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## The Effect of Housing Wealth Losses on Spending in the Great Recession

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### Abstract

We use panel data on a complete inventory of household spending and assets to estimate the spending response to the sharp and largely unexpected declines in house values that occurred in the Great Recession. Our study complements the existing literature on this topic by relying exclusively on longitudinal micro data on both household wealth and expenditure. Our data span the period 2002–2012, allowing us to separate trends in spending from innovations in response to unexpected wealth changes. We find the marginal propensity to consume out of an unexpected housing wealth change to be six cents per dollar among older American households.

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The quantitative relationship between an unexpected wealth loss or gain (a wealth shock) and consumption can sharpen our understanding of intertemporal decisions. In the absence of constraints, it reveals the choice between present and future consumption and shows how consumption is traded off against other uses of wealth such as leisure. In the presence of constraints, it shows the realized ability to smooth consumption. Further, from a macro perspective, the average response of households to wealth shocks has the potential to exacerbate booms or busts in the economy. Windfall gains in the housing or stock market may lead to spending increases, possibly contributing to bubbles in those markets. Unanticipated wealth losses may cause spending reductions, adding to the deflationary forces that were responsible for the losses. Consequently, policy makers have considerable interest in the consumption response to a wealth shock.

In this paper, we use household-level data on wealth changes and spending from before, during, and after the Great Recession to estimate the response of household spending to wealth shocks. Because of data availability, we rely on a sample of American adults over the age of 50 and focus on housing wealth changes brought about by the recession. Middle-aged and older individuals are more likely to be home owners and hold a large fraction of their wealth in the form of housing. They have a shorter life-cycle horizon than their younger counterparts, are more likely to be concerned with inheritance considerations and to

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downsize. Thus, they may respond more markedly to changes in home values. Coupled with the fact that housing wealth changes induced by the crisis were large and plausibly unanticipated, the demographic characteristics of our sample enhance our ability to detect consumption responses to wealth shocks.

Because of the importance to economic policy, there is an extensive literature investigating the consumption effects of wealth changes. Among studies based on aggregate time series data, Slacalek (2009) finds that, across 16 countries, the marginal propensity to consume (MPC) out of wealth is about 0.05; that is, a gain of one dollar in wealth, whether housing or financial, will increase consumption by about five cents. This response is typical; as summarized by Paiella (2009), “All these studies find that a dollar increase in aggregate wealth leads to an increase in aggregate consumption of 3–5 cents ...” (p. 955). Several caveats apply, though. Recent work shows substantial differences between the response to a housing wealth shock and to a financial wealth shock, and, at least by some estimations, the sensitivity of consumption to unexpected changes in housing wealth is greater (Case et al., 2013). A second issue concerns the timing of the response. Carroll et al. (2011) estimate that the short-run (one-quarter) response of consumption to a housing wealth shock is just 0.02, whereas the long-run response is 0.09. A third issue is the interpretation of the correlation as causal. Campbell and Cocco (2007), using data from the UK, find that unexpected variations in house prices cause household consumption to change, especially among older households. According to Attanasio et al. (2009), however, such estimated relationships are driven by common factors that affect both household consumption and housing wealth.

Empirical analyses based on micro data have been hampered by the lack of suitable data sets containing detailed information on household assets and liabilities as well as on the different categories of consumption expenditure. Excepting the data set we will use in this study, we know of no data that satisfy these requirements. For instance, Aladangady (2017) examines the relationship between housing wealth and consumption over the period 1986:2008, using the Consumer Expenditure Survey (CES). However, in the absence of self-reported home values in the CES before 2007, the author constructs a measure of changes in housing wealth by applying the growth rate of the county-level house price index to the median home value in the county where an individual resides. Changes in consumption patterns are plausibly induced by changes in home values as perceived by an individual and these may be different from those observed in the county of residence. A number of studies have been based on imputed household expenditures in the Panel Study of Income Dynamics (Juster et al., 2006; Morris, 2006), using observations on household wealth stocks and flows. However, their implementation requires deriving active savings from capital gains calculations that take the difference of observed asset values across adjacent waves and net out asset purchases and sales. This method is likely to amplify the impact of the measurement error in each of those components.

Further, existing studies examine the relationship between house price dynamics and household consumption over a longer history and consider a time span that largely excludes the Great Recession. In contrast, we focus on the period covering the Great Recession to assess the response of household expenditure to large and abrupt housing wealth shocks. A similar research question to ours is posed by Banks et al. (2013), who use panel data on

dining out and clothing in the population over age 50 as measured in the English Longitudinal Study of Ageing. Spending on these items was declining in panel prior to the recession, and over the course of the recession there was a negative (though small) deviation from that trend. Bottazzi et al. (2013) exploit data from the Survey on Household Income and Wealth (SHIW) from before, during, and after the recession in Italy and analyze the response of consumption to financial wealth shocks.

Christelis et al. (2015) use data from an Internet supplement to the Health and Retirement Study that was administered in May-August 2009. That survey asked respondents to recollect by how much their total spending had changed in the past year, by what percent the value of various financial assets had changed since September 2008, and by how much their house value had changed since 2006. It would appear that these tasks are especially challenging for a respondent, as they involve the recollection of changes in value from specific prior dates. Consequently, the elicited measures are likely subject to considerable reporting error. The authors estimate that the marginal propensities to consume associated with a financial and housing wealth shock were about 0.03 and 0.01, respectively.

Mian and Sufi (2011) find that the rise in U.S. house prices from 2002 to 2006 was accompanied by a strong, \$1.25 trillion increase in borrowing against higher home values. They suggest that the debt was mainly used to increase consumption. Under this scenario, with the decline in house prices observed during the Great Recession, this source of consumption financing would disappear, potentially leading to a decline in household spending. In a follow-on paper, Mian et al. (2013) use zip-code level data on auto sales and county-level data on credit/debit card purchases and estimate an MPC of 0.06–0.08 out of housing wealth. Their findings are re-affirmed by Kaplan et al. (2016) in non-proprietary data.

This paper represents the first U.S. study employing exclusively household-level longitudinal data spanning the period before, during, and after the Great Recession to estimate the response of household spending to negative wealth shocks induced by the sharp declines in house prices. The richness and quality of our data allows for an accurate quantitative assessment of the household propensity to consume out of unexpected changes in housing wealth. We use panel data from the Consumption and Activities Mail Survey (CAMS), a sub-study of the Health and Retirement Study. CAMS has a complete inventory of household spending as obtained on 39 categories of spending, thereby permitting us to avoid biases that may result from using partial measures of spending. Furthermore, it uses a variable recall period when eliciting spending to reduce recall error. Exploiting data on income and assets of the same households, we can assess the household-level decline in housing wealth brought about by the Great Recession and quantify the response of household spending to such shock. Because our data begin well before the recession and extend after it, we can disentangle normal changes in household spending, occurring in non-recession times, and departures from the norm due to unexpected wealth variations in recession times. Moreover, relying on the longitudinal dimension of our data, we can control for life-cycle effects.

Our empirical strategy develops along two complementary dimensions. First, we document differences in household spending across geographic areas with different degrees of housing market turmoil. Specifically, we show that, compared to the period before and after, during the Great Recession household spending decreased by 10 percentage points more in states with sharper house price drops than in states with modest house price declines. While such observed differences may be driven by other factors correlating with local house prices, in supplementary estimates we investigate such factors, and show that changes in them between recessionary and non-recessionary periods do not diverge across states with different degrees of house price turmoil. Moreover, we find no differential changes across states in the spending behavior of nonhomeowners, who, while affected by all other aspects of the local economy, do not experience a change in wealth brought about by unexpected changes in house prices.

In a second stage, we instrument changes in household-level housing wealth with changes in house prices at the state level to estimate the elasticity of consumption to housing wealth shocks. While this Instrumental Variables (IV) strategy purges idiosyncratic household factors that might jointly affect household expenditure and housing wealth, it does not remove potential confounding effects due to local economic circumstances that can induce co-movements in household consumption and housing wealth. Potential biases stemming from other such mechanisms are addressed by including controls for changes in household-level income, labor market outcomes, financial wealth, and expectations about bequests and future economic outlook. Thus, the identifying assumption is that, conditional on these variables and other household-level demographics, the variation across states in house price changes during the decade 2002–2012 affected household spending only through changes in perceived housing wealth. It should be noted that our empirical specification, which follows from a standard consumption Euler equation, relates changes in household spending to changes in housing wealth, thereby permitting unobservable time-invariant household characteristics that are related to the level of spending to be differenced out.

We estimate a sizeable and statistically significant marginal propensity to consume out of housing wealth shocks of about 6 cents per dollar. This is slightly larger than previously estimated MPCs based on microeconomic data and samples representative of the entire population. For instance, Aladangady (2017) finds that a \$1 increase in house values induces a \$0.047 increase in spending among homeowners. We interpret the difference between our and existing causal estimates of the expenditure response to housing wealth shocks as stemming from the age composition of our sample. As mentioned above, we expect middle-age and older individuals to exhibit a higher sensitivity to changes in home values, as they may be more likely to have accumulated, and, therefore, to extract equity from their house, may be closer to downsizing, and may have stronger bequest or inter-vivos transfers saving motives. Notably, we document that the reduction in spending following a loss in housing wealth is significantly larger for those households that were more leveraged in the prerecession period. These households may have relied more heavily on equity extraction during the boom and suffered more severe consequences when this source of credit dried up after the bust. This is in agreement with the findings of Adelino et al. (2016), who shows that mortgage credit increased across all income levels and FICO scores before the recession

and larger incidences of delinquency during the Great Recession were observed in areas in which the crisis was preceded by more marked house price increases.

## 1 Data

The data for our empirical analyses come from the Health and Retirement Study (HRS), a longitudinal survey that is representative of the U.S. population over the age of 50 and their spouses. The HRS conducts core interviews of about 20,000 persons every two years. In addition, it collects spending data on a sub-sample of households in the Consumption and Activities Mail Survey (CAMS). High-quality data on household spending are few and far between. A contribution of our paper comes from our use of much richer and more reliable longitudinal spending data than prior studies in this literature, combined with detailed information on wealth and its components for the same households.

### Health and Retirement Study Core Interviews

Since 1992, the HRS has been interviewing individuals over the age of 50 and their spouses, irrespective of age, every two years. The survey provides detailed information on the health, labor force participation, economic circumstances, and social well-being of its respondents, including a complete inventory of their assets and income sources. In this study, we rely on demographic and financial information from the HRS core waves spanning the years 2002 through 2010.

### Consumption and Activities Mail Survey

CAMS is a mail survey of a random sub-sample of about 5,000 HRS households. The primary objective of the CAMS is to elicit a valid and reliable measure of total annual household spending that can be merged with the data collected on the same households in the HRS core interviews.<sup>1</sup> As discussed in Hurd and Rohwedder (2009), the features of the CAMS survey instrument were chosen to maximize data quality while keeping respondent burden manageable (details are provided in the Appendix). The first wave of CAMS was collected in 2001 and, using a longitudinal design, it has been collected every two years since.

Spending in CAMS is measured in 39 categories covering both durables and nondurables. These categories were chosen to match aggregate categories in the Consumer Expenditure Survey (CES) so as to facilitate comparison and they are meant to be inclusive of total spending. The resulting data have proven of high quality. For the population 55 or older, CAMS total spending lies within 5% of spending measured in the CES in each of the CAMS waves, except for the first two waves, in which the CAMS estimates ran slightly higher than those in the CES. Furthermore, “active saving,” the difference between HRS after-tax income and CAMS total spending, matches quite well actual wealth change as observed in HRS panel, providing additional evidence of the validity of the CAMS spending measure (Hurd and Rohwedder, 2015).

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<sup>1</sup>Copies of the questionnaires are accessible on the HRS website (<http://hrsonline.isr.umich.edu/>).

## Sample Selection

In this study, we use five waves of CAMS (2003, 2005, 2007, 2009, and 2011) merged with the RAND HRS version M data file. The number of households in the sample is 6,134. Of these, 83% are observed for at least three periods, 7% are observed for two periods, and 10% for one period only. The total number of observations at our disposal is 18,830. We drop respondents below the age of 40 and above the age of 90. This leaves us with 5,993 households and 18,189 observations. We use the CAMS respondent (and his/her characteristics) if he/she is between 51 and 90 years of age, and the CAMS respondent's spouse whenever the CAMS respondent is younger than 51.<sup>2</sup>

## Key Analysis Variables

Our measure of household spending is total outlay excluding payments for mortgage principal. In what follows, we will refer to household spending and consumption interchangeably, while recognizing the conceptual difference that household spending does not measure the flow of consumption from durables. Housing wealth is the gross self-reported value of the primary residence. Financial wealth is the sum of stocks, bonds, certificates of deposit, and checking/saving accounts. All other variables used in the analysis are standard demographics and personal characteristics, such as age, education, marital status, health and work status. Monetary measures are expressed in 2011 dollars using the Consumer Price Index of the Bureau of Labor Statistics.

## 2 Changes in Household Wealth and Spending

The labor, housing, and stock markets were all affected by the Great Recession. Figure 1 shows the evolution of the unemployment rate, house prices and stock prices in the U.S. over the decade 2002–2012, relative to their value in January 2002. We use the state- and national-level unemployment rate published by the Bureau of Labor Statistics, the state- and national-level All-Transactions House Price Indices published by the Federal Housing Finance Agency (FHFA) at quarterly frequency and the monthly Standard & Poor's 500.<sup>3</sup>

Nationwide, the unemployment rate was below 6% in the first quarter of 2002, decreased to 4.5% by the second quarter of 2007, and increased to 9.9% in the third quarter of 2009. House prices steadily increased between 2002 and 2007 up to a 40% gain, and decreased by 20% thereafter. The evolution of the Standard & Poor's 500 index mimics a roller-coaster ride. Share prices appreciated by 30% between 2004 and 2007, lost 45% of their value by the first quarter of 2009, and came near their pre-crisis level in 2011. Figure 1 also shows the timing of all HRS and CAMS waves fielded during this period. The economic situation at the time of interview varied greatly over the waves, particularly in the waves surrounding the recession. House prices were near their peak during both the HRS 2006 and CAMS 2007 interview periods and then declined substantially by the next waves of HRS 2008 and CAMS 2009. Stock prices were still increasing during HRS 2006; the third wave of CAMS (CAMS 2007) occurred right at the time the stock market reached its highest point. Stocks

<sup>2</sup>In a couple, the CAMS respondent is assigned at random.

<sup>3</sup>State- and national-level All-Transactions House Price Indices can be downloaded from <http://www.fhfa.gov/DataTools/Downloads>.

were falling sharply during HRS 2008, although most interviews during which household wealth was elicited were conducted before the crash of September 2008. By the time CAMS 2009 went into the field stocks were on the rise again.

National indicators, such as those in Figure 1, mask the considerable amount of regional variation in the housing market over the course of the recession. This is very well documented by Figure 2. On the left, the figure shows the variation in house prices for four states. In California, house prices doubled between the first quarter of calendar year 2002 (2002q1) and 2007q1 and almost halved between 2007q1 and 2011q4. In New York and Ohio, house prices increased by roughly 50% and 10%, respectively, before the onset of the Great Recession and hardly decreased thereafter. In Michigan, house prices were on a downward trend before the crisis and continued to fall during the recessionary and post-recessionary periods. On the right, Figure 2 shows the variation in self-reported house values (our measure of housing wealth) from the HRS. The figure demonstrates that changes in self-reported house values track actual house price changes quite closely. Our empirical strategy for estimating the effect of shocks to housing wealth on household spending relies on such differences in house prices induced by the Great Recession across states.

In what follows, we divide the decade 2002–2012 into non-recessionary and recessionary periods using the dating of business cycles by the National Bureau of Economic Research: 2007q4 marks the beginning and 2009q3 marks the end of the recession. Our main outcome of interest is household spending. We consider as “non-recessionary” spending changes to be changes observed between 2003–2005, 2005–2007, and 2009–2011, and as “recessionary” changes those observed between 2007 and 2009.<sup>4</sup> Relying only on households observed in the two adjacent waves, we compute that spending declined by about 4.3% in non-recessionary times and by 7.8% in recessionary times. That is, the average household experienced a 3.5-percentage-point excess decrease in spending during the recession (statistically significant at 1%).<sup>5</sup>

In Table 1, we compare spending of home owners in states that experienced different degrees of housing market turmoil during the Great Recession. For each two-year period ( $t=2003/t+1=2005$ ;  $t=2005/t+1=2007$ ; etc.), we classify a household as home owner if it owns a house at time  $t$ . To measure the degree of housing market turmoil, we calculate, state by state, the percentage decline in house prices as measured by the FHFA index during the Great Recession (from 2007q4 to 2009q3) and assign each household to one of three groups corresponding to the terciles of the distribution of state-level price declines. Households residing in states that experienced large house price drops during the Great Recession (3rd tercile) report larger (negative) changes in their level of spending. For example, households in the 3rd tercile reduced spending by 12% during the recession period compared to an average reduction of about 4% between waves in non-recession times. More generally, home owners in states with greater housing market decline (2nd and 3rd tercile) exhibit substantial

<sup>4</sup>Changes in spending observed in the post-recession period (2009–2011) are in line with those observed in the pre-recession period (2003–2007) and significantly different from those observed during the recession period (2007–2009). The conclusions of our analysis do not change if we separate the pre-recession periods (2003–2005 and 2005–2007) from the post-recession period (2009–2011).

<sup>5</sup>The decline in spending during the non-recessionary period can be attributed to an observed slight reduction in household size in panel, and possibly to life-cycle effects.

and mostly statistically significant excess decreases in spending compared to their counterparts residing in states with small drops in house prices (1st tercile). The observed excess decreases, which are also graphed in the left panel of Figure 3, range from 5 to 8 percentage points.

The right panel of Figure 3 shows the excess change in spending during the recession for non-home owners by tercile of housing price decline. Non-home owners residing in states with small (1st tercile) and moderate (2nd tercile) house price declines show increases in spending ranging from 3 to 4 percentage points, while those living in states where house prices decreased the most (3rd tercile) exhibit a modest decrease of 4 percentage points. These changes are not statistically significant and they are not statistically different across terciles. Hence, while cross-state differences in house price declines, and therefore in housing wealth, are reflected in cross-state spending differences for home owners, there is no evidence that this is the case for non-home owners as well.

### 3 Changes in Spending among Home Owners by Degree of Housing Market Decline

The documented differences in household spending across areas with different degrees of housing market turmoil may be confounded with differential changes in income, wealth, and more generally in socioeconomic status, experienced by households residing in different states. To account for these sources of possible bias, we adopt the above classification of states in terciles of house price decline during the Great Recession and estimate the following regression model for both home owners and non-home owners. This allows us to check to what extent other factors correlating with local house prices may be driving changes in spending of home owners.

$$\begin{aligned} \Delta \ln(C_{ist+1}) = & x'_{ist} \alpha + \beta \mathbb{1}(Recession = 1) + \sum_{s=1}^3 \gamma_s \mathbb{1}(Tercile = s) + \\ & + \sum_{s=1}^3 \delta_s [\mathbb{1}(Recession = 1) \times \mathbb{1}(Tercile = s)] + \\ & + \lambda_t + \sum_{s=1}^3 \mu_s [\mathbb{1}(Tercile = s) \times t] + v_{ist+1}. \end{aligned} \quad (1)$$

The dependent variable in equation (1) is the percent change in spending between times  $t$  and  $t + 1$  of household  $i$ , residing in tercile  $s = 1, 2, 3$ ;  $\mathbb{1}(Recession = 1)$  is an indicator for recession times;  $\mathbb{1}(Tercile = s)$  is an indicator for tercile  $s = 1, 2, 3$ ;  $\lambda_t$  are time fixed effects, and  $[\mathbb{1}(Tercile = s) \times t]$  are tercile-specific trends.<sup>6</sup> The vector of household characteristics at time  $t$ ,  $x_{it}$ , includes a quadratic in age, categorical variables for different levels of education, marital status, household size, health status, indicators for household income and wealth quartiles, and indicators for labor force status. To reduce the influence of outliers when

<sup>6</sup>Throughout the analysis we use total outlay as a measure of household spending excluding mortgage payments. Our results are unchanged if we exclude other house-related expenditures such as mortgage interest payments and maintenance.



estimating equation (1), we trim in each wave households for which percent changes in spending are in the top or bottom 1% of the sample. We focus on the coefficients  $\delta_2$  and  $\delta_3$ , which show the excess change in spending induced by the recession for home owners in the 2nd and 3rd tercile compared to those in the 1st tercile, respectively.

The results in Table 2 column (i) confirm the empirical evidence revealed by the unconditional comparisons presented above. Specifically, home owners in the states with the largest house price declines (3rd tercile) reduced their spending by 10 percentage points more during the recession than those in the states with the smallest house price declines (1st tercile). The excess decrease in spending with respect to home owners in states with moderate house price declines (2nd tercile) amounts to 5 percentage points (significant at the 10% level).<sup>7</sup> In Table 2, we present standard errors clustered at the state level. Since we ultimately exploit heterogeneity in house market turmoil across terciles, standard errors should be clustered at the tercile level. As demonstrated by Bertrand et al. (2004), however, a Wald test based on a small number of clusters tends to severely over-reject the null. We therefore perform the wild cluster bootstrap procedure suggested by Cameron et al. (2008), which delivers a valid Wald test in the presence of few clusters. This confirms the statistical significance of the coefficients of interest. Specifically, we obtain p-values of 0.02 for the null that  $\delta_2$  and  $\delta_3$  are zero. Since we deal with only three clusters, this procedure may still lead to over-rejection of the null. Thus, we prefer to report statistical significance based on state-level clustered standard errors.

The observed differential behavior of household spending across areas characterized by different degrees of housing market turmoil may be driven by other factors correlating with local house prices. These may range from differential shocks to the labor market and variations in earnings, to changes in individual expectations about future job opportunities, asset returns and overall economic outlook. While such factors should affect home owners and non-home owners alike, house price changes do not affect the wealth of non-home owners. In order to assess the extent to which concurrent changes in the local economy drive the observed excess decline in household spending in states with more dramatic house price declines, we estimate equation (1) for non-home owners. As can be seen from column (ii) in Table 2, there is no evidence that non-home owners differentially changed their spending across areas with different degrees of housing market turmoil.

Home owners and non-home owners differ in their characteristics and, therefore, are likely to have different expenditure paths. Our regressions compare *changes* in household spending over time across terciles, separately for home owners and non-home owners. Thus, we allow for different spending levels and changes for these two groups and examine whether, during the Great Recession, their respective spending paths deviated from their usual spending path in similar ways. We find significant deviations from the usual spending path for home owners, but not for non-home owners, which is consistent with the interpretation that different changes in housing wealth across areas brought about by the crisis induced the observed differences in spending.

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<sup>7</sup>These results are robust to the inclusion of state fixed effects. Regression results including state fixed-effects are provided in Table B.2 in the Appendix.

### 3.1 Examining Robustness of Results

**Changes in home ownership**—Home ownership may have changed during the recession. Thus, the composition of ownership groups may differ before and after the recession if only specific types of households changed home ownership status in response to shocks brought about by the crisis.<sup>8</sup> This, in turn, could potentially bias our results. We investigate this issue in column (iii) of Table 2, where we re-estimate equation (1) excluding from the sample households that changed home ownership between 2006 and 2010. The regression results do not change and confirm the patterns described above.

**House price changes and unemployment**—We further check whether states that experienced different house price declines during the Great Recession also exhibit marked differences in other relevant economic outcomes. As shown in Figure B.1 in the Appendix, the relationship between changes in house prices and the unemployment rate varied greatly across states. For example, Michigan had a sharp increase in unemployment and a modest decline in house prices, whereas California experienced substantial changes in both. In Figure 4, we focus on labor force outcomes and report differences between recessionary and non-recessionary periods for the three groups of states identified by the terciles of house price decline. The fraction of individuals unemployed or out of the labor force increased relatively more in those states where house prices fell more markedly; but the magnitude of these changes is modest and comparisons across terciles are not statistically significant. Moreover, as revealed by Figure 5, average earnings appear to have increased relatively more (although differences across terciles are not statistically significant) during the recession in states with more pronounced house price drops, diluting any differential effects from unemployment. Indeed, column (iv) in Table 2 shows that our regression results are unaffected by excluding households that experienced unemployment spells between 2006 and 2010.<sup>9</sup>

**Expectations**—Even if a household's actual economic situation does not change much during a recession, expectations about the future may and, accordingly, spending patterns may be revised. Along these lines, the observed excess decline in spending in states with larger house price swings could have been driven, other things held constant, by more pessimistic expectations about the future economic outlook. Figure 6 does not support this hypothesis as there are no clear differences across terciles of house price declines in the changes of various measures of expectations, such as the subjective probability of losing a job or of leaving a bequest of at least \$100,000; the beliefs that the stock market will be higher in a year's time or that the economy will face a depression in 10 years.<sup>10</sup>

<sup>8</sup>Over the study period, about 8% of households in our sample changed home ownership. Households who switched before the recession (2002–2006) are, on average, older, in better health and more affluent than those who switched during or after the recession (2008–2010).

<sup>9</sup>It should be noted that less than 2% of the sample report being unemployed.

<sup>10</sup>The HRS does not elicit house price expectations. We use a common specification to estimate house price expectations of the type  $\dot{p}_t^e = \lambda \dot{p}_{t-1}^e + (1 - \lambda) \dot{p}_{t-1}$ , where  $\dot{p}_t^e$  and  $\dot{p}_t$  denote changes in expected and actual prices between time  $t - 1$  and  $t$ , respectively. With values of  $\lambda$  ranging from 0.2 to 0.5, we do obtain that the gap between expectations and realization was greatest in states with larger house price swings.

**Migration**—Another possible threat to our identification strategy is across-state mobility, as the composition of state terciles before and after the Great Recession may change due to households changing state of residence in response to the crisis. Relocation is relatively uncommon, with 9% of sampled households moving across states over the entire study period. Nonetheless, we re-estimate equation (1) excluding households that changed state of residence between 2006 and 2010. As can be seen in column (v) of Table 2, the results are unaffected both qualitatively and quantitatively.

## 4 The Elasticity of Household Spending in Response to Housing Wealth Shocks

In this section, we aim to quantify the response of household spending to the magnitude of the wealth shocks brought about by the Great Recession. For this purpose, we consider the following equation:

$$\Delta \ln(C_{it+1}) = \Delta Z'_{it+1} \lambda + \epsilon \Delta \ln(HW_{it+1}) + u_{it+1}. \quad (2)$$

The dependent variable,  $\ln(C_{it+1})$ , is the change in log spending between time  $t$  and  $t+1$  of household  $i$ ,  $\ln(HW_{it+1})$  represents changes in housing wealth, and  $Z_{it+1}$  captures changes in household characteristics.

The parameter  $\epsilon$  measures the elasticity of household spending with respect to housing wealth. If  $\epsilon = 0$ , equation (2) becomes a standard log-linearized Euler equation (Attanasio and Weber, 1995), where, as long as anticipated, changes in wealth across two periods do not predict consumption growth.<sup>11</sup> This implication of the standard life-cycle consumption model may be difficult to test since, from an empirical standpoint, it is hard to measure what for individuals constitutes expected changes in wealth and what does not. One way around this problem is to identify macroeconomic episodes during which large and mostly unexpected wealth changes took place. We follow this approach and distinguish between changes in housing wealth that occurred during the Great Recession, which we argue were sizeable and largely unanticipated, and those observed before and after the economic turmoil, which were plausibly more in line with individuals' expectations. More precisely, we consider:

$$\Delta \ln(C_{it+1}) = \Delta Z'_{it+1} \lambda + \theta \mathbb{1}(Recession = 1) + \epsilon_0 \Delta \ln(HW_{it+1}) + \epsilon_1 \mathbb{1}(Recession = 1) \Delta \ln(HW_{it+1}) + u_{it+1}, \quad (3)$$

where, as before,  $\mathbb{1}(Recession = 1)$  is an indicator for recession times, identified by the interval between CAMS 2007 and CAMS 2009. Since household consumption information reported in each CAMS wave is linked to demographic and wealth measures collected in the preceding HRS wave, we assign to the recessionary interval the demographic and wealth changes observed between HRS 2006 and HRS 2008. The term  $u_{it+1}$  in equation (3) is

<sup>11</sup>The same equation has been used, among others, by Souleles (1999) to estimate the response of spending to income tax refunds, and by Disney et al. (2010) and Christelis et al. (2015) to infer the elasticity of spending to housing and financial wealth.

assumed to be an *i.i.d.* disturbance. Because we examine changes in spending over time, household fixed effects for levels of spending are differenced out.<sup>12</sup>

According to a standard life-cycle model, the elasticity of consumption with respect to an unanticipated and permanent shock to total remaining life-time wealth should be equal to 1, as long as there are no constraints preventing full adjustment. However, there are several reasons to expect the estimated elasticity to housing wealth shocks to be much smaller. First, remaining life-time wealth not only includes the value of real estate, but also the value of financial assets, the present discounted value of the stream of future labor income and Social Security benefits, as well as the value of defined-benefit and defined-contribution pension plans or IRAs. In our specification, we abstract from the latter components and focus on wealth as measured by the value of housing assets. Clearly, an unexpected drop in the value of housing assets should induce a reduction in consumption that is commensurate with the fraction of total wealth lost, which is smaller than the fraction of housing wealth lost. Second, since assets are not completely fungible due to their differing risk and return characteristics, households may prefer to own some assets over others for saving purposes, bequest motives, liquidity, tax or other reasons. Because of the unique qualities of housing as an asset, the effect of housing wealth changes on consumption depends on the extent to which home equity is perceived as fungible and can be accessed. Third, while home owners are exposed to fluctuations in house values, they are hedged against fluctuations in future rent payments (Sinai and Souleles, 2005). Hence, responses to house price changes may be weakened depending on the extent to which they internalize this trade-off and their expected tenure.

Estimating equation (3) by OLS is likely to return biased estimates of the relationship between changes in housing wealth and spending. Housing wealth changes observed over time not only reflect variations in asset prices, but are also the result of active saving and investment decisions. Such decisions, in turn, may have been made in response to specific household circumstances in both crisis and non-crisis periods. Moreover, macroeconomic factors affecting house prices may simultaneously affect a household's financial situation through changes in labor force status and income, as well as in expectations about future economic outlook, thereby leading to independent changes in spending. We estimate equation (3) by Instrumental Variables (IV), instrumenting changes in self-reported housing wealth with changes in house prices at the state level. While this IV estimation purges idiosyncratic household factors that might jointly affect household expenditure and housing wealth, it does not remove potential confounding effects due to local economic growth inducing co-movements in household consumption and house prices.<sup>13</sup> Our rich data set, however, allows us to control for potential channels through which these macroeconomic factors may affect spending. Specifically, in our baseline specification, the vector  $Z_{it+1}$  includes basic demographics such as age and education of the survey respondent, change in marital status, change in household size, and change in health status of the survey

<sup>12</sup>Since households move across states (even though only a minority do so), state fixed effects are not differenced out in equation (3). When we estimate equation (3) including state-fixed effects, the results (available upon request) are unchanged.

<sup>13</sup>An additional reason for using IV estimation is measurement error in the change in house value caused by observation error (survey noise) and by the temporal mismatch between the HRS measure of housing wealth and the CAMS measure of spending.

respondent across two consecutive waves. In a second and richer specification, we add controls for changes in total household income, work status and non-housing wealth. We further augment the set of controls with changes in the expectation of leaving a bequest of at least \$100,000, in the expectation of positive stock market returns one year ahead, and in the expectation of an economic depression in the following 5 years.

Thus, we exploit the differential variation across states in house prices during the decade 2002–2012 to identify the response of spending to housing wealth shocks. Our exclusion restriction is that, conditional on changes in household demographics, labor force status, income, non-housing wealth and expectations about bequests and future economic outlook, changes in house prices brought about by the Great Recession had an impact on spending decisions of home owners only through changes in house values.

In Table 3, we report the results of the IV estimation of equation (3) on a sample of home owners age 51–90. To reduce the influence of outliers, we trim, in each survey wave, households that report percentage changes in spending in the top or bottom 1% of the sample. The first-stage regression results (reported in Table C.2 in the Appendix) show a strong correlation between the instruments and changes in housing wealth. The null hypotheses that the model is under- and weakly identified are both rejected at any conventional level of significance. Reduced-form regressions (Table C.3 in the Appendix) document a significant association between changes in household spending and changes in house prices during the recession period, as well as the absence of such an association during non-recessionary times.

The estimates in Table 3 are qualitatively consistent with theoretical predictions. The elasticity of household spending to changes in housing wealth is indistinguishable from zero in non-recessionary periods, but positive and statistically significant in recessionary periods. The estimated elasticity is 0.38 in column (i), where we control for changes in basic household demographics, as well as in column (ii), where we also take into account changes in labor force status, income and non-housing wealth. The implied marginal propensity to consume (MPC) out of housing wealth is about 0.06.<sup>14</sup> The estimated elasticity and MPC are slightly larger in column (iii), where we add controls for expectation updates about bequest and future economic conditions. Because of skip patterns for expectation questions and a considerable number of missing values, the sample size is substantially reduced in column (iii). Most importantly, the sample with available expectation data is likely to be a selected one. For these reasons, we view the specification in column (iii) as a check of the robustness of our results and refer to the specification in column (ii) as our preferred model.<sup>15</sup>

As for the other regressors, whose estimated coefficients are in Table C.1 in the Appendix, we notice a significant effect of changes in marital status (change in spending of about 10

<sup>14</sup>We obtain the MPC in recessionary (non-recessionary) times by running regressions where the growth rate of housing wealth in recessionary (non-recessionary) times is multiplied by the ratio of average spending to average housing wealth in recessionary (non-recessionary) times. We prefer this scaling factor over the ratio of individual spending to housing wealth since the latter is an extremely noisy measure.

<sup>15</sup>As mentioned above, our measure of total outlay excludes payments for mortgage principal. We obtain very similar estimates when adopting total outlay net of house-related expenditures such as mortgage interest payments and home repair and maintenance.

percentage points). This is not surprising, given that the CAMS elicits consumption at the household level. Albeit differences across education groups are modest, we estimate that households with more education have smaller reductions in spending as they age (flatter consumption paths). This is consistent with a life-cycle model where lower mortality risk, which is associated with higher education, causes spending to be reduced more slowly with age. In line with the empirical evidence discussed in Section 3, changes in household income and work status are not associated with revisions of household spending decisions in our main sample nor do they affect the estimated response of household spending to changes in house prices.<sup>16</sup> A recent paper by Demyanyk et al. (2018) shows that, in the population at large, growth of income, growth of housing wealth, and fluctuations in unemployment are the most important determinants of changes in household consumption over the 2000s. In our study, the income and labor market channels are relatively unimportant for middle-age and older households over the same observation period. This fact increases our confidence that the estimates in Table 3 identify a true response of spending to housing wealth shocks. It also underlines our study's original contribution of focusing on middle-age and older households, who may be subject to different types of shocks than the rest of the population and/or respond differently to the same type of shocks experienced by the rest of the population. In the subsample of individuals with non-missing expectation information, the transition from working to not working is associated with a 7.6 percentage point reduction in spending, while we find no correlation between expectation updating and changes in spending and a slight increase in the estimated MPC (column (iii) of Table 3).

In Table 4, we perform further checks to assess the robustness of our results to alternative sample selection criteria meant to address potential threats to our identification strategy. Specifically, in column (i) we exclude households that changed home ownership around the time of the Great Recession (2006–2010). In column (ii) and (iii) we exclude households that experienced unemployment spells and moved across states over the same period, respectively. For each of these estimations, we adopt our preferred specification, controlling for changes in household demographics as well as work status, income and non-housing wealth. As shown in Table 4, the estimated elasticities and MPCs are very similar to those in column (ii) of Table 3.

Changes in interest rates are bound to affect adjustable-rate mortgage payments and, in turn, to impact household spending decisions over time (Bhutta and Keys, 2016). When we control for changes in the interest rate over the observation period, we estimate the MPC out of housing wealth shocks to be \$0.062 per \$1 (and significant at 1%).<sup>17</sup> Most importantly, we note that if this mechanism was at play, then the interest rate reductions during the Great Recession would have made more resources available for consumption, thereby attenuating the drop in household expenditure at the time of the crisis documented throughout our analysis.

<sup>16</sup>In our sample, the average change in household income across two consecutive waves is roughly  $-0.5\%$  in both non-recessionary and recessionary periods. Roughly 8% of the sample transition from working to not working over the 2002–2012 decade. Among them, 80% retire and 13% become unemployed or move out of the labor force across two consecutive waves. About 5% become disabled and 2% report working part-time.

<sup>17</sup>Results are available upon request.

#### 4.1 Comparison with prior findings

Our estimated MPC out of housing wealth is within the range found in previous studies. Using aggregate time series for U.S. states, Case et al. (2005, 2013) estimate an MPC between 3 and 4 cents on the dollar. Carroll et al. (2011) estimate an “eventual” (medium-run) MPC out of housing wealth of 0.09. As far as evidence based on microeconomic data is concerned, studies of wealth effects have been limited by the lack of reliable household-level data on both consumption and wealth. Engelhardt (1996) uses a sample of home owners under age 65 drawn from the 1984–1989 Panel Study of Income Dynamics. He defines savings as the difference between self-reported non-housing asset values between 1984 and 1989 and relates such measure to real housing capital gains over the same period. He estimates an MPC out of housing wealth of 0.14 for the average household and of 0.03 for the median household. He documents that the response of consumption to changes in home values is entirely driven by changes in the behavior of households experiencing capital losses, while those experiencing capital gains do not revise their spending plans. Such evidence is in agreement with our findings: we estimate sizeable and statistically significant housing wealth effects during the Great Recession, when home values decreased sharply in most areas, but no response of consumption to housing wealth during non-recessionary periods, when home values were either increasing prior to the crisis or recovering after the crisis. Campbell and Cocco (2007) use cross-sectional micro-data from the UK Family Expenditure Survey (FES) over the period 1988–2000. Exploiting regional home price variation and an IV estimation strategy similar to ours, they find that home owners above the age of 40 exhibit an elasticity of consumption to housing wealth as large as 1.2, implying an MPC of 0.11; renters 40 or younger do not respond to changes in local house prices. In contrast, Attanasio et al. (2009) use FES data from 1978 to 2002 and document a stronger relationship between house prices and consumption growth for younger households compared to older households.

More recently, Aladangady (2017) exploits geographically linked data from the CES over the period 1986–2008 and estimates that a \$1 increase in home values leads to an increase in spending for home owners of \$0.047. This value is lower than our estimated MPC, although well within the corresponding 95% confidence interval. We attribute the discrepancy in the point estimate to two important differences between the two studies. First, our sample is representative only of households over the age of 50, which may potentially emphasize the endowment effect of changing home values. As pointed out by Sinai and Souleles (2005), homeowners face asset price risk to the extent that they plan to move and/or bequeath their house. Since such risk comes in the future, it is larger in present value for middle-age and older households for whom the probabilities of downsizing and leaving a bequest are both larger than for younger households. Hence, it is plausible to expect middle-age and older households to exhibit a more pronounced response to changes in house values than their younger counterparts. We view the empirical confirmation of this life-cycle model prediction as a valuable lesson that can be learned by comparing our findings, based on a sample of middle-age and older households, to those of existing studies on the same topic using samples representative of the population at large. Second, we explicitly focus on the response of spending to the housing wealth shock brought about by the Great Recession. If, as documented in previous work, wealth losses are more likely to induce changes in

behavior than gains, our estimates may reflect a more pronounced sensitivity of household spending to falling house values. Overall, while acknowledging that our estimates cannot be generalized to the population at large, we note that our work studies an interesting and sizeable group, which may exhibit specific responses to housing wealth shocks. Assessing the magnitude of these responses is critical in view of the growing size of the population age 50 and older. At the same time, our study complements the existing literature on this topic by relying exclusively on longitudinal household-level data on both expenditure and house values.

## 5 Heterogeneity in the Response of Spending to Housing Wealth Shocks

One possible mechanism driving our results is that the house can be used as collateral in a loan. When prices are steadily increasing, a relatively high level of consumption can be sustained by the continued extraction of the increasing equity. Indeed, Mian and Sufi (2011) show that American home owners significantly increased their borrowing in response to changes in their home equity over the decade 1997–2008 and used it to mainly finance real outlays, such as consumption or home improvements. Thus, in the run-up to the recession, elevated consumption levels would be associated with rising house values, but consumption levels would not necessarily be increasing. When home prices decreased during the Great Recession, however, households would have had to reduce consumption from its high level as the source of credit dried up and borrowing constraints became binding, inducing a positive association between changes in household spending and changes in housing wealth.

In Tables 5 and 6 we investigate this hypothesis by assessing the extent to which the response of spending to changes in house values differs by household leverage. Specifically, we construct two measures of household leverage. The first is the debt-to-income ratio, defined as the ratio of all household debt to household income. The second is housing leverage, which is defined as the ratio of outstanding mortgage and home loans to the value of the primary residence. We compute the distributions of these two variables in the pre-recession period (2003–2007) and classify households according to whether their pre-recession leverage levels were below or above the sample median. We then estimate equations (1) and (3) separately for these different sub-samples.

The results in Table 5 show remarkable and statistically significant differences in spending behavior between low and high leveraged households across states. Specifically, high leveraged home owners in states with large (3rd tercile) and moderate (2nd tercile) house price declines reduced their spending by as much as 15 and 8 percentage points, respectively, compared to their counterparts living in states with small house price declines (1st tercile). This is in contrast to low leveraged households whose spending drops associated with the recession appear to be very modest and rather homogenous across states characterized by different housing market behaviors.

In Table 6, we estimate the elasticity to and the MPC out of housing wealth shocks by leverage levels. Even though differences between groups with different leverage levels are only significant at the 10% level, they confirm a stronger response of spending to unexpected changes in housing wealth among households that were highly leveraged in the



pre-recession period. In particular, the MPC is about 11 cents on the dollar for households above the median debt-to-income ratio and about 5 cents on the dollar for households below the median debt-to-income ratio. In general, both elasticity and MPC are about double the size for home owners with high leverage compared with their counterparts with low leverage.

## 6 Conclusions

We exploit heterogeneity in housing market behavior across states in the period before, during and after the Great Recession to identify the response of household spending to housing wealth shocks. We find the marginal propensity to consume out of unexpected housing wealth changes in the range of 5.6–6.2 cents per dollar for a sample of households over the age of 50. To our knowledge, our study is the first to estimate these elasticities on household-level data with longitudinal information on all variables of interest, including self-reported house values and a complete measure of total household spending (rather than just sub-components).

Our findings are broadly consistent with estimates based on aggregate data (Slacalek, 2009), and also with the findings of Mian et al. (2013), who rely on zip- and county-level data on auto sales and credit card purchases. Our estimates are slightly larger than those of Aladangady (2017), who uses cross-sectional micro data from the CES and a nationally representative sample of the US adult population over the period 1986–2008. This difference is potentially suggestive of larger wealth effects of changing home values among older households as well as a more pronounced sensitivity of household spending to falling as opposed to increasing house values.

A marginal propensity to consume of 0.06 out of housing wealth would have led to declines in spending during the recession that, in some cases, would have been substantial: in California a decline in house value of \$100,000 was not unusual, and that would have caused a reduction in spending of \$6,000. Such large reductions in spending may have contributed to the instability in the macro economy. We document that the response of spending to housing wealth shocks varies with the degree of household leverage. Specifically, in the wake of the Great Recession, spending declined significantly more among households whose pre-crisis debt-to-income and housing leverage ratios were above the sample median. These may have relied more heavily on equity extraction during the boom and suffered more severe consequences when this source of credit dried up after the bust.

Reactions to wealth shocks depend on portfolio composition, life-cycle position, the ability to adjust consumption and the cost of doing so, as well as on the opportunity to modify other (non-spending) dimensions. Our analysis focuses on middle-aged and older households, who are more likely to be home owners and hold a large fraction of their wealth in the form of housing. They have a shorter life-cycle horizon than their younger counterparts, are more likely to be concerned with inheritance considerations and with downsizing decisions. Thus, they may respond more markedly to changes in home values. We find this to be the case in the wake of the Great Recession, when this group reduced their spending following losses in housing wealth. Our findings suggest feedbacks from wealth loss to spending reductions.

These may have exacerbated the effect of the crisis and can potentially help shed light into the dynamics of household spending in future recessionary events, especially in view of a rapidly aging population and an increasingly important economic role of middle-age and older households.

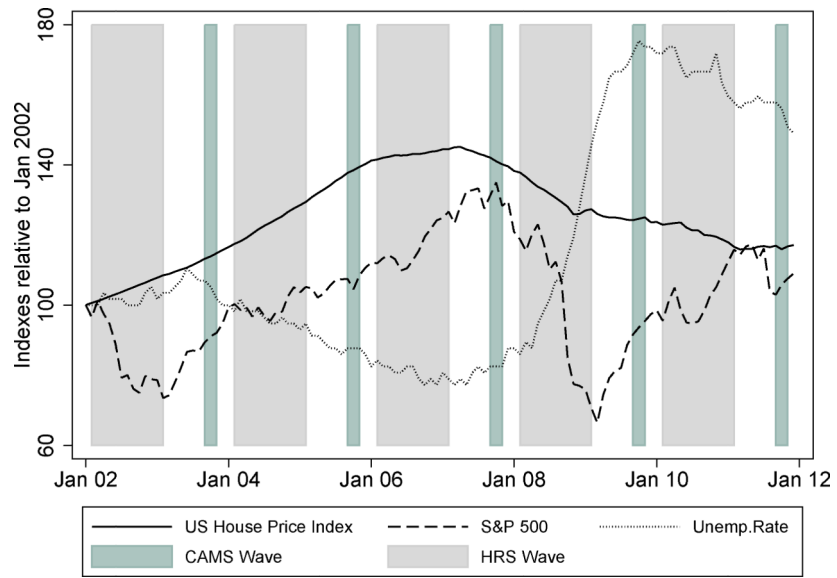
## Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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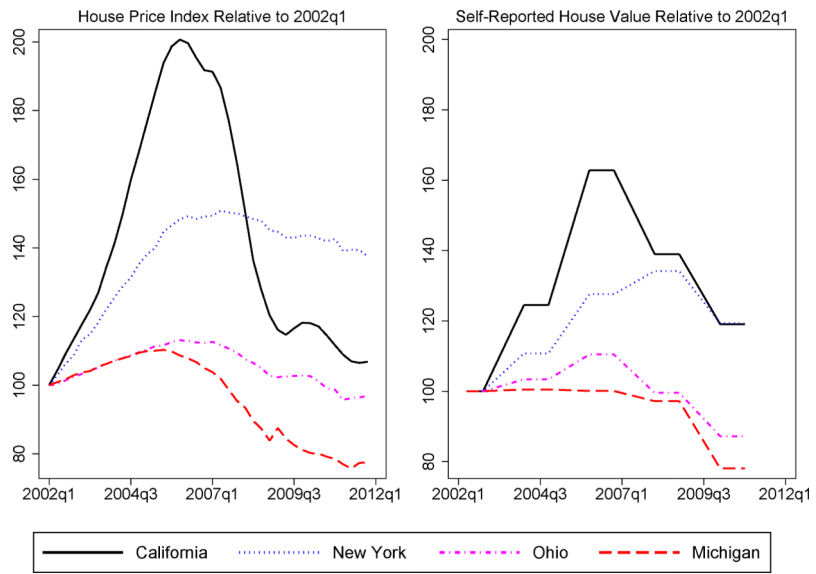
**Figure 1:**  
National Indices 2002–2012, relative to January 2002

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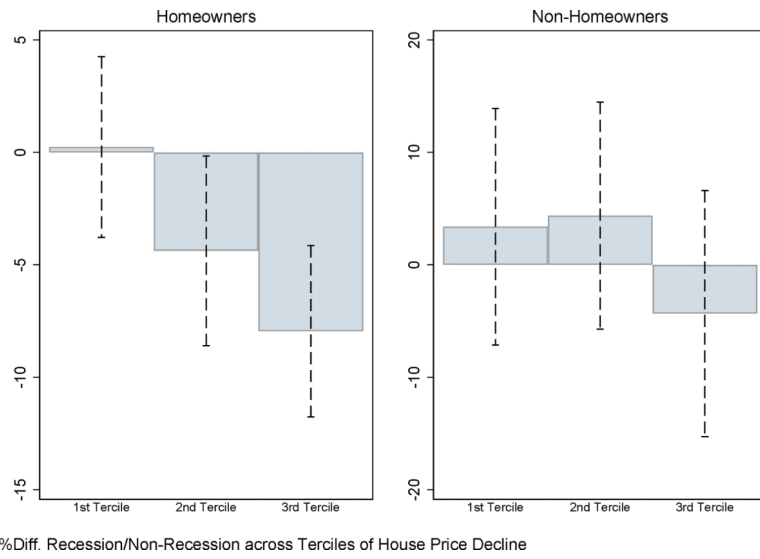
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**Figure 2:** Evolution of House Price Indices and Self-Reported House Values in Selected States, relative to 2002q1

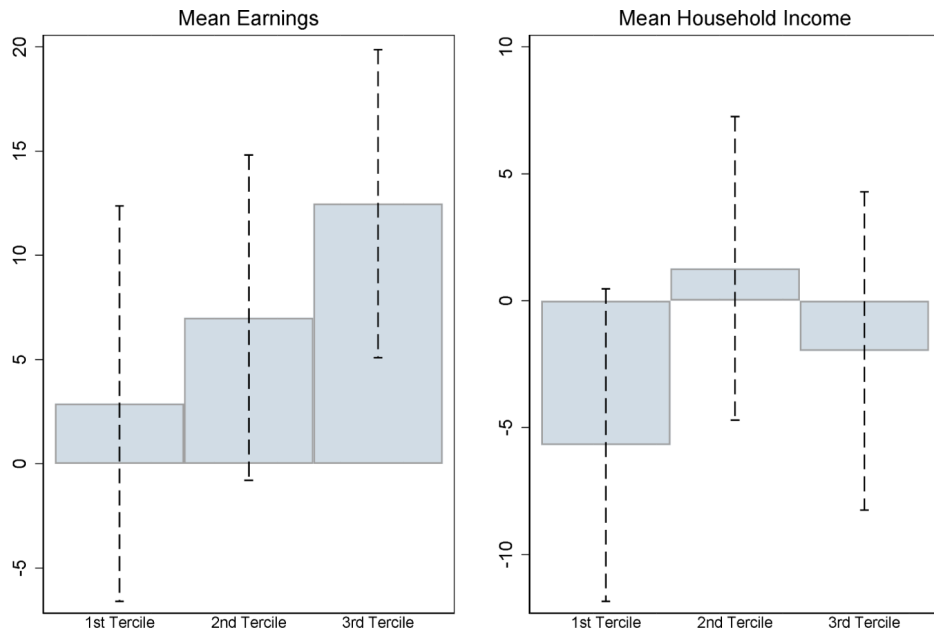


**Figure 3:**  
Percent Change in Household Spending between Recession and Non-Recession Times by Home Ownership and across States with Different Degrees of Housing Market Decline



Diff. Recession/Non-Recession across Terciles of House Price Decline

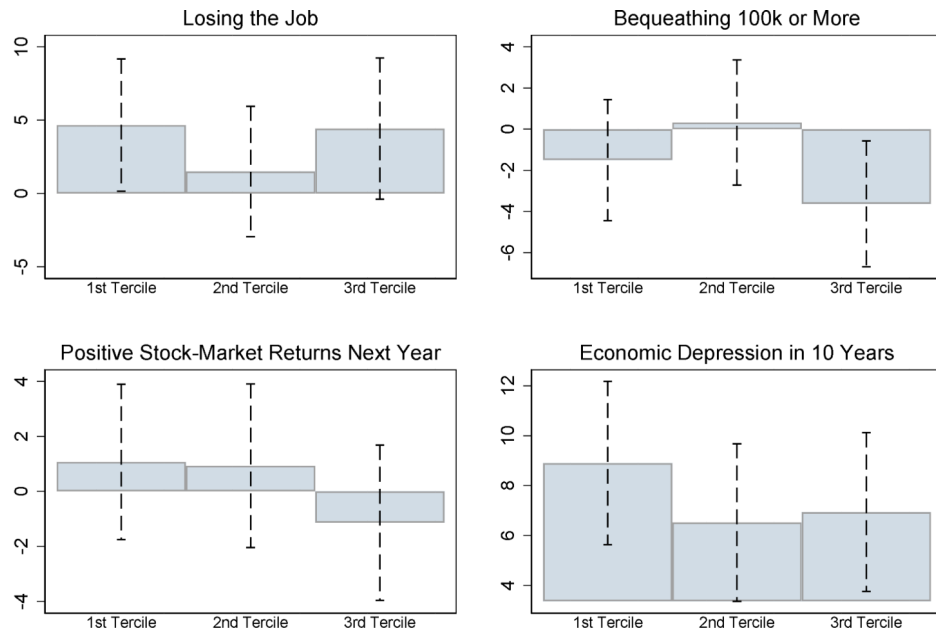
**Figure 4:**  
 Labor Force Outcomes – Percentage Point Differences between Recession and Non-Recession Times across States with Different Degrees of Housing Market Decline (Home Owners)



%Diff. Recession/Non-Recession across Tertiles of House Price Decline

**Figure 5:**  
Earnings and Income – Percent Change between Recession and Non-Recession Times  
across States with Different Degrees of Housing Market Decline (Home Owners)





Diff. Recession/Non-Recession across Tertiles of House Price Decline

**Figure 6:**  
 Expectations – Percentage Point Differences between Recession and Non-Recession Times across States with Different Degrees of Housing Market Decline (Home Owners)

**Table 1:**

Mean Household Spending across States with Different Degrees of Housing Market Decline (Home Owners)

	Non-Recession			Recession		
	1 <sup>st</sup> Ter	2 <sup>nd</sup> Ter	3 <sup>rd</sup> Ter	1 <sup>st</sup> Ter	2 <sup>nd</sup> Ter	3 <sup>rd</sup> Ter
$t$	44,724 (600)	45,808 (622)	46,794 (609)	42,196 (934)	47,283 (1,116)	46,034 (954)
$t + 1$	42,373 (624)	44,361 (646)	44,876 (643)	40,077 (858)	43,719 (1,037)	40,488 (879)
% $\Delta : (t + 1) - (t)$	-5.26 (1.18)	-3.16 (1.14)	-4.10 (1.17)	-5.02 (1.67)	-7.54 (1.82)	-12.05 (1.55)
$\Delta$ : Recession - Non-Recession				0.24 (2.05)	-4.38 (2.15)	-7.95 (1.94)
$(2^{nd}) - (1^{st})$			-4.62 (2.96)			
$(3^{rd}) - (1^{st})$			-8.19 (2.82)			
$(3^{rd}) - (2^{nd})$			-3.57 (2.89)			

Terciles are defined at the state level: the first and third terciles comprise the 17 states with the smallest and largest house price decline from 2007q4 to 2009q2, respectively. Delta Method standard errors in parentheses. Values are in 2011 dollars. In each survey wave we drop households with spending values in the top 1% or bottom 1% of the sample. For non-recession times,  $t = 2003; 2005; 2009$  and  $t + 1 = 2005; 2007; 2011$ . For recession times  $t = 2007$  and  $t + 1 = 2009$ . The computations only include households observed in both time  $t$  and  $t + 1$ .

**Table 2:**

Regressions of Changes in Spending by Degree of House Price Decline Dependent variable: change in log spending

	HomeOwn (i)	Non-HomeOwn (ii)	Always HO (iii)	HomeOwn No Unemp (iv)	Same State (v)
$\mathbb{1}(\text{Recession} = 1)$	0.063** (0.024)	-0.006 (0.062)	0.040 (0.028)	0.068** (0.024)	0.060** (0.026)
$\mathbb{1}(\text{Tercile} = 2)$	0.053* (0.031)	0.086* (0.047)	0.045 (0.030)	0.051 (0.031)	0.045 (0.033)
$\mathbb{1}(\text{Tercile} = 3)$	0.014 (0.026)	0.166** (0.046)	0.039 (0.028)	0.012 (0.027)	0.025 (0.031)
$\mathbb{1}(\text{Recession} = 1) \times \mathbb{1}(\text{Tercile} = 2)$	-0.051* (0.026)	0.003 (0.056)	-0.040 (0.030)	-0.058** (0.027)	-0.051* (0.029)
$\mathbb{1}(\text{Recession} = 1) \times \mathbb{1}(\text{Tercile} = 3)$	-0.104** (0.027)	-0.038 (0.072)	-0.098** (0.032)	-0.103** (0.027)	-0.114** (0.029)
Hypothesis Testing:					
$\mathbb{1}(\text{Recession} = 1) \times \mathbb{1}(\text{Tercile} = 2) = \mathbb{1}(\text{Recession} = 1) \times \mathbb{1}(\text{Tercile} = 3)$	F=4.89 p-val=0.03	F=0.32 p-val=0.58	F=4.75 p-val=0.03	F=3.53 p-val=0.07	F=5.40 p-val=0.03
N	9,122	2,036	7,980	8,994	7,997

States are grouped in terciles of the distribution of house price declines from 2007q4 to 2009q2 (1st tercile includes states with the smallest declines; 3rd tercile includes states with the largest declines). Standard errors clustered at the state level in parentheses. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively. Other regressors are a quadratic in age, education dummies, marital status, household size, health status, indicators for household income and wealth quartiles, indicators for labor force status, time fixed effects and tercile-specific time trends. Estimated coefficients for these variables are in Table B.1 in the Appendix.

**Table 3:**

## IV Regressions of Change in Log Spending on Change in Housing Wealth

	(i)	(ii)	(iii)
$\ln(\text{Housing Wealth})_{\text{Non-Recession}}$	-0.036 (0.041)	-0.037 (0.041)	-0.016 (0.118)
$\ln(\text{Housing Wealth})_{\text{Recession}}$	0.384** (0.157)	0.379** (0.157)	0.433** (0.209)
<b>Implied Marginal Propensity to Consume</b>			
$MPC_{\text{Non-Recession}}$	-0.008 (0.009)	-0.008 (0.009)	-0.003 (0.027)
$MPC_{\text{Recession}}$	0.062*** (0.024)	0.061** (0.024)	0.073*** (0.021)
<i>N</i>	8,790	8,790	3,238

Standard errors clustered at the state level in parentheses. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively. In each survey wave we drop households with changes in log spending in the top 1% or bottom 1% of the sample. In column (i) regressors include age, education, change in marital status, change in household size, and change in health status. In addition, regressors in column (ii) include changes in total household income, work status and wealth other than housing; in column (iii) they also include changes in bequest and economic outlook expectations. Estimated coefficients for these variables are in Table C.1 in the Appendix.

**Table 4:**

## IV Regressions of Change in Log Spending on Change in Housing Wealth Robustness Checks

	Always HO (i)	No Unemp (ii)	Same State (iii)
$\ln(\text{Housing Wealth})_{\text{Non-Recession}}$	-0.022 (0.040)	-0.052 (0.042)	-0.007 (0.043)
$\ln(\text{Housing Wealth})_{\text{Recession}}$	0.361** (0.157)	0.379** (0.158)	0.332** (0.156)
<b>Implied Marginal Propensity to Consume</b>			
$MPC_{\text{Non-Recession}}$	-0.005 (0.009)	-0.011 (0.008)	-0.001 (0.010)
$MPC_{\text{Recession}}$	0.060*** (0.022)	0.058** (0.025)	0.056** (0.023)
<i>N</i>	7,869	8,670	7,730

Standard errors clustered at the state level in parentheses. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively. In each survey wave we drop households with changes in log spending in the top 1% or bottom 1% of the sample. Set of regressors as in column (ii) of Table 3.

**Table 5:**

Regressions of Changes in Spending by Degree of House Price Decline Separating Households with Low and High Leverage Dependent variable: change in log spending

	Debt-to-Income		Housing Leverage	
	Median	> Median	Median	> Median
$\mathbb{I}(\text{Recession} = 1)$	0.053 (0.039)	0.074** (0.032)	0.066* (0.034)	0.062* (0.036)
$\mathbb{I}(\text{Tercile} = 2)$	0.072** (0.034)	0.041 (0.044)	0.043 (0.032)	0.080* (0.042)
$\mathbb{I}(\text{Tercile} = 3)$	-0.003 (0.030)	0.031 (0.037)	-0.032 (0.030)	0.080** (0.036)
$\mathbb{I}(\text{Recession} = 1) \times \mathbb{I}(\text{Tercile} = 2)$	-0.014 (0.043)	-0.077** (0.038)	-0.025 (0.037)	-0.080* (0.044)
$\mathbb{I}(\text{Recession} = 1) \times \mathbb{I}(\text{Tercile} = 3)$	-0.046 (0.045)	-0.153** (0.035)	-0.057 (0.041)	-0.154** (0.041)
Hypothesis Testing:				
$\mathbb{I}(\text{Recession} = 1) \times \mathbb{I}(\text{Tercile} = 2) =$	F=1.16 p-val=0.29	F=5.87 p-val=0.02	F=0.74 p-val=0.39	F=3.50 p-val=0.07
$\mathbb{I}(\text{Recession} = 1) \times \mathbb{I}(\text{Tercile} = 3)$				
N	4,014	4,966	4,755	4,088

States are grouped in terciles of the distribution of house price declines from 2007q4 to 2009q2 (1st tercile includes states with the smallest declines; 3rd tercile includes states with the largest declines). Standard errors clustered at the state level in parentheses. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively. In each survey wave we drop households with changes in log spending in the top 1% or bottom 1% of the sample. Other regressors as in Table 2.

**Table 6:**

IV Regressions of Change in Log Spending on Change in Housing Wealth Separating Households with Low and High Leverage

<b>Debt-to-Income</b>		
	Below Median	Above Median
$\ln(\text{Housing Wealth})_{\text{Non-Recession}}$	-0.070 (0.059)	-0.009 (0.046)
$\ln(\text{Housing Wealth})_{\text{Recession}}$	0.288** (0.144)	0.534** (0.237)
$MPC_{\text{Non-Recession}}$	-0.017 (0.014)	-0.002 (0.011)
$MPC_{\text{Recession}}$	0.048* (0.029)	0.107** (0.049)
N	3,859	4,801
<b>Housing Leverage</b>		
	Below Median	Above Median
$\ln(\text{Housing Wealth})_{\text{Non-Recession}}$	-0.039 (0.048)	-0.045 (0.064)
$\ln(\text{Housing Wealth})_{\text{Recession}}$	0.271 (0.239)	0.399** (0.190)
$MPC_{\text{Non-Recession}}$	-0.009 (0.012)	-0.011 (0.015)
$MPC_{\text{Recession}}$	0.049 (0.047)	0.074** (0.035)
N	4,589	3,969

Standard errors clustered at the state level in parentheses. \*\*\*, \*\* and \* indicate significance at the 1%, 5% and 10% level, respectively. In each survey wave we drop households with changes in log spending in the top 1% or bottom 1% of the sample. Other regressors as in column (ii) of Table 3.