Essays on Housing Wealth and Consumer Behavior

by

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Dedication

This dissertation is dedicated to my parents Michael and Jeri Cooper, my brother Andrew, my grandmother Marilyn, and my fiancée Jodi.

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Table of Contents

List of Figures

List of Tables

Abstract

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This dissertation considers how housing wealth impacts household behavior. The essays pay close attention to the borrowing collateral role of housing wealth, and address how changing house prices affect household spending. Chapter II of the dissertation investigates the relationship between house values and consumption. The chapter demonstrates that house values impact consumption by serving as borrowing collateral for households to finance and smooth their consumption. Changing house values have little effect, however, on the expenditures of households without apparent borrowing needs. In addition, the chapter shows that the impact of falling house prices on aggregate consumption is relatively small.

Chapter III examines how households' home equity extraction during 2001 to 2003 and 2003 to 2005 affects their spending and saving behavior. The chapter finds that a 1 dollar increase in equity extraction leads to 95 or 98 cent higher consumption expenditures. Nearly all of this spending increase is reversed in the subsequent period. Households who extract extract equity are somewhat more likely to pay down their higher cost credit card debt as well as invest in other real estate and businesses. Overall, the results in the chapter are consistent with households extracting equity to fund one-time durable good type consumption needs.

The final chapter of this dissertation considers the theoretical relationship between collateralized borrowing and household consumption. The chapter examines households' consumption decisions when they can borrow against their equity in an illiquid

asset (house) to finance their consumption. This theoretical approach addresses questions that are not easily answered empirically such as whether household spending responds symmetrically to positive versus negative house price shocks. The paper finds that collateralized borrowing capacity acts as a partial hedge against future labor income risk. Indeed, households borrow to smooth their consumption somewhat in response to negative labor income shocks. In addition, the consumption growth responses to illiquid asset price shocks are relatively symmetric. Also, the impact of house price shocks on consumption is not large compared to income shocks.

Chapter I

Introduction

This decade has witnessed a dramatic run-up in house prices followed by a substantial house price collapse. Indeed, aggregate house prices in the United States rose roughly than 45 percent in real terms between early 2000 and late 2006 and have declined roughly 10 percent since their peak. This drop off in prices is even larger in localized areas hit by large numbers of foreclosures and other economic problems. Many people in the popular press and elsewhere blame much of the current economic recession on the bursting of the so-called housing bubble along with the unscrupulous borrowing and lending behavior by households and banks respectively during the housing boom. The standard argument is that many households used rising house prices as an excuse to spend beyond their means, and thus suffered disproportionably when house prices collapsed.

Despite these claims, there has been somewhat limited academic research examining how housing related borrowing affects households' consumption and saving behavior. In comparison, there is fairly extensive research on recent lending practices and the credit markets, as well as the role of housing as an investment vehicle and as part of households' portfolio choices. In addition, a number of papers have examined the so-called "housing wealth effect" (HWE). Such HWE analysis is based on the idea that households feel richer or poorer as house prices fluctuate and they adjust their consumption accordingly. To a first order approximation, however, households should not feel better or worse off as their house prices increase or decrease conditional on their income not changing and their not planning to downsize their housing stock in the near future.

Despite the focus on the HWE, the main economic channel for house prices influencing consumption is therefore through the role of housing wealth as borrowing collateral. This dissertation investigates how households' ability to borrow against their homes impacts their consumption. The remaining chapters of this dissertation focus on housing wealth's potential benefit to households as an alternative vehicle for financing household expenditures. Chapter II looks specifically at the role of housing

wealth as borrowing collateral. In particular, it finds little evidence of a HWE once households' borrowing demands are taken into account. Indeed, the non-housing expenditures of households who demand borrowing increase 11 cents per dollar gain in their housing wealth. In contrast, the spending of households who do not need to borrow is little changed when their house values fluctuate. The chapter also shows that the direct, aggregate consumption effect of falling house prices is relatively small.

Chapter III considers the impact of home equity borrowing on household behavior in more detail during the early 2000s. In particular, the essay considers how households who extract equity between 2001 and 2003 adjust their spending and balance sheets between 2003 and 2005. The chapter finds that households who borrow against their homes have a 20 percentage point lower predicted probability of positive consumption growth between 2003 and 2005. Similarly, households who increase their equity extraction by 1 dollar have roughly 18 cent lower consumption in the subsequent period. Households also seek to improve their balance sheets by reducing housing debt and increasing liquidity following the period in which they extract equity. There is also a positive relationship between equity extraction and durable good purchases. All of the results are broadly consistent with households using equity extraction to finance a one-time consumption shock. More importantly, the data through 2005 show little evidence that households borrowed against their homes to persistently live beyond their means.

The final chapter analyzes households' decisions to borrow against the collateral in their homes from a theoretical point of view. In particular, the model in the chapter endows households with an illiquid asset (house) they can borrow against. Households decide how much to borrow and consume in a basic optimal consumption decision framework. The chapter finds that collateralized borrowing capacity acts as a partial substitute for liquid saving as a hedge against future labor income risks. Indeed, simulation results show that households borrow against the equity in their illiquid asset to at least partially smooth consumption in response to a negative income shock. The model simulations also show limited evidence that households respond asymmetrically to positive versus negative illiquid asset (house) price shocks.

Chapter II

Impending Spending Bust? The Role of Housing Wealth as Borrowing Collateral

2.1 Introduction

Understanding the relationship between house prices and consumption is important for determining the impact of the housing market cycle on household spending. Figure 2.1 plots real house price growth and real consumption growth. The two series exhibit similar patterns especially through the late 1990s, and have an overall correlation coefficient of about 0.4.[1] Despite this positive connection, however, the mechanism that drives the relationship between house values and household expenditures is less clear. The purpose of this paper is to analyze the causal relationship between housing wealth and consumption. The paper also explores whether accounting for this causal connection matters when considering the aggregate economic implications of falling house prices.

Changing house prices potentially has a large impact on the aggregate economy since roughly two-thirds of households in the United States are homeowners. In addition, the 2005 Panel Study of Income Dynamics (PSID) suggests that, on average, housing wealth makes up 50 percent of total household wealth. This percentage rises to more than 60 percent for households in the lower portion of the overall wealth distribution. The standard assumption in the literature and in many large scale macroeconomic forecasting models is that housing wealth has a direct or net wealth effect on consumption similar to non-housing financial wealth. The idea is that households feel richer when their housing wealth increases and thus consume more. Conversely, households feel poorer when house prices decline and therefore reduce their spending.

[1] To the naked eye, the correlation between the two series appears to weaken somewhat recently, however, the correlation is actually stronger since 2000 than it is historically.

There are a few alternative explanations for why housing wealth affects consumption. The main argument is that housing wealth can serve as borrowing collateral and relax households' credit constraints. Changing house prices allow homeowners who demand borrowing to finance more or less additional spending. In addition, house price fluctuations may redistribute wealth from households who are long housing to households who are short housing. Finally, there may be a life-cycle type effect of housing wealth based on changing household demographics such as age. The redistribution channel or the life-cycle channel impact consumption to the extent that various household groups have different marginal propensities to consume (MPC) out of housing wealth. Buiter (2008) discusses the theoretical relationship between consumption and housing wealth in some detail. This paper focuses on comparing the net wealth channel with the borrowing collateral channel for understanding the relationship between house values and household expenditures.

The aggregate data from the most recent housing cycle in the United States are broadly consistent with households borrowing against their homes to fund consumption. In particular, real house prices rose fifty percent between 2000 and late 2006 while home equity debt relative to income doubled.[2] The issuance rate for home equity lines of credit (HELOC) also rose substantially. The volume of HELOCs from commercial banks to households grew at an annual rate of 30 to 40 percent from 2002 to 2005, according to the Federal Reserve Board. HELOCs provide homeowners access to their housing wealth to finance consumption. These lines of credit are similar to credit cards, but with greater borrowing limits and much lower interest rates. Indeed, credit card debt relative to income peaked in 2000 and has trended down somewhat since then as households switched to cheaper forms of credit. In addition, Greenspan and Kennedy (2005) calculate that mortgage equity withdrawal (cash out refinancing) averaged roughly 6 percent of disposable income from 2000 to 2005. This rate of equity extraction was much higher than during the 1990s.

Economists are currently concerned with the impact of the recent housing market bust on aggregate consumption since households' ability to finance spending through home equity borrowing has decreased substantially. Indeed, *The New York Times* noted in June 2008 how Washington Mutual "reduced or suspended about $6 billion of available credit under existing home equity lines. Countrywide, Bank of America and JPMorgan Chase have made similar moves." The cutback at Washington Mutual amounted to roughly 10 percent of its outstanding HELOCs.[3] According to anecdotal reports, numerous households have had their HELOCs reduced or suspended. Given

[2] Appendix section A.1 provides data definitions and discusses the data sources.

[3] "Shrinking Lines of Credit," *New York Times*, June 8, 2008.

these credit market changes, the relevant question is how households' consumption is affected by their ability to finance more or less spending through home equity borrowing. Understanding this issue is important for analyzing the macroeconomic effects of falling house prices.

This paper examines the relationship between housing wealth and household spending using household level data from the PSID. The PSID has both cross-sectional and time-series variation across households in terms of housing wealth as well as income, financial wealth and mortgage debt. The data also allow me to distinguish between households who likely do and do not have a high demand for borrowing. In addition, I can control for a variety of additional household demographic variables in my analysis given the available data. One drawback of the PSID is that it only consistently contains a direct measure of households' food consumption. One novelty of my approach, however, is to impute households' total non-housing consumption using their reported income and saving data.

The results show that a 1 dollar increase in house values leads to a roughly 3.5 cent permanent rise in households' non-housing consumption. This estimate of the so-called net housing wealth effect (NHWE) is roughly in line with the range of previous NHWE estimates (see Lasky (2007) for a summary of these previous results).[4] In contrast, when I incorporate households' borrowing needs into my analysis, I find that consumption increases around 11 cents per dollar increase in housing wealth for households who potentially need to borrow. The spending of households with limited borrowing need, however, is unaffected by changes in their house values. In other words, there is evidence of a net housing wealth effect after controlling for the borrowing collateral role of housing wealth.

The paper also considers the role of household leverage in the relationship between housing wealth and consumption. This analysis is an alternative way of testing the borrowing collateral role of housing wealth. In particular, highly levered households potentially benefit from changes in the value of their homes, which increase their home equity and lower their borrowing costs. Indeed, consumption is higher on average for highly levered households who experience a positive housing capital gain. In addition, households who both potentially need to borrow *and* are highly levered exhibit a particularly strong response to changes in their housing wealth relative to their less levered counterparts. Overall, the results with household leverage reinforce the importance of housing wealth as borrowing collateral.

Finally, I investigate the aggregate implications of the estimated relationship be-

[4]The estimated increases in spending due to housing wealth are permanent since house prices are assumed to roughly follow a random walk.

tween housing wealth and consumption. The results suggest that direct impact of falling house prices on aggregate, real non-housing consumption in 2008 was relatively small. In particular, the roughly 11 percent decline in real housing wealth between the end of 2007 and the end of 2008, as reported in the Flow of Funds accounts, caused a roughly 0.75 percent decrease in aggregate real non-housing consumption. This estimated effect is robust to alternative calculation approaches. In addition, roughly two-thirds of the decline in consumption is due to the borrowing collateral role of housing wealth.

There have been a number of previous papers that examine the relationship between consumption and housing wealth. Skinner (1989) quantifies this relationship using data on food consumption and housing wealth from the PSID, and Lehnert (2004) uses age as a proxy for household credit constraints when considering the relationship between housing wealth and consumption. In addition, Morris (2006) examines the potential life-cycle relationship between house values and household spending using the PSID, while Campbell and Cocco (2007) look at how the housing wealth effect varies based on households' age and tenancy status (renter versus owner) using British household level data. A paper that is similar in principle this one is Yamashita (2007). He uses PSID data through 1993 to analyze households' probability of having a second mortgage conditional on state-level house price appreciation. Finally, Hurst and Stafford (2004) consider whether households, especially potentially liquidity constrained ones, take advantage of rising housing wealth through mortgage refinancing. In particular, they analyze a specific module of the PSID in 1996 that asked households questions about their mortgage refinancing activity.[5]

This paper takes a broader approach to examining the relationship between housing wealth and consumption, and pays particular attention to the borrowing collateral role of housing wealth. In particular, the baseline specifications look directly at the relationship between housing wealth and households' borrowing demand. I identify households' borrowing need based on their current income relative to their average or permanent income. This approach differs from that of previous authors who used age and other more indirect measures to capture households' credit needs. My methodology also incorporates the fact that households' borrowing demand and corresponding lending rules are very different now than when Zeldes (1989) looked at the relationship between consumption and households' liquidity needs. Owning a home no longer means that a household has substantial equity and financial resources. Homeowners,

[5]A related, but separate thread in the literature utilizes a structural approach to evaluate the relationship between consumption and house prices and or housing wealth and household portfolio choice. Examples include Li and Yao (2007), Bajari et al. (2008), Piazzesi et al. (2007), and Lustig and Nieuwerburgh (2005).

especially those who are highly levered, may have a particularly strong desire to borrow against their equity as house prices increase.

The rest of the paper proceeds as follows. Section 2.2 discusses the theoretical background for this paper and my empirical approach. Section 2.3 explains the data and the various data measurement issues. Section 2.4 reports my baseline results and the aggregate implications of falling house prices. Section 2.5 considers potential extensions. Section 2.6 concludes.

2.2 Empirical Approach

2.2.1 Background

Total consumption for homeowners, which includes the service flow from housing and other durable goods, should rise, on average, when housing wealth increases given the measurement approach for housing services in the National Income and Product Accounts (NIPA). Rising house prices ceteris paribus imply higher owner-occupied rents and hence greater expenditures on housing services for owner-occupants.

Whether or not a homeowner is better or worse off because of changing house prices depends on whether they are a net buyer of housing, a net seller or neither. On average, homeowners who do not intend to move in the near future should be no worse off when prices decline and no better off when prices increase. When house prices decline homeowners can continue to live in their homes and consume the same amount of housing services all else equal. Homeowners are also no better off when house prices rise, since an equivalent property to the one the household is living in costs more. Households, must downsize and consume less housing services to realize a positive capital gain when house prices rise, and they must purchase more housing for a lower price to benefit when prices decrease. On net, the cross-sectional impact of changing house values on households' consumption should be close to zero if the majority of households do not intend to move in the near future.

Housing wealth may,however, *indirectly* impact households' non-housing consumption because of its role as borrowing collateral. In particular, financial institutions allow households to borrow against their accumulated home equity through second mortgages or lines of credit. The interest costs of such collateralized home debt are substantially lower than other forms of borrowing such as credit cards. In addition, the Tax Reform Act of 1986 raised households' incentives to borrow against their homes by increasing the home mortgage interest deduction and eliminating the deduction for non-collateralized consumer loans. As a result, homeowners who wish

to borrow to finance some of their consumption benefit from changes in house prices that increase their home equity borrowing capacity. This implies that there should be a positive relationship between changes in house values and consumption changes for households with high borrowing demand. In addition, more households likely wish to extract equity from their home than those who wish to move.

Much of the existing literature and many large scale macroeconomic forecasting models fail to distinguish between changes in house values benefiting net sellers and buyers of houses and house price appreciation and depreciation impacting homeowners borrowing capacity. Instead, the standard approach has housing wealth directly impacting homeowners' non-housing expenditures through a direct or net housing wealth effect. In other words, all households view fluctuating house prices as permanent changes in their wealth, and they adjust their consumption accordingly based on feeling richer or poorer as home prices rise or fall. This reasoning suggests households should have a positive MPC out of housing wealth. Indeed, many existing studies find a household spending, ceteris paribus, increases 3 to 6 cents per dollar increase in house prices (see Lasky (2007) for an review of such studies).

The fact that the existing literature finds strong evidence of a positive net housing wealth effect (NHWE) could be due to an empirical mis-specification. Simply regressing consumption on housing wealth and other controls potentially masks the true connection between household expenditures and housing wealth. Indeed, the coefficient on housing wealth may be capturing the borrowing collateral role of housing wealth for homeowners who demand borrowing, rather than identifying an actual wealth effect for all households. It is therefore important to control for households' borrowing needs to fully evaluate the relationship between housing wealth and non-housing consumption.

2.2.2 Baseline Specification

My baseline empirical model accounts for differences in households borrowing needs, while nesting the standard approach in the literature for estimating the NHWE. In particular,

$$\begin{aligned} C^i_{t,t-1} &= \beta_0 + \beta_1 Y^i_\ell + \beta_2 W^i_{t-1} + \beta_3 H^i_{t-1} + \beta_4 \left(H^i_{t-1} \cdot I^i_\ell\right) \\ &+ \beta_5 I^i_{t-1} + \eta \mathbf{Z^i_{t-1}} + \delta_t + e^i_t \end{aligned} \tag{2.1}$$

where $C^i_{t,t-1}$ is a household's average, real non-housing consumption over the period $t-1$ through t, Y^i_ℓ is the lagged level of a household's real after tax income, W^i_{t-1},

is a household's real non-housing financial wealth as of $t-1$, H^i_{t-1} is a household's stock of real housing wealth in $t-1$, I^i_ℓ is an indicator variable that takes a value of 1 if household is borrowing constrained and is 0 otherwise, and $\mathbf{Z^i_{t-1}}$ is a vector of household demographic variables that includes a cubic term in the age of the household head, the number of household members, and the number of children younger than eighteen.[6] Equation 2.1 also include year fixed effects, δ_t, to account for any potential aggregate macroeconomic trends that may impact consumption. The next section discusses the data and relevant measurement issues in detail.

I use the the term "borrowing constrained" here somewhat loosely. Such a household is not constrained in the strict sense that they cannot borrow. Instead, a household is "constrained" if it has an increased need or demand for borrowing. Such a household may wish to access the equity in its home. Section 2.3.3 discusses how I identify these potential borrowers in detail. I will use the term "borrowing constrained" at times to identify households with high borrowing need for ease of discussion. I will also refer to households who are less likely to need or want to borrow as "unconstrained."

In equation 2.1 the interaction term between the borrowing constrained indicator variable and housing wealth, $\left(H^i_{t-1} \cdot I^i_\ell\right)$, captures the marginal impact of house values on constrained households' consumption. Changes in house values allow these households to finance more or less consumption though home equity borrowing. If the borrowing collateral role of housing wealth is important for household spending, then changes in housing wealth should have a positive and substantial impact on constrained households' consumption ($\beta_4 > 0$). In addition, the direct effect of housing wealth on the consumption of unconstrained households should be small ($\beta_3 \approx 0$).

Housing wealth should not impact unconstrained households' spending if households' home equity borrowing needs are the only factor driving the relationship between house values and consumption. The estimated NHWE (β_3) may be non-zero in equation 2.1, however, if I mistakenly identify some households as not needing to borrow when the opposite is true. Alternatively, some of the so-called unconstrained households may intend to move in the near future. As a result, such households may rationally adjust their consumption accordingly in response to changing housing prices. For instance, a household who plans to downsize realizes a positive lifetime resource gain when house prices increase.

[6]Financial wealth is measured as the total value of a household's non-housing assets less any non-collateralized debt they may hold. These assets include stocks, bonds, saving accounts, other real estate, vehicles, annuities or IRAs, and the value of any business or farm the household operates. In addition, using a quadratic in the age of the household head instead of a cubic does not impact my results.

Even if the direct effect of housing wealth on consumption is non-zero, the estimate of the NHWE (β_3) should be lower relative to estimated NHWE when I do not account for the borrowing collateral role of housing wealth. In particular, if I set $\beta_4 = 0$ and $\beta_5 = 0$ in equation 2.1, then the empirical specification is similar to the approach used in the existing literature to estimate the NHWE.

$$C^i_{t,t-1} = \alpha_0 + \alpha_1 Y^i_\ell + \alpha_2 W^i_{t-1} + \alpha_3 H^i_{t-1} + \zeta \mathbf{Z^i_{t-1}} + \delta_t + e^i_t \tag{2.2}$$

Indeed, if the borrowing collateral channel matters for the relationship between housing wealth and consumption then the estimated MPC out of housing in equation 2.2 should be attenuated relative to the estimated MPC in my baseline specification ($\beta_3 < \alpha_3$). Section 2.2.4 discusses the timing in my empirical model along with other estimation issues.

2.2.3 Specification with Household Leverage

If households' borrowing needs are important for explaining the relationship between housing wealth and consumption, then there should also be differences in household consumption based on homeowners' existing leverage. Banks generally prefer to lend to households with substantial collateral. Households' consumption, conditional on borrowing needs, should also differ based on existing leverage, which proxies for their borrowing capacity.

The standard measure of a household's leverage is its loan-to-value (LTV) ratio, which compares the household's outstanding mortgage debt to the value of its home. In particular,

$$\text{LTV}^i_t = \frac{M^i_t}{V^i_t}$$

where M^i_t is the amount of a household's outstanding mortgage (primary and secondary) debt, and V^i_t is its home value. A lower LTV ratio implies that a household has little housing debt relative to its house value, while a high ratio implies that the household has a relatively large amount of debt.

The effect of households' LTV ratios (leverage) on the relationship between consumption and housing wealth is likely non-linear. Homeowners with less than 20 percent equity in their homes must hold private mortgage insurance (PMI), which greatly increases their borrowing costs and affects their borrowing behavior (see Hurst and Stafford (2004)). As a result, there should be a kink in the relationship be-

tween housing wealth, leverage and consumption at a LTV ratio of 0.8, to the extent that the borrowing collateral role of housing wealth matters for household spending.[7] Households with more than 20 percent equity in their home likely have greater access to credit. Indeed, households with less than 20 percent equity, however, benefit greatly from gains in their house values that move them outside the leverage cut-off for needing PMI and substantially reduce their borrowing costs. Gains in house prices also provide highly levered households with additional borrowing capacity.

I consider the role of household leverage in the relationship between house values and consumption with the following empirical specification:

$$\begin{aligned} C^i_{t,t-1} &= a_0 + a_1 Y^i_\ell + a_2 W^i_{t-1} + a_3 H^i_{t-1} + a_4 \left(high^i_{t-2} \cdot loss^i_{t-1} \right) \\ &+ a_5 \left(high^i_{t-2} \cdot gain^i_{t-1} \right) + a_6 \left(low^i_{t-2} \cdot gain^i_{t-1} \right) + \eta \mathbf{Z^i_{t-1}} + \delta_t + e^i_t \quad (2.3) \end{aligned}$$

where $high^i_{t-2} \cdot loss^i_{t-1}$ equals 1 if a household has a LTV ratio greater than 0.8 in period $t-2$ *and* experiences a house price loss between $t-2$ and $t-1$, $high^i_{t-2} \cdot gain^i_{t-1}$ equals 1 if a household has a LTV ratio greater than 0.8 in period $t-2$ *and* experiences a house price gain between $t-2$ and $t-1$, and $low^i_{t-2} \cdot gain^i_{t-1}$ equals 1 if a household has a LTV ratio less than 0.8 in period $t-2$ *and* experiences a house price gain between $t-2$ and $t-1$.

Households' LTV ratios are measured as of $t-2$ to capture the impact of changing house prices on household spending conditional on existing home leverage. If house price increases reduce borrowing costs for highly levered households, then these households should have higher consumption, on average, in response to house price gains ($a_5 > 0$). In comparison, the average consumption of other households, who either are less levered or who experience a house price drop, should be less affected. Indeed, highly levered households can borrow and increase their spending when house prices rise but are not necessarily forced to reduce their consumption when house prices fall. Similarly, the consumption of less levered households does not necessarily respond to changes in housing wealth since these households should possess sufficient equity to have already financed additional consumption through borrowing independent of any current house price changes.

If the borrowing collateral role of housing wealth is important, then household leverage should also matter for the consumption behavior of constrained households in response to changes in their housing wealth. To investigate this further, I also

[7]The LTV requirements likely eroded a good bit during the period of easy credit in the early 2000s. My results, however, hold across time periods. There are also few households in the data who report LTV ratios above 0.9, so using the historical cut-off seems reasonable.

estimate a modified version of my baseline specification that incorporates the potential interaction between household leverage and households' borrowing needs.

$$\begin{aligned} C^i_{t,t-1} &= \gamma_0 + \gamma_1 Y^i_\ell + \gamma_2 W^i_{t-1} + \gamma_3 H^i_{t-1} + \gamma_4 \left(H^i_{t-1} I^i_\ell\right) + \gamma_5 I^i_{t-1} \\ &+ \gamma_6 \left(I^i_\ell L^i_{t-1}\right) + \gamma_7 \left(H^i_{t-1} I^i_\ell L^i_{t-1}\right) + \eta \mathbf{Z^i_{t-1}} + \delta_t + e^i_t \end{aligned} \tag{2.4}$$

where L^i_{t-1} is an indicator variable that takes the value of 1 if the household has a LTV ratio greater than or equal to 0.8 in period $t-1$ and is 0 otherwise. The rest of the variables are defined the same as before.

The consumption of highly levered, constrained households should be lower on average than the spending of less levered households because of the former households limited equity and high borrowing costs ($\gamma_6 < 0$). At the same time, highly levered, constrained households potentially benefit a lot from changes in housing wealth that reduce their borrowing costs. Therefore, the MPC out of housing wealth for highly levered, constrained households is likely greater than for those homeowners with less leverage ($\gamma_7 > 0$). Finally, if the borrowing collateral role of housing wealth matters then the estimated NHWE for unconstrained households should be attenuated relative to the MPC out of housing wealth when I do not account for household borrowing constraints or leverage ($\gamma_3 < \alpha_3$).

A household's LTV ratio as of $t-1$ is also potentially endogenous. Households who have borrowed to fund consumption in the past will potentially have both high consumption *and* a high LTV ratio. Such households differ from homeowners whose LTV ratio is *exogenously* high owing to a lack of equity in their home from either a small down payment or falling house prices. The latter households are the ones who may benefit from house price growth that increases their borrowing capacity. These homeowners are the ones whose spending behavior is worth examining, and thus it is important to consider the potential endogeneity between their LTV ratios and spending.

2.2.4 Timing in Empirical Model

The timing and setup in my baseline empirical specifications incorporate the fact that the data on non-housing consumption cover two-year and five year horizons (five years prior to 1999 and two years thereafter). This timing is due to the availability of the saving data in the PSID, which I use for imputing households' non-housing consumption. The next section discusses this imputation method and the timing issues in detail. The dependant variable in my empirical specifications is households'

average consumption over the relevant two or five year periods. This allows for pooling all the household spending observations cross-sectionally over time. In addition, all of the demographic and financial variables included in the econometric specifications are measured as of beginning of the consumption period (period $t-1$). For example, housing wealth is measured as of 1984 for household consumption between 1984 and 1988. The next section these measurement issues more closely.

The empirical specifications also include "lagged" income, Y_ℓ^i, which controls for households' income one period prior to the beginning of the consumption period (i.e. 1983 for consumption between 1984 and 1988). I include "lagged" income to avoid regressing income (less saving) on itself, since my imputed consumption measure is constructed using households' income and saving data. Household income tends to be highly persistent so lagged income is likely a good proxy of households' average income over the consumption period. Whether or not a household needs to borrow also depends on its income, and thus households' borrowing is also included with a lag. As an example, equation 2.1 becomes the following for household spending between 1984 and 1988:

$$\begin{aligned} C^i_{88,84} &= \beta_0 + \beta_1 Y^i_{83} + \beta_2 W^i_{84} + \beta_3 H^i_{84} + \beta_4 \left(H^i_{84} \cdot I^i_{83}\right) \\ &+ \beta_5 I^i_{83} + \eta \mathbf{Z^i_{84}} + \delta_8 8 + e^i_{88} \end{aligned} \tag{2.5}$$

where $C^i_{88,84}$ is a household's average yearly consumption between 1984 and 1988.

I estimate equations 2.1 to 2.4 using two-stage least squares (2SLS) in order to control for potential endogeneity between consumption and income due to serially correlated income reporting errors. I use twice-lagged income as an instrument for Y_ℓ^i (i.e. 1982 income as an instrument for 1983 income). An alternative approach would be to include households' average income over the same period as average consumption (period $t-1$ to t), and use 2SLS to account for any resulting endogeneity between consumption and income. My results are similar using this alternative empirical setup. The setup outlined above, however, avoids any concerns about data construction induced measurement error given my method for imputing households' non-housing expenditures. Section 2.3 discuss the data measurement and construction in more detail.

2.2.5 Additional Empirical Discussion

I estimate equations 2.1 to 2.4 in both levels and logs. According to Muellbauer (2007), estimating the relationship between consumption and housing wealth in levels

is important for capturing the long-run interactions between the two series in addition to any short-run variation. A levels setup for my empirical models is also appropriate because it fits with the available consumption data. In particular, I impute the *level* of households' consumption and not the change in their spending. It is therefore appropriate to consider the relationship between housing wealth and my available consumption measure without further transformations.

The standard argument against estimating the relationship between house prices and consumption in levels is that such a setup fails to control for households' marginal utility of wealth. A one dollar change in housing wealth may impact a homeowner with a small house differently than one with a multi-million dollar house. Conditional on needing to borrow, however, an additional dollar of housing wealth (equity) should benefit households similarly regardless of the initial size of their homes. Since I am interested in investigating the borrowing collateral role of housing wealth, estimating the relationship between consumption and housing wealth in levels seems adequate.

Finally, my estimation approach is limited by the data. In particular, my consumption imputation approach assumes that households know their income and saving behavior and report them correctly. This assumption is reasonable especially since James N. Morgan designed the saving module in the PSID to not only capture households' saving but also to indirectly obtain households' total spending. Still, there is likely some measurement error in households' non-housing consumption. Differencing consumption to calculate households' spending growth would likely amplify any existing measurement error and contaminate the analysis. In addition, the change in households' average consumption over five year horizons is likely a relatively noisy measure of their spending growth even with a perfect measure of household expenditures. As a result, conducting the analysis in this paper using the level of household spending seems the most appropriate given the data issues and the other considerations.

2.3 Data and Measurement

2.3.1 PSID Data

The PSID is a nationally representative, longitudinal survey of households and their offspring that began in 1968. The survey was conducted annually between 1968 and 1997 and has been collected biannually since 1997. The most recent data are for 2005.[8] Each wave asks homeowners to report their home values as well as the amount of any

[8]Data for the 2007 wave will hopefully be available soon.

outstanding mortgage balances. Section A.5 in the appendix discusses the variation in households' reported housing wealth. There is also data on family income in every wave, and the PSID contains detailed information on households' financial asset holdings as part of wealth supplements in 1984, 1989, 1994, and 1999 onwards. The PSID data also include core information about family structure, employment, marital status, the age and sex of household members, and other household demographic characteristics.

The consumption data in the PSID, however, are somewhat limited. The only consistently available spending measure over time is households' food consumption. Previous authors have used food expenditures as their household spending measure when examining housing wealth effects. Food consumption, however, may not be the margin and or the only margin on which households adjust their spending in response to changes in housing wealth. The PSID also added questions starting in 1999 on households' mortgage payments, health expenditures, child care expenditures, utilities and transportation related expenses. These data, however, still do not cover all of households' discretionary spending, and is somewhat limited by its short time horizon. Section 2.4.3 analyzes the relationship between housing wealth and these reported PSID consumption measures.

A more comprehensive measure of household expenditures, however, is arguably better at capturing the overall effect of changing house values on household spending. I therefore impute households' consumption *excluding* housing using the available PSID data on households' income and saving. In particular, I define households' non-housing consumption as follows:

$$C^i_{t,t-1} = (Y^i_{t,t-1} - T^i_{t,t-1}) - S^i_{t,t-1} \tag{2.6}$$

where $C^i_{t,t-1}$ is household consumption excluding housing between period $t-1$ and t, $S^i_{t,t-1}$ is household saving between period $t-1$ and t, $Y^i_{t,t-1}$ is household income (excluding rental income), and $T^i_{t,t-1}$ is a household's lump sum income taxes.

This approach is based on a household's budget constraint and it measures a family's out of pocket spending over a given period. Strictly speaking, $C^i_{t,t-1}$, measures household expenditures and not consumption from a national accounting sense, since it does not include the service flow from durable goods. Non-housing expenditures is the correct measure of consumption, however, for my analysis. Consumption including housing services is related to housing wealth by construction, while consumption excluding housing services should not depend on changing house prices. The goal of this paper is to examine how households' non-housing expenditures respond to changes in their housing wealth, and my imputed measure of non-housing consump-

tion helps to capture this relationship.[9]

The PSID waves have the necessary data on household income and saving to operationalize equation 2.6. I obtain data on households' income taxes using the NBER's TAXSIM software. Household saving comes from the active saving data in the PSID. These saving data *exclude* capital gains, which is necessary for obtaining households' saving out of their disposable income and calculating equation 2.6. I discuss the saving data in more detail in the next subsection. The appendix discusses the relationship between my imputed consumption measure and relevant consumption benchmarks.

2.3.2 Calculating Household Saving

My method for calculating so-called "active saving" follows the approach in Juster et al. (2005). Earlier work using active saving data includes Kosobud and Morgan, eds (1964), Klein and Morgan (1951) and Holbrook and Frank Stafford (1971). Active saving measures households' net contributions to various financial assets over time, and it *excludes* capital gains. For instance, households who pay off some of their outstanding mortgage principal have positive active saving. In contrast, increases in housing wealth owing to house price appreciation do not count as active saving.

Starting in 1989, the PSID wealth supplements include questions about households' additions to and subtractions from their financial assets since the previous wealth supplement. For example, households report the amount they contribute to 401k or IRA savings plans as well as the amount they withdraw from such plans. Other active saving categories include: investment in businesses or farms, checking and saving accounts, bond holdings, stock holdings, housing, other real estate, vehicles, and non-collateralized debt (NCD).[10] Given the timing of the wealth supplements active saving data is available between the following years: 1984 and 1989, 1989 and 1994, 1994 and 1999, 1999 and 2001, 2001 and 2003, and 2003 and 2005. These data allow me to calculate households' non-housing consumption over the same time periods.

The exact definition of active saving between period $t-1$ and t depends on the type of asset. For assets with potentially large capital gain components, such as stocks, IRA accounts or annuities, other real estate, and investment in businesses or farms, active saving for household i in asset j, $AS^{i,j}_{t-1,t}$, is defined as follows:

[9]Imputed non-housing consumption implicitly includes a household's monthly mortgage payment. Changing house prices, however, should not greatly impact this debt service unless a household refinaces and uses the proceeds to reduce its monthly payments.

[10]Other real estate includes vacation homes, rental properties, and land holdings. NCD includes credit card debt as well as student loans and other unsecured debt.

$$AS^{i,j}_{t-1,t} = I^{i,j}_{t-1,t} - R^{i,j}_{t-1,t} \tag{2.7}$$

where $I^{i,j}_{t-1,t}$ is the amount invested by household i in asset j between $t-1$ and t and $R^{i,j}_{t-1,t}$ is the amount removed from asset j by household i over that same period.

I initially calculate active saving in stocks using equation 2.7. The validity of the stock active saving data in the PSID are somewhat questionable, however, because stock prices change rapidly. Arguably, households cannot easily distinguish between capital gains in stocks and excess income they invested in equities over a two or five year period. As a result, I construct a counter-factual measure of households' active saving in stocks using their reported portfolio values in the wealth supplements and the actual change in stock prices between the data periods. This approach yields a potentially more reliable measure of active saving in stocks, and I discuss it in more detail in the appendix.

For asset categories where capital gains are not a factor, active saving is the difference in a household's reported asset value in period t compared with its value in period $t-1$. These assets include: households' checking and saving account holdings, bond holdings, vehicle values, and NCD. In particular,

$$AS^{i,j}_{t-1,t} = V^{i,j}_{t} - V^{i,j}_{t-1} \tag{2.8}$$

where V^{j}_{t} is the value of asset j in time t.

The remaining active saving category is housing ($j = h$). The actual calculation of such saving depends on whether or not a household moves. Households who do not move "save" by paying down their mortgage principal, while households who move potentially save or dis-save by altering the amount of equity in their homes.

$$AS^{i,h}_{k-1,k} = \begin{cases} D^{i,h}_{k-1} - D^{i,h}_{k} & \text{if move } =0 \\ E^{i,h}_{k} - E^{i,h}_{k-1} & \text{if move } =1 \end{cases} \tag{2.9}$$

where $D^{i,j}_{k}$ is a household's amount of outstanding mortgage debt in period k, $E^{i,j}_{k}$ is the amount of equity a household has in its home at time k, and *move* is an indicator variable that equals one if a household moved between $k-1$ and k and is zero otherwise. I use k as the time subscript to represent the fact that the time horizon for active saving in housing is different from the other assets. Prior to 1999, housing data are available yearly and the difference between k and $k-1$ represents one year while $t-1$ to t covers 5 years. After 1999, the housing and active saving data cover two year horizons and $t = k$. More formally:

$$AS^{i,h}_{t-1,t} = \begin{cases} \sum_{k=t-1}^{t} AS^{i,h}_{k,k+1} & t \leq 1999 \\ AS^{i,h}_{k,k+1} & t > 1999 \end{cases} \tag{2.10}$$

I sum yearly active saving in housing prior to 1999 so it covers the same time horizon as the other active saving measures.

Total active saving for a given household is simply the sum of saving its saving in the individual asset components.

$$AS^{i}_{t-1,t} = \sum_{j} AS^{i,j}_{t-1,t} \tag{2.11}$$

Given this measure of household saving out of current income, I calculate a household's non-housing consumption using a modified version of equation 2.6.

$$C^{i}_{t-1,t} = (Y^{i}_{t-1,t} - T^{i}_{t-1,t}) - AS^{i}_{t-1,t} \tag{2.12}$$

2.3.3 Identifying Households' Borrowing Demand

When thinking about households' borrowing demand it is important to distinguish between households who are poor with permanently low income, and those households who experience a temporary decline in their income. This distinction is important because the former households have limited if any borrowing capacity while the latter households may want to borrow to smooth their consumption. The goal is to identify households with temporarily low income who likely have high borrowing demand relative to other households. Such "constrained" households may be younger and have not yet realized their full earning potential, or they may be older households experiencing a transitory negative income shock. Such households likely desire to borrow against the equity in their homes to the extent they lack sufficient liquid assets and or otherwise cannot borrow against their future income to smooth consumption.

Given this framework, I use the panel structure of the PSID to determine which households are potential borrowers (constrained). In particular, I compare a household's current (lagged) real income with their average income:

$$I^{i}_{\ell} = \frac{Y^{i}_{\ell}}{\bar{Y}^{i}}$$

where $\bar{Y}^{i}$ is a household's average real income over time based on all their available family income data in the PSID between 1968 and 2005. Average income captures households' earning potential and serves a proxy for their permanent income. I identify households as potentially needing to borrow if their current income is at least

ten percent lower than their average income ($I_\ell^i \leq 0.9$). Eberly (1994) uses a similar approach for identifying constrained households when looking at households' durable goods purchases. Section 2.5 considers alternative income cut-offs for determining households' borrowing needs, and shows that the results are not sensitive to my choice of income cut-off.

This approach for identifying borrowing demand is consistent with the economic definition of potential borrowers in a permanent income or life-cycle type model. A household's current income relative to its permanent income is arguably a good indicator of its potential inability to fund its desired amount of current consumption. Such cash-flow constrained households are more likely to want to borrow. In addition, given this indentification approach, a household can be cash constrained in one period but not necessarily in another depending on how the household's current income fluctuates over time relative to its average income. As a result, there is variation both in the number of borrowing constrained households in a given period and in a household's own borrowing demand over time.

As noted earlier, households' existing LTV ratios are an alternative indicator of their borrowing capacity and needs. Previous authors have also considered households' age or their liquid wealth relative to income (LWY) ratios as proxies for borrowing needs or demand (see for example Lehnert (2004) or Yamashita (2007)). I consider these potential alternative borrowing demand measures as well. A direct survey question about households' credit demand is arguably a better indicator of their borrowing needs. The PSID does not contain such a question. Jappelli et al. (1998), however, impute households' borrowing needs and limitations using credit application data available in the Survey of Consumer Finances (SCF). The authors' approach is clever, but it is not clear that their method identifies households who want to borrow because of negative income shocks or other household specific factors. Having a household specific measure of borrowing demand is important for analyzing the relationship between households' housing wealth and consumption.

2.3.4 Estimation Sample

My estimation sample includes all homeowners in the PSID between 1984 and 2005 where the household head is sixty-five or younger. This includes households from the low income sample in 1968. The sample excludes households who move between wealth periods. Such households potential realize actual capitals and loses on their housing, and the goal of this paper is to investigate how households respond to changes in their house value conditional on them being content with their current amount of

housing services.

Where applicable, all household demographic variables are measured for the household head, and all nominal values are converted to 2000 dollars using the annual personal consumption expenditure (PCE) deflator from the Bureau of Economic Analysis (BEA). The sample begins in 1984 because that is when the wealth data became available. The complimentary active saving data were first published in 1989 and covered the 1984 to 1989 period. The data cover the 1986 Tax Reform Act where many of the tax law changes occurred that made home equity borrowing much more attractive relative to other forms of credit. In fact, there has been a dramatic general decline in mortgage transaction costs over the whole sample horizon.

I further restrict the sample by removing households who have missing or incomplete financial and or active saving data. The sample also excludes households who are farmers or families who live in a mobile home following the approach in Yamashita (2007). Renters are also not in the sample since they do not have any housing wealth by definition. I also eliminate homeowners who move since I am interested in how households' spending responds to changes in their housing wealth conditional on them owning a home and not needing to move. Finally, I remove outliers by eliminating households who have income, financial wealth, or housing wealth in the top or bottom 1 percent of the respective income and wealth distributions. I also exclude households with negative imputed consumption as well as negative reported financial assets.[11]

2.4 Results

2.4.1 Baseline Regressions

Table 2.1 and Table 2.2 report estimates of equations 2.1 and 2.2 respectively using 2SLS. In addition, Table A.2 in the appendix demonstrates the attenuation bias in the estimates of households' MPC out of income in OLS regressions that do not control for the potential endogeneity of lagged income. Table 2.1 shows the estimates using the levels (dollar value) of all the relevant variables, while the bottom panel shows the results from estimating my baseline specification in logs. Overall, the results are qualitatively and quantitatively similar. In particular, the so-called direct housing wealth effect is around 3.5 cents on the dollar in the regression (column 1) that does not control for the borrowing collateral role of housing wealth. Note that the reported coefficients in Table 2.2 for the regressions in logs represent elasticities. For instance

[11] Households with negative financial assets are removed mainly because negative financial wealth likely dramatically alters their borrowing and spending capabilities. Including or excluding these households, however, does not substantially alter the results.

the elasticity of consumption with respect to housing wealth is 0.09 (column 1). This is equivalent to an MPC of 3.5 cents per dollar of housing wealth as noted in the memo line of the table.[12]

The regressions that control for households' borrowing needs, however, show little evidence of a direct housing wealth effect (columns 2 and 3 of both tables). In particular, a 1 dollar increase in housing wealth leads to more than a nearly 11 cent increase in constrained households' non-housing consumption. This effect is precisely estimated and is a bit larger than the corresponding impact based on the log regressions (6 cents per dollar of housing wealth). In contrast, the impact of changing housing wealth on unconstrained households' consumption is small and for the most part not statistically different from zero. The direct wealth effect is also attenuated substantially relative to the regressions that do not control for households' potential borrowing needs.

The results are relatively unchanged when I account for the potential interaction between households' borrowing needs and their *financial* wealth (column 3 of both tables). The interaction effect itself is essentially zero. This result is consistent with the inherently different nature of financial wealth and housing wealth. Changes in the value of housing do not necessarily make households better off, but the asset serves as borrowing collateral. Permanent changes in households' financial assets, however, represent changes to their lifetime resources, and thus it is not surprising that changes in financial wealth have more of a direct impact on household expenditures. Overall, these baseline findings are consistent with the borrowing collateral role of housing wealth and not a net housing wealth effect.

In addition, the magnitude of the NHWE is roughly in-line with previous estimates in the literature. The size of the NHWE relative to the financial wealth effect depends, however, on whether the model is estimated in levels or logs. The level results suggest that the housing wealth effect is smaller than the financial wealth effect, which is consistent with financial wealth being more liquid than housing wealth. In contrast, the log estimates suggest that households' MPC out of financial wealth (0.005) is smaller than the MPC out of housing wealth (0.035). Both of these estimates are precisely estimated and the result is in line with previous findings of a *larger* housing wealth effect than financial wealth effect (see for example Case et al. (2001)). Except

[12] I convert the elasticities to MPCs by multiplying them by ratio of households' average consumption relative to the mean of the variable in question. For example, the MPC out of housing wealth, MPC^H, is:

$$MPC^H = 0.09 \cdot \frac{\bar{C}}{\bar{H}}$$

where $\bar{C}$ is average spending and $\bar{H}$ is average house values.

for the differences in the relative size of the two wealth effects, all of the other estimates in logs versus levels are qualitatively and quantitatively similar.

The different estimates of the financial wealth effect relative to the NHWE could result from the treatment of households who report zero financial wealth (roughly 200 households in the sample). The level estimates include these wealthless households. In the log estimates, however, I give these households a small amount (0.00001) of financial wealth so that they are not dropped from the sample. The estimate of the financial wealth effect in the log regressions increase a good bit if I drop the zero wealth households from the sample. Including or excluding these households, however, has a minimal impact on the other estimated relationships especially the one between consumption and housing wealth. Including the households with zero financial wealth is important, however, because they may have particularly high borrowing demand when they experience a temporary negative income shock. As a result, the remaining tables will only include regression estimates in levels. These level estimates also have the added benefit of being directly interpretable as MPCs. The results in logs are very similar and are available upon request.

2.4.2 Baseline Regressions Across Age Groups

Previous work by authors such as Lehnert (2004) use age as proxy for households' borrowing demand. In particular, young households may be more likely to want to borrow to smooth their consumption because they have yet to realize their full earnings potential. Lehnert (2004) therefore examines whether the consumption of young households may be particularly sensitive to changes in their housing wealth. He finds some evidence of such an effect. I re-estimate my baseline specification by household age groups as a potential alternative way of capturing households' borrowing demand. This analysis also serves as a robustness check that the behavior of older households is not driving my results. Older households who are nearing retirement age may benefit from housing capital gains, on average, if they intend to downsize their housing stock.

Table 2.3 reports estimates of my baseline specification across household age groups. In particular, I divide households into three groups: young households (younger than thirty-five), middle aged (thirty-five to fifty) and nearing retirement (fifty to sixty-five). The exact age cut-offs for these groups, however, do not noticeably impact the estimates. The results show that older households' spending behavior is *not* the only factor influencing the relationship between housing wealth and household consumption. In particular, constrained households in both the oldest and middle age group have a substantial MPC out of housing wealth.

Households who are young and constrained also respond strongly to changes in their housing wealth. This effect is not precisely estimated, however, perhaps because of relatively small number of young households in my sample. There is limited evidence, however, of a direct housing wealth effect among the youngest households. Arguably, this finding is not surprising since all of these households are homeowners. Such households are likely unconstrained, on average, since they own property. Recall, that the vast majority of unconstrained households in Zeldes (1989) were homeowners. As a result, the young property owners in my sample do not need to borrow in general just because they are young. In contrast, the consumption of households who are both young and who need to borrow increase 6 cents for a dollar increase in their housing wealth. This effect is not precisely estimated, but the direct housing wealth effect is noticeably attenuated after controlling for young households' borrowing needs. Overall, this finding is further consistent with the importance of the borrowing collateral role of housing wealth.

The direct housing wealth effect for the oldest age group remains relatively strong despite attenuating a good bit after controlling for borrowing demand. This result makes sense since some older households are likely planning to downsize and changes in housing wealth represent real gains or losses in their lifetime resources. At the same time changes in housing wealth also matter for older households who experience a negative income shock and likely wish to borrow regardless of their future housing plans. The estimates for the middle age group are further consistent with this view. In In particular, there is little evidence of a direct housing wealth effect for this age group because the households are still relatively young and have a fair amount of housing left to consume over their lifetimes. Changes in housing wealth matter for these households though to the extent they need to borrow. In particular, the consumption of constrained, middle age households increases over 11 cents per dollar increase in their housing wealth. Overall, the results by household age group are consistent with the borrowing collateral role of housing wealth.

2.4.3 Incorporating Household Leverage

Table 2.4 reports the impact of incorporating household leverage into my analysis. Columns 3 and 4 show the estimates of equation 2.3, which considers the average consumption of households based on their leverage (high versus low) and whether they experience a positive or negative housing capital gain. The regressions suggest that the average consumption of highly levered households is higher in response to a positive housing capital gain. To the extent households with high leverage are

constrained by a lack of equity and or potentially high borrowing costs, it makes sense that they consume more in response to a positive housing capital gain. This effect is more precisely estimated in the regression that also controls for households' borrowing needs $[I_\ell^i]$ (column 4). In other words, conditional on households who potentially want to borrow for cash flow reasons, those households who are constrained due to a lack of equity in their house (or high borrowing costs) have higher consumption on average in response to housing capital gains. This finding reinforces the idea that housing wealth impacts consumption by allowing households to borrow. In addition, the borrowing collateral role of housing wealth appears to matter regardless of why households need or want to borrow. In other words, housing wealth changes do not just impact the consumption of households with limited financial resources.

The last column of Table 2.4 shows the estimates of equation 2.4 which considers the relationship between housing wealth and consumption for households who are highly levered *and* who have low income relative to average. The results are consistent with the empirical predictions in Section 2.2.2, and further reinforce the borrowing collateral role of housing wealth. First, the average consumption of highly levered, constrained households is lower than their less levered counterparts. This finding is consistent with the idea that households with greater housing collateral can more easily smooth through transitory income shocks and maintain a higher level of consumption. In addition, the marginal consumption response to changes in housing wealth is particularly strong for constrained households with high leverage especially relative to their less levered counterparts. Positive housing wealth changes potentially move highly levered households above the threshold where their benefits from borrowing and consuming more outweigh the costs.

2.4.4 Baseline Results with Alternative Consumption Measures

As a further robustness check, I re-estimate my baseline specifications using food consumption rather than households' total non-housing consumption. This approach is similar to the ones used by Skinner (1989) and Lehnert (2004). I convert the food expenditure data to cover the same two or five year horizons as total non-housing consumption. I also divide total food consumption into the amount spent at home and the amount spent away from home.

Table 2.5 shows that households' MPC out of total food consumption is small (0.5 cent per dollar of housing wealth), but precisely estimated. This direct housing wealth effect for food consumption is roughly 3 cents per dollar smaller than for total

non-housing consumption, which is consistent with food consumption making up a relatively small portion of overall household expenditures. In addition, constrained households' MPC (food) out of housing wealth is nearly double the response of unconstrained households in the regressions that account for the borrowing collateral role of housing wealth. The estimated NHWE is also attenuated slightly from 0.54 cents per dollar of housing wealth to 0.47 cents per dollar.

Overall, the food consumption results are broadly consistent with the borrowing collateral role of housing wealth especially given food spending's relatively small share of total household expenditures. Unlike in the baseline results, however, the NHWE persists for food spending at home even after controlling for households' borrowing needs. Perhaps households feel better about their future financial prospects when their housing wealth increases, and thus purchase items like mesclun lettuce rather than iceberg lettuce. In contrast, changes in housing wealth results in higher spending on food *away* from home only for households who demand borrowing. It seems somewhat surprising that households would borrow against their home to finance meals at restaurants. Households' ability to borrow to fund needed expenditures may free up other cash for eating out. Such behavior is not necessarily rational, but perhaps such households derive self-worth or some other form of utility from their ability to eat out.

There is also additional reported household expenditure data available in the PSID starting in 1999. These data include expenditures on vehicles (loan payments and purchase costs), medical expenditures, transportation expenses and other related items. See Charles et al. (2007) for a discussion of these data.I add these data to the food consumption data to form an additional consumption measure [CPSID], which I use to further check the robustness of my results. [13]

Given the data availability and short time horizon, I measure CPSID at a point in time (e.g. 1999) rather than as an average over two or five year periods. The relevant empirical specification is therefore:

$$\begin{aligned} CPSID_t^i &= \beta_0 + \beta_1 Y_t^i + \beta_2 W_{t-1}^i + \beta_3 H_{t-1}^i + \beta_4 \left(H_{t-1}^i \cdot I_\ell^i \right) \\ &+ \beta_5 I_{t-1}^i + \eta \mathbf{Z_{t-1}^i} + \delta_t + e_t^i \end{aligned} \tag{2.13}$$

[13] I exclude the additional expenditure data related to housing costs (mortgage payments, taxes etc), childcare and schooling. The schooling data exhibit odd patterns as noted in Charles et al. (2007). Housing costs are directly related to housing wealth changes by construction and childcare is not a discretionary type expenditure. The CPSID equivalent measure in the consumer expenditure survey makes up roughly 40 percent of overall expenditures.

The main difference between this setup and equation 2.1 is that I include household income contemporaneously since regressing income on itself is no longer an issue given that CPSID is reported and not imputed.

Table 2.6 reports the 2SLS estimates of equation 2.13, where lagged income (Y^i_{t-1}) serves as an instrument for households current earnings Y^i_t. Overall, the results using CPSID as the dependent variable in the housing wealth analysis are qualitatively similar to my baseline findings. In particular, the MPC out of housing wealth for constrained households is much higher than for unconstrained households. The direct wealth effect is also attenuated in the regression that controls for households' borrowing demand. In addition, when I restrict the sample to only include households present in my baseline estimates there is no evidence of a direct housing wealth effect. Changing house values only impact the spending of potential borrowers. Overall, these results further reinforce the importance of the borrowing collateral role of housing wealth for explaining the relationship between house values and household spending.

2.4.5 Aggregate Implications of Household Level Results

I use my baseline housing wealth MPC estimates and the PSID housing wealth data to calculate the impact of the 11 percent decline in real housing wealth between the end of 2007 and the end of 2008, as reported in the Flow of Funds accounts, on aggregate non-housing consumption. Since the PSID data is only available through 2005, I project households' house values forward to the end of 2007 using state level house price growth data from OFHEO. I then apply the appropriate wealth decline to each household's housing position and calculate the implied non-housing consumption effect using the estimated MPCs out of housing wealth from equations 2.1 and 2.2. I use the PSID weights to the household level spending responses into an aggregate effect.[14] This exercise considers the direct impact of falling house prices on aggregate consumption holding all else equal.

Table 2.7 reports the estimated aggregate consumption results. The numbers in parentheses represent a 95 percent confidence interval for the estimated effects. Column 1 in the table reports the "pooled" aggregate consumption effects assuming that the NHWE alone describes households' consumption response to changes in housing wealth. In particular, I use the estimated results from column 1 in Table 2.1 and calculate the pooled aggregate spending impact as follows:

[14]This requires re-scaling the 2005 PSID weights to account for the fact that there are roughly 110 million households in the United States of which roughly two-thirds are homeowners.

$$\Delta C_{2008} = \sum_{i}^{N^h} \omega_i (H_{08}^i - H_{07}^i) * 0.036 \tag{2.14}$$

where ΔC_{2008} is the change in aggregate consumption in 2008 due to changing house prices, ω_i is a household's adjusted family weight, and H_{08}^i is a household's housing wealth at the end of 2008 (after the relevant price decline) and H_{07}^i is a household's imputed housing wealth in 2007. The change in aggregate consumption is summed over all homeowners (N^h) in the PSID.

The second column in Table 2.7 reports the aggregate effects based on just the spending response for constrained households with high borrowing need. In particular,

$$\Delta C_{2008} = \sum_{i}^{N^h} \omega_i \left[I_{05}^i \cdot \left(H_{08}^i - H_{07}^i \right) * 0.109 \right] \tag{2.15}$$

where I_{05}^i is an indicator variable for a household's borrowing demand in 2005. Overall about 34 percent of households are potential borrowers in 2005.[15] Using households borrowing demand from 2005 for this exercise is not ideal, but I need some household level information about homeowners borrowing need, and I am restricted by the data availability. Arguably, this approach is somewhat reasonable since the relevant question is what happens to consumption based on people borrowing in the previous period or periods and needing to scale back their spending as house prices fall.

Finally, the third column reports the results that incorporate the behavior of both constrained and unconstrained households.

$$\Delta C_{2008} = \sum_{i}^{N^h} \omega_i \left[\left(1 - I_{05}^i \right) \cdot \left(H_{08}^i - H_{07}^i \right) * 0.014 + I_{05}^i \cdot \left(H_{08}^i - H_{07}^i \right) * 0.109 \right] \tag{2.16}$$

The percent change in aggregate consumption relative to 2007 based on changes in housing wealth is:

$$\%\Delta C = \left(\left(\frac{C_{2007} + \Delta C_{2008}}{C_{2007}} \right) - 1 \right) * 100$$

The top half of the table reports the consumption effects assuming that all households experience the aggregate housing wealth decline reported in the Flow of Funds (FOF) accounts for 2008. The FOF data report that real housing wealth fell roughly 11 percent, and thus

[15] The number of potential borrowers varies over my sample depending on the year. The mean number in a given year in my sample is about 25 percent.

$$H_{08}^{i} = 0.89 H_{07}^{i}$$

This 11 percent drop in wealth leads to a roughly 75 basis point decline in real non-housing consumption all else equal (row 1). The estimated effect is similar for both the pooled data (equation 2.14) and the analysis that takes the borrowing collateral role of housing wealth into account and separates the constrained from unconstrained households (equation 2.16). The results in the middle column do show,however, that roughly two-thirds of the reported aggregate decline in spending is due to the behavior of constrained households. In other words, much of the aggregate impact of falling house prices results from the diminished borrowing collateral role of housing wealth. Overall, these findings suggest that controlling for households' borrowing demand has little impact on the estimated size of the consumption decline due to falling housing wealth. Accounting for borrowing collateral role of housing wealth, however, demonstrates the mechanism by which changing house prices impact aggregate spending.

I also estimate the aggregate consumption effect of falling house prices using households' MPCs out of housing wealth based on the food consumption data (Table 2.5). In particular, I re-scale the estimated food MPCs to account for food consumption making up only about 16 percent of total non-housing consumption expenditures, and then calculate overall spending impact using the same procedure outlined above. The results using the food consumption data are consistent with the estimates based on my imputed non-housing consumption measure (Table 2.7-row 2). The implied direct aggregate impact of falling house prices on household spending is relatively small, and is not driven by the household consumption measure used for the analysis. The only difference about the converted food consumption MPC results is that they attribute less of the decline in consumption to the borrowing collateral role of housing wealth.

The bottom half of table shows estimates of the aggregate consumption effect of changing housing wealth using the actual state level house price changes for 2008 as reported by OFHEO. Overall, the estimates using the state level data are very similar to the result that assume all households experience an 11 percent decline in housing wealth. The aggregate consumption effects might have been larger after controlling for households' borrowing demand if the large state level house price declines disproportionately hit constrained households versus unconstrained households. Given the results, however, this does not appear to be the case. The results reinforce, however, that direct effect of falling house prices on aggregate consumption in 2008 was relatively small.

The state level price data suffers from the fact that the actual price change for households New York City likely differs a good deal from those households living

near Rochester, New York. Using the state level data, therefore, may understate the actual price declines for some households. In particular, constrained households may been affected disproportionately on the MSA level relative to households with limited borrowing need, but not on the state level. As a result, the aggregate impact of falling prices may be larger after controlling for households' borrowing demand using the MSA level house price declines in 2008. Unfortunately, the MSA level data are not available in the public data set.

Finally, all of the estimates in Table 2.7 are illustrative and are very much a partial equilibrium exercise. In particular, I ignore the fact that the stock market fell along with the housing market. The key point, however, is that the impact of falling housing wealth on aggregate consumption is small regardless of my estimation approach. These estimates could even be biased upward somewhat since I ignore renters who wish to enter the housing market and are better off when house prices decline.

2.5 Extensions

2.5.1 Alternative Cut-offs for Identifying Households' Borrowing Demand

As a robustness check, I consider whether the results depend on the income cut-off for determining households' borrowing needs. Recall that the baseline setup identifies households' borrowing need based on if their current income is 10 percent or more below their average income. Table 2.8 shows the baseline regression estimates when I set the current cut-off at 5 percent below households' average income as well as 15 percent below average income. The results are essentially the same as in the baseline case. As a result, it does not appear that my findings are sensitive to the income cut-off for identifying households' borrowing demand.

I also conduct a so-called false experiment where I identify constrained households as those whose current income is 10 percent or more *above* their average income. These households experience a positive income shock so they should have sufficient funds to finance their spending, and they should have limited, if any, borrowing demand. The consumption of these households therefore should not increase in response to a positive change in their housing wealth. Indeed, the MPC out of housing wealth is essentially zero for households with income 10 percent or more above their average income (Table 2.8, column 4). As a result, it appears that housing wealth matters for

households with income shortfalls but not positive income surprises. [16] This finding reinforces the idea that changing house values impact consumption because of the borrowing collateral role of housing wealth.

As an additional check, I re-estimate my baseline specification using households' lagged income relative to their average income ($\frac{Y_\ell^i}{\bar{Y}}$) (in logs) to capture their borrowing needs rather than an indicator variable. Table 2.9 reports these results and shows that the interaction term between the continuous borrowing demand variable and housing wealth is substantial, has the correct sign and is precisely estimated. In particular, the more income a household has relative to its average income the lower its MPC out of housing wealth. For example, the MPC out of housing wealth is 7.6 cents on the dollar for a household with income 25 percent *below* their average income $\left(\frac{Y_\ell^i}{\bar{Y}} = -0.25\right)$. In contrast, the MPC is essentially zero for a household with income 25 percent *above* their average income. This result is consistent with the idea that households with sufficient current income have a much lower need to borrow against their housing wealth.

The main difference with using the continuous variable for households' borrowing demand versus the indicator variable is that the estimated MPCs out of housing wealth are slightly smaller for households who demand borrowing. For instance, a household with current income 10 percent below its average income has a MPC of 5.8 cents per dollar of housing wealth compared with more than 10 cents on the dollar in my baseline results. In addition, households who have slightly higher income than average (10 percent) exhibit a small, positive MPC out of housing wealth (3.4 cents on the dollar). Overall, these results are consistent with the borrowing collateral role of housing wealth. They just suggest that the borrowing collateral effect may be most noticeable for households who experience large house price shocks.

2.5.2 The Role of Households' Liquid Wealth

I also look at how my baseline results vary across the liquid wealth to income (LWY) distribution.[17] Households who have less liquid assets to use to smooth consumption in response to a negative income shock should have higher demand for borrowing against their housing wealth. Zeldes (1989) and others have used households' liquid assets holdings as an indicator of so-called "liquidity constraints."

Table 2.10 reports the results from re-estimating my baseline specification across

[16] The regression results for this false experiment also show a strong direct housing wealth effect. This is coefficient, however, captures the impact of housing wealth on the consumption of households who *want* to borrow, so it is not surprising that there is a strong effect.

[17] I define liquid wealth as households' stock market wealth plus cash holdings less any outstanding non-collateralized debt.

households' liquid wealth to income quintiles (LWY). The estimates suggest that the direct housing wealth effect is strongest and most precisely estimated for households in the lowest quintile of the LWY distribution (top panel). This finding is consistent with the idea that changes in housing wealth matter the most for households with limited other liquid financial resources. There is also evidence of a direct wealth effect for households in the third wealth quintile. Households in the highest quintile also exhibit a substantial response to housing wealth changes, but the effect is not precisely estimated.

When I control for households' borrowing needs, the results suggest that the borrowing collateral role of housing wealth matters for the relationship between house values and consumption even across the LWY distribution. In particular, households who are constrained and in the lowest wealth quintile increase their consumption 9 cents per dollar increase in their housing wealth. The direct wealth effect for households in the lowest quintile is also attenuated a good deal. As a result, it appears that households who have low liquid assets *and* low income relative to average are the ones who respond the most to changes in their housing wealth. This finding is consistent with the results in Hurst and Stafford (2004) as well.

The consumption of constrained households with high levels of liquid assets responds strongly to changes in their housing wealth. This finding is somewhat surprising, since households with sufficient liquid assets should not need to borrow against their homes to finance consumption. This result, however, may be driven by the behavior of older households. Such households likely have accumulated lots of assets given their age, and they may respond to changes in housing wealth because of plans to downsize their housing stock and realize their housing capital gains. The result is also consistent with a potential preference by all households for using home equity financing because of its relatively low cost. To the extent households believe they can earn a higher return on their liquid assets than the interest costs on their collateralized borrowing then it makes sense to borrow to smooth their consumption rather then spending down their higher yielding assets.

2.5.3 Other Sensitivity Analysis

An additional potential concern with my results is that my approach for capturing households borrowing demand may be capturing income changes from households' planned labor market transitions rather than true income shocks. For instance, a spouse may enter and then decide to leave the labor force. If this move is anticipated then it does not represent a shock to households' spending capabilities, and thus my

approach may not identify households' true borrowing need. My results are little changed, however, if I eliminate households with labor market transitions from my sample (not reported).

I also investigate whether my treatment of households' saving in equities impacts my results. Recall, that I construct and use a counter-factual measure of households' saving in equities rather than use the reported data in the PSID. To check the sensitivity of my results to this approach, I recalculate household consumption using two alternative measures of active saving: total active saving as reported in the PSID (including stocks) and total reported active saving *excluding* equities.[18] Using these alternative measures of non-housing consumption, however, do not substantially impact my results (not reported).

Finally, I investigate the sensitivity of my results to how I control for potential macroeconomic trends in household consumption. Accounting for such trends is important because there could be some macroeconomic shock that influences both house prices and consumption. For example, if households feel better (or worse) about their future income prospects, then their spending would likely rise (fall). House prices would increase (decrease) as well in anticipation of a change in the future demand for housing services. As a result, housing wealth and consumption would be positively correlated, but the change in house prices would not be causing the variation in consumption. My baseline specification accounts for potential macroeconomic trends with the year fixed effects. These year dummies theoretically pick up changing employment, interest rates, technology or other time varying aggregate factors that may influence both consumption and house prices. Estimating my baseline specification using the actual change in the unemployment rate or the change in interest rates over the relevant periods in the data rather than the year fixed effects does not noticeable alter the results.[19]

2.6 Conclusion

Real house prices rose rapidly in the United States in the first half of the 2000s. Banks willingly and without much scrutiny extended primary mortgages to first time homeowners and secondary mortgages to existing homeowners who wanted to borrow against their homes to finance their spending. Aggregate consumption remained robust despite the collapse of the technology bubble in the stock market, and the

[18]Excluding household saving in equities could bias up my measure of non-housing consumption. This consumption calculation is valid, however, to the extent that the majority of households' direct saving in equities (non-retirement accounts) is not very large.

[19]These results and others that are not reported in this section are available upon request.

economic slowdown following the events of September 11, 2001. Indeed, the annual personal saving rate continued its downward trend in the early part of the 2000s, and was nearly zero in 2005 before rebounding a little starting in 2006. Many economists and politicians attributed the strong spending and low saving to households feeling wealthy as a result of their rapidly appreciating home values. The key question, especially now that house prices have declined substantially, is how household consumption will respond.

This paper investigated the causal relationship between changes in housing wealth and consumption using data from the PSID. In particular, I examined the borrowing collateral role of housing wealth versus a so-called direct or net wealth effect of housing wealth on households' financial resources. Since higher house prices imply a higher cost of housing services, rising house values should theoretically impact consumption to the extent they allow households opportunities to smooth consumption by borrowing against their home. The data do not cover the most recent housing slump, but they do span previous housing cycles.

The estimation results support the borrowing collateral role of housing wealth. In particular, a 1 dollar increase in housing wealth leads to roughly 11 cents higher consumption for households with potentially high borrowing needs. In contrast, changes in housing wealth have little impact on the expenditures of households whose borrowing demand is low. The results that incorporate household leverage further reinforce the importance of the role of housing wealth as borrowing channel. Finally, my back-of-the-envelope calculations show that the direct impact of the decline in house prices in 2008 on aggregate non-housing consumption is relatively small. In particular, the roughly 11 percent decline in real housing wealth lead to a 75 basis point fall in consumption, much of which can be attributed to the borrowing collateral role of housing wealth.

An interesting and related question given my results, is on what margin or margins do households adjust their consumption in response to a decline in housing wealth after a period of robust house price growth and much home equity financed borrowing? In particular, does the consumption of households who borrowed return to its pre-boom level or do these households have to substitute some of their pre-boom spending for increased debt service costs? Unfortunately, the PSID does not have the necessary detailed consumption data to consider households' margin(s) of spending adjustment in response to house price changes. A data set such as the Consumer Expenditure Survey has the necessary detailed consumption data for such analysis, but lacks adequate information about households' housing and other wealth changes. Considering what areas of consumption are impacted by falling house prices is worth-

while because it provides information as to which sector(s) of the economy may be affected the most by changing home values. I leave these considerations, however, to future research.

Table 2.1

Baseline Regressions

Levels

Regressor	(1)	(2)	(3)
Lagged Income (Y_ℓ)	0.824***	0.903***	0.901***
	(0.054)	(0.060)	(0.061)
Financial Wealth$_{t-1}$	0.065***	0.063***	0.064***
	(0.006)	(0.006)	(0.007)
Housing Wealth$_{t-1}$	0.036***	0.014	0.014
	(0.010)	(0.012)	(0.012)
I_ℓ		2735.0	2887.8
		(2816.8)	(2845.0)
Housing Wealth$_{t-1} \cdot I_\ell$		0.094***	0.097***
		(0.025)	(0.024)
Finacial Wealth$_{t-1} \cdot I_\ell$			−0.004
			(0.015)
Memo:			
MPC Housing Wealth $\mid I_\ell = 1$		0.109***	0.110***
		(0.022)	(0.022)
N	6172	6172	6172

Y_ℓ is households' lagged income, and I_ℓ is an indicator variable that takes a value of 1 if a household is a potential borrower and is 0 otherwise. All regressions treat income as endogenous and are estimated using two-stage least squares (2SLS). Each specification also controls for year fixed effects, a cubic term for the age of the household head, the number of household members, and the number of children younger than 18. Robust errors are in parentheses: * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Table 2.2

Baseline Regressions

Logs

Regressor	(1)	(2)	(3)
Lagged Income (Y_ℓ)	0.826^{***}	0.942^{***}	0.942^{***}
	(0.036)	(0.040)	(0.040)
Financial Wealth$_{t-1}$	0.010^{***}	0.009^{***}	0.008^{***}
	(0.004)	(0.002)	(0.002)
Housing Wealth$_{t-1}$	0.090^{***}	0.033^{*}	0.035^{*}
	(0.019)	(0.020)	(0.020)
I_ℓ		-0.945^{*}	-0.799^{*}
		(0.445)	(0.458)
Housing Wealth$_{t-1} \cdot I_\ell$		0.121^{***}	0.105^{***}
		(0.039)	(0.041)
Finacial Wealth$_{t-1} \cdot I_\ell$			0.005
			(0.005)
Memo:			
MPC Financial Wealth	0.005^{***}	0.005^{***}	0.004^{***}
	(0.001)	(0.001)	(0.001)
MPC Housing Wealth	0.036^{***}	0.013^{*}	0.014^{*}
	(0.007)	(0.008)	(0.008)
MPC Housing Wealth $\mid I_\ell = 1$		0.060^{***}	0.054^{***}
		(0.016)	(0.016)
N	6167	6167	6167

Y_ℓ is households' lagged income, and I_ℓ is an indicator variable that takes a value of 1 if a household is a potential borrower and is 0 otherwise. All regressions treat income as endogenous and are estimated using two-stage least squares (2SLS). Each specification also controls for year fixed effects, a cubic term for the age of the household head, the number of household members, and the number of children younger than 18. Robust errors are in parentheses: * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Table 2.3

Baseline Regressions by Age Group

Regressor	age ≤ 35		$35 <$ age ≤ 50		$50 <$ age ≤ 65	
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged Income (Y_ℓ)	0.987***	1.069***	0.890***	0.959***	0.695***	0.769***
	(0.153)	(0.171)	(0.079)	(0.088)	(0.083)	(0.095)
Financial Wealth$_{t-1}$	0.044**	0.048*	0.060***	0.056***	0.075***	0.075***
	(0.020)	(0.028)	(0.009)	(0.010)	(0.009)	(0.011)
Housing Wealth$_{t-1}$	0.026	0.003	0.016	−0.005	0.070***	0.051***
	(0.021)	(0.024)	(0.015)	(0.017)	(0.017)	(0.019)
I_ℓ		7961.1		1004.8		3331.6
		(5664.9)		(4305.5)		(4780.5)
Housing Wealth$_{t-1} \cdot I_\ell$		0.058		0.114***		0.075*
		(0.053)		(0.033)		(0.039)
Finacial Wealth$_{t-1} \cdot I_\ell$		−0.018		0.008		−0.008
		(0.036)		(0.027)		(0.020)
Memo:						
MPC Housing Wealth $\mid I_\ell = 1$		0.061		0.109***		0.126***
		(0.049)		(0.031)		(0.035)
N	948	948	3160	3160	2064	2064

Y_ℓ is households' lagged income, and I_ℓ is an indicator variable that takes a value of 1 if a household is a potential borrower and is 0 otherwise. All regressions treat household income as endogenous and are estimated using 2SLS. Each specification also controls for year fixed effects, a cubic term for the age of the household head, the number of household members, and the number of children younger than 18. Robust errors are in parentheses: * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Table 2.4

Baseline Regressions with Household Leverage

Regressor	(1)	(2)	(3)	(4)	(5)
Lagged Income (Y_ℓ)	0.824***	0.901***	0.825***	0.891***	0.897***
	(0.054)	(0.061)	(0.054)	(0.060)	(0.061)
Financial Wealth$_{t-1}$	0.065***	0.064***	0.066***	0.063***	0.064***
	(0.006)	(0.007)	(0.006)	(0.006)	(0.007)
Housing Wealth$_{t-1}$ (h_{t-1})	0.036***	0.014	0.034***	0.026**	0.015
	(0.010)	(0.012)	(0.011)	(0.011)	(0.012)
I_ℓ		2887.8		$1.5e+04$***	4198.1
		(2846.0)		(1997.6)	2994.9
Housing Wealth$_{t-1} \cdot I_\ell$		0.097***			0.086***
		(0.024)			(0.025)
Finacial Wealth$_{t-1} \cdot I_\ell$		−0.004			−0.004
		(0.015)			(0.015)
$LTV_{t-2} \geq 0.8, \Delta p^H_{t-1} < 0$			-1879.3	-1315.0	
			(1862.0)	(1841.4)	
$LTV_{t-2} \geq 0.8, \Delta p^H_{t-1} \geq 0$			2699.3	3415.9*	
			(1920.8)	(1933.7)	
$LTV_{t-2} < 0.8, \Delta p^H_{t-1} \geq 0$			1179.2	1402.6	
			(1114.8)	(1122.2)	
L_{t-1}					1346.3
					(1674.7)
$L_{t-1} \cdot I_\ell$					$-1.7e+04$***
					(1674.7)
$h_{t-1} \cdot L_{t-1} \cdot I_\ell$					0.145***
					(0.054)
Memo:					
MPC HW $\mid I_\ell = 1$[a]		0.110***			0.101***
		(0.022)			(0.022)
MPC $\mid I_\ell = 1 \& L_{t-1} = 1$					0.245***
					0.049
N	6172	6172	6172	6172	6172

[a] MPC out of housing wealth. Y_ℓ is households' lagged income, I_ℓ is an indicator variable that takes a value of 1 if a household is a potential borrower and is 0 otherwise, L_{t-1} is a indicator that equals one if a household's LTV ratio is greater than 0.8 and is zero otherwise, and Δp^H_{t-1} is the change in house prices between time $t-2$ and $t-1$. The positive and negative price changes correspond to the *loss* and *gain* variables in equation 2.3. Similarly, $LTV_{t-2} \geq 0.8$ or $LTV_{t-2} < 0.8$ signifies that a households' leverage is *high* or *low* respectively. See text for a further discussion. All regressions treat household income as endogenous and are estimated using 2SLS. Each specification also controls for year fixed effects, a cubic term for the age of the household head, the number of household members, and the number of children younger than 18. Robust errors are in parentheses: * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Table 2.5

Baseline Regressions with Food Consumption

Regressor	Total Food		Food at Home		Food Away	
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged Income (Y_ℓ)	0.029**	0.031*	0.021***	0.022***	0.008	0.009
	(0.014)	(0.016)	(0.004)	(0.004)	(0.013)	(0.015)
Financial Wealth$_{t-1}$	0.000	0.000	−0.000	−0.000	0.000**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Housing Wealth$_{t-1}$	0.0054***	0.0047***	0.0046***	0.0043***	0.0008	0.0004
	(0.0013)	(0.0012)	(0.0005)	(0.0006)	(0.0012)	(0.0011)
I_ℓ		-547.8		-42.8		-492.9
		(640.5)		(213.2)		(592.5)
Housing Wealth$_{t-1} \cdot I_\ell$		0.004**		0.001		0.003**
		(0.002)		(0.001)		(0.001)
Finacial Wealth$_{t-1} \cdot I_\ell$		0.001*		0.001**		0.000
		(0.001)		(0.000)		(0.000)
Memo:						
MPC Housing Wealth $\mid I_\ell = 1$		0.0088***		0.0052***		0.0036***
		(0.0014)		(0.0009)		(0.0008)
N	6148	6148	6155	6155	6161	6161

Variables, regression setup and notation are the same as defined in previous tables.

Table 2.6

Baseline Regressions with Additional PSID Consumption Data (1999-2005)

Regressor	(1)	(2)	(3)	(4)
Income (Y_t)	0.201***	0.207***	0.209***	0.218***
	(0.012)	(0.012)	(0.017)	(0.017)
Financial Wealth$_{t-1}$	0.001*	0.001	0.003**	0.002
	(0.000)	(0.001)	(0.001)	(0.001)
Housing Wealth$_{t-1}$	0.008***	0.005**	0.004	0.002
	(0.002)	(0.003)	(0.003)	(0.003)
I_ℓ		-1.3e+03		-957.4
		(732.8)		(866.5)
Housing Wealth$_{t-1} \cdot I_\ell$		0.013**		0.011*
		(0.005)		(0.006)
Finacial Wealth$_{t-1} \cdot I_\ell$		−0.000		0.003
		(0.001)		(0.003)
Memo:				
MPC Housing Wealth $\mid I_\ell = 1$		0.018***		0.012**
		(0.005)		(0.005)
N	5879	5879	4392	4392
Sample	Unrestricted		Restricted	

"Unrestricted" regressions use all the available consumption data minus outliers as discussed in the text; the "restricted" sample is limited to those households who are also in my baseline regressions. All regressions treat household income as endogenous and are estimated using 2SLS. The rest of the setup is the same as defined in previous tables.

Table 2.7

Implied Aggregate Non-Housing Consumption Change in 2008

Real Price Change	**Pooled**[a]	**Constrained Only**[b]	**Separating Constrained & Unconstrained**[c]
	Percent Change		
Aggregate Price Data			
11 % Decline[d]	-0.73 (-0.70 -0.76)	-0.47 (-0.42 -0.52)	-0.71 (-0.68 -0.74)
11 % Decline[d] *(w/ converted food MPCs)*[e]	-0.69 (-0.66 -0.71)	-0.24 (-0.21 -0.26)	-0.71 (-0.68 -0.74)
State by State Data			
Actual Price Decline[f]	-0.69 (-0.64 -0.73)	-0.45 (-0.39 -0.51)	-0.66 (-0.60 -0.72)
Actual Price Decline[f] *(w/ converted food MPCs)*[e]	-0.65 (-0.60 -0.69)	-0.23 (-0.20 -0.26)	-0.67 (-0.62 -0.71)

[a] Aggregate effects ignoring the borrowing collateral role of housing wealth; [b] aggregate effects assuming just constrained households are impacted by change in housing wealth; [c] aggregate effects incorporating borrowing collateral role of housing wealth for both constrained and unconstrained households; [d] based on aggregate Flow of Funds data for 2008; [e] results based on using converted food consumption housing wealth MPCs as discussed in the text; [f] actual state level house price declines based on reported OFHEO data.

Table 2.8

Sensitivity of Baseline Results to Borrowing Demand Indicator Cut-offs

Regressor	Baseline (1)	Cutoff (0.95) (2)	Cutoff (0.85) (3)	Cutoff (1.10) (4)
Lagged Income (Y_ℓ)	0.901^{***}	0.912^{***}	0.902^{***}	0.920^{***}
	(0.061)	(0.063)	(0.061)	(0.064)
Financial Wealth$_{t-1}$	0.064^{***}	0.066^{***}	0.064^{***}	0.056^{***}
	(0.007)	(0.008)	(0.007)	(0.009)
Housing Wealth$_{t-1}$	0.014	0.009	0.013	0.071^{***}
	(0.012)	(0.012)	(0.012)	(0.014)
I_ℓ	2887.7	3149.6	2210.0	$-4.4e+03^{**}$
	(2847.0)	(2467.7)	(3173.6)	(2042.9)
Housing Wealth$_{t-1} \cdot I_\ell$	0.097^{***}	0.093^{***}	0.122^{***}	-0.067^{***}
	(0.024)	(0.021)	(0.026)	(0.017)
Finacial Wealth$_{t-1} \cdot I_\ell$	-0.004	-0.012	-0.009	0.012
	(0.015)	(0.013)	(0.015)	(0.012)
Memo:				
MPC Housing Wealth $\mid I_\ell = 1$	0.110^{***}	0.095^{***}	0.124^{***}	0.010
	(0.022)	(0.017)	(0.022)	(0.013)
N	6172	6172	6172	6172

The cut-off value refers to the level of current income relative to average income that determines households' borrowing demand. In particular, a cut-off of 0.95 means that current income is at least 5 percent lower than average income. The cut-off in my baseline specification is 0.90. The cut-off of 1.10 is the false experiment as discussed in the text. All regressions treat household income as endogenous and are estimated using 2SLS. Each specification also controls for year fixed effects, a cubic term for the age of the household head, the number of household members, and the number of children younger than 18. Robust errors are in parentheses: * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Table 2.9

Baseline Regressions with Continuous Borrowing Demand Variable

Regressor	(1)	(2)
Lagged Income (Y_ℓ)	0.824***	1.074***
	(0.054)	(0.071)
Financial Wealth$_{t-1}$	0.065***	0.058***
	(0.006)	(0.007)
Housing Wealth$_{t-1}$	0.036***	0.047***
	(0.010)	(0.012)
$\frac{Y_\ell^i}{Y}$		-1.4e+04***
		(3625.3)
Housing Wealth$_{t-1} \cdot \frac{Y_\ell^i}{Y}$		-0.119^{***}
		(0.030)
Financieal Wealth$_{t-1} \cdot \frac{Y_\ell^i}{Y}$		0.008
		(0.013)
N	6172	6167

$\frac{Y_\ell^i}{Y}$ is households lagged income relative to their average income in logs. The rest of the setup is the same as discussed previously.

Table 2.10

Housing Wealth Effects by Liquid Wealth to Income Quintile

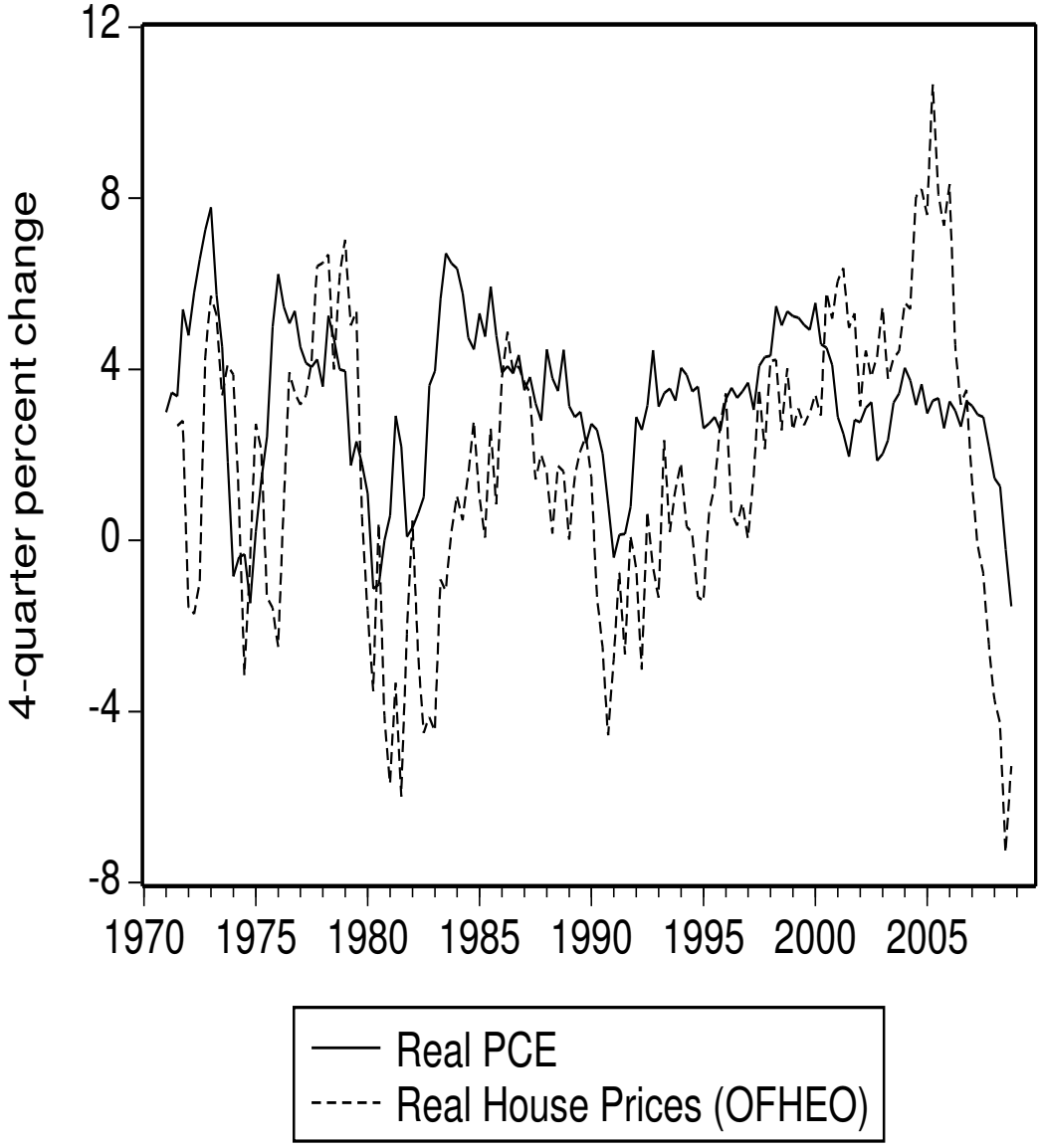
Regressor	First Quintile (1)	Second Quintile (2)	Third Quintile (3)	Fourth Quintile (4)	Fifth Quintile (5)
Lagged Income (Y_ℓ)	0.783***	0.726***	0.672***	0.796***	1.043***
	(0.121)	(0.104)	(0.106)	(0.098)	(0.135)
Financial Wealth$_{t-1}$	0.066***	0.071*	0.074***	0.052***	0.054***
	(0.016)	(0.036)	(0.023)	(0.015)	(0.008)
Housing Wealth$_{t-1}$	0.043***	0.020	0.032**	0.005	0.051
	(0.015)	(0.023)	(0.016)	(0.016)	(0.035)
N	1254	1205	1236	1242	1235

Regressor	First Quintile (1)	Second Quintile (2)	Third Quintile (3)	Fourth Quintile (4)	Fifth Quintile (5)
Lagged Income (Y_ℓ)	0.850***	0.737***	0.729***	0.831***	1.212***
	(0.139)	(0.116)	(0.104)	(0.107)	(0.163)
Financial Wealth$_{t-1}$	0.069***	0.090*	0.055***	0.052***	0.051***
	(0.017)	(0.047)	(0.019)	(0.019)	(0.009)
Housing Wealth$_{t-1}$	0.027*	0.013	0.029*	−0.010	0.002
	(0.016)	(0.026)	(0.016)	(0.017)	(0.046)
I_ℓ	7503.1*	5459.5	3906.0	-2.4e+03	5200.5
	(3910.6)	(3524.8)	(4041.0)	(5640.4)	(9486.2)
Housing Wealth$_{t-1} \cdot I_\ell$	0.055*	0.030	−0.027	0.088**	0.160**
	(0.028)	(0.039)	(0.025)	(0.045)	0.066)
Financial Wealth$_{t-1} \cdot I_\ell$	−0.027	−0.087*	0.129***	−0.010	0.000
	(0.038)	(0.048)	(0.049)	(0.031)	(0.017)
Memo:					
MPC Housing Wealth $\mid I_\ell = 1$	0.082***	0.043	0.001	0.077*	0.162***
	(0.027)	(0.032)	(0.025)	(0.042)	(0.051)
N	1254	1205	1236	1242	1235

Quintiles are determined based on the distribution of households' liquid wealth relative to income in the baseline sample. Variable definitions are the same as discussed in previous tables. All regressions treat household income as endogenous and are estimated using 2SLS. Each specification also controls for year fixed effects, a cubic term for the age of the household head, the number of household members, and the number of children younger than 18. Robust errors are in parentheses: * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Figure 2.1

Consumption Growth versus House Price Growth



Source: Author's calculations based on NIPA data (Real PCE) and house price data (OFHEO).

A Appendix

A.1 Data Definitions

Real House Prices: Published by the Office of Housing Enterprise Oversight (OFHEO). The house price index is constructed based on a repeat sales methodology using conforming loan data from Freddie Mac and Fannie Mae. The current ceiling for conforming home loans is four hundred and seventy one thousand dollars. See http://www.ofheo.gov/HPI.aspx for more details regarding the construction of the house price index. The nominal data are deflated using the personal consumption expenditure (PCE) deflator excluding housing. This deflator is based off of the published price deflators for total PCE and total housing services consumption in the National Income and Product Accounts (NIPA).

Real Consumption Excluding Housing: Calculated using the fisher aggregation method given the NIPA data on total PCE and total housing services.

Aggregate Real Housing Wealth: Comes from the Flow of Funds (FOF) accounts published by the Federal Reserve Board (Table B.100 line 4). I deflate the nominal data from the FOF, where applicable, using the PCE deflator excluding housing.

Total Household Wealth: Comes from the Flow of Funds (Table B.100 line 1).

Home Equity Debt Relative to Income: Data on households' home equity debt comes from the Flow of Funds (Table L.218 line 22). The income data is households' disposable income (total income less taxes) from the NIPA accounts.

A.2 Active Saving in Stocks

Generally, households have a good sense of what their portfolio is worth at a given point in time. They are likely less able to distinguish between capital gains on equity holdings and any additional investments or withdrawals from their brokerage accounts as they are asked to do in the PSID. As a result, I construct an alternative measure of households' active saving in stocks based on households' reported portfolio values and the market rate of return between period $t-1$ and period t.

In particular, I take the value of a household's stock portfolio at time $t-1$ and calculate its implied portfolio value in period t based on the actual stock market growth rate between $t-1$ and t. This yields a measure of the household's stock

portfolio value at period t excluding any additions to or subtractions from the account. More formally,

$$V_t^{i,m} = (1 + g_{t-1,t})V_{t-1}^i \tag{A.1}$$

where $V_t^{i,m}$ is the implied value of a household's portfolio based on the market return, V_{t-1}^i is the value of the household's reported equity positions at time $t-1$, and $g_{t-1,t}$ is the stock market growth rate.[20] I assume that a household's active saving in equities is the difference between its reported portfolio value in period t and its implied portfolio value $V_t^{i,m}$ from equation A.1. In particular,

$$\bar{AS}_{t-1,t}^{i,s} = V_t^{i,cg} - V_{t-1}^i \tag{A.2}$$

where $\bar{AS}_{t-1,t}^{i,s}$ is the implied measure of active saving in stocks for each household. I use this saving measure in place of households' reported measure of active saving in stocks in my analysis.

A.3 Data Comparisons to Various Benchmarks

House Prices

Housing wealth in the PSID is self-reported, which raises potential measurement error concerns. Benítez-Silva et al. (2008) show however that households' self-reported house prices are reasonably accurate relative to actual prices using data on self-reported prices and actual home sale prices from the Health and Retirement Survey. Self-reported house values are appropriate for the analysis in this paper, to the extent households' consumption responds to their ex-post rationalized housing wealth gains or losses, .

Figure A.1 compares the mean reported house price growth in the PSID to the year-over-year house price growth as reported by OFHEO. The two series track each other nicely over time, although the growth downturns in the PSID data are not as severe as in the OFHEO data. In addition, aggregate housing wealth data in the PSID is relatively consistent with the aggregate housing wealth data reported in the FOF accounts (not reported). Overall the data suggest that households in the PSID report reasonably accurate housing wealth changes over time. Lovenheim (2008) reaches a similar conclusion about the housing wealth data in the PSID using a slightly different approach. Section A.5 discusses the variation in house prices across households and

[20] I use the equal weighted, total market index published by CRSP (Center for Research in Security Prices) to calculate the stock market growth rate.

across location in more detail.

Consumption

I evaluate the reasonableness of my imputed non-housing consumption measure in two ways. First, I compare spending cross-sectionally by household age groups with the relevant data in the Consumer Expenditure Survey (CEX). The CEX data are used for calculating much of the Consumer Price Index, and are considered by many to be the most complete and comprehensive measure of micro level household spending. Figure A.2 graphs the relevant consumption-age profiles.

Both the PSID and CEX profiles show the expected hump shaped patterns over the age distribution. My imputed consumption measure, however seems on average to be a bit lower than the CEX data for the younger age groups. In contrast, consumption in the PSID is a good bit higher for older households. Non-housing consumption peaks later in the PSID than the CEX, but this is true even for actual reported consumption measures in the PSID post-1999 (see Charles et al. (2007) for more details). Overall the age profile for imputed non-housing consumption looks reasonable. Non-housing spending in the PSID is not dramatically too low or orders of magnitude too high relative to the CEX. The fact that there is too much consumption for older households is not a huge concern since I limit my estimation sample to households younger than 65. My results also hold across different age groups.

I also aggregate the imputed non-housing consumption data and compare them with the relevant non-housing consumption data in the NIPA accounts. These results appear in Table A.1 below. Again, the implied aggregate non-housing consumption data from the PSID is not orders of magnitude different from the NIPA data. The PSID data, however, are a good bit lower than the NIPA data and they do not monotonically increase over time. One possible explanation for this pattern is that the PSID weights are designed for comparing sample means to population means and not sample aggregates to population aggregates. Overall, the evidence in Figure A.2 and Table A.1 suggest that the imputed consumption data are a reasonable measure of households' non-housing expenditures.

Table A.1

Average Consumption Excluding Housing per Period
Billions of 2000 Dollars

Period	NIPA	PSID
84-89	3570	3640 (3530 3760)
89-94	4105	3570 (3470 3670)
94-99	4874	4560 (4400 4720)
99-01	5690	4750 (4600 4900)
01-03	6061	4630 (4500 4760)
03-05	6467	4700 (4560 4840)

Numbers in parentheses represent a 95 percent confidence interval for the PSID totals. The table reports average expenditures over the relevant period.

A.4 OLS versus 2SLS Estimates

Table A.2 below reports estimates of my baseline specification where I do and do not control for the potential endogeneity of income. Households' MPC out of income is attenuated toward zero when I do not account for the potential endogeneity (OLS estimates). In comparison, the 2SLS estimates show that households' non-housing consumption moves roughly one for one with changes in their income. These estimates are more reasonable. In particular, consumption and income are co-integrated and households' MPC out of income should be 1 if the income data capture households' permanent income. Households' reported income data in the PSID likely includes some amount of transitory income, however, so it is not surprising that their MPC out of income is not exactly 1 even after controlling for the potential endogeneity.

I also use a modified distance test to check the endogeneity of lagged income (Y_ℓ). I can reject the null that lagged income is *exogenous* at all conventional levels. My instrument (twice lagged income) also passes the standard weak instrument tests (first stage F-stat ≈ 900).

Table A.2

OLS versus 2SLS Estimates

Regressor	(1)	(2)	(3)	(4)
Lagged Income (Y_ℓ)	0.546***	0.299***	1.101***	0.824***
	(0.081)	(0.058)	(0.045)	(0.054)
Financial Wealth$_{t-1}$		0.075***		0.065***
		(0.007)		(0.006)
Housing Wealth$_{t-1}$		0.105***		0.036***
		(0.010)		(0.010)
Age$_{t-1}$	3156.3	378.7	2531.0	1615.9
	(2882.0)	(2583.5)	(2931.4)	(2630.8)
Age$^2_{t-1}$	−60.4	0.296	−63.2	−39.0
	(66.1)	(59.3)	(67.6)	(60.6)
Age$^3_{t-1}$	0.408	-0.064	0.539	0.303
	(0.492)	(0.441)	(0.505)	(0.453)
# Family Unit$_{t-1}$	3894.4***	4975.1***	−886.2	941.3
	(1010.2)	(826.3)	(862.5)	(815.1)
# Kids$_{t-1}$	-3.2e+03***	-4.4e+03***	1278.3	-454.0
	(979.1)	(972.5)	(1084.3)	(1002.1)
N	6172	6172	6172	6172
Method	OLS	OLS	2SLS	2SLS

Y_ℓ is households lagged income. Regression methods used are ordinary least squares (OLS), and two-stage least squares (2SLS) where household income is treated as endogenous. Robust standard errors are in parentheses: * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

A.5 PSID versus Actual House Price Variation

In order to identify the relationship between housing wealth and consumption at the household level, there needs to be sufficient variation in reported house values in the PSID both across households and over time. This section discusses the variation in actual house prices over my sample period based on the OFHEO data as well as the reported house value changes in the PSID.

Figure A.3 shows the real, year-over-year growth rates of the OFHEO house price index from 1971 until the present. The actual OFHEO index begins in 1975, however I overlay data from the Freddie Mac Conventional Mortgage House Price Index (CMHPI), which begins earlier.[21] The benefit of using the OFHEO or CMHPI house price indices to analyze trends in US house prices is that they control for changes in housing quality over time. In addition, the the indices have much broader geographic coverage compared to the Case-Shiller index.

[21]The CMHPI follows the same repeat sales methodology as the OFHEO index, but includes a smaller number of housing transactions.

The data suggest that prior to the run-up in house prices in the mid-1990s there were two previous housing cycles. One cycle occurred in the late 1970s and the other from the mid-1980s until the early 1990s. Neither of these previous episodes exhibit the extended run-up in house price growth that occurred during the most recent housing boom. Both earlier cycles, however, included periods of high positive and high negative house price growth. The PSID data in this paper thus cover a period where house prices rose sharply (late 1980s) and declined considerably (early 1990s).

In addition, actual house prices at the local level vary greatly over my sample period. Table A.3 shows the relative peaks and troughs of real, four-quarter OFHEO house price growth for selected MSAs between 1980 and 2006. The table also reports the cumulative, real price growth in each MSA between the first quarter of 1980 and the fourth quarter of 2005. The data suggest that large house price growth fluctuations occurred in MSAs on both coasts over this period while interior MSAs experienced more modest price changes. The MSA data also show that periods of strong price growth or large price declines did not occur simultaneously across areas of the country. For instance, while the Los Angeles MSA witnessed more than a 11 percent decline in prices in late 1994, Denver experienced a period of robust price *growth*. Similarly, MSAs like Denver and St. Louis experienced large price growth declines in the late 1980s while other MSAs had substantial price appreciation. In addition, prices declined in late 2001 in the Rochester MSA at a time when elsewhere house prices rose considerably. Overall, these data show that my sample covers a period with noticeable actual house price variation.

The question remains though whether there is adequate reported house price fluctuations in the PSID data to exploit the actual house price variation for identifying the relationship between housing wealth and consumption. I cannot directly compare the actual MSA house price growth to the reported house price changes in the PSID because the public PSID data do not have MSA level identifiers. I can, however, examine variation based on households' state of residence. Table A.4 shows that there is indeed substantial fluctuations in reported house value changes in the PSID across states and over time. For example, roughly 41 percent of households in Michigan report price declines greater than 10 percent between 1982 and 1984. In contrast, only 16 percent of households in Massachusetts reported price drops of the same magnitude over that period. This trend is consistent with the price growth reported by OFHEO at the MSA level for Detroit versus Boston in the early 1980s (see Table A.3). Notice as well that some households report large price declines during the early 2000s when overall house price growth in the United States shot up. As a result, my sample includes variation in reported house values even during the recent

price boom. In addition, there is plenty of within state housing wealth fluctuations. California and Tennessee are particularly good examples.

Table A.5 shows the percentage of households in my sample for selected states. The data in the table suggest that there is adequate household representation in the PSID across the regions that experienced the largest house price fluctuations over time. Arguably, only knowing a household's state of residence is a potential concern since there is a big difference in housing trends between cities such as New York and Rochester that are in the same state. This data limitation should not adversely impact my results, however, to the extent that households in Rochester and New York City recognize that their local house value fluctuations differ from other areas of the state.

Table A.3

Peak and Trough Real House Price Growth for Selected MSAs

Boston		Cincinnati		Chicago		Dallas		Denver	
1982Q2	-2.2	1982Q3	-10.9	1981Q4	-8.9	1978Q4	11.9	1978Q4	15.8
1985Q2	26.3	1987Q3	8.3	1985Q2	4.7	1987Q4	-11	1982Q1	4.9
1990Q4	-12.8	1991Q3	-0.3	1990Q4	-2.3	1998Q3	5.3	1987Q4	-7.7
2002Q2	12.5	2004Q4	9.0	2002Q2	4.3	2001Q4	5.1	1994Q2	10.7
2006Q3	-2.5			2006Q3	-1.2	2004Q4	-0.7	2000Q1	12.2
								2003Q3	-0.4
269.4		21.9		89.7		-4.4		63.3	
Detroit		**Houston**		**Los Angeles**		**New York City**		**Philadelphia**	
1979Q1	16.4	1982Q2	11.5	1982Q3	-6.2	1982Q2	-1.1	1982Q1	-6.9
1982Q4	-22	1987Q3	-12.8	1989Q3	19.3	1986Q4	22.6	1987Q3	16.2
1987Q1	11.3	1999Q4	6.2	1994Q4	-11.5	1990Q4	-11.1	1995Q1	-6
1990Q4	-0.9	2004Q4	0.5	2006Q4	28.3	1997Q1	-0.3	2004Q3	14.5
1998Q1	7.6					2004Q3	15.8		
2006Q3	-5.4								
52.5		-13.5		183.4		231.9		119.6	
Pittsburgh		**Rochester**		**San Francisco**		**St. Louis**		**Tuscon**	
1981Q1	-14.3	1983Q1	13	1979Q3	15.1	1981Q2	-15.6	1981Q2	13.3
1987Q3	3.7	1990Q4	-5.6	1982Q1	-6.3	1987Q2	4.7	1982Q4	-14.9
1995Q1	-3.2	1995Q1	-6.2	1988Q4	20.3	1990Q4	-5.7	1986Q2	6.6
1998Q1	4.8	1998Q2	3.3	1991Q1	-8.8	2005Q2	5.9	1990Q4	-5.4
1994Q4	-1.7	2001Q4	-3.5	2000Q3	21.5			1994Q3	8.0
2003Q4	3	2004Q2	2.5	2003Q3	1.4			1997Q2	-0.2
				2005Q2	18.4			2005Q4	25.2
20.0		24.8		220.0		50.2		82.3	

Source: Office of Federal Housing Enterprise Oversight (OFHEO). The second column in each cell lists the real four-quarter growth rate for house prices (in percentage points) as of the given quarter in column one. Prices are deflated using the personal consumption expenditure deflator excluding housing. The number at the bottom of each cell is the cummulative percent change in real house prices between 1981Q1 and 2005Q4. Cell headings are abbreviated. The official MSA names are: Boston: Boston-Quincy, MA ; Chicago: Chicago-Naperville-Joilet, IL; Cincinnati: Cincinnati-Middletown, IN-OH-KY; Dallas: Dallas-Plano-Irving, TX; Denver: Denver-Aurora, CO; Detroit: Detroit-Livonia-Dearborn, MI; Houston: Houston-Sugarland-Baytown, TX; Los Angeles: Los Angeles-Long Beach-Glendale, CA; New York City: New York City-White Plains-Wayne, NY-NJ; Philadelphia: Philadelphia, PA; Pittsburgh: Pittsburgh, PA; Rochester: Rochester, NY; San Francisco: San Francisco-San Mateo-Redwood City, CA; St. Louis: St. Louis, MO-IL; Tuscon: Tuscon, AZ.

Table A.4

Distribution of Self-Reported Real House Price Changes in the PSID for Selected States

House Price Change	1982-1984	1987-1989	1992-1994	1997-1999	1999-2001	2001-2003
			Texas			
Decrease more than 10 %	23	23.4	15.5	17.6	14.4	13.8
Decrease 0 to 10 %	5.9	14.2	14.2	12.4	12.4	13.6
Rise 0 to 10 %	7	3.1	8.3	12.8	8.1	11
Rise more than 10 %	64.2	59.3	61.9	57.2	65.1	61.6
			Tennessee			
Decrease more than 10 %	39.8	19.9	24.6	15	17.5	24
Decrease 0 to 10 %	9.8	22.1	14.6	14.2	16.8	14.9
Rise 0 to 10 %	8.9	8.4	8.2	11	10.7	8.4
Rise more than 10 %	41.5	49.6	52.7	59.8	55	52.6
			New York			
Decrease more than 10 %	14.2	14.9	14.1	11.8	12.4	11.6
Decrease 0 to 10 %	4.4	15.7	20.4	19.5	7.3	6.7
Rise 0 to 10 %	10.5	11.6	13.1	10.4	7.6	8.6
Rise more than 10 %	71	57.8	52.4	58.4	72.7	73.1
			Missouri			
Decrease more than 10 %	34.7	17.3	12.8	18.8	15.6	16.8
Decrease 0 to 10 %	9.4	20.8	17.3	16.1	12.7	8.6
Rise 0 to 10 %	10.3	9.4	20.5	13.4	9.3	12.1
Rise more than 10 %	45.5	52.5	49.4	51.6	62.5	62.5
			Michigan			
Decrease more than 10 %	40.6	20.6	16.7	9.3	10	12.8
Decrease 0 to 10 %	8.3	16.4	17	7.7	9.4	14.7
Rise 0 to 10 %	5.6	7.1	13	13	11.7	9
Rise more than 10 %	45.6	55.9	53.3	70	68.9	63.5
			Masachusetts			
Decrease more than 10 %	16	13.9	21	9.3	4.1	10.1
Decrease 0 to 10 %	7.1	13.9	32.4	16.1	7.5	7.2
Rise 0 to 10 %	13.5	8.3	12.4	13.6	10.9	8.6
Rise more than 10 %	63.5	63.9	34.3	61	77.6	74.1
			Illinois			
Decrease more than 10 %	24	13.2	9.6	15.4	12.3	8.9
Decrease 0 to 10 %	11.1	6.9	16.6	12.2	7.6	8.9
Rise 0 to 10 %	9.2	11.3	10.8	14.9	12.3	8.5
Rise more than 10 %	55.8	68.6	63.1	57.5	67.8	73.6
			California			
Decrease more than 10 %	24.8	11.2	25.7	11.4	7.7	9.3
Decrease 0 to 10 %	11.9	8.2	11.4	10.4	8.8	7.2
Rise 0 to 10 %	6.4	7	5.7	8.7	6.2	6.8
Rise more than 10 %	56.9	73.7	57.1	69.5	77.3	76.7
			Pennsylvania			
Decrease more than 10 %	24.4	16	14.6	14.2	14.5	20.3
Decrease 0 to 10 %	7.6	15.4	15	21.2	18.3	11.4
Rise 0 to 10 %	6.5	8.2	10.8	12.7	11.4	9.5
Rise more than 10 %	61.5	60.4	59.6	51.9	55.8	58.9

Source: Author's calculations using PSID data. The chosen years for price changes correspond to years preceding the periods of active saving and non-housing consumption in my sample. Arguably, these are the price changes that potentially influence households' consumption decisions.

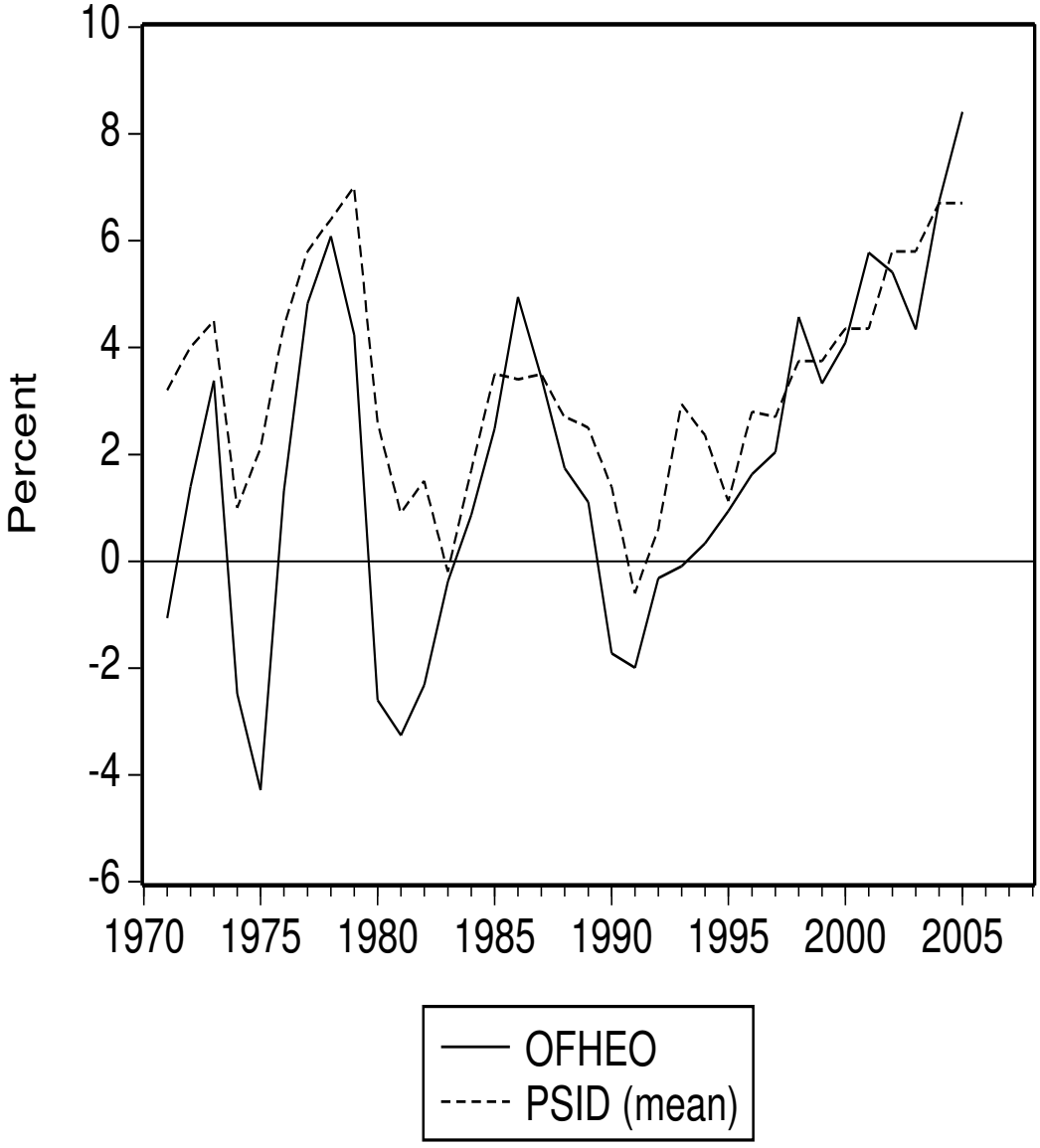
Table A.5

Percent of PSID Sample in Selected States by Sample Year

	1984	1989	1994	1999	2001	2003	2005
CA	9.5	8	6.8	6.7	5.6	5.9	7.6
CO	1.1	1.6	1.7	1.9	2	2	2.1
IL	3.1	3.1	2.9	3	3.5	3.3	3.2
MA	2.1	2.9	3	2.9	3	2.5	3.1
MI	5	5.2	5.3	5.9	5.1	5.2	4.8
MO	3.1	2.6	3.2	3.2	3.3	3.1	3.3
NY	4.3	4.1	3.6	3.8	3.9	3.7	4.2
OH	4.4	4.9	4.9	5.4	5.4	5.3	5.3
PA	5.2	4.4	5.7	5	4.6	5.1	4.1
TN	1.5	1.9	2.3	2.1	2	2.1	1.7
TX	6.1	4.1	4.3	3.5	3.7	4.8	4.9
% Total Sample	45.4	42.8	43.7	43.4	42.1	43	44.3

Figure A.1

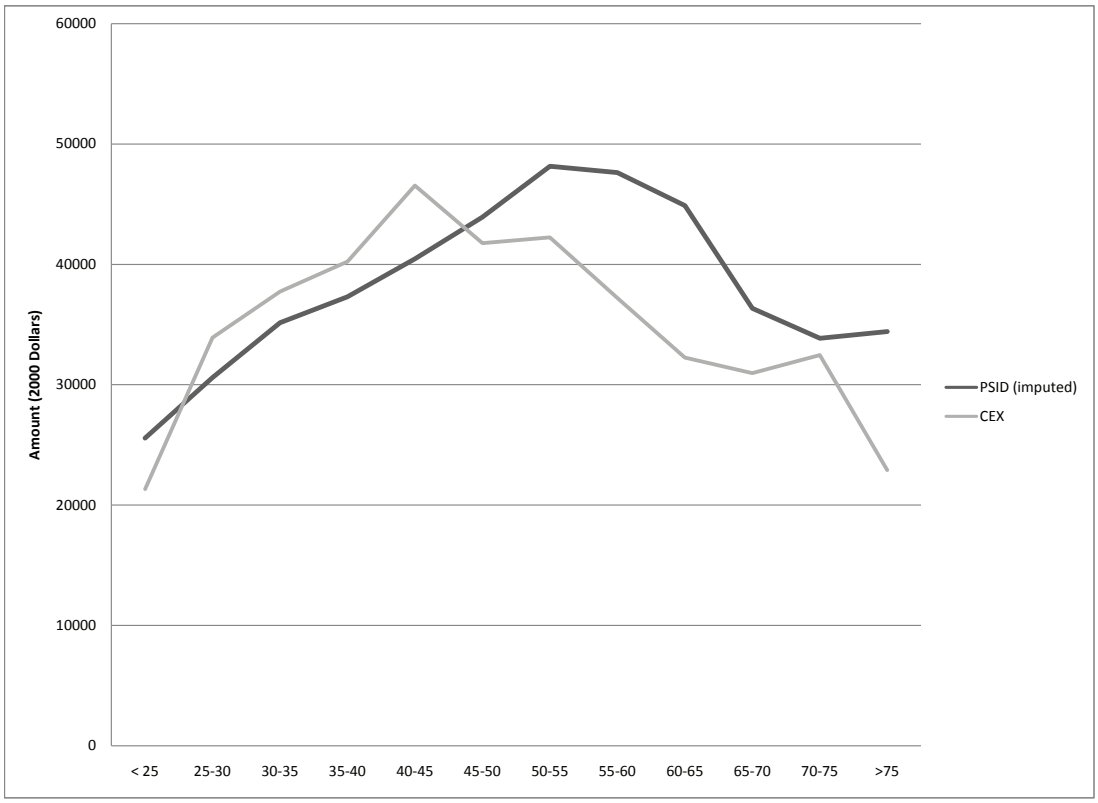
Real Annual House Price Growth: OFHEO versus PSID



Source: Author's calculations based on OFHEO and PSID data.

Figure A.2

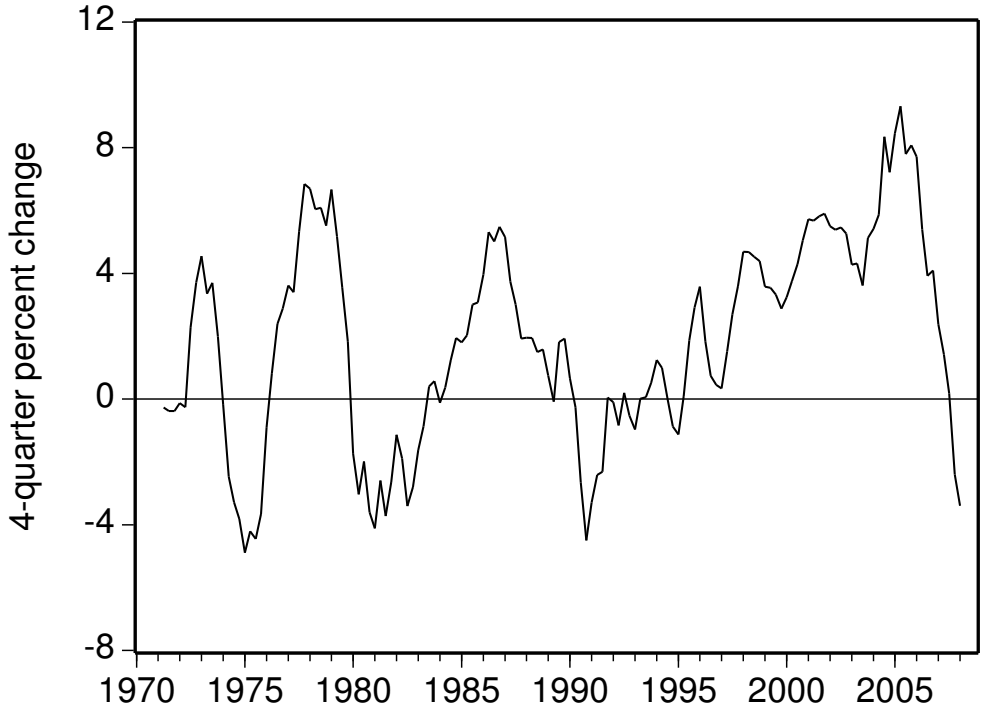
Imputed PSID Spending Data and CEX Data by Age (2001)



Source: Author's calculations based on CEX and PSID data.

Figure A.3

Real House Price Growth



Source: Author's calculations based on OFHEO and CMHPI data.

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Chapter III

Did Easy Credit Lead to Economic Peril? Home Equity Borrowing and Household Behavior in the Early 2000s

3.1 Introduction

According to work by Greenspan and Kennedy (2007), households' net equity extraction from their homes averaged nearly 6 percent of disposable income between 2001 and 2005. Cooper (2009) shows that changes in housing wealth impact households' spending primarily by serving as borrowing collateral. Historically households appear to smooth consumption during periods of income shortfalls by borrowing against their homes. This paper considers the role of equity extraction in more detail during the recent house price boom. In particular, I analyze what factors influence households' decisions to extract equity from their homes. I further consider how such equity extraction impacts household spending and affects households' wealth accumulation and balance sheets.

There are a number of reasons why households may extract equity from their homes in addition to smoothing consumption in response to negative income shocks. For instance households may extract equity to make home repairs or improvements. Anecdotal evidence from the house price boom suggests that many households borrowed to upgrade kitchens and redo landscaping or to expand their homes. In this case, equity extraction is used to fund a one-time consumption shock.

Alternatively, households may borrow against their homes to consolidate other more costly debt such as credit cards. Advertisements during the early 2000s encouraged households to extract equity to pay down their non-collateralized debt. Indeed, home equity credit is one of the cheapest forms of borrowing so it makes sense for households to substitute toward such financing. Not only are the interest rates on home equity lines of credit low compared to credit cards, but the interest payments on

home equity debt are for the most part tax deductible.[1] Indeed, the the ratio of credit card (revolving) debt relative to income peaked around 2000 and has subsequently trended down slightly. At the same time, home equity debt relative to income shot up starting around 2000 and has only recently fallen back (see Figure 3.1).

These alternative roles for home equity borrowing go beyond households' using their housing wealth to smooth consumption. The key question therefore is whether households extracted equity during the house price boom to finance one-time consumption needs or to pay down their more costly debt as the anecdotal evidence suggests. Examining the impact of of home equity borrowing on consumption and household balance sheets is therefore important for understanding what motivated households to borrow against their homes. Such analysis allows me to differentiate between households borrowing to fund additional spending compared with balance sheet reshuffling or consumption smoothing. Making such a distinction is important because the economic implications of the various reasons equity extraction are different.

I investigate households' home equity borrowing behavior using data from the Panel Study of Income Dynamics (PSID) through 2005. The 2007 data, which are also relevant for this study, have not been released as of May 2009. The 2007 data will be incorporated into a future version of this research once they become available. The PSID is beneficial for this study because it tracks families over time. The study also contains data on households' income, housing wealth and mortgage debt, as well as data on households' balance sheets and active saving. One drawback to the PSID is that it has limited data on household expenditures especially prior to 1999. I impute a more comprehensive measure of households' spending, however, using the income and saving data in the PSID. The PSID also contains data on households' vehicle purchases as well as their spending on home improvements and repairs. Both data are useful for investigating the impact of equity extraction on households' big ticket type spending. In addition, the panel structure of the data allows for examining households' borrowing behavior over time.

This paper considers the behavior of households who extract equity during the early 2000s (2001-2005). The analysis also covers households' reasons for equity extraction during the mid-1990s to determine whether their reasons for borrowing have changed over time. Overall the percentage of homeowners extracting equity has increased since the mid-1990s. Households' reasons for extracting equity, however,

[1]Home equity loans used to purchase or improve a property are tax deductible. Home equity lines of credit used for other purposes are deductible up to one hundred thousand dollars. These deductibility rules therefore cover the vast majority of homeowners.

are similar over time. Households with more financial wealth are less likely to extract equity as are households with little existing equity in their homes. Those families who do extract equity tend to live in regions that experience high house price growth and are overall somewhat more educated. Overall, the data are broadly consistent with households using their home equity to finance spending when they lack other resources.

Turning to the relationship between equity extraction and consumption, I find that a 1 dollar increase in equity extraction during either the 2001 to 2003 or 2003 to 2005 periods leads to a nearly 1 dollar increase in households' non-housing consumption over the same period. A sizeable portion of this spending, roughly 17 to 27 cents depending on the period, goes toward home repair and improvement. Households also use their home equity to help finance used car purchases. In addition, households who extract equity in the early 2000s also have a roughly 10 percentage point higher predicted probability of paying down their credit card debt. Homeowners who extract equity are also slightly more likely to increase their investment in other real estate such as vacation homes. As a result, there is some balance sheet reshuffling because of equity extraction, but households appear to primarily spend the money they extract. Overall, my findings are consistent with the refinancing induced "consumption binge" discussed in the popular press.

Further analysis suggests that households indeed extracted equity to fund one-time consumption expenditures. In particular, much of the consumption increase due to equity extraction is reversed in the subsequent period. A 1 dollar increase in equity extraction between 2001 and 2003 leads to a roughly 75 cent decline in consumption between 2003 and 2005.[2] Additional analysis confirms this reversal in expenditures in the period after households' borrow against their homes. Households cannot borrow indefinitely to finance higher spending because of their lifetime budget constraint, but they could potentially borrow smaller amounts for a couple of periods in a row. The expenditure patterns along with the fact only roughly 8 percent of homeowners are repeat borrowers over the aforementioned periods, however, suggest that households did not have persistently high consumption during the early years of the house price boom.

The most relevant previous work on equity extraction and consumption is Hurst and Stafford (2004). In that paper the authors use survey data from the PSID about households' mortgage refinancing activity between 1991 and 1994 to look at the relationship between consumption and home equity borrowing. The authors find evidence

[2]The timing of the equity extraction and consumption analysis is a result of the two year span between waves of the PSID since 1999. I discuss the data availability in greater detail in section 3.3.

that households indeed use their home equity to smooth income shocks. My approach expands on their work by examining the relationship between equity extraction during the house price boom in the early 2000s. My analysis is also not limited to mortgage refinancing activity, but rather incorporates the behavior of households who increase their mortgage debt for any reason. I can also investigate equity extraction behavior over time, and not just during the early 1990s. This research differs from Hurst and Stafford (2004) as well since it analyzes how equity extraction impacts households' balance sheets. In addition, Klyuev and Mills (2006) look at the relationship between mortgage equity withdrawal and household saving using aggregate data across countries. I am interested, however, in the behavior of US households. By using household level data to analyze equity extraction and household behavior, this paper exploits variation across households in terms of their leverage and individual specific house price growth that is not possible with aggregate analysis.

The remainder of the paper proceeds as follows. Section 3.2 presents my empirical approach. Section 3.3 discusses the data and reports summary statistics about equity extraction and households' balance sheets. Section 3.4 presents my empirical results. Section 3.5 concludes.

3.2 Theoretical Framework and Empirical Approach

This paper empirically addresses two primary questions. First, what factor or factors determine whether or not a household extracts equity from its home and have those reasons changed over time? Second, how does equity extraction impact households' spending and balance sheets? I discuss my basic empirical approach for analyzing these issues in the next two subsections.

3.2.1 Factors Affecting Equity Extraction

Macroeconomic theory, and in particular the permanent income hypothesis, states that households' consume the annuity value of their lifetime resources. Households' smooth through transitory income gains by lending or saving and they smooth through transitory income shortfalls by dis-saving or borrowing. The lower a household's non-housing financial assets the greater its demand for borrowing in response to a negative income shock. In fact, households' demand for equity extraction should be inversely related to their amount of *liquid* financial wealth. Households' less liquid assets, such as IRAs, pension accounts, or businesses are not easily accessed to smooth consumption over a short horizon. In contrast, housing wealth, while illiquid, is easily

collateralizable at relatively low costs. This was especially true in the first part of this decade. Indeed, home equity borrowing has been an attractive mode of obtaining credit since 1986 when Congress increased the deductibility of mortgage interest and eliminated the tax deduction for credit card interest. Households with greater equity in their homes should therefore be more likely to extract equity conditional on needing to borrow.

The following cross-sectional, binary choice model considers the factors that determine a household's decision to extract equity from its home:

$$\begin{aligned} E^i_{t,t+1} &= a_0 + a_1 lw^i_t + a_2 iw^i_t + a_3 v^i_t + a_4 L^i_t + a_5 y_t + a_6 \Delta y_{t+1,t} \\ &+ \quad + + a_7 U^i_t + a_8 \Delta p^i_t \beta \mathbf{R^i_t} + \eta \mathbf{Z^i_t} + \epsilon^i_{t,t+1} \end{aligned} \tag{3.1}$$

In particular, $E_{t,t+1}$ is an indicator variable that takes a value of 1 if a homeowner extracts equity from his or her home between period t and period $t+1$ and is zero otherwise, lw^i_t is a household's real liquid financial wealth, iw^i_t is a household's real illiquid financial wealth, U^i_t is an indicator variable that takes a value of 1 if the household suffers a spell of unemployment in period t and is zero otherwise,[3] v^i_t is a household's home loan-to-value (LTV) ratio, L^i_t is an indicator variable that takes a value of 1 if a household's LTV ratio is greater than 0.8 and is zero otherwise, y^i_t is the household's log real disposable income as of period t, $\Delta y_{t+1,t}$ is a household's percent change in income over the equity extraction period, Δp^i_t is the change in the household's home value between $t-1$ and t, $\mathbf{R^i_t}$ is a vector of dummy variables for the region in which the household lives, and $\mathbf{Z^i_t}$ is a vector of household demographics and other covariates. The vector of covariates includes a series of dummy variables for the education level of the household head (HS Grad, College Grad, Advanced Degree), whether the household has college age kids (age 17-21), a cubic term for the age of the household head, a dummy for whether or not the household head is married, and an indicator for whether or not there are multiple earners in the household.

I estimate equation 3.1 using a probit specification. The estimated effects from the regressions report how a given covariate impacts households' predicted probability of extracting equity. The regressions control for the potential endogeneity a household's change in income and their decision to extract equity. Section 3.3 discusses how I determine whether or not a household extracts equity from its home along with how the other relevant variables are calculated. If households extract equity in response

[3] A household is unemployed if the head or spouse (or both) report 6 or more weeks out of working in year t. This approach is consistent with the one used in Hurst and Stafford (2004).

to an income shortfall then there should be a negative relationship between income growth and equity extraction [$a_6 < 0$].

Higher financial wealth should also reduce a household's probability of extracting equity from its home [$a_1 < 0$], holding all else equal, to the extent households use equity extraction to finance necessary expenditures or consumption shocks. In addition, households with LTV ratios greater than 0.8 should be less likely to extract equity given the increased costs of borrowing they face [$a_4 < 0$]. Indeed, banks generally require households to hold primary mortgage insurance when they have less than 80 percent equity in their homes, which greatly increases their borrowing costs. This equity requirement was relaxed somewhat during the house price boom, however, there are few households in the data who report LTV ratios above 0.9. Therefore, leaving the cut-off at 0.8 results in more precise estimates and is consistent with previous approaches in the literature.[4]

In comparison, having college age children may lead to a *higher* probability of equity extraction to the extent that households use home equity loans to help finance post-secondary education. Similarly, households may be more likely to borrow against their homes in regions of the country that experience particularly large house price growth. As prices rise so does households' equity, and banks in general prefer to lend to families with substantial collateral. Finally, households who are unemployed may also have a higher probability of extracting equity [$a_3 > 0$]. These households demand credit to smooth consumption to the extent their unemployment spell restricts their cash flow and limits their ability to finance their consumption.

I estimate equation 3.1 for three time periods: 1994-1996, 2001-2003 and 2003-2005. The 1994 to 1996 period precedes much of the run-up in house prices. These results over this horizon thus provide insight into whether households' reasons for extracting equity during the house price boom differed from their motivations 8 or 10 years earlier. In addition, the results from 2001 to 2003 versus 2003 to 2005 address whether households' reasons for borrowing differed even during the house price boom. Section 3.4.1 reports these results.

[4]See Hurst and Stafford (2004) for a detailed discussion about the (potentially non-linear) relationship between households' LTV ratio and their borrowing and spending behavior.

3.2.2 Impact of Equity Extraction on Household Behavior

3.2.2.1 Consumption

Background

Arguably, there are two basic explanations for why households extract equity from their homes for consumption purposes. The first is that home equity borrowing capacity acts as an alternative buffer stock for labor income risk. Indeed, the fourth chapter of this dissertation shows theoretical evidence that households who face future income uncertainty treat collateralized borrowing capacity as a partial substitute for liquid saving. Households may therefore borrow to smooth consumption in response to a temporary income shortfall. Alternatively, households may extract equity to finance anticipated or unanticipated consumption shocks such as the need to purchase a car, pay college tuition or pay for unforseen medical expenses. These different reasons for equity extraction imply different household spending patterns.

Figure 3.2 shows households' potential consumption patterns in response to equity extraction. If a household borrows to smooth consumption, then its spending pattern will be relatively smooth in response to a negative income shock in period t (top panel - solid line). This compares to the situation where a household cannot borrow and lacks sufficient financial resources to smooth spending in response to the income shortfall. Such a household experiences a temporary drop in consumption (top panel - dashed line). A household who borrows to partially smooth its consumption has a spending pattern somewhere in between these two extremes (top panel - dotted line). Household consumption between the shock period (t) and the next ($t+1$) should be about *unchanged* when a household extracts equity to completely smooth consumption in response to a negative income shock. In contrast, the change in consumption will be *positive* between t and $t+1$ if the household either does not smooth its consumption or if it uses equity extraction to partially smooth its spending.

In comparison, a household's spending will fall between t and $t+1$ if they extract equity to finance a one-time consumption shock as shown in the middle panel of Figure 3.2. In particular, the household's expenditures jump up in period t as it extracts equity to fund its one-time spending needs. The household's spending in period $t+1$ can follow two potential paths. In the baseline situation spending simply returns to its pre-shock level (middle panel- solid line). In comparison, since the household faces increased debt carrying costs because of its borrowing in period t, its non-debt service consumption may fall below its original level in period $t+1$ (middle panel - dashed line). Alternatively, the household may choose to save more of its income

in period $t+1$ than it did prior to the shock, in order to rebuild its buffer stock of borrowing collateral. In this case consumption will also fall below its pre-shock level. In either situation, consumption is lower in $t+1$ than t. The change in consumption between the two periods is therefore negative when equity extraction is used to finance one-time expenditure shocks.

Finally, a household's budget constraint prevents it from repeatedly extracting large amounts of equity from its home.[5] Arguably, households could extract small amounts to fund additional consumption in consecutive periods. The bottom panel of Figure 3.2 illustrates this potential consumption pattern. A household's level of consumption should be about unchanged if it extracts equity to pay for additional spending in periods t and $t+1$. Eventually however, the household's spending will have to mean revert (not shown). Such a scenario of repeat borrowing is unlikely given the transaction costs associated with home equity borrowing. I present this situation, however, for the sake of completeness.

Households' decisions to extract equity from their homes and their consumption behavior in the subsequent period(s) likely depends on their need to smooth consumption through borrowing, and whether they are pre-disposed to be savers versus non-savers.[6] Non-savers are likely less concerned about the future, and thus they may be more willing to use their home equity to fund a one-time consumption need. In contrast, savers are more cautious in general and likely will only extract equity when necessary. Either way, I can gain insight into households' reasons for borrowing against their homes by looking at the relationship between consumption growth and households' equity extraction.

Baseline Empirical Approach

My baseline empirical approach examines the impact of equity extraction between 2001 and 2003 or 2003 and 2005 on households' total non-housing consumption over those periods. The setup follows a basic consumption function approach. In particular, economic theory says there is a relationship between between consumption, income, wealth and other controls, such as age, for households' life-cycle spending variations. The question then is whether equity extraction has any additional explanatory power for consumption beyond these basic economic relationships. In other words, this approach addresses whether consumption indeed rises when households

[5]This assumes that households do not die with zero housing wealth, which is supported by the data. It also assumes that house prices do not increase indefinitely.

[6]Hurst (2006) provides an interesting discussion of saver versus non-saver type households and how consumption and pre-retirement wealth differ based on households' saving behavior.

extract equity. The econometric model of interest is:

$$c^i_{t+1,t} = b_0 + b_1 x^i_{t+1,t} + b_2 y^i_{t+1,t} + b_3 w^i_t + b_4 h^i_t + b_5 U^i_t + \zeta \mathbf{R^i_t} + \gamma \mathbf{Z^i_t} + \epsilon^i_{t+1,t} \qquad (3.2)$$

where $c^i_{t+1,t}$ is a household's non-housing consumption between period t and $t+1$, $x^i_{t+1,t}$ is the amount of equity that a household extracts from (or saves in) its home between t and $t+1$, w^i_t is a household's real financial wealth, h^i_t is a household's real housing wealth in period t, and $y^i_{t+1,t}$ is a household's disposable income between t and $t+1$. Finally, $\mathbf{R^i_t}$ and $\mathbf{Z^i_t}$ are vectors of regional dummy variables and household demographic covariates respectively, as defined earlier. The next section discusses how household consumption is calculated in more detail. If household spending follows the consumption shock pattern outlined in Figure 3.2 (middle panel) then there should be a positive relationship between equity extraction and consumption [$b_1 > 0$].

Endogeneity Issues

There are some potential endogeneity issues involved in estimating equation 3.2. These issues can best be described algebraically using a somewhat simplified example. Suppose that household consumption is determined by the following data generating process.

$$c^i_t = b_0 + b_2 y^{i,p}_t + \epsilon^i_t + \nu^i_t \qquad (3.3)$$

where $y^{i,p}_t$ is a household's permanent income, ϵ^i_t is a shock to consumption that is potentially correlated with permanent income, and ν^i_t is a transitory consumption shock that is assumed to be uncorrelated with permanent income. One can think of the transitory shock as a taste shock. An example of a consumption shock that is a correlated with permanent income is a credit shock that causes an economic downturn and job losses. If $E[y^{i,p}_t \epsilon_t] \neq 0$ then OLS estimates of households' marginal propensity to consume out of permanent income will be biased toward zero.

An additional potential source of endogeneity occurs because most often the econometrician has an imperfect measure of households' permanent income. In particular, the econometrician typically estimates the following version of equation 3.3

$$c^i_t = b_0 + b_2 y^i_t + \epsilon^i_t + \nu^i_t \qquad (3.4)$$

where y^i_t is a household's *current* income. Current income is also potentially corre-

lated with ϵ_t^i since it captures households' permanent plus transitory income. These earnings may also be correlated with households' transitory consumption shocks if families take on additional temporary jobs to fund their current consumption desires. To resolve the potential income endogeneity issues the econometrician can estimate equation 3.4 with two stage least squares (2SLS) using lagged income as an instrument for a household's current earnings. This approach is exactly correct if actual income follows a random walk. I make this assumption and estimate equation 3.2 with 2SLS using lagged income and households' marginal tax rates as instruments for $y_{t+1,t}^i$. Lagged income should be uncorrelated with both consumption shocks if it follows a random walk.[7]

Failing to account for consumption taste shocks (ν_t^i) when estimating equation 3.4 leads to non-standard measurement error. This alternative form of endogeneity does not directly impact the coefficient estimates in equation 3.4, all else equal, since these taste shocks are assumed to be uncorrelated with the other shocks to consumption. The relevant question, however, is what information households' equity extraction (x_t^i) provides about the relationship between taste shocks and consumption. In particular, assume that a portion λ of a household's taste shock is financed by equity extraction such that

$$x_t^i = \lambda \nu_t^i, \tag{3.5}$$

and the remaining $1-\lambda$ of the shock is financed through other means such as savings, unsecured debt or borrowing from family members. If the econometrician includes equity extraction in equation 3.4 and estimates

$$c_t^i = b_0 + b_1 x_t^i + b_2 y_t^i + \epsilon_t^i + \nu_t^i \tag{3.6}$$

then the estimate of b_1 equals the proportion of the transitory shock that is financed by equity extraction. In other words, $\hat{b}_1 = \lambda$.[8]

Adding equity extraction to the standard consumption function therefore poten-

[7]The timing in equation 3.2 is slightly different than in the DGP example in equation 3.3 because of the data availability. The endogeneity issues, however, are analogous.

[8]This analysis assumes that λ is constant across all households. It is possible, however, that different households finance varying amounts of their consumption taste shocks with equity from their homes ($x_t^i = \lambda^i \nu_t^i$). In such a situation, the estimate of the equity extraction effect across all households is just the average of their individual financing proportions ($\hat{b}_1 = \bar{\lambda}$). In addition, there is also potentially some noise in the amount of equity a household extracts to fund its taste shock.

$$x_t^i = \lambda \nu_t^i + u_t^i$$

where u_t^i is some random error term. This situation does not impact the results, however, assuming u_t^i is uncorrelated with the amount households extract as well as income.

tially provides useful information about how households finance their taste shocks. The ultimate goal of this paper is to determine how equity extraction impacts households' spending conditional on their income. Equation 3.2 captures this relationship, and the discussion in this section suggests that the estimation approach is valid.

Additional Empirical Approaches

I address whether households extract equity to finance a one-time consumption shock versus smoothing through a negative income shock by looking at the lagged impact of equity extraction $x^i_{t+1,t}$ using the same setup as in equation 3.2. My analysis also examines the effect of equity extraction on the *change* in consumption between 2003 and 2005. In particular,

$$\Delta c^i_{05,03} = \alpha_0 + \alpha_1 x^i_{03,01} + \alpha_2 w^i_{01} + \alpha_3 h^i_{01} + \alpha_4 \Delta y^i_{05,03} + \zeta \mathbf{R^i_{01}} + \gamma \mathbf{Z^i_{01}} + \epsilon^i_{05,03} \quad (3.7)$$

where $\Delta c^i_{05,03}$ is the change in spending between the 2001 to 2003 period and the 2003 to 2005 period, and $x^i_{03,01}$ is the amount of equity extracted between 2001 and 2003. This timing is based on data availability in the PSID. Section 3.3.1 discuss the data construction and timing in more detail.

If households extract equity to finance a one-time consumption shock then there should be a negative relationship between the amount extracted and the relative change in consumption over the subsequent period [$\alpha_1 < 0$]. In fact, 1 dollar of additional equity extraction that goes toward consumption should be completely offset by 1 dollar lower consumption in the subsequent period [$\alpha_1 = -1$]. Alternatively, if households extract equity to smooth consumption then there should not be a noticeable change in spending between the equity extraction period and the subsequent one [$\alpha_1 \approx 0$].

To address the fact that there may be measurement error in my consumption growth data, I also estimate the relationship between equity extraction and the change in consumption and equity extraction using a binary dependent variable approach. In particular, the dependant variable equals 1 if a household's change in consumption is positive between 2003 and 2005 and is 0 otherwise. This approach provides a useful robustness check since the relative magnitude of consumption between the two periods should be accurate even if a household's actual consumption change is measured with error. The exact empirical setup is:

$$C^i_{05,03} = \beta_0 + \beta_1 E^i_{03,01} + \beta_2 w^i_{01} + \beta_3 h^i_{01} + \beta_4 \Delta y^i_{05,03} + \beta_4 U^i_{04} + \zeta \mathbf{R^i_{01}} + \gamma \mathbf{Z^i_{01}} + \epsilon^i_{05,03} \quad (3.8)$$

where $C^i_{05,03}$ is the indicator variable for whether or not a household has a positive consumption change, $E_{03,01}$ is an indicator variable that takes a value of 1 if a homeowner extracts equity from his or her home between during the previous period and is 0 otherwise. The rest of the setup is similar to equation 3.7. I control for the potential endogeneity between the binary consumption variable and the change in household income using conditional maximum likelihood.

The sign of the estimated relationship between the consumption change indicator variable and the equity extraction indicator variable (β_1) will depend on households' reasons for equity extraction. In particular, $\beta_1 < 0$ if households extract equity to fund one-time consumption shocks. In comparison, $\beta_1 \approx 0$ if households completely smooth consumption in response to a negative income shock or they borrow to fund persistently higher levels of spending.

3.2.2.2 Balance Sheets

Households who borrow against their homes need not spend any or all of what they extract. For instance, households may use their extracted equity to pay down their higher cost non-collateralized debt. Alternatively, some households may borrow in order to invest in other assets such by paying the necessary down-payment on a second home. Households who refinance and cash-out equity may also place some or all of the money in their savings account to spend as needed, especially if they cash out more than they intend to spend immediately. Regardless, if there are balance sheet effects of equity extraction in addition to or instead of consumption effects, then one should observe dis-saving in housing and *increased* saving in other assets and or additional non-collateralized debt repayment.

In addition, saving in housing may *increase* in the period after households extract equity. In particular, home equity loans and lines of credit tend to be variable rate loans so there is an incentive to repay them as quickly as possible. Households may also pay down some of their housing debt to the extent they view housing collateral as a substitute hedge against future labor income risk. Such behavior is consistent with the role of home equity borrowing as a substitute buffer stock. At the very least, households' saving in housing in the period following the one in which they extract equity should be non-negative to the extent they borrow to finance a one-time consumption need. In other words, there should not be continued dis-saving in

housing.

I examine the relationship between equity extraction and household saving by looking at average saving behavior across asset classes for households who do and do not extract equity. These asset classes include saving in housing, other real estate, businesses or farms, cash, stocks, bonds, vehicles, reduced non-collateralized debt, and IRA/401k accounts. I discuss these results and also explain the household saving data in detail in the next section.

In addition, I analyze whether equity extraction impacts the probability of households increasing (or decreasing) their saving in the various asset classes using the following binary dependent variable model:

$$S^{i,j}_{t,t+1} = d_0 + d_1 E^i_{t+1,t} + d_2 \Delta y^i_{t+1,t} + d_3 y^i_t + d_4 w^i_t + d_5 U^i_t + \alpha \mathbf{R^i_t} + \psi \mathbf{Z^i_t} + \epsilon^i_{t,t+1} \quad (3.9)$$

where $S^{i,j}_{t,t+1}$ is an indicator variable that takes the value of 1 if a household's active saving in asset j between period t and $t+1$ is positive and is zero otherwise, and y^i_t is a household's real, after tax income level in period t. The remainder of the variables are defined previously. The specification also controls for a household's lagged income level in case households' saving behavior differs based on their earnings. The income growth term captures any additional saving or dis-saving by the household because of a recent income surprise. In addition, the estimates of equation 3.9 control for the potential endogeneity between household income and saving.

If equity extraction impacts households' saving in a given asset then the estimated effect of equity extraction on a given saving category [d_1] should be precisely estimated. For example, if households extract equity to repay non-collateralized debt then equity extraction should increase households' predicted probability of non-collateralized debt repayment [$d_1 > 0$ for j = non-collateralized debt]. In contrast, equity extraction should have a *negative* impact on households' predicted probability of saving in their housing [$d_1 > 0$ for j = housing].

A modified version of equation 3.9 captures whether equity extraction impacts households' saving going forward. In particular,

$$S^{i,j}_{t,t+1} = d_0 + d_1 E^i_{t,t-1} + d_2 \Delta y^i_{t,t-1} + d_3 y^i_{t-1} + d_4 w^i_{t-1} + d_5 U^i_t + \alpha \mathbf{R^i_t} + \psi \mathbf{Z^i_t} + \epsilon^i_{t,t+1} \quad (3.10)$$

where the dummy variable for equity extraction is lagged one period relative to the period over which a household's saving is measured. The timing for the rest of the variables is also adjusted accordingly. If the one-time consumption shock story

explains the relationship between equity extraction and consumption then households should not dis-save in their housing in the period following the one in which they borrow [$d_1 \geq 0$ for j = housing]. In addition, there should be a strictly positive relationship between lagged equity extraction and households' probability of saving in housing if households seek to rebuild their buffer stock of housing collateral.

3.3 Data

3.3.1 Data Construction

The PSID is a nationally representative, longitudinal survey of households and their offspring that began in 1968. The survey was conducted annually between 1968 and 1997 and has been collected every other year since 1997. The most recent data are for 2005. Each wave asks homeowners to report their home values, the amount of any outstanding mortgage balances and whether they have moved since the previous survey. The PSID also includes "wealth supplements" that have detailed information on households' non-housing financial assets in 1984, 1989, 1994, and 1999 onwards. As mentioned earlier, these assets include other real estate, businesses or farms, cash, stocks, bonds, vehicles, non-collateralized debt, and IRA/401k accounts. There is also data on households' so-called "active saving" in 1989, 1994, and 1999 onwards. Active saving measures households' net contributions to their various asset holdings between the wealth surveys. Active saving excludes capital gains, and thus measures households' saving out of their current income. I discuss these data in more detail below.

3.3.1.1 Equity Extraction

The estimation sample is restricted to homeowners since renters by definition do not have housing equity they can borrow against. I identify households who extract equity based on the mortgage and moving data in the PSID. In particular, households who extract equity as those who do *not* move, but who increase their mortgage debt. Homeowners also extract equity when they move from one owner-occupied property to another and reduce the amount of equity they have in their home. For example, a household that moves and had thirty-thousand dollars of equity in their old home and only twenty-thousand dollars in their new home, extracts ten-thousand dollars of equity.

Let $E^i_{t,t+1}$ be an indicator variable for whether a household extracts equity from its home between period t and $t+1$. In particular,

$$E^i_{t,t+1} = \begin{cases} 1 & \text{if } m^i_{t+1} > m^i_t \ \& \ \text{move}^i_{t+1} = 0 \\ 1 & \text{if } e^i_{t+1} < e^i_t \quad \& \ \text{move}^i_{t+1} = 1 \\ 0 & \text{otherwise} \end{cases}$$

where m^i_t is a household's mortgage debt in period t, e^i_t is the household's amount of home equity in period t, and move^i_{t+1} is an indicator variable that takes a value of 1 if the household has moved between t and $t+1$ and is 0 otherwise. A household's home equity is defined as the value of its house ($p^{h,i}_t$) less any outstanding mortgage debt (m^i_t).

$$e_t = p^h_t - m_t$$

In addition, let x^i_t be the actual (dollar) amount of equity a household extracts:

$$x^i_{t+1} = \begin{cases} m^i_{t+1} - m^i_t & \text{if } E^i_{t,t+1} = 1 \ \& \ \text{move}^i_{t+1} = 0 \\ e^i_t - e^i_{t+1} & \text{if } E^i_{t,t+1} = 1 \ \& \ \text{move}^i_{t+1} = 1 \\ 0 & \text{otherwise} \end{cases}$$

3.3.1.2 Household Saving

I use the so-called "active saving" data in the PSID wealth supplements to calculate household saving. My approach follows the one in Juster et al. (2005). Active saving measures households' net contributions to various financial assets over time, *excluding* capital gains. For example, households who pay off some of their outstanding mortgage principal have positive active saving. In contrast, housing wealth gains due to house price appreciation do *not* count as active saving.

Starting in 1989 households report the amount they contributed to 401k or IRA saving plans since the previous wealth supplement as well as the amount they withdrew from such plans. Other active saving categories include: investment in businesses or farms, checking and saving accounts, bond holdings, stock holdings, housing, other real estate, vehicles, and non-collateralized debt (non-collateralized debt).[9]

Given the timing of the PSID wealth supplements the active saving data covers the following years: 1984 and 1989, 1989 and 1994, 1994 and 1999, 1999 and 2001, 2001 and 2003, and 2003 and 2005. The exact definition of active saving between successive wealth years depends on the type of asset. See the appendix for additional details about the active saving definition and calculation. The active saving data are

[9]Other real estate includes vacation homes, rental properties, and land holdings. non-collateralized debt includes credit card debt as well as student loans and other unsecured debt.

used to construct a measure of households' non-housing consumption in addition to being used directly to measure households' saving out of current income.

3.3.1.3 Consumption

As noted earlier, one of the main drawbacks to the PSID is that it has limited household expenditure data. To circumvent this problem, I impute a measure of households' non-housing consumption using the income and active saving data available in the PSID. In particular, I construct non-housing consumption between $t-1$ and t, $c^i_{t,t-1}$, as follows:

$$c^i_{t,t-1} = (y^i_{t,t-1} - t^i_{t,t-1}) - as^i_{t,t-1} \tag{3.11}$$

where $as^i_{t,t-1}$ is a household's active saving and $(y^i_{t,t-1} - t^i_{t,t-1})$ is its disposable income. Data on a household's lump sum tax burden comes from the NBER's TAXSIM module.

The timing notation in equation 3.11 captures the fact the active saving data spans the time horizon between wealth years. Household income data are available in every year of the PSID, but they are aggregated them along with the tax data to match the frequency of the active saving data. My imputed consumption measure therefore covers five year horizons prior to 1999 and two year horizons starting in 2001. For example, I define a household's non-housing consumption between 2003 and 2005 as follows:

$$c^i_{05,03} = (y^i_{05,03} - t^i_{05,03}) - as^i_{05,03} \tag{3.12}$$

3.3.1.4 Consumption Changes

The change in consumption between two periods is calculated as follows given the consumption definition above:

$$\Delta c^i_{t+1,t} = c^i_{t+1,t} - c^i_{t,t-1} \tag{3.13}$$

In particular, $\Delta c^i_{t+1,t}$ measures the difference in household expenditures over multiple year horizons. Indeed, the change in consumption between 2003 and 2005 is really the change in consumption between the 2001 to 2003 period and the 2003 to 2005 period.

$$\Delta c^i_{05,03} = \bar{c}^i_{05,03} - \bar{c}^i_{03,01} \tag{3.14}$$

For ease of discussion, I will often refer to $\Delta c^{i}_{05,03}$ as the difference in non-housing expenditures between 2003 and 2005.

I also calculate the change in households' expenditures using the available PSID food consumption data. These data are reported at a point in time (covering the year in question), so the actual change in food spending between 2003 and 2005 can be calculated directly. In particular,

$$\Delta c^{f,i}_{05,03} = c^{f,i}_{05} - c^{f,i}_{03} \tag{3.15}$$

where $c^{f,i}_{05}$ is the level of a household's food consumption in 2005 and so on. There are additional direct measures of household expenditures in the PSID starting in 1999 as discussed in Charles et al. (2007). These expenditures cover education and medical expenses among other spending categories. I use these data to examine whether households extract equity for medical expense or school needs, and also to check the overall robustness of my results.

3.3.2 Summary Statistics

Table 3.1 reports the distribution homeowners' equity extraction over time. My analysis stops in 2005 because of data availability in the PSID, even though house prices and home equity borrowing peaked in late 2006 or early 2007. The results in Table 3.1 show that the average amount of equity extraction has increased over time (in real terms), which is consistent with aggregate data reported in Greenspan and Kennedy (2007). The data also suggest that even though the amount of equity extraction increases somewhat between 2001 to 2003 and 2003 to 2005 there are fewer households who actually borrow. In other words, the increase in borrowing appears to be due to households extracting larger amounts conditional on borrowing rather than more households deciding to borrow.

The data in bottom panel of Table 3.1 suggest that households extract larger amounts relative to their house values in the mid-1990s than in the early 2000s. This could be a result of higher transactions costs in the 1990s relative to the early 2000s, which raised the price of extracting small amounts of equity. Alternatively, households who extracted equity in the early 2000s likely had higher house values, on average, relative 1990s due to the rapid home price appreciation. In addition, 6 percent of households extract equity in both the mid 1990s and between 2001 and 2003. In comparison, 8.9 percent of homeowners extracted equity between 2001 to 2003 and between 2003 and 2005 (not reported). This result suggests that the percentage of repeat borrowers grew slightly in the early 2000s. The data do not, however, show a

dramatic spike in the number of repeat borrowers during the house price boom. This finding is consistent with the idea that the vast majority of households extract equity to finance one-time spending needs.

Table 3.2 compares the sample means for various household demographic and financial variables depending on whether or not households extract equity from their homes. Overall, households who extract equity in the early 2000s tend to be younger and have larger family sizes. A greater percentage of them are also married. These findings are broadly consistent with households extracting equity to finance and smooth consumption. Larger households, on average, have greater consumption costs. In addition, younger households are more likely to borrow to finance consumption, on average, since they have accumulated less liquid assets over their lifetimes to smooth through income shortfalls than their older counterparts.

Households who extract equity also have less liquid wealth than those households who do not borrow against their homes. In comparison, households' mean non-housing illiquid asset holdings are roughly the same for borrowers and non-borrowers over time. This finding is consistent with the idea that households extract equity to finance consumption when they lack sufficient liquid assets to use instead. Indeed, borrowers' cash holdings are on average a good deal lower than the holdings of non-borrowers (bottom panel-Table 3.2). In comparison, households who extract equity in the early 2000s have higher income growth, on average, than households who do not borrow. This result, unlike the financial wealth data, is consistent with households extracting equity to fund one-time consumption shocks rather than to make up for income shortfalls.

Households who borrow against their homes also have experienced greater recent house price growth than non-borrowers, which is consistent with households responding to rising house prices by accessing the equity in their homes. In addition, the home values of households who extract equity are higher, on average, than for households who do not extract equity. The relative amount of home equity for borrowers versus non-borrowers though is similar. These differences in home values versus home equity holdings for borrowers versus non-borrowers are much less evident in the mid-1990s. The reason for this shift over time is somewhat unclear. Banks perhaps paid more attention to the value of homeowners' property than their existing debt when originating loans during the early 2000s when the credit markets were loose. Indeed, the data show that households who extracted equity had higher loan-to-value ratios during the early 2000s than during the mid-1990s.

In addition, households who extract equity have higher amounts of non-collateralized debt than households who do not borrow, especially during the early 2000s. This re-

sult is broadly consistent with anecdotal evidence suggesting that banks encouraged households to extract equity to pay off their outstanding higher cost debt during the house price boom . In addition, a greater percentage of households who extract equity have college age children than households who do not extract equity. Home equity financing is a relatively inexpensive way for parents to fund their children's education. Indeed, recent work by Lovenheim (2008) finds a link between households' greater home equity values and increased college enrollment.

Finally, Table 3.3 shows summary statistics for the amount of total non-housing and food consumption of households who do and do not extract equity from their homes. These data suggest that households who borrow against their home unconditionally spend more than those households who do not borrow. The difference in spending for households who extract equity versus those who do not is greater during the early 2000s than during the mid-1990s. This finding is consistent with households extracting equity in the early 2000s to fund one-time consumption needs rather than just smooth consumption, but the differences are not statistically significant. Households who extract equity in the early 2000s also have higher income on average than those households who do not borrow. This finding further supports the one-time consumption shock story. Overall, the summary statistics fit with economic reasoning and the anecdotal evidence for why households extracted equity from their homes.

3.4 Results

3.4.1 Predictors of Equity Extraction over Time

Table 3.4 reports the results from estimating equation 3.1. The estimation sample is restricted to households who own homes at the beginning and end of the equity extraction period. In other words, households must own their homes in both 2001 and 2003 to be in the sample for the regression over that time period. In addition, I control for outliers by eliminating households with reported data in the top or bottom one percent of the income, financial wealth, and home equity distributions.

The coefficient estimates in Table 3.4, and all of the other probit results in this paper, report the *marginal* impact of the given variable on the predicted probability of households extracting equity over the relevant time period. This marginal effect is evaluated at the mean of the other independent variables. For continuous variables such as financial wealth, the coefficients report the impact of a small change in that variable on households' predicted probability of extracting equity. For binary variables, such as whether or not a household is unemployed, the coefficient reports

the difference in households' predicted probability of equity extraction when the the variable is true versus false. For example, the marginal impact of unemployment on equity extraction in equation 3.1, $\hat{a}_2$, is defined as follows:

$$\hat{a}_2 = F(\bar{X}_t^i * b | U_t^i = 1) - F(\bar{X}_t^i * b | U_t^i = 0) \tag{3.16}$$

where $F(\cdot)$ is the normal CDF, $\bar{X}_t$ is the vector of independent variables evaluated at their means, b is the vector of coefficient estimates, and U_t^i is the indicator variable for unemployment.[10] The results are similar when evaluating the marginal impact of the various covariates on equity extraction at the 25^{th} or 75^{th} percentiles of the other explanatory variables. Appendix Table B.1 compares these alternative marginal effect calculations for the 2001-2003 time period.

Overall, the results in Table 3.4 suggest that households with higher levels of *liquid* assets have a lower predicted probability of extracting equity from their homes.[11] In particular, a ten thousand dollar increase in households' liquid assets relative to the mean *reduces* their predicted probability of extracting equity by roughly 0.3 percentage point in the early 2000s. The same ten thousand dollar increase in liquid wealth lowers households predicted probability of equity extraction by 1.5 percentage points in the mid-1990s. In contrast, households' non-housing illiquid wealth, however, has little impact on their probability of extracting equity. These results are consistent with households being more likely to borrow against their homes when they lack sufficient liquid resources to help finance their consumption. In addition, households' lack of liquid resources seems to have a much larger impact on their equity extraction decisions prior to the recent house price boom.

The pattern of households equity extraction decisions also differs between periods based on their income growth. In the mid-1990s, higher household income growth lead to a much lower predicted probability of equity extraction. This finding combined with the financial wealth estimates is consistent with households extracting equity when they experience financial distress during the mid-1990s. In contrast, income growth and equity extraction are positively correlated during the early 2000s. None of the income growth effects are precisely estimated, but the income data and financial wealth data suggest that a temporary income shortfall and lack of financial resources was less of an incentive for households to extract equity in the early 2000s compared with the mid-1990s. This finding is consistent with the anecdotal evidence that households extracted equity in the early 2000s to fund their one-time consumption needs.

[10] When $\bar{X}_t$ includes additional dummy variables, they are evaluated at their mean value as well.
[11] Liquid assets equal cash plus stock holdings less any outstanding non-collateralized debt.

In comparison, households who experience a spell of unemployment in the early 2000s have a higher predicted probability of extracting equity than those households who are not unemployed.[12] This effect is precisely estimated for the 2001 to 2003 period only, however the results for both that period and 2003 to 2005 are broadly consistent with the findings in Hurst and Stafford (2004) that unemployed households are more likely to refinance and extract equity from their homes. This finding, unlike the income growth data results, suggests that some households extract equity during periods when their cash flow is restricted. As a result, the results show evidence of both consumption smoothing and households using their home equity to finance one-time consumption shocks.

There is also a strong regional pattern for equity extraction, especially during the early 2000s. In particular, households living in the West in 2001 had over a 7 percentage point higher predicted probability of extracting equity from their homes between 2001 and 2003. Living in the West has a similar impact on equity extraction between 2003 and 2005 as well. Living in the Northeast in 2003 also increased households' probability of extracting equity between 2003 and 2005 by about 10 percentage points. These results are consistent with the strong regional trends in house price growth. Indeed house price growth in the early 2000s was the strongest in the Northeast and West, as shown in Figure 3.3, and began somewhat earlier in places like California than the Northeastern states (not shown).

The regional pattern for equity extraction is different during the mid-1990s when house price growth was low if not negative across much of the country. Households living in the North Central region (Midwest) have a roughly 5 percentage point lower predicted probability of extracting equity than households living elsewhere in the country. This finding suggests that a household's location of residence had a bigger (positive) impact on equity extraction during the recent house price boom than in the 1990s. The regional differences in equity extraction over time are also broadly consistent with changes in banks' lending practices between the 1990s and early 2000s. Anecdotal evidence suggests that banks lent and consumers borrowed in certain areas of the country (coasts) during the recent house price boom based on expectations that house prices would continue to rise indefinitely. Credit was relatively much tighter

[12] A household is categorized as unemployed if the household head or spouse (or both) report 6 or more weeks of unemployment during the equity extraction period (1995, 2002, and 2004 respectively). The timing of the unemployment spells are tricky since many are short lived. I also look at unemployment prior to the equity extraction periods (1993, 2000, and 2002 respectively) to avoid potential endogeneity. These results (not reported) also suggest a positive relationship between unemployment and equity extraction. Not surprisingly, however, the magnitude and precision of the estimated effects are small since the unemployment spell is farther removed from equity extraction period.

during the 1990s.

Households' existing leverage also impacts their predicted probability of equity extraction. In particular, households with LTV ratios above 0.8 have substantially lower predicted probabilities of extracting equity from their homes than households who are less levered. This result holds over time, and is consistent with highly levered households facing increased borrowing costs. These households are also limited by having minimal amounts of equity should they want to borrow. In addition, the impact of households' actual LTV ratio on their home equity borrowing changes over time. A marginal increase in leverage relative to the mean in the mid-1990s *decreases* the likelihood of households extracting equity from their homes. In contrast, the same marginal change in leverage *increases* the probability that households extract equity during the early 2000s. This result is suggests that households exhibited greater caution, given their existing leverage, when extracting equity in the mid-1990s compared with the early 2000s. This finding is further consistent with anecdotal evidence that households more willingly maintained higher leverage in their homes during the house price boom when credit flowed relatively freely from banks.

The results that look at the predictors of the actual amount of equity extraction, rather than whether or not households choose to borrow against their homes, are very similar to those in this section. These results are available upon request.

3.4.2 Equity Extraction and Household Spending

3.4.2.1 Contemporaneous Effects

The top panel of Table 3.5 reports the results from estimating equation 3.2, which analyzes the relationship between equity extraction and total household non-housing spending. The regression results show that a 1 dollar increase in equity extraction leads to a 0.95 cent increase in consumption between 2001 to 2003. The same 1 dollar change leads to 98 cent higher consumption between 2003 and 2005. These estimates suggest that households' finance the vast majority of their taste shocks through equity extraction given the discussion in section 3.2.2.1. The results are further consistent with households borrowing against their homes to finance additional spending rather than to smooth consumption.

Even though regressing consumption on equity extraction likely captures the proportion of households' consumption shocks that are financed by home equity borrowing, the amount of equity extraction is still potentially endogenous. In particular, equity extraction could be correlated with income shocks if a booming economy leads to rapidly rising house prices. The appendix includes regression results that attempt

to control for the potential endogeneity between equity extraction and household spending in equation 3.2. These 2SLS regressions use households' self-reported house value changes as an instrument for current period home equity borrowing. This instrument along with other potential ones for equity extraction are weak, however, and the results are not very meaningful. See section B.3 in the appendix for a further discussion of these results.

The bottom panel of Table 3.5 shows estimates of equation 3.2 using food consumption rather than households' non-housing. Using food consumption in place of households' total non-housing consumption captures whether equity extraction has an impact on households' non-durable type expenditures. Food consumption is a relatively non-discretionary type expenditure, and is likely not subject to taste shocks for which households would extract equity. Households' may, however, use equity extraction to smooth food consumption in response to an income shortfall.

The results suggest that equity extraction has a minimal effect, at best, on household food consumption. In particular, a 1 dollar change in equity extraction raises food consumption by 1.5 cents in 2003. In 2005, however, the impact of equity extraction on food consumption in is essentially zero. Overall, equity extraction does not appear to have a substantial impact on households' non-durable good expenditures.[13] This finding is further consistent with the one-time, durable good type consumption shock explanation for why households borrowed against their homes during the early 2000s.

3.4.2.2 Lagged Effects

Table 3.6 reports the regression results for how equity extraction impacts consumption in the subsequent period (equations 3.7 and 3.8). All the results are consistent with consumption falling in the period following the one in which households borrow against their homes. In particular, average household consumption between 2003 and 2005 is lower than in the previous period given a 1 dollar increase in equity extraction between 2001 and 2003. This effect though is not precisely estimated.

The headline result, however, is that a 1 dollar increase in equity extraction leads to a 75 cent decline in consumption between the equity extraction period and the subsequent one. This effect is precisely estimated, and the decline is not statistically different from a consumption decrease of 1 dollar. In other words, the increase in consumption due to equity extraction does not persist. In addition, consumption falls by roughly the same amount in the post-equity extraction period as it rises when

[13]The bottom panel of Table B.2 shows the food consumption estimates that control for the potential endogeneity of equity extraction.

households' borrow against their home. This finding is consistent with households' extracting equity to finance a one-time consumption need.

The results further imply that the negative effect of lagged equity extraction on current period consumption is better captured by examining the change in consumption rather than looking at households' average spending levels. Looking at households' change in consumption likely does a better job of distinguishing between the behavior of households who do and do not extract equity. Consumption smoothing households who do not extract equity should have no change in spending, all else equal, between the two periods. In contrast, the consumption of equity extractors changes quite a bit. Considering the average level of consumption for households who do and do not extract equity in the previous period provides less of a dichotomy of expenditures across households. The expenditures of a household who extracted equity versus one who did not could be similar in the current period even if they differed in the previous period.

The negative impact of equity extraction on consumption in the subsequent period is further confirmed by estimates of the binary dependent variable model (equation 3.8). In particular, households who extract equity from 2001 to 2003 have a more than 18 percentage point lower predicted probability of positive consumption growth between 2003 and 2005. In other words, household expenditures are unlikely to continue increasing in the period after the one in which a homeowner extracts equity. This finding reinforces the idea that higher spending due to equity extraction is likely a one-time event.

Table 3.7 shows the lagged equity extraction effect estimates using food consumption. The regressions suggest that previous period equity extraction has essentially no impact on current period food consumption. In particular, there is little change in food consumption between 2003 and 2005 for households who do and do not extract equity in the previous period. This finding contrasts with the strong negative impact we observe using total non-housing consumption. The results do not rule out households using their home equity to help smooth food spending during a period of economic distress. Indeed, if households use home equity to smooth food consumption than the change in spending between the periods should be negligible. Such behavior on a broad scale seems somewhat unlikely,however, given the booming economy during that time period and the contemporaneous equity extraction and food consumption results in the previous section. The food consumption results in Table 3.7 are also further consistent with equity extraction having a much larger impact on households' durable type expenditures.

3.4.2.3 Equity Extraction and Durable Good Type Expenditures

Car Purchases

The PSID contains detailed questions on households' automobile purchases starting in 1999. In particular, households are asked whether they purchased a vehicle or vehicles since the previous survey, what kind of vehicle(s) they purchased (new or used) and how they financed the purchase (pay cash, lease, take out a loan etc.). There should be a relationship between vehicle purchases and equity extraction to the extent households borrow against their homes to finance big-ticket type consumption items.

Table 3.8 presents unconditional summary statistics about households' who do and do not purchase vehicles in the early 2000s. The data show that households who purchase used cars tend to have less home equity and lower house values. In addition, households who purchase new cars have higher disposable income and liquid assets than households who purchase used cars. Not surprisingly, households who purchase used cars have more limited financial resources than other households. The data also suggest that a greater portion of households who extract equity purchase used vehicles than new vehicles especially during the 2003 to 2005 period. This result makes sense to the extent used car buyers have more limited resources and thus have a greater need to access their home equity to finance their vehicle purchase. Overall, the data in Table 3.8 provide unconditional evidence that there is a correlation between equity extraction and (used) vehicle purchases.

The following empirical model for households' binary choice to purchase a vehicle or not, examines the conditional relationship between equity extraction and vehicle purchases. In particular, the setup examines whether equity extraction impacts households' car purchase decisions after controlling for their financial resources as well as other factors that capture the life-cycle profile of household expenditures.

$$\begin{aligned} B^i_{t+1,t} &= g_0 + g_1 E^i_{t+1,t} + g_2 \Delta y^i_{t,t-1} + g_3 y^i_t + g_4 \Delta w^i_{t,t-1} + g_5 w^i_t + g_6 U^i_t \\ &\quad + \zeta \mathbf{R^i_t} + \gamma \mathbf{Z^i_t} + \nu^i_{t+1,t} \end{aligned} \tag{3.17}$$

where $B^i_{t+1,t}$ is an indicator variable that takes a value of one if a household purchases a car between period t and $t+1$ and is zero otherwise, $\Delta w^i_{t,t-1}$ is the change in a household's financial wealth between $t-1$ and t, and the rest of the variables are the same as defined previously. The regression controls for households' level of income and wealth since families with higher resource levels are more likely to purchases

vehicles. The setup also includes the lagged change in households' financial resources to capture homeowners who utilize recent income or wealth surprises to buy a car. If the one-time consumption shock story holds and households' extract equity to purchase vehicles then equity extraction should increase the predicted probability of households' vehicle purchases [$g_1 > 0$].

The results in Table 3.9 show that equity extraction has a positive impact on *used* vehicle purchases between 2001 to 2003 and between 2003 and 2005. In particular, households who extract equity have a roughly 6 to 8 percentage point higher predicted probability of purchasing a used car than households who do not borrow against their homes. Equity extraction does *not*, however, impact households' new vehicle purchases.[14] The results also show that households have a higher predicted probability of purchasing a new car the higher their income and wealth, and a lower predicted probability of purchasing a used car. This finding is consistent with economic intuition that households with adequate resources are the ones who purchase new cars. As a result, the econometric setup in equation 3.17 seems to capture what impacts households' decisions to purchase new or used vehicles.

Overall, the results in Table 3.9 are consistent with households extracting equity to finance one-time durable good type purchases. The fact that equity extraction matters for *used* car purchases is arguably somewhat surprising, but is consistent with the unconditional results in Table 3.8. This finding does not appear to be based on households extracting equity to purchase used cars because they have limited financial resources. Indeed, there is no interaction effect between equity extraction and households' liquid wealth (not reported).

An alternative explanation is that households extract equity to finance used car purchases rather than paying the relatively high interest rates on used car loans. Such interest rates tend to be closer to credit card borrowing costs than the prime rate benchmark that is used for many second mortgages. Indeed, a recent article discussed used car loan interest rates being as high as 14.5 percent.[15] This compares with home equity loan interest rates that have averaged 4 or 5 percent over the last decade. Extracting equity to pay for used cars is therefore rational behavior for financially constrained households who otherwise face high borrowing costs.

In addition, there is much less of an interest rate divide between home equity rates

[14]This finding holds whether or not I exclude households' who lease new vehicles. It is unlikely households who have the resources to lease a car would need to extract equity from their homes. The results are also similar if I control for the potential endogeneity between equity extraction and vehicle purchases. All of these results are available upon request.

[15]`http://money.cnn.com/galleries/2009/autos/0904/gallery.car_buyers/index.html` accessed April 9, 2009.

and new car loan rates, because financing options on new cars tend to be relatively inexpensive. Therefore, it is not surprising that borrowing costs would have an impact on households' decisions to extract equity to purchase used cars but not new cars. Interest payments on home equity type loans are also tax deductible, which adds to the benefits of such loans over standard used car loans. Indeed, households who extract equity to purchase used cars have an increased predicted probability of itemizing deductions on their tax forms for non-medial or charitable reasons (not reported). In contrast, there is no relationship between households who itemize and new car purchases. In addition, when I control for households who obtained a vehicle loan conditional on purchasing a car, the results show that equity extraction still impacts used vehicle purchases.[16] This reinforces the idea that households borrow against their homes as an alternative way of financing used vehicle purchases.

Overall, the car purchase results are consistent with households using their home equity to fund one-time spending needs. In particular, home equity borrowing appears to be a cost-effective way for households to finance some durable good expenditures. In addition, households do not appear to extract equity to purchase fancy new cars. In other words, equity extraction may result in an increase in household spending, but the car data suggest that households did not borrow for increased spending on luxury items.

Home Improvement and Repair Expenditures

The PSID also includes a question about whether a homeowner has made additions or repairs to its house totalling more than ten thousand dollars since the previous survey. Households who respond yes are then asked a follow-up question about the actual amount they spent on such improvements. I use these data to examine the extent to which households use the equity they extract for home improvement, and how much they spend on such repairs conditional on borrowing against their home.

Table 3.10 shows estimates of the relationship between equity extraction and home improvement expenditures. In particular, the first two columns report results from a regression of whether or not households make repairs conditional on whether they extract equity. The empirical setup is similar to equation 3.17 except the dependent variable equals one if a household reports making repairs and is zero otherwise. The results suggest that households who extract equity have a 5 percentage point to roughly 11 percentage point higher predicted probability of making repairs depending on the time period. These effects are precisely estimated and suggest that households

[16] All of these results are available upon request.

indeed extract equity to make home repairs. Not surprisingly, households are more likely to make repairs the higher their financial wealth and income, and homeowners with college age children have a slightly lower predicted probability of making home improvements. This finding makes sense since college tuition payments likely place a high demand on households financial resources.

The last two columns of Table 3.10 show the impact of equity extraction on the amount of money households spend on home repairs conditional on them deciding to make repairs to their homes. In particular, a 1 dollar increase in equity extraction leads to a nearly 27 cent increase in home repair spending during the 2003 to 2005 period. Between 2001 and 2003, roughly 17 cents of each dollar of equity extraction is spent on home improvements.[17] Overall, these findings suggest that a good portion of the money households extract from their houses is is spent on home improvement. This result is consistent with the anecdotal evidence for why households borrowed against their homes during the early 2000s. The result also further reinforces the idea that households extracted equity to fund one-time consumption needs.

3.4.3 Equity Extraction and Balance Sheet Effects

Table 3.11 reports the impact of equity extraction and other controls on the probability of households having positive saving in various asset classes (equation 3.9). The table shows results for both the 2001 to 2003 period and the 2003 to 2005 period. Not surprisingly, households who extract equity have negative saving in their home. This occurs by definition, but confirms that the estimates of the balance sheet effects are reasonable. In particular, the regression results suggest that households who extract equity have an 8 to 12 percentage point higher predicted probability of paying down their non-collateralized debt conditional on their income. This finding is consistent with the anecdotal evidence that banks encouraged households to extract equity to pay off some of their higher cost, unsecured debt.

Households are also roughly 2 to 3 percentage points more likely to invest in other properties. This finding is consistent with some households using their home equity to potentially fund a down payment on a vacation home or other real estate investment. In addition, households have a slightly higher predicted probability of increasing their cash holdings, however, this effect is not precisely estimated. Higher cash holdings as a result of equity extraction could result from households cashing out equity through mortgage refinancing but not spending all the proceeds immediately. Overall, the results in Table 3.11 are consistent with households doing some balance

[17] The regressions in columns 3 and 4 are estimated using a Tobit specification (lower bound equal to 10,000) to account for the fact that the home repair data is truncated.

sheet reshuffling when they borrow against their homes. In other words, not every household spends the equity they extract.

Table 3.12 shows the dollar impact of equity extraction on selected households' saving in selected assets. The table includes the two saving categories (other real estate and reduced debt) in which households' have a higher predicted probability of saving based on the probit regressions.[18] The results also include households' dollar saving in business and farms. An additional explanation for equity extraction is that households borrowed against their homes to help finance entrepreneurship. A simple zero-one variable for business investment may not adequately capture households' business saving especially since so few homeowners report owning a business and increasing or decreasing their investment. Indeed, a 1 dollar increase in equity extraction leads to roughly 11 cents higher saving in households' businesses between 2001 and 2003 and results in roughly 3 cents higher saving between 2003 to 2005. As a result, it appears that some households extracted equity to fund entrepreneur type activities.

In addition, roughly 10 cents of a dollar of equity extraction between 2001 and 2003 goes toward households' investment in other real estate. A dollar increase in equity extraction also results in roughly 2 cents of reduced non-collateralized debt between 2003 and 2005. This effect is relatively small and the similar debt repayment effect between 2001 and 2003 is essentially zero despite the results in Table 3.8 showing households have a fairly strong predicted probability of increasing their non-collateralized debt repayment when they extract equity. This could be the result of some households increasing their non-collateralized debt when they extract equity, and thus offsetting the positive dollar impact of equity extraction on non-collateralized debt repayment when the results are averaged across all households. In particular, some households with college age kids may both borrow against their homes and from the bank to pay for college. Such college loans appear as higher non-collateralized debt in the data.[19] Regardless, the dollar saving results in Table 3.12 are broadly consistent with households using some of the equity they extract for non-consumption purposes.

I also analyze the impact of lagged equity extraction on households' balance sheets. In particular, Table 3.13 reports estimates of the effect of equity extraction between 2001 and 2003 on households' probability of positive saving in various assets between 2003 and 2005. The results suggest that households who extract equity have a roughly

[18] Equity extraction continues to have little effect on the other asset categories even in dollar terms. These results are available upon request.

[19] In the probit regressions households who extract equity by increase their non-collateralized debt are treated as "0" in term of having positive debt repayment.

20 percentage point higher predicted probability of having in their home between 2003 and 2005 than households who do not borrow. In addition, lagged equity extraction has little, if any, impact on household saving in the other asset categories. This finding suggests that households do not persistently borrow against their homes, and it reinforces the idea that equity extraction is primarily a one-time event.

3.4.4 Summary

Table 3.14 summarizes where a dollar of equity extraction by homeowners ends up in terms of consumption and investments or saving in the early 2000s. A number of the dollar effects are not statistically different from zero but they are included anyway for the sake of completeness. The results in the table confirm that households spend the vast majority of the equity they extract. Roughly a quarter of those expenditures are on home repairs and improvements, while little if any are on non-durable goods such as food expenditures. In addition, some households who borrow against their homes do make relatively small balance sheet adjustments. Such homeowners appear to primarily invest the proceeds of their equity extraction in debt repayment and personal businesses along with purchasing other properties.

3.5 Conclusion

This paper examined the relationship between home equity extraction and household behavior during the early 2000s using data from the PSID. The goal was to analyze the factors that impact households' decisions to borrow against their homes and see whether these reasons for borrowing have changed over time. The paper also considered how equity extraction impacts household expenditures as well as households' balance sheets. In particular, the analysis addressed whether households extract equity to fund one-time consumption needs or to smooth through adverse income shocks.

Overall, the results suggest that households' reasons for borrowing against their homes have changed little over time. Households who have lower levels of financial wealth are more likely to extract equity as are households who experience strong local or regional house price growth. In addition, my consumption analysis suggests that households borrowed against their homes in the early 2000s to finance one-time consumption shocks. A 1 dollar increase in equity extraction leads to a roughly 95 cent increase in consumption between 2001 and 2003, which does *not* persist over time. Indeed, consumption falls by roughly the same amount in the period following

the one in which households extract extract equity (2003 to 2005).

Additional analysis suggests that households extract equity for one-time, durable good type purchases. Roughly a quarter of each dollar of equity extraction goes toward home repair and improvement, which is consistent with anecdotal evidence. Households also extract equity for used car purchases. There is limited evidence, however, that households' (non-durable) food purchases increase when they borrow against their homes. My findings also show that households have a roughly 10 percentage point higher predicted probability of paying down their non-collateralized debt when they extract equity. Households are also slightly more likely to invest in other real estate or personal businesses when they borrow against their homes. As a result, there are some balance sheet effects of equity extraction in addition to households borrowing to fund their one-time consumption needs.

The analysis in this paper only covers the early part of the recent house price boom since the PSID data are available through 2005. A key question is whether the observed relationships between equity extraction, consumption and households balance sheet continued during the peak years of the house price boom. In particular, do households continue pay off non-collateralized debt or is even more of the money they extract shifted toward consumption? Another interesting question is whether the number of repeat borrowers increased. It is possible that households became more optimistic about future house price growth as the price boom continued and started to use their home equity to finance persistently higher spending. If such behavior occurred, it likely exacerbated the drop off in consumption during the house price bust starting in 2007.

An additional and related question is what happens with equity extraction during the house price bust. Did it cease completely, or did isolated households with sufficient equity continue to use home equity borrowing to fund their one-time consumption needs? Alternatively, is there a shift toward households using equity extraction to smooth consumption rather than for consumption shocks as the economy and their real incomes deteriorated. I plan to consider these issues more closely in future work as the necessary data for the analysis become available.

Table 3.1

Distribution of Equity Extraction by Period

2000 Dollars

	1994-96	2001-03	2003-05
mean	27100	34786	35176
median	14104	18507	17970
1^{st} Percentile	133	128	285
5^{th} Percentile	913	797	860
25^{th} Percentile	4769	7056	6755
75^{th} Percentile	34939	37578	41812
95^{th} Percentile	95387	116910	120464
99^{th} Percentile	199121	237890	257792
% Homeowners who Extracted Equity	19.5	27.8	24.8
N (Homeowners)[a]	3473	3522	3797

Source: Author's calculations using PSID data. [a] Number of homeowners in sample. The sample is restricted to households owning a home at the beginning and end of the equity extraction period. Households who report greater than 1 million dollars of equity extracted are also dropped. Households who move from one house to another owner occupied home during the sample period are included as discussed in the text. All estimates are weighted using the appropriate (end of period) family weights from the PSID.

Equity Extraction Relative to House Values

	1994-96	2001-03	2003-05
mean	0.344	0.302	0.281
median	0.169	0.114	0.102
1^{st} Percentile	0.002	0.001	0.001
5^{th} Percentile	0.007	0.005	0.005
25^{th} Percentile	0.050	0.045	0.038
75^{th} Percentile	0.405	0.227	0.230
95^{th} Percentile	1.077	0.742	0.634
99^{th} Percentile	3.748	2.383	1.077
% Homeowners who Extracted Equity	19.5	27.8	24.8
N (Homeowners)[a]	3473	3522	3797

Source: Author's calculations using PSID data. [a] Number of homeowners in sample. The sample is restricted to households owning a home at the beginning and end of the equity extraction period. Households who report greater than 1 million dollars of equity extracted are also dropped. Households who move from one house to another owner occupied home during the sample period are included as discussed in the text. All estimates are weighted using the appropriate (end of period) family weights from the PSID.

Table 3.2

Summary Statistics: Households who do and do not Extract Equity

Household Demographics and Financial Assets

Variable	1994-96		2001-03		2003-05	
	EE[a]	No EE[b]	EE[a]	No EE[b]	EE[a]	No EE[b]
Age of Household Head	44.8	49.0	47.6	54.6	48.7	54.1
Number in Family Unit	3.2	2.9	2.8	2.5	2.9	2.5
Married (%)	80.8	76.4	74.7	70.4	74.4	67.3
College Age Kids (% with)	19.6	16.7	20.5	14.0	18.5	13.2
Advanced Degree (% with)	22.2	21.5	23.0	13.5	17.9	12.8
College Degree (% with)	37.8	40.2	42.8	32.1	35.7	30.7
HS Graduate (% with)	85.8	86.9	93.7	90.4	93.8	89.9
% Unemployed	1.6	2.4	5.4	3.1	7.1	4.8
Disposable Income	45306	43733	49737	47505	52308	46236
% Change Income	0.5	1.1	1.3	−2.5	6.3	3.4
House Value	115756	119384	185000	149792	202833	166534
% Change House Prices	10.8	7.1	14.0	12.0	17.0	12.0
Home Equity	64491	62536	95456	99816	113769	108218
LTV Ratio	0.35	0.38	0.47	0.32	0.43	0.33
LTV Ratio ≥ 0.8 (% with)	7.4	14.6	7.7	11.0	9.3	9.9
Value of Liquid Assets	31388	47629	30032	51686	28140	42813
Value of Illiquid Assets[c]	46588	47529	91076	95688	92554	89635

Source: Author's calculations based on PSID data. [a]Households who extract equity; [b]Households who do not extract equity; [c]Excludes housing wealth. Homeowners who do and do not extract equity are identified as discussed in the text. All variables are measured at the beginning of each period and are in real 2000 dollars where applicable. The change in house prices is calculated over the two year period prior to the reference period (e.g. 1992-1994 for refinancing between 1994 and 1996). Liquid assets are net of non-collateralized debt. Illiquid assets exclude housing wealth. Summary statistics are constructed using the appropriate (end of period) PSID family weights.

Detailed Non-Housing Asset Positions

Variable	1994-96		2001-03		2003-05	
	EE[a]	No EE[b]	EE[a]	No EE[b]	EE[a]	No EE[b]
Other Real Estate	13804	13431	18109	16427	21984	17453
Farm/Business Value	9788	8342	8468	10634	9916	8671
Cash Holdings	15309	20705	10890	20685	14316	20539
Stock Holdings	18093	24760	21785	26653	19587	22271
Bond Holdings	5803	5766	4449	5760	4961	4621
Vehicle(s)	14308	13840	16821	16043	15290	15428
Non-Collateralized Debt	3846	3359	6019	2809	5915	2904
IRA/Retirment Account	549	480	24269	32360	26839	27107

Source: Author's calculation based on PSID data. [a]Households who extract equity; [b]Households who do not extract equity. All asset data are measured at the beginning of each respective period and are in real 2000 dollars. Summary statistics are constructed using the appropriate (end of period) PSID family weights.

Table 3.3

Summary Statistics: Consumption and Equity Extraction

2000 Dollars

Variable	1994-96		2001-03		2003-05	
	EE[a]	No EE[b]	EE[a]	No EE[b]	EE[a]	No EE[b]
Non-housing Consumption						
Mean	NA	NA	66361	45425	66246	60749
Median			55865	35837	48873	42652
Food Consumption						
Mean	6363	6176	6695	5839	7026	6073
Median	5929	5907	6076	5346	6563	5534
Memo:						
Disposable Income						
Mean	45306	43733	49737	47505	52308	46236
Median	40405	39778	45634	37702	47010	40839

Source: Author's calculations based on PSID data. [a]Households who extract equity; [b]Households who do not extract equity. Non-housing consumption data is not available for the 1994-1996 period. Summary statistics are constructed using the appropriate PSID family weights.

Table 3.4

Predicted Probability of Equity Extraction by Period
(Probit Regressions)

Regressor	1994-96	2001-03	2003-05
	Percentage Points		
Liquid Fin. Wealth$_t$ (10000s)	-1.5^{*}	-0.3^{*}	-0.3^{**}
	(0.9)	(0.1)	(0.1)
Illiquid Fin. Wealth$_t$ (10000s)	-0.3	-0.0	-0.0
	(0.9)	(0.1)	(0.1)
Disposable Income$_t^a$	-2.6	2.2	1.1
	(6.8)	(2.1)	(2.8)
% Change in Income$_{t,t+1}{}^b$	-7.6	7.3	25.3
	(13.0)	(7.0)	(28.4)
% Change in House Prices^c	1.6	-0.8	0.3
	(2.8)	(2.6)	(2.9)
Unemployed^d	-9.6	10.2^{*}	6.0
	(6.8)	(5.5)	(5.1)
LTV Ratio$_t$	-4.7	26.3^{***}	9.0^{**}
	(4.7)	(4.7)	(4.4)
LTV $\geq 0.8_t^e$	-13.2^{***}	-22.4^{***}	-11.2^{***}
	(2.3)	(2.3)	(3.0)
College Age Kids$_t^e$	-4.2	3.9	-1.6
	(2.7)	(2.8)	(2.5)
Regions:			
Northeast$_t^e$	2.5	-2.9	10.2^{***}
	(3.1)	(3.2)	(3.5)
North Central$_t^e$	-4.6^{*}	3.4	3.5
	(2.4)	(2.7)	(2.6)
West$_t^e$	-0.4	7.2^{**}	5.6^{*}
	(3.0)	(3.4)	(3.4)
N	1327	1866	1750

[a] Variable is in logs; [b] the change in income is treated as endogenous and the regressions are estimated using MLE; [c] the change in house prices is calculated over the two period prior to the reference period (e.g. 1992-1994 for refinancing between 1994 and 1996); [d] indicator variable that takes the value of 1 if the household head or wife reports 6 or more weeks of unemployment in 1995, 2002, or 2004 respectively; [e] indicator variable that takes the value of 1 if the statement and true and is 0 otherwise. The table reports marginal effects evaluated at the mean of the other independent variables. The change in income is treated as endogenous in all specifications. All variables are measured at the beginning of each respective period (t = 1994 etc.) unless otherwise noted, and are in real 2000 dollars where applicable. The regressions also include a cubic term for the age of the household head, dummy variables for the education of the household head, and an indicator variable for whether there are multiple earners in the household. Robust errors are in parentheses: * indicates significance at the 10 percent level , ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Table 3.5

Effect of Equity Extraction on Total Non-housing Consumption (2000 dollars)

Regressor	2001-2003	2003-2005
Amount Equity Extracted ($)$_{t,t+1}$	0.946***	0.980***
	(0.172)	(0.128)
Income$_{t,t+1}$	0.568***	0.768***
	(0.112)	(0.109)
Financial Wealth$_t$	0.130***	0.160***
	(0.026)	(0.024)
House Value$_t$	0.025	−0.012
	(0.033)	(0.035)
N	1660	1952

The estimates treat income as endogenous and are estimated using 2SLS. Financial wealth and housing wealth are measured at the beginning of the period (e.g. 2001 for consumption between 2001 and 2003). The regressions also include a cubic in the age of the household head, and indicator variables for whether the household head is married as well as dummy variables for the household head's education and the household's region of residence. Robust errors are in parentheses: * indicates significance at the 10 percent level , ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Effect of Equity Extraction on Food Consumption (2000 dollars)

Regressor	2003	2005
Amount Equity Extracted ($)$_{t,t+1}$	0.018***	0.003
	(0.007)	(0.003)
Income$_{t,t+1}$	0.018***	0.017***
	(0.003)	(0.002)
Financial Wealth$_t$	−0.000	−0.000
	(0.000)	(0.000)
House Value$_t$	0.004	0.004***
	(0.001)	(0.001)
N	2019	2366

The estimates treat income as endogenous and are estimated using 2SLS. The amount of equity extraction is measured over the period immediately preceding and including the date over which food consumption is measured (e.g. 2001- 2003 for food consumption in 2003). In addition, financial and housing wealth are measured at the beginning of the equity extraction period. The regressions also include a cubic in the age of the household head, and indicator variables for whether the household head is married as well as dummy variables for the household head's education and the household's region of residence. Robust errors are in parentheses: * indicates significance at the 10 percent level , ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Table 3.6

Lagged Effect of Equity Extraction on Total Non-Housing Consumption

(2000 dollars)

Regressor	**Average Consumption 2003-2005**	**Δ Consumption 2001-2003 to 2003-2005**	**Positive Cons. Δ 2001-2003 to 2003-2005**[e]
Amount Extracted ($)$_{01,03}$	−0.123	−0.748**	
	(0.175)	(0.291)	
Extract Equity$_{01,03}$[a]			−0.183***
			(0.025)
Average Income$_{03,05}$[b]	0.824***		
	(0.105)		
House Value$_{03}$	0.013		
	(0.036)		
Financial Wealth$_{03}$	0.148***		
	(0.024)		
Change Income$_{03,05}$[b,c]		1.341***	
		(0.241)	
House Value$_{01}$		0.013	0.003***
		(0.027)	(0.001)
Financial Wealth$_{01}$		−0.084***	−0.002**
		(0.022)	(0.001)
% Change Income$_{03,05}$[b,d]			0.370
			(0.491)
Unemployed$_{04}$[e]			−0.093*
			(0.052)
N	1958	1858	2290

[a] Dummy variable for whether or not a household extracts equity between 2001 and 2003; [b] income is treated as endogenous; [c] the change in income covers the same period as the change in consumption [$\Delta Y = Y_{03,05} - Y_{01,03}$]; [d] the percent change in income covers the same period as the change in consumption; [e] dependent variable equals 1 if the household has a positive consumption change between the two periods and is zero otherwise. The coefficients in column 3 report marginal effects evaluated at the mean of the other explanatory variables. The regressions also include a cubic in the age of the household head, and indicator variables for whether the household head is married as well as dummy variables for the household head's education and the household's region of residence. Robust errors are in parentheses: * indicates significance at the 10 percent level , ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Table 3.7

Lagged Effect of Equity Extraction on Food Consumption

(2000 dollars)

Regressor	Food Consumption 2005	Δ Food Consumption 2003 to 2005	Positive Food Cons. Δ 2003 to 2005[e]
Amount Extracted ($)$_{01,03}$	0.007	0.003	
	(0.007)	(0.010)	
Extract Equity$_{01,03}$[a]			−0.009
			(0.026)
Average Income$_{03,05}$[b]	0.018***		
	(0.003)		
House Value$_{03}$	0.005***		
	(0.001)		
Financial Wealth$_{03}$	−0.001*		
	(0.001)		
Change Income$_{03,05}$[b,c]		−0.001	
		(0.006)	
House Value$_{01}$		0.001*	0.000
		(0.000)	(0.000)
Financial Wealth$_{01}$		0.000	0.000
		(0.000)	(0.000)
% Change Income$_{03,05}$[b,d]			0.171
			(0.503)
Unemployed$_{04}$[e]			−0.013
			(0.055)
N	1968	1954	1681

[a] Dummy variable for whether or not a household extracts equity between 2001 and 2003; [b] income is treated as endogenous; [c] the change in income covers the same period as the change in consumption [$\Delta Y = Y_{03,05} - Y_{01,03}$]; [d] the percent change in income covers the same period as the change in consumption; [e] dependent variable equals 1 if the household has a positive consumption change between the two periods and is zero otherwise. The coefficients in column 3 report marginal effects evaluated at the mean of the other explanatory variables. The regressions also include a cubic in the age of the household head, and indicator variables for whether the household head is married as well as dummy variables for the household head's education and the household's region of residence. Robust errors are in parentheses: * indicates significance at the 10 percent level , ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Table 3.8

Summary Statistics: Households who do and do not Purchase Vehicles

2003 to 2005

Variable	Buy New Car		Buy Used Car	
	Yes	No	Yes	No
Extract Equity 2003-2005	24.2	24.9	32.1	22.3
Age of Household Head	52.1	54.6	50.3	55.5
Unemployed 2004 (%)	3.3	7.7	5.8	7.2
College Age Kids (% with)	13.7	14.3	21.3	11.8
Disposable Income	57584	46013	47528	48335
House Value	221406	166830	154877	184406
Home Equity	142115	106485	89794	121040
LTV Ratio	0.36	0.33	0.39	0.32
LTV Ratio ≥ 0.8 (% with)	7.9	6.5	10.4	6.6
Value of Liquid Assets	51003	40651	24225	48870
Value of Illiquid Assets	121735	92050	80187	103347

Source: Author's calculations based on PSID data. All variables are measured as of 2003 unless noted, and are in real 2000 dollars where applicable. Liquid assets are net of non-collateralized debt. Illiquid assets exclude housing wealth. Statistics are constructed using the appropriate PSID family weights.

2001 to 2003

Variable	Buy New Car		Buy Used Car	
	Yes	No	Yes	No
Extract Equity 2001-2003	30.2	27.4	33.6	26.0
Age of Household Head	52.8	49.9	48.8	53.4
Unemployed 2002 (%)	4.3	3.6	5.5	3.1
College Age Kids (% with)	15.1	16.0	24.8	12.5
Disposable Income	56713	42002	43545	45701
House Value	197259	148082	138385	165962
Home Equity	119830	91121	81240	103125
LTV Ratio	0.40	0.36	0.40	0.36
LTV Ratio ≥ 0.8 (% with)	10.6	10.5	11.4	10.2
Value of Liquid Assets	57156	42756	27396	52693
Value of Illiquid Assets	113642	88341	90929	94706

Source: Author's calculations based on PSID data. All variables are measured as of 2001 unless noted, and are in real 2000 dollars where applicable. Liquid assets are net of non-collateralized debt. Illiquid assets exclude housing wealth. Statistics are constructed using the appropriate PSID family weights.

Table 3.9

Effect of Equity Extraction on Car Purchases
Probit Regressions

Regressor	Buy New Car[a]		Buy Used Car[a]	
	2003-2005	2001-2003	2003-2005	2001-2003
$E_{t+1,t}$	-0.011	-0.006	0.078^{***}	0.056^{**}
	(0.021)	(0.024)	(0.026)	(0.028)
Fin. Wealth$_t$	0.023^{***}	0.025^{**}	-0.028^{***}	-0.039^{***}
	(0.008)	(0.010)	(0.009)	(0.011)
Income$_t$	0.123^{***}	0.196^{***}	-0.073^{***}	-0.106^{***}
	(0.024)	(0.029)	(0.029)	(0.031)
ΔFin. Wealth$_{t,t-1}$	-0.002	-0.007	0.017	0.014
	(0.012)	(0.011)	(0.014)	(0.012)
ΔIncome$_{t,t-1}$	-0.091	-0.023	0.125^{***}	0.007
	(0.029)	(0.026)	(0.036)	(0.022)
Married$_t$[a]	0.014	0.006	0.082^{***}	0.092^{***}
	(0.025)	(0.031)	(0.028)	(0.032)
Unemployed$_t$[a]	-0.069^{*}	-0.027	0.017	0.067
	(0.034)	(0.051)	(0.051)	(0.061)
College Age Kids$_t$[a]	-0.029	-0.084^{***}	0.104	0.196
	(0.022)	(0.025)	(0.030)	(0.035)
N	1805	1421	1805	1421

[a] Indicator variable that takes the value of 1 if the statement and true and is 0 otherwise. $E_{t+1,t}$ is a dummy variable for whether or not a household extracts equity between t and $t+1$ (e.g. 2003-2005 for car purchases over that period). The table reports marginal effects evaluated at the mean of the other independent variables. All regressors are in 2000 dollars where applicable. The regressions also include a cubic term for the age of the household head, dummy variables for the education of the household head, and dummy variables for the household's region of residence.

Table 3.10

Effect of Equity Extraction on Home Improvement Expenditures (2000 dollars)

Regressor	**Make Repairs**[a]		**$ Value of Repairs**[b,c]	
	2003-2005	2001-2003	2003-2005	2001-2003
$E_{t+1,t}$	0.053***	0.108***		
	(0.020)	(0.023)		
Amount Extracted$_{t+1,t}$ ($)			0.268**	0.171*
			(0.125)	(0.098)
ln(Financial Wealth)$_t$	0.035***	0.034***		
	(0.007)	(0.009)		
ln(Income)$_t$	0.091***	0.061**		
	(0.021)	(0.024)		
Financial Wealth$_t$			0.017*	0.027**
			(0.010)	(0.011)
Income$_t$			−0.010	0.110
			(0.091)	(0.080)
House Value$_t$			0.019	−0.013
			(0.020)	(0.025)
College Age Kids$_t$[d]	−0.032*	−0.069***	-8.9e+03**	-9.4e+03*
	(0.019)	(0.020)	(3624.3)	(5034.3)
Method	Probit	Probit	Tobit	Tobit
N	1801	1421	275	227

[a] Indicator variable that takes the value of 1 if a homeowner makes repairs to his or her house over the relevant period and is 0 otherwise; [b] regressions conditional on households deciding to make home repairs; [c] data left censored at 10000 (nominal) dollars; [d] Indicator variable that takes the value of 1 if the statement and true and is 0 otherwise. In addition, $E_{t+1,t}$ is a dummy variable for whether or not a household extracts equity between t and $t+1$ (e.g. 2003-2005 for repair expenditures over that period). Variables measured as of time t are reported in 2001 for the 2001-2003 sample horizon and in 2005 for the 2003-2005 horizon. Columns 1 and 2 report marginal effects evaluated at the mean of the other independent variables. The regressions also include a cubic term for the age of the household head, dummy variables for the education of the household head, dummy variables for the household's region of residence, controls for marital status, unemployment spells, and the household's change in income and wealth between $t-1$ and t. Robust errors are in parentheses: * indicates significance at the 10 percent level , ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Table 3.11

Positive Active Saving Outcomes between 2001 and 2003[a]
(Probit Regressions)

Regressor	Home	Other Property	Business or Farm	Cash	Stocks	Bonds	Vehicles	Reduced Debt	IRA/ 401k
Extract Equity$_{01,03}$[b]	-0.581^{***}	0.030^{***}	0.014	0.034	0.004	0.022	0.041	0.117^{***}	-0.021
	(0.018)	(0.010)	(0.009)	(0.026)	(0.016)	(0.019)	(0.025)	(0.024)	(0.018)
% Chg. Income$_{99,01}$	-0.010	0.010	-0.003	0.008	-0.056^{**}	0.039	0.014	-0.022	-0.021
	(0.039)	(0.014)	(0.015)	(0.034)	(0.024)	(0.024)	(0.033)	(0.031)	(0.027)
Income$_{01}$[c]	0.186^{***}	0.007	0.009	0.083^{***}	0.109^{***}	0.072^{***}	0.043^{*}	0.021	0.133^{***}
	(0.031)	(0.009)	(0.011)	(0.025)	(0.017)	(0.018)	(0.025)	(0.023)	(0.019)
N	1898	1860	1898	1898	1898	1898	1898	1898	1898

Positive Active Saving Outcomes between 2003 and 2005[a]
(Probit Regressions)

Regressor	Home	Other Property	Business or Farm	Cash	Stocks	Bonds	Vehicles	Reduced Debt	IRA/ 401k
Extract Equity$_{03,05}$[b]	-0.557^{***}	0.022^{**}	0.010	0.037	-0.009	0.026	0.011	0.079^{***}	-0.007
	(0.017)	(0.010)	(0.007)	(0.025)	(0.011)	(0.018)	(0.025)	(0.023)	(0.018)
% Chg. Income$_{01,03}$	-0.038	-0.016	-0.016	-0.068^{**}	-0.032^{**}	-0.047^{**}	-0.067^{**}	0.018	-0.095^{***}
	(0.037)	(0.014)	(0.011)	(0.033)	(0.017)	(0.022)	(0.033)	(0.031)	(0.025)
Income$_{03}$[c]	0.213^{***}	0.048^{***}	0.011	0.037	0.063^{***}	0.039^{**}	0.038	0.036	0.086^{***}
	(0.030)	(0.009)	(0.008)	(0.026)	(0.013)	(0.018)	(0.026)	(0.023)	(0.019)
N	2077	2077	2077	2077	2077	2077	2077	2077	2077

[a] The dependent variable takes a value of 1 if the households' saving in the given asset category is positive and is 0 otherwise; [b] indicator variable that takes the value of 1 if the statement and true and is 0 otherwise; [c] variable in logs. The table reports marginal effects evaluated at the mean of the other independent variables. All variables are in 2000 dollars where applicable. The regressions also include a household's financial wealth holdings, a cubic in the age of the household head, and indicator variables for whether the household head is married as well as dummy variables for the household head's education and region of residence. Robust errors are in parentheses: * indicates significance at the 10 percent level , ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Table 3.12

Dollar Impact of Equity Extraction on Active Saving

Active Saving between 2003 and 2005[a]

Regressor	Other Property	Business or Farm	Reduced Debt
Amount Extracted ($)$_{03,05}$	−0.095	0.025**	0.022*
	(0.113)	(0.014)	(0.012)
Income$_{03,05}$	0.098*	0.111	0.010
	(0.057)	(0.213)	(0.008)
Liquid Financial Wealth$_{03}$	−0.017	−0.012*	−0.011***
	(0.011)	(0.007)	(0.003)
Illiquid Financial Wealth$_{03}$	−0.008	0.005	0.002*
	(0.011)	(0.006)	(0.001)
N	2373	2426	2483

[a] The dependent variable is the amount of saving in the given category between 2003 and 2005. Income is treated as endogenous. All variables are in 2000 dollars where applicable. The regressions also include a cubic in the age of the household head, indicator variables for whether the household head is married as well as dummy variables for the household head's education and the (regional) location of the household. Robust errors are in parentheses: * indicates significance at the 10 percent level , ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Active Saving between 2001 and 2003[a]

Regressor	Other Property	Business or Farm	Reduced Debt
Amount Extracted ($)$_{01,03}$	0.099*	0.109**	−0.008
	(0.054)	(0.046)	(0.016)
Income$_{01,03}$	0.019	0.015	−0.003
	(0.022)	(0.016)	(0.008)
Liquid Financial Wealth$_{01}$	0.037**	0.007	−0.003
	(0.020)	(0.010)	(0.002)
Illiquid Financial Wealth$_{01}$	−0.002	−0.002	0.002
	(0.006)	(0.006)	(0.002)
N	2049	2049	2028

[a] The dependent variable is the amount of saving in the given category between 2001 and 2003. Income is treated as endogenous. All variables are in 2000 dollars where applicable. The regressions also include a cubic in the age of the household head, indicator variables for whether the household head is married as well as dummy variables for the household head's education and the (regional) location of the household. Robust errors are in parentheses: * indicates significance at the 10 percent level , ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Table 3.13

Lagged Impact of Equity Extraction on Active Saving between 2003 and 2005[a]
(Probit Regressions)

Regressor	Home	Other Property	Business or Farm	Cash	Stocks	Bonds	Vehicles	Reduced Debt	IRA/ 401k
Extract Equity$_{01,03}$[b]	0.186***	0.006	0.002	0.015	0.010	−0.008	−0.004	0.035	0.001
	(0.024)	(0.008)	(0.008)	(0.024)	(0.012)	(0.017)	(0.024)	(0.022)	(0.017)
% Chg. Income$_{01,03}$	0.128***	0.039***	0.015	−0.032	0.037*	0.004	−0.036	0.061**	0.005
	(0.037)	(0.012)	(0.015)	(0.033)	(0.019)	(0.024)	(0.033)	(0.032)	(0.026)
Income$_{01}$[c]	0.163***	0.047***	0.022**	0.040*	0.092***	0.050***	0.035	0.042*	0.126***
	(0.025)	(0.008)	(0.010)	(0.024)	(0.012)	(0.017)	(0.024)	(0.022)	(0.018)
N	2073	2073	2053	2073	2073	2073	2073	2073	2073

[a] The dependent variable takes a value of 1 if the households' saving in the given asset category is positive and is 0 otherwise; [b] indicator variable that takes the value of 1 if the statement and true and is 0 otherwise; [c] variable in logs. The table reports marginal effects evaluated at the mean of the other independent variables. All variables are in 2000 dollars where applicable. The regressions also include a household's financial wealth holdings, a cubic in the age of the household head, and indicator variables for whether the household head is married as well as dummy variables for the household head's education and region of residence. Robust errors are in parentheses: * indicates significance at the 10 percent level , ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Table 3.14

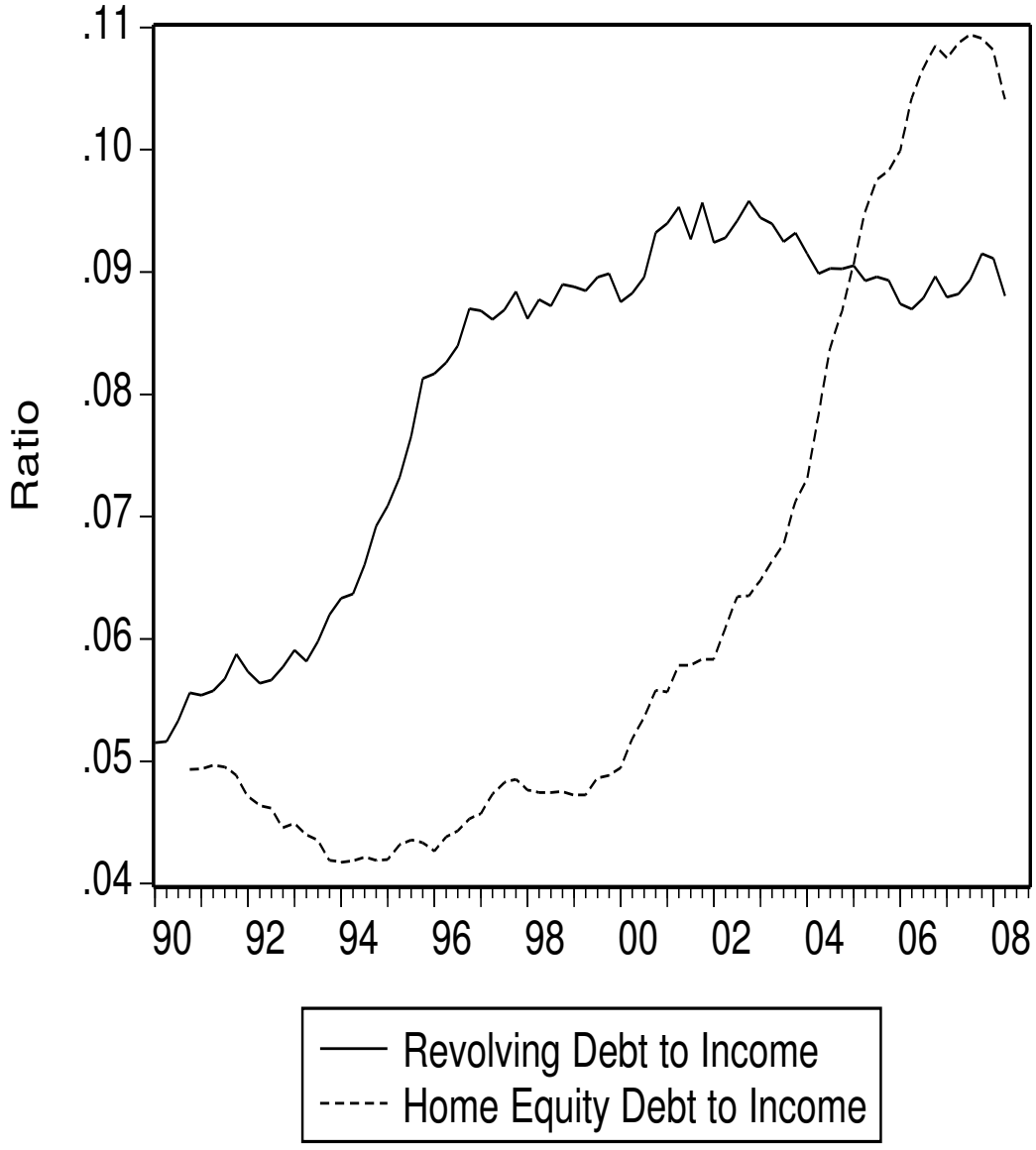
Destination for 1$ of Equity Extraction

Item	Fraction of Homeowners with such Spending[a]	Amount Spent	
		2001-2003	2003-2005
Consumption[b]	1.00	0.946	0.980
Home Repair/Improvement	0.13	0.171[c]	0.268[c]
Medical Expenses	0.97	0.177[c,d]	0.006[c,d]
School Expenses	0.35	0.019[c,d]	−0.010[c,d]
Cars			
Used	0.35	Yes[e]	Yes[e]
New	0.18	No[e]	No[e]
Food Expenditures	1.00	0.018	0.003[d]
Saving			
NCD[f] Repayment	1.00	−0.008[d]	0.022
Business Investment	1.00	0.109	0.025
Other Real Estate	1.00	0.099	−0.095[d]
Stocks	1.00	0.010[d]	0.008[d]
Bonds	1.00	0.044[d]	0.060
Cash	1.00	0.017[d]	0.019[d]
IRA/401k	1.00	0.003[d]	0.008[d]
Vehicles	1.00	−0.037[d]	0.037[d]

[a] Fraction of homeowners who spend or save in the given category (averaged over the two time periods); [b] The spending and investment data may add to more than 1 dollar due to measurement or reporting error in saving and consumption;[c] results conditional on houses who have such expenses; [d] not statistically different from zero; [e] the actual amount of household spending on vehicles is unknown, but the data show that households extracted equity for used car purchases but not new car purchases; ; [f] non-collateralized debt.

Figure 3.1

Home Equity and Credit Card Debt

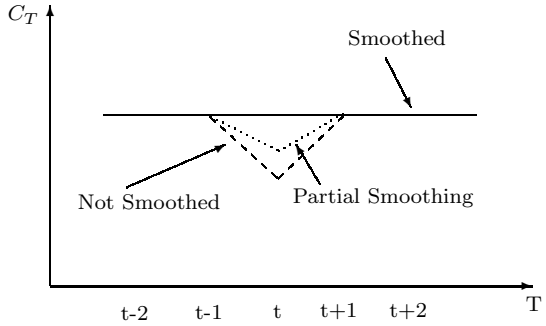


Sources: Income - NIPA; Home Equity Debt - Federal Reserve Z.1 release; Revolving Debt - Federal Reserve G.19 release.

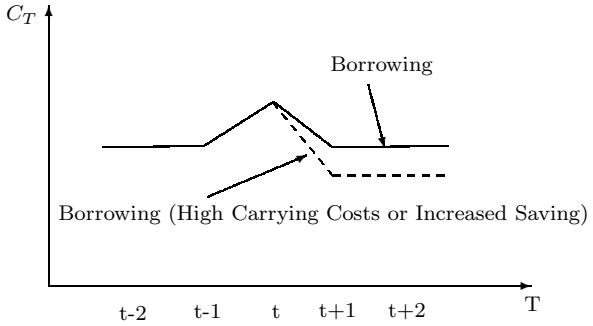
Figure 3.2

Potential Consumption Paths with Equity Extraction

Temporary Negative Income Shock
with Consumption Smoothing through Equity Extraction



Temporary Consumption Shock



Persistent Home Equity Borrowing

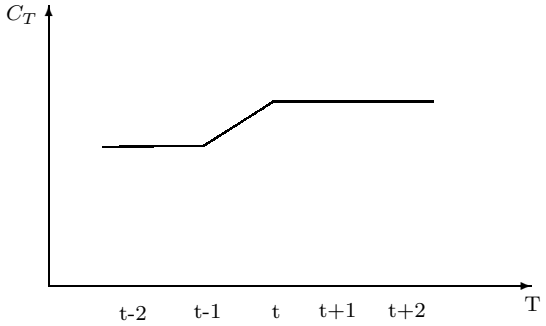
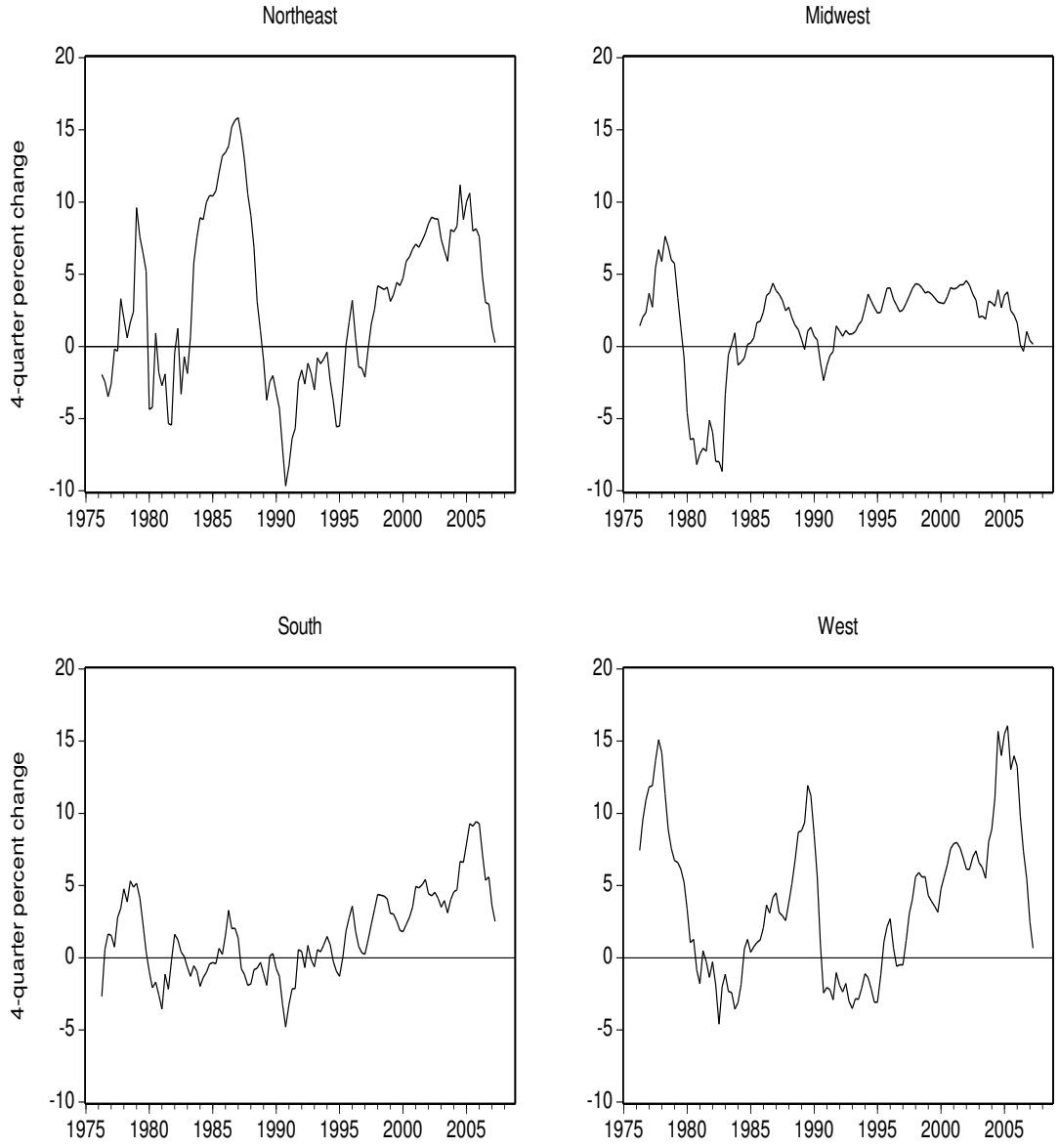


Figure 3.3

OFHEO Regional House Price Growth



Source: OFHEO

B Appendix

B.1 Detailed Active Saving Calculations

Calculating households' active saving in the PSID depends on the asset in question. In particular, active saving for assets with potentially large capital gain components, such as stocks, IRA accounts or annuities, other real estate, and investment in businesses or farms is defined as follows:

$$as^{i,j}_{t-1,t} = I^{i,j}_{t-1,t} - R^{i,j}_{t-1,t} \tag{B.1}$$

where $as^{i,j}_{t-1,t}$ is active saving for household i in asset j, $I^{i,j}_{t-1,t}$ is the amount invested by household i in asset j between $t-1$ and t and $R^{i,j}_{t-1,t}$ is the amount removed from asset j by household i over that same period.

For asset categories where capital gains are not a factor, active saving is simply the difference in a household's reported asset value in period t compared with its value in period $t-1$. These assets include: households' checking and saving account holdings, bond holdings, vehicle values, and non-collateralized debt. In particular,

$$as^{i,j}_{t-1,t} = V^{i,j}_{t} - V^{i,j}_{t-1} \tag{B.2}$$

where V^{j}_{t} is the value of asset j at time t. The remaining active saving category is housing ($j = h$). The actual calculation of households saving in housing depends on whether or not a household moves. Households who do not move "save" by paying down their mortgage principal, while households who move may potentially save or dis-save by altering the amount of equity in their homes. In particular,

$$as^{i,h}_{k-1,k} = \begin{cases} D^{i,h}_{k-1} - D^{i,h}_{k} & \text{if move } =0 \\ E^{i,h}_{k} - E^{i,h}_{k-1} & \text{if move } =1 \end{cases} \tag{B.3}$$

noindent where $D^{i,j}_{k}$ is a household's amount of outstanding mortgage debt in period k, $E^{i,j}_{k}$ is the amount of equity a household has in its home at time k, and *move* is an indicator variable that equals one if a household moved between $k-1$ and k and is zero otherwise. I use k as the time subscript to represent the fact that the time horizon for active saving in housing is different than for the other assets. Prior to 1999, housing data is available yearly and the difference between k and $k-1$ represents one year while $t-1$ to t covers 5 years. After 1999, the housing and active saving data cover two year horizons and $t = k$. More formally:

$$as^{i,h}_{t-1,t} = \begin{cases} \sum_{k=t-1}^{t} as^{i,h}_{k,k+1} & t \leq 1999 \\ as^{i,h}_{k,k+1} & t > 1999 \end{cases} \tag{B.4}$$

I sum yearly active saving in housing prior to 1999 so it covers the same time horizon as the other active saving measures.

Total active saving for a given household is simply the sum of saving its saving in the individual asset components.

$$as^{i}_{t-1,t} = \sum_{j} as^{i,j}_{t-1,t} \tag{B.5}$$

B.2 Calculating Marginal Effects

In Table B.1 below I consider different approaches for calculating the marginal effect of a given explanatory variable on the probability of equity extraction between 2001 and 2003 (equation 3.1). My baseline approach in the text is to evaluate the marginal effect of each explanatory variable at the mean of the other independent variables. In this section, I analyze how my results are impacted if I evaluate the marginal effects at the 25^{th} or 75^{th} percentiles of the other independent variables. The table shows that my findings are essentially the same regardless of my approach for calculating the marginal effects. As a result, my results are not being driving by the way I calculate the marginal effects for the probit regressions.

B.3 Controlling for the Potential Endogeneity of Equity Extraction

Table B.2 reports the estimates of equation 3.2 when I control for the potential endogeneity of equity extraction. The estimates of the equity extraction effect are all over the place and not very believable. This is likely the result of not having a good instrument for households' amount of equity extracted. In particular, the regressions use households' lagged and twice lagged change in self-reported house values as excluded instruments. These instruments, however, do not pass the standard weak instrument tests (first-stage F-stat < 5). Alternative instruments offer little improvement as there seems to be little available data in the PSID to predict households amount of equity extraction. MSA level actual house price changes are a potential alternative instrument, however, these data are not available in the public dataset.

The estimates that control for the potential endogeneity of equity extraction with respect to food consumption suggest that perhaps the OLS estimates of the equity

extraction effect are somewhat downward biased (Table B.2- bottom panel). The point estimate of a 43 cent increase food consumption for a 1 dollar increase in the amount of equity extracted seems too large, however, to be believable. Once again, the instruments for the amount of equity extracted do not pass the standard weak instrument tests. An additional reason for the lack of precision could be that the equity extraction data span two years while the food consumption data is reported for only a year at the end of the equity extraction period. As a result, I may not be able to completely capture the dynamic relationship between equity extraction and food consumption.

B.4 Equity Extraction Estimates with Transitory Consumption Shocks

Recall from Section 3.2.2 that the data generating process of interest is

$$c_t^i = b_0 + b_2 y_t^i + \epsilon_t + \nu_t^i \tag{B.6}$$

where ϵ_t is a macroeconomic shock and ν_t^i is a transitory shock to household spending. Suppose that the econometrician estimates the following regression

$$c_t^i = b_0 + b_1 x_t^i + b_2 y_t^i + u_t^i \tag{B.7}$$

where x_t^i is the amount of equity extracted and u_t^i is the composite estimation error term ($u_t^i = \epsilon_t + \nu_t^i$).

For illustration purposes, assume that $b_0 = 0$ and $E[y_t^i u_t^i] = 0$ so that y_t^i can be dropped from the discussion for simplicity. The estimate of the equity extraction effect across all households, $\hat{b}_1$, is therefore defined as follows:

$$\begin{aligned} \hat{b}_1 &= (x_t' x_t)^{-1} x_t c_t \\ &= (x_t' x_t)^{-1} x_t (b_1 x_t + u_t) \end{aligned} \tag{B.8}$$

Note that I drop the i superscripts because OLS averages across all households. Further suppose that $x_t = \lambda \nu_t$ which implies that $(1 - \lambda)$ of the transitory shock remains in the composite error term $u_t = \epsilon_t + (1 - \lambda)\nu_t$. This implies that

$$
\begin{aligned}
\hat{b}_1 &= (x_t' x_t)^{-1} x_t (b_1 x_t + \epsilon_t + (1-\lambda)\nu_t) \qquad \text{(B.9)} \\
&= b_1 + (x_t' x_t)^{-1} x_t \epsilon_t + (x_t' x_t)^{-1} x_t (1-\lambda)\frac{x_t}{\lambda} \\
&= b_1 + \frac{1-\lambda}{\lambda} + (x_t' x_t)^{-1} x_t \epsilon_t \\
\Rightarrow E[\hat{b}_1] &= b_1 + \frac{1-\lambda}{\lambda}
\end{aligned}
$$

The last equation holds since equity extraction is assumed to be uncorrelated with the macroeconomic shock and $E[x_t \epsilon_t] = 0$. This result implies that the estimate of the equity extraction effect is biased upward relative to the true value assuming $\lambda < 1$.

Table B.1

Probability of Equity Extraction: Marginal Effects Evaluated at Different Values

Regressor	Evaluated at: Mean	25^{th} Pctile	75^{th} Pctile
Liquid Fin. Wealth (10000s)	-0.003^{**}	-0.003^{*}	-0.004^{**}
	(0.002)	(0.002)	(0.002)
Illiquid Fin. Wealth (10000s)	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)
Disposable Income[a]	0.030	0.028	0.035
	(0.019)	(0.017)	(0.022)
% Change in House Prices	-0.009	-0.008	-0.010
	(0.025)	(0.022)	(0.029)
Unemployed[b]	0.091^{*}	0.085^{*}	0.101^{*}
	(0.052)	(0.049)	(0.055)
LTV Ratio	0.255^{***}	0.232^{***}	0.296^{***}
	(0.046)	(0.033)	(0.057)
LTV ≥ 0.8[c]	-0.215^{***}	-0.169^{***}	-0.258^{***}
	(0.023)	(0.021)	(0.035)
College Age Kids[c]	0.043	0.040	0.049
	(0.027)	(0.025)	(0.031)
Married[c]	0.019	0.017	0.022
	(0.027)	(0.025)	(0.032)
Regions:			
Northeast[c]	-0.034	-0.031	-0.040
	(0.031)	(0.028)	(0.037)
North Central[c]	0.036	0.034	0.041
	(0.026)	(0.024)	(0.029)
West[c]	0.075^{**}	0.071^{**}	0.085^{**}
	(0.033)	(0.031)	(0.036)
N	1966	1966	1966

[a] Variable is in logs; [b] Indicator variable that takes the value of 1 if the household head or wife reports 6 or more weeks of unemployment in 2002; [c] Indicator variable that takes the value of 1 if the statement is true and zero otherwise. All variables are measured as of 2001 unless noted, and are in real 2000 dollars where applicable. The change in house prices is calculated over the two period prior to the equity extraction period (e.g. 1999-2001). The regressions also include a cubic term for the age of the household head, dummy variables for the education of the household head, and an indicator variable for whether there are multiple earners in the household.

Table B.2

Effect of Equity Extraction on Total Non-housing Consumption
Regressions that Control for the Potential Endogeneity of Equity Extraction
(2000 dollars)

Regressor	2001-2003	2003-2005
Amount Equity Extracted ($)$_{t,t+1}$	−1.375	2.486
	(4.524)	(2.862)
Income$_{t,t+1}$	0.627***	0.679***
	(0.181)	(0.199)
Financial Wealth$_t$	0.119***	0.168***
	(0.030)	(0.029)
House Value$_t$	0.074	−0.031
	(0.100)	(0.053)
N	1660	1952

Each equation treats income *and* equity extraction as endogenous and is estimated using 2SLS. Financial wealth and housing wealth are measured at the beginning of the period (e.g. 2001 for consumption between 2001 and 2003). The regressions also include a cubic in the age of the household head, and indicator variables for whether the household head is married as well as dummy variables for the household head's education and the household's region of residence. Robust errors are in parentheses: * indicates significance at the 10 percent level, ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

Effect of Equity Extraction on Food Consumption
Regressions that Control for the Potential Endogeneity of Equity Extraction
(2000 dollars)

Regressor	2003	2005
Amount Equity Extracted ($)$_{t,t+1}$	0.432	−0.090
	(0.301)	(0.101)
Income$_{t,t+1}$	0.014*	0.021***
	(0.007)	(0.005)
Financial Wealth$_t$	0.001	−0.001
	(0.001)	(0.001)
House Value$_t$	−0.002	0.006***
	(0.004)	(0.002)
N	1967	2338

Each equation treats income *and* equity extraction as endogenous and is estimated using 2SLS. The amount of equity extraction is measured over the period immediately preceding and including the date over which food consumption is measured (e.g. 2001- 2003 for food consumption in 2003). In addition, financial and housing wealth are measured at the beginning of the equity extraction period. The regressions also include a cubic in the age of the household head, and indicator variables for whether the household head is married as well as dummy variables for the household head's education and the household's region of residence. Robust errors are in parentheses: * indicates significance at the 10 percent level , ** indicates significance at the 5 percent level, and *** indicates significance at the 1 percent level.

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Chapter IV

The Collateral Value of Illiquid Wealth: Home Equity Borrowing and Households' Precautionary Saving Motive

4.1 Introduction

House prices in the United States rose roughly 45 percent in real terms between 2000 and their peak at the end of 2006 according to the house price index published by OFHEO (Office of Federal Housing Enterprise Oversight). This dramatic increase in home prices resulted in huge equity windfalls, at least on paper, for homeowners. Anecdotal evidence along with data in Greenspan and Kennedy (2005), and empirical analysis in Cooper (2009a) suggest that households extracted equity from their homes to finance consumption. Indeed, mortgage equity withdrawal averaged roughly 6 percent of households' disposable income a year.[1] In addition, home equity debt relative to income more than doubled between 2000 and 2006 according to the Flow of Funds (FOF) accounts.

Understanding the interactions between house prices, household borrowing and spending is important especially given the current economic situation where house prices are dropping and households' home equity borrowing capabilities are diminishing. There is a fairly extensive empirical literature looking at the relationship between housing wealth and household spending. Frequently cited papers include early work by Skinner (1989) as well as more recent analysis by Lehnert (2004), Campbell and Cocco (2007), Aron and Muellbauer (2006), and others. Cooper (2009b) shows that housing wealth impacts household spending through its role as borrowing collateral. My results reinforce the idea that changes in house prices affect household behavior because housing wealth fluctuations impact homeowners' ability to borrow cheaply

[1] Mortgage equity withdrawal calculations based on updated estimates provided by Jim Kennedy of the mortgage system data presented in Greenspan and Kennedy (2005).

and easily.

The goal of this paper is to examine the relationship between collateralized borrowing and household behavior from a theoretical point of view. In particular, I extend the basic liquidity constrained consumption model presented in Deaton (1991) to allow households to borrow against the equity they have in an *illiquid* asset. The value of this asset fluctuates stochastically over time, and households can use the asset as collateral to help fund their desired level of consumption. The illiquid asset is effectively a house, but is not labeled as such in order to abstract from housing's role as a consumption good, and focus entirely on how its role as borrowing collateral impacts households' consumption behavior. Providing households access to collateralized credit as part of their consumption decision process is consistent with the real economy. According to the 2004 SCF roughly 15 percent of households reported having a home equity loan or line of credit. This percentage is up only slightly relative to the 1990s, which suggests that home equity type borrowing has been present in the economy over time.

The model is useful because it can address some issues theoretically that are difficult to answer empirically. In particular, I can analyze potential asymmetric consumption responses to changes the value of households' equity. Rising collateralizable equity prices allow households to borrow and consume more, however, falling prices do not necessarily force households to spend less if they have other means to finance their spending. The theoretical model also enables me to investigate whether the role of households' collateralized borrowing capacity serves as an alternative buffer stock. Some argue that households view their home equity as a substitute hedge against labor income risk, and thus maintain lower liquid saving than they would in a world with out such borrowing capabilities. This is one potential explanation for why the personal saving rate in the US was so low especially during the house price boom in the first half of this decade.

This paper also examines how households' consumption responds to house price shocks that do and do not occur simultaneously with income shocks. One concern with the results from empirical studies on housing wealth and consumption is that house values and household spending are potentially endogenous and any identified empirical relationship is not causal. Indeed, house prices and consumption could increase simultaneously in response to some common underlying factor such as favorable news about future economic growth. Most empirical studies attempt to control for this potential endogeneity. A theoretical model, however, can compare how household spending responds to a house price shock that is truly *exogenous*, compared with a shock that is correlated with income changes.

The results from solving the model using numerical methods suggest that collateralized borrowing benefits households with limited financial resources by allowing them to increase their consumption. In addition, collateralized borrowing capacity serves as an alternative hedge against future labor income risk. Indeed, households with sufficient resources reduce their saving out of current income relative to the case where they are not allowed to borrow against an illiquid asset. This reduction in saving is mitigated a bit if households face higher fixed borrowing costs or if policymakers institute borrowing collateral limits.

In addition, the model simulation results suggest that collateralized borrowing capacity helps households smooth their consumption somewhat in response to unexpected income shocks. Changes in illiquid asset prices, however, have a minimal overall impact on households' spending compared with similar sized income shocks. This result is consistent with findings in the second chapter of this dissertation that suggest changes in housing wealth have a small, but significant impact on aggregate household consumption. The simulation results also show that consumption growth falls somewhat more on impact in response to a negative price shock compared to a positive one. The path of the consumption growth response to positive versus negative shocks, however, is relatively symmetric.

In related literature, Aiyagari (1994) examines how households behave when they can borrow against their lifetime resources, and Lopes (2006) considers the theoretical effect of *unsecured* (credit card type) borrowing and default on household behavior. My approach differs from these papers because in my model households must have sufficient collateral in order to borrow, and their future borrowing capacity is uncertain. More recent papers by Li and Yao (2007) and Bajari et al. (2008) take a more general equilibrium approach to analyzing how housing and house prices affect household behavior. Their models are complex and the borrowing collateral role of housing wealth is just one component. In particular, Li and Yao (2007) use a life-cycle model to look at how changes in house prices affect households' transitions into and out of the labor market along with their consumption decisions. The latter authors write down a model to capture and estimate housing demand and they too focus on households' housing tenure decisions. In both of these papers it is difficult to disentangle the effect of home equity borrowing on household consumption from the impact that other model features have on household behavior. The goal of this paper, however, is to focus on how households behave conditional on owning a home against which they can borrow. I therefore present and analyze a more parsimonious model than in the existing literature in order to focus on how households' collateralized borrowing capabilities impact their spending and saving behavior holding everything else

constant.

The rest of the paper is organized as follows. Section 4.2 presents the model and discusses the model predictions. Section 4.3 discusses my numerical results. Section 4.4 presents the results from my model simulation exercises. Section 4.5 concludes.

4.2 Model

4.2.1 Background

The model in this paper is an extension of the basic decision rule consumption model with liquidity constraints and precautionary saving presented in Deaton (1991). In that model, households are subject to labor income risk and are restricted from having non-negative liquid asset holdings. In other words, they are not allowed to borrow to smooth consumption. Households with sufficient resources therefore save some of their current income to guard against future labor income risk, and thus exhibit so-called "precautionary saving" behavior. In addition, households with limited current resources who wish to consume more than their current income but cannot due to the no-borrowing restriction, are deemed "liquidity constrained." Indeed, these households are forced to consume only their existing resources.

In the decision rule model below, households similarly face both permanent and transitory labor income risk and they *cannot* borrow against their future income. Unlike in the Deaton model, however, households are endowed with an illiquid asset. The value of this asset fluctuates stochastically over time. Households can borrow against any equity they have accumulated in their illiquid asset either from price increases or because they purchased the asset using limited leverage. This part of the model mimics the key features of the home equity borrowing market in the United States.

The goal of the model is to capture the impact of collateralized borrowing on households' spending decisions, while abstracting from households' housing tenure choices and the fact that housing doubles as a consumption good. The model therefore does not inclued other aspects of households' housing related decisions, and I label the asset as "illiquid" rather than a home to avoid unnecessary confusion. Households' "illiquid asset holdings" are synonymous in principle, however, with the collateral value households have in their homes. Indeed, I parameterize the price process for households' illiquid assets based on aggregate US house price data (see section 4.3).

One way of thinking about this modeling approach is that households' collateralized borrowing capacity is an additively separable component of their utility.

Households benefit from having access to this borrowing capability because it provides them an alternative resource for financing their spending needs. The model assumes, however, that households are simply endowed with this borrowing capacity. In other words, households posses their desired amount of housing services, and thus there is nothing to gain by modeling their choice over the amount of the illiquid asset (housing) that they own.

The model also includes separate stochastic processes for illiquid asset prices and household income. Some argue that household income growth and house price growth are jointly determined, and therefore it is difficult to empirically identify the impact of a house price shock on household spending. The model, however, captures the impact of simultaneous versus independent asset price and income shocks on household behavior. In other words, it addresses what happens when prices go up independent of households' income changing as opposed to income and asset prices rising concurrently because of some common underlying macroeconomic shock.

In addition, the model requires that households service their debt in every period, but they are otherwise allowed to roll over their debt indefinitely. I discuss this assumption in more detail in section 4.2.3, however, this setup is consistent with the majority of second mortgages being interest only loans. Even with a more conventional, amortized loan, the majority of a household's mortgage payment over the initial repayment horizon goes toward interest costs. The model further assumes that interest rates are fixed over time and that the real borrowing rate r^D is higher than the real lending rate (risk free return) r^A. This assumption ensures that households do not borrow to save. Section 4.3.1 discusses the model parametrization choices in more detail.

I also model extensions that include a fixed cost for collateralized borrowing as well as restrictions on the maximum percentage of equity households are allowed to borrow against. These features capture the relative ease with which households can borrow against their homes. A frequent argument, especially in the popular press, is that households' ability to easily and cheaply obtain credit during the early 2000s helped fuel high spending levels. These analysts further contend that this so-called period of "easy credit" is at least partly responsible for the current economic crisis since falling home prices reduced households' ability to finance consumption with collateralized borrowing. The borrowing costs and collateral restrictions model extensions address whether household spending differs during periods of restrictive credit (high borrowing costs) versus lose credit (few borrowing restrictions).

4.2.2 Specification

The model is based on an infinite lived, representative agent consumer who seeks to maximize the present discounted value of his or her lifetime utility. In each period the agent chooses whether or not to borrow assuming he or she has positive borrowing capacity. Conditional on that decision the household chooses consumption (and borrowing) optimally subject to his or her budget constraint.

The household's decision problem can thus be written as follows:

$$\max_{B_t,\, b_t,\, c_t} \quad \mathrm{E_t}\left[\sum_{t=0}^{\infty} \beta^t u(c_t)\right]$$

subject to:

$$\begin{aligned} x_{t+1} &= \left[x_t - c_t - r^D D_t + (b_t - f)B_t\right](1 + r^A) + Y_{t+1} && (4.1)\\ c_t &\leq x_t + b_t B_t && (4.2)\\ b_t &\leq \alpha\,(v_t - D_t) && (4.3) \end{aligned}$$

$$D_0, x_0, v_0 \text{ given}$$

where c_t is household consumption, x_t is a household's so called cash-on-hand, v_t is the value of the household's illiquid asset, and D_t is its stock of existing debt. In addition, B_t is an indicator variable that takes a value of one if a household chooses to borrow and is zero otherwise, b_t is the amount borrowed, f is the fixed cost the household must pay in order to borrow, and α is the maximum percentage of its equity a household can borrow against. For the baseline model analysis, $f = 0$ and $\alpha = 1$.

In addition, the following accounting identities also hold:

$$\begin{aligned} D_{t+1} &= D_t + b_t B_t && (4.4)\\ \Leftrightarrow D_{t+1} &= \sum_{j=0}^{t} b_j B_j + D_0 && (4.5)\\ x_t &= Y_t + A_t && (4.6) \end{aligned}$$

Equations 4.4 and 4.5 state that a household's current stock of debt is the sum of its past borrowing plus its initial leverage. The last identity, shows that a household's

so-called cash-on-hand is the sum of its existing *liquid* assets (A_t) and current income (Y_t). This accounting approach for measuring households' liquid resources is standard in the literature.

4.2.3 Debt Repayment

In the model, households must pay debt-service (interest) costs in every period, but can indefinitely roll over their debt. In addition, households cannot have negative equity in their illiquid asset,

$$v_t \geq D_t \tag{4.7}$$

and thus are forced to repay some of their debt if their asset value declines substantially. Such a situation requires households to pay back enough debt so they eliminate their negative equity position and $v_t = D_t$. An additional model extension considers the case where households are allowed to maintain negative equity up to a maximum of forty-percent of their illiquid asset value.[2] Restricting households to non-negative or limited negative equity holdings is reasonable considering extremely few households in the Panel Study of Income Dynamics (PSID) report negative equity positions in their homes through 2005.

The model does not, however, include voluntary debt repayment. In other words, households do not choose to pay down some of their debt when they have a positive equity position. This assumption may seem somewhat restrictive. Indeed, households may wish to repay debt in a period in which they experience a positive income shock so that they have potentially higher borrowing capacity in the future to guard against adverse income shocks.

I experimented with including voluntary debt repayment as an additional component of households' decision set and found limited evidence of households choosing to pay down their existing debt. This feature greatly increased the complexity of the model, however, while generating little if any additional insight about households collateralized borrowing behavior. I therefore chose the more parsimonious approach without repayment to focus more directly on households' collateralized borrowing decisions. Arguably, examining households' decisions to pre-pay their outstanding housing debt is an interesting topic. Properly considering such decisions, however, likely requires a somewhat different modeling approach, and I leave this issue future research.

[2]This is equivalent to a maximum loan-to-value ratio of 1.4.

4.2.4 Default

There is also no default in the model. I make this modeling choice in order to maintain a parsimonious model that focuses on households' decisions to extract equity from their homes. A household's choice to default has been explored in some detail in Lopes (2006) in the context of a model with *unsecured* borrowing. In particular, she explores the stigma and higher costs associated with default. How households' *collateralized* borrowing decisions are affected by their ability to default or simply walk away from their debt is an interesting research topic. Arguably, households are potentially more likely to over-borrow in a world with limited recourse voluntary default than if they cannot simply walk away from their mounting debt. I intend to explore this issue in future research.

Excluding default from the model assumes that households live in a world where banks do not allow them to become over-leveraged. Such an assumption is reasonable historically in the United States except for perhaps during the recent house price boom. The idea of this paper, however, is not just to model collateralized borrowing in the US economy in the early 2000s. Instead, the goal is to investigate how collateralized borrowing capacity impacts households' spending decisions in general.

Two additional underlying assumptions, rule out the possibility of default in the model. First, households always have sufficient income to service their debt even during a period with a particularly adverse income shock. In particular, households who exhaust their borrowing capacity face debt service costs that are no more than seven standard standard deviations *below* their mean per period income. Given this setup, the chance of a negative income shock occurring that leaves a household with inadequate resources to service its debt is essentially a zero probability event.Similarly, households also have sufficient resources to eliminate any negative equity positions they incur because of an adverse illiquid asset price shock. In particular, illiquid asset values never exceed one-half of households' permanent income, and periods in which asset values drop more than 15 or 20 percent are essentially zero probability events.[3]

4.2.5 Stochastic Processes

In the model household income and the price of the illiquid asset are assumed to be exogenous and stochastic. I define the household's income process following the approach in Carroll (1992) and Ludvigson and Michaelides (2001). In particular, I assume that income Y_t has a permanent (P_t) and transitory component (N_t)

[3]The next section as well as the appendix discuss the particular model parameterizations in more detail.

$$
\begin{aligned}
Y_t &= P_t N_t && (4.8)\\
P_t &= G P_{t-1} \Gamma_t && (4.9)
\end{aligned}
$$

In equation 4.9, G is the mean growth rate for permanent income and Γ_t is the per period multiplicative shock to permanent income. This setup implies that the permanent component of income follows a random walk with drift, and the log of income y_t is subject to both permanent and transitory shocks each period. In particular, permanent income can be re-written as:

$$
\begin{aligned}
p_t &= g + p_{t-1} + \gamma_t \\
\Rightarrow \Delta p_t &= g + \gamma_t && (4.10)
\end{aligned}
$$

where the lowercase variables represent logs. Overall household labor income can be transformed as follows:

$$
\begin{aligned}
y_t &= p_t + n_t \\
\Rightarrow \Delta y_t &= \Delta p_t + n_t \\
\Leftrightarrow \Delta y_t &= g + \gamma_t + n_t - n_{t-1} && (4.11)
\end{aligned}
$$

I further assume that the permanent and transitory shocks are independently distributed normal variables with mean 0 and positive variance.

$$
\begin{aligned}
\gamma_t &\sim N(0, \sigma_\gamma^2) \\
n_t &\sim N(0, \sigma_n^2)
\end{aligned}
$$

I therefore can define household income growth as being normally distributed with mean g and variance σ_y^2.

$$
\Delta y_t \sim N(g, \sigma_y^2) \tag{4.12}
$$

where

$$
\sigma_y^2 = \sigma_\gamma^2 + 2\sigma_n^2 \tag{4.13}
$$

In terms of illiquid asset prices, the annual home price data from OFHEO sug-

gests that house prices have a permanent component, but that price *growth* is mean reverting. As a result, illiquid asset price growth in the model follows a first-order autoregressive process. In particular,

$$\Delta v_t = \rho \Delta v_{t-1} + \epsilon_t \tag{4.14}$$

where ρ captures the persistence of the price growth process. Shocks to price growth are normally distributed with a potentially non-zero mean and positive variance.

$$\epsilon_t \sim N(\mu_\epsilon, \sigma_\epsilon^2) \tag{4.15}$$

The implicit assumption underlying equation 4.15 is that shocks to illiquid asset prices are permanent. This modeling choice is consistent with the idea that asset price changes in general are permanent. In addition, since homes are relatively illiquid and transactions occur somewhat slowly, it is arguably unclear what would cause a transitory shock to prices. I estimate the relevant parameters of the price process using the OFHEO data. Section 4.3 discusses the parameterizations for both the income and illiquid asset price processes in more detail.

4.2.6 Solution

The relevant Bellman equation for the household's problem is :

$$\mathcal{V}(x, v, D, \Delta v) = \max_{\substack{borrow, \\ noborrow}} \quad \begin{Bmatrix} \max\limits_{c^b, b} & \left[u(c^b) + \beta \mathrm{E}\mathcal{V}(x', v', D', \Delta v)\right], \\ \max\limits_{c^n} & \left[u(c^n) + \beta \mathrm{E}\mathcal{V}(x', v', D, \Delta v)\right] \end{Bmatrix}$$

where $\mathcal{V}(\cdot)$ is the household's continuation value for a given set of state variables, E is the expectations operator, and variables with a prime, (e.g. x'), represent the next period's value. The relevant state variables are the household's cash on hand, illiquid asset value, stock of debt, and the current illiquid asset price growth (Δv). This last state variable is necessary because of the auto-regressive price growth process.

In addition, a household's optimal consumption choice is likely different conditional on its borrowing decision. I make this distinction clear by denoting consumption accordingly for when a household does borrow, (c^b), and when they do not borrow, (c^n). Consumption in each regime is defined based on the household's budget constraint. Continuing with the notation used in the Bellman equation:

$$c^b = x + b - f - r^D D + \frac{y' - x'}{1 + r^A} \tag{4.16}$$

$$c^n = x - r^D D + \frac{y' - x'}{1 + r^A} \tag{4.17}$$

The key difference in spending in the two regimes is the amount the household chooses to borrow less the fixed cost (if any) the household must pay $(b - f)$. Unfortunately, there is not a closed form solution for the amount a household borrows, should they choose to do so, because of the multiple borrowing related constraints and the impact current period borrowing has on a household's future borrowing capacity and debt burden. When a household chooses not to borrow, however, the first order condition for its optimal decision making reduces to the familiar one from the basic consumption decision rule model in (Deaton (1991)).

$$u'(c_t^n) = \max\left\{u'(x_t),\ \beta(1 + r^A)E_t\left[u'(c_{t+1}^n)\right]\right\} \tag{4.18}$$

In other words, a household who does not borrow maximizes its inter-temporal marginal utility over consumption. The household consumes its cash-on-hand when it lacks sufficient resources to consume the optimal amount needed to maximize its lifetime utility.

There is no analytical solution to the model, regardless of whether or not the household borrows. I therefore solve the model using numerical techniques. In particular, the solution to the household's problem is a consumption policy function of the form:

$$c_t = \omega(\mathbf{Z_t}) \tag{4.19}$$

where $\mathbf{Z_t}$ is the vector of relevant state variables from the model and ω is some unknown, possibly non-linear function of these state variables. As noted above, the state variables in the model are $\{x_t, v_t, D_t, \Delta v_t\}$, and the policy function is therefore

$$c_t = \omega(x_t, v_t, D_t, \Delta v_t) \tag{4.20}$$

To solve the model, I first discretize the state space using Chebysev nodes. I then solve for ω and calculate the policy function using the method of parameterized expectations. The appendix discusses this numerical solution method in more detail.

4.2.7 Households' Optimal Decision Making Process

A household's optimal consumption and borrowing decisions can perhaps be best understood diagrammatically. Figure 4.1 shows a stylized version of a household's marginal utility plotted against its choice of consumption. The top panel shows the decision a household faces in the standard no-borrowing (Deaton) model. The household's optimal inter-temporal consumption for the first period is denoted by c_0^*. When the household's current period financial resources (x_0) are limited, however, such that $x_0 < c_0^*$ than the household maximizes its utility by consuming $c_0 = x_0$.

The bottom panel of Figure 4.1 demonstrates a household's optimal decision when it can borrow against an illiquid asset to help finance consumption. Suppose that the household has $x_0 < c_0^*$ and cannot consume his or her optimal amount without borrowing. Further suppose that the household also has some equity, e_0, it can borrow against.[4] If the amount of equity is sufficient such that the household's cash-on-hand plus its available collateralizable equity exceeds its optimal level of consumption, $x_0 + \alpha e_0 > c_0^*$ (point z^* on the figure), then the household can potentially borrow to consume its optimal amount.

Whether the household actually borrows this amount, however, depends on the inter-temporal trade-offs that go along with extracting equity from its home. In particular, the first order conditions for the model (not reported) include a dynamic multiplier from the household's borrowing constraint that captures the discounted shadow value of an added dollar of future borrowing capacity. In other words, a household potentially limits the amount in can borrow in the future, should the need arise, by borrowing a lot in the current period. The household also faces increased debt service costs, although they are relatively small relative to the household's overall per period spending. Finally, a household will likely also borrow, conditional on the same trade-offs, even if $x_0 + \alpha e_0 < c_0^*$ (point z^{**} on the figure). Such a household gets somewhat closer to its optimal consumption level by consuming its cash-on-hand plus some amount of borrowing even though the household still is somewhat consumption constrained.

4.2.8 Discussion

Both Deaton (1991) and Aiyagari (1994) have explored how households behave when faced with limited borrowing opportunities based on their income. This paper continues to assume that households face limited opportunities to borrow against their income (they cannot), but allows households to borrow in another way that does not

[4] $e_0 = v_0 - D_0$.

require accessing the high cost, unsecured credit markets. Not allowing households the opportunity to borrow against their future income is arguably a somewhat extreme assumption especially given the sheer volume of borrowing by households that occurs in today's economy. Deaton (1991), however, made such an assumption in order to isolate the impact of borrowing restrictions on households' saving behavior.

My model incorporates the same income borrowing restriction in order to isolate and investigate the impact of collateralized borrowing on household behavior while holding all else equal. Such an approach allows me to examine how collateralized borrowing impacts households' consumption smoothing decisions in response to temporary income shocks. In addition, the model addresses how changes in illiquid asset values impact households' behavior even when they do not have current borrowing needs, but know they *cannot* borrow against their income in the future. The model setup also addresses whether households' collateralized borrowing capacity helps explain the low levels of personal saving in the US especially during the recent run-up in house prices.

An alternative way of thinking about the income borrowing restriction, is that households could potentially borrow against their future earnings, but the costs of doing so are prohibitive. For example, an April 2009 CNN.com article discusses how some households face very high interest rates for used car purchases. The article mentions a couple who, despite having a steady income, received a loan offer with a 14.5 percent interest rate for buying a used car. Rather than pay the incredibly high rate the couple decided against purchasing the car, and is making do with just one family vehicle.[5] This situation represents a case where a household could not borrow through traditional channels despite having an income stream. If the household had a collateralizable asset, however, they could have potentially financed their desired consumption by borrowing against their equity at a much lower cost. Indeed, home equity borrowing is one of the cheapest forms of household credit. Arguably, it is therefore important to understand how collateralized borrowing affects households' behavior when their other consumption financing options are limited.

4.2.9 Predictions

In the standard Deaton model without borrowing, households with sufficient cash-on-hand to fund their desired amount of consumption exhibit so-called precautionary saving behavior. In particular, these households save some of their existing resources as protection against negative income shocks in the future. In contrast, households

[5] `http://money.cnn.com/galleries/2009/autos/0904/gallery.car_buyers/index.html` accessed April 9, 2009.

with low values of cash-on-hand consume all of their available resources because they lack the funds to finance their desired level of consumption. Section 4.3.2 discusses the policy function for the no-borrowing model in more detail.

To the extent that households view their collateralized borrowing capacity as an alternative safeguard against future labor income risk, consumption will likely be higher in my model for so-called precautionary savers than in the no-borrowing model. If households feel that they can use collateralized borrowing to smooth consumption in response to a future negative income shock, then they will likely consume more currently because of their perceived reduced liquid savings needs. In addition, households with substantial collateralizable equity should have smoother consumption in response to a transitory income shock than similar households with more limited borrowing capacity. The former households can borrow against their equity to finance their consumption despite the income shortfall

From a static point of view, households with limited initial resources (low cash-on-hand) should consume more in my model then in the standard no borrowing model assuming that they have sufficient equity to borrow against. The key question, however, is how much equity households extract conditional on deciding to borrow. In other words, do households borrow to consume as close to their optimal level of consumption as possible? Alternatively, do they show some borrowing restraint given the trade-off they face when borrowing in terms of potentially less future borrowing capacity as well as increased debt service costs?

Not all households will likely borrow an amount equal to their available collateral. In particular, households will likely not borrow to the point that the additional cash pushes their consumption beyond its optimal level (i.e $c_0 \neq z_0^* > c_0^*$ in Figure 4.1). Households with limited resources, however, that restrict their spending to be well below its optimal level (x_0 close to the origin in Figure 4.1) are much more likely to borrow the maximum amount their equity allows given their greater need to finance additional consumption. For these households, the future costs of increased current period borrowing are likely small compared to their utility gain from consuming closer to or at their optimal level. In contrast, households with adequate collateral, and cash-on-hand that allows them to spend close to but slightly less than their optimal amount ($z_0^* * \leq x_0 \leq c_0^*$ in Figure 4.1), may borrow somewhat cautiously. High actual and or implied future costs of borrowing may outweigh the utility gains these households would receive from borrowing. As a result, these households may choose not to increase their spending very much, and thus they likely will not borrow as much as their collateral allows (assuming they have sufficient borrowing capacity).

In addition, requiring households to pay a fixed cost in order to borrow will likely

impact their decisions on the margin. Households will not borrow if the amount of equity they can extract is less than the borrowing costs they must pay. Similarly, households with sufficient borrowing capacity but who wish only to borrow a small amount will also likely not extract equity when the cost exceeds the amount they wish to borrow. In general, instituting a fixed cost of borrowing or increasing an existing fixed cost will crowd out borrowers with limited capacity or limited borrowing demand. The borrowing behavior of households with sufficient need and collateral will likely be relatively unchanged assuming that the fixed cost of borrowing is small. I also may observe increased saving by households with sufficient resources when their is a fixed borrowing cost. Even though these households do not borrow in the current period, the increased borrowing costs make it more expensive for them to borrow in the future to smooth consumption.

A policy that restricts the percentage of collateral a household can borrow against will also likely reduce borrowing. Such collateral limits, however, will likely impact households with high borrowing demand rather than those households with marginal borrowing demand or needs. In particular, the affected households will be those with limited liquid financial resources who want to borrow against as much collateral as they have. These households will be force to borrow less than they would have without collateral restrictions There may also be less substitution away from precautionary saving and toward current consumption by households who view their borrowing collateral as an alternative hedge against future labor income risk. Such households will not be able to borrow as much in the future should the need arise given, and thus they may wish to maintain a higher level of liquid savings. Overall, borrowing should decline and saving will likely increase in response to any policy that raises households' borrowing costs.

In terms of price and income shocks, the amount consumption growth declines in response to a large negative illiquid asset price shock should depend on households' past borrowing behavior and the institutional rules in the borrowing market. Households' should not necessarily be any worse off when prices fall assuming that their income remains relatively constant and they are not highly levered from past borrowing. Households with high leverage potentially suffer more from falling illiquid asset prices to the extent they develop negative equity positions that they are forced to eliminate by repaying some of their debt. Such repayment restricts their cash flow for other consumption expenditures.

Such forced repayment to eliminate negative equity positions may be unrealistic in the United States since home loans in many states are non-recourse. In addition, households are allowed to hold negative equity positions assuming they can still service

there outstanding debt. If negative equity repayment has a big impact on the model results, then the consumption effects should mitigate when households are allowed to maintain negative equity in their illiquid asset. Finally, a one standard deviation transitory income shock should have a greater impact on consumption growth than a one standard deviation price shock since in many instances households' spending will be unaffected by falling asset prices assuming their income remains steady.

4.3 Numerical Results

4.3.1 Parametrization

Solving the model requires assuming a functional form for household utility as well as setting the relevant model parameters. In particular, I assume that household utility is iso-elastic with respect to consumption as is common in the literature.

$$u(c_t) = \frac{c_t^{1-\gamma}}{1-\gamma} \tag{4.21}$$

where γ is the coefficient of relative risk aversion (CRRA). I set households' CRRA equal to two ($\gamma = 2$). This implies that their elasticity of intertemporal substitution (EIS) is one-half ($\frac{1}{\gamma} = 0.5$), which is in line with the consensus values in the empirical EIS literature (see for example Gruber (2006)).

I set the remaining parameter values as follows:

Model Parameter Values

Parameter	Value
β	0.95
σ_γ	.08
σ_n	.1
r^A	0.02
r^D	0.06
ρ	0.51
μ_ϵ	.008
σ_ϵ	.025

The parameter values for the income growth process are based on the data in Ludvigson and Michaelides (2001). In that paper, the authors estimate the transitory and permanent components of households' income using annual data from the PSID. The parametrization implies that income grows 2 percent per year on average, and

that the variance of income growth is dominated by the transitory component (recall that $\sigma_y^2 = \sigma_\gamma^2 + 2\sigma_n^2$).

I estimate the parameters of the illiquid asset price growth process using the available OFHEO data on annual house prices in the US from 1975 to 2008. Real house price growth has a persistence parameter of about 0.5 (p-value 0.000), and average yearly growth is roughly 1 percent on average. I use the aggregate data to determine this parametrization because shocks to illiquid asset price growth are common across all households in the model. Notice as well that the variance of house price growth is a good deal smaller than the variance of household income growth.

In addition, I set the real risk-free rate to 2 percent, which is fairly standard in the literature. Real debt service costs for collateralizable loans are 6 percent per year. This spread between the borrowing rate and saving rate is consistent with the data. The difference between the prime rate, which is used to set borrowing rates, and the 3-month treasury bill rate has averaged more than 3 percent since 1960. Changing the interest rate on debt in the model does not affect my results.[6] There is no banking sector in my model, but implicitly the sector is making large profits given the interest rate spread. Again, such profits are consistent with the data especially during the house price boom.

Finally, households' time discount rate, β, is 0.95. This ensures that there is a proper contraction mapping to solve the model given the real interest rate. Appendix section C.2 discusses the grid of values for the state variables in the model.

4.3.2 Baseline Model Policy Functions

The top panel in Figure 4.2 plots consumption versus cash-on-hand for a parametrization of the no borrowing model that is consistent with the grid space and parameter values discussed in the previous section. Notice that the consumption function is kinked. Households with low levels of liquid assets, those to the left of the kink, consume along the so-called forty-five degree line. These households spend all of their available resources ($c_0 = x_0$). In contrast, households with sufficient assets (those right of the kink) save some of their liquid assets to fund consumption in future periods since labor income is uncertain. As a result, these so-called precautionary savers spend less than their available cash-on-hand. The amount of precautionary saving increases with a household's amount of initial cash-on-hand. A household with cash-on-hand near the kink saves very little, while a household with the maximal amount

[6] Interest payments are very low for households relative to their average income. An interest rate of 4 percent or 6 percent on collateralized loans does not have a noticeable effect on households' spending.

initial assets saves about two-thirds of its liquid resources.

The bottom panel of Figure 4.2 shows a series of consumption policy functions from my baseline model for households with different levels of borrowing capacity. Every grid point in the figure represents an initial endowment of the state variables. Hence each position can either be thought of as what a household would spend if given that endowment or as one particular household's endowment out of many possibilities. For simplicity, I will most often refer to how one household behaves versus another.

Since the model state space is multi-dimensional, I must fix certain state variables at various levels in order to plot the consumption policy functions for the model. In particular, I set illiquid asset price growth at its mean value. In addition, the policy functions show four different levels of household borrowing capacity: high capacity, low capacity, "medium capacity–high value" and "medium capacity–low value." High capacity households' collateralized credit is equal to roughly one-half of their average liquid asset to income (LY) ratio, while low capacity households have virtually no borrowing capacity. Medium capacity households can borrow up to about a quarter of their average LY ratio. There are two different ways, however, that households can have medium capacity. They can either have a highly valued illiquid asset and substantial debt (high-value) or a low valued illiquid asset and minimal debt (low-value).[7]

The results in the bottom panel of Figure 4.2 suggest that households' consumption increases with their level of borrowing capacity. This is true for households with low liquid asset values as well as households with substantial initial cash-on-hand. In particular, precautionary savers reduce their saving (increase their consumption) as their borrowing capacity rises. As a result, borrowing capacity acts as a partial hedge against future labor income risk. Resource constrained households increase their spending as well given sufficient borrowing capacity. The amount these households raise their consumption, however, is limited by their available borrowing collateral. Overall, these findings suggest that in a static framework, households' ability to borrow against an illiquid asset increases their consumption.

Figure 4.3 compares the results from my model to the no-borrowing (Deaton) model. The top panel shows households with low and high borrowing capacity relative to the no-borrowing case, and the bottom panel compares households with medium capacity to the no-borrowing model. The results are further consistent with collateralized borrowing capacity increasing households' consumption relative to the case where they are not permitted to borrow. In particular, households' precaution-

[7]See section C.2 in the appendix for more details on the range of households' initial endowments and borrowing capacity.

ary saving declines relative to the no borrowing case. Spending also rises relative to the no borrowing model for households with limited resources and sufficient borrowing capacity. The only households whose consumption does not rise in a world with collateralized borrowing are those households who have low cash-on-hand and lack the borrowing capacity to increase their consumption.

There are two additional findings worth noting given the results in Figure 4.3. First, households with virtually non-existent current borrowing capacity but sufficient liquid assets reduce their precautionary saving relative to the Deaton model (top panel-dotted line). This suggests that households place a high value on the option to borrow against their illiquid asset in the future to help smooth their consumption in response to a negative income shock. Implicity these households assume that their asset values will increase sufficiently so they can borrow should the need arise. This behavior is potentially problematic if the households are hit with a large, negative income shock in the near future while they still have limited borrowing capacity. Such households will be worse off then they would have been had they not reduced their liquid saving because of the potential future borrowing capacity. The fact that households are willing to bear this risk, however, suggests how strongly they view their collateralized borrowing capacity as a substitute buffer stock.

In addition, households with sufficient cash-on-hand and medium borrowing capacity spend more (save less) when they have a highly valued illiquid asset (and high debt) than when they have a low valued liquid asset (and low debt). These households' borrowing capacity is the same in each instance as confirmed by the fact that households with low cash-on-hand spend the same amount through borrowing regardless of their asset value. This result is consistent with households, who have sufficient borrowing capacity, placing more weight on the value of their illiquid asset than their actual borrowing capacity when making their consumption and saving decisions. Arguably, households may misperceive the value of their illiquid asset for their amount of available collateral rather than their actual available equity. Households' mis-perceptions, however, are not built into the model. Instead, the static model results simply suggest that households discount their existing debt when making consumption decisions.

4.3.3 Policy Functions for Model Extensions

Figure 4.4 reports the policy functions when households face a non-zero fixed borrowing cost, and compares the results to the policy functions from the baseline case

without such costs.[8] In particular, I assume that households pay roughly 5 percent of their average LY ratio in order to borrow.[9] The fixed borrowing cost is analogous to a closing cost or fee that the household must pay to originate the loan. Indeed, the baseline setup without fixed borrowing costs implicitly assumes that the loan originators either waive or do not require such a fee. A world without loan transaction costs arguably represents an era of easy credit like in the early 2000s when banks did whatever they could to lend money to households. During this period households' borrowing frictions were essentially non-existent.

Adding a fixed borrowing cost to the model reduces households' consumption relative to the baseline case. In particular, households with limited resources cannot consume all of their collateral like in the baseline case because they must pay to access the equity in their home. In addition, households with sufficient resources, who are precautionary savers in the baseline model, *increase* their saving when faced with a fixed cost of borrowing. Indeed, households with both high borrowing capacity (top panel) and low borrowing capacity (lower panel) exhibit greater precautionary saving.

The increase in saving in the model with fixed borrowing costs relative to the baseline case is consistent with households viewing their collateralized borrowing capacity as a substitute hedge against labor income risk. Households recognize that if they need to borrow in the future to smooth their consumption then they will have to pay the fixed cost. As a result, households' option to extract equity in the future loses some of its value as a substitute for precautionary saving. Saver type households consequently spend less and save more of their liquid assets to guard against future negative income shocks. Even with fixed borrowing costs, however, households continue to exhibit *less* precautionary saving behavior than in the no-borrowing regime.

A similar pattern of household behavior emerges when I restrict the percentage of equity households can borrow against. Figure 4.5 plots the relevant policy functions for the case when households can only borrow up to 80 percent of their available collateral ($\alpha = 0.8$). Indeed, the majority of households' consumption falls relative to my baseline results. In particular, the consumption of households with limited resources is somewhat restricted relative to the baseline model because these households can only borrow 80 percent of their equity. Households' precautionary saving increases slight relative to the baseline case as well. Once again households who see their collateral borrowing capacity as a substitute hedge for future labor income risk recognize that their future borrowing capabilities will be more limited, and they

[8] I omit households with medium borrowing capacity from the figure, but the pattern of results is similar.

[9] An alternative approach would be to force households to pay a certain percentage of the amount they borrow. This setup will likely not substantially change the results.

adjust their saving behavior accordingly.[10]

These findings have important policy implications. The results suggest that policymakers can increase households' liquid saving in a world with collateralized borrowing by raising borrowing costs or instituting collateral limits. Any of these policy changes will lead saver-type households to spend less of their cash (save more) than they would with lower borrowing costs. As a result, there will be less of a a crowding out effect of precautionary saving by households' collateralized borrowing capacity.

I also analyze households' consumption behavior relative to my baseline model when illiquid asset owners can maintain a limited amount of negative equity. The policy functions (not reported) are essentially the same as in the baseline case. This result is consistent with the fact that negative equity holdings impact how much debt households may have to repay in response to a large illiquid asset price drop, but it does not necessarily affect their behavior at a point in time. Households who start with negative equity obviously cannot borrow, but otherwise the static impact of permitted negative equity holdings on household behavior is minimal.

4.4 Model Simulations

This section takes a dynamic approach to examining households' behavior when they are allowed to borrow against an illiquid asset. In particular, I simulate my baseline model multiple times for roughly five thousand households who have randomized initial endowments of liquid and illiquid assets. I average the simulation results across households and across iterations to look at how consumption growth responds to various income and illiquid asset price shocks.[11]

As noted earlier, the simulations allow me to consider a number of additional questions about how collateralized borrowing capacity affects household consumption. In particular, I analyze how households respond to income versus illiquid asset price shocks as well as the impact of unexpected price growth and income shocks, which occur simultaneously versus independently, on household behavior. I also address whether households' access to collateralized borrowing capacity allows them to smooth consumption response to adverse income shocks. Finally, I examine whether

[10]The consumption of a few households with high borrowing capacity and cash-on-hand near the kink in the policy function is higher than in the baseline model. This could be the result of the discrete nature of the state space. Alternatively, some households may view the trade-off between current and future borrowing capacity differently when faced with collateral restrictions. These households may therefore decide to consume (borrow) more today relative to the baseline case.

[11]My results are essentially the same if I aggregate my simulated data across households and then average across iterations rather than averaging first across households and then across individuals.

households' spending responds asymmetrically to positive versus negative illiquid asset price shocks.

Unless otherwise noted, I set price growth and permanent income growth to their mean values over the simulation horizon. This avoids noisy consumption growth responses to the various shocks. In addition, all of the figures plot the consumption growth response to the shock or shocks relative to the (mean) case with no shock(s).

4.4.1 Price versus Income Shocks

How household consumption responds to either a permanent or transitory income shock is fairly well known and studied. It is less clear how consumption responds to changes in illiquid asset prices when households are allowed to borrow against such assets to help finance their consumption. Figure 4.6 depicts the consumption growth response to a 1 standard deviation positive and negative income shock, and a 1 standard deviation illiquid asset price growth shock. The upper panel of the figure shows the actual, per period consumption response while the bottom panel shows the cumulative growth response.

What is most striking about the results in Figure 4.6 is that the impact of a 1 standard deviation illiquid asset price growth shock is very small compared to the effect of a 1 standard deviation transitory income shock. Indeed, a one standard deviation price growth shock leads to roughly a 0.5 percentage point increase in consumption growth. In contrast, a one standard deviation price shock raises consumption growth by roughly 5 percentage points. This result holds whether or not the shocks to prices and income are positive or negative.[12] Indeed, the unexpected price growth shock would need to be at least 3 or 4 standard deviations from the mean to have a similar impact on consumption growth as the effect of an unexpected income shock. Alternatively, households' illiquid asset value could be 3 to 4 times larger than their income, however, the model does not focus on such a situation. These findings suggest that changes in illiquid asset price growth have a limited effect on household consumption growth. In addition, the results are consistent with income being the primary mechanism that drives households' spending. Collateralized borrowing capacity affects spending by helping households fund some of their consumption, but does not substantially impact households' consumption decisions.

Figure 4.7 shows households' consumption response to concurrent income and price shocks compared with when the shocks occur independently of each other. Not

[12]The results are qualatatively similar if I assume a 1 standard deviation *permanent* income shock rather than a transitory one. The only difference is that the cumulative effect of the income shock does not mean revert. These results are available upon request.

that the top panel of Figure 4.7 does not plot the independent shock to income because its impact on consumption growth is virtually identical to the large spike in consumption that occurs with the concurrent income and price shocks. The differences in the consumption response to the independent versus coincident shocks is most evident in the bottom panel of the figure. Indeed, the impact on consumption growth from the coincident shocks is very similar to the effect of an income shock without the price shock.[13] This finding is consistent with illiquid asset price shocks having a minimal impact on consumption growth. The result further implies that an illiquid asset (house) price shock in the empirical literature is likely exogenous if it has a small effect on household spending. Indeed, Cooper (2009b) shows that changing housing wealth has a relatively small effect on aggregate consumption.

I do not report how an illiquid asset price shock impacts household behavior in a world with collateral capacity constraints or fixed borrowing costs. In either regime, households' overall spending at a point in time is reduced relative to the baseline model. As a result, a price growth shock will have an even smaller impact on households' consumption growth than the effects reported in Figures 4.6 and 4.7.

4.4.2 Evidence of Consumption Smoothing Behavior

An additional question is whether households' borrowing capacity helps them smooth their consumption in response to transitory income shocks. Again, the standard argument is that households should use their collateralized borrowing capacity to help finance their spending during periods of income shortfalls, and not just spend more in general because they have a valuable illiquid asset. I address households' consumption smoothing behavior in two ways. First, I look at how household spending responds when households experience a negative income shock at the same time as they receive a favorable illiquid asset price growth shock. Analyzing this situation addresses whether illiquid asset prices increasing when household income falls for some households, such as during the 2001 recession, is beneficial for household spending versus income falling and prices remaining steady. I also take a more standard approach and examine how households' spending responds to a temporary income shortfall given their pre-shock borrowing capacity.

Figure 4.8 shows households' consumption response to a negative income shock and positive illiquid asset price growth shock that occur independently and also concurrently. Both shocks are 1 standard deviation impulses. Not surprisingly, the transitory income shock leads to a temporary decline in consumption, while the price

[13] A similar pattern emerges with negative income and price shocks rather than positive ones.

shock causes consumption growth to increase for a period of time. When the income and price shocks occur at the same time, the decline in consumption is less severe than in the case where households experience a large income decline and asset price growth remains at its mean level. The consumption decline is about 1 percentage point less relative to the mean when the two shocks occur simultaneously. This result is consistent with illiquid asset price growth helping to support spending during a period of temporarily declining income. Once again, however, households need to realize very large price gains in order to completely offset the impact of the negative price shock.

The results in Figure 4.9 tell a similar story. The figure plots how consumption responds to a negative income shock based on households' pre-shock borrowing capacity. In particular, I divide the sample into households with "high" borrowing capacity one period prior to the shock and households with "low" capacity. This sample separation is based on households having more or less than the mean amount of borrowing capacity in my state space. The results show that households with adequate borrowing capacity are able to smooth their consumption somewhat in response to a temporary drop in income relative to those households with limited borrowing capabilities. This finding is consistent with households with substantial borrowing collateral financing their desired consumption more easily when faced with an unexpected temporary income shortfall.

The bottom panel of Figure 4.9 shows households' consumption growth response to a negative income shock if they can maintain negative equity in their illiquid asset. Indeed, spending growth is slightly smoother when negative equity holdings are allowed compared to the baseline case with no negative equity holdings. This finding is broadly consistent with households who can maintain negative equity being less wary of having to potentially repay debt in the future in response to a negative asset price shock. As a result, they are more willing to borrow freely to smooth consumption in the current period. In other words, households with adequate borrowing capacity borrow to finance their consumption when the future costs of doing so are lower. In contrast, allowing for negative equity holdings does not impact the consumption smoothing of households with low borrowing capacity relative to the baseline case (not reported). This likely occurs because low capacity households have less flexibility about how much they can borrow in the first place.

The results are similar if I choose alternative cut-offs for defining households with high versus low borrowing capacity. Overall the results are consistent with the idea that collateralized borrowing capacity helps households smooth their consumption somewhat in response to income shortfalls. Once again, however, very large changes

in illiquid asset price growth are needed for households' illiquid asset holdings to have a large impact on their spending behavior.

4.4.3 Asymmetric Effects

A final issue is whether households exhibit an asymmetric response to positive versus negative illiquid asset price shocks. Arguably, households may respond more to positive price shocks than negative shocks. A positive increase in illiquid asset prices improves households' abilities to finance their consumption if they are constrained, while a decline in prices, all else equal, need not dramatically alter households' behavior assuming that their income remains relatively constant. One caveat is that a decline in prices may force households to repay some of their existing debt given the setup in my model. I address the effect of this requirement, however, by also considering asymmetric behavior in the model where households are allowed to hold negative equity.

Figure 4.10 shows the cumulative response of household consumption to an unexpected 2 standard deviation positive versus negative illiquid asset price growth shock. The simulations show limited evidence of an asymmetric response by households to the shocks. Indeed, the consumption growth response to a negative price growth shock is somewhat *larger* in magnitude than reaction of consumption to a positive price shock. The time pattern of the responses, however, are similar. The fact that the consumption deviation from its mean is a bit stronger for a negative price shock is not, however, the result of the no negative equity holdings restriction in my baseline model. Indeed, the response of consumption to positive versus negative price growth shocks when negative equity holdings are allowed is very similar to the baseline responses.

Overall, the results in Figure 4.10 are broadly consistent with households exhibiting a relatively *symmetric* response to positive versus negative illiquid asset price changes. The reason for consumption falling more on impact for a negative price shock than it rises for a positive shock is not completely transparent. One potential explanation is that precautionary saving increases a lot with large negative asset price shocks–more so than such saving declines when asset prices increase. In other words, the asymmetry results are broadly consistent with precautionary savers becoming particularly concerned about the option value of their illiquid asset as a hedge against labor income risk when asset prices fall. As a result, these households may ratchet down their consumption and increase their liquid saving. Alternatively, the model may be too parsimonious to fully capture that households are not necessarily

worse off when illiquid asset prices decline.[14]

4.5 Conclusion

In this paper, I proposed an extension of a standard consumer maximization problem with liquidity constraints to examine the impact of households' ability to borrow against an illiquid asset on their consumption behavior. The model is parsimonious, but it is designed to focus on the role of households' home equity borrowing capabilities. This is an aspect of the household borrowing market that has received limited direct attention. The model purposely abstracts from the dual role of housing as a consumption good and a financial asset, and focuses directly on households' ability to borrow against the equity in their homes. The paper investigated how collateralized borrowing impacts households' behavior in general as well as how changing illiquid asset prices affect household spending. In addition, I considered how collateralized borrow impacts households' ability to smooth consumption in response negative income shocks.

The model results suggest that households with limited liquid financial resources but adequate borrowing capacity increase their spending when they are allowed to borrow against the equity in their illiquid assets. Collateralized borrowing capacity also acts as a partial substitute for households' precautionary saving against future labor income risk. Indeed, households with adequate financial resources save *less* in a world with collateralized borrowing than they do when they are not allowed to borrow. Policy makers who are concerned about this reduction in savings, however, can potentially get households to save more by imposing fixed borrowing costs or limiting the amount of collateral households can borrow against.

In addition, home equity type borrowing allows households to smooth their consumption somewhat in response to a temporary decline in their income. The recurring theme from all the model simulation results, however, is that regardless of the situation the effect of a change in illiquid asset price growth on household consumption is relatively small. Indeed, at least a 3 or 4 standard deviation price growth change is needed in order for illiquid asset prices to have a similar impact on consumption as income changes. This finding is consistent with the relatively small impact of changes in housing wealth on household consumption that is observed in the empirical literature.

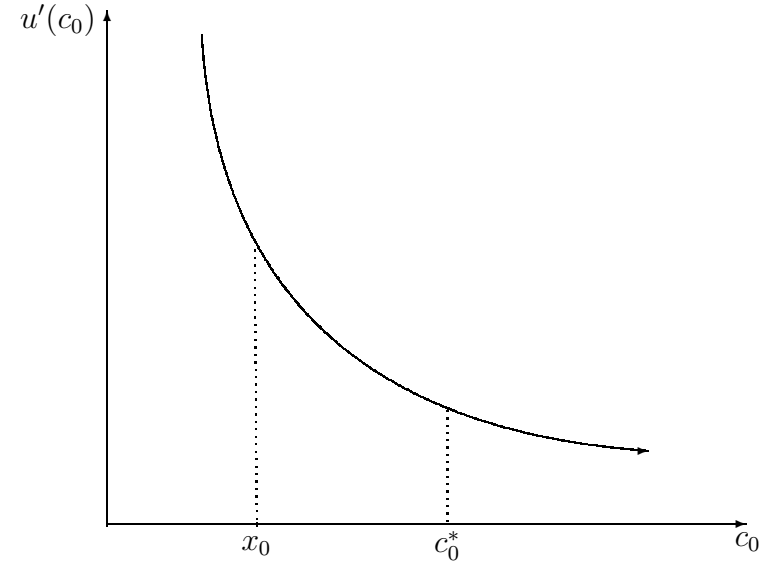
One issue that remains following this analysis is whether consumption exhibits an asymmetric response to positive versus negative illiquid asset (house) price growth shocks. My basic analysis suggests that the response is relatively symmetric, although

[14]Capturing this effect likely requires modeling households service flow from housing.

consumption falls somewhat more on impact for a negative shock than it rises for a positive. This finding challenges the conventional wisdom that households are not necessarily worse off, all else equal, when illiquid asset prices decline. Further analysis of this issue therefore seems worthwhile. In particular, a model that also addresses households' choices over their amount of housing services may better capture the fact that households are not necessarily adversely effected, all else equal, when prices decline. I leave these considerations, however, to future research.

Figure 4.1

Households' Optimal Decision Making Process



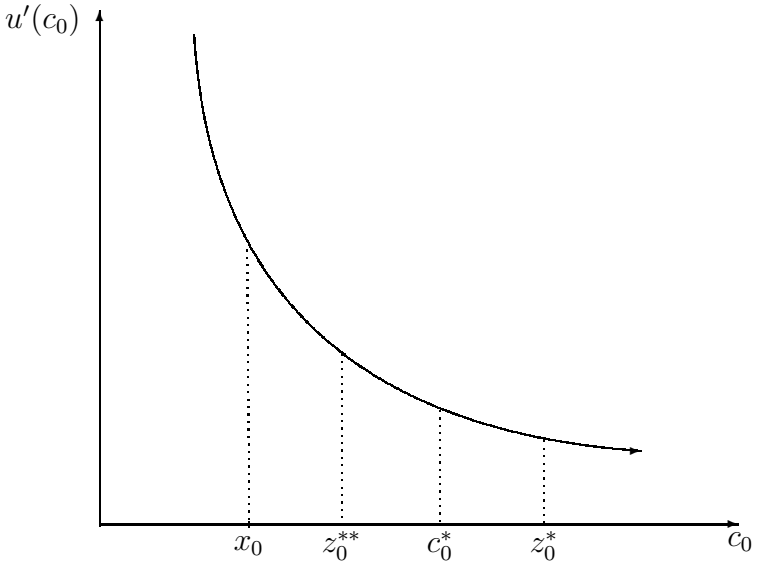
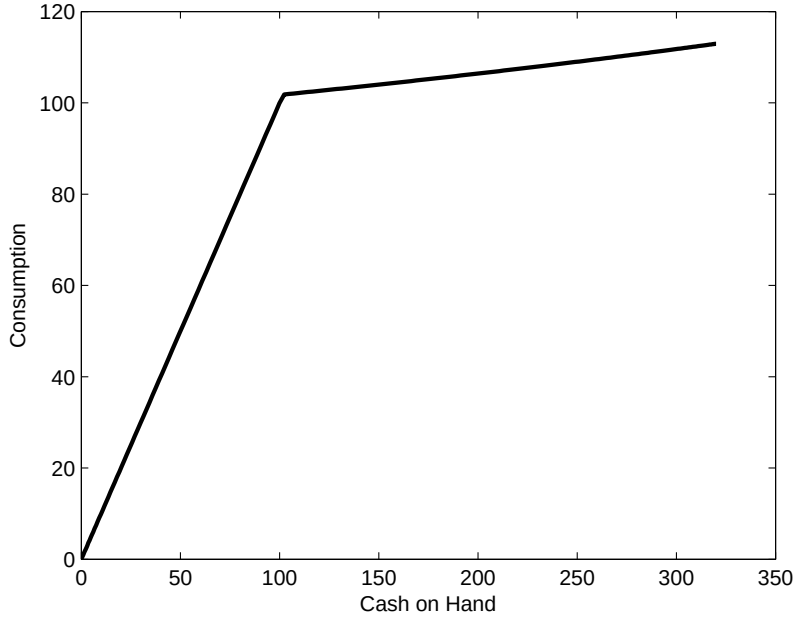


Figure 4.2

Consumption Policy Function: No Borrowing (Deaton) Model



Consumption Policy Function for Different Borrowing Capacities: Collateralized Borrowing Model

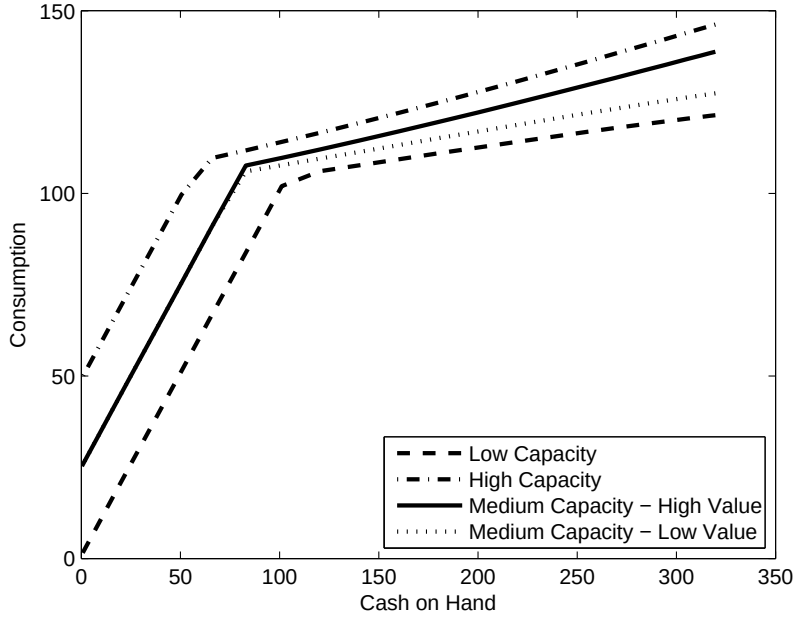
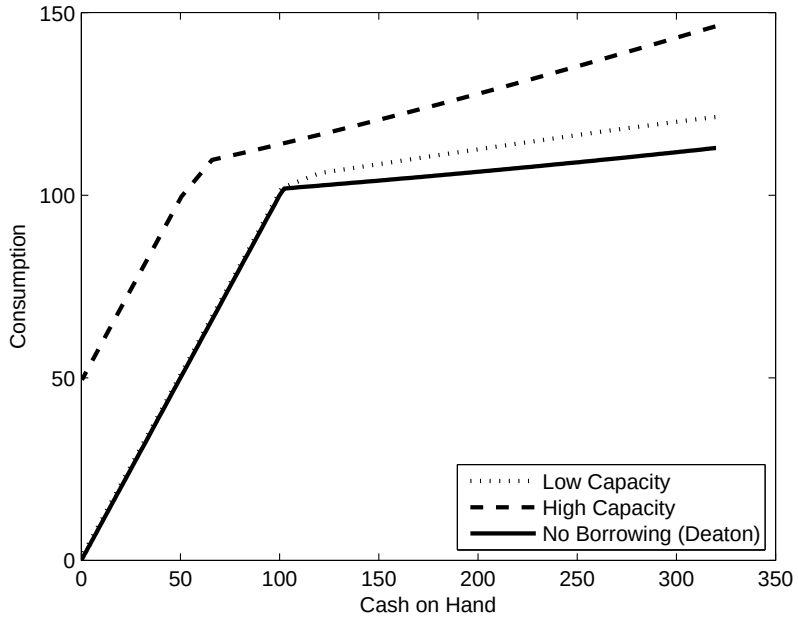


Figure 4.3

Consumption Policy Functions: Collateralized Borrowing versus No Borrowing Models



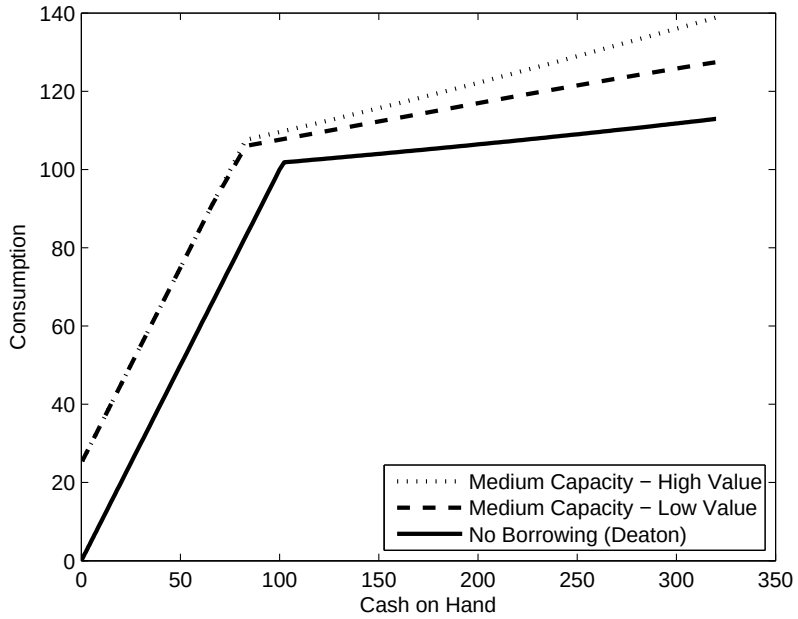
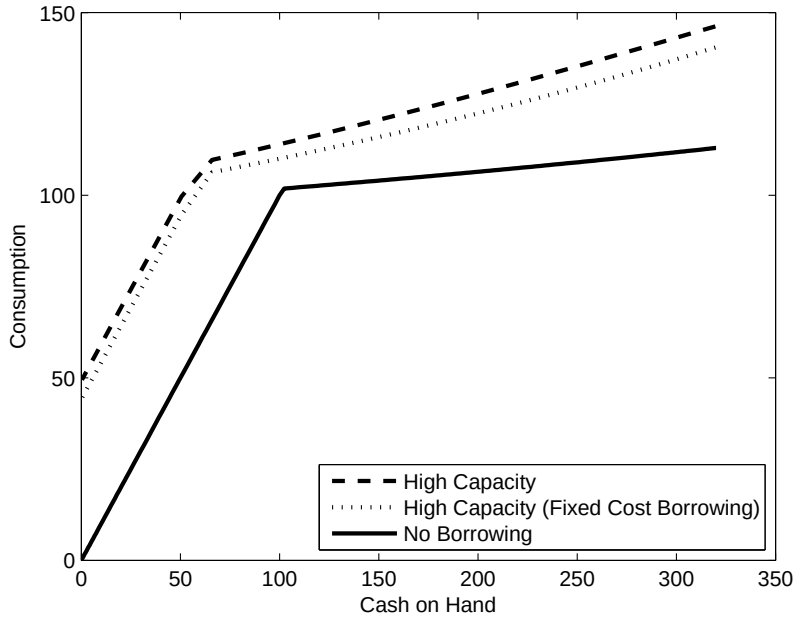


Figure 4.4

Consumption Policy Functions: Effect of a Fixed Cost for Collateralized Borrowing



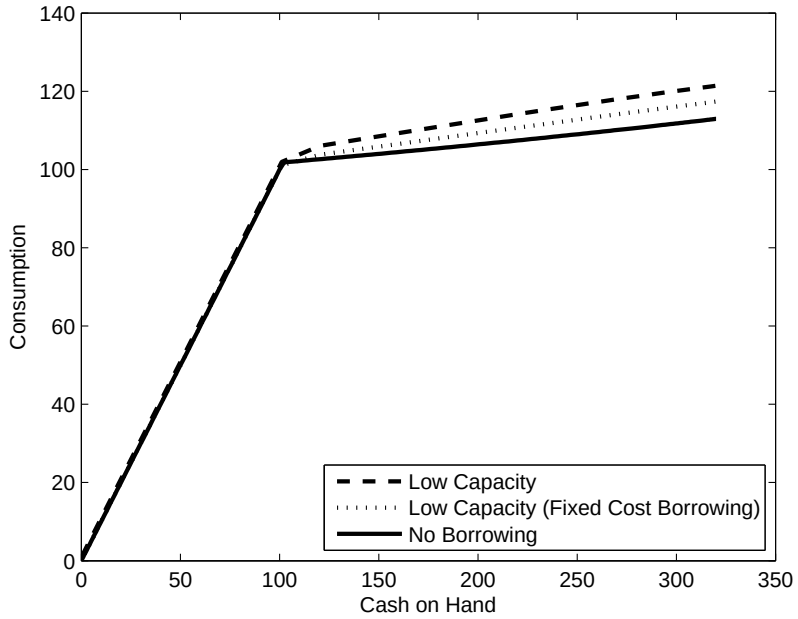
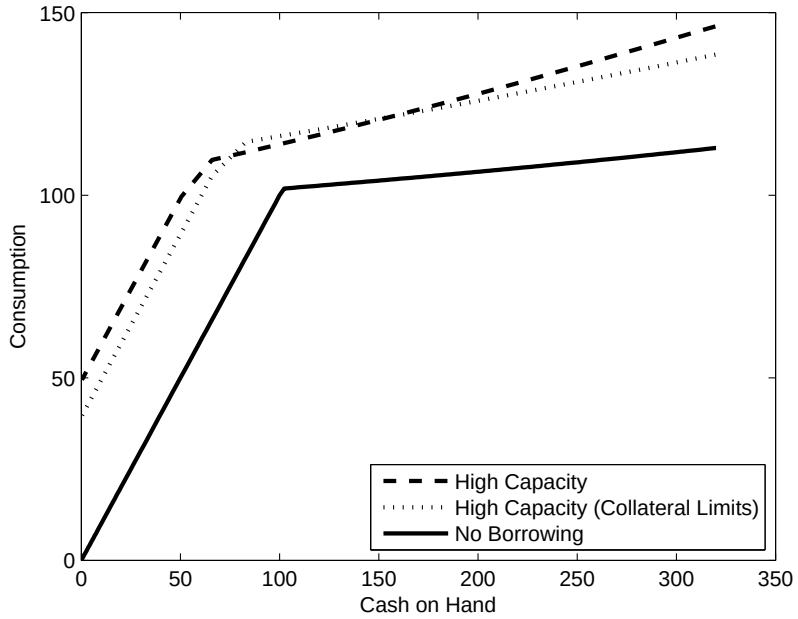


Figure 4.5

Consumption Policy Functions: Effect of Borrowing Collateral Limits



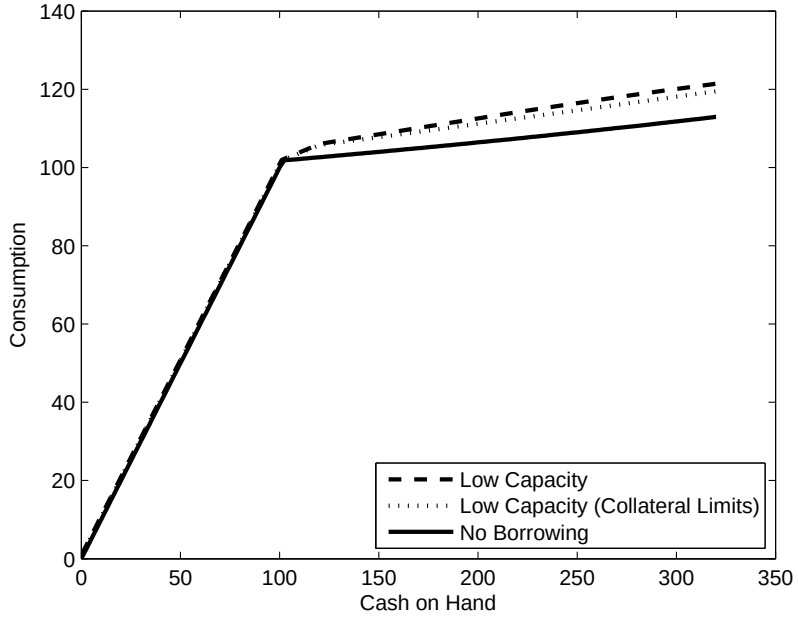


Figure 4.6

Consumption Growth Response: Illiquid Asset and (Transitory) Income Shocks

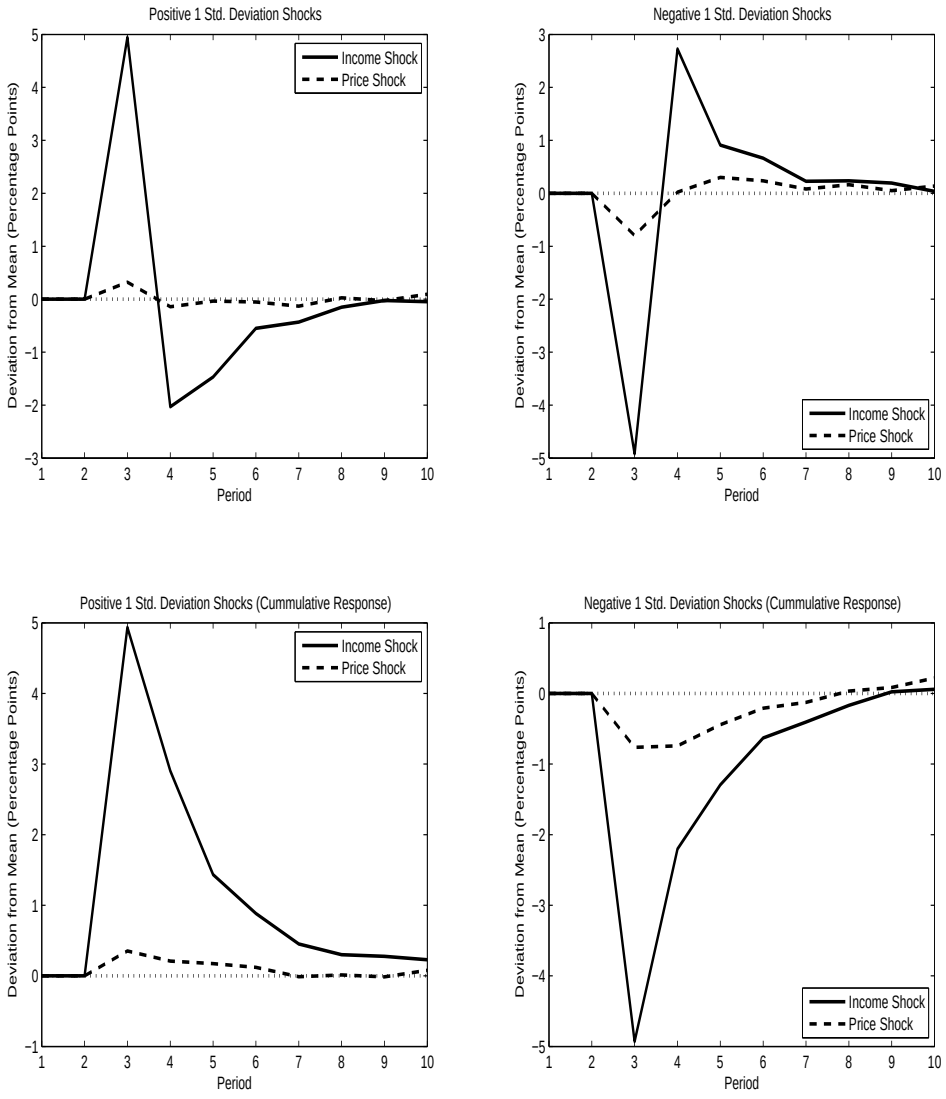
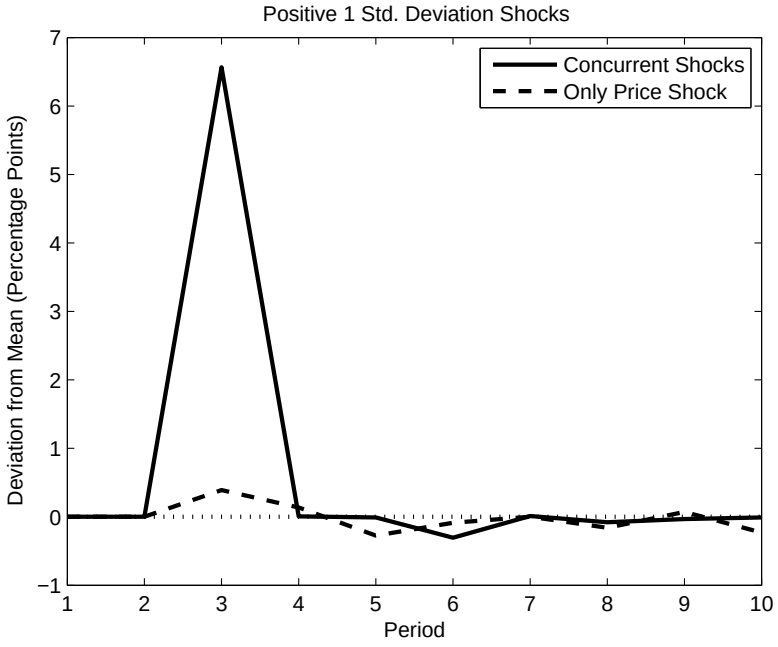


Figure 4.7

Consumption Growth Response: Positively Correlated Illiquid Asset and (Permanent) Income Shocks



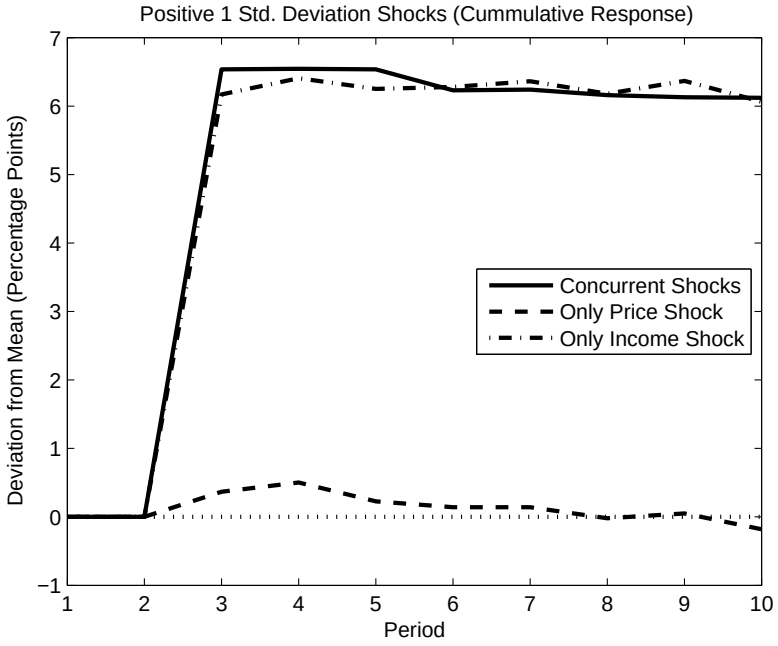
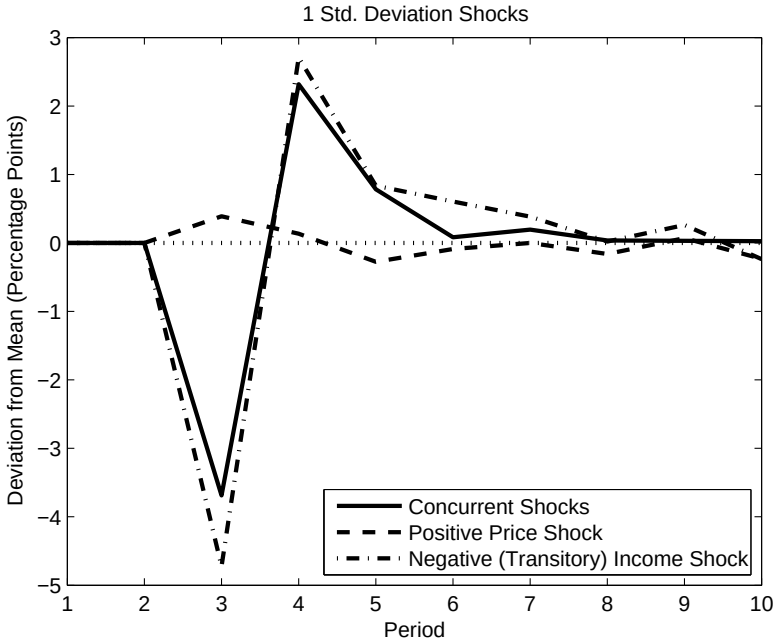


Figure 4.8

Consumption Growth Response: Negatively Correlated Illiquid Asset and (Transitory) Income Shocks



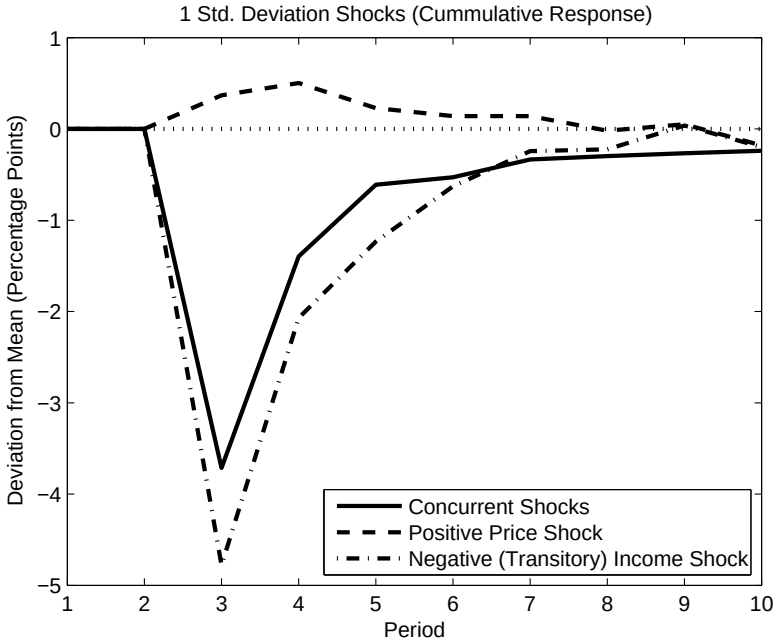
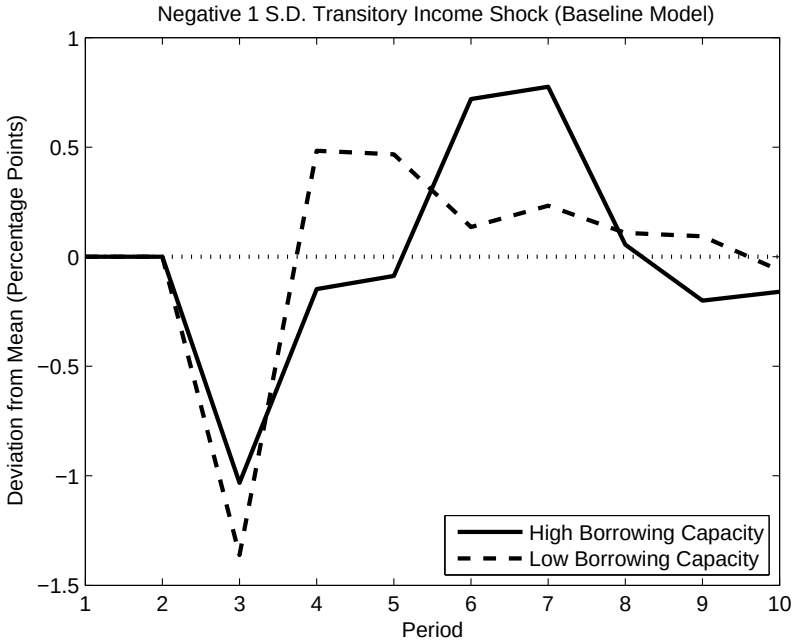


Figure 4.9

Consumption Growth Response to Transitory Income Shock: Households with Different Borrowing Capacity



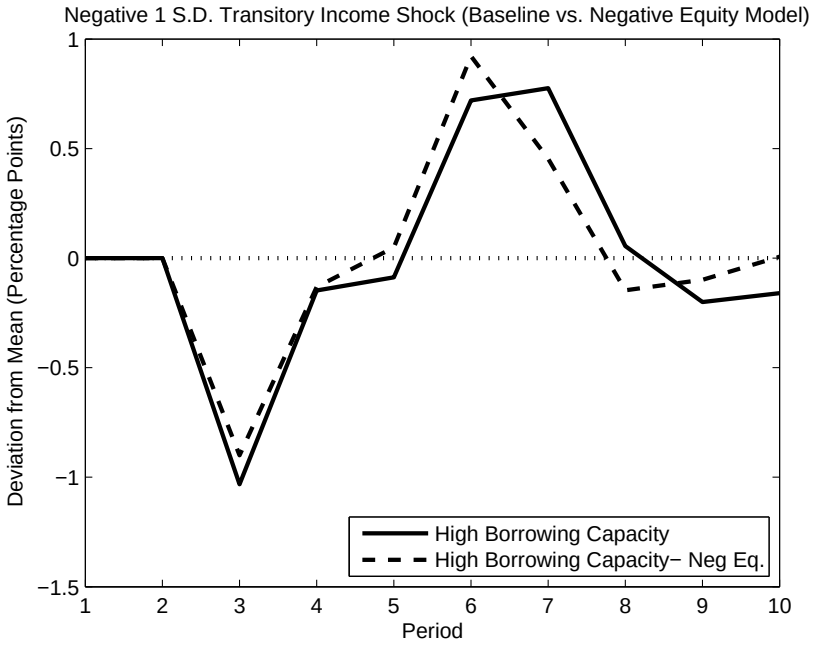
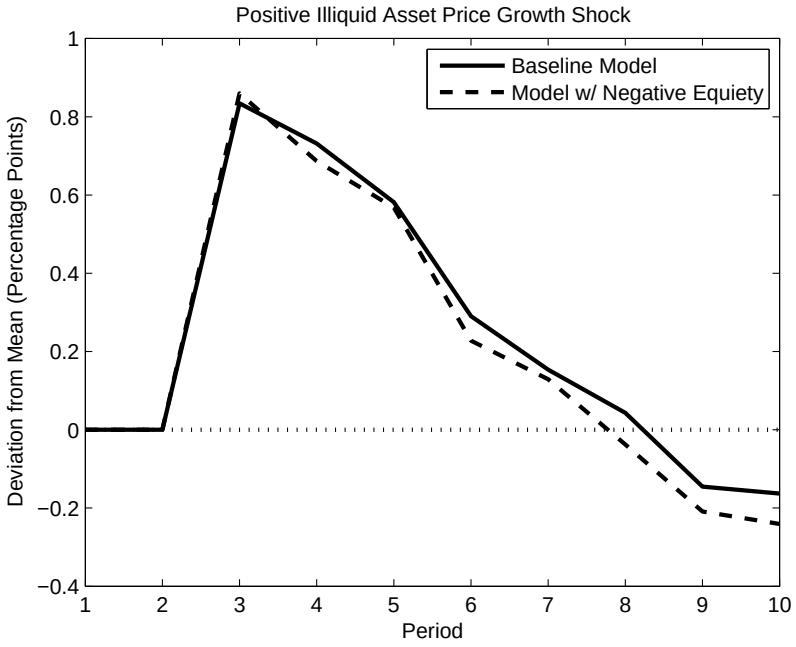
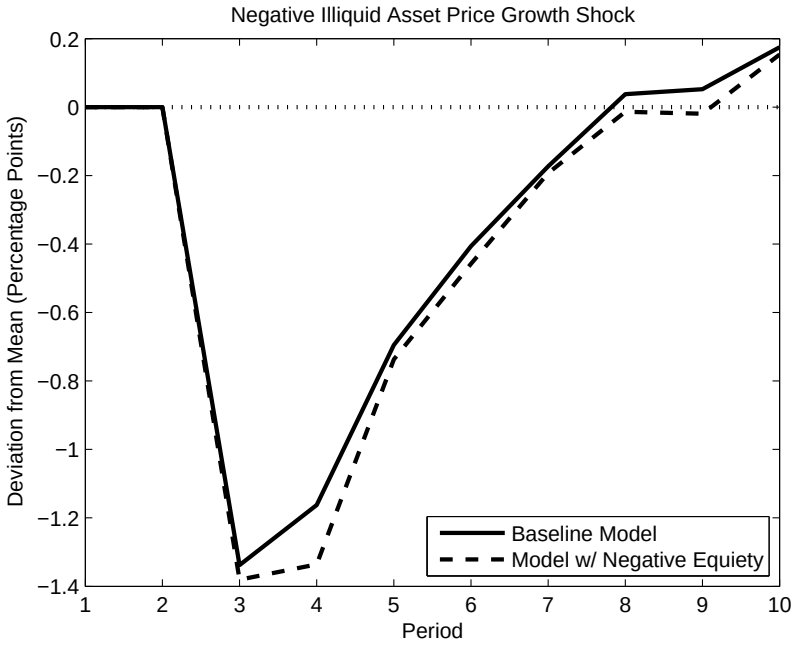


Figure 4.10

Cumulative Consumption Growth Response: 2 Standard Deviation Price Growth Shocks





C Appendix

C.1 Model Solution Method

I use the method of parameterized expectations (PEA) to solve the model in this paper. The PEA approach is presented in den Haan and Marcet (1990). In addition, Christiano and Fisher (1994) provide an overview of the PEA technique and other numerical methods for solving rational expectations models. The PEA approach approximates households' expectations using orthogonal polynomials. I use Chebyshev polynomials for the solution implementation, but any polynomial type in the class of orthogonal polynomials will suffice. The coefficients that map the polynomials into households' expectations are updated with each successive iteration of model solution until they converge.

The PEA approach is best summarized through an example. Consider the standard liquidity constrained consumption model in Deaton (1991). The Euler equation for a household's optimal consumption decision is:

$$u'(c_t) = \max\{u'(x_t), \beta(1+r)E_t[u'(c_{t+1})]\} \tag{C.1}$$

In this model, cash-on-hand (x_t) is the only state variable. The solution then is a consumption policy rule of the form:

$$c_t = f(x_t) \tag{C.2}$$

where $f(\cdot)$ is some unknown, potentially non-linear function of cash-on-hand. Finding c_t is straight forward if $E_t\left[u'(c_{t+1})\right]$ is know, which it is not. Since the expectation is taken over future values of labor income, it cannot be calculated directly. The expectation can be approximated, however, using polynomials and numerical integration techniques.

Given equation C.2, next period's marginal utility is:

$$u'(c_{t+1}) = u'(f(x_{t+1})) \tag{C.3}$$

where x_{t+1} is given by the household's budget constraint:

$$x_{t+1} = (1+r)(x_t - c_t) + Y_{t+1} \tag{C.4}$$

I covert each value of x_{t+1} into the appropriate polynomial, and then I evaluate the marginal utility function at the current set of parameter values. I repeat this process for all the values of cash-on-hand in my grid space. Potential income values are determined based on Gaussian quadrature. I then calculate a household's *expected* marginal utility by numerically integrating the actual marginal utility values for different potential realizations of income (Y_{t+1}). In other words, I create a discrete grid for x_t using Chebyshev nodes and calculate households' expected marginal utility at each node. Finally, the parameter values for the polynomial approximation are updated using OLS. In particular,

$$\mathbf{Y} = \mathbf{X}\beta + \epsilon \tag{C.5}$$

where $\mathbf{Y}$ is a vector of expected marginal utility values for each x_t, $\mathbf{X}$ is a matrix of the orthogonalized polynomial values associated with each x_t, and ϵ is the approximation error term.

The model solves when the estimate of $\hat{\beta}$ from the current iteration is sufficiently close to the estimated coefficient vector from the previous iteration. If the difference between the polynomial coefficients is too large between iterations, then the coefficients are updated and the process repeated until the coefficient estimates converge. Once a solution is reached, I can calculate households' optimal consumption using the converged estimate of $\hat{\beta}$ and the relevant polynomial value for each grid point in the state space.

I solve the model in this paper using the same process. The main difference is that I have multiple state variables and more than one source of future uncertainty for a given household. In particular, households face uncertainty about the transitory and permanent components of their labor income as well as illiquid asset price growth. The policy function of interest is:

$$c_t = \omega(x_t, v_t, D_t, \Delta v_t) \tag{C.6}$$

Since a household's marginal utility of consumption is conditional on their decision to borrow or not, I calculate households' expected marginal utility based on whether they do or do not decide to borrow. The rest of the approach for using PEA to solve my model is the same as what I just described for the Deaton model.

C.2 Grid Space for State Variables

The table below shows the range of values I use for the state space when solving the model. The grid limits are scaled by permanent income in the solution procedure expect for illiquid asset price growth, however, I present the unscaled versions in the table for ease of discussion.

Range of Values for the Model State Space

Variable	**Minimum**	**Maximum**
Baseline Model		
Cash-on-hand (x_0)	0	320
Illiquid Asset Value (v_0)	25	50
Debt (D_0)	0	25
Price Growth (Δv_0) [%]	-7	11
Model w/ Negative Equity		
Cash-on-hand (x_0)	0	320
Illiquid Asset Value (v_0)	25	50
Debt (D_0)	0	35
Price Growth (Δv_0) [%]	-7	11

I choose this grid mainly for tractability and simplicity in illustrating the model solution, but the values are not completely arbitrary. In particular, the range for cash-on-hand is the same as the one used in Deaton (1991). Replicating his grid facilitates

an easy comparison of my results to that model. The range for price growth is three standard deviations around the mean. This ensures that large price growth shocks that could push households' price growth off the grid are low probability events. In addition, households' maximum borrowing collateral is roughly one-half of their mean income in every period (not reported). In other words, households can borrow at most about half of their average income in any period. When I allow for negative equity holdings, households can have a maximum loan-to-value (LTV) ratio of 1.4. This relative amount is within the range of households' reported LTV ratios in the PSID. Finally, I use 25 grid points for cash-on-hand, 6 each for households' illiquid asset values and debt holdings and 5 for price growth.

Arguably the my grid space is reasonable given the data and the existing literature. The model results are also robust to alternative specifications for the grid range (within reason) and for the number of nodes in the grid. The grid space for the version of the model with fixed borrowing costs and the version with collateral limits is the same as in the baseline model.

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Chapter V

Conclusion

This dissertation investigated the impact of housing wealth and house prices on household behavior from both an empirical and theoretical point of view. The relationship between house values and household consumption and saving is important given the dramatic swings in house prices that have occured over the last decade. The papers in this thesis contribute to understanding how the recent housing cycle affected households' behavior as well as the implications of changing house prices on aggregate consumption and the macroeconomy. It is easy to claim that the current US recession is due to the collapse of the housing market. Thoughtful conclusions about the relationship between house values and consumer behavior, however, require careful empirical analysis.

This thesis demonstrated that housing wealth impacts household spending through its role as borrowing collateral. Households do not respond to changing housing wealth because they feel richer or poorer. Instead, changing house values impact the spending of households who demand borrowing. The results in Chapter II of this dissertation also showed that falling house prices have a minimal direct effect on aggregate consumption. The theoretical results in Chapter IV further confirmed that very large illiquid asset (house) price shocks are needed to generate large swings in household spending assuming that households' permanent income remains relatively constant.

Chapter III in this thesis looked at household behavior in the period following the one in which homeowners borrow against their primary residence. It found that a 1 dollar increase in equity extraction leads to roughly a 95 to 98 cent increase in household expenditures. Roughly a quarter of this expenditure increase is spent on home improvements. In addition, much of this spending increase is reversed in the subsequent period. Overall, the results in the chapter are consistent with households using equity extraction to fund a one-time consumption binge on durable good type expenditures. There is little evidence, however, of households persistently borrowing to fund their consumption. Additional results suggest that equity extraction also results in some balance sheet reshuffling by households. Indeed, some households

use their extracted equity to pay down higher cost non-collateralized debt as well as increase their investment in other real estate or personal businesses. In addition, the theoretical results in Chapter IV showed how households use their home equity to partially smooth consumption in response to a negative income shock.

The results in this thesis add important insight into the relationship between house values and household behavior. Much work remains, however, in order to fully understand how changing house prices impacted consumption and the macroeconomy during the most housing cycle. One important avenue of future research is to consider whether the patterns observed in this dissertation with data through 2005 continued through the end of the house price boom as well as the subsequent house price bust starting in late 2006 or early 2007. Housing wealth likely continued to impact consumption through boom given its role as borrowing collateral. The question, however, is whether households extracted from their homes for less rational reasons as they became more caught up in the so-called "housing bubble" during the peak years of the price boom (2005 and 2006). Households may have become more willing to extract equity from their homes to the extent they believed house prices would increase indefinitely.

In addition, examining how, if at all, household behavior changed with the onset of the house price decline is also important. The theoretical results in Chapter IV showed relatively symmetric household spending responses to positive versus negative illiquid asset (house) price shocks. Empirical results (not reported) based on data from past housing cycles are also consistent with relatively symmetric household responses to positive versus negative housing wealth changes. It is possible, however, that households' behavior in the current downturn, given its severity, may not match their behavior in previous housing cycles. Indeed, the current housing cycle may inherently different from previous episodes given the lax lending rules in the early 2000s and the sheer volume of household borrowing. The impact of falling prices could be particularly large if households extracted equity at the peak of the cycle to fund elevated levels of consumption.

Addressing these issues empirically in greater detail requires the use of more recent household level than what is available currently. This data will become available over the next few months and years. Ultimately, it will probably take a few more years before the impact of the recent housing cycle on the macroeconomy is fully understood.