

Mortgage Debt Overhang: Reduced Investment by Homeowners with Negative Equity

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Abstract

Homeowners with negative equity have less incentive to invest in their property. They face a debt overhang: in expectation, some value created by equity investments in the property will go to the lender. Using rich microdata on household expenditures, I show that debt overhang plays an important role in household financial decisions. I find that homeowners with negative equity cut back substantially on mortgage principal payments, home improvements and home maintenance spending. At the same time, these households show no difference in durable spending on automobiles, furniture and home appliances, investments that are not attached to the home. The decline in mortgage principal payments is particularly large for negative equity homeowners in non-recourse states, where strategic default is more likely because lenders have limited claim on non-housing wealth. Debt overhang, rather than financial constraints, best explains this set of facts. Given the prevalence of negative home equity in today's housing market, the results suggest that home prices will grow more slowly in the future because of underinvestment. In addition, the potential deadweight loss due to home foreclosures is only part of the economic inefficiency that follows the spree of mortgage borrowing in the 2000s and the subsequent real estate price decline.

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I. Introduction

A long-standing and important idea in finance theory is that leverage can distort investment decisions. Myers (1977) introduces the notion of corporate debt overhang, emphasizing that high leverage can cause firms to underinvest, since the benefits of new capital investments accrue largely to debt holders rather than equity holders. In public finance, Keynes (1920), Krugman (1988) and Sachs (1990) emphasize that heavy public debt loads reduce incentives for public sector investments in infrastructure and private sector investments in physical and human capital. This paper applies the same thinking to household financial decisions, and provides evidence that households with mortgage debt overhang underinvest in their homes.

The reasoning behind debt overhang is straightforward. For an incremental investment in a debt-free asset, the owner captures the investment's payoffs in all states of the world. In contrast, for a levered asset with some risk of default, the investment's payoffs accrue to the foreclosing lender if the owner defaults. Faced with the same investment outlay today and the prospect of sharing the future payoffs with the lender, the owner of a levered asset may underinvest, foregoing some investments that have positive net present value for a debt-free owner.

Following the precipitous decline in the United States housing market between 2007 and 2009, during which average home prices fell by 14% nationwide and by as much as 50% in some states¹, mortgage debt overhang has become an important issue. Up to 20% of homeowners are in a negative equity position, facing mortgage liabilities that exceed the value of their home.

¹ These figures are based on Fiserv Case-Shiller Home Price Index data between the second quarter of 2007 and the first quarter of 2009. State-level declines of 40 to 50% occurred in AZ, CA, FL, MI and NV.

Understanding how these homeowners behave is important in forecasting home prices, mortgage defaults and residential investment, and in evaluating foreclosure reduction policies.

This paper contributes to these broad goals by answering, first, whether housing investments, in the form of improvements, maintenance and mortgage principal payments, differ among negative equity households and, second, whether debt overhang explains these differences. To answer these questions, I use rich household microdata from the Bureau of Labor Statistics' Consumer Expenditure Survey (CE). These data contain comprehensive property-specific information for a national sample of homeowners, including mortgage balances and principal payments, home improvement and maintenance expenditures, and property values as estimated by the homeowners. I construct an estimate of mortgage loan-to-value and an indicator for negative home equity, and use regression analysis to estimate the difference in housing investment between homeowners with and without large mortgage debts.

I find that negative equity homeowners invest \$215 less in home improvements and maintenance on average, a 30% reduction relative to positive equity homeowners. Households with negative equity also pay \$370, or 25%, less in mortgage principal, controlling for differences in mortgage balance. This disparity in home investment is not explained by differences in total expenditures, income or wealth. Nor is it explained by variation in household demographic characteristics like age, race, education and household size, or property characteristics like property value, age of home, duration of ownership and various traits of the physical structure.

The detailed, household-level data of the CE are useful in narrowing the interpretation of the empirical results and ruling out alternatives to the debt overhang interpretation. Aside from indicating debt overhang, negative equity may proxy for other differences between households –

differences in wealth, borrowing capacity and investment opportunities, or varied exposure to economic shocks – that explain their lower home investment spending. For example, in aggregate data at the state or MSA level a negative correlation between mortgage loan-to-value and home improvements might arise from regional economic shocks that reduce real estate values, wealth, employment and household spending, including spending on home-related investments. However, this mechanism does not explain my findings, which are identified using household-level variation in negative equity, conditional on total expenditures. Borrowing and liquidity constraints also fail to explain the results: among homeowners with higher income and limited unsecured debt, who are evidently not financially constrained, negative equity still predicts lower spending on home investments. Finally, it is natural to question whether negative equity homeowners, many of whom have experienced a large decline in their home's value, invest less because they perceive low returns from improvements. Even debt-free owners might invest less in these circumstances. But this line of thinking does not account for the reduction in principal payments, which do not change the underlying asset and therefore should not fall simply due to low forecast returns from marginal investments.

Two falsification exercises strengthen the case for debt overhang by confirming that negative equity is unrelated to durable investments in categories that are not subject to mortgage overhang. Notably, negative equity homeowners do not spend less on furniture and home appliances, which are home improvements that face no overhang because they are not sacrificed to the lender in the case of default. Nor do they cut spending on new and used vehicles. Viewed together with the main results, this evidence strongly supports debt overhang relative to other accounts, since it demonstrates within-household variation in overhang that explains the investment patterns of negative equity homeowners. Alternative hypotheses that postulate a

household-level difference among heavily indebted homeowners – like the expectation of low future income or the preference to invest little in home improvement and durables – would not account for these facts.

The final extension of the main analysis tests whether the choices of negative equity homeowners depend on state foreclosure laws. Ten states provide mortgage creditors with recourse, or the ability to claim mortgage debtors' other assets when the value of the collateral falls short of the loan balance. If negative equity homeowners in these states are less likely to default, as Ghent and Kudlyak (2009) find, they should also be less likely to cut back on principal payments and home improvements. Evidence on this point is mixed. Negative equity reduces principal payments more in non-recourse states, but has a similar effect on home improvements in recourse and non-recourse states.

The motivation for this research is threefold. First, the impact of financial distress among homeowners and the optimal policy response are important issues. This paper extends the existing literature on negative equity – which focuses on negative equity's role as a cause of mortgage default (Foote, Gerardi and Willen 2008; Guiso, Sapienza and Zingales 2009; Bhutta, Dokko and Shan 2010) and reduced household mobility (Chan 2001; Ferreira, Gyourko and Tracy 2008) – to provide new evidence on how and why negative equity borrowers change their behavior. Regarding foreclosure reduction policy, my findings highlight the importance of mortgage principal reduction in restoring homeowners' incentives to pay their mortgages, consistent with Haughwout, Okah and Tracy (2009), but also to care for their homes. The latter point suggests an additional economic motivation for principal reduction as part of mortgage modification programs: aside from preventing foreclosure-related externalities, principal

reduction also mitigates underinvestment, encouraging the optimal level of residential housing investment.²

Second, surprisingly little research examines the empirical relevance of debt overhang, even though this friction is a common feature of theoretical models within corporate, public and macro finance. In light of the recent housing crisis, Mulligan (2008) even proposes a model of labor supply in which mortgage debt overhang plays a crucial role.³ But the only empirical study on this topic is Olney (1999), who finds loan delinquency patterns during the great depression that are consistent with debt overhang.⁴ I provide more direct and expansive evidence, grounded in microdata, that households are forward looking in their investment choices and that household balance sheet quality affects these choices above and beyond the effect of liquidity constraints.⁵

Third, home improvement decisions are worthy of study in their own right. Mendelsohn (1977) and Montgomery (1992) offer descriptive analyses of improvement spending across households, and Gyourko and Tracy (2006) find a small role for improvement spending in consumption smoothing. But more work is needed to understand the variety of economic factors that influence these decisions. For households outside the top income decile, their home constitutes roughly 50% of their total assets (Bucks et al. 2009), and home improvement decisions are some of their most significant ongoing asset management decisions. The contributions of home improvement and maintenance spending to the housing sector are also sizeable. From 1993 to 2007 such spending averaged \$142 billion (measured in 2009 dollars),

² Campbell, Giglio and Pathak (forthcoming) examine foreclosure spillovers: they estimate a 1% reduction in home price for each foreclosure with 0.05 miles.

³ In the model, heavily indebted homeowners work less to qualify for mortgage modifications that are available to borrowers with low current income.

⁴ Households continued to pay installment loans secured by durable goods in which they typically had significant equity, but ceased payments on (non-recourse) mortgages that likely exceeded their home's value.

⁵ Hurst and Stafford (2006) find that home equity is used to finance current expenditures, particularly among those that appear liquidity constrained. Mian and Sufi (forthcoming) observe that homeowners, particularly those that seem to be liquidity constrained, borrow against increases in home equity and do not use the proceeds to pay down other debt. The authors postulate that this borrowing finances consumption, including home improvement spending.

almost half of the \$300 billion invested annually in construction of new homes over this period. Annual maintenance and improvement spending, at 0.9% of the housing stock, is similarly large relative to the long term growth in existing home values. Typical estimates call for real growth of 2-3% per year, so it is plausible that quality increases driven by improvement and maintenance spending explain between one third and one half of this growth, especially considering that the aggregate value of improvements and maintenance cited above exclude the value of homeowners' time.⁶ Viewed in this context, the empirical results of this paper suggest that home prices will grow more slowly in the future, especially in states with substantial debt overhang.

The rest of the article proceeds as follows. The next section outlines the predictions tested in the regression analysis. Section III describes the data and basic sample statistics. Sections IV and V cover the regression model and estimation results. Section VI concludes.

II. Predictions: Debt Overhang, Negative Equity and Home-related Investments

This section outlines the testable predictions of the debt overhang hypothesis, with discussion to highlight how these predictions differentiate debt overhang from other economic mechanisms linking negative equity and housing investments. The empirical analysis that follows uses an indicator for negative equity as a practical measure of debt overhang, so each hypothesis is framed with negative equity status as the independent variable of interest. Section III.2 provides further discussion of this choice.

⁶ The Historical Census of Housing Tables from the U.S. Census show 2.3% real growth in median home prices from 1940 to 2000 (<http://www.census.gov/hhes/www/housing/census/historic/values.html>).

Prediction 1: Negative equity homeowners will invest less in improving and maintaining their homes.

Studies of mortgage default show that default rates are substantially higher among negative equity homeowners (Deng, Quigley and Van Order 2000; Deng and Gabriel 2006; Foote, Gerardi and Willen 2008). Being closer to default, negative equity homeowners have less incentive to improve the property, since doing so makes the debt claim more secure and valuable without necessarily increasing the asset's value to the owner.⁷ Stated otherwise, even a project that achieves a certain return of \$1.15 for every \$1 invested looks unattractive if the lender keeps the \$1.15 payoff 10% of the time.

Prediction 2: Negative equity homeowners will reduce mortgage principal payments.

The reasoning behind Prediction 1 holds also for principal payments. When there is a large debt overhang, principal payments are a poor investment because they pay off mostly to the lender. Prediction 2 is useful in testing whether negative equity homeowners reduce home improvement spending because they perceive limited home investment opportunities. Principal payments should not be sensitive to this consideration. Their marginal return is determined by the interest rate on the loan and the probability of default, and only indirectly by forecast returns on the home or its renovation.⁸ So, for homeowners to cut back on principal payments they must be responding to variation in the probability of default, i.e. variation in the extent of debt overhang.

⁷ I assume that informational frictions – difficulty specifying optimal improvements and maintenance, and difficulty identifying homeowners that are underinvesting – prevent borrowers and lenders from overcoming debt overhang through ex ante contracting and contract renegotiation.

⁸ Forecast asset returns affect the likelihood of future default.

Prediction 3: The reduction in principal payments and home investments will not be limited to negative equity homeowners that appear financially constrained.

Homeowners with negative equity might prefer to invest more in their home but are unable to finance those expenditures. They lack a key source of secured funding – borrowing against home equity through cash-out refinancing or a line of credit. In fact, homeowners that refinance or take out home equity loans often report home improvement as the use of the proceeds (Brady, Canner and Maki 2000), so accounting for liquidity constraints is crucial.

Prediction 3 separates debt overhang from financial constraints: debt overhang should still affect the improvement spending of homeowners with higher income and limited unsecured debt, who appear to have the borrowing capacity and liquidity to fund improvements.

Prediction 4 (Falsification): Negative equity homeowners will show no difference in spending on durable investments that are not attached to the home, including outlays for vehicles and home improvements that do not go to the mortgage lender, like furniture and home equipment.

Home improvements that are not part of the property's physical structure, like furniture and most home appliances, stay with the homeowner in the event of default. As do other durable assets, like vehicles, provided that the mortgage lender lacks recourse or chooses not to exercise this right. So the debt overhang hypothesis predicts no difference in expenditures on these items. In contrast, other explanations that posit a different taste for durable or home-related spending would predict lower spending in these categories too.

Prediction 5: The reduction in principal payments and home investments will be smaller for negative equity homeowners in recourse states.

In states that provide mortgage lenders recourse to borrowers' other assets or future income, mortgage default among negative equity homeowners should be less likely. Particularly for homeowners who are considering default because of a fall in home value rather than an event like job loss or a shock to medical expenditures, the loss of other assets offsets the gain from defaulting on the mortgage. Ghent and Kudlyak (2009) offer confirming evidence: default rates among negative equity homeowners in recourse states appear to be at least 20 percent lower.

Accordingly, homeowners' responses to debt overhang should be less dramatic in recourse states. That is, the difference in principal payments and improvement spending attributable to negative equity should be smaller in recourse versus non-recourse states.

III. Data

The primary data for this study come from the Consumer Expenditure Interview Survey, which follows a rotating random sample of roughly 7,500 households for a year-long period and provides quarterly observations on each household's expenditures. These data are well-suited for this study because they combine detailed information on housing expenditures with information on mortgage debt and property characteristics, including the owner's valuation of the home.

CE expenditure data are extraordinarily detailed. Housing expenditures are measured by property, broken down into narrow categories. For this study, the classifications of interest are home improvements, home maintenance, furnishings and household equipment. In principle the latter two categories are home improvements, but I exclude them from the improvements measure, focusing instead on projects that are closely tied to the physical structure, like electrical

work, insulation, plumbing and remodeling. The distinction between improvements and maintenance is blurry; I rely on the homeowner's classification of jobs, with "maintenance and repair" allocated to maintenance and the remaining categories – "addition," "alteration," "replacement" and "new construction" – allocated to improvements. The expenditure data are also nearly comprehensive, allowing for analysis of housing expenditures holding fixed total expenditures.

Mortgage information is crucial in measuring the flow consumption of housing, so the BLS also takes considerable care in measuring mortgage liabilities and payments. Homeowners report mortgage borrowing per property and by type of loan – first mortgage, home equity loan (lump sum) and home equity line of credit. For first mortgages and lump sum home equity loans, borrowers report their most recent monthly mortgage payment and the amount of any additional, unscheduled principal payments during the quarter. They also provide the origination date, original principal balance, loan type (fixed/floating and interest only), interest rate and term. The CE does not ask for the current mortgage balance in these loan categories, instead estimating it by applying the appropriate amortization schedule to the original balance, given the loan characteristics.⁹ For lines of credit, borrowers report the loan balance and the total payment made during the quarter, from which the CE imputes principal and interest assuming an interest rate of prime plus 1.5 percentage points. Summing across the actual or estimated balance in each loan category, I form an estimate for total mortgage debt on each property as of the beginning of the quarter. Likewise, I estimate total principal paid for each property during the quarter by summing across all loans.

⁹ The current mortgage balance will be measured with error if the homeowner has deviated from the mortgage payment schedule prior to entering the survey. However, more significant errors due to refinancing events are not an issue. The CE probes for refinancing events, and brings the mortgage balance and loan terms up to date as of the refinancing date.

The final component of CE data used in this study is housing information. The CE collects a variety of property characteristics, discussion of which I leave to the subsequent section on the sample's summary statistics. Most important for this study is the homeowner's estimate of property value, which the survey elicits with the question: "About how much do you think this property would sell for on today's market?" Some respondents refuse to answer and for these instances I follow an imputation scheme designed to use only directly related information. If the homeowner never reports a home value in any interview, I leave property value as missing for each quarter. If the homeowner provides a valid response in some but not all quarters, I replace the missing value with the prior quarter's home value, if available, or by the next quarter's home value, if not.

To supplement the CE data I code state foreclosure laws, following the classification of lender recourse in Ghent and Kudlyak (2009), which is also nearly identical to coding in Pence (2006).

III.1 Regression Sample

The regression sample includes homeowners surveyed in the CE between the first quarter of 2006 and the first quarter of 2009. In total there are 71,698 household-quarter observations. Missing data among key independent variables limit the sample: property values and mortgage balances are missing for 9500 and 2200 observations, respectively, and state identifiers are suppressed for roughly 8,300 observations, primarily for states with small populations. The remaining sample has a number of observations with very low home values and in some cases implausibly high loan-to-value ratios. A natural explanation is that these cases are reporting or coding errors, where the reported value is missing a zero or is reported in thousands. With no

systematic manner of identifying and correcting these cases, I focus the analysis on homes with value above \$30,000 and loan-to-value ratio of 2 or less.¹⁰ This selection rule excludes roughly 8,500 observations, leaving the final analysis sample at just over 44,000 observations.

III.2 Negative Equity

The empirical analysis uses an indicator variable for negative equity (*NegEquity*), defined as one if the property value equals or exceeds the total mortgage balance, and zero otherwise. There is a strong rationale for estimating a non-linear effect of mortgage loan-to-value, as I do with the negative equity indicator. Negative equity is a necessary condition of mortgage default in most models; among borrowers unable to pay debt service, selling or refinancing the home is preferable to defaulting when there is positive equity. And among borrowers with the resources to pay, negative equity beyond a certain level becomes a sufficient condition for default.¹¹ For both of these reasons, homeowners' probability of default should accelerate at or around the point where combined mortgage balances exceed the home value, a fact that is roughly confirmed by Foote, Gerardi and Willen (2008), who show that default rates rise rapidly when equity falls below 15% of the mortgage balance.

The prevalence of negative equity in the CE data increased dramatically over the sample period, rising from 3.3% of homeowners in the first quarter of 2006 to 6.8% in the first quarter of 2009. The latter number is low relative to other estimates. For example, data from First American CoreLogic, a large mortgage loan servicer, suggests 14% of homeowners had negative

¹⁰ Even within a sample of homeowners from the worst performing housing markets, who also had combined loan-to-value of 100% at origination, Bhutta, Dokko and Shan (2010) estimate that there are very few instances of LTV in excess of 2.

¹¹ As noted in Kau, Keenan and Kim (1994), simply being above 100% loan-to-value is not sufficient for default. There is option value in delaying default while there is still reasonable chance of regaining positive equity.

equity in the third quarter of 2009.¹² Though negative equity appears to be underreported in the CE, the state cross-section displays the pattern that one would expect. Figure 1 shows a scatter plot comparing the CE and First American estimates of negative equity by state. Florida, Michigan, Nevada, Arizona and California have among the highest rates of negative equity, consistent with the First American report, and across states, the correlation of negative equity in the CE and in First American data is quite high at 0.7.

Why might the CE estimates be low? Self-reporting bias is one possibility: homeowners might be optimistic about their home's value or reluctant to acknowledge that they owe more than their home is worth. Sampling bias is another possibility: perhaps the CE is less likely to locate or obtain survey consent for homeowners in significant financial distress.¹³

These concerns imply that we should be cautious in generalizing the findings to all homeowners, but the fact that the cross-sectional variation looks sensible bodes well for internal validity. Though this cannot be tested, the hope is that cross-household variation is similarly high quality.

III.3 Summary Statistics

Table 1 shows summary statistics for the sample, separating observations by *NegEquity*. Naturally, households with negative equity have larger mortgage balances. Their mortgage debts are higher in each category, with the largest difference in the first mortgage balance; they borrow \$245,000 through first mortgages, compared to \$76,700 for those with positive equity. These differences remain quite large even after excluding the 1/3 of positive equity households without

¹² First American estimates the proportion of borrowers, rather than homeowners, that have negative equity. I adjust their figure to account for the fact that only 68% of homeowners have a mortgage (American Community Survey).

¹³ Underestimating negative equity is not specific to the Consumer Expenditure Survey. The proportion of homeowners reporting negative equity in the American Housing Survey in 2009 is around 6%, similar to the CE.

mortgage debt. Negative equity households also own lower value homes, \$216,800 on average compared to \$296,629. Homes in which the owner has positive equity are older – built 5 years earlier on average – but in size and other physical characteristics there is little difference between the two groups.

Negative equity households do not differ much in income, employment and education, but they are younger, spend more and are more likely to be minorities. Both groups have annual income just over \$70,000, but those with positive home equity spend less, \$15,200 per quarter compared to \$16,900 per quarter. Negative equity homeowners are not disproportionately unemployed: income from unemployment insurance claims does not differ, and the average number of weeks worked is very similar after accounting for the greater share of retirees in the positive equity group. In education, the positive equity group has more variance – more with a high school degree or less and more with graduate degrees – but average levels of education are similar. The two groups are at different points in the life-cycle: *NegEquity* households have owned the home for six years on average, compared to fourteen; they are younger, with a head of household nine years younger, at 44 compared to 53; and they are less likely to be retired. Racial and ethnic composition also differs between the groups. Black, Hispanic and Asian groups comprise a larger share of negative equity households.

Looking ahead to the empirical analysis, a number of these differences must be accounted for, particularly those that are expected to influence home improvement spending. New homeowners and younger households are known to spend more on improvements (Mendelsohn 1977; Montgomery 1992; Gyourko and Tracy 2006; Davidoff 2006). Older and larger homes are also likely to require more maintenance (Mendelsohn 1977; Montgomery 1992). Financial constraints are a key issue, as discussed in the Introduction and Section II. Based on life cycle,

race and wealth information, negative equity households appear more likely to be financially constrained. Because of the rich, household-level detail in the CE, I am able to measure and control for these differences.

IV. Regression Model

The main regression model is given by:

$$y_{ipst} = \alpha + \beta NegEquity_{ipt} + \vec{\gamma}X_i + \vec{\delta}Z_p + \eta_s + \mu_t + \varepsilon_{ist}$$

Depending on the specification, the dependent variable is quarterly expenditures on improvements, maintenance or mortgage principal payments of household i on property p in state s during year t . The vectors X and Z include household- and property-level controls, respectively. Household-level covariates in X are: total quarterly expenditures; number of household members; quadratic in head of household's age; and a set of dummy variables indicating the head of household's education and race.¹⁴ Property-level covariates in Z are: quadratics in age of home and number of years owned; number of rooms, bedrooms and bathrooms; and indicators for central air conditioning, off street parking, porch and swimming pool. All specifications include state and year fixed effects, signified by η and μ .

In models explaining home improvement and maintenance spending, Z also includes a linear control in property value to ensure that differences in maintenance and improvements due to housing quantity are not attributed to negative equity, which naturally correlates with property value. Likewise, total mortgage balance is mechanically related to both negative equity and scheduled principal payments, so in models explaining principal payments, Z includes a linear control for total mortgage debt and an indicator variable for mortgagors.

¹⁴ Racial categories: white, black, Hispanic, Asian and other. Education categories: less than high school degree, high school degree, some college, college degree and graduate degree.

The model is estimated with OLS, providing an estimate of beta, the difference in mean spending on improvements, for example, between positive and negative equity homeowners. In calculating standard errors, observations are clustered by household; both negative equity and spending likely persist over time, so successive quarterly observations on the same household are unlikely to be independent.

V. Results and Discussion

V.1 How do Home Investments Vary with Negative Equity?

Before discussing the regression analysis, it is instructive to begin with the raw data. Figure 2 shows the average level of improvement and maintenance spending and principal payment by loan-to-value category. Improvements and maintenance and unscheduled principal payments decline consistently as loan-to-value rises, with particularly rapid declines within the negative equity region, if not exactly at 100% LTV. On the other hand, scheduled principal payments show a U-shaped pattern, falling until 100% LTV and then rising in negative equity territory. Perhaps the positive correlation between mortgage balance and LTV, and the corresponding rise in scheduled principal payments causes this positive correlation.

Table 2 shows the main regression results. Negative equity homeowners spend \$367 less per quarter on mortgage principal payments, a 24% reduction relative to the average quarterly payment of \$1508 by mortgagors. Among principal payments, additional or unscheduled payments are dramatically lower: those with negative equity pay \$144, or 66%, less than the average mortgagor's payment of \$219.¹⁵ Improvement and maintenance spending is also lower

¹⁵ This result may be surprising in light of the prevalence of prepayment penalties among high-LTV homeowners, a group that is almost certainly over-represented in the negative equity group. However, the vast majority of

for negative equity properties. Combined spending on these items is lower by \$215, with improvements falling by \$187 and maintenance falling by \$27. The difference in improvements and maintenance is slightly larger than that of principal payments: a 30% reduction relative to average spending. In each of these models the estimated beta shows strong statistical significance, generally at the 1% level and never less than the 5% level.

These results confirm the first two predictions about debt overhang – that negative equity households invest less in their homes, both in incremental improvements and in paying down debt balances. At this stage, though, these relationships are suggestive correlations.

V.2 Does Negative Equity Proxy for Liquidity and Borrowing Capacity?

The analysis presented in Table 3 explores whether the spending differences of negative equity homeowners are driven by financial constraints. The approach is to limit the sample to households with higher incomes and borrowing capacity, who are evidently not financially constrained, and estimate the impact of negative equity among these households.¹⁶

The regression results show that even in the restricted sample homeowners with negative equity invest less in their properties. Among households that report no unsecured debt (credit cards and installment loans), those with negative equity spend \$489 (p-value 0.01) less on principal payments and \$407 (p-value 0.001) less on improvements and maintenance compared to their positive equity counterparts. For homeowners with income above the \$65,000 median, negative equity corresponds to a \$422 (p-value 0.01) reduction in mortgage principal paid and a \$194 (p-value 0.15) reduction in improvements and maintenance. Finally, when combining the

prepayment penalties, which are indeed common in high-LTV loans, apply only to payments that exceed 20% of principal outstanding.

¹⁶ Sorting households by assets would be sensible as well, but is not feasible with the CE data. Financial asset information is frequently missing in the CE because asset questions are only asked in the 5th interview. Income and liability questions are asked in both the 2nd and 5th interviews.

two sample conditions to isolate higher income households without unsecured debt, we see again significantly lower principal payments and improvement spending by those with negative equity. The estimated differences are larger than in the main sample, partly accounted for by the fact that average of spending in restricted samples is higher.

These findings confirm Prediction 3 by showing that the main result – lower home investment spending among negative equity households – is not explained by financial constraints. We should not conclude, however, that home equity plays no role in relaxing liquidity constraints or that liquidity constraints have no effect on home improvement spending. The regressions include total expenditures as a dependent variable, so if non-improvement expenditures also rise as liquidity constraints are relaxed, then variation in improvements due to liquidity constraints will load on total expenditures rather than *NegEquity*. Furthermore, the regression results show differences between negative and positive equity homeowners, but do not explore how improvement spending differs among those with positive equity, where equity might be important in financing spending.

V.3 How Does Other Durable Spending Vary with Negative Equity?

Though the CE data allow for a number of important controls, a nagging concern is that some unobservable difference between households – one that correlates with both negative equity and durable or property-related spending – might be responsible for the main findings. The results in Table 4 help to address this question.

Spending on vehicles, furniture and home appliances does not differ much between positive and negative equity homeowners. Regression estimates imply that negative equity households spend \$55 (p-value 0.32) less on vehicles and \$47 (p-value 0.54) less on home

durables. These point estimates are statistically insignificant and small in magnitude, even relative to average spending in these categories. Precision is somewhat of an issue, particularly for the results on home durables, but a 30% decline in spending – as found for home improvements – can be rejected with p-value 0.09.

These facts confirm Prediction 4. The spending differences attributed to negative equity are specific to categories for which we expect mortgage overhang: they are specific to the home and even within the home they are specific to investments in the permanent physical structure. The latter finding is very interesting. The main regression results do not isolate specific, exogenous variation in negative equity, so it is natural to worry that the correlations do not reveal a causal effect of negative equity on home investments. For example, underinvesting might cause negative equity, or heavily indebted borrowers, those at greatest risk of negative equity, might be a different type of homeowner for whom most positive equity homeowners are a poor comparison group. But it is hard to imagine that such unobserved heterogeneity across households would not show up also in other durable spending, particularly in home improvements that are closely related, but not attached, to the home.

V.4 Foreclosure Laws, Lender Recourse and Negative Equity Effects

The analysis presented in Table 5 parses the main results, testing whether the spending differences attributable to *NegEquity* vary with state foreclosure laws. The coefficient of interest is the interaction term between *NegEquity* and *Recourse*, an indicator for whether the state permits mortgage lenders to pursue borrowers' other assets when the collateral value falls short of the loan balance. Prediction 5 suggests that debt overhang matters less in recourse states and that the interaction coefficient should be positive. The results offer weak confirmation that this is

the case for principal payments. The interaction coefficient is positive and significant at the 1% level for total principal payments and positive but not quite significant (p-value 0.15) for unscheduled payments. On the other hand, for improvements and maintenance the estimated interaction coefficient is smaller and statistically insignificant.

V.5 Robustness

The analysis presented in Table 6 examines the robustness of the main findings. The first two models use variations of the dependent variables: an indicator for any spending and log spending. The second two models include additional control variables: MSA-year fixed effects and a control for income. The results are broadly similar to the main findings, helping to address any concerns about functional form assumptions, outliers in investment spending, left censoring of the main dependent variables, and bias due to regional economic trends that affect negative equity.

Looking at the extensive margin, negative equity homeowners are 1.1 percentage points less likely to make any principal payment, 5 percentage points less likely to make principal payments beyond the scheduled amount and 2.8 percentage points less likely to make improvements. The latter two declines are substantial, with unscheduled principal payments being 35 percent less likely and improvements being 10 percent less likely. The log-linear model shows that among those making positive principal payments, negative equity homeowners pay 0.10 log points less, implying a roughly 10 percent decline as opposed to the 25 percent decline in the main analysis. The log-linear results show an insignificant 12 percent decline in additional principal payments, indicating that most of the decline in these payments occurs along the

extensive margin. For improvements, on the other hand, negative equity homeowners also reduce spending on the intensive margin, with a 0.22 log point decline in spending.

The second set of models includes additional control variables. First, I confirm that controlling for income does not change the main results. Second, I include MSA-year fixed effects, a change that limits the sample to the 45% of observations for which I observe the homeowner's MSA (revealed for MSAs with population above 100,000). This model restricts the identifying variation in negative equity by controlling for city-level trends, including trends in housing markets. The negative equity coefficients are unchanged, which confirms that the main results do not rely on a potentially flawed comparison across cities with very different real estate markets.

V.6 Interpretation

In the extreme, debt overhang is unsurprising behavior. When a homeowner is days away from default and certain of the outcome, it is not surprising that they do not invest in their home. But the magnitude of the estimates in this analysis suggests that a much larger group of homeowners is cutting back and doing so on a forward looking basis as they anticipate the increased possibility, if not certainty, of default. Foreclosure starts peaked at a quarterly rate of 1.25% of loans, or 0.81% of homeowners after accounting for non-mortgagors. So, if each homeowner going into foreclosure reduced to zero home improvement and maintenance spending, average quarterly spending would fall by less than 1%, far below the 30% reduction that I estimate.

VI. Conclusion

This paper extends our understanding of the financial decisions made by heavily indebted homeowners, a topic of significance after the rapid rise in mortgage borrowing – a doubling between 2000 and 2007 – and the substantial fall in U.S. home prices thereafter. For up to 15% of homeowners, mortgage debts even exceed the value of their home. Finance theory predicts that homeowners in these circumstances will underinvest, reducing both mortgage principal payments and home improvement spending due to debt overhang.

Using detailed household-level data on housing expenditures, I test this hypothesis and find that negative equity homeowners do indeed cut back on principal and improvements, by roughly 30%. These differences do not reflect a general spending decline by negative equity homeowners, nor are they limited to borrowing constrained households. Within the household, the cutbacks are specific to durable investments in the physical structure, on which the mortgage lender has a claim in foreclosure. Debt overhang best explains this set of facts.

The results suggest that national spending on home improvements, a sizeable component of total housing investment, will be roughly 5% lower (15% of homeowners with negative equity reducing spending by 30%) until the negative equity problem is resolved through price appreciation, default or principal reduction. The estimates also imply that in a state like Nevada, where the incidence of negative equity is 50%, home prices are likely to grow 5-10% slower because of underinvestment.¹⁷ Finally, this analysis is helpful in assessing mortgage principal reduction: provided that it restores positive equity, such a policy appears to improve homeowners' willingness to make mortgage payments and additional equity investments. An

¹⁷ Assumes 40-50% of price appreciation is driven by improvements. $50\% \text{ negative equity} * 50\% \text{ of appreciation} * 30\% \text{ reduction due to negative equity} = 7.5\% \text{ decline in growth rate.}$

interesting question for future empirical work is whether changes in mortgage debt overhang also affect labor supply, as suggested by Mulligan(2008).

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Figure 1

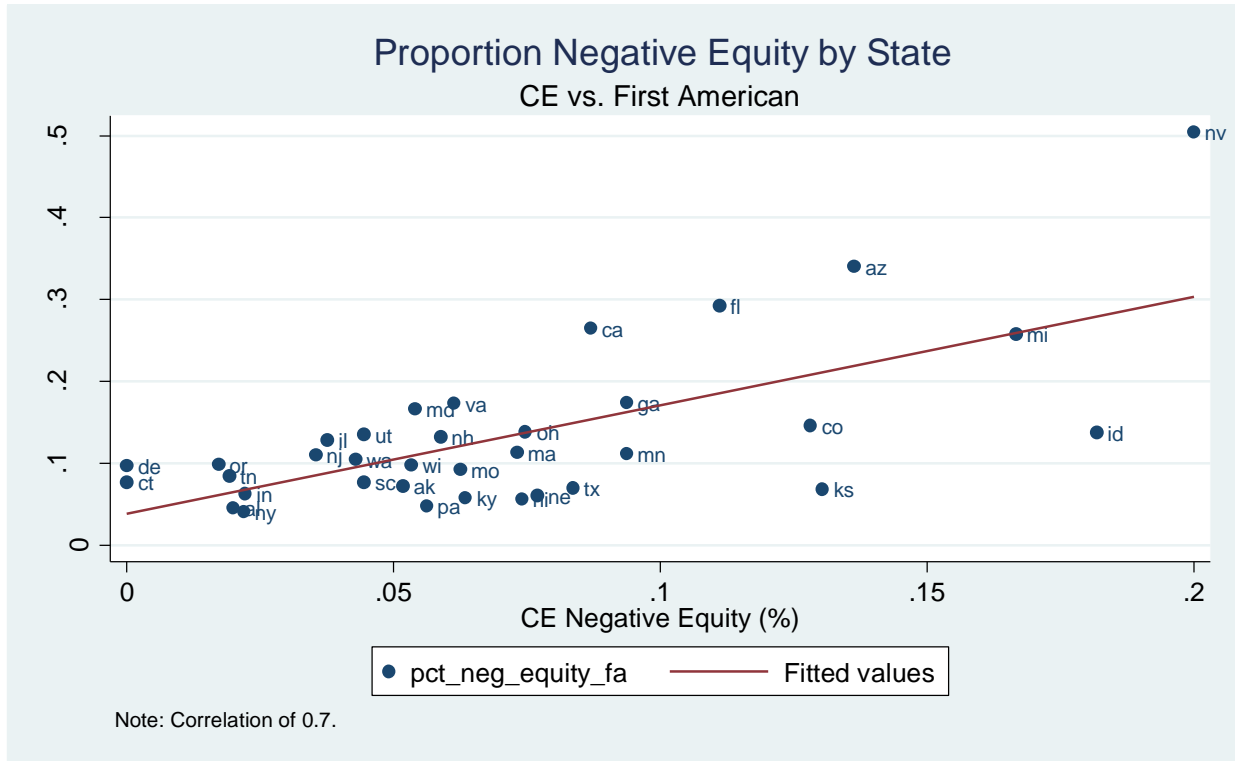


Figure 2

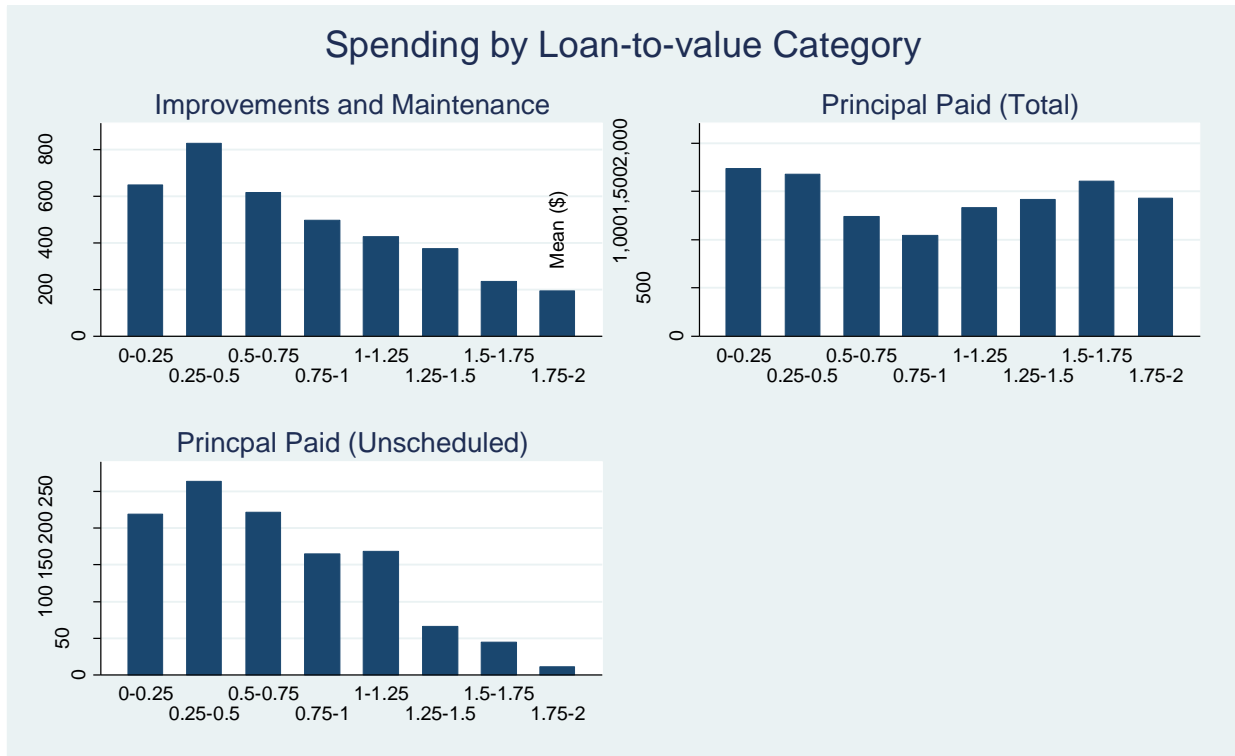


Table 1: Summary Statistics, Stratified by Negative Equity

<i>PANEL A: Housing Characteristics</i>	<i>NegEquity= 0</i>		<i>NegEquity = 1</i>		Diff. significant at 5% level
	obs	mean	obs	mean	
Property value	53,555	296,629	2,116	216,800	*
Mortgagor (d)	53,555	0.65	2,116	0.99	*
Total mortgage	53,555	82,579	2,116	264,742	*
First mortgage	53,555	76,714	2,116	245,542	*
Home equity loan	53,555	1,786	2,116	8,717	*
Home equity LOC	53,555	4,079	2,116	10,484	*
Age of home	49,852	37.2	1,912	31.9	*
Years owned	52,270	14.4	2,074	6.1	*
Rooms	53,302	6.9	2,092	6.7	*
Bedrooms	53,311	3.2	2,095	3.3	*
Bathrooms	53,305	1.9	2,096	1.9	
Central air (d)	53,491	0.69	2,109	0.74	*
Swimming pool (d)	53,491	0.11	2,109	0.11	
Porch (d)	53,491	0.84	2,109	0.82	*
Off-street parking (d)	53,491	0.83	2,109	0.79	*
<i>PANEL B: Household Characteristics</i>					
Income/Wealth					
Annual income	51,758	72,154	2,039	71,235	
Expenditures (qtr)	53,555	15,214	2,116	16,908	*
Liquid assets	28,126	37,094	1,031	9,637	*
Financial assets	26,411	120,700	997	39,789	*
Unsecured credit (2)	53,555	3,999	2,116	7,628	*
Unsecured credit (5)	20,224	8,505	898	13,000	*
Employment/Insurance					
Weeks worked	53,551	38.2	2,116	45.8	*
Unempemployment ins.	51,375	98.4	2,018	79.5	
Retired	53,555	0.24	2,116	0.07	*
Education					
No high school degree	53,555	0.10	2,116	0.09	
High school only	53,555	0.24	2,116	0.21	*
Some college	53,555	0.30	2,116	0.33	*
College degree	53,555	0.22	2,116	0.24	
Graduate degree	53,555	0.15	2,116	0.13	*
Race/Ethnicity					
White	53,555	0.80	2,116	0.68	*
Black	53,555	0.07	2,116	0.13	*
Hispanic	53,555	0.08	2,116	0.12	*
Asian	53,555	0.04	2,116	0.06	*
Other	53,555	0.01	2,116	0.02	*
Other					
Age	53,555	53.3	2,116	43.6	*
Family size	53,555	2.7	2,116	3.2	*

Table 2: Negative Equity and Home Investments

Below are OLS estimation results for regressions of principal payments, improvements and maintenance spending on an indicator for negative equity and control variables. Standard errors, in parentheses, are calculated with observations clustered by household.

	Dependent Variable				
	[mean]				
	<i>Total Principal Paid</i>	<i>Unscheduled Principal Paid</i>	<i>Improvements & Maintenance</i>	<i>Improvements</i>	<i>Maintenance</i>
	[1508]	[219]	[705]	[614]	[91]
<i>NegEquity</i>	-367 (97)	-144 (54)	-215 (82)	-187 (81)	-27 (10)
<i>Total expenditures</i>	0.019 (0.003)	0.006 (0.002)	0.046 (0.006)	0.038 (0.006)	0.008 (0.001)
<i>Property Value</i>			0.001 (0.0002)	0.001 (0.0002)	0.00004 (0.00002)
<i>Mortgage debt</i>	0.003 (0.0003)	0.0004 (0.0002)			
R ²	0.07	0.01	0.03	0.02	0.03
N	44,264	44,264	44,264	44,264	44,264
State & year fixed effects?	Y	Y	Y	Y	Y
Mortgagor fixed effect?	Y	Y	N	N	N
Housing characteristics?	Y	Y	Y	Y	Y
Household characteristics?	Y	Y	Y	Y	Y

Table 3: Negative Equity Effects for Financially Unconstrained

This table presents regression coefficients estimated on subsets of the main sample, chosen to isolate households that are not financially constrained. Standard errors, in parentheses, are calculated with observations clustered by household.

	Dependent Variable [mean]					
	<i>Total Principal Paid</i> [1684]	<i>Total Principal Paid</i> [1857]	<i>Total Principal Paid</i> [2136]	<i>Improvements & Maintenance</i> [736]	<i>Improvements & Maintenance</i> [966]	<i>Improvements & Maintenance</i> [1134]
	Sample: Unsec. Debt = 0	Income > 65K	Unsec. Debt = 0 & Income > 65K	Unsec. Debt = 0	Income > 65K	Unsec. Debt = 0 & Income > 65K
<i>NegEquity</i>	-489 (197)	-422 (145)	-745 (306)	-407 (122)	-194 (135)	-504 (237)
<i>Total expenditures</i>	0.025 (0.006)	0.018 (0.004)	0.025 (0.008)	0.049 (0.010)	0.044 (0.008)	0.045 (0.012)
<i>Property Value</i>				0.001 (0.0004)	0.001 (0.0003)	0.001 (0.0005)
<i>Mortgage debt</i>	0.004 (0.0006)	0.003 (0.0004)	0.003 (0.0007)			
R ²	0.10	0.06	0.08	0.03	0.03	0.03
N	19,041	24,177	9,190	19,041	24,177	9,190
State & year fixed effects?	Y	Y	Y	Y	Y	Y
Mortgagor fixed effect?	Y	Y	Y	N	N	N
Housing characteristics?	Y	Y	Y	Y	Y	Y
Household characteristics?	Y	Y	Y	Y	Y	Y

Table 4: Falsification, Negative Equity and Other Durables

Below are estimation results from two falsification exercises, in which spending on vehicles and spending on other property-related durables are regressed on the negative equity indicator and control variables. Standard errors, in parentheses, are calculated with observations clustered by household.

	Dependent Variable	
	[mean]	
	<i>Vehicles</i>	<i>Furniture and Home Equipment</i>
	[981]	[502]
<i>NegEquity</i>	-55 (56)	-47 (77)
<i>Total expenditures</i>	0.10 (0.01)	0.05 (0.01)
<i>Property Value</i>		-0.0001 (0.0001)
R ²	0.16	0.12
N	48,366	44,264
State & year fixed effects?	Y	Y
Housing characteristics?	N	Y
Household characteristics?	Y	Y

Table 5: Negative Equity and Mortgage Recourse

Below are regression results for a model that includes an interaction between *NegEquity* and *Recourse*, an indicator for whether the state allows mortgage lenders to claim other assets from defaulted homeowners. Standard errors, in parentheses, are calculated with observations clustered by household.

	Dependent Variable		
	<i>Total Principal Paid</i>	<i>Unscheduled Principal Paid</i>	<i>Improvements and Maintenance</i>
<i>NegEquity</i>	-781 (156)	-230 (57)	-270 (180)
<i>NegEquity*Recourse</i>	531 (172)	110 (77)	72 (196)
R ²	0.07	0.01	0.03
N	44,264	44,264	44,264
State & year fixed effects?	Y	Y	Y
Mortgagor fixed effect?	Y	Y	N
Housing characteristics?	Y	Y	Y
Household characteristics?	Y	Y	Y
Control for total expenditures?	Y	Y	Y
Control for mortgage balance?	Y	Y	N
Control for property value?	N	N	Y

Table 6: Robustness

Panel A shows regression results for variations on the dependent variables: linear probability models for any spending in columns 1 to 3 and a log-linear model in columns 4 to 6. Panel B shows results for a model that includes MSA-year fixed effects (columns 1 to 3) and a model that includes a control for income (column 4 to 6). Standard errors in each model are shown in parentheses and are calculated with observations clustered by household.

Panel A						
	-----Indicator for any spending-----			-----Logs-----		
	<i>Total</i>	<i>Unscheduled</i>	<i>Improvements &</i>	<i>Total</i>	<i>Unscheduled</i>	<i>Improvements &</i>
	<i>Principal Paid</i>	<i>Principal Paid</i>	<i>Maintenance</i>	<i>Principal Paid</i>	<i>Principal Paid</i>	<i>Maintenance</i>
	[0.97]	[0.14]	[0.24]	[6.70]	[5.56]	[6.48]
<i>NegEquity</i>	-0.011 (0.008)	-0.050 (0.010)	-0.028 (0.011)	-0.10 (0.03)	-0.12 (0.16)	-0.22 (0.09)
R ²	0.86	0.07	0.03	0.26	0.12	0.10
N	44,264	44,264	44,264	29,164	4,357	10,514
Panel B						
	-----With income control-----			-----With MSA-Year Fixed Effects-----		
	<i>Total</i>	<i>Unscheduled</i>	<i>Improvements &</i>	<i>Total</i>	<i>Unscheduled</i>	<i>Improvements &</i>
	<i>Principal Paid</i>	<i>Principal Paid</i>	<i>Maintenance</i>	<i>Principal Paid</i>	<i>Principal Paid</i>	<i>Maintenance</i>
	[1509]	[219]	[705]	[1712]	[204]	[818]
<i>NegEquity</i>	-309 (96)	-127 (53)	-212 (82)	-440 (159)	-156 (85)	-303 (106)
R ²	0.08	0.01	0.03	0.09	0.01	0.04
N	44,264	44,264	44,264	19,404	19,404	19,404
State & year fixed effects?	Y	Y	Y	Y	Y	Y
Mortgagor fixed effect?	Y	Y	N	Y	Y	N
Housing characteristics?	Y	Y	Y	Y	Y	Y
Household characteristics?	Y	Y	Y	Y	Y	Y
Control for total expend.?	Y	Y	Y	Y	Y	Y
Control for mortgage bal.?	Y	Y	N	Y	Y	N
Control for property value?	N	N	Y	N	N	Y