HOUSE PRICE FLUCTUATIONS: THE ROLE OF HOUSING WEALTH AS BORROWING COLLATERAL

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Abstract—Rising house prices affect household spending by either loosening a household's lifetime budget constraint (pure wealth effect) or the household's borrowing constraint so that consumption rises toward the level implied by the consumption Euler equation (borrowing collateral effect). The empirical findings in this paper are consistent with house price appreciation affecting household spending through the borrowing collateral channel and not the pure wealth effect channel. The consumption of potentially borrowing constrained households increases between $0.06 and $0.18 per dollar increase in their housing equity, while the consumption of unconstrained households is little changed.

I. Introduction

THE impact of household wealth on household spending has long been a topic of interest to economists, and there has been renewed focus on the subject given the recent housing boom and bust. Figure 1 plots real consumption growth and real house price growth since 1970. The two series are positively correlated with a correlation coefficient of about 0.4 historically and 0.7 during the 2000s. Despite this positive correlation, the mechanism that drives the relationship between house values and household expenditures is less clear.

The standard assumption in the literature is that rising home prices, much like rising nonhousing financial asset prices, raise consumption by relaxing households' lifetime resource constraint (pure wealth effect). That is, households feel richer (poorer) and consume more (less) as house prices appreciate (depreciate). An alterative explanation is that housing wealth serves as borrowing collateral, and rising house prices provide households additional borrowing capacity and increase their current consumption closer to the level implied by the consumption Euler equation (borrowing collateral channel).[1] Falling house prices reduce homeowners' borrowing capacity and potentially prevent them from optimally reallocating their resources over time. This paper analyzes whether the borrowing collateral channel explains the empirical relationship between consumption and housing wealth.

There are reasons to think that an increase in house prices will not have the same substantial pure wealth effect on consumption as an equivalent increase in stock prices or other financial asset prices. This idea is presented formally in Buiter (2010), who argues that housing wealth is not really wealth. Flavin and Nakagawa (2008) make a similar argument using a somewhat more complex model. The intuition behind the arguments in both papers is straightforward. Housing wealth differs from other financial wealth because it serves as both an asset and a consumption good. As a result, when house prices rise, the ownership (or rental) costs of housing increase, which results in a negative wealth effect to all consumers. Housing appreciation therefore unambiguously harms renters, who have to consume fewer nonhousing goods in order to offset the higher cost of their housing. In contrast, homeowners' decrease in nonhousing consumption from higher housing costs is offset by the capital gain they receive from higher house values. The net housing wealth effect for homeowners is therefore ambiguous. It depends on how much they spend of their unrealized housing gains or their realized gains from reoptimizing their housing stock and downsizing.[2]

In the absence of a pure housing wealth effect, the observed empirical relationship between house prices and consumption is likely driven by the role of housing wealth as borrowing collateral. How housing wealth actually affects consumption, however, is an empirical question. This analysis is important given the recent changes in credit market conditions. To the extent that households use housing wealth as collateral to relax their borrowing constraints and increase nonhousing consumption, then continued tight credit markets will inhibit their ability to reallocate their resources optimally over time.

The aggregate data from the early 2000s housing boom show rapid growth in households' home equity debt as housing appreciated. Figure 2 shows that households' home equity debt growth has moved in line with real house price growth since the early 1990s. In addition, Greenspan and Kennedy (2005) calculate that mortgage equity withdrawal averaged roughly 6% of households' disposable income from 2000 to 2005, a much higher rate than during the 1990s. The issuance rate for home equity lines of credit (HELOC), also shot up at an annual rate of 30% to 40% from 2002 to 2005, and home equity debt relative to income doubled between

Received for publication September 5, 2009. Revision accepted for publication July 16, 2012.

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A previous version of this paper was circulated under the title "Impending Spending Bust? The Role of Housing Wealth as Borrowing Collateral." I am grateful to to the editor and three anonymous referees for helpful suggestions, as well as to Matthew Shapiro for his guidance and support. I also thank Ruediger Bachmann, Bob Barsky, Dennis Capozza, Adam Cole, Serena Ng, Michael Palumbo, Eric Sims, Frank Stafford, and Rebecca Thornton. Kevin Todd provided helpful research assistance. The paper also benefited greatly from the comments of seminar participants at the University of Michigan and numerous other locations. The views in this paper are my own and not necessarily those of the Federal Reserve Bank of Boston. All errors are my own.

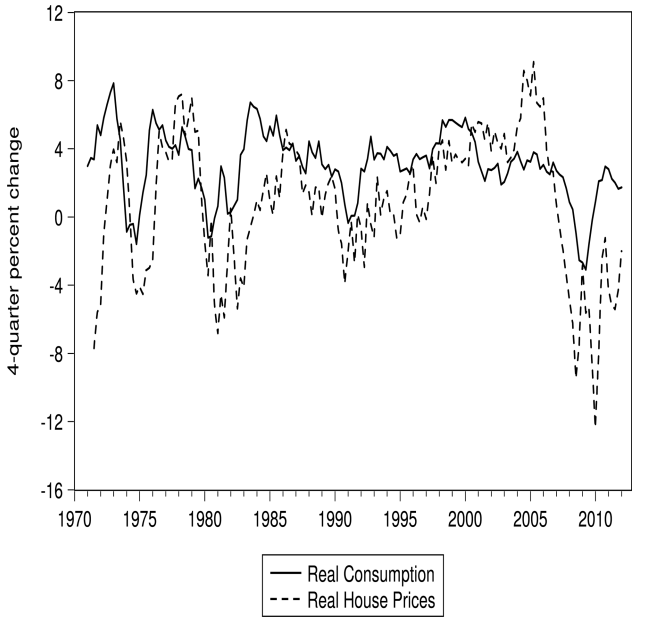
A supplemental appendix is available online at http://www.mitpressjournals.org/doi/suppl/10.1162/REST_a_00323.

[1] The terms housing equity and housing wealth are used interchangeably throughout the paper. Both refer to a household's house value less any outstanding mortgage debt.

[2] Homeowners who downsize face high transaction costs. In addition, to experience a positive net wealth effect, they must downsize enough to offset the initial negative wealth effect of rising house prices on nonhousing consumption.

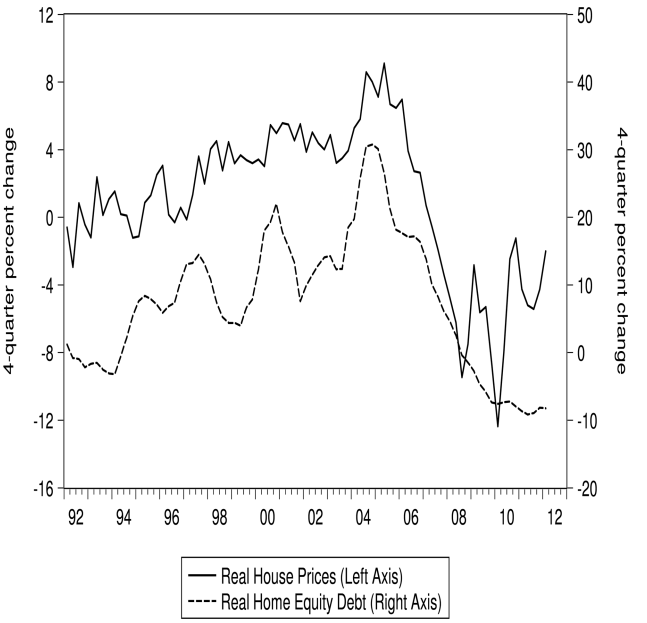
The Review of Economics and Statistics, October 2013, 95(4): 1183–1197

FIGURE 1.—CONSUMPTION GROWTH VERSUS HOUSE PRICE GROWTH



Source: Author's calculations based on NIPA data (consumption) and FHFA data (house prices). FHFA house prices are extended backward from 1975 using the growth rate in the Conventional Mortgage House Price Index (CMHPI) and are deflated using the PCE deflator excluding housing.

FIGURE 2.—REAL HOUSE PRICE GROWTH AND REAL HOME EQUITY DEBT GROWTH



Source: Home Equity Debt, Federal Reserve Z.1 release, table 218; house prices—FHFA. House prices are deflated using the PCE deflator excluding housing.

2000 and 2006 according to the Federal Reserve Board.[3] These aggregate data are broadly consistent with households borrowing against their homes to finance consumption.

This paper uses household data from the Panel Study of Income Dynamics (PSID) to analyze the impact of housing wealth on consumption. A major advantage of using household-level data is that one can identify potentially credit-constrained households. The PSID is particularly advantageous for this analysis because it follows the same households over time and contains within-household variation in consumption, housing wealth, and other variables. One can therefore control for unobserved household-specific factors that might have an impact on the relationship between housing wealth and consumption. The paper also contributes to the literature by imputing households' total nonhousing expenditures (NHE) for use in the analysis rather than relying on the more limited reported expenditure data in the PSID.

The results are consistent with housing wealth affecting households' nonhousing consumption through the borrowing collateral channel and not the pure wealth effect channel. In particular, a $1.00 increase in housing equity leads to a roughly $0.06 increase in NHE across all households. This effect, however, is concentrated among households that are potentially borrowing constrained. The nonhousing consumption of households with below-median liquid wealth-to-income (LWY) holdings rises by roughly $0.06 per dollar in their housing wealth, while the consumption of households with above-median LWY is essentially unchanged in response to housing appreciation.[4] When credit conditions were loose during the early 2000s, constrained households exhibited an even greater consumption response to changes in their housing wealth. In contrast, unconstrained households' consumption response over this period remained unchanged.

Alternative approaches for identifying potentially constrained households yield a similar pattern of results. Households with high debt service burdens (DSB) and low LWY spend roughly $0.09 per dollar increase in their housing equity. In contrast, the consumption of households with high DSB and high LWY holdings, which are less likely to be constrained, is essentially unchanged in response to housing wealth fluctuations. Households with high expected future income growth also exhibit a relatively large consumption response to changes in their housing wealth compared to households with low expected income growth. The former households potentially have high borrowing demand to the extent they want to reallocate their resources over time and smooth consumption.

A number of previous papers have examined the relationship between consumption and housing wealth. An early paper by Skinner (1989) quantifies this relationship using data from the PSID and finds little impact of house values on consumption after controlling for household-specific effects.[5] A more recent paper by Lehnert (2004) uses age as a proxy for household credit constraints and finds that

[3] H.8 Statistical Release; Flow of Funds (Z.1 Release Table L.218).

[4] Liquid wealth is households' cash, checking, and savings account holdings.

[5] Skinner imputes household spending in the PSID using the observed relationship between food consumption and total consumption in the Consumer Expenditure Survey.

younger households have a higher elasticity of consumption with respect to housing wealth. Bostic, Gabriel, and Painter (2009) perform cross-sectional analysis and find higher housing wealth elasticities than financial wealth elasticities. The authors also show that the consumption of constrained versus unconstrained households responds differently to house price fluctuations. Case, Quigley, and Shiller (2005, 2011) investigate the relationship between housing wealth and consumption across states and across countries using aggregate data and find strong housing wealth effects and weak financial wealth effects. Calomiris, Longhofer, and Miles (2009) replicate the analysis in Case etl al. (2005) and show that the estimated impact of housing wealth on consumption disappears after controlling for households' permanent income. Additional related papers include Campbell and Cocco (2007), who look at how the relationship between housing wealth and consumption varies based on households' age and tenancy status (renter versus owner) using British household-level data; Yamashita (2007), who uses PSID data through 1993 to analyze households' probability of having a second mortgage conditional on state-level house price appreciation; and Hurst and Stafford (2004), who use a special PSID refinancing module in 1996 to consider whether households take advantage of rising housing wealth through mortgage refinancing. In addition, Cooper (2009) analyzes households' uses of extracted equity during the 2000s and finds that a portion of the money goes toward consumption.[6]

Relative to the previous studies, this paper focuses on analyzing the borrowing collateral channel for housing wealth and uses a measure of households' nonhousing consumption that is much closer to the equivalent National Income and Product Account (NIPA) data. The paper also controls for household-specific effects and uses multiple approaches to identify potentially borrowing-constrained households.

The rest of the paper proceeds as follows. Section II discusses the theoretical background and empirical approach for this paper. Section III explains the data and measurement approach. Section IV reports my baseline results and the aggregate implications of falling house prices. Section V concludes.

II. Empirical Approach

A. Background

In a world where households consume housing and nonhousing goods, rising house prices, all else equal, imply increased housing consumption costs relative to nonhousing consumption costs for renters and owner-occupants. Since households' spending decisions are subject to a budget constraint, an increase in the relative cost of housing will require them to reduce their nonhousing consumption. This negative income effect is offset for homeowners to the extent they spend some of their capital gains from their home price appreciation.[7] Renters, however, are unambiguously worse off when house prices increase because they consume only housing and do not hold it as an asset on their balance sheets.

This basic framework suggests that housing appreciation likely does not have a substantial pure positive wealth effect on household consumption. Buiter (2010) and Flavin and Nakagawa (2008) formalize this basic intuition using fully specified models of households' intertemporal consumption decisions over housing and nonhousing expenditures. A main difference between the two models is that the one in Flavin and Nakagawa (2008) incorporates housing adjustment costs. That is, the model captures the idea that adjusting one's housing consumption bundle is costly due to transaction costs and other factors.

With transaction costs in the model, it is not possible to analytically determine the magnitude of the impact of housing appreciation on households' nonhousing consumption. In other words, it is unclear analytically whether the positive effect of rising house values offsets the negative effect of rising housing costs due to increased house prices. As a result, there is no guarantee that rising house prices will lead to a pure wealth effect on consumption that is substantial or even positive.

To the extent that house prices affect households' nonhousing consumption but the pure housing wealth effect is inconsequential, then housing appreciation likely has an impact on spending through the borrowing collateral channel. The empirical approach in this paper tries to determine the channel through which housing wealth affects consumption by examining whether the relationship between consumption and housing wealth is driven by the spending behavior of borrowing-constrained households.

B. Baseline Specification

The baseline empirical specification is a hybrid log and level equation that follows the approach in Muellbauer (2007) to estimate the relationship between housing wealth and consumption. Muellbauer argues that this setup captures the long-run relationship between consumption and wealth in addition to the short-run effects. Consumption (the dependent variable) and after-tax income are included in logs, while financial wealth and housing equity are scaled by income. Scaling the wealth variables rather than taking logs avoids having to drop households with zero or negative wealth from

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

[7] The term *spend* is used somewhat loosely. Households need not physically spend their housing gains. Households that do not reoptimize their housing consumption after an increase in house prices—those that stay in their current house—implicitly "spend" some of their gains by consuming the new higher value of housing services associated with their home. Given high transaction costs, most households likely do not reoptimize their housing in response to short-term house price fluctuations. Households that do downsize realize a positive net wealth effect only to the extent that their housing wealth gains offset the negative effect of rising housing costs.

the estimation. The setup also includes a number of controls aimed at capturing households' permanent income, future income expectations, and where they are in the lifecycle:

$$c_t^i = \beta_0^d + \beta_1^d y_t^i + \beta_2^d \frac{W_{t-1}^i}{Y_t^i} + \beta_3^d \frac{H_{t-1}^i}{Y_t^i} + \eta^d \mathbf{Z_{t-1}^i} + \delta_t + \alpha^i + e_t^i, \quad (1)$$

where c_t^i is a household's real nonhousing consumption (in logs), y_t^i is a household's real after-tax income (in logs), Y_t^i is a household's real after-tax income in period t (in levels), W_{t-1}^i, is a household's real nonhousing financial wealth, H_{t-1}^i is a household's housing equity, and $\mathbf{Z_{t-1}^i}$ is a vector of household control variables that includes a household's two-year-ahead expected labor income growth, a cubic term in the age of the head of the household, and the number of household members.[8] Households' expected income growth is a proxy for their expectations of future demand that may influence their spending as well as house prices.

The superscript $d \in [0, 1, 2]$ in equation (1) indicates the (sub)sample of households over which equation (1) is estimated. The estimation sample includes all households ($d = 0$) and is also divided into potentially borrowing-constrained households ($d = 1$) and borrowing-unconstrained households ($d = 2$). This approach allows all of the parameters to be estimated freely for each group of households. An alternative method would be to interact housing equity (the variable of interest) with an indictor variable for whether a household potentially needs to borrow. This approach is less appealing, however, because the consumption of constrained households likely responds differently not only to housing wealth fluctuations but also to changes in household income and financial wealth. Splitting the sample is equivalent to interacting all of the explanatory variables with an indicator for whether a household is borrowing constrained.

The term *borrowing constrained* is used somewhat loosely for ease of discussion. A household is not necessarily constrained in the strict sense that it cannot borrow. Instead, the household is "constrained" because it has an increased need or demand for borrowing. If the borrowing collateral role of housing wealth explains the relationship between housing appreciation and consumption, then changes in housing wealth should have a positive and substantial impact on constrained households' expenditures $\beta_3^1 > 0$. The housing wealth coefficient for unconstrained households, β_3^2, captures evidence of a pure housing wealth effect. To the extent there is not a substantial pure housing wealth effect, then β_3^2 should be close to 0. The estimated impact of housing wealth on consumption across all households β_3^0 will be a weighted average of the two subsample effects.

[8] Housing equity is a household's self-reported house value less any outstanding mortgage debt on the property. Financial wealth is measured as the total value of a household's nonhousing assets less any noncollateralized 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.

Equation (1) also includes time δ_t and household-specific effects α^i. The time effects account for any potential aggregate macroeconomic trends that may have an impact on household consumption behavior. Controlling for household-specific effects is necessary as well because households may have unobserved, individual-specific factors that influence their spending decisions, especially with regard to their wealth. For example, some households may tend to be wealth hoarders (savers) by nature and thus are not inclined to spend their housing equity or other wealth gains. In contrast, other households may always be looking for ways to increase their purchases. Accounting for such household-specific factors helps isolate the exogenous effect of housing wealth on household spending.

Finally, consumption and income are measured as of time t, while the wealth variables are measured as of $t - 1$. This timing is consistent with Muellbauer (2007). Wealth is dated as of $t - 1$ because it is a stock variable, and the relevant empirical question is how households' beginning-of-period assets affect their spending decisions. Lagging wealth relative to consumption is also necessary because wealth and consumption are jointly determined. Data used to evaluate whether households are potentially borrowing constrained are also measured as of $t - 1$. Note that given the availability of the wealth data in the PSID, the $t - 1$ timing notation represents beginning-of-period wealth, and not one calendar year prior to time t. For example, a household's NHE as of 2001 (period t) are regressed on its wealth as of 1999 (period $t - 1$), and NHE as of 1999 are regressed on 1994 wealth.[9] The timing and availability of the data are discussed in more detail in the next section.

III. Data and Measurement

The data used in this paper come from the PSID, a longitudinal survey that follows households and their offspring beginning in 1968. The panel aspect of the data allows one to control for household-specific effects. The survey was conducted annually between 1968 and 1997 and has been collected biennially since 1997. This paper uses data through 2007.

Each PSID wave asks homeowners to report their home values as well as the amount of any outstanding mortgage balances (first and second liens). The online appendix discusses households' self-reported house values in more detail and shows that they line up well, on average, with the published Federal Home Finance Administration (FHFA) house price index. Total family income and labor income data are available in every wave, and detailed information on households' financial asset holdings is reported as part of wealth supplements in 1984, 1989, 1994, and 1999 onward. Starting in 1989, the wealth supplements include data on households'

[9] NHE are measured between $t - 1$ and t and then annualized as of period t.

so-called active saving, which captures their saving out of current income in various asset categories and excludes capital gains. These saving data are discussed in greater detail in the online appendix. The PSID waves also include core information about family structure, employment, marital status, the age and sex of household members, and other household characteristics. Detailed data on households' location of residence at the Metropolitan Statistical Area (MSA) are available through a confidential data agreement with the PSID.

A. *Household Saving*

Households' active saving ($S^i_{t,t-1}$) is calculated following the approach in Juster et al. (2006). The exact method is outlined in the online appendix. Active saving measures households' net contributions to various financial assets over time, and it excludes capital gains. For instance, households that pay off some of their outstanding mortgage principal have positive active saving. In contrast, increases in financial wealth due to stock price appreciation do not count as active saving.[10]

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 noncollateralized debt.[11] The active saving data span the following years: 1984 and 1989, 1989 and 1994, 1994 and 1999, 1999 and 2001, 2001 and 2003, 2003 and 2005, and 2005 and 2007.

B. *Consumption Data*

The only consistently available spending data in the PSID are households' food consumption. Previous authors such as Lehnert (2004) have used food expenditures as their dependent variable when examining the impact of housing wealth on household spending. Food consumption is a necessary household expenditure and thus is likely not the margin or the only margin on which households adjust their consumption in response to changes in their housing wealth. A more comprehensive measure of household expenditures is arguably better at capturing the impact of changing housing equity on household spending.

This paper imputes a broad measure of household spending based on households' budget constraints and the available income and active saving data in the PSID. In particular, a household's nonhousing consumption is defined as

$$C^i_{t,t-1} = (Y^i_{t,t-1} - T^i_{t,t-1}) - S^i_{t,t-1}, \tag{2}$$

where $C^i_{t,t-1}$ is a household's consumption excluding housing between period $t-1$ and t, $S^i_{t,t-1}$ is a household's active saving over the same period, $Y^i_{t,t-1}$ is household income (excluding rental income), and $T^i_{t,t-1}$ is the household's lump-sum income tax burden. As noted, the active saving data exclude capital gains, which is appropriate for obtaining households' actual saving out of their disposable income. Data on households' income taxes come from the NBER's TAXSIM software.

Strictly speaking, $C^i_{t,t-1}$ measures households' NHE and not consumption from a national accounting perspective, since it does not include the service flow from durable goods. NHE are appropriate for the analysis in this paper since the goal is to examine how changes in housing wealth affect households' discretionary spending. A measure of household expenditures that includes the service flow from housing would be linked to households' housing wealth by construction given that housing costs are proportional to house prices.[12]

The timing of the NHE calculation in equation (2) is important. The standard household budget constraint framework states that consumption today equals income today less any active saving. $C^i_{t,t-1}$, however, measures households' expenditures over multiple periods because the active saving data in the PSID are available only between wealth supplements. That is, the 2001 wealth supplement asks households to report their saving since 1999, the 1999 supplement asks for saving since 1994, and so on. Income data are available for the intervening survey waves, but the lack of high-frequency saving data requires expenditures to be calculated over two- or five-year periods.[13]

The measure of c^i_t used in estimating equation (1) is the log of a household's annualized NHE, and the time periods used in the estimation are 1989, 1994, 1999, 2001, 2003, 2005, and 2007. Although households' NHE cannot be calculated in every PSID wave, these data are much more comprehensive than the other expenditure data available in the PSID or through alternative imputation approaches such as the one

[10] Earlier work using active saving data includes Kosobud and Morgan (1964), Klein and Morgan (1951), and Holbrook and Stafford (1971).

[11] *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.

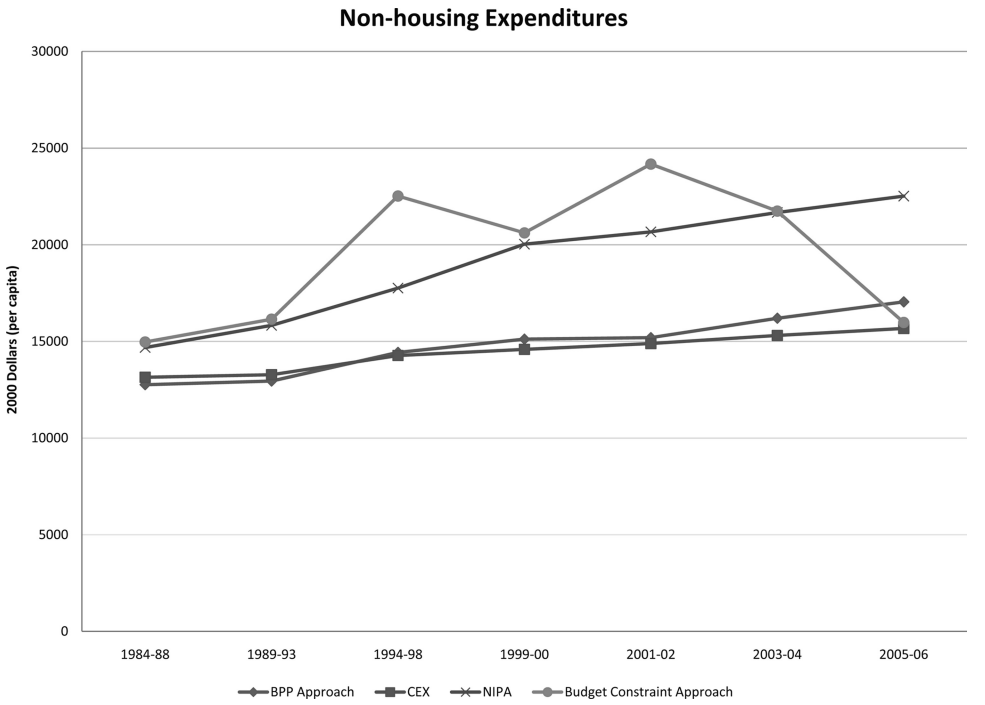
[12] $C^i_{t,t-1}$ potentially includes a household's monthly mortgage payment since it measures households' out-of-pocket expenditures. Changing house prices, however, should not affect a household's mortgage payment, which is fixed by contract, unless a household refinances and uses the proceeds to reduce its monthly payments.

[13] As an example, expenditures between the 1999 and 2001 waves are calculated based on equation (2) as follows:

$$C^i_{2000,1999} = (Y^i_{2000,1999} - T^i_{2000,1999}) - S^i_{2000,1999}.$$

The timing notation acknowledges that the saving data in 2001 primarily cover 1999 and 2000 since the PSID surveys occur early in the year. Income is similarly recorded for the previous two years (1999 and 2000). As a result, households' imputed expenditures for 2001 capture their spending in 1999 and 2000. Over the five-year expenditure horizons, income is summed for all of the intervening survey years (1994, 1995, 1996, 1997, and 1998 for consumption between 1994 and 1999) when calculating NHE.

FIGURE 3.—COMPARISON OF EXPENDITURE DATA TO AGGREGATE BENCHMARK



Source: Author's calculations.

in Blundell, Pistaferri, and Preston (2006). The NHE data also do a good job of tracking nonhousing consumption in the NIPA, especially compared to the relevant alternative measures, as shown in figure 3.

In addition, accurately capturing households' NHE relies on them accurately reporting their spending and income data. Given that the NHE line up well relative to the equivalent NIPA data, it would appear that any measurement problems at the very least cancel each other out on average. The online appendix examines the saving and income data in the PSID in more detail and also discusses the alternative consumption data and the related results.

C. *Estimation Sample*

The estimation sample includes all homeowners in the PSID between 1984 and 2007 where the household head is age 65 or younger. Households from the original low-income (SEO) sampling group are included in the empirical analysis since these households are likely to be potentially borrowing constrained. For sample selection purposes, a household must own its home at the beginning and end of the expenditure period (periods t and $t-1$). Renters are not included in the sample because they do not own their housing, and the goal of the paper is to identify the channel through which housing appreciation affects consumption. Movers are also eliminated from the sample, as are households with missing wealth data or negative imputed NHE. All household demographic variables are measured for the head of the household where applicable, and all nominal values are converted to 2000 dollars using the annual PCE deflator from the Bureau of Economic Analysis. In addition, households in the top and bottom 1% of the consumption, income, financial wealth-to-income, and housing equity-to-income distributions are eliminated to remove outliers.

The last consumption observation used to estimate equation (1) is for 2005 because the estimates include households' two-year-ahead expected labor income growth. This estimation period covers the boom and bust in the housing market (mainly on the coasts) in the late 1980s and early 1990s, as well as the nationwide housing boom in the early 2000s. The attractiveness of home equity borrowing relative to other forms of credit increased for homeowners early in the sample period with the passage of the 1986 Tax Reform Act. This legislation eliminated the tax deduction for interest on noncollateralized debt and made interest payments on the first $100,000 of home equity loans and lines of credit tax deductible. In addition, the availability of housing-related credit increased sharply during the latter part of the sample. Foote, Gerardi, and Willen (2012) note that there is little doubt that available credit expanded during the housing boom, and Gerardi et al. (2008) show that credit grew noticeably for higher-risk borrowers between 1999 and 2007. Changes in the availability of credit over the sample horizon allow one to examine whether the relationship between housing wealth and consumption was stronger when credit was looser.

Table 1 reports relevant summary statistics for the estimation sample. The average age of the head of the household is roughly 44, and the vast majority of households (78%) are

TABLE 1.—SUMMARY STATISTICS

Variable	Mean	SD	Minimum	Maximum	N
Age Head	43.7	9.4	19	64	9,695
Age Spouses	41.4	9.1	15	71	7,780
Married (%)	78	41.4	0	100	9,695
Family Size	3.2	1.4	1	11	9,695
Disposable Family Income ($)	64,697	33,602	1,160	189,006	9,695
Liquid Wealth (Cash Holdings) ($)	12,307	29,783	0	582,939	9,695
Financial Wealth ($)	77,808	177,748	−145,002	4,821,932	9,695
Housing Equity ($)	62,118	71,844	−178,714	953,492	9,689
Expected Labor Income Growth (%)	−3.8	32.5	−129.7	290.2	9,695
Financial Wealth-to-Income Ratio	1.1	2.3	−1.5	26.9	9,695
Housing Equity-to-Income Ratio	1	1.2	0	14.3	9,695
MSA Expected Income Growth (p.c.) (%)	4.7	2.5	−6.7	32.1	6,672
MSA Income (p.c.) ($)	32,698	13,739	11,577	87,753	6,672
MSA Income Growth (p.c.) (%)	4.2	2.1	−10.2	16.5	6,672
MSA Unemployment Rate	5.1	1.8	1.2	29.5	6,239
MSA House Price Growth (%)	3.3	5.7	−14.6	36.7	5,495

p.c.: per capita. MSA data come from HAVER Analytics and are divided by the total U.S. population where applicable. "Married" reports the proportion of households in the sample who are married and not separated from their spouse. Data are deflated by the PCE deflator (2000 base year) where applicable. House price growth is calculated over the year prior to each PSID wave.

married. Households report greater average financial wealth ($77,808) than housing equity ($62,118). Households' liquid wealth holdings are also nontrivial, and they make up a sizable portion of households' overall financial wealth. On average, households' income is similar in magnitude to their average financial and housing wealth. In addition, the mean of households' expected labor income growth is small and negative, but the data are highly variable across households. Local economic conditions are also favorable, on average, where households live. The average MSA unemployment rate is 5.1%, mean house price growth is 3.3%, and average income growth per capita is 4.2%.

D. *Identifying Households' Borrowing Demand*

The PSID does not have a direct measure of households' credit constraints or borrowing needs. As a result, a number of indirect proxies are used to identify households that potentially need to borrow and may benefit from increases in their housing wealth. A standard approach in the literature is to identify constrained households based on their liquid wealth holdings relative to their average income (see Zeldes, 1989).[14] Households that face an income shortfall with low levels of cash or near-cash assets relative to their income likely have a greater need to borrow to help finance their expenditures than households with sufficient liquid asset holdings. The sample is therefore split between households with below-median LWY ($d = 1$) and households with above-median LWY ($d = 2$).

Households' expected labor income growth is also used as an indicator of their borrowing needs. In particular, households with high expected future income growth relative to their current income may potentially want to borrow to reallocate their resources and smooth consumption. The PSID does not contain actual data on households' income expectations, so expected labor income growth is defined as households' ex post realized growth between the current period and two years hence (for example, between 2003 and 2005 for 2003 expenditures).[15] Potentially constrained households are determined based on whether their expected income growth is in the top quartile of the income growth distribution. The sample is then split between households with high expected income growth ($d = 1$) and households with low expected income growth ($d = 2$).

A final approach looks at households' debt service ratios (DSR) as an indicator of borrowing constraints, as proposed in Johnson and Li (2010). The authors find that households with a high DSR are "significantly more likely" to get turned down for credit. A household's DSR is the ratio of its debt payments to its disposable income. Debt payments include outlays for mortgages, home equity debt, car loan payments, and credit cards.[16] The PSID contains the data necessary to compute households' DSR starting in 1999, and the sample is split between potentially constrained households with above-median DSR ($d = 1$) and likely unconstrained households with below-median DSR ($d = 2$). Some specifications further split high-DSR households into those with above-median LWY and those with below-median LWY. Conditional on having a high debt service burden, households with low liquid wealth holdings likely have a greater borrowing need to finance their expenditures than similar households with substantial liquid wealth holdings. Johnson and Li (2010) find evidence that households with high DSR ratios and low liquid wealth holdings are particularly likely to be constrained.

A potential concern with this approach is that there are differences across household types that drive the relationship between consumption and housing wealth instead of the fact

[14] Households' average labor income over time is used to calculate this ratio in order to smooth through transitory income shocks.

[15] Income growth over this period actually covers 2002 to 2004 because of the timing of the data in the PSID waves.

[16] Households are assumed to pay a minimum monthly payment of 2.5% on their credit cards (Johnson & Li, 2010).

TABLE 2.—SUMMARY STATISTICS BY HOUSEHOLD TYPE

	Household Group					
	High-Income Growth	Low-Income Growth	Below-Median LWY	Above-Median LWY	Above-Median DSR	Below-Median DSR
Age Head	43.1	43.9	42.0	45.4	43.7	46.7
Family Size	3.2	3.2	3.4	3.1	3.3	2.9
Disposable Family Income ($)	56,498	67,326	55,664	73,701	71,651	65,428
Housing Equity ($)	58,987	63,123	40,145	84,023	54,898	74,733
Liquid Wealth-to-Income Ratio	0.3	0.3	−0.1	0.8	0.1	0.4
Expected Labor Income Growth	35.8	−16.5	−2.8	−4.8	−1.4	0.9
Financial Wealth-to-Income Ratio	1.4	1.1	0.4	1.8	0.8	1.3
Housing Equity-to-Income Ratio	1.2	0.9	0.8	1.2	0.8	1.3
Amount of Equity Extracted ($)	7,170	7,501	8,072	6,771	12,241	7,556
Average Labor Income ($)	51,107	51,126	43,586	58,634	47,350	53,409
MSA Expected Income Growth (p.c.) (%)	3.1	5.2	4.7	4.7	4.3	3.9
MSA Income (p.c.) ($)	33,454	32,455	32,423	32,965	38,801	38,222
MSA Income Growth (p.c.) (%)	3.7	4.3	4.2	4.2	3.3	3.1
MSA Unemployment Rate	5.0	5.1	5.2	5.0	5.3	5.3
MSA House Price Growth (%)	3.8	3.1	3.4	3.2	5.6	4.8
N	2,354	7,341	4,834	4,862	2,224	1,981

The table reports mean values for the relevant household group. p.c.: per capita. MSA data come from HAVER Analytics and are divided by the total U.S. population where applicable. DSR is a household's debt-service ratio as defined in Johnson and Li (2010). LWY is liquid wealth (cash and near-cash assets) relative to income. High-income-growth households are those in the top quartile of the expected labor income growth distribution. Low-income-growth households are all households not in the top quartile. Households' equity extracted is calculated following the procedure in Cooper (2009). Average labor income is the mean of households' labor earnings for all waves they are in the PSID. Data are deflated by the PCE deflator (2000 base year) where applicable. The MSA-related summary statistics are averages over the subset of households that live in identifiable MSAs.

that one group versus another is potentially borrowing constrained. For example, if potentially constrained households live in areas with more favorable economic conditions than unconstrained households, then the estimated relationship between consumption and housing wealth could be picking up a location effect and not a borrowing collateral channel. Alternatively, constrained households may have substantial housing wealth to use as borrowing collateral, while unconstrained households may have little or no collateral, so even if they wanted to, they could not borrow.

Table 2 shows summary statistics by household type. There do not appear to be major differences across groups that could affect the relationship between consumption and housing wealth. In particular, the data show that constrained households have less housing equity on average than unconstrained households—especially below-median-LWY households whose average housing equity ($40,145) is less than half that of households with above-median LWY ($84,023). Income per capita in the MSAs where households reside is about equal across all household groups, and there is little difference in local unemployment rates or average per capita income growth. Potentially constrained households are also slightly younger (42 to 44 years old) on average than unconstrained households (44 to 47 years old), which is consistent with the idea that younger households are more likely to be credit constrained. In addition, below-median-LWY households and households with above-median DSR have slightly larger family sizes. This result is consistent with larger households potentially having a greater need to borrow to finance their expenditures.

The borrowing constraint indicators also do not appear to be identifying households with higher average (permanent) income. Indeed, the average labor income of below-median-LWY households is roughly $15,000 lower than the average labor income of households with above-median LWY. The average income for above-median DSR households ($47,350) is also smaller than the average income of below-median DSR households ($53,409). High- and low-expected-income-growth households have roughly the same average labor income. Overall, these statistics confirm that potentially constrained households are no better off in terms of their lifetime resources than unconstrained households. The data are thus inconsistent with borrowing-constrained households having greater propensities to consume their housing wealth than unconstrained households because of higher unobserved permanent income.

A final potential concern is that the saving rates of constrained households are systematically different from those of unconstrained households. This could potentially bias the estimates of NHE for constrained households relative to unconstrained households. Table 3 reports mean and median saving rates across household groups. The data suggest that saving behavior is very similar across the different household splits. Overall, constrained households do not appear different from unconstrained households based on observables.

IV. Results

A. *Baseline Findings*

Table 4 reports estimates of equation (1) for all households ($d = 0$) using a linear fixed effects estimator.[17] Each column

[17] Table A-7 in the online appendix reports OLS estimates of the baseline equation without fixed effects for completeness. The estimates are similar to those in table 4, although the estimated relationships between housing wealth and consumption and financial wealth and consumption are somewhat smaller.

TABLE 3.—SAVING RATES BY HOUSEHOLD TYPE

	Household Group					
	High-Income Growth	Low-Income Growth	Below-Median LWY	Above-Median LWY	Above-Median DSR	Below-Median DSR
Mean	−0.01	0.01	0.02	−0.01	−0.02	−0.02
Median	0.04	0.03	0.03	0.03	0.02	0.01
SD	0.42	0.32	0.29	0.39	0.34	0.38
N	2,354	7,341	4,834	4,862	2,224	1,981

DSR is a household's debt-service ratio as defined in Johnson and Li (2010). LWY is liquid wealth (cash and near-cash assets) relative to income. High-income-growth households are those in the top quartile of the expected labor income growth distribution, and low-income-growth households are those not in the top quartile. The saving rate data include imputed household saving in stocks based on households' reported stock market wealth and the implied change in the stock market index between wealth supplements, as discussed in the online appendix.

TABLE 4.—HOUSING EQUITY AND CONSUMPTION: BASELINE RESULTS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log Income	0.45***	0.63***	0.64***	0.68***	0.69***	0.68***	0.67***	0.69***
	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
(Financial Wealth)/Income		0.07***	0.07***	0.08***	0.08***	0.08***	0.08***	0.08***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
(Housing Wealth)/Income		0.06***	0.06***	0.06***	0.07***	0.06***	0.06***	0.06***
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Expected Labor Income Growth			0.04	0.01	0.02	0.01	0.01	0.02
			(0.03)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
MSA Income (p.c.)				0.06				0.19
				(0.17)				(0.19)
MSA Unemployment Rate					0.00			0.01
					(0.01)			(0.01)
MSA Income Growth (p.c.)						−0.56		−1.02**
						(0.41)		(0.46)
Expected MSA Income Growth (p.c.)							1.45***	1.84***
							(0.42)	(0.46)
N	9,694	9,694	9,694	6,672	6,239	6,672	6,672	6,239
Adjusted R^2	0.19	0.26	0.26	0.27	0.27	0.27	0.27	0.27
SE regression	0.33	0.31	0.31	0.31	0.31	0.31	0.31	0.31

Estimates control for household-specific effects using a linear fixed-effects estimator. Additional controls include age, age squared, age cubed, family size, and year fixed effects. MSA data are on a per capita (p.c.) basis as noted. Expected income growth is measured as ex post realized income growth between the current and subsequent period. Robust standard errors clustered at the household level are in parentheses. Significant at ***1%, **5%, and *10%.

in the table offers (an) additional explanatory variable(s), and each specification also controls for a cubic term in the age of the head of the household, family size, and year effects. The estimated effects of housing wealth and financial wealth on consumption are identified based on within-household variation in housing equity and financial wealth over time. This identification approach eliminates household-specific factors that may influence the estimated relationship between consumption and housing wealth. It also isolates how households respond to changes in their own housing wealth relative to their average housing wealth, which is likely an important decision margin for when they determine whether to borrow against their homes.

The coefficient estimates for the wealth variables are consumption elasticities but can be interpreted as households' marginal propensity to consume (MPC) out of housing or financial wealth in all tables since the average consumption-to-income ratio over the sample is essentially 1.[18] The estimates in column 2 show that overall, households consume $0.06 per dollar increase in their housing wealth. One cannot yet draw conclusions about the channel through which housing wealth effects consumption since the estimates do not yet control for constrained versus unconstrained households.

Households' estimated MPC out of housing wealth in table 4 is comparable in size to the estimates in Bostic et al. (2009) and is broadly consistent with other results in the literature that those authors survey. The estimated financial wealth effect—about $0.07 per dollar increase in financial wealth—is slightly larger than the estimated housing wealth effect across all the specifications. This finding contrasts with much of the recent literature that finds larger MPCs out of housing wealth than financial wealth. The estimated differences between these MPCs are not statistically distinguishable from one another, and the larger point estimates for financial wealth could be a result of this paper's controlling for household-specific effects, unlike the vast majority of previous studies.

A potential concern is that the positive correlation between housing wealth and consumption could be spurious if consumption and house prices are both higher due to households' favorable expectations about future economic activity and income. The estimates in column 3 proxy for households'

[18] The elasticities can be converted to MPCs in this case by multiplying them by the mean CYR. The CYR is 0.98 over the sample.

TABLE 5.—HOUSING EQUITY AND CONSUMPTION: ALTERNATIVE TIMING

	(1)	(2)	(3)	(4)	(5)	(6)
Log Income	0.64***	0.35***	0.84***	0.60***	0.27***	0.84***
	(0.03)	(0.04)	(0.05)	(0.03)	(0.04)	(0.05)
(Financial Wealth)/Income	0.07***	0.08***	0.10***	0.07***	0.08***	0.10***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
(Housing Equity)/Income	0.06***	0.06***	0.06***	0.02*	−0.02	0.06***
	(0.01)	(0.02)	(0.02)	(0.01)	(0.02)	(0.02)
Expected Labor Income Growth	0.05*	0.10**	0.03	0.05*	0.08	0.03
	(0.03)	(0.05)	(0.05)	(0.03)	(0.05)	(0.05)
Restrictions						
Before 2001		X			X	
2001 and after			X			X
Alternative home equity timing				X	X	X
N	9,695	4,794	4,901	9,659	4,758	4,901
Adjusted R^2	0.25	0.27	0.20	0.24	0.25	0.20
SE regression	0.32	0.22	0.30	0.32	0.22	0.30

Households' home equity in the first three columns is measured at the same time as financial wealth (for example, 1994 for consumption between 1994 and 1999 and 1999 for consumption between 1999 and 2001). Households' housing equity in the last three columns is measured two years prior to the end of the consumption period (for example, 1999 for consumption between 1999 and 2001 and 1997 for consumption between 1994 and 1999) regardless of the year. Estimates control for household-specific effects using a linear fixed-effects estimator. Additional controls include age, age squared, age cubed, family size, and year fixed effects. Expected income growth is measured as ex post realized income growth between the current and subsequent period. Robust standard errors clustered at the household level are in parentheses. Significant at ***1%, **5%, and *10%.

expected future income by including their ex post realized future labor income growth.[19] The estimated relationship between consumption and housing wealth is essentially unchanged, suggesting that households' MPC out of housing equity is not driven by their future income expectations.

The remaining columns in table 4 include MSA-level data for current and future economic conditions to control for other potential endogeneities between consumption and housing wealth. The MSA data include MSA income per capita (column 4), the MSA unemployment rate (column 5), MSA income growth per capita (column 6), and expected MSA income growth—measured as ex post realized two-year-ahead income growth—(column 7). All of these additional controls are included together in column 8. Adding these variables helps ensure that the estimated relationship between housing wealth and consumption is not capturing the fact that some households feel wealthier than others because they live in more prosperous areas and hence have a better economic outlook. MSA-level ex post realized income is included because it is subject to less measurement error than households' self-reported future income growth and may do a better job of capturing local economic trends.[20]

Overall, adding these additional controls individually or together has a negligible impact on the estimated relationship of household wealth, income, and consumption. Taken together, the results in table 4 suggest that housing wealth affects household spending and that this relationship is not driven by unobserved current or future economic conditions. These findings do not completely rule out an endogenous relationship between housing wealth and consumption, but they are consistent with the coefficient estimates' picking up the effect of exogenous variation in housing wealth on consumption. The analysis going forward excludes the MSA controls to maintain a larger sample size given that these variables have little impact on the estimated effects of interest.

B. *Baseline Parameter Stability*

This section examines whether the baseline estimates are time varying. There are a few reasons to question whether the baseline parameter estimates are stable over time. First, the regressions combine household expenditure data measured over five-year intervals prior to 1999 and two-year intervals thereafter. These data are annualized for estimation purposes, but five years is a long time for beginning-of-period housing wealth to have an impact on households' consumption decisions. The baseline estimates of the impact of housing wealth on consumption may therefore depend on the length of time over which expenditures are measured despite the fact the data are annualized. In addition, the availability of housing credit, especially to riskier borrowers, increased over the sample horizon. One would therefore expect that to the extent that the borrowing collateral channel matters, the relationship between consumption and housing wealth is stronger during the early 2000s when credit was easier to obtain than in prior years.

Columns 2 and 3 of table 5 report baseline estimates for the pre-2001 and the post-2001 periods, respectively. The pre-2001 sample includes consumption measured between 1984 and 1989, 1989 and 1994, and 1994 and 1999, while the later period covers consumption from 1999 to 2001, 2001 to 2003, and 2003 to 2005. This sample split separates the

[19] The results are very similar using future labor income growth for the head of the household only. This alternative measure eliminates fluctuations in households' labor income due to spouses entering and exiting the labor force. In addition, households' ex post realized future income growth is likely an imperfect proxy for their income expectations at time t. Using households' current income growth as an instrument for future income growth yields nearly identical results for the wealth coefficients. A better instrument for households' income expectations would be their current consumption, but using consumption as an instrument is not possible given the regression framework.

[20] The sample sizes in columns 4 to 8 are noticeably smaller than for the estimates in columns 1 to 3 because not all households live in an MSA or have an MSA identifier. The unemployment rate data are also not available for all MSAs.

TABLE 6.—HOUSING EQUITY AND CONSUMPTION: ACROSS HOUSEHOLD GROUPS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Log Income	0.60***	0.84***	0.62***	0.56***	0.87***	0.86***	0.82***	0.76***	0.70***	0.70***	0.26***	0.30***
	(0.03)	(0.05)	(0.05)	(0.05)	(0.07)	(0.09)	(0.09)	(0.09)	(0.12)	(0.19)	(0.06)	(0.08)
(Financial Wealth)/Income	0.07***	0.10***	0.12***	0.07***	0.14***	0.08***	0.06**	0.17***	0.13*	0.24***	0.08***	0.08***
	(0.01)	(0.01)	(0.02)	(0.01)	(0.04)	(0.02)	(0.03)	(0.04)	(0.07)	(0.04)	(0.03)	(0.02)
(Housing Equity)/Income	0.02*	0.06***	0.06***	0.00	0.10***	0.00	0.04	0.05*	0.09**	−0.04	0.01	−0.03
	(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	(0.04)	(0.03)	(0.03)	(0.04)	(0.05)	(0.03)	(0.03)
Expected Labor Income Growth	0.05*	0.03	0.08*	0.01	0.01	0.01	−0.03	0.02	−0.07	0.05	0.08	0.11
	(0.03)	(0.05)	(0.04)	(0.05)	(0.06)	(0.09)	(0.09)	(0.07)	(0.11)	(0.11)	(0.08)	(0.08)
Restrictions												
2001 and later		X			X	X	X	X	X	X		
1999 and earlier											X	X
Below-median liquid wealth			X		X				X		X	
Above-medium liquid wealth				X		X				X		X
Below-medium DSR							X					
Above-median DSR								X	X	X		
N	9,659	4,901	4,804	4,855	2,574	2,327	1,980	2,205	1,348	857	2,230	2,528
Adjusted R^2	0.24	0.20	0.30	0.21	0.32	0.17	0.15	0.23	0.27	0.27	0.19	0.29
SE regression	0.32	0.30	0.23	0.33	0.21	0.31	0.27	0.26	0.20	0.24	0.15	0.21

DSR is a household's debt-service ratio as defined in Johnson and Li (2010). Households' housing equity is measured two years prior to the end of the consumption period (for example, 1999 for consumption between 1999 and 2001 and 1997 for consumption between 1994 and 1999) regardless of the year. Estimates control for household-specific effects using a linear fixed-effects estimator. Additional controls include age, age squared, age cubed, family size, and year fixed effects. Expected income growth is measured as ex post realized income growth between the current and subsequent period. Robust standard errors clustered at the household level are in parentheses. Significant at ***1%, **5%, and *10%.

five-year expenditure data from the two-year data and also allows one to check whether the relationship between household spending and housing wealth differed during the housing boom when housing credit was readily available. The results show that the baseline relationship between housing wealth and consumption is stable over time.[21]

The last three columns of table 5 use an alternative timing convention for measuring households' housing equity. In the baseline specifications, housing equity, along with financial wealth, is measured at the beginning of the consumption period (for example, 1994 for consumption between 1994 and 1999). The PSID records households' housing data in every wave, however, so it is possible to incorporate households' housing equity from a year closer to the end of the consumption period. The estimates in columns 4 to 6 incorporate households' amount of housing equity two years prior to the end of the consumption period (for example, 1997 for consumption between 1994 and 1999) to be consistent with the timing of the wealth data after 1999. The estimated impact of housing wealth on consumption over the full sample (column 4) declines from \$0.06 per dollar increase in housing equity in the baseline specification to \$0.02 per dollar increase with this alternative timing. The subsample estimates in columns 5 and 6 show that the lower estimated effect in column 4 is driven by a slightly negative but not statistically significant MPC out of housing wealth for households between 1984 and 1999.

The findings in columns 4 to 6 suggest that the timing convention for measuring households' housing equity matters for determining the relationship between housing wealth and consumption during the period in which NHE data are available over five-year intervals. It is difficult to conclude which timing convention yields more accurate estimates of the relationship between housing wealth and consumption for the pre-2001 sample. In theory, one should measure households' beginning-of-period wealth when considering their consumption decisions, but the five-year annualized consumption data make using households' beginning-of-period housing equity somewhat unappealing since house prices can change a lot over five years.[22] At the same time, the results show a stronger relationship between consumption and housing wealth during the early 2000s, when household credit was easy to obtain.

Section IVC discusses further the impact of credit supply on the estimated relationship between consumption and housing wealth. In addition, the online appendix includes results that examine the relationship between housing wealth and consumption prior to 2001 using more frequently available expenditure data.

C. *Borrowing Constraints*

Table 6 splits the sample based on potentially constrained versus unconstrained households. The two measures used to identify potentially constrained households in this analysis are their LWY and DSR as discussed in section IIID. The baseline results using the alternative timing for measuring household's housing equity, as discussed in the last section, are shown in column 1. Column 3 reports baseline estimates for households with below-median LWY, while column 4 shows results for households with above-median LWY. Low-wealth households have an MPC out of housing equity of \$0.06 while high-wealth households' consumption does not

[21] Households' MPC out of income is substantially lower in the pre-2001 period than in the later period. There is likely a larger disconnect, however, between current income and (annualized) household spending measured over five years than there is with spending measured over two years.

[22] It is not possible to check how the timing of the financial wealth data affects the results prior to 2001 because these data are available only every five years.

respond to changes in their housing equity. These estimated effects are statistically different from one another (p-value 0.02) and are consistent with the borrowing collateral channel explaining the relationship between housing wealth and consumption.

The differential consumption response of low- versus high-LWY households to changes in their housing equity is even more pronounced from 2001 onward, as shown in columns 5 and 6. Potentially constrained, low-LWY households increase their consumption \$0.10 per dollar increase in their housing wealth, while the consumption of unconstrained households remains unchanged during this period of easier access to credit. In contrast, the estimates in columns 11 and 12 show that neither constrained nor unconstrained households exhibited much of a spending response to housing wealth changes prior to 2001. These results provide further support for housing wealth affecting consumption through the borrowing collateral channel during the period that housing credit was relatively easy to obtain. There also continues to be little evidence of housing appreciation having a pure wealth effect on household expenditures.

Columns 7 and 8 report the housing wealth effect estimates for households with below-median DSR and above-median DSR, respectively. The effect of housing wealth on consumption is similar across the two groups. Johnson and Li (2010) find, however, that high-DSR households with low liquid wealth holdings are the most likely to be borrowing constrained. The estimates in columns 9 and 10 show that such households have a differentially strong consumption response to changes in their housing wealth. In particular, high-DSR households with low LWY spend \$0.09 per dollar increase in their housing wealth, while the spending response of high-DSR households with above-median LWY is negative in magnitude but not statistically distinguishable from 0. Overall, these results are consistent with housing wealth affecting consumption through its role as borrowing collateral.

The results in table 6 also show that in nearly all cases, potentially constrained households' MPC out of financial wealth is greater than or statistically indistinguishable from unconstrained households' MPC out of financial wealth. This finding is consistent with constrained households' needing to access their wealth to reallocate their resources intertemporally and smooth consumption. In addition, the consumption of unconstrained households exhibits a positive response to changes in their financial wealth compared with essentially no response to changes in their housing equity. If changes in house prices had a pure wealth effect impact on consumption, then one would expect both housing and financial wealth increases to have a positive impact on unconstrained households' spending.[23] The financial wealth results in table 6 therefore provide further evidence that house price fluctuations do not have a pure wealth effect on consumption.

The results in table 7 consider households' expected income growth (EYG) as an additional measure of potential borrowing constraints. Households with higher EYG are more likely than households with low EYG to want to reallocate their resources over time through borrowing to smooth consumption. High-EYG households are those with ex post realized two-year-ahead labor income growth that is in the top quartile of the expected income growth distribution. The top panel of the table shows results for the pre-2001 sample period, while the bottom panel shows results for 2001 onward. The pre-2001 sample results should be compared to the baseline results in column 5 of table 5, while post-2001 results should be compared to the results in column 6 of table 5.[24]

The results show a relatively strong differential effect of housing wealth on consumption for constrained households during the period of easy credit (2001 onward) and little effect of housing wealth on consumption during the relatively tighter credit period prior to 2001. In particular, the upper panel of table 7 reports that potentially constrained, high-EYG households consume \$0.18 per additional dollar of their housing wealth. Low-EYG households consume only \$0.04 per dollar increase in their housing wealth, an effect that is not statistically distinguishable from 0. The equivalent results in columns 1 and 2 at the bottom panel of table 7 show limited evidence of house prices affecting consumption differently for constrained versus unconstrained households. In fact, the point estimates are negative, but the effects are small and not precisely estimated. Overall, the results are consistent with what one would expect if the borrowing collateral channel explains the relationship between housing wealth and consumption, that is, the impact of housing wealth on consumption is strongest when household credit was easy to obtain.

The remaining columns in the table further decompose high- and low-EYG households based on their LWY holdings. High-EYG households with limited financial resources should be more likely to borrow against their homes to smooth consumption than similar households with sufficient financial resources. The results prior to 2001 are broadly consistent with this claim, as shown in columns 3 and 4 of the bottom panel, even though the point estimates are implausibly large in absolute value presumably because of the small sample size. The results in the upper panel suggest that from 2001 onward, high EYG is a more important determinant of households' borrowing needs than their liquid wealth positions. High-EYG households with above-median LWY exhibit a stronger consumption response to changes in housing wealth than the consumption of high-EYG households with low liquid wealth. LWY holdings do matter for the relationship between consumption and housing wealth for low-EYG households that do not necessarily need to borrow based on their expected future income. In particular,

[23] Financial wealth increases represent an unambiguous lifetime resource gain for households.

[24] Full sample results are available in the online appendix.

TABLE 7.—HOUSING EQUITY AND CONSUMPTION: ACROSS HOUSEHOLD GROUPS

	(1)	(2)	(3)	(4)	(5)	(6)
			A: Results from 2001 Onward			
Log Income	1.07***	0.76***	1.61***	0.82***	0.77***	0.79***
	(0.15)	(0.08)	(0.24)	(0.18)	(0.18)	(0.10)
(Financial Wealth)/Income	0.10***	0.10***	0.12***	0.04	0.10***	0.12*
	(0.03)	(0.02)	(0.03)	(0.04)	(0.03)	(0.07)
(Housing Equity)/Income	0.18***	0.04	0.31***	0.09	−0.01	0.06*
	(0.07)	(0.03)	(0.12)	(0.08)	(0.05)	(0.03)
Expected Labor Income Growth	−0.11	−0.25***	−0.34	−0.04	−0.27*	−0.12
	(0.22)	(0.09)	(0.32)	(0.33)	(0.15)	(0.13)
Restrictions						
High expected income growth	X		X	X		
Low expected income growth		X			X	X
Below-median liquid wealth				X		X
Above-median liquid wealth			X		X	
N	1,702	3,199	824	878	1,503	1,696
Adjusted R^2	0.31	0.15	0.50	0.43	0.13	0.23
SE regression	0.12	0.24	0.11	0.07	0.25	0.17
			B: Results prior to 2001			
Log Income	0.32*	0.33***	−0.11	4.24***	0.40***	0.33***
	(0.19)	(0.05)	(0.24)	(1.28)	(0.09)	(0.10)
(Financial Wealth)/Income	0.15***	0.09***	−0.03	0.59***	0.10***	0.13*
	(0.02)	(0.01)	(0.11)	(0.21)	(0.02)	(0.07)
(Housing Equity)/Income	−0.06	−0.01	−0.69***	1.16***	0.02	−0.03
	(0.07)	(0.02)	(0.23)	(0.24)	(0.03)	(0.04)
Expected Labor Income Growth	0.01	0.04	−0.15	2.32***	0.12	−0.01
	(0.23)	(0.07)	(0.40)	(0.72)	(0.11)	(0.11)
Restrictions						
High expected income growth	X		X	X		
Low expected income growth		X			X	X
Below-median liquid wealth				X		X
Above-median liquid wealth			X		X	
N	639	4,119	285	354	2,243	1,876
Adjusted R^2	0.42	0.26	0.80	0.74	0.33	0.19
SE regression	0.09	0.21	0.05	0.04	0.20	0.14

Estimates control for household-specific effects using a linear fixed-effects estimator. Additional controls include age, age squared, age cubed, family size, and year fixed effects. Expected income growth is measured as ex post realized income growth between the current and subsequent period. Robust standard errors clustered at the household level are in parentheses. Significant at ***1%, **5%, and *10%.

households with low EYG and low LWY exhibit a positive response to changes in their housing wealth compared with no response for low-EYG and high-LWY households.

There is less evidence that EYG matters for how household consumption responds to changing housing equity if the sample is split between households with above-median EYG and households with below-median EYG (not shown). Rather than suggesting that the results are not robust, this finding demonstrates that only households with very high EYG are the ones that wish to borrow to reallocate their resources over time. Indeed, households are likely more inclined to try to smooth large positive swings in their income through borrowing rather than small fluctuations. Greater EYG may also represent a more permanent change in households' income, whereas lower EYG may be driven by households' transitory earnings changes.

Overall, the results show that changes in housing equity affect consumption the most for households that are potentially borrowing constrained. This finding supports the role of housing wealth as borrowing collateral and informs the ongoing debate about why housing wealth fluctuations matter for household spending. Robert Shiller argued recently that housing wealth affects consumption through "animal spirits" (Coy, 2011).[25] The borrowing collateral channel identified in this paper provides a more tangible reason for why fluctuating house prices may affect households' spending.

D. *Discussion*

The online appendix includes a number of tables with estimates of equation (1) using alternative measures of consumption. The alternative spending measures include one proposed by Blundell et al. (2006) to impute consumption in the PSID based on spending relationships observed in the Consumer Expenditure Survey. In general, the results show that the impact of housing wealth on consumption is smaller using the alternative measures of consumption than in the baseline estimates, although the estimated effects are stronger from 2001 onward when household credit was easy to obtain. There is also somewhat less evidence to support housing wealth affecting consumption through the borrowing collateral channel.

[25] "Animal sprits" refers to households spending out of their housing wealth due to overall optimism or because others around them are spending their household wealth.

The main drawback to these alternative results is that none of the consumption measures is as comprehensive or appropriate for this paper's analysis as the NHE measure used in the baseline estimates. It is therefore not surprising that the results are somewhat smaller or different. The remainder of this section discusses other issues regarding the identification and external validity of the baseline results.

The main results in this paper are identified off within-household variation in housing equity. The fixed-effects estimation approach, along with controlling for households' expected future income, addresses concerns that the estimated impact of housing wealth on consumption is picking up differences in households' permanent income or expectations about future economic conditions. In addition, the controls for local economic conditions in table 4 provide evidence against the claim that local geographic factors are driving the observed relationship between consumption and housing wealth.

The fixed-effects estimation technique and additional control variables, however, do not guarantee that the baseline estimates identify the exogenous effect of housing equity on household spending. Indeed, there could be additional unobserved factors that lead to higher housing wealth and consumption. The fact that the paper finds an effect of housing wealth on consumption across different household groups, however, argues against additional unobserved factors driving the results. Any endogeneity between housing wealth and consumption should apply to all households unless better future economic conditions or some other unobserved factor(s) are correlated only with households that have a positive MPC out of housing wealth.

The fact that the baseline results show a positive relationship between consumption and housing wealth based on different approaches for identifying constrained households argues against the endogeneity applying to certain households but not others. In addition, the summary statistics in table 2 do not show any substantial observable differences between constrained and unconstrained households. Endogeneity would be more of a concern if, for instance, all households with low LWY lived in areas with much better economic conditions than high-LWY households.

In terms of external validity, the estimated MPCs out of housing wealth across all households of \$0.02 to \$0.06, depending on the specification, are in line with previous estimates in the literature, such as Juster et al. (2006), Lehnert (2004), and Bostic et al. (2009). The magnitude of the overall results is also comparable to previous estimates using aggregate data (see Lasky, 2007). Bostic et al. (2009) and Lehnert (2004) also show some evidence that changes in housing equity have a greater impact on the consumption of credit-constrained households. Unlike previous studies, this paper does not find that housing wealth has a greater impact on consumption than financial wealth. Instead, the estimated effects are roughly the same across all households. The results across household groups, however, at least tell a consistent story with regard to consumption and wealth. Unconstrained households respond to changes in their financial assets that represent an unambiguous wealth gain. Constrained households respond to both the unambiguous financial wealth gain and housing appreciation that increases their borrowing collateral.

In addition, it is difficult to go too far in terms of comparing the results in this paper to the previous literature because the vast majority of existing papers do not control for household-specific effects when evaluating the relationship between wealth and consumption. Households that are inherently savers may have very different responses to changes in the value of their wealth than households that inherently spend a lot. Controlling for such household-specific effects helps identify the actual impact of wealth fluctuations on household spending.[26]

V. Conclusion

There have been two major housing market cycles in the past few decades in the United States: the coastal house price run-up and subsequent drop in the late 1980s and early 1990s and the strong boom and bust during the 2000s that was particularly severe in the so-called sand states. A key question, especially for policymakers, is how aggregate economic activity, and in particular household spending, responds to fluctuating house prices.

This paper examines the relationship between house prices and household expenditures using household-level data from the PSID. An advantage of household-level analysis is that one can control for unobserved factors such as a household's permanent income that could affect the observed relationship between housing wealth and household expenditures. Household-level data also allow one to consider the potential channels through which housing wealth affects spending by looking at how consumption responds to changes in housing wealth across heterogenous groups of households.

The paper employs a broad, imputed measure of households' NHE in the PSID and finds that a \$1.00 increase in housing wealth leads to a \$0.02 to \$0.06 rise in nonhousing expenditures across all households. Further analysis shows that this effect is concentrated among households that are potentially borrowing constrained. The spending of unconstrained households exhibits little, if any, response to changing housing wealth, whereas the consumption response for potentially constrained households is particularly strong.

[26] An additional concern is that the results may be affected by heteroskedasticity, and the variance/covariance matrix of the estimates may vary by household type. Indeed, I cannot reject the null of no heteroskedasticity in the variance/covariance matrix of the baseline estimates using a Breusch-Pagan or other similar tests. The standard errors of the estimates are clustered at the household level, however, to account for this heteroskedasticity. Sometimes the presence of heteroskedasticity is due to model misspecification. The empirical specification in this paper, though, is based on a standard approach in the literature for estimating housing wealth effects, and there are no obvious economic reasons that it is misspecified. It is worth noting that regressing consumption on income in the PSID, as suggested by the PIH, also results in a heteroskedastic error structure.

The results support the idea that housing equity affects consumption through its role as borrowing collateral, and there is little evidence that house prices have a pure wealth effect on consumption.

These results raise interesting issues for thinking about how to analyze and forecast the impact of changing house prices on aggregate consumption. To the extent that the borrowing collateral channel explains household behavior with respect to fluctuating house prices, as the main results in the paper suggest, then the effect of rising house prices on aggregate consumption will depend on the demand for home equity borrowing during periods of rising prices. Similarly, the impact of falling prices will depend on how many households were borrowing against their homes to finance spending but can no longer borrow or the number of households that were planning to borrow but cannot due to the decline in their housing equity. These house price effects may very well be asymmetric, and simply assuming that $1.00 of extra housing wealth raises consumption by $0.03 or more for all households, as is the case in many macroeconomic models, could result in inaccurate consumption forecasts. Overall, the results in this paper suggest that one should think carefully about what assumptions to make when when analyzing or predicting the impact of housing wealth fluctuations on household consumption.

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