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Economic Policy Analysis

Do house prices matter for household consumption?

Real house prices in the Netherlands peaked in 2008 and have since then fallen by about 27% until the end of 2013. Aggregate household consumption dropped by 7% during 2008-2013. To what extent have large declines in house prices driven household consumption after the crisis? What are the underlying channels at work? These are the key questions of this paper.

On the macro level the drop in consumption of households who have negative home equity has the biggest impact on macro consumption, because their number sharply increased during the crisis. Precautionary savings motives appear to contribute most to the decline.

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Do house prices matter for household consumption? Evidence from Dutch administrative data[☆]

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Abstract

To what extent do large drops in house prices drive household consumption? Using a large panel of Dutch households over the period 2007 to 2014, when house price dropped 27%, we find a significantly positive relationship between house prices and household (durable) consumption. A 10% change in home values leads to a 0.7% change in household consumption for homeowners, but a negligible response for renters. Young and middle-aged homeowners have larger consumption sensitivities to house prices than old households. Delving into the underlying channels, a pure wealth effect can explain part of the consumption sensitivity to house prices. Furthermore, we find strong evidence that house prices affect consumption through the borrowing collateral (and precautionary saving) channel.

Keywords: consumption, house price declines, automobile purchases, wealth effect, borrowing constraints

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1. Introduction

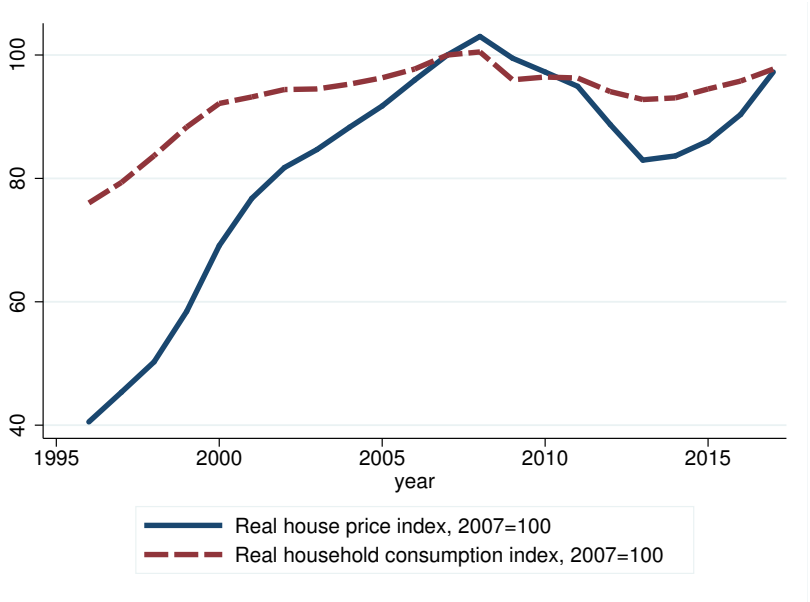
Housing wealth is the most important element of household wealth around the world. Large swings in house prices pose great risk to household welfare (Mian et al., 2013). The recent housing booms and subsequent busts during the 2007/8 global financial crisis have raised increasing concerns among academics and policy makers about the real consequences of housing price movements. The plunge in house prices is frequently cited as a main driver of the sharp decline in consumption and sluggish recovery in the aftermath of the crisis.

As in many other countries, the crisis had severe repercussions for the real economy in the Netherlands.[1] Real house prices in the country peaked in 2008 and have since then fallen by about 27% until the end of 2013. The level of real household consumption moved closely with the level of house prices as shown in Figure 1. Aggregate household consumption dropped by 7% during 2008-2013. Up until the end of 2016, Dutch households still consumed less on average than they did in 2008. To what extent have large declines in house prices driven household consumption after the crisis? What are the underlying channels at work? These are the key questions of this paper.

Despite its importance, the role of house prices in affecting household consumption is not fully understood. While there is strong evidence of a positive relationship between housing prices and consumption in the macro literature (Case and Shiller, 2005, 2013), identifying causality from the comovements in the aggregate data remains challenging, and disentangling the underlying mechanisms has proven to be difficult. The purpose of this paper is to examine the relationship between house prices and household consumption using unique administrative data on a large ran-

[1] For example, Veldhuizen et al. (2018) show that Dutch households falling into negative equity due to unanticipated declining house prices are 18% less likely to move compared with households maintaining positive home equity. Meekes and Hassink (2019) examine the interaction between housing markets and labour markets. They show that displaced Dutch workers experience, in addition to substantial losses in employment and wage, an increase in the commuting distance and a decrease in the probability of moving home.

Figure 1: The development of house prices and consumption in the Netherlands



domly selected panel of 191,091 Dutch households over the period 2007-2014. We provide new empirical evidence both on the effect of house prices on household consumption and on the underlying channels driving this effect.

The richness of this dataset allows us to address some important empirical challenges to identification and contribute to the existing literature in several ways. First, we track *individual* house prices over time by using the property values (the so-called WOZ value in Dutch) that are adopted by the local municipalities to calculate property tax. The WOZ-values are reassessed every year based on the sales prices of nearly comparable properties. Compared with the existing literature that uses house prices across broadly defined geographical areas (e.g. regions), using house prices at the household level provides a more accurate assessment of the heterogenous effect of house prices. To the best of our knowledge, very few countries have such information on housing prices at the household level. Second, we track households over time. The panel structure allows us to exploit time-series variation within individual households for identification (through household fixed effects) and ensures that the estimation does not simply pick up household unobserved characteristics. Third, the

data contain rich household characteristics. For example, the different consumption responses to house prices between homeowners and renters helps rule out the possibility that the positive correlation between house prices and consumption is largely driven by common factors. Iacoviello and Neri (2010) show that the bulk of the positive correlation captures common factors that move house prices and consumption in the same direction, such as shifts in preferences, interest rates, or technology. The different sensitivities between *constrained* and *unconstrained* households further unravels channels through which housing prices affect household consumption. Lastly, we use two measures for household consumption, namely an imputed measure and automobile purchases. The latter not only provides a validation of the imputed measure, which critically depends on the underlying quality and wealth data, but also offers an alternative way of examining (durable) consumption.

We present two sets of results. First, we find a significantly positive correlation between house prices and consumption. For every 10% change in house prices, consumption responds by 0.4%. This elasticity translates into a marginal propensity to consume out of housing wealth of one cent per euro. The consumption response is much larger for homeowners (0.7%), but close to zero for renters. Further, young and middle-aged homeowners have a significantly larger consumption response than old homeowners. Second, delving into the channels, we find that potentially borrowing-constrained households exhibit significantly larger consumption responses than unconstrained households, suggesting that the collateral or precautionary saving channel is important for the consumption decisions of some households. These results are in line with those of Bijlsma and Mocking (2017), who show that a house price decline induces additional saving, thus *implying* less consumption. In comparison with their paper, my contribution lies in measuring household consumption directly. The use of imputed consumption and automobile purchases opens up revenue for future research on household consumption. To the best of my knowledge, this paper is among the first to use these measures in the Dutch context (except Ji et al., 2019). In addition, Bijlsma and Mocking (2017) did not explicitly distinguish various chan-

nels through which house prices affect consumption, whereas we test and discuss the relative importance of these channels. These results further improve our understanding of the relationship between house prices and household consumption.

2. House prices and consumption

2.1. Theoretical channels

The starting point adopted for examining the impact of house prices on consumption is the permanent income hypothesis (PIH). Under standard assumptions, the optimal consumption level chosen by a household is determined by their expected present value of life-time wealth. This gives rise to a "pure" wealth effect, where optimal consumption responds to changes in housing wealth, all else being equal.

The existence of pure wealth effects is subject to debate. Housing is both a consumption good and an investment good (Henderson and Ioannides, 1983), and all households must consume some level of housing. Increased housing prices do not necessarily increase the real wealth of homeowners, as it may be offset by higher implicit rental costs (Sinai and Souleles, 2005); as Buiter (2008) points out, housing wealth is not wealth. Buiter (2008) argues that when the housing market is in equilibrium, total consumption of housing services must equal the stock of available housing. This implies that the household sector as a whole cannot substitute out of housing to finance additional non-housing consumption, therefore there can be no aggregate wealth effects of house prices on consumption. The changes in house prices merely redistribute wealth from those "long" in housing, who are planning to reduce their consumption of housing in the future (e.g. from homeowners to renters, or owners of a smaller house) to those "short" in housing. The individual housing wealth effect therefore depends on the characteristics of the household (Campbell and Cocco, 2007).

In the absence of pure wealth effects, housing wealth could affect aggregate consumption through its role as borrowing collateral. In this view, the appreciation of house prices leads to the increased collateral value of housing, and its associated

relaxation of borrowing constraints. This feature generates a positive consumption response to an increase in house prices in two (related) ways: 1) allow borrowing-constrained households to extract more home equity for current consumption through, for example, home equity withdraw, and 2) reduce the need for precautionary saving due to a homeowner's increased ability to refinance in the future if they experience negative income shocks (Gan, 2010). Cooper (2013) uses several alternative approaches to show that borrowing constraints strengthen the relationship between consumption and housing wealth in U.S. household-level data during the housing boom before the global financial crisis. 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. Following the same rationale, a fall in house prices results in a decline in consumption particularly for borrowing-constrained households because they experience a loss in wealth and because the decline in housing equity limits their capacity to use housing equity as collateral to smooth consumption. The strong reaction of this group is also consistent with the precautionary saving argument. A decline in house prices will cause a substantial drop in their already small or negative precautionary wealth. This will force them to cut back consumption in order to rebuild their precautionary wealth. It is important to note that we are unable to distinguish which of these two theories drive the results. Carroll et al. (2011) suggest that the precautionary saving motive can generate behaviour that is virtually indistinguishable from that generated by borrowing constraints as the precautionary saving motive induces self-imposed reluctance to borrow (or to borrow too much). Distinguishing these two mechanisms remains an avenue for future research.

2.2. Empirics

There are two types of empirical literature that investigate the relationship between house prices and consumption. The literature using aggregate macro data has generally found strong positive relationships between house prices and consump-

tion. While methodological and data differences have led to a wide range of estimates, the reported elasticities of consumption to house prices range between 0.1 and 0.2 (Berger et al., 2018). A well-known study by Case and Shiller (2005) demonstrates a statistically significant and rather large effect of housing wealth upon household consumption both the international panel and a panel of U.S. states. An updated version of their paper (Case and Shiller, 2013) reports the elasticities of consumption to housing wealth that range from 0.03 to 0.18, with a central estimate of 0.08.[2] However, it is often not possible to test which channels outlined above drive these results. Causal identification is particularly difficult in this area, because house price variation is endogenous and compelling quasi-experiments are rare.

This paper relates to a handful of studies that use household-level micro data to examine how households respond to changes in housing wealth. These studies have made important steps in identifying movements in housing wealth that are orthogonal to other factors that might also affect consumption and in understanding the heterogenous behaviours among households. Campbell and Cocco (2007) study micro data from the UK Family Expenditure Survey from 1988-2000. They use repeated cross-sections of household expenditure data and regional house price information to estimate a small, positive consumption response to home prices for young homeowners, and a large positive response for old homeowners. This translates into marginal propensities to consume out of housing wealth of 0.06 for young homeowners, and 0.11 for old homeowners. On the contrary, Attanasio et al. (2009), using similar data, document an average consumption elasticity of 0.15, but they find that the response is much stronger for young homeowners (0.21) than that for old homeowners (0.04). Several recent papers use heterogeneity in local housing supply to explore the link between home equity, debt, and spending. For exam-

[2]Carroll et al. (2011) propose a time-series based method that exploits the sluggishness of consumption growth to distinguish between immediate and eventual wealth effects. Using the U.S. data, they estimate that the immediate (next-quarter) marginal propensity to consume from a $1 change in housing wealth is about 2 cents, with an eventual effect of around 9 cents, substantially larger than the effect of shocks to financial wealth.

ple, Mian and Sufi (2011) make use of the considerable differences across US urban areas in the degree to which topographical factors are a constraint to on housing construction. They show that households extracted as much as $0.25 per dollar of home equity growth during the mid-2000s. In the Dutch context, Bijlsma and Mocking (2017) observe a significantly negative impact of house price shocks on savings, indicating a house price decline induces additional saving, thus implying less consumption. Their estimates suggest that house price decline explains between 5-13% of the aggregate consumption decline during the recent crisis in the Netherlands. Ji et al. (2019) show that the average consumption of households with high debt has decreased much more strongly during the crisis than that of other households. Overall, the consumption sensitivity appears to vary across countries (and over time), which makes it hard to compare (Gan, 2010). It often depends on the institutional context of housing markets and financial markets (e.g. easiness to extract housing equity).

3. Estimation strategy

3.1. Baseline specification

We examine how the development of house prices, income, and other household characteristics explain the variation in household consumption. The baseline model specification is as followed:

$$C_{it} = \alpha + \beta HP_{it} + \kappa INC_{it} + \gamma CTRL_{it} + \theta_t + \mu_W e + \sigma_{jt} + \epsilon_{it}, \;\; i = 1, ..., N; t = 1, ..., T. \tag{1}$$

where C_{it} is consumption of household i in year t (in logs); HP_{it} is the property value (in logs); INC_{it} is household after-tax income (in logs); $CTRL_{it}$ is a matrix of control variables, including the level of liquid wealth, other financial wealth, leverage, loan-to-value ratio (LTV) and key household characteristics (age, household size, the number of wage earners, marital status, and whether households have children).

Equation (1) includes year-fixed effects θ_t to account for any potential macroeconomic trends that may have an impact on household consumption behaviour, and μ_i captures unobserved household-specific fixed effects. The development of house prices could well be correlated with other economic indicators at the regional level. To alleviate the concern of omitted variables, such as GDP and unemployment, time-varying fixed effects σ_{jt} at the provincial level are included to control for factors that drive house prices and consumption in the same direction. Lastly, ϵ_{it} is a white noise error term.

3.2. Testing channels

To test for the relative strength of a "pure" wealth channel vs. a borrowing collateral channel, We divide the sample into potentially borrowing-constrained households and borrowing-unconstrained households and reestimate equation 1 (Cooper, 2013). If the borrowing collateral channel explains the relationship between housing prices and consumption, We expect the consumption sensitivity of housing prices is larger for constrained households than for unconstrained ones.

We rely on the subsample estimates to test the channels. This approach allows all of the parameters to be estimated in each subsample separately. An alternative approach would be to interact housing prices with dummy variables for whether a household has more than one house, or whether a household is borrowing constrained. The alternative approach is less appealing, however, because two groups of households are likely to respond differently not only to changes in house prices, but also to changes in income and other circumstances. Given the large sample size, We prefer to split the sample rather than use interaction terms for the analysis. Note that splitting the sample is equivalent to interacting all the explanatory variables with the dummy variables.

4. Data and measures

4.1. Data

The data used in this paper are based on several Dutch public administrative registers for a random sample of 10% of the Dutch residential addresses. We then track households that lived at these addresses during the period 2007-2014. The choice of the sample period is limited by the availability of wealth data, which is crucial for computing household consumption. The collection of wealth data starts in 2006. The change in reporting format of wealth data makes it difficult to extend the sample period beyond 2014. After cleaning, the final sample consists of 191,091 households.[3] The data are anonymised and made available to researchers by Statistics Netherlands (CBS). My main source of data is the house register, which contains information on the type of usage (owner-occupied or rented) and the property value. Information on income, assets, and liabilities are obtained from the personal income register, which is on basis of the data originating from tax returns. Information regarding personal characteristics (e.g., age, area of residence, and family relations) are taken from the population register. Furthermore, we retrieve individual-level information on car ownership, which includes data on the number of cars each person owns as well as the year in which a car was first registered with the tax authorities. Using information on family relations, we aggregate all individual data to the household level. A household is defined as either one adult or two adults living together, plus any number of children.

4.2. Measuring household consumption

Register-based data on consumption are unfortunately not available at the household level. Existing data on household consumption are collected from surveys. Households are asked how much they spend in a given time period for specific categories. While survey-based data can provide easily accessible and detailed informa-

[3]We follow closely the sample selection procedure used by Bijlsma and Mocking (2017).

tion on household expenditures, they are often subject to serious biases due to, for example, small sample sizes, reporting errors, and selection problems. Kolsrud et al. (2017) show that the discrepancies between register- and survey-based consumption measures that increase with income and wealth. While the mean and median of the consumption distribution are similar, the survey understates the consumption of wealthy and high- income households, while slightly overstating consumption of the poorest quintile of households.

Owing to these issues, a handful of studies put forward an alternative approach to impute household consumption using administrative income and wealth information (Browning and Weber, 2003). This approach is based on a simple accounting identity in which total expenditure in a period is linked to income and the change in wealth across the period, as follows:[4]

$$C_{it} = INC_{it} - \Delta W_{it} \tag{2}$$

where C_{it} is consumption of household i at year t, INC is income, and W is wealth. C_{it} is deflated using CPI to the price level in 2015.

The main issue with this approach is that the change in the value of a household's holding of a particular asset (or liability) does not necessarily reflect a change in the physical stock of that asset, i.e. net purchases. Changes in the asset's price, i.e. capital gains or losses, are also included, and it is generally not possible to separate the two sources of variation. This means that the imputed measure of consumption may contain measurement errors.

[4]The quality of the imputation is investigated by Browning and Weber (2003) using data drawn from the Danish Family Expenditure Survey (DES) for the years 1994-1996. The DES gives diary- and interview-based information on expenditure on all goods and services, which can then be aggregated to give total expenditure in a sub-period within the calendar year for each household in the survey. The households in the DES can be linked to their administrative income/wealth tax records for the years around the survey year, making it possible to check directly the reliability of the imputation against the self-reported total expenditure measure at the household level. Browning and Weber (2003) find that the imputation provides a measure that performs quite well in terms of matching individual households' self-reported total expenditure.

We address these measurement problems in the following ways. For stock and bond holders, we obtain national account data from the CBS on the change in portfolio values induced by price changes (not by financial transactions) and add it back into imputed consumption. This procedure is much more accurate compared with using general stock market index to proxy returns in other studies, a method that underestimates the amount of financial transactions and potentially introduces more biases in the imputation. Additionally, we conduct robustness tests where all stock owners are excluded; in this sample, there is clearly no valuation effect of stock prices on measured consumption.

For most home owners, fluctuations in housing prices are undoubtedly the most important source of capital gains or losses. Fortunately, our data allow us to identify those households that moved (changed address in any given year). We removed these households from our sample.[5] For the remaining households in the sample, who do not change their physical stock of housing, any change in the value of their housing wealth must be due to capital gains or losses. We therefore exclude housing wealth when summing up the changes in the values of the households' assets.

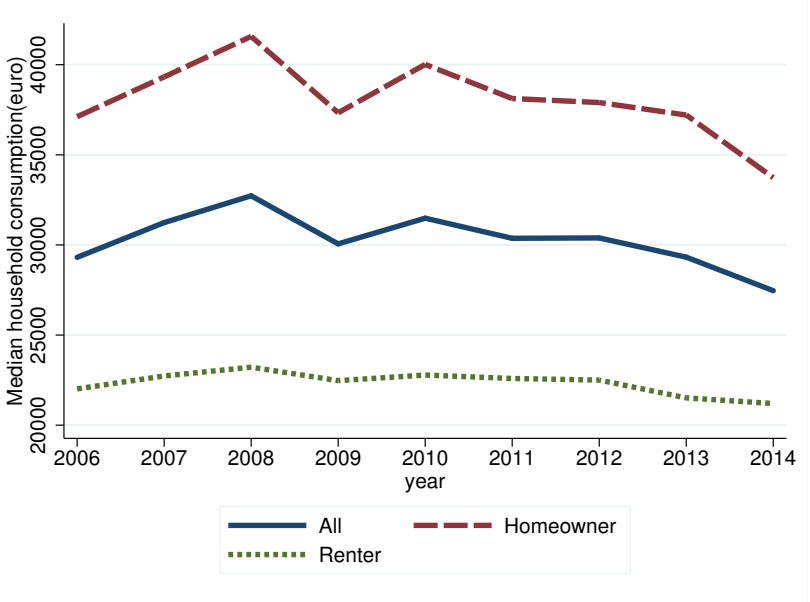
Figure 2 illustrates the development of median yearly household consumption for all households, and for homeowners and renters, respectively. The consumption of an average Dutch household peaked in 2008 and kept declining afterwards. The trend is more pronounced for homeowners than renters, suggesting that consumption of homeowners is more likely to be affected when house prices change.

4.3. Measuring house prices, income, wealth, and other household characteristics

House prices are measured by the property value (so-called WOZ values). The WOZ-values are determined every year by local municipalities and are used for levying property tax. To measure income, we use household disposable income and

[5] We refer to Ji et al. (2019), who examine the consumption patterns of movers. Their method relies on additional assumptions regarding the profits/losses households make during particular transactions. Nevertheless, they show that movers as a whole do not contribute significantly to the macro consumption drop in the Netherlands because the size of this group is rather small.

Figure 2: The development of imputed household yearly consumption



deflate it using CPI to the price level in 2015. In addition, we control for the source of household income, where we define whether households obtain income from wages, entrepreneurial venturing, wealth, allowance, and pension.

We control for the effects of household wealth. The key variables we include are the level of liquid saving, other financial wealth, leverage, and the loan to value ratio (LTV). The level of liquid saving is defined as the sum of bank deposits divided by household income. Other financial wealth includes the ratio of investments in equities, bonds, and other financial assets to household income. Leverage is the ratio of total debts to total assets.

Lastly, we control for a range of household characteristics, including age, household size, the number of wage earners, marital status, and whether households have children.

4.4. Identifying constrained vs. unconstrained households

Following Cooper (2013), the term *borrowing constrained* is defined somewhat loosely in this paper. A constrained household does not mean that he cannot borrow. Instead, the household is "constrained" because it has an increased need or demand

for borrowing. There are no direct measures of households' credit constraints or borrowing needs in my dataset. As a result, indirect proxies are used to identify constrained households.

A standard measure used in the literature to identify constrained households is their liquid wealth holdings relative to their income (Cooper, 2013). Households that face an income shortfall with low levels of cash or near-cash assets relative to their income are likely to have a greater need to borrow to finance their consumption relative to households with sufficient liquid assets. The sample is therefore split between households with below-median liquid wealth-to-income ratio and households with above-median liquid wealth-to-income ratio.

Next, households' leverage, proxied by the debt-to-income (DTI) ratio is also used as an indicator of their borrowing needs. Highly-leveraged households are likely to face tighter credit constraints. Johnson and Li (2010) show that households with high leverage are "significantly more likely" to get turned down for credit. We construct the DTI ratio as the total debt (mortgages plus other debts) divided by income from household wealth information and subsequently split the sample based on the median DTI ratio. Alternatively, we also use the loan-to-value (LTV) ratio as the percentage of mortgage debt to home value. Table 1 reports the summary statistics for the whole sample.

5. Empirical Results

5.1. Main results

Westart the analysis by looking at the effect of house prices, income, other household characteristics on imputed household consumption for a sample 191,091 Dutch households over the period 2007 to 2014.

Table 2 reports the benchmark results. We begin by estimating equation (1) for all households in column (1).[6] We find a positive and significant impact of house price

[6]To minimise the influence of outliers, we dropped households when when their consumption

Table 1: Summary statistics

Variable	Mean	SD	Minimum	Maximum	N
Yearly consumption (euro)	44880	209212	0.08	1210800	1692814
House values (WOZ)	227355	127510	1000	5873000	1719819
Yearly income (euro)	35013	22902	1	1165230	1719819
LTV (%)	27	39.61	0	250	1719819
Liquid wealth to income (%)	1.54	6.39	0	100	1719819
Financial wealth to income (%)	0.54	4.61	0	100	1719819
Leverage, debts/assets (%)	4.25	19.37	0	100	1719819
Family size	1.95	0.99	1	14	1719819
Number of wage earners	0.95	0.99	0	9	1719819
Age head	51	15.76	15	85	1719819
Household status (dummy)					1719819
Single	0.29	0.45	0	1	1719819
Married	0.46	0.49	0	1	1719819
Divorce	0.11	0.31	0	1	1719819
Wedow	0.09	0.29	0	1	1719819
Missing	0.04	0.19	0	1	1719819
Household composition (dummy)					1719819
One person	0.38	0.48	0	1	1719819
Couple	0.37	0.48	0	1	1719819
Couple with chidren	0.18	0.38	0	1	1719819
One parent with children	0.04	0.2	0	1	1719819
Income source (dummy)					1719819
Wage	0.41	0.49	0	1	1719819
Enterpreneur	0.08	0.28	0	1	1719819
Wealth	0.004	0.07	0	1	1719819
Allowance	0.09	0.28	0	1	1719819
Pension	0.4	0.49	0	1	1719819
Other/missing	0.004	0.06	0	1	1719819

on household consumption after controlling for income and other household characteristics, as well as household and year fixed effects. For every 10% change in house prices, consumption responds by 0.4%.[7] As expected, the increase in income boosts household spending. For every 10% change in income, consumption responds by 4.5%.

Table 2: House prices and consumption: homeowners and renters

	(1)	(2)	(3)
	All	Homeowner	Renter
Log of house price	0.041***	0.066***	0.005
	(0.009)	(0.014)	(0.008)
Log of income	0.452***	0.4***	0.57***
	(0.005)	(0.006)	(0.009)
Controls	Yes	Yes	Yes
Household FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Province*Time FE	Yes	Yes	Yes
Obs	1669901	1009135	660766
No. households	190985	118907	79278
R-square	0.342	0.215	0.458

The dependent variable is the log of imputed household consumption. Control variables are omitted for exposition. Clustered standard errors at the household level are in parentheses,*** p<0.01, ** p<0.05, * p<0.1.

Although we have included an extended set of control variables, there is still concern that omitted common factors, such as future income growth, might drive the positive relationship between house prices and consumption (Attanasio et al., 2009). Therefore, we compare homeowners with the control group: renters. The former are expected to cut back consumption more than the latter when house prices decrease (due to the loss of housing wealth and collateral). Columns (2) and (3) report results

levels belong to the top and bottom 1 and 5 percentile, respectively. This has no impacts on the main results. These results are available upon request.

[7]For the ease of exposition, consumption sensitivity is computed as for every 10% change in house prices throughout this paper.

for homeowners and renters, respectively. Consistent with the hypothesis, we find that homeowners on average have a large and significant consumption sensitivity. For every 10% change in house prices, consumption by homeowners responds by 0.7%. This translates into a marginal propensity to consume (MPC) out of housing wealth of roughly 2 cents per euro.[8] On the contrary, renters have insignificant sensitivity close to zero. The differences in consumption sensitivities between homeowners and renters provide evidence that the positive relationship between house prices and consumption is not driven by common factors.

Existing literature provides different estimates regarding the magnitude of the housing wealth effect on consumption, i.e., the MPC. They differ in the sample, measure, and specification used. Recent studies on the estimated magnitude can be broadly categorized into two groups (see Table A.1 in the Appendix). The first group consists of studies that report relatively large MPCs out of housing wealth, above 0.05. For example, Mian et al. (2013) use zip-code-level data on auto sales and county-level data on credit card or debit card purchases handled by MasterCard. They estimate an MPC of 0.05-0.07 out of housing wealth. The second group consists of most studies reporting modest MPCs, somewhere between 0 and 0.03 depending on whether only homeowners or all households including renters are included in the sample. My finding of a MPC out of housing wealth of 0.02 for homeowners is in line with the estimates in Australia and Canada (Atalay et al., 2016), Hong Kong (Gan, 2010), and Italy (Paiella and Pistaferri, 2017). While my MPC estimates seem to be at the lower end, this might be due to the sample period used. While very few studies focus on the period during the crisis, Soss and Mo (2013) provide some indication that the estimated wealth effects for both housing and financial wealth in the United States are smaller when post-financial crisis data are used in the analysis.

[8]To convert my elasticity to a MPC out of housing wealth requires dividing the elasticity of consumption to house prices by the ratio of housing wealth to consumption. The ratio of H/C in 2007, where H is measured as the market value of owner-occupied real estate (1,119 billion euros) and C is measured as total household consumption (287 billion euros) is 3.9. Hence, we obtain a MPC out of housing wealth for homeowners of $0.7/3.9 = 0.018$.

5.2. Channels

Having established the significant positive relationship between house prices and consumption, we further examine whether the pure wealth channel or the borrowing collateral channel drives this relationship by splitting the sample based on potentially constrained versus unconstrained households. Given that renters are less likely to be affected, my analysis in this section focuses on homeowners.

If the pure wealth channel plays a role, we expect the consumption sensitivity of housing prices is significant for unconstrained households. This rules out the effect of the borrowing collateral channel. However, if the borrowing collateral channel dominates, we expect the consumption sensitivity of housing prices is larger for constrained households than for unconstrained ones.

Table 3 reports the results. Columns (1) and (2) report the estimates for households with low (below-median) vs. high (above-median) liquid to wealth ratio. Columns (3) and (4) show the results for homeowners with high (above-median) vs. low (below-median) DTI ratio. The median DTI ratio is 2.23, meaning that the median homeowner has debt twice the amount of their annual income. Columns (5) and (6) further distinguish homeowners with high (above-median) vs. low (below-median) LTV ratio, respectively. The median LTV ratio is 36%.

We find that the consumption sensitivity for homeowners who have high levels of liquid wealth (i.e. unconstrained homeowners) is significant in column (1). However, column (2) shows that constrained homeowners with low levels of liquid wealth have a much larger consumption sensitivity. The estimated coefficients (0.034 vs. 0.138) are significantly different from each other (p-value$<$0.01). Similarly, constrained homeowners with high levels of leverage, captured by the DTI and LTV ratios in columns (4) and (6), react more strongly to house price changes than those with lower levels of the DTI and LTV ratios in columns (3) and (5), respectively. Notably, the income elasticity to consumption is much higher for constrained households than for unconstrained ones.

Although the housing wealth channel plays a role, these findings suggest that the borrowing collateral is likely to be a more important channel through which house price declines affect household consumption. As argued before, we do not observe homeowners that borrow through refinancing their mortgages, my findings are also consistent with the precautionary saving channel.

Table 3: Pure wealth channel vs. borrowing collateral channel

	(1)	(2)	(3)	(4)	(5)	(6)
	High LW	Low LW	Low DTWe	High DTWe	Low LTV	High LTV
Log of house price	0.034*	0.138***	0.041**	0.103***	0.05**	0.132***
	(0.016)	(0.019)	(0.03)	(0.02)	(0.019)	(0.02)
Log of income	0.332***	0.476***	0.389***	0.415***	0.371***	0.43***
	(0.009)	(0.009)	(0.01)	(0.008)	(0.01)	(0.009)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Province*Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs	503336	505799	503804	505331	499071	510064
No. households	59485	59422	60596	58311	60250	58675
R-square	0.17	0.275	0.158	0.246	0.168	0.212

The dependent variable is the log of imputed household consumption. Control variables are omitted for exposition. Clustered standard errors at the household level are in parentheses,*** p<0.01, ** p<0.05, * p<0.1.

Furthermore, we examine the heterogeneity between different age groups. Older homeowners in our sample have larger wealth and lower levels of leverage, and are therefore less likely to be constrained. If the pure wealth effect dominates, we expect a larger response for older homeowners as they have larger housing wealth (both in absolute amount and share of housing wealth in total wealth) in our sample. If the borrowing collateral channel dominates, young and middle-aged homeowners are expected to react more. We divide the sample into young (aged below 40), middle-aged (aged between 40-60), and old (above 60) households, a cutoff that follows

Campbell and Cocco (2007).[9]

The results are shown in Table 4. We find that young and middle-aged homeowners have larger and more significant consumption sensitivity to house prices than old ones.[10] These findings further ascertain that although the pure housing wealth channel plays a role, the dominant driver of the consumption sensitivity to house prices is the borrowing collateral channel.

Table 4: Homeowners by age groups

	(1) Young (<40)	(2) Middle-age (40-60)	(3) Old (>60)
Log of house price	0.099***	0.118***	0.073**
	(0.026)	(0.021)	(0.026)
Log of income	0.412***	0.396***	0.493***
	(0.011)	(0.008)	(0.019)
Controls	Yes	Yes	Yes
Household FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Province*Time FE	Yes	Yes	Yes
Obs	291104	454216	263905
No. households	34218	53485	31204
R-square	0.222	0.185	0.186

The dependent variable is the log of imputed household consumption. Control variables are omitted for exposition. Clustered standard errors at the household level are in parentheses,*** p<0.01, ** p<0.05, * p<0.1.

5.3. Robustness checks

We conduct a series of robustness checks based on equation 1 and demonstrate that my results are insensitive to alternative measures and specifications.

We first check whether the robustness of consumption imputation by excluding stock owners. In this sample there is clearly no valuation effect of stock prices on

[9] As robustness checks, we use different cutoffs at age 35 and 55 instead of 40 and 60. The results are quantitatively similar and are available upon request.

[10] The estimated coefficients for three groups are somewhat larger than those of the whole sample, which could be due to better fit in sub-samples. The results are not that much different if we reestimate the model with interaction terms. Young and middle-aged homeowners react consistently stronger than old-homeowners. These results are available upon request.

measured consumption. The results reported in column (1) in Table 5 are very similar to those reported in Table 2. We further exclude households that own bonds and entrepreneurial assets, and report the estimation results in column (2). Overall my results do not seem to be driven by the treatment of stock and other asset returns in imputing consumption.

One potential concern is the endogenous tenure choice: homeowners and renters are not randomly assigned. The literature has identified several factors that affect owing or renting a house, including income, tax incentive, the correlation between income and housing returns, race, immigration, and family status (Gan, 2010). Since many of these factors are time-invariant, they are controlled to a large extent by the household fixed effects. We nevertheless adopt a propensity score weighting technique. We obtain propensity scores by using household income and wealth at the beginning of the sample to predict the probability of being a homeowner and then run a weighted regression using propensity scores as the weight. The results in column (3) remain remarkably similar to those reported in Table 2, further confirming that endogenous tenure choices do not drive the results.

In addition, to make sure that the measured differences between homeowners and renters are not simply driven by time-varying income differences, We compare the response of house prices for high-income homeowners and renters vs. low-income homeowners and renters based on the median of average household income. The results are shown in columns (4)-(7). While the high-income (low-income) group contains more homeowners (renters), We find that the results are very similar to those reported in 2. The different consumption responses to house prices between homeowners and renters are unlikely to be driven by their income differences.

5.4. Additional analysis: durable consumption

My analysis critically depends on the accuracy of consumption imputation. An alternative way of measuring consumption is through durable purchases, which appear to be reported sufficiently well. We use data on automobile registry over the

Table 5: Robustness checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Consumption measure		PSW	High-income		Low-income	
				Homeowner	Renter	Homeowner	Renter
Log of house price	0.049***	0.045***	0.04**	0.064***	-0.018	0.07***	0.01
	(0.009)	(0.008)	(0.01)	(0.016)	(0.02)	(0.025)	(0.008)
Log of income	0.515***	0.64***	0.456***	0.426***	0.604***	0.354***	0.573***
	(0.007)	(0.007)	(0.005)	(0.007)	(0015)	(0.012)	(0.01)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province*Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs	1128453	1034199	1665833	701419	160657	307549	500071
No. households	128196	117354	190378	82236	20370	36632	58910
R-square	0.412	0.438	0.342	0.12	0.213	0.066	0.318

The dependent variable is the log of imputed household consumption. Control variables are omitted for exposition. Clustered standard errors at the household level are in parentheses,*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

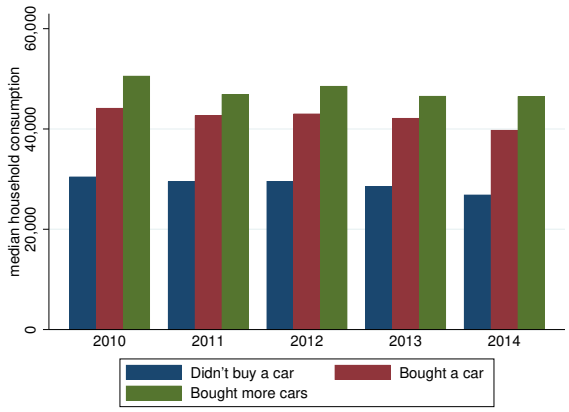
period 2009 to 2014 and construct an indicator on whether a household bought one or more vehicles in a given year. Further, We are able to identify whether an vehicle is a second-hand or a new one based on the year it first enters the registry.

Using data on such purchases, We first provide some quality checks for the imputed consumption measure. Figure (3a) shows that for each year, consumption is higher for households that purchased more vehicles than households that purchased one vehicle, which in turn is higher than those that did not buy an vehicle. Figure (3b) further illustrates that among households that purchased only one vehicle, those that bought a new one consume more than those that bought a second-hand one, which in turn is more than those that did not purchase an vehicle. These findings suggest that automobile purchases are an important component of consumer durables, which are probably the most cyclically sensitive segment of household

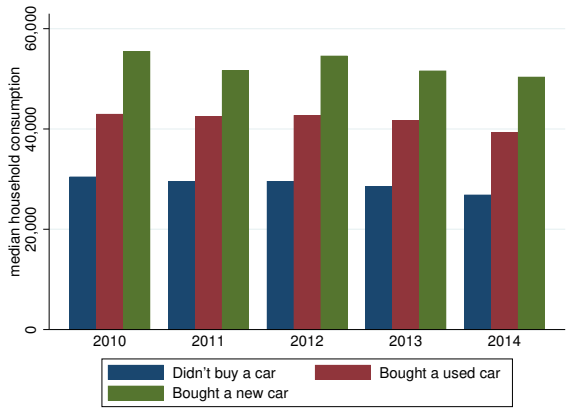
consumption.[11]

Figure 3: Household consumption and automobile purchases

(a) Consumption and the number of auto's



(b) Consumption and new/second-hand automobiles



Next, we explore whether the changes in house prices affect automobile purchases of households in Table 6. Were-estimate equation (1) but use vehicle ownership (i.e. the number of auto's each household owns each year) as the dependent variable. Note that automobile ownership data has a shorter time span from 2010 to 2014. During this period, the percentage of households without automobiles in my sample increases slightly from 22.9% to 24.3%. The percentage of households with one vehicle stay roughly constant at 55%, whereas the percentage of households with more vehicles increases slightly.[12] We find that a positive relationship between house prices and automobile ownership, suggesting that a decrease (increase) in house prices decreases (increases) the possibility of automobile purchases. Consistent again with previous findings, the positive relationship is only found in the sample of homeowners in column (2), albeit only at the 10% significance level,

[11] It is possible that households that purchased auto's consume more than other households in any case. In this case, the differences in consumption does not reflect the value of auto's, but simply different spending patterns. As robustness checks, Were-plot Figure 3 for households that belong to the same income quantile (e.g. 25, 50 or 75 percentile). The patterns shown in Figure 3 remain, albeit the differences become smaller in some cases.

[12] Wedrop the households owning more than six vehicles in the sample.

not renters in column (3). Notably, automobile purchases depend less on household income in comparison with imputed consumption in Table 2.[13]

Table 6: House prices and auto purchases

	(1) All	(2) Homeowner	(3) Renter
Log of house price	0.019**	0.022*	0.008
	(0.008)	(0.012)	(0.009)
Log of income	0.122***	0.128***	0.106***
	(0.003)	(0.004)	(0.005)
Controls	Yes	Yes	Yes
Household FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Province*Time FE	Yes	Yes	Yes
Obs	889839	541032	348807
No. households	190906	118045	75333
R-square	0.236	0.155	0.177

The dependent variable is the number of auto's a household owns. Control variables are omitted for exposition. Clustered standard errors are in parentheses,*** p<0.01, ** p<0.05, * p<0.1.

[13] As an additional robustness check, we control for automobile purchase and re-estimate equation (1). The results (available upon request) remain similar to the main results.

6. Conclusion

The global financial crisis of 2007-8 has reignited a debate on the role of house prices in driving household consumption. Exploring a far more granular source of variation that relies on idiosyncratic rather than regional variation in house prices, this paper documents a significant positive relationship between house prices and household (durable) consumption for a large panel of Dutch households that did not move during 2007-2014. A 10% change in home values led to a 0.7% change in household consumption for homeowners, but a negligible response for renters. Young and middle-aged homeowners have larger consumption sensitivities to house prices than old households. While a pure wealth channel plays a role, we find strong evidence that house prices affect consumption through the borrowing collateral (and precautionary saving) channel.

My findings have important policy implications. To craft truly constructive policy, it is vital that the channels through which housing affects our economy are well understood. While the decline in house prices is often perceived as the main factor holding back household consumption, a simple back-of-the-envelope calculation suggests that it may have contributed up to 1 out of 7 percent decline in aggregate consumption in the Netherlands during the house price downturn from 2008 to 2013. While consumer spending may be sluggish in the near future for other reasons, it is unlikely that recent decline in house prices is a major contributor to this problem.

A clear limitation of the analysis is that we do not consider the mobility of households. Recent decline in house prices has significantly affected household mobility. Veldhuizen et al. (2018) show that Dutch households falling into negative equity due to unanticipated declining house prices are 18% less likely to move compared with households maintaining positive home equity. Movers are excluded from the sample as commonly done in the literature, as the consumption imputation is challenging for this group of households, in particular for those involved in housing transactions. It is unclear how movers respond to a decline in house prices and thereby

contribute to the drop in aggregate consumption. On the one hand, they need to sell their devalued properties and, in some cases, refinance their residual mortgage debt. Therefore, these households have a clear incentive to save more and consume less (Bijlsma and Mocking, 2017). On the other hand, there is a one-off increase in (durable) consumption expenditure associated with moving. Ji et al. (2019) provide some evidence on the consumption patterns of movers by imposing additional assumptions in the data. As movers represent a small percentage of total households, they do not drive the results at the macro level.

A promising direction in which the research can be extended is towards incorporating housing transaction data. With this data, the consumption pattern of movers can be better traced and analysed. This will shed more light on the relationship between house prices, household mobility, and consumption.

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Appendix

Table A.1: Literature Review

	Country	Sample period	Data source	MPC out of housing wealth
Group 1: MPC ¿0.03				
Campbell and Cocco (2007)	UK	1988-2000	Household-level survey	0.07
Cooper (2013)	US	1984-2007	Panel Study of Income Dynamics	0.06 homeowners
Mian et al. (2013)	US	2006-2009	Car sales, Mastercard bills	0.05-0.07
Group I: MPC between 0 to 0.03				
Browning et al. (2013)	Denmark	1988-1996	Danish adminstrative data	0.028
Christelis et al. (2015)	US	2008-2009	Internet Survey of the Health and Retirement Study	0.009
Disney et al. (2010)	UK	1994-2003	British Household Panel survey	max. 0.01
Atalay et al. (2016)	Australia	1975-2004	Household Expenditure Surveys	0.015 homeowner, 0 renter
	Canada	1969-1997	Family Expenditure surveys (FAMEX)	0.032 homeowner, 0 renter
Windsor et al. (2015)	Australia	2002-2010	The Household, Income and Labour Dynamics Survey	0.03 young homeowners, 0 old homeowners
Gan (2010)	Hongkong	2000-2002	Credit card statements	0.02 homeowner
Saxena and P.Wang (2017)	Australia	2001-2010	The Household, Income and Labour Dynamics Survey	0.03
Paiella and Pistaferri (2017)	Italy	2008-2010	Survey of Households Income and Wealth	0.03 homeowner
Bover (2005)	Spain	2002	Spanish household finances	0.02 homeowner