AGE} AGE_{i,j,t,\tau} + \beta_{LOAN} LOAN_{i,j,t,\tau} + \varepsilon_{i,j,t,\tau}$$

The dependent variable is a dummy variable equal to 1 if the property was sold at foreclosure (to a third-party) and 0 if the property was sold by the owner. The independent variables include $YEAR_{i,j,\tau}$, the set of indicator variables for origination year with 2003 as default year, $AGE_{i,j,t,\tau}$, the set of indicator variables for loan age at sales of the property i and $LOAN_{i,j,t,\tau}$the set of information on the HECM loan including FICO scores, marriage, sex, maximum claim amount, loan type, borrower age at origination, amount of withdrawals at origination and the property value relative to the area's median house value. Panel A provides the basis results while Panel B provides results from interaction effects and nonlinear effects measured by splines.

A. Without Interaction Effects

	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
origin_yr=2004	0.077	0.064	0.060	0.064	0.064	0.061	0.063	0.073	0.060	0.063
	(8.17)	(6.73)	(6.26)	(6.73)	(6.74)	(6.51)	(6.68)	(7.96)	(6.47)	(6.69)
origin_yr=2005	0.162	0.135	0.131	0.135	0.134	0.132	0.134	0.168	0.126	0.135
	(18.26)	(15.19)	(14.39)	(15.26)	(15.16)	(15.06)	(15.14)	(19.45)	(14.44)	(15.26)
origin_yr=2006	0.227	0.182	0.177	0.185	0.181	0.179	0.184	0.234	0.170	0.181
	(27.11)	(21.56)	(20.27)	(21.77)	(21.29)	(21.33)	(21.71)	(28.28)	(20.36)	(21.36)
origin_yr=2007	0.275	0.218	0.214	0.221	0.216	0.211	0.221	0.254	0.199	0.218
	(33.06)	(25.55)	(24.49)	(25.75)	(25.24)	(24.89)	(25.82)	(30.51)	(23.53)	(25.55)
origin_yr=2008	0.276	0.211	0.208	0.213	0.209	0.202	0.213	0.238	0.186	0.211
	(32.42)	(24.00)	(23.34)	(24.21)	(23.70)	(23.17)	(24.28)	(27.81)	(21.44)	(24.07)
origin_yr=2009	0.177	0.114	0.109	0.116	0.112	0.109	0.117	0.206	0.089	0.114
	(20.13)	(12.60)	(11.97)	(12.84)	(12.35)	(12.10)	(12.94)	(23.15)	(9.93)	(12.64)
origin_yr=2010	0.149	0.093	0.087	0.095	0.091	0.088	0.096	0.168	0.061	0.094
	(15.26)	(9.39)	(8.70)	(9.62)	(9.16)	(8.92)	(9.70)	(17.29)	(6.27)	(9.50)
origin_yr=2011	0.112	0.069	0.063	0.071	0.067	0.066	0.072	0.132	0.036	0.072
	(10.83)	(6.60)	(6.00)	(6.83)	(6.37)	(6.40)	(6.90)	(12.98)	(3.50)	(6.88)
origin_yr=2012	0.117	0.091	0.087	0.094	0.089	0.089	0.094	0.148	0.056	0.096
	(9.64)	(7.52)	(7.14)	(7.71)	(7.31)	(7.37)	(7.78)	(12.54)	(4.69)	(7.92)

loan_age	0.058	0.125		0.125	0.125	0.128	0.125	0.118	0.122	0.127
	(87.05)	(49.78)		(49.82)	(49.62)	(51.12)	(49.83)	(48.32)	(49.03)	(50.56)
loan_age_squared		-0.0060		-0.0060	-0.0060	-0.0060	-0.0060	-0.0056	-0.0058	-0.0060
		(-27.71)		(-27.73)	(-27.63)	(-28.17)	(-27.70)	(-26.81)	(-27.41)	(-27.89)
loan_age_yr=2			0.027							
			(2.52)							
loan_age_yr=3			0.118							
			(11.36)							
loan_age_yr=4			0.236							
			(23.04)							
loan_age_yr=5			0.314							
			(30.79)							
loan_age_yr=6			0.380							
			(37.14)							
loan_age_yr=7			0.414							
			(40.39)							
loan_age_yr=8			0.464							
			(44.79)							
loan_age_yr=9			0.500							
			(46.75)							
loan_age_yr=10			0.523							
			(45.73)							
loan_age_yr=11			0.501							
			(37.65)							
loan_age_yr=12			0.511							
			(29.39)							
loan_age_yr=13			0.457							
			(17.62)							
loan_age_yr=14			0.418							
			(6.90)							
fico_@orig				- 0.00003						

				(-3.54)						
fico_change-orig-to-sale					-0.00003					
					(-3.80)					
married						-0.121				
						(-30.43)				
male						0.040				
						(11.23)				
Amt_repair_set_aside							0			
							(6.11)			
max_claim_amount								-0.00089		
								(-64.85)		
term_loan									-0.142	
									(-22.72)	
tenure_loan									-0.234	
									(-38.39)	
borrower_age										0.00341
										(16.34)
max claim amount<150k										
MCA<150k*MCA										
MCA>150k*MCA										
MCA<150*post2008										
MCA<150k*MCA*post 2008										
MCA>150k*MCA*post 2008										

frm_post_2008										
arm_draw%*post_2008										
draw%*pre_2009										
zip_price_diff										
metro_price_diff										
Constant	-0.150	-0.248	-0.109	-0.248	-0.247	-0.239	-0.253	-0.048	-0.188	-0.517
	(-17.83)	(-27.28)	(-9.41)	(-27.31)	(-27.12)	(-26.17)	(-27.71)	(-5.13)	(-20.68)	(-27.51)
Observations	72,835	72,835	72,835	72,835	72,835	72,835	72,835	72,835	72,835	72,835
Adjusted R-squared	0.143	0.152	0.152	0.152	0.152	0.162	0.152	0.198	0.173	0.155

B. With Interaction Effects

	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
origin_yr=2004	0.076	0.073	0.062	0.063	0.073	0.057	0.072	0.072	0.068	0.065
	(8.33)	(8.00)	(6.80)	(6.66)	(7.93)	(6.11)	(7.80)	(7.80)	(7.75)	(7.32)
origin_yr=2005	0.180	0.171	0.123	0.134	0.167	0.128	0.166	0.166	0.159	0.157
	(20.95)	(19.85)	(14.32)	(15.13)	(19.39)	(14.56)	(19.17)	(19.17)	(19.26)	(18.47)
origin_yr=2006	0.251	0.235	0.164	0.181	0.233	0.175	0.231	0.231	0.220	0.217
	(30.45)	(28.56)	(19.98)	(21.40)	(28.18)	(20.82)	(27.86)	(27.86)	(27.47)	(26.30)
origin_yr=2007	0.265	0.254	0.189	0.214	0.253	0.211	0.251	0.251	0.225	0.224
	(32.00)	(30.70)	(22.74)	(25.11)	(30.37)	(24.79)	(30.16)	(30.15)	(27.94)	(27.20)
origin_yr=2008	0.244	0.234	0.166	0.201	0.236	0.207	0.236	0.236	0.193	0.192
	(28.67)	(27.45)	(19.45)	(22.89)	(27.53)	(23.70)	(27.62)	(27.52)	(23.22)	(22.88)
origin_yr=2009	-0.010	0.186	0.138	0.108	0.204	0.129	0.206	0.206	0.00217	0.00021
	(-0.72)	(20.91)	(11.83)	(11.96)	(22.89)	(14.37)	(23.14)	(23.02)	(0.14)	(0.01)
origin_yr=2010	-0.050	0.145	0.094	0.091	0.166	0.104	0.167	0.167	-0.056	-0.061
	(-3.44)	(14.95)	(7.88)	(9.17)	(17.16)	(10.60)	(17.26)	(17.22)	(-3.59)	(-3.86)
origin_yr=2011	-0.083	0.111	0.070	0.065	0.131	0.082	0.133	0.132	-0.085	-0.089
	(-5.57)	(10.85)	(5.62)	(6.28)	(12.86)	(7.90)	(13.01)	(12.97)	(-5.32)	(-5.58)
origin_yr=2012	-0.067	0.126	0.084	0.088	0.147	0.107	0.149	0.149	-0.071	-0.074
	(-4.18)	(10.68)	(6.05)	(7.28)	(12.45)	(8.89)	(12.63)	(12.59)	(-4.21)	(-4.34)
loan_age	0.119	0.118	0.116	0.124	0.118	0.124	0.118	0.118	0.114	
	(49.10)	(48.63)	(47.46)	(49.59)	(48.31)	(49.70)	(48.35)	(48.34)	(48.82)	
loan_age_squared	-0.0058	-0.0057	-0.0055	-0.0059	-0.0056	-0.0059	-0.0056	-0.0056	-0.0054	
	(-27.63)	(-27.01)	(-26.15)	(-27.55)	(-26.79)	(-27.68)	(-26.83)	(-26.83)	(-26.66)	
loan_age_yr=2										0.036
										(3.68)
loan_age_yr=3										0.127
										(13.24)
loan_age_yr=4										0.234
										(24.51)
loan_age_yr=5										0.306

										(32.15)
loan_age_yr=6										0.364
										(38.21)
loan_age_yr=7										0.395
										(41.23)
loan_age_yr=8										0.441
										(45.51)
loan_age_yr=9										0.475
										(47.53)
loan_age_yr=10										0.505
										(47.20)
loan_age_yr=11										0.492
										(39.57)
loan_age_yr=12										0.506
										(31.19)
loan_age_yr=13										0.453
										(18.77)
loan_age_yr=14										0.440
										(7.81)
fico_@orig									-0.0001	-0.0001
									(-7.78)	(-7.79)
fico_change-orig-to-sale									-0.0001	-0.0001
									(-8.17)	(-8.22)
married									-0.069	-0.069
									(-18.17)	(-18.06)
male									0.026	0.026
									(7.74)	(7.68)
Amt_repair_set_aside									0	0
									(7.23)	(7.19)
max_claim_amount					- 0.00088		- 0.00086	- 0.00086		
					(-62.35)		(-57.86)	(-57.69)		

term_loan									-0.030	-0.030
									(-4.84)	(-4.89)
tenure_loan									-0.096	-0.096
									(-15.67)	(-15.69)
borrower_age									0.0058	0.00579
									(28.79)	(28.73)
max claim amount<150k	0.182	0.321							0.095	0.094
	(9.38)	(21.13)							(5.07)	(5.01)
MCA<150k*MCA	-0.0024	-0.0026							-0.0018	-0.0018
	(-15.85)	(-21.24)							(-12.40)	(-12.35)
MCA>150k*MCA	-0.0011	-0.0006							-0.0011	-0.0011
	(-37.09)	(-36.16)							(-36.28)	(-36.30)
MCA<150*post2008	0.256								0.249	0.247
	(8.12)								(8.17)	(8.11)
MCA<150k*MCA *post2008	-0.0007								-0.0007	-0.0006
	(-2.66)								(-2.65)	(-2.60)
MCA>150k*MCA *post2008	0.00072								0.0007	0.00071
	(19.28)								(19.29)	(19.30)
frm_post_2008			0.256						0.229	0.228
			(29.39)						(26.22)	(26.04)
arm_draw%*post_2008			0.233						0.211	0.209
			(18.38)						(16.98)	(16.85)
draw%*pre_2009			0.371						0.326	0.327
			(61.93)						(52.01)	(52.00)
zip_price_diff				-0.047	-0.0068			-0.0015	0.0017	0.0018
				(-17.54)	(-2.53)			(-0.50)	(0.60)	(0.64)
metro_price_diff						-0.0751	-0.0134	-0.0127	-0.0154	-0.0155
						(-29.04)	(-4.87)	(-4.19)	(-5.24)	(-5.26)
Constant	-0.014	-0.128	-0.407	-0.201	-0.043	-0.177	-0.042	-0.041	-0.583	-0.468
	(-1.24)	(-12.76)	(-44.12)	(-21.20)	(-4.51)	(-18.92)	(-4.42)	(-4.28)	(-28.90)	(-22.12)

Observations	72,835	72,835	72,835	72,835	72,835	72,835	72,835	72,835	72,835	72,835
Adjusted R-squared	0.209	0.205	0.203	0.155	0.198	0.162	0.198	0.198	0.268	0.268