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Are rising house prices really good for your brain? House value and cognitive functioning among older Europeans

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Abstract

This study examines how house prices influence cognitive functioning for individuals aged 50+ in Europe. Using data from the Survey of Health, Ageing and Retirement, we compute the median house price for each region-year, employing individual self-reported house values. We allow housing market fluctuations to have different effects during episodes of price increases and decreases, and we study owners with a mortgage, owners without a mortgage, and tenants separately. House price booms do not systematically improve cognitive outcomes: for outright owners, rising prices have a negative impact on cognitive health. For richer households, this negative effect is driven by respondents with no second home, suggesting that high prices make second home ownership less affordable and reduces household residential mobility. Finally, house price decreases are associated with better cognitive health for mortgaged owners, but this beneficial effect is largely due to the burst of the house price bubble in Spain.

Keywords: House prices; Wealth; Cognitive functioning; Health; Older Europeans; Europe; SHARE.

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1 Introduction

During the Great Recession, the housing market exhibited excessive instability and households experienced sharp house price declines in a number of countries. For instance, house prices markedly decreased in the US during the bursting of the housing bubble starting 2006-2007. In Europe, the UK experienced a big numerical fall in house prices in 2007-2010, and Spain was one of the most affected countries. More generally, volatility is known to be a key feature of the housing market.

A growing literature focuses on the impact of housing wealth variations on individual well-being and health.[1] There are several routes through which house prices may have an influence on health, and the overall effect is theoretically ambiguous for both homeowners and tenants (Sung, 2017). In particular, for homeowners, since housing wealth is generally a major component of household assets, an increase in housing prices goes hand in hand with an increase in lifetime wealth. This may strengthen feelings of economic security, decrease stress, and improve cognitive functioning. Moreover, positive wealth shocks likely lead to an increase in spending: some spending (such as spending in leisure activities or healthy foods) may have a positive impact on health, while other spending (such as spending on risky behaviors) may have detrimental consequences. For both homeowners and tenants, an increase in home values may mean that local conditions (labor opportunities for instance) improve, which should translate into better health. For tenants, higher prices could be equivalent to a decrease in their relative socioeconomic status compared to homeowners, which may have a negative impact on their health. Moreover, in this population group, greater house prices may lead to a tighter budget constraint – this should be the case for tenants who would like to buy their own houses, and this should also be the case if rents move in the same direction as house prices. Consequently, the overall impact of house prices is unclear for both homeowners and tenants.

[1] This literature is related to research on the impact of house prices on economic outcomes: see Mian, Rao, and Sufi (2013) for the impact of the housing collapse on consumption and Mian and Sufi (2014) for the effect of house prices on borrowing and spending, for instance.

The empirical literature on the relationship between house prices and health generally uses data on the UK and the US. In contrast, the impact of prices on health in most European countries remains largely unknown. However, housing values have widely fluctuated in Europe following the burst of the house price bubble in the US. In particular, house prices sharply declined in the Netherlands, Portugal, or Spain in the aftermath of the crisis. In contrast, property prices have almost continuously soared in Sweden or Belgium during the 2000s.

As far as we are aware, articles on the effect of house prices on health do not consider the possibility that the relationship between prices and health may be different during episodes of price booms and busts. However, a substantial literature in social psychology and behavioral economics highlights that individuals do not give equal weights to gains and losses. For instance, in relation to anticipated outcomes, "losses loom larger than gains" (Kahneman and Tversky, 1979). Moreover, actual losses in income have a larger effect on well-being than equivalent income gains (Boyce et al., 2013). For this reason, house price increases and decreases may not affect health in the same way.

Previous research on the impact of house prices on health focuses on self-assessed health, mental health, and physical conditions. Empirical findings indicate that an increase in home equity has a positive impact on these health outcomes (Fichera and Gathergood, 2016; Ratcliffe, 2013), or that price decreases are associated with poorer health (Lin et al., 2013; Yilmazer, Babiarz, and Liu, 2015). Evidence on the effect of house prices on cognitive health is scarce. However, in the context of aging populations, memory loss and dementia in late life have become major public health concerns (Bonsang, Adam, and Perelman, 2012; Celidoni, Dal Bianco, and Weber, 2017; Mazzonna and Peracchi, 2012, 2017; Rapp, Apouey, and Senik, 2018; Rohwedder and Willis, 2010). Consequently, exploring the association between house prices and cognition seems important from a policy perspective. As far as we are aware, the article by Hamoudi and Dowd (2014) is the only study that examines this effect. Using information on the house price boom in the US between the mid-1990 and the mid-2000s, the authors find that price increases

are associated with increases in some cognitive tasks for homeowners, but not for renters.

The literature on the link between house prices and health is closely related to the large body of research on the so-called health gradient (Marmot and Bobak, 2000). This literature shows that richer individuals are in better health and live longer than poorer people. To make causal statements regarding the effect of economic conditions on health, studies use bequests, lottery winnings, and stock market fluctuations as exogenous sources of wealth variations (Apouey and Clark, 2015; Kim and Ruhm, 2012; Lindahl, 2005; Schwandt, 2014; Van Kippersluis and Galama, 2014). An advantage of exploiting wealth variations generated by housing market fluctuations, rather than by other shocks, is that home value accounts for a large share of households assets. Consequently, house price fluctuations should have a greater effect on health than other types of wealth variations (Fichera and Gathergood, 2016).

In this article, we contribute to the literature on the link between house prices and health by examining the impact of price variations across Europe between 2004 and 2015. We focus on a series of cognitive ability outcomes, while the previous literature generally pays attention to general, mental, and physical health and lifestyles. Importantly, we systematically divide our sample into episodes of price increases and decreases and estimate different models for these two types of price evolutions. We also estimate our models for tenants and owners separately, and for the latter, we distinguish between owners with a mortgage and owners with no mortgage. Compared with the previous literature, this approach allows us to highlight heterogeneous effects and different mechanisms during booms and busts depending on tenure status.

Our data come from waves 1 (2004) to 6 (2015) of the Survey of Health, Ageing and Retirement (SHARE) and cover 17 countries. The survey focuses on individuals aged 50+. The data contain measures of cognitive functioning for numeracy, orientation in time, and immediate and delayed recall. In each household, the financial respondent is asked to assess the market value of his own property, which provides us with a self-reported house price. This price thus captures perceived housing wealth. Importantly, in

terms of wealth effects, perceived house value matters more than objective house price. In our sample, individuals whose cognitive skills are deteriorating may be more likely to over- (or under-) estimate the value of their property. To address this reverse causality issue, we use the median reported price in the area at the time of the interview as our main explanatory variable. This area-level variable is arguably less endogenous than individual reported price.

Our approach takes into account potential confounding factors that may have an impact on both prices and health. Specifically, we first take advantage of the longitudinal nature of the data and employ individual fixed effects in our models to adjust for time-invariant individual characteristics. In addition, our regressions are adjusted for a number of control variables, including the regional unemployment rate to capture local economic conditions. Our paper also discusses attrition and selection issues, due to residential relocation and mortality, that may bias our estimates. Finally, although our study focuses on cognitive functioning, we present some results for mental health.

To preview the results, separate models for price booms and busts show that the effect of prices on cognition is highly asymmetric. First, price increases have beneficial effects on cognitive health for mortgaged owners, consistent with previous findings in the literature. However, we show a detrimental effect of house price increases on cognitive measures for owners without a mortgage. This negative effect is stronger for richer individuals in each country. Moreover, in this richer group, only individuals who do not own a second home are negatively affected by rising prices. Unexpectedly, house price declines are beneficial to cognitive health for owners with a mortgage. However, this result is driven by the specific Spanish situation where the sharp decline in house prices was due to the burst of a bubble.

The rest of the paper is organized as follows. The following section summarizes the previous literature. Section 3 describes the data used in the paper and presents the descriptive statistics. Section 4 contains the empirical model and discusses endogeneity and selection issues. The main results are presented in Section 5, while Section 6 focuses

on the mechanisms. Last, Section 7 concludes.

2 Background

2.1 Cognitive functioning

A substantial literature tries to identify the determinants of cognitive functioning. Findings indicate that economic hardship is negatively associated with functioning. For instance, using data on a relatively young cohort of adults from the Coronary Artery Risk Development in Young Adult study, Zeki Al Hazzouri et al. (2017) find a negative association of sustained poverty and verbal memory, processing speed, and executive function. Employing data on the US and India, Mani et al. (2013) present two studies that highlight that lacking money impedes cognitive performance (captured by spatial and reasoning tasks) and suggest that poverty-related concerns consume mental resources, which leaves less resources for cognitive tasks. Using macro-level data, Kanazawa (2006) shows that national IQs (as measured from the SAT data) correlate with macroeconomic performance of the nations.

A strand of the literature investigates the determinants of cognitive functioning among the elderly in Europe and the US. Crystallized intelligence is found to be stable with age, although some studies suggest that it increases with age. In contrast, age is negatively associated with fluid intelligence. In addition, retirement has a negative effect on cognition (Rohwedder and Willis, 2010; Bonsang, Adam, and Perelman, 2012; Mazzonna and Peracchi, 2012, 2017). Finally, cognitive functioning is associated with health status and lifestyles (Jones and Parsons, 1971; Hurstak et al., 2017). For instance, chronic stress has a negative impact on cognition (Marin et al., 2011).

2.2 Impact of houses prices on health

Our article directly relates to the literature on the impact of house prices on health. This literature has mainly focused on the US and the UK. Of particular interest to us is the article of Hamoudi and Dowd (2014), who explore the effect of the increase in house prices in the US between the mid-1990s and the mid-2000s on cognitive and mental health. Cognition is measured using working memory and knowledge outcomes. Findings show that for homeowners, the correlation between price changes and cognitive functioning is always positive. However, this correlation is only significant for two outcomes – long-term memory and numeracy. For renters, effects are never significant. Moreover, house prices are negatively correlated with anxiety for female homeowners. Because the beneficial effect are observed for homeowners but not renters, the authors conclude that the wealth effect is more important than the local condition effect. The impact on life satisfaction is positive but not statistically significant. Compared with this article, we use European data, distinguish episodes of price increases and decreases, analyze owners with a mortgage and outright owners separately, and focus on a different set of cognitive functioning outcomes.

Except from Hamoudi and Dowd (2014), recent research on the impact of house prices on health has not considered cognitive functioning, and has focused on self-assessed health, mental health, and physical health, with the broad finding that higher prices are beneficial to health, or that smaller prices have a detrimental effect. To identify the effect of prices, most studies take advantage of the drop in housing prices during the Great Recession.

A first series of articles focus on the US. Lin et al. (2013) use data on individuals aged 55-64 and find that the decline in housing prices went hand in hand with an increase in the prescription of antidepressants between 2006 and 2009, using county-level data. Moreover, Yilmazer, Babiarz, and Liu (2015) employ data from the Panel Study of Income Dynamics (PSID) between 2007 and 2011, and focus on psychological distress,

depression, self-reported health status, and clinically-diagnosed onsets of high blood pressure. They show that a decline in home equity has a detrimental effect on mental health and self-assessed health. The effect is significant but quantitatively small. In contrast, experiencing difficulties with mortgage and the start of a foreclosure have a large negative effect on mental health. In addition, Golberstein, Gonzales, and Meara (2016) study the impact of economic conditions on mental health for a sample of children aged 4-17 in the US. Findings highlight the negative impact of the housing crisis on mental health. Using individual data from the 2002-2012 Behavioral Risk Factor Surveillance System (BRFSS) combined with home ownership data from the March Current Population Survey (CPS) and Metropolitan Statistical Area (MSA) housing prices from Freddie Mac, Sung (2017) investigates the short- and long-run effects of housing prices on health, lifestyles, and access to health care, for individuals of all ages. Findings indicate positive contemporaneous effects on health for homeowners, but negative effects for tenants. Moreover, prices increase risky behaviors for tenants.

For the UK, Ratcliffe (2013) uses individual data from the British Household Panel Survey (BHPS) between 1991 and 2007 matched with average house prices by postcode areas. She finds a positive correlation between house prices and mental well-being (as measured by the General Health Questionnaire (GHQ)) for both homeowners and renters. She argues that this impact is due to amenities and economic opportunities in the area. Moreover, Fichera and Gathergood (2016) focus on the impact of price booms and busts on self-assessed health, psychological health (depression and GHQ), and chronic conditions, for home owning households in the UK. They use micro data from the 1993-2008 BHPS, in which house values are self-reported. Results show that house prices have a significant impact on health conditions and self-assessed health but no effect on depression and GHQ, both in the short and long runs. Additional findings highlight that house prices are negatively correlated with hours of work, suggesting that leisure could be one of the mechanisms behind the positive effect of prices on health.[2]

[2]On a related matter, Gathergood (2012) is interested in the impact of over-indebtedness on psychological health. He uses local-level house prices as exogenous shocks affecting the severity of arrears on

The literature on countries other than the UK and the US is more limited. Atalay, Edwards, and Liu (2017) focus on the impact of house prices on mental and physical health in Australia, using the Household, Income and Labour Dynamics in Australia (HILDA) survey for the 2001-2015 period. The impact of house prices is different for owners and tenants: while house prices have a positive impact on physical health for outright owners, they are associated with a degradation of both mental and physical health for renters.

In a nutshell, existing evidence on the effect of housing prices on health has mainly focused on the US and the UK so far. Moreover, some of the studies presented above employ cross-sectional data (like the BRFSS) and cannot take individual unobserved characteristics into account. Most existing research either uses data on periods of monotonic evolutions of house prices (Lin et al., 2013; Yilmazer, Babiarz, and Liu, 2015; Ratcliffe, 2013) or pools episodes of house price increases and decreases (Fichera and Gathergood, 2016).[3] Finally, the impact of prices on cognitive health has been little studied so far. In contrast, in this paper, we use longitudinal data on 17 European countries and allow episodes of price increases and decreases to have different effects on health. Our article also intends to complement the literature by focusing on cognitive health outcomes.

3 Data and summary statistics

3.1 The SHARE data

The data come from the SHARE, waves 1 (2004-2006), 2 (2006-2007), 4 (2010-2012), 5 (2013), and 6 (2015).[4] The goal of the survey is to monitor the health of individuals ages

housing payments. He shows that financially-distressed homeowners suffer less decrease in mental health in localities where prices are growing than in localities where prices are decreasing.

[3]More precisely, Fichera and Gathergood (2016) provide robustness checks where they regress their health indicators on two different variables for house price booms and busts and find no significant effects of price decreases. However, prices started to decline at the very end of their period of interest (1993-2008).

[4]We do not use wave 3, i.e. SHARELIFE, because this wave only contains retrospective information on life histories. For a detailed presentation of the data, see the SHARE project website: http://www.share-project.org/.

50 and older in the European Union and Israel. The data are nationally representative and the survey is longitudinal. We focus on the countries which are present in at least two waves, namely Austria, Belgium, Czechia, Denmark, Estonia, France, Germany, Greece, Israel, Italy, the Netherlands, Poland, Portugal, Slovenia, Spain, Sweden, and Switzerland.

3.2 Cognitive functioning

The SHARE data is unique in providing information about cognitive functioning, which is derived from simple tests administered to all respondents. These tests capture four different aspects of cognition: numeracy, orientation in time, and immediate and delayed recall.[5]

First, *numeracy* is measured by a task in which individuals are asked to subtract seven from 100, and then go on subtracting four times. This test is administered in waves 4 to 6. The SHARE team derives from the test a numeracy score for mathematical performance. This variable ranges from 1 to 5.

Memory is tested by asking respondents four questions about the interview date (day of the week, day, month, and year). This test, which is administered in all waves, captures *orientation in time*. The score ranges from 0 to 4, and a very large share of the sample answers correctly to the four questions.

The SHARE also contains a test of verbal learning and recall. Indeed, individuals are asked to learn a list of 10 words and recall them immediately (*immediate recall*) and five minutes later approximately (*delayed recall*). The test is performed in all waves. The scores range from 0 to 10.

[5]The SHARE data also contain a test of verbal fluency. Following the previous literature (Celidoni, Dal Bianco, and Weber, 2017), we do not use this test in our paper because it suffers from floor and ceiling effects.

3.3 Mental health

We also use a series of mental health outcomes from the EURO-D depression scale. This scale was developed with the aim of facilitating cross-cultural research into late-life depression in Europe. It is constructed using answers to 12 questions on depression, pessimism, suicidality, guilt, sleep, interest, irritability, appetite, fatigue, concentration, enjoyment, and tearfulness. We use these 12 variables and recode them so that 0 represents poor mental health (depression) and 1 good mental health (no depression).

3.4 Housing

Information on house prices comes from the following question, that is asked to homeowners: "In your opinion, how much would you receive if you sold your property today?" The question is asked to one member of the household (the financial respondent) and it deals with the household main home. Prices in euros are adjusted for inflation. Using individual responses to the question, we construct a region-level measure by taking the median self-assessed price for each region-year. Finally, median prices are transformed to natural logarithms to allow for the non-linearity of the price-health associations.

Ideally, we would like to estimate the effect of house prices on individual health, using objective house prices in the area of residence of the individual. Price data would be provided at a small area level and would be comparable between areas across Europe. However such data are not available as far as we are aware. Existing standardized data are only provided at the country level. For this reason, we employ subjective, self-reported information on prices from the SHARE. We believe that these subjective data are reliable. Indeed, a large literature evaluates the accuracy of self-reported house prices and finds that they are a good proxy for objective house prices (see Kiel and Zabel (1999)). For instance, for the US in recent years (2006-2012), Davis and Quintin (2017) find that self-assessed prices adjust to booms and busts in house prices (with a lag).

We check the internal consistency of household reported prices in our data by com-

paring prices across waves. When prices dramatically increase or decrease between two consecutive waves – i.e. prices are multiplied (or divided) by three or more – we set them to missing.[6]

In our empirical specification, we employ median prices in each region-year rather than household-level prices to address potential reverse causality and sample selection concerns. Indeed, cognitive health may have a causal impact on reported house prices; and poor cognitive health could lead to non-response to the housing price question. In contrast, individual cognitive health should not have any impact on median house prices in the region. To avoid reverse causality issues and limit the non-response bias, we assign to each respondent the median house price in his region.

To compute the median price in the area, we define a region as a NUTS 2 statistical region, for most countries.[7] For some countries, we use a different definition because we want to have a comparable number of observations across regions or because data are not available. More precisely, we employ NUTS 1 regions for Germany, Israel (NUTS 2 regions are not available), the Netherlands, Spain, and Poland (NUTS 3 regions are too small compared to other countries in our sample), and NUTS 3 regions for Estonia (NUTS 2 regions are not available). When there are less than 10 individuals reporting a house price in a region-year, we do not compute the median and drop the corresponding observations.

To show that self-reported prices in our sample are consistent with objective values, we represent the evolutions of subjective and objective prices over time for each country (see Figure A1 in Appendix A). Objective house price data come from Eurostat (2015 = 100). Note that Eurostat does not provide house price information for Greece, Switzerland, and Israel. Eurostat computes three national indices: an index on purchases of new dwellings, an index on purchases of existing dwellings, and a global index on purchases of new and existing dwellings. Our figure highlights that these three indices evolve in

[6]Results remain unchanged when we use different thresholds such as multiplications or divisions by two or five.

[7]NUTS are territorial units defined by Eurostat. The NUTS 2 level corresponds to areas with a population between 800,000 and 3 million people.

the same way over time. Regarding subjective data, we use the median house price for each country-wave. We standardize the data so that 2015 serves as the reference year (2015 = 100). In most countries, self-assessed house prices follow the same pattern as objective data, which implies that they consistently capture changes in prices. Note that in Czech Republic and Spain, self-assessed prices seem to adjust with delay to objective price decreases, consistent with findings from Davis and Quintin (2017).

In Germany, substantial differences between objective and subjective price series emerge: self-assessed prices decrease over time, whereas objective prices increase. To understand this discrepancy, we represent subjective price evolutions in urban and rural areas separately. Figure A2 in Appendix A shows that self-assessed prices in urban areas are relatively similar to objective prices. The housing market has become increasingly polarized over the period in Germany, with a boom in urban house prices and a simultaneous decrease in rural house prices (Westermeier and Grabka, 2017). Because rural areas are over-represented in our sample of elderly Germans, the evolutions of self-reported prices are not in line with the increase in the objective index. This does not challenge the validity of our subjective price measure, and Figure A1 provides strong evidence that self-assessed house prices are a good proxy for objective house prices in our sample.

Note also the SHARE data contain information on whether the household moved or not. However, we do not have information on the new region of residence for movers. For this reason, we estimate our model for the sample of non-movers in our main specification. Selection issues related to non-random relocation are discussed in Section 4.

3.5 Control variables

In our specification, we include a number of control variables from the SHARE: age (recoded in seven categories), marital status, the logarithm of household size, the logarithm of the number of co-resident children (plus one), household income, and year dummies. In additional specifications, we also control for individual retirement status and for the regional unemployment rate (obtained from Eurostat).

Descriptive statistics are presented in Appendix B.

4 Empirical strategy

We estimate the effect of the median house price in the area on individual health using the following model:

$$H_{iact} = \alpha + P^*_{act}\beta + U_{act}\delta + X_{iact}\gamma + \alpha_i + \lambda_{ct} + \epsilon_{iact} \quad (1)$$

where H_{iat} denotes health for individual i living in area a in country c and interviewed in year t, P^*_{act} the median house price in the area, and X_{iact} a vector of control variables. λ_{ct} is a country-time fixed effect that accounts for country-level changes.

To allow for asymmetric effects during booms and busts, we estimate the model for episodes of price increases and decreases separately. Episodes are defined by comparing prices between consecutive waves. For any individual, an episode of price increase (respectively decrease) corresponds to the observations in consecutive waves with a continuous price increase (resp. decrease).[8] In our specification, to ensure a proper identification of the effects of price booms and busts, we include an individual fixed effect which is episode-specific. In equation (1), α_i captures this individual-episode fixed effect. Note that respondents' level of education, which generally remains stable over time, is captured by this fixed effect. We estimate the model for owners with a mortgage, outright owners, and tenants separately. Equation (1) is estimated using a linear probability model. Standard errors are clustered at the regional level.

In our main specification, we employ the sample of non-movers. Attrition and selection, due to household relocation and mortality, may be important sources of bias in our main approach. We address this issue and check the robustness of our findings (see

[8]For instance, suppose that an individual is observed in all waves (i.e. waves 1, 2, 4, 5, and 6), and assume that prices rise in waves 1, 2, and 4, decrease between waves 4 and 5, and increase again between waves 5 and 6, in her region. We consider that there are two episodes of price increases – the first episode corresponds to waves 1 to 4 and the second to waves 5 to 6 – and one episode of price decreases – this episode corresponds to waves 4 and 5 – for this person.

Section 5.2).

5 Effect of house prices on cognitive health

5.1 Main results

We first show our main results on the effect of price increase and decrease episodes on cognitive outcomes (Tables 1 and 2). Results for mortgaged owners, outright owners, and tenants are presented separately. In a nutshell, while house price increases have a positive impact on cognitive functioning for owners with a mortgage, they have a detrimental influence for outright owners. For owners with a mortgage, the effect of prices is asymmetric, since both increase and decrease episodes are associated with better cognitive health.

More precisely, results for periods of house price increases are reported in Table 1. In the full sample (top panel), price increases are associated with lower numeracy: a 10% increase in house prices is associated with a 0.037 unit decrease in the numeracy score. When we break down the results by tenure status, we find that for outright owners, prices are also negatively associated with both immediate and delayed recall. A 10% increase in house prices is associated with a 0.079 unit (i.e. 2.2%) decrease in delayed recall.

In contrast, for owners with a mortgage, price increases are associated with an improvement in cognitive abilities. In particular, the correlation between prices and (immediate and delayed) recall is positive and significant. When the median house price in the area increases by 10%, the delayed recall score increases by 0.070 units, which represents a 1.5% increase.

For tenants, results are generally not significant at conventional levels. However, column (1) shows a negative impact of prices on numeracy, consistent with results for the entire sample and for outright owners.

Table 2 shows results for episodes of price decreases. A positive coefficient in this table reads as a detrimental effect of price decreases on health. The general picture is

Table 1: Impact of house prices on health, house price increase episodes - Panel fixed effect estimation

	(1) Numeracy	(2) Orientation in time	(3) Immediate recall	(4) Delayed recall
Any tenure status				
Log median self-reported price	-0.369**	0.008	-0.266	-0.427
	(0.172)	(0.077)	(0.170)	(0.272)
Number of observations	55525	45767	75304	75304
Number of individuals	31308	37420	40953	40953
Mortgaged owners				
Log median self-reported price	-0.045	0.059	0.488**	0.698**
	(0.358)	(0.144)	(0.225)	(0.334)
Number of observations	9955	8846	13763	13763
Number of individuals	5811	7125	8221	8221
Outright owners				
Log median self-reported price	-0.240	0.019	-0.427**	-0.786**
	(0.181)	(0.149)	(0.181)	(0.331)
Number of observations	29550	23606	40103	40103
Number of individuals	18787	20702	24663	24663
Tenants				
Log median self-reported price	-0.610*	0.054	-0.175	0.172
	(0.343)	(0.099)	(0.282)	(0.339)
Number of observations	9487	8165	12809	12809
Number of individuals	5596	6687	7489	7489

Standard errors clustered by regions in parentheses. * p<0.10, ** p<0.05, *** p<0.01.
All regressions include individual-episode fixed effects.
Controls not shown: age group, marital status, logarithm of household size, logarithm of the number of children, and survey year.
Data source: SHARE, waves 1, 2, 4, 5, and 6.

that cognitive scores either improve or remain stable when prices decrease. In particular, for owners with or without a mortgage, cognitive functioning improve during episodes of price decreases. For tenants, effects are generally not significant.

Table 2: Impact of house prices on health, house price decrease episodes - Panel fixed effect estimation

	(1) Numeracy	(2) Orientation in time	(3) Immediate recall	(4) Delayed recall
Any tenure status				
Log median self-reported price	-0.051*	-0.007	-0.009	-0.090***
	(0.026)	(0.020)	(0.016)	(0.028)
Number of observations	77516	54513	91671	91671
Number of individuals	39914	41346	44540	44540
Mortgaged owners				
Log median self reported price	-0.004	-0.014	-0.101	-0.175***
	(0.032)	(0.032)	(0.070)	(0.036)
Number of observations	11155	8433	14275	14275
Number of individuals	6759	6930	8170	8170
Outright owners				
Log median self-reported price	-0.047*	-0.010	-0.003	-0.073**
	(0.026)	(0.023)	(0.016)	(0.030)
Number of observations	49782	33950	57270	57270
Number of individuals	27332	26388	30074	30074
Tenants				
Log median self-reported price	-0.025	-0.079	0.099*	-0.026
	(0.077)	(0.053)	(0.054)	(0.081)
Number of observations	9353	7014	11668	11668
Number of individuals	5438	5678	6574	6574

Standard errors clustered by regions in parentheses. * p<0.10, ** p<0.05, *** p<0.01.
All regressions include individual-episode fixed effects.
Controls not shown: age group, marital status, logarithm of household size, logarithm of the number of children, and survey year.
Data source: SHARE, waves 1, 2, 4, 5, and 6.

5.2 Attrition and selection

Attrition and selection, due to household relocation and mortality, may be important sources of bias. Specifically, price evolution may lead or even force people to move, by increasing their purchasing power or by providing them an incentive to realize a capital gain, in times of house price growth, or by threatening their solvency, in periods of house price decline and economic crisis. To address this issue, some studies include an individual-region fixed effect (Ratcliffe, 2013; Atalay, Edwards, and Liu, 2017). Because information on the new region of residence is not available for movers in our data, we cannot implement this strategy. Instead, we assume that movers stay within the same

region and re-estimate our model for this larger sample. Because we adopt a broad definition of regions, this assumption seems reasonable. Our results are virtually unchanged, suggesting that the bias is limited.

Note also that attrition might be linked to mobility between waves. However, compared to studies in the general population, relocation issues are less of a concern in our sample of individuals aged 50+. Indeed, movers only represent 2.49% of observations in our sample. This figure is consistent with Angelini and Laferrère (2012), who find an average residential mobility rate of around 2% per year, even when accounting for attrition, using data on the 11 countries participating in the first two waves of the SHARE (2004 and 2006).

Finally, mortality may also be an important source of bias in our models. To address this issue, we restrict our sample to individuals under 65 because mortality is less of an issue for them, and re-estimate our models using this sample. Results highlight that our findings are not driven by attrition. See Appendix C for more details on attrition and selection.

5.3 Additional controls for economic conditions

The significant correlation between prices and health may be due to the omission of confounding factors, although we control for individual-episode fixed effects. To address this concern, we re-estimate our models including control variables for economic conditions. We control for the unemployment rate in the area and for individual labor market status. Results are presented in Appendix D. For price increase episodes, although the coefficients are less precisely estimated, results are mostly unchanged (Table D1). For price decrease episodes, the coefficients remain negative and significant for owners with a mortgage, while they are no longer significant for outright owners (Table D2).

6 Mechanisms and additional results

In the previous section, we established that price increases are negatively associated with cognitive functioning for outright owners (Tables 1 and D1) and that price decreases have a beneficial impact on cognition for owners with a mortgage (Table D2). Because these results may seem puzzling, we now examine the mechanisms behind these correlations. We focus on two potential explanations: first, the deterring effect of price increases on second home ownership and residential mobility for richer individuals, and second, the specific economic situation in Spain.

6.1 Price increases, socioeconomic status, and second home ownership

We first show that results on the impact of price increases on cognition (Tables 1 and D1) are consistent with findings for mental health outcomes. More precisely, we explore the impact of price increases on the 12 components of the EURO-D depression scale. These components are binary variables for different symptoms of depression; the variables are recoded so that 1 always indicates good mental health. Appendix E highlights that for the complete sample and for owners without a mortgage, house price increases have a detrimental impact on mental health (irritability), whereas for owners with a mortgage, house price increases are positively associated with mental health (lower risk of depression and suicidality, higher level of concentration). These results support our previous findings on the role of price increases in cognition.

Increases in house prices may have different effects depending on socioeconomic status. We re-estimate our models for low- and high-income individuals separately (i.e. individuals whose income is below and above median household income in the country) (see Appendix F). For full owners, there is some evidence that the negative correlation is driven more by high-income individuals than by low-income respondents.

For richer full owners, the detrimental impact of price increases on cognition may be due to the deterring effect of price increases on second home ownership and mobility. Indeed, price booms represent a barrier to second home ownership. We test this hypothesis focusing on price increase episodes for the sample of richer individuals. We regress cognition outcomes on prices, for individuals who own a second home or not, separately. We also test whether the effect of prices for individuals with a second home is statistically significant from its effect for individuals with no second home, by including an interaction term in our model. Results are given in Table 3. We find that rising prices are significantly more detrimental for individuals with no second home than for respondents with a second home. We conclude that for richer outright owners, rising prices act as a barrier to second home ownership, which partly drives the negative effect of prices on cognition.

Table 3: Impact of house prices on health, house price increase episodes, controlling for unemployment and retirement - Richer households - Panel fixed effect estimation

	(1) Numeracy	(2) Orientation in time	(3) Immediate recall	(4) Delayed recall
Outright owners with no second home				
Log median self-reported price	-0.192	-0.090	-0.772***	-1.205***
	(0.279)	(0.257)	(0.280)	(0.358)
Number of observations	9665	8140	13472	13472
Number of individuals	7443	7516	10244	10244
Outright owners with a second home				
Log median subj price	-0.584	0.234	-0.185	-0.600
	(0.463)	(0.320)	(0.342)	(0.617)
Number of observations	4928	3779	6565	6565
Number of individuals	3800	3491	4999	4999
Outright owners				
Log median subj price	-0.162	-0.086	-0.523**	-0.782**
	(0.183)	(0.207)	(0.235)	(0.329)
No second home	0.388	0.077	1.975*	2.202**
	(1.339)	(0.621)	(1.084)	(1.110)
No second home × Log med subj price	-0.037	-0.003	-0.164*	-0.185*
	(0.112)	(0.053)	(0.090)	(0.095)
Number of observations	14593	11919	20037	20037
Number of individuals	10560	10816	14235	14235

Standard errors clustered by regions in parentheses. * p<0.10, ** p<0.05, *** p<0.01.
All regressions include individual-episode fixed effects.
Controls not shown: age groups, marital status, logarithm of household size, logarithm of the number of children, survey year, retirement status, and regional unemployment rate.
Data source: SHARE, waves 1, 2, 4, 5, and 6.

6.2 Price decreases and the role of Spain

Table D2 highlighted that for owners with a mortgage, house price decreases have a beneficial effect on cognition. We examine the role of the economic situation in Spain in this result. Indeed, in our sample, Spain is one of the countries where house prices dropped the most after 2008.

On the one hand, failure to pay mortgage led to mortgage foreclosures and evictions in Spain. For these households, price decreases should have a large detrimental impact on health. On the other hand, a large majority of Spanish households with a mortgage had a variable rate loan. Concurrent with house price decreases during the economic

crisis, interest rates that had sharply increased between 2006 and 2008 plummeted by 50 percent in a few months. This evolution may have translated into improvements in cognitive abilities for mortgaged owners, by alleviating their debt burden.[9]

In our approach, the effect of price decreases for mortgaged owners is identified using a sample of individuals who do not move and keep the same tenure status across waves. This sample contains mortgaged owners who were positively impacted by the drop in interest rates, but does not contain evicted households who were negatively affected by the crisis. Consequently, in our model, price decreases should improve cognitive functioning for Spanish owners with a mortgage.

To highlight the role of this country in our finding (for price decreases, for mortgaged owners), we re-run our regression without Spain. Controls for individual retirement status and for the regional unemployment rate are included. Results are presented in Table 4. For mortgaged owners, while two coefficients were negative and significant in Table D2, only one of them remains significant in Table 4. Spanish households thus significantly drive our previous results.

We also find that for full owners, the correlation between prices and immediate recall is now positive and significant.[10]

[9]See pages 33-34 in `https://www.ecb.europa.eu/pub/pdf/other/ebbox201705_03.en.pdf?ecfc5f38a2d711a0a55c247c7422d564`.

[10]In Appendix G, we give results on the effect of house price increases for the restricted sample without Spain. As expected, these results are very similar to those presented in Table D1, since house price increases were only observed in a few regions in Spain for our period of interest.

Table 4: Impact of house prices on health, house price decrease episodes, controlling for unemployment and retirement (excluding Spain) - Panel fixed effect estimation

	(1) Numeracy	(2) Orientation in time	(3) Immediate recall	(4) Delayed recall
Any tenure status				
Log median self-reported price	-0.036	-0.011	0.028	-0.012
	(0.028)	(0.022)	(0.023)	(0.040)
Number of observations	64477	45849	77176	77176
Number of individuals	33586	35645	38609	38609
Mortgaged owners				
Log median self-reported price	0.007	-0.023	-0.101	-0.122**
	(0.042)	(0.032)	(0.071)	(0.051)
Number of observations	10378	7873	13375	13375
Number of individuals	6216	6464	7595	7595
Full owners				
Log median self-reported price	-0.016	-0.014	0.045*	-0.016
	(0.032)	(0.024)	(0.026)	(0.045)
Number of observations	38826	26782	45155	45155
Number of individuals	21675	21476	24684	24684
Tenants				
Log median self-reported price	-0.074	-0.080	0.090	0.069
	(0.087)	(0.055)	(0.059)	(0.093)
Number of observations	8915	6706	11181	11181
Number of individuals	5156	5452	6297	6297

Standard errors clustered by regions in parentheses. * p<0.10, ** p<0.05, *** p<0.01.
All regressions include individual-episode fixed effects.
Controls not shown: age group, marital status, logarithm of household size, logarithm of the number of children, survey year, retirement status, and regional unemployment rate.
Data source: SHARE, waves 1, 2, 4, 5, and 6.

Some additional mechanisms that may drive the correlations between prices and cognition are worth mentioning. In particular, for respondents, price increases may mean that their children can no longer afford to buy a house. If respondents are altruistic, house price booms may then have a detrimental effect on health. To test this hypothesis, information on children housing tenure status is necessary, but such information is not available in the SHARE.

7 Conclusion

This paper uses the SHARE data on 17 European countries between 2004 and 2015 to study the relationship between house prices and cognitive health. We construct a region-level house price index using self-reported home values and show that this index is a consistent measure of objective prices. In our regression models, we take advantage of the longitudinal nature of the data and control for individual time-invariant characteristics. We distinguish episodes of house price increases and decreases and explore the heterogeneous effects of prices depending on individual tenure status.

Findings indicate that in the full sample, house prices are negatively associated with cognitive functioning during booms and busts. Interestingly, the effect of prices on cognition is highly asymmetric.

First, price increases have beneficial effects on cognitive health for owners with a mortgage, consistent with previous findings in the literature (Hamoudi and Dowd, 2014). However, we show a detrimental effect of house price increases for outright owners. This negative effect is stronger for richer individuals, and in this richer group, only individuals who do not own a second home are negatively affected by rising prices. This result suggests that the detrimental impact on cognitive functioning for outright owners may be due to the fact that high prices make second home ownership less affordable and reduces residential mobility.

Moreover, baseline regressions show that house price declines are beneficial to cognitive health for owners with a mortgage. However, this puzzling result is driven by the specific Spanish situation where the sharp decline in house prices was due to the burst of a bubble.

Finally, for tenants, associations between prices and cognitive functioning outcomes are generally not significant. This absence of effect is consistent with previous findings for renters (Hamoudi and Dowd, 2014).

There are some limitations to our study. First, our data combine information on

17 countries and we compute the average effect of prices for this sample. However, the effect may be heterogeneous between countries, given differences in economic conditions and cultural backgrounds. The relatively small sample sizes for each country-year and the broad geographic regions do not allow to describe this heterogeneity. On a related matter, SHARE does not contain precise information on household location (in particular geolocation data are not available) and future research may complement our study by using local price data to better capture household economic conditions. Moreover, our study suggests that the effect of prices on cognitive outcomes is very specific in Spain, and future studies could further investigate this point. Finally, we use data on individuals ages 50+, and our results may not be generalizable to the rest of the population. Indeed, compared with younger individuals, older persons are more likely to own a house and may be more interested in buying a second home. Moreover, they are less likely to have a mortgage and have smaller mortgage loans. They may thus be affected by housing market fluctuations in a different way than the rest of the population. Future research may be interested in persons of all ages.

In spite of these limitations, our paper provides an overview of the effect of house price variations in Europe, for a comprehensive set of cognitive health measures. Our findings provide additional evidence that the consequences of the crisis go far beyond the macroeconomic impact on property values and labor market participation. But unlike other studies, our findings also suggest that house price increases may also deteriorate individual health. Our results have implications for policy responses to house price busts and booms: we need to be ready for the possibility that cognitive functioning behaves in very different ways for owners with a mortgage and outright owners.

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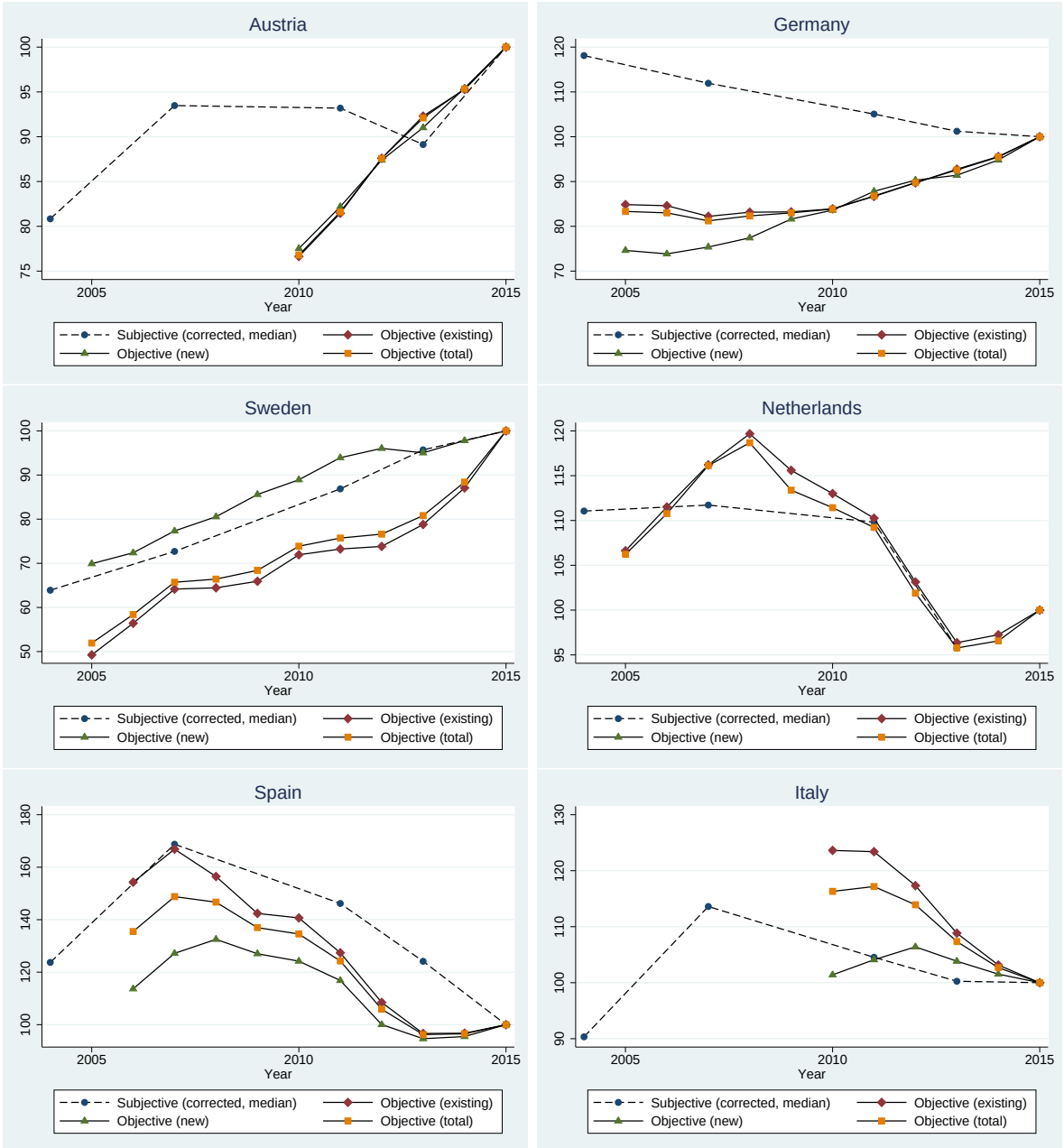
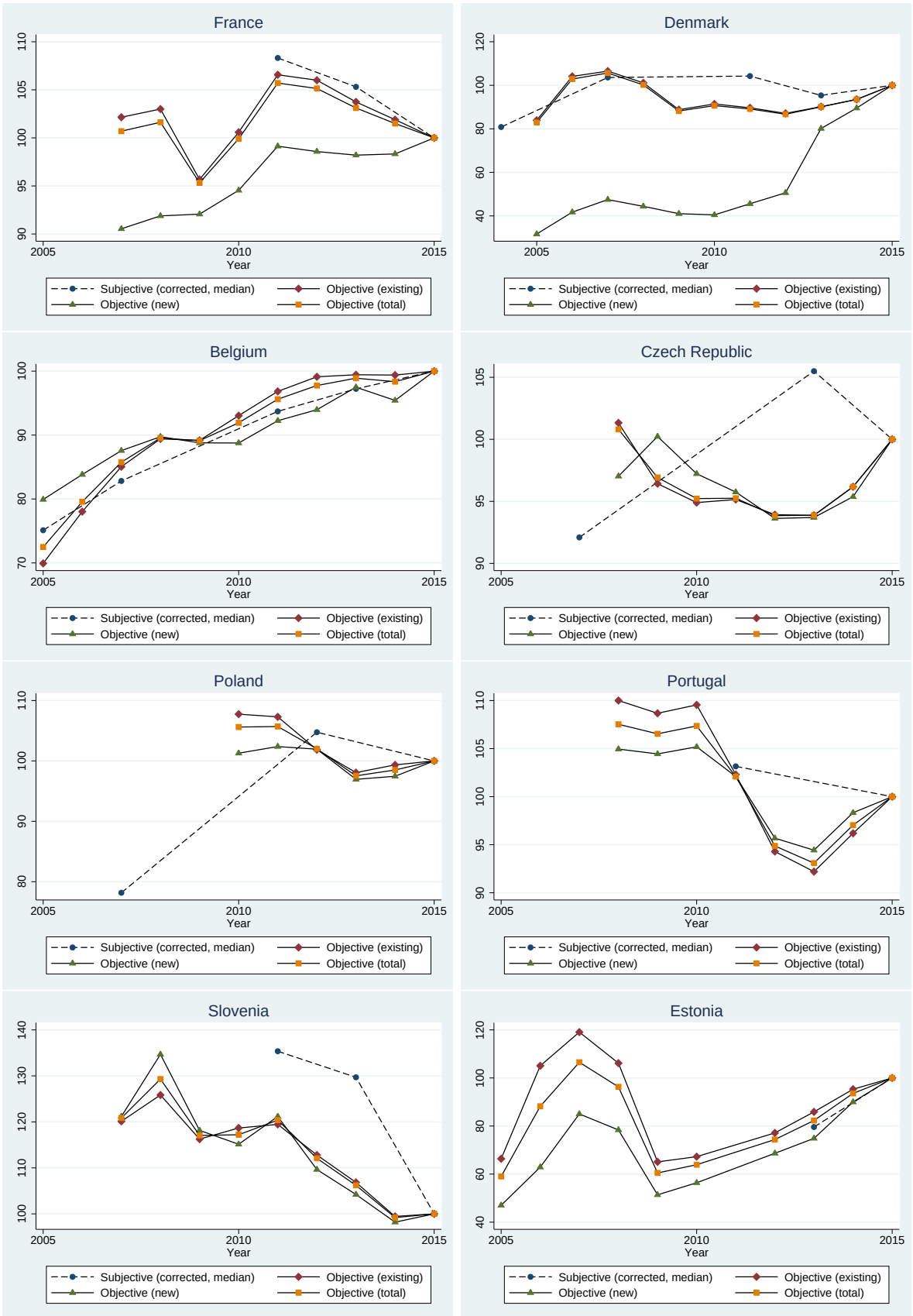
Appendix: Online only material

Appendix A: Objective and subjective prices

Figure A1: Evolution of subjective and objective prices

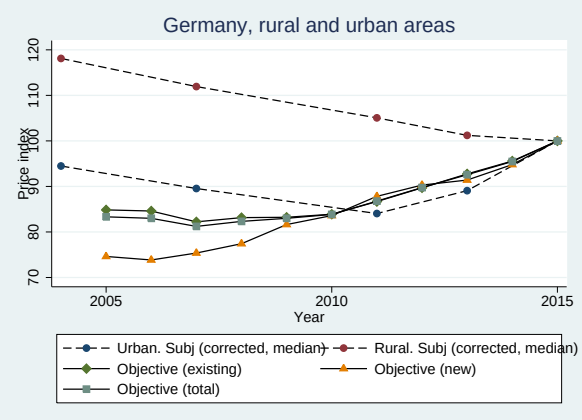


Evolution of subjective and objective prices (continued)



Notes: Data on the house price index come from Eurostat (data for Greece, Israel, and Switzerland are not available on the Eurostat website). For France, the SHARE does not survey all regions in waves 1 and 2, so we do not use these waves in the figure.

Figure A2: Evolution of prices in rural and urban areas in Germany



Appendix B: Descriptive statistics

The table below shows descriptive statistics by population groups. Outright owners represent more than half of the observations and individuals. In the full sample, the scores on numeracy and orientation in time are high. In contrast, the immediate recall measure is only equal to 5.2, and the delayed recall score is smaller than 4, on scales ranging from 0 to 10. Owners with a mortgage score higher on cognitive function scales than owners without a mortgage and tenants. However, owners with a mortgage are younger and have higher income level than other population groups.

Tenants are less likely to be married and more likely to be divorced than owners. Unsurprisingly, their average household size is smaller.

Table B1: Descriptive statistics

Variables	All population groups	Mortgaged owners	Outright owners	Tenants
Cognitive functioning				
Numeracy (0-5)	4.08	4.45	4.02	4.05
	(1.48)	(1.09)	(1.63)	(1.48)
Orientation in time (0-4)	3.79	3.86	3.79	3.78
	(0.63)	(0.46)	(0.63)	(0.64)
Immediate recall (0-10)	5.17	5.82	5.05	5.14
	(1.83)	(1.62)	(1.82)	(1.82)
Delayed recall (0-10)	3.79	4.63	3.61	3.81
	(2.16)	(1.99)	(2.13)	(2.15)
Housing				
Median house price	214,573.6	242,852.5	204,693.1	235,163.0
	(199,154.1)	(159,097.4)	(219,088.7)	(137,371.7)
Log(median house price)	12.04	12.24	11.95	12.23
	(0.65)	(0.55)	(0.67)	(0.50)
Socio-demographic characteristics				
Age	66.87	61.80	67.61	66.36
	(10.29)	(8.56)	(9.86)	(10.79)
Never married (Ref)	35.71%	37.12%	34.79%	38.57%
Married	46.72%	52.41%	50.14%	35.57%
Divorced	7.49%	6.88%	5.27%	15.86%
Widowed	10.06%	3.57%	9.79%	9.98%
Household size	2.13	2.34	2.17	1.86
	(0.99)	(0.98)	(0.96)	(0.94)
Number of children	2.13	2.24	2.10	2.08
	(1.33)	(1.24)	(1.28)	(1.56)
Household income	38,419.11	61,918.92	32,321.79	44,670.25
	(70,488.91)	(103,988)	(53,062.11)	(87,601.64)
Observations	135,391	22,535	78,642	19,971
Number of individuals	72,528	13,921	44,584	12,070

Standard errors for continuous variables are reported in parentheses. The numbers of observations and individuals correspond to sample of the model for numeracy in which episodes of price increases and decreases are all taken into account.

Appendix C: Attrition and selection

In our main models, we employ the sample of non-movers. However, selective relocation may bias our estimates. To check the robustness of our findings, we assume that individuals who move remain within the same region and re-estimate our model using this larger sample. Given that regions are relatively large in our approach, this assumption seems reasonable to us. Results are shown in Tables C1 and C2 below. Results are qualitatively similar to those presented in Tables 1 and 2. This implies that selective relocation is not an important source of bias.

Table C1: Impact of house prices on health, house price increase episodes, including movers - Panel fixed effect estimation

	(1) Numeracy	(2) Orientation in time	(3) Immediate recall	(4) Delayed recall
Any tenure status				
Log median self-reported price	-0.346**	-0.014	-0.210	-0.421
	(0.160)	(0.062)	(0.173)	(0.270)
Number of observations	62339	49553	82867	82867
Number of individuals	33260	39389	42612	42612
Mortgaged owners				
Log median self-reported price	-0.126	0.041	0.467**	0.608*
	(0.362)	(0.129)	(0.232)	(0.336)
Number of observations	11255	9615	15227	15227
Number of individuals	6289	7560	8754	8754
Outright owners				
Log median self-reported price	-0.192	-0.032	-0.399**	-0.835***
	(0.169)	(0.146)	(0.171)	(0.318)
Number of observations	31987	24906	42688	42688
Number of individuals	19785	21631	25595	25595
Tenants				
Log median self-reported price	-0.699*	0.054	0.022	0.308
	(0.391)	(0.085)	(0.268)	(0.333)
Number of observations	11496	9277	15093	15093
Number of individuals	6432	7343	8348	8348

Standard errors clustered by regions in parentheses. * p<0.10, ** p<0.05, *** p<0.01.
All regressions include individual-episode fixed effects.
Controls not shown: age groups, marital status, logarithm of household size, logarithm of the number of children, and survey year.
Data source: SHARE, waves 1, 2, 4, 5, and 6.

Table C2: Impact of house prices on health, house price decrease episodes, including movers - Panel fixed effect estimation

	(1) Numeracy	(2) Orientation in time	(3) Immediate recall	(4) Delayed recall
Any tenure status				
Log median self-reported price	-0.054**	-0.008	-0.010	-0.089***
	(0.026)	(0.020)	(0.015)	(0.028)
Number of observations	85995	59303	100697	100697
Number of individuals	42072	43970	46411	46411
Mortgaged owners				
Log median self-reported price	0.004	-0.025	-0.082	-0.138***
	(0.032)	(0.029)	(0.070)	(0.046)
Number of observations	12355	9038	15572	15572
Number of individuals	7282	7324	8661	8661
Outright owners				
Log median self-reported price	-0.055**	-0.013	-0.007	-0.078***
	(0.028)	(0.023)	(0.016)	(0.029)
Number of observations	53939	36363	61582	61582
Number of individuals	28545	27849	31228	31228
Tenants				
Log median self-reported price	-0.033	-0.065	0.085**	0.013
	(0.077)	(0.040)	(0.043)	(0.107)
Number of observations	11437	8182	13940	13940
Number of individuals	6312	6485	7437	7437

Standard errors in parentheses. * p<0.10, ** p<0.05, *** p<0.01.
All regressions include individual-episode fixed effects.
Controls not shown: age group, marital status, logarithm of household size, logarithm of the number of children, and survey year.
Data source: SHARE, waves 1, 2, 4, 5, and 6.

Mortality could also bias our estimates. To check the robustness of our findings, we re-estimate our models restricting our sample to individuals under 65. They represent approximately half of the sample. Reassuringly, we get very similar results, which suggests that our results are robust (results available upon request).

Appendix D: Unemployment and retirement

The significant correlation between prices and health in Tables 1 and 2 may be due to the omission of confounding factors, although we control for individual-episode fixed effects. To address this concern, we re-estimate our models including control variables for economic conditions. Specifically, we control for the unemployment rate in the area and for individual labor market status. Labor market status is measured using a dummy variable which is equal to one if the individual is retired.

Results are reported in Tables D1 and D2 below. Findings are consistent with results from our main specifications. For outright owners, the coefficients on numeracy and delayed recall remain negative but are no longer significant (Table D2, columns (1) and (4)). All other results are only marginally affected by the inclusion of these additional economic controls, suggesting that the correlation between prices and cognitive health is not totally explained by regional economic conditions and by individual labor market status.

Table D1: Impact of house prices on health, house price increase episodes, controlling for unemployment and retirement - Panel fixed effect estimation

	(1) Numeracy	(2) Orientation in time	(3) Immediate recall	(4) Delayed recall
Any tenure status				
Log median self-reported price	-0.259	-0.036	-0.306*	-0.341
	(0.156)	(0.076)	(0.169)	(0.246)
Number of observations	52982	44038	72686	72686
Number of individuals	29917	36069	39545	39545
Mortgaged owners				
Log median self-reported price	0.053	-0.011	0.442*	0.659*
	(0.385)	(0.138)	(0.240)	(0.345)
Number of observations	9812	8716	13606	13606
Number of individuals	5699	7019	8100	8100
Outright owners				
Log median self-reported price	-0.095	-0.114	-0.484***	-0.645**
	(0.135)	(0.193)	(0.174)	(0.263)
Number of observations	27457	22225	37973	37973
Number of individuals	17573	19578	23434	23434
Tenants				
Log median self-reported price	-0.551	0.015	-0.151	0.236
	(0.342)	(0.110)	(0.290)	(0.357)
Number of observations	9390	8084	12697	12697
Number of individuals	5531	6623	7416	7416

Standard errors clustered by regions in parentheses. * p<0.10, ** p<0.05, *** p<0.01.
All regressions include individual-episode fixed effects.
Controls not shown: age group, marital status, logarithm of household size, logarithm of the number of children, survey year, retirement status, and regional unemployment rate.
Data source: SHARE, waves 1, 2, 4, 5, and 6.

Table D2: Impact of house prices on health, house price decrease episodes, controlling for unemployment and retirement - Panel fixed effect estimation

	(1) Numeracy	(2) Orientation in time	(3) Immediate recall	(4) Delayed recall
Any tenure status				
Log median self-reported price	-0.028	-0.010	-0.025	-0.065**
	(0.028)	(0.021)	(0.022)	(0.031)
Number of observations	71372	50062	85444	85444
Number of individuals	36691	38620	41769	41769
Mortgaged owners				
Log median self-reported price	0.005	-0.012	-0.122*	-0.132***
	(0.042)	(0.038)	(0.071)	(0.049)
Number of observations	10949	8276	14066	14066
Number of individuals	6590	6809	8023	8023
Outright owners				
Log median self-reported price	-0.019	-0.009	-0.015	-0.049
	(0.028)	(0.023)	(0.023)	(0.034)
Number of observations	44580	30221	52005	52005
Number of individuals	24450	23995	27533	27533
Tenants				
Log median self-reported price	-0.071	-0.091*	0.061	0.014
	(0.084)	(0.054)	(0.059)	(0.093)
Number of observations	9201	6892	11514	11514
Number of individuals	5328	5604	6488	6488

Standard errors clustered by regions in parentheses. * p<0.10, ** p<0.05, *** p<0.01.
All regressions include individual-episode fixed effects.
Controls not shown: age group, marital status, logarithm of household size, logarithm of the number of children, survey year, retirement status, and regional unemployment rate.
Data source: SHARE, waves 1, 2, 4, 5, and 6.

Appendix E: Effect of house price increases on mental health outcomes

Results on the effect of price increases on the 12 components of the EURO-D depression scale are shown in Table E1. For the complete sample and for owners without a mortgage, house price increases have a detrimental impact on mental health (irritability), whereas for owners with a mortgage, house price increases are positively associated with mental health (lower risk of depression and suicidality and higher level of concentration). This supports our main findings presented in Tables 1 and D1.

Table E1: Impact of house prices on mental health (12 variables forming the EURO-D scale), house price increase episodes, controlling for retirement and unemployment - Panel fixed effect estimation

	Good mental health											
	(1) Depression	(2) Pessimism	(3) Suicidality	(4) Guilt	(5) Sleep	(6) Interest	(7) Irritability	(8) Appetite	(9) Fatigue	(10) Concentration	(11) Enjoyment	(12) Tearfulness
Any tenure status												
Log median subj price	0.054	0.021	0.004	-0.037	-0.023	0.006	-0.094***	0.014	-0.003	0.006	0.038	-0.001
	(0.037)	(0.037)	(0.020)	(0.033)	(0.030)	(0.037)	(0.034)	(0.022)	(0.038)	(0.028)	(0.031)	(0.025)
Number of observations	71375	71223	71247	71237	71402	71330	71346	71471	71351	71240	71297	71366
Number of individuals	39188	39130	39137	39123	39190	39158	39183	39230	39178	39139	39153	39192
Mortgaged owners												
Log median subj price	0.147*	0.021	0.068***	-0.021	0.035	-0.062*	0.020	0.060	0.072	0.119**	0.045	0.046
	(0.076)	(0.057)	(0.025)	(0.044)	(0.066)	(0.037)	(0.070)	(0.048)	(0.059)	(0.053)	(0.056)	(0.072)
Number of observations	13502	13482	13492	13492	13504	13495	13498	13513	13501	13491	13502	13507
Number of individuals	8039	8027	8033	8034	8042	8035	8037	8046	8041	8036	8036	8045
Outright owners												
Log median subj price	0.025	-0.003	0.008	-0.060	0.018	0.038	-0.102**	-0.009	-0.032	-0.009	0.046	-0.026
	(0.036)	(0.043)	(0.028)	(0.048)	(0.041)	(0.060)	(0.041)	(0.024)	(0.050)	(0.036)	(0.031)	(0.031)
Number of observations	37298	37233	37241	37239	37314	37287	37291	37345	37301	37239	37256	37288
Number of individuals	23181	23159	23160	23154	23186	23172	23183	23206	23178	23156	23165	23175
Tenants												
Log median subj price	0.144*	0.160**	0.028	-0.036	-0.081	0.005	-0.055	0.049	-0.018	0.038	0.073	-0.029
	(0.082)	(0.068)	(0.044)	(0.046)	(0.062)	(0.042)	(0.068)	(0.047)	(0.087)	(0.054)	(0.060)	(0.057)
Number of observations	12539	12514	12519	12514	12540	12523	12530	12553	12532	12505	12521	12538
Number of individuals	7354	7338	7341	7335	7351	7342	7351	7361	7349	7329	7337	7352

Standard errors clustered by regions in parentheses. * p<0.10, ** p<0.05, *** p<0.01.
All regressions include individual-episode fixed effects.
Controls not shown: age group, marital status, logarithm of household size, logarithm of the number of children, survey year, retirement status, and regional unemployment rate.
Data source: SHARE, waves 1, 2, 4, 5, and 6.

Appendix F: Effect of house prices by socioeconomic status

Table F1: Impact of house prices on health, house price increase episodes, controlling for unemployment and retirement - Poorer households - Panel fixed effect estimation

	(1) Numeracy	(2) Orientation in time	(3) Immediate recall	(4) Delayed recall
Any tenure status				
Log median self-reported price	-0.422**	0.055	-0.012	-0.221
	(0.198)	(0.117)	(0.206)	(0.230)
Number of observations	26440	21523	36342	36342
Number of individuals	17873	18857	24008	24008
Mortgaged owners				
Log median self-reported price	-0.982	-0.192	0.264	1.209**
	(1.012)	(0.282)	(0.407)	(0.574)
Number of observations	3453	3044	4894	4894
Number of individuals	2523	2752	3635	3635
Full owners				
Log median self-reported price	0.038	0.113	-0.223	-0.529**
	(0.210)	(0.268)	(0.233)	(0.262)
Number of observations	12858	10304	17923	17923
Number of individuals	9658	9538	13197	13197
Tenants				
Log median self-reported price	-0.244	0.171	0.259	0.089
	(0.484)	(0.159)	(0.334)	(0.464)
Number of observations	6004	5059	8127	8127
Number of individuals	3964	4342	5305	5305

Standard errors clustered by regions in parentheses. * p<0.10, ** p<0.05, *** p<0.01.
All regressions include individual-episode fixed-effects.
Controls not shown: age groups, marital status, logarithm of household size, logarithm of the number of children, survey year, retirement status, and regional unemployment rate.
Data source: SHARE, waves 1, 2, 4, 5, and 6.

Table F2: Impact of house prices on health, house price increase episodes, controlling for unemployment and retirement - Richer households - Panel fixed effect estimation

	(1) Numeracy	(2) Orientation in time	(3) Immediate recall	(4) Delayed recall
Any tenure status				
Log median self-reported price	-0.154	-0.026	-0.423**	-0.473
	(0.200)	(0.128)	(0.202)	(0.313)
Number of observations	26542	22515	36344	36344
Number of individuals	17674	19530	23897	23897
Mortgaged owners				
Log median self-reported price	0.216	0.072	0.424	0.503
	(0.312)	(0.263)	(0.283)	(0.429)
Number of observations	6359	5672	8712	8712
Number of individuals	4175	4771	5804	5804
Full owners				
Log median self-reported price	-0.178	-0.104	-0.630***	-0.884***
	(0.166)	(0.207)	(0.214)	(0.322)
Number of observations	14599	11921	20050	20050
Number of individuals	10563	10816	14243	14243
Tenants				
Log median self-reported price	-0.930*	-0.195	-0.496	0.646
	(0.538)	(0.218)	(0.464)	(0.458)
Number of observations	3386	3025	4570	4570
Number of individuals	2372	2679	3262	3262

Standard errors clustered by regions in parentheses. * p<0.10, ** p<0.05, *** p<0.01.
All regressions include individual-episode fixed effects.
Controls not shown: age groups, marital status, logarithm of household size, logarithm of the number of children, survey year, retirement status, and regional unemployment rate.
Data source: SHARE, waves 1, 2, 4, 5, and 6.

Appendix G: Effect of house prices on cognitive outcomes, excluding Spain

As shown in the table below, results for episodes of price increases remain largely unchanged when we exclude Spain from the sample, since house price increases were only observed in a few regions in Spain.

Table G1: Impact of house prices on health, house price increase episodes (excluding Spain) - Panel fixed effect estimation

	(1) Numeracy	(2) Orientation in time	(3) Immediate recall	(4) Delayed recall
Any tenure status				
Log median self-reported price	-0.382**	0.008	-0.286*	-0.452
	(0.174)	(0.077)	(0.170)	(0.274)
Number of observations	53985	43817	72368	72368
Number of individuals	30365	35475	38659	38659
Mortgaged owners				
Log median self-reported price	-0.073	0.059	0.484**	0.700**
	(0.360)	(0.144)	(0.226)	(0.334)
Number of observations	9871	8708	13570	13570
Number of individuals	5752	6987	8053	8053
Outright owners				
Log median self-reported price	-0.251	0.019	-0.465**	-0.846**
	(0.185)	(0.149)	(0.179)	(0.333)
Number of observations	28212	21981	37637	37637
Number of individuals	17946	19081	22724	22724
Tenants				
Log median self-reported price	-0.577*	0.054	-0.176	0.178
	(0.343)	(0.099)	(0.283)	(0.340)
Number of observations	9440	8110	12726	12726
Number of individuals	5562	6632	7419	7419

Standard errors clustered by region in parentheses. * p<0.10, ** p<0.05, *** p<0.01.
All regressions include individual-episode fixed effects.
Controls not shown: age group, marital status, logarithm of household size, logarithm of the number of children, and survey year.
Data source: SHARE, waves 1, 2, 4, 5, and 6.