EUROPEAN CENTRAL BANK

EUROSYSTEM

Working Paper Series

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Accuracy and determinants of self-assessed euro area house prices

No 2328 / November 2019

Household Finance and Consumption Network (HFCN)

This paper contains research conducted within the Household Finance and Consumption Network (HFCN). The HFCN consists of survey specialists, statisticians and economists from the ECB, the national central banks of the Eurosystem and a number of national statistical institutes.

The HFCN is chaired by Ioannis Ganoulis (ECB) and Oreste Tristani (ECB). Michael Haliassos (Goethe University Frankfurt), Tullio Jappelli (University of Naples Federico II) and Arthur Kennickell act as external consultants, and Juha Honkkila (ECB) and Jiri Slacalek (ECB) as Secretaries.

The HFCN collects household-level data on households' finances and consumption in the euro area through a harmonised survey. The HFCN aims at studying in depth the micro-level structural information on euro area households' assets and liabilities. The objectives of the network are:

1) understanding economic behaviour of individual households, developments in aggregate variables and the interactions between the two;
2) evaluating the impact of shocks, policies and institutional changes on household portfolios and other variables;
3) understanding the implications of heterogeneity for aggregate variables;
4) estimating choices of different households and their reaction to economic shocks;
5) building and calibrating realistic economic models incorporating heterogeneous agents;
6) gaining insights into issues such as monetary policy transmission and financial stability.

The refereeing process of this paper has been co-ordinated by a team composed of Pirmin Fessler (Oesterreichische Nationalbank), Michael Haliassos (Goethe University Frankfurt), Tullio Jappelli (University of Naples Federico II), Juha Honkkila (ECB), Jiri Slacalek (ECB), Federica Teppa (De Nederlandsche Bank) and Philip Vermeulen (ECB).

Abstract

Using microdata from the second wave of the Household Finance and Consumption Survey, we investigate the accuracy of property values estimated by homeowners - so called *"self-assessed"* house prices - and explore the drivers of possible deviations of these prices from official hedonic house price indices. We find evidence that euro area homeowners overestimate the value of their properties by around 9%. Across the largest euro area countries, the overestimation lies in a range between 3.2% in Germany and 22% in Italy. Household characteristics, including the level of indebtedness, appear to explain significant discrepancies between hedonic and self-assessed house price indices, while the limited available data related to property characteristics are generally not affecting this gap. For the euro area, we find that higher self-assessed house prices are associated with a mild increase in consumption expenditures.

JEL Codes: E31, C21, O18.

Keywords: house prices, micro data, under/overvaluation, wealth effects, quantile regressions.

Non-technical summary

The value of a real-estate property declared by a household in a survey may differ from the value inferred from official statistical sources or valuations provided by appraisers. Investigating the gap between these two measures – the one self-assed by households and those derived from official sources – and studying its main determinants is relevant for different reasons.

First of all, the housing primary residence generally represents the main asset of households, accounting for close to 60% of their gross wealth in the euro area. This notwithstanding, estimates of self-assessed house prices are very scant for the euro area as a whole and its largest euro area countries. Our contribution aims to fill this gap. Understanding the "true value" of the households' main residence is crucial to assess the key features and dynamics of actual and perceived wealth across households. Perceived housing wealth may influence consumption, savings, investment and borrowing decisions which could, in principle, prove excessive or not fully appropriate for households in a context of overestimation of the value of their house. This is even more interesting in view of the on-going euro area housing upturn, which started in 2013 and has reached a relatively mature phase characterised by some signs of house price overvaluation (ECB (2018)).

Using the second wave of the Eurosystem's Household Finance and Consumption Survey (HFCS) we investigate, by means of quantile regressions, the accuracy and determinants of self-assessed house prices and their main determinants in the euro area and its five largest euro area countries since the 1970s. We find evidence that euro area homeowners overestimate the value of their properties by around 9% on average. Across the largest euro area countries, the overestimation lies in a range between 3.2% in Germany and 22% in Italy and differs significantly depending on the year of property acquisition.

We investigate, for the first time to the best of our knowledge, the possible drivers of this overestimation in terms of property, household characteristics and a combination of them. Property characteristics are generally not a significant factor affecting self-assessed house price valuations. However, data limitations on the property characteristics, for example on property location, appearance, neighbourhood, energy-class, etc., hamper the possibility to perform a fully-fledged analysis and to estimate hedonic regressions of subjective house prices, which could control for their intrinsic qualities. These limitations have to be born in mind when interpreting our results. The year of property acquisition, the level of indebtedness and the wealth quintile of households are instead important drivers of subjective house prices in the vast majority of countries examined. In particular, we find that a larger valuation is associated with a more recent year of property acquisition. In addition, households with a higher loan-to-value ratio generally attribute a higher value to their

properties, by between 9 and 37% compared to households with no debt. The rational could be found in the fact that borrowers taking out large loans leading to high loan-to-value ratios are likely to have high house price expectations compared to market fundamentals. In addition, due to risk aversion, higher leveraged borrowers may be more reluctant than lower leveraged one to report losses. Finally, we find that households who belong to higher wealth quintiles generally exhibit a larger house price valuation than other individuals. For example, for the euro area, households in the fifth wealth quintile value their house by 1/3 more than those in the first quintile.

The results described are robust to a battery of robustness checks including the estimation of quantile regressions at the 25th and 75th percentiles, the exclusion of housing wealth from our measure of net wealth and the elimination of the top 5% of the wealth distribution to account for possible oversampling of wealthy households.

The paper also explores the possible effects of self-reported house price valuation on consumption expenditures. Evidence across euro area countries is mixed, but for the euro area as a whole higher self-assessed house prices are associated with a mild increase in consumption expenditures.

Our results point to significant heterogeneity in self-assessed property valuations. In view of the importance of the housing market not only for its macroeconomic implications but also for financial stability considerations, the level of household indebtedness and wealth appear as important drivers of valuations and should be carefully monitored.

1. Introduction and existing results

Understanding the determinants and accuracy of property values estimated by homeowners – so called self-assessed[1] house prices – is of primary importance for different reasons.

First, the housing primary residence generally represents the main asset of households. According to the second wave of the Household Finance and Consumption Survey (HFCS), it accounts for 58% of the gross wealth of euro area households and for between 52 and 72% of gross wealth in the five largest euro area countries (see chart A2 in the Annex). Understanding the "true value" of the households' main residence is therefore crucial to assess the key features and dynamics of actual and perceived wealth across households.

Second, wealth effects are based on valuations as they are perceived and assessed by households, which could differ from those based on official hedonic house prices. Housing wealth has been shown to be a key variable in decisions such as retirement (see, for example, Lusardi and Mitchell, 2007), consumption (see, for example, Campbell and Cocco, 2007 and Bover (2015)), savings (see, for example, Juster et al., 2004; Klyuev and Mills, 2006), and the debt composition of households (see, for example, Disney et al. 2006). Investigating the wedge in valuations and their drivers can be informative, given that possible deviations between the perceived and actual value of housing wealth may contribute to consumption, savings and borrowing decisions which could, in principle, prove excessive or not fully appropriate for households. Investment decisions in risky-assets could also be affected, given that households who overestimate the value of their house also overestimate the total wealth allocated to risky assets, which could in turn decrease the share of stocks allocated in their portfolio, as shown in Corradin et al. (2017).

Moreover, a growing consensus recognizes that beliefs play a major role in shaping house price dynamics beyond their fundamental determinants and are important in explaining housing boom and bust cycles. Adelino et al. (2018) find that risk perceptions are strongly correlated with housing decisions and future intentions to buy or to rent. While owners update their beliefs of the riskiness of housing in response to recent local house price changes fairly quickly, renters are found to be slower in adjusting their expectations. A large literature exists on the perception of house prices by households, but it mainly refers to the US housing market (Kish and Lansing (1954), Goodman and Ittner (1992), Kiel and Zabel (1999), Bucks and Pence (2008)), and the evidence for other countries is limited (see: for Spain: Bover (2015), for Mexico: Gonzalez-Navarro and Quintana-Domeque (2009)). The focus is generally on selected US cities or counties, with a limited time sample. The main asset of

[1] Self-assessed or "subjective" house prices are used as synonyms throughout the paper to indicate the house prices declared by households in the HFCS survey.

these studies lies in the diversity of microdata they generally use and the set of possible explanatory variables they investigate. For the euro area, Mathä et al. (2017) use the first wave of the HFCS to investigate the importance of subjective house price changes in household wealth. They also raised the question whether *"the respective over- or under-evaluation for the household main residence relative to the macroeconomic index, is related to household and country characteristics."* However, in the first wave of the HFCS, data of the purchasing value were missing for France and Finland, limiting the scope of the analysis for the euro area as a whole. Given the scant evidence for the euro area and the euro-area countries, this paper aims to fill this gap, providing an extensive analysis, for the first time to the best of our knowledge, of self-assessed house prices and their determinants for the five largest euro area countries and the euro area as a whole.

Overall, the literature generally reports a slight overvaluation of housing by their owners. In the vast majority of cases, these findings are based on comparisons of homeowner's estimates – mainly obtained from survey data – with either hedonic house price indices (national or regional) or with lender or appraiser's estimates. The seminal paper by Kish and Lansing (1954) reports an average overvaluation for the US by 4% at the national level, Kain and Quigley (1972) by -2% (for a single city[2]), Goodman and Ittner (1992) by 6%, Kiel and Zabel (1999) show that homeowners overvalue their house by about 5% on average, with a range between 3.3% and 8.4%, depending on the length of the tenure. Bucks and Pence (2006) state that *"most homeowners appear to report their house values and broad mortgage terms reasonably accurately",* with household estimates generally 3 to 6% higher on average than benchmark estimates. Benítez -Silva et al. (2015) find evidence that US homeowners overestimate the value of their properties by around 8%, with an estimated range between 3.4% and 12.7%.

The literature also investigates the possible determinants and the theoretical mechanisms that are at play in the formation of housing self-assessment. Bucchianeri et al. (2010) explore the theoretical mechanisms of possible bias in the self-reported house prices (see Table 1 for a selected literature overview). First, households attribute more value to things merely because they own them, the so called "endowment effect". This effect occurs because of loss aversion generally defined as a tendency to prefer avoiding losses to acquiring equivalent gains. In addition, households' characteristics influence the formation of self-assessed price valuations across households. In particular, households who are better off – in terms of income, home value, or reported health – would exhibit a larger reported-actual price discrepancy than other individuals (so called "status syndrome" effect).

[2] Saint-Louis (Missouri), 1967.

Some determinants of over/undervaluation are not unambiguously accepted in the literature. For instance, Kiel and Zabel (1999) or Bucks and Pence (2006) show that the wedges between reported and official house prices are not related to characteristics of the households (except for the length of the tenure), of the house or of the neighbourhood, while Ihlanfeldt et al. (1986) show that they are (in particular in relation to age and income). In addition, the effect of the length of tenure on the self-assessment of the residence is unclear. According to Kain and Quigley (1972) or Gonzalez-Navarro et al (2009), homeowners who have owned for longer have outdated information and overestimate more systematically their house value. On the contrary, Kiel and Zabel (1999) show that recent homeowners – who bought their house 12 months prior to the interview – overestimate the price by 8.4%, while older ones only overestimate the price of their house by 3.3%. This difference may be related to the perception of bargaining capacity in the housing market which is higher for recent buyers, while older buyers rely more upon market information than on their subjective perception.

Other key determinants of self-assessed house prices are also considered in the literature. Benítez-Silva et al. (2015) show that households who bought in downturns might be more likely to underestimate the value of their properties if they later sell in better times (they underestimate the amplitude of the upturn). Chan et al. (2016) and Choi et al. (2018) investigate the effect of debt on self-assessed house prices. As a consequence of the endowment effect (see above), more highly leveraged borrowers may be more likely to underestimate losses and thus to overestimate the value of their house. In addition, Choi et al (2018) find that underwater homeowners are actually aware of the actual (lower) house price, but that they are reluctant to admit their losses in accordance with the theory of loss aversion.

A substantial stream of the literature also focuses on households' expectations of house prices. These papers share common points with those on self-assessed prices, but include also specificities, focusing, for instance, more on the formation of expectations. Armona et al. (2016) show that households extrapolate expectations from past information, but too little at a short horizon, where actual momentum is strong, and too much at a longer horizon, where house price growth tends to revert to the mean. Davis et al. (2017) show that households optimally update the estimate of the sale price of their home using a Kalman filter. They find that self-assessed house prices tend to be sticky, given that households adjust only partially their assessment by the full changes in local house prices indexes. This implies that self-assessed house prices are relative low during a boom and high during a bust, a result corroborating those of Benítez-Silva et al. (2015) discussed above.

Assessing accuracy of self-reported house prices by households is quite challenging, since housing is a very specific asset. Compared with other goods, houses are traded less frequently, are more

heterogeneous, and have larger price variances over time.[3] Thus, knowing one's current house value is difficult. It is possible that homeowners who report smaller losses in value than those suggested by market-based indices are correct, and that the market estimates are not fully accurate. The latter are, after all, based only on the homes that are sold in a given period, which may not be a random subsample of the total housing stock. Most studies have not considered the possibility that the self-reported house value could be more accurate than the market index, as homeowners may have private information about the condition of their house and the neighbourhood they live in. By going further, Kain and Quigley (1972) state that "the only accurate estimate of the market value of an owner-occupied house is its sale price at the time of purchase." This is why in the rest of this article we mainly refer to price "over/undervaluation", "misalignments" or "discrepancies" rather than to price "misjudgements" or "inaccuracies".

The remainder of the paper is organised as follows. Section 2 presents the data used, some descriptive statistics and the computation of the subjective house prices. In Section 3 we provide a description of the methodology used. Section 4 presents empirical results of the determinants of overvaluation in subjective house prices, including robustness checks. In Section 5 we provide additional results on the effects of housing valuation on consumption expenditures and the effects of the housing cycle on valuations.

[3] Furthermore, some assets can be traded at the same time but at different prices, see for instance, the famous example of the Royal Dutch Shell puzzle, in Lamont and Thaler (2003).

Table 1: Selected literature review

Authors (date)	Data source (country)	Model	Main findings	Type of study (*)
Agarwal (2007)	Panel data set of credit lines (2002/2005); US	Multinomial logit	Overestimation by 3.1%; overestimators more likely to increase spending	2
Bucchianeri and Miron-Shatz (2010)	ERM data set (2006), on 800 randomly chosen women in Franklin County, US	Hedonic regressions (for benchmark), regressions	Higher status (income, better neighbourhood, health) is associated with higher self-reported home values	1
Chan, Dastrup and Ellen (2016)	American Housing Survey (1997-2011, 1998-2010); US	OLS regressions	Self-reported house prices exceed market-based one when households are in negative equity (proxied by LTV) and when house prices fall.	1
Choi and Painter (2018)	Panel Study of Income Dynamics (1985/2013); US	OLS regressions	Underwater home owners generally report their house value above market estimates. Longer tenure household report higher home values	1
Corradin, Fillat and Vergara-Alertet (2017)	Panel Study of Income Dynamics household level (1984-2013): US	Augmented portfolio choice model with housing misperception	Households systematically overvalue or undervalue their houses. Misperception is sizable, countercyclical, and persistent. We note that 25 percent of the home owning households in our sample undervalue their house by at least 11 percent, while 25 percent of the homeowners overvalue their house by at least 9 percent	1

Davis and Quintin (2017)	Decennial Census of Housing and the American Community Survey (2000-2011); US	Kalman filter	Self-assessed house prices are relative low during a boom and high during a bust. Households optimally update the estimate of the sale price of their home using a Kalman filter	1
Gonzales and Quintana-Domeque (2009)	Acayucan Standard of Living Household Survey (2006): Mexico	OLS regressions	Homeowners with long-tenure largely overestimate the value of their home, other household specific characteristics are largely not significant	2
Goodman and Ittner (1992)	American Housing Survey (1985, 1987); US	OLS regressions	Owners overstate by 6%, future sellers 2-3% over non sellers; error in measurement is not correlated with house, owner or market characteristics	2
Kain and Kingley (1972)	Self-designed (1967); US		Owners understate house value by 2%	2
Mathä, Porpiglia and Ziegelmeyer (2017)	HFCS (1st wave)	Median regressions and decomposition techniques (Oaxaca-Blinder)	Study determinants of wealth accumulation: homeownership, housing value appreciation and intergenerational transfers. All three factors are found important drivers of wealth accumulation. They provide evidence that subjective house-price data report real estate dynamics relatively well across different euro area countries.	1

Note: (*) 1 Indicates a group of studies where homeowners house price estimates are assessed vis-à-vis hedonic house prices; 2 indicates a group of studies where homeowners house price estimates are assessed vis-à-vis lender/appraisers house prices estimates.

2. Data framework for subjective house prices and stylised facts

2.1 Descriptive statistics

The data used are from the Eurosystem's HFCS, whose aim is to gather micro-level structural information on European households' assets, liabilities, consumption and income, coupled with a large range of socio-demographic variables[4]. For the euro area, it includes 75 000 observations, which represent almost 144 million households. The dataset contains data both at the household and at the individual level, for a sample of households that is representative at the national and at the euro area level.

The survey took place for most countries in 2010 and 2011 for the first wave and mainly between 2013 and the first half of 2015 for the second wave, except for Spain where the reference period is somewhat older (2011-2012). We use household data for the second wave of the survey for all euro area countries excluding Lithuania, for which data are missing. In 2018, this represented 99.6% of the euro area nominal GDP, 99.2% of the population and 99.1% of the households. According to HFCN (2016a), homeowners represent 61% of euro area households. At the country level, the homeownership rates lie in a range between 44% in Germany and 85% in Slovakia.

Compared with previous papers using the first wave of the HFCS (for instance, Mätha et al (2017)), we use a more exhaustive dataset. In particular, we have now data for France and Finland on the purchasing date and price of the household main residence, while this data was missing in the first wave of the HFCS. A brief summary of relevant figures of the dataset is presented in Annex 1 in Tables A1 to A3.

For each homeowner and for all countries, the following data are available: the year of property acquisition, the property value at the time of its acquisition and the current price of the household main residence. Other additional housing characteristics can be available, as the size of the household main residence (in square meters[5]), or the type of dwelling[6]. However, for confidentiality reasons, important property characteristics such as the location of the property and other indicators of the quality of a dwelling (such as its outward appearance, the rating of surrounding buildings, security measures, etc.) are available in the HFCS but not accessible for research purposes. In addition, other important property characteristics such as the energy class, the year of construction, the number of bedrooms etc. are not

[4] For further information, see: https://www.ecb.europa.eu/pub/economic-research/research-networks/html/researcher_hfcn.en.html

[5] Data are available for all euro area countries. In the Netherlands, the data refers to the size of the main room.

[6] Data available for 15 euro area countries (missing in Spain, Ireland and the Netherlands), with the following breakdown: individual houses, semi-detached houses, flats/apartments and other kind of dwellings.

available in the HFCS. These data limitations on the property characteristics have to be taken into account when interpreting the results. Luckily, a larger set of variables related to household characteristics is available in the HFCS and could be used in our study: age, level of education, gender, employment status, as well as information on wealth, indebtedness and consumption decisions. We focus only on the main residence of the households and exclude from our scope other properties, first because we do not have their price at the date of purchase and because a large share of these properties consists of non-residential assets (commercial real estates, farms, warehouses, etc.).

In order to tackle the problem of missing variables, the HFCS is a multiply imputed dataset of five values: each observation is provided in five "replicates", (HFCN 2016b). In our analysis, we compute, first, for each variable of interest the median for the five replicates, before any further regression or statistical computation.

At the best of our knowledge, two papers (Albacete et al. (2016) and Mathä et al., 2017) derive house prices from HFCS data either computing average price changes at the individual level, or aggregating average prices of transactions at a specific date. We build on these methodologies and elaborate them further in sections 2.2 and Annex 2.

Data series of house price indices are manifold and can refer to slightly different concepts (for instance, depending on the type of dwellings). For all countries, the series chosen are those used in the Eurosystem's macroeconomic projections and considered to be the most representative for the evolution of house prices. Accordingly, the sources of house price indices are the ECB for Spain, the Netherlands and the euro area aggregate, national statistical institutes for Germany and France, and Banca d'Italia for Italy.

2.2 Subjective house price dynamics

Different approaches can be used to assess house price misalignments, i.e. the wedge (positive or negative) between house prices reported by households and those entailed in other sources (official/unofficial or estimated). A first approach, which is used in this paper and illustrated below, compares homeowner estimates with hedonic house price indices. A second approach compares individual homeowner estimates to lender or researcher/appraiser estimates (see Table 1 for an overview). The first approach is used in this paper, given the lack of alternative property estimates by lenders/appraisers for the countries examined[7].

[7] A third approach, much less common in the literature, uses panel data to examine whether homeowners describe their homes and mortgages consistently over time (Kennickell and Starr-McCluer (1997)).

So called “self-assessed” house prices are residential property prices as they are declared by households in the HFCS. Along with characteristics of their house, homeowners declare in the survey the property value of their main residence at the time of its acquisition and its current price. Thus, the self-reported price appreciation can be compared with the change of the house price index over the same period of time and possible misalignments can be derived.

Using data of the HFCS, we compute a self-assessed estimation of house price changes called Unit Average Change (UAC), based on the homeowner declarations of the value of their main residence. This indicator is a yearly average rate of return of owning a given household’s real estate asset, from the year of purchase to the time of the interview. This method was applied by Albacete et al. (2016) for the Austrian housing market, for both the main residences and the other real estates.

Let us denote with i each household who is owner of his main residence, P_{it} is the price at which the house was purchased and P_{iT} the current house price as estimated by the households when the survey was conducted. This price is a fictional price, since no transaction took place. The resulting nominal UAC index is then given by the following compound interest formula:

$$UAC_i = \left(\frac{P_{iT}}{P_{it}}\right)^{\frac{1}{T-t}} - 1 \qquad (1)$$

As a benchmark, one can construct a macro UAC (UAC_M) based on the national house price index (P_M) which can be compared, for each country, with the weighted average of the UAC_i at the micro level (UAC_m). [8]

$$UAC_M = \left(\frac{P_{MT}}{P_{Mt}}\right)^{\frac{1}{T-t}} - 1$$

$$UAC_m = \sum_{i=0}^{N} w_i \, UAC_i$$

Assuming that the house price at the date of purchase is correctly reported by households and coincides with the national market price index ($P_{M,t} = P_{m,t}$), we can derive an estimation of over/undervaluation as:

$$estim_t = \frac{P_{m,T}}{P_{M,T}} - 1 = \left(\frac{UAC_m + 1}{UAC_M + 1}\right)^{T-t} - 1 \qquad (2)$$

[8] The HFCS procedure for computing and adjusting survey weights takes into account: (i) the unit’s probability of selection; (ii) coverage issues; (iii) unit nonresponse; and (iv) an adjustment of weights to external data (calibration), see HFCN (2016b) for a discussion. Weights play a critical role in the interpretation of survey data, in obtaining population totals, means, and shares from the data. Even if there is no unanimous agreement on how weights should be used in regressions, we follow Mathä et al (2017) and weight all the descriptive statistics and the estimations of the regressions.

Since we have: $\begin{cases} P_{M,t}.(UAC_M + 1)^{T-t} = P_{M,T} \\ P_{m,t}.(UAC_m + 1)^{T-t} = P_{m,T} \end{cases}$

This approach has the advantage of simplicity but is also prone to some caveats.

First, the estimation is based on the assumption that the purchasing price declared by households is accurate. Since the purchase of the main residence is an important and rather unique moment in the life of a household, it appears reasonable to assume that households recall accurately the price at which they bought their home, even long ago (Bucks and Pence, 2006). However, the introduction of the single currency and the changeover between the national currency and the euro could have distorted the declaration of the value at the time of acquisition. In addition, cases when households used different subcontractors and/or provided own labour (so called "sweat equity") to build a property may also lead to difficulties to report a "correct" market value.

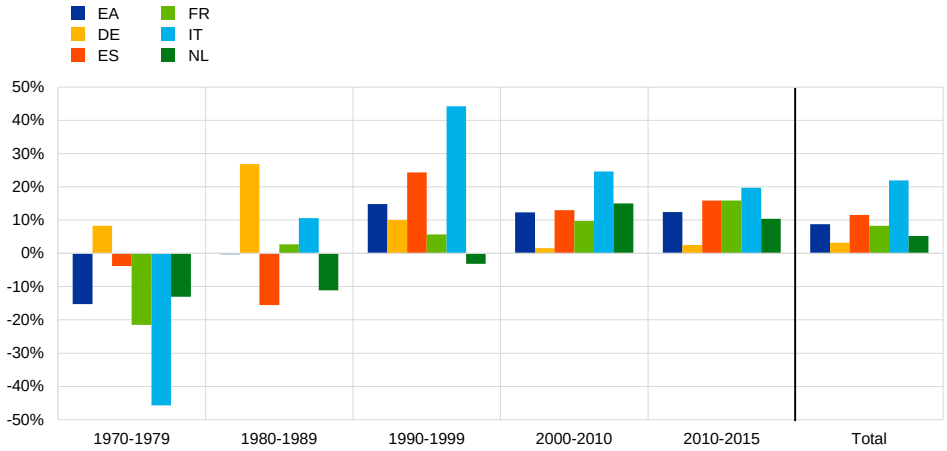
Second, we assume that prices at the time of purchase coincide with the national market price index ($P_{M,t} = P_{m,t}$). This can be empirically checked comparing the national house price indices with the median price of transactions reported in the HFCS. This index does not rely on the price of the same object over time, but appears nevertheless broadly comparable with the hedonic price of residential properties and Annex 2 shows that there is a cointegration relationship between the two price concepts. Finally, the house price reported by households at the time of the interview is based on the prices of the stock of capital (dwellings), which may differ from the prices of the transactions (as some houses are not traded much).

Bearing in mind these caveats and based on equation (2), we find that, on average, euro area households overestimate the value of their main residence by 8.7%, with an interquartile range of 61%. Across the largest countries of the euro area, the overestimation lies in a range between 3.2% in Germany and 22.0% in Italy (Chart 1). The distribution of these estimates varies across countries and is less disperse for the Netherlands and France and more disperse in the case of Italy and Spain (see Chart A3).

Estimates differ significantly depending on the year of property purchase. Households who purchased properties in the early part of the sample tend to undervalue them. Moreover, for properties purchased after the year 2000 the degree of cross-country heterogeneity of the estimates is lower than for properties purchased before 2000, which is a period characterised by both cross-country undervaluation and overvaluation. Results disaggregated by year of purchase should be cautiously interpreted due to possible compositional effects affecting them. In particular, the number of transactions varies across

periods and this may to some extent distort results. Periods of low transactions, generally coinciding with a downturn in the housing cycle, could amplify the wedge between self-assessed house prices and hedonic house prices (given that the latter is based on the actual number of transactions). In addition, the composition of new/existing dwellings could also vary over time and affect the estimates via changes in the hedonic house price index. Other compositional effects could also play a role: for instance, households who bought in 1970-1979 could have purchased properties in peripheral regions that are no longer attractive; hence, the self-assessed price of their house could be below the average house prices reflected by the macro-indicators, which entail more urban areas. Data on the location of the properties purchased are available in the survey, but are not disseminated for confidentiality reasons; therefore, there is unfortunately no way to test this hypothesis in our data.

Chart 1: over/underestimation of household main residence by period of purchase and country
(percentage)



Source: HFCS and own calculations.

3. Methodology

We investigate the main potential drivers of the wedge between self-assessed and hedonic house prices, which were discussed in Section 2.2 and computed in equation (2), using a quantile regression framework.

3.1 Quantile regression framework

In this section, we briefly review the quantile regression approach (see Koenker (1978) and (2005) for further details). While linear regression models predict how, on average, dependent variables react to a given level of regressor variables, quantile regression fits specified percentiles of the response of the dependent variables. Thus, quantile regression aims to model the conditional quantile functions, in which the quantiles of the conditional distribution of the dependent variable are expressed as functions of observed covariates.

Let us consider a general regression of the following form:

$$Y = X\beta + \varepsilon_t$$

where X is a $T \times k$ vector of regressors, β is a vector of coefficients and Y is a set of i.i.d dependent variables $(Y_t)_{t=1,\dots T}$.

For the average response $E(Y|X)$ of the former equation, β is estimated by solving the least squares minimization problem:

$$\hat{\beta} = argmin_{\beta}\{(Y - X\beta)'(Y - X\beta)\}$$[9]

For each quantile τ, defined as $0 < \tau < 1$, we can model the conditional quantile of Y given X, denoted $Q_{\tau}(Y|X)$, which is the value of Y below which the proportion of the conditional response is τ. For each quantile level, there is a set of regression coefficients, which is denoted β_{τ}.

By contrast with the OLS estimation of $\hat{\beta}$, it can be shown that the quantile estimator $\widehat{\beta_{\tau}}$ corresponds to the solution of the following minimization problem:

$$\widehat{\beta_{\tau}} = argmin_{\beta}\left\{\sum_{y_t - q \geq 0} \tau|Y_t - \beta| + \sum_{y_t - q < 0}(1-\tau)|Y_t - \beta|\right\} \quad (3)$$

For example, for τ = 0.5, the median regression is obtained as the solution of the minimizing problem of a sum of equally weighted absolute residuals: $\widehat{\beta_{0.5}} = argmin_{\beta} \sum_{t=1}^{T}|Y_t - \beta|$.

[9] Assuming that X is invertible, $\hat{\beta}$ can be assessed as: $\hat{\beta} = (X'X)^{-1}X'Y$.

Contrary to OLS or maximum likelihood, the minimization of (3) uses linear programming methods and can be computationally intensive. Nonetheless, quantile regression presents considerable appeal, which motivates our estimation choice.

First, quantile regressions estimates are more robust than OLS against outliers (and non-normal errors), which can be a main concern using microdata based only on household declarations. The choice of using quantile regressions is preferable compared with an arbitrary correction or elimination of outliers in the data sample.

Second, the choice of quantile regressions enables us to study the effect of regressors on the overall distribution of the dependent variable, and not only on its mean. It provides a richer view of the relationship of the dependent variable and the covariates, allowing to examine the relationship between a set of covariates and the different parts of the distribution of the response variable (see for example Sousa et (2006), Gerdesmeier et al (2015) as well as Zietz et al. (2008), McMillen (2008) and Liao and Wang (2010) for other applications to house prices).

Finally, the median regression can be more efficient than mean regression estimators in the presence of heteroscedasticity. Since our dependent variable (over/underestimation) cannot be log-linearized, heteroscedasticity could be a concern.

3.2 Estimation

We estimate for the euro area as a whole[10] and for the five largest euro area countries (Germany, France, Italy, Spain and the Netherlands) the following three sets of equations:

$$(A) \quad estim_{ic} = a_{ic} * type_{ic} + b_{ic} * size_{ic} + c_{ic} * year_{ic}$$

$$(B) \quad estim_{ic} = a_{ic} * age_{ic} + b_{ic} * education_{ic} + c_{ic} * labour_{ic} + d_{ic} * wealth_{ic} + e_{ic} * LTV_{ic}$$

$$(C) \quad estim_{ic} = a_{ic} * type_{ic} + b_{ic} * year_{ic} + c_{ic} * wealth_{ic} + d_{ic} * LTV_{ic}$$

Equation (A) refers to the characteristics of the properties: $estim_{ic}$ is the difference, expressed in percentage, between the self-assessed house price and the corresponding hedonic house price index for household i in country c (a positive number indicates overvaluation); $type_{ic}$ is the type of property (semi-detached house, flat/apartment, other) purchased by household i in country c; $size_{ic}$ is the size of the household's main residence broken down by quintile and $year_{ic}$ is the year of property acquisition.

[10] The euro area aggregate includes all countries for which observations are available.

Equation (B) refers to the household characteristics: age_{ic} is the age of the household at the year of purchase, $education_{ic}$ is the level of completed education (up to lower secondary education, between upper and post-secondary and tertiary or higher), $labour_{ic}$ refers to the labour market status of the household (self-employed, unemployed, retired or other); $wealth_{ic}$ to the wealth quintile of the household and LTV_{ic} to the loan to value ratio (zero, positive but below 90%, above 90% of the property value).

Finally, equation (C) combines some of the properties and household characteristics described above.

To guarantee comparability across samples, all estimations include a category dummy variable used to control for missing observations.

4. Estimation results and robustness

Estimation results of equation (A) are presented in Table A7 in the Annex. For each variable, the estimated coefficients are relative to the first bracket of estimation and show the marginal effects from a given bracket to the first one used as a baseline. Results shown are for the median (50th percentile).

Among the property characteristics, the type or size of a property do not generally influence the self-assessed property valuation of households. Results for the year of property acquisition differ across countries. In the Netherlands, owners who bought their properties more recently attribute a higher subjective price to them. For example, households who bought at the peak of the housing cycle between 2005 and 2010 value their house by more than 26% compared to those who bought before 1975. In Germany, the year of property acquisition does not affect the self-assessed valuation of homeowners. In the euro area, France and Italy results point to a larger valuation associated to the more recent year of property acquisition, which would support the evidence found by Kiel and Zabel (1999) and Agarwal (2007). Overall, the specific property characteristics analysed – with the exception of the year of property acquisition – seem to influence little the formation of subjective house prices by households and results broadly confirm the large spectrum of outcomes shown in the related literature (see Section 1).

Looking at the household characteristics and the estimation results of equation (B) in Table A8, it appears that some of these characteristics affect self-assessed house prices[11]. In the euro area, France, Italy and the Netherlands retired households value less their properties compared to employees, by between 10 and 20%. This result could be related to higher risk-aversion of retired households or higher "inattention" should these households be less informed of the actual developments and prices in property markets compared to younger households. However, the labour market conditions of households could be correlated with their age at the year of purchase. Households above 45-year appear to value more their properties in Italy and, to a lesser extent, in the Netherlands and the euro area but results are only mildly statistical significant in the latter two countries. The level of household education does not generally affect the value of properties, with the exception of Italy where higher educated households value less their properties. For the euro area, Germany, France, Italy and Spain households belonging to higher wealth quintile value more their properties, possibly in line with the "status syndrome" theory discussed above. For the euro area, households in the fifth quintile value their house by 1/3 more than those in the first quintile. More generally, the size of the coefficients associated to the fifth wealth quintile bracket is

[11] Additional households characteristics to those reported in Table A8 were tested and generally found not statistical significant for the majority of countries. These include gender, the fact that households are credit constrained or not as well as their behaviour regarding risky/non risky investments.

roughly double than for households in the second quintile in the euro area, Germany and Spain and about three times in France and Italy. On the contrary, wealth status does not generally affect self-assessed house prices in the Netherlands. These results should however be cautiously treated, given that it was not possible to hedonically adjust subjective house prices using their property characteristics, due to the data limitation discussed in Section 2.1. To this end, it could be argued that our results may also reflect, at least to some extent, the fact that wealthier households can better maintain their homes, with their prices rising faster than the price index. Finally, across all countries examined, households with a higher loan-to-value ratio attribute a higher value to their properties, by between 9 and 37% compared to households with no debt. This result is consistent with Chan et al. (2016), Choi et al. (2018) and Agarwal (2007). The intuition for this result is twofold. First, borrowers taking out large loans leading to high loan-to-value ratios are likely to have high house price expectations compared to market fundamentals (leading to some self-selection bias). Second, higher leveraged borrowers may be even more reluctant than lower leveraged one to report losses due to risk aversion.

Finally, we explore both selected household and property characteristics in equation (C) and the related results are presented in Table A9. Interestingly, results discussed above separately for property and household characteristics are broadly confirmed: the year of property acquisition, the level of indebtedness and the wealth quintile of households are important drivers of subjective house prices in the vast majority of countries examined, while property characteristics do not generally influence them.

To ascertain the validity of our conclusions, we perform a battery of robustness checks. First, in addition to median regressions of the overvaluation, we estimate quantile regressions at the 25th (first quartile) and 75th percentile (third quartile) of the house price distribution focusing on the specification of equation (C) which combines property and household characteristics (see Table A10). Results for the year of property acquisitions are broadly confirmed for the lower (25th) and higher (75th) percentiles of the overvaluation distribution: in the euro area, France and Italy results continue to point to a larger valuation associated with the more recent year of property acquisition. For the Netherlands, the year of property acquisition loses significance in the higher part of the distribution. Households belonging to the fifth wealth quintile value more their properties compared with those in the first wealth quintile both at the lower and higher tails of the house price distribution. Interestingly, the extent of this overvaluation is generally considerably larger at the third quartile of the house price distribution compared to the first[12]: for example for the euro area it is 29% compared to 49%, but the increase is even larger in Germany (from 38% to 86%). Results for the loan to value ratio are also broadly confirmed: households with a higher

[12] Italy is an exception, given that at the higher tail of the distribution wealth is not statistical significant.

loan-to-value ratio attribute a higher value to their properties and this is more apparent at the lower end of the house price distribution (especially for Germany, Spain and Italy).

Second, we exclude housing wealth (in the form of the household main residence) from our measure of net wealth to assess possible endogeneity issues in the estimations (see results in Tables A11 and A12). Results are reassuring and confirm those of the baseline specifications: the year of property acquisition and the level of indebtedness continue to be important drivers of subjective house prices. Our measure of wealth net of the housing main residence, i.e. financial wealth and other non-financial assets (including other properties than the main residence) is generally not statistical significant in the estimation. This may reflect the fact that the proxy used is far from optimal, still including financial wealth and housing wealth in the form of secondary properties. Using as alternative only financial wealth would also not be ideal given its relatively small share in the overall asset composition of households.

Third and finally, to address potential problems of oversampling of wealthy households which may be present in several countries (see Annex 1 for a discussion), we exclude the top 5% quintile of the wealth distribution for each variable used in the estimations. Results broadly confirm those of the baseline estimations (see Table A13) and also confirmed when we use age, education and labour market status instead of the type of dwelling and year of property acquisition.

5. Additional results: effect of housing valuation on consumption expenditures and the effects of the housing cycle on valuations

5.1 Effect of housing valuation on consumption

In this subsection, we investigate how housing valuation may affect households' consumption decisions. The intuition is that households who overestimate more the value of their main residence may tend to consume more, as a consequence of positive wealth effects.

Wealth effects refer to the channel through which household consumption is affected by changes in households' assets value, such as stocks, bonds and real estate. The vast literature on this topic presents mixed results on the assessment of the marginal effect of net wealth on consumption across countries. For example, Guerrieri and Mendicino (2018) find that the marginal propensity to consume (MPC) out of total wealth averages around 3% across the five largest euro area economies. Nocera and Roma (2018) estimate, for the euro area as a whole, a (peak) elasticity of consumption close to 0.1 to a 1% increase in real house prices.

Exploiting household level data in the HFCS, we regress consumption spending - expressed as a share of net income - on housing overvaluation, using median regressions. The consumption measure used accounts for the amount spent on consumer goods and services, as declared by households in the HFCS. It encompasses a broader range of consumption items compared to other narrow measures – also available in the HFCS – such as the amount spent in food, utilities etc. According to the euro area national accounts, the amount spent on consumer goods and services by households in 2017 represented more than 50% of their expenditure and more than 65% of their expenditure excluding actual and imputed rentals[13]. We assume that a large share of these items can be sensitive to wealth effects: food, clothing, recreational and cultural services, etc.

As regards net income, the HFCS variable measures the total household gross income, net of interest payments. Household gross income includes both labour income and interest/property income.

Through this regression method, we do not assess narrowly a wealth effect as a marginal propensity to consume, first, because wealth effects rely on the change in the wealth stock and not in a marginal valuation measure. Second, MPC are commonly evaluated using a time span, which is not available in the HFCS. However, within our sample of households, we assess how a higher housing valuation may positively affect the consumption behaviour of households.

[13] The amount spent on consumer goods and services available in the HFCS slightly differs from the national account concept, as it excludes certain items such as insurance policies or durable goods.

For the five largest countries of the euro area, and in the euro area as a whole, we find that a higher overvaluation is correlated with higher consumption expenditures. In addition, the estimated coefficients are statistical significant for France, Italy, Spain and the euro area. Even if correctly signed, coefficients are not significant in the case of Germany and the Netherlands (see Table A14). For France, Italy and the euro area, when we control for the position in the net wealth, the estimates remain positive and significant. Nevertheless, the estimated elasticities lie in a low range between 0.02 and 0.04, which cannot be directly compared with the MPC, for the reasons stated in the previous paragraph.

5.2 Cyclicality of self-assessed house prices

Finally, in this subsection, we explore whether the state of the housing cycle affects the subjective valuation of house prices. Corradin and al. (2017) show that household misperception is countercyclical in the US housing market. The rationale behind this finding is that households that bought during an upturn tend to underestimate the value of their house, since they are not fully aware of the amplitude and length of the upturn. On the contrary, if they bought in a downturn, they tend to underestimate the actual drop in the value of their property. Similar findings are reported by Benítez-Silva et al. (2015).

We assess this matter, subject to the constraint that we only have, at best, the quarter of interview for each household and we cannot assess changes of misperception across the cycle. First of all, we identify upturns and downturns of real house prices (deflated by HICP) using a modified Bry and Boschan (1971) quarterly algorithm, as in Harding and Pagan (2002). The parameter of minimum phase duration is set to six quarters, as in Borio and McGuire (2004) and Bracke (2011). At the micro level, using a dummy variable, we identify whether households bought during an upturn (1) or a downturn (0). In a first step, we regress this dummy variable on the level of over/undervaluation ($estim_{ic}$ as previously defined, Table A15). The signs of the coefficients are both positive and negative, depending on the countries, and the results are, in general, not statistical significant. To go beyond this crude estimation, we take into account that other factors than the position in the cycle at the date of purchase could affect the household valuation. For instance, if in the past households have experienced a higher number of upturns in terms of quarters (compared with the quarters of downturns); they may underestimate more the value of their house. Hence, in a second estimation, we regress the proportion of quarters of upturns experienced by households (as a share of the total number of quarters since the date of purchase) on the house price over/undervaluation. Results are generally consistent with our assumption of countercyclicality, the higher is the share of experienced upturns the lower is the degree of overvaluation (see table A16). Nevertheless, the results are not robust when we add the date of purchase in the regression; which point

to an overall fairly weak evidence of counter cyclicality of self-assessed house prices in our sample (see table A17).

6. Conclusions

Using the second wave of the HFCS we investigate, with the use of quantile regressions, the accuracy and determinants of self-assessed house prices and their main determinants in the euro area and its five largest countries. We find evidence that euro area homeowners overestimate the value of their properties by around 9%. Across the largest euro area countries, the overestimation lies in a range between 3.2% in Germany and 22% in Italy and differs significantly depending on the year of property acquisition.

We investigate, for the first time to the best of our knowledge, the possible drivers of this overestimation in terms of property, household characteristics and a combination of them. Property characteristics are generally not a significant factor affecting self-assessed house price valuations. The year of property acquisition, the level of indebtedness and the wealth quintile of households are instead important drivers of subjective house prices in the vast majority of countries examined. In particular, in line with the evidence found by Kiel and Zabel (1999) and Agarwal (2007), we find that a larger valuation is associated with the more recent year of property acquisition. In addition, across the vast majority of countries examined, households with a higher loan-to-value ratio attribute a higher value to their properties, by between 9 and 37% compared to households with no debt. This result is consistent with Chan et al. (2016), Choi et al. (2018) and Agarwal (2007). The rational could be found in the fact that borrowers taking out large loans leading to high loan-to-value ratios are likely to have high house price expectations compared to market fundamentals. In addition, due to risk aversion, higher leveraged borrowers may be more reluctant than lower leveraged one to report losses. Finally, we find that households who belong to higher wealth quintiles generally exhibit a larger house price valuation than other individuals possibly in line with the so-called “status syndrome” theory. For example, for the euro area, households in the fifth wealth quintile value their house by 1/3 more than those in the first quintile. An important caveat related to this result is that, due to data limitations on the property characteristics, subjective house prices are not adjusted by means of hedonic regressions. To this end, it could be argued that our results may also reflect, at least to some extent, the fact that wealthier households have more valuable dwellings.

The results described are robust to a battery of robustness checks including the estimation of quantile regressions at the 25th and 75th percentiles (in addition to median regressions), the exclusion of housing wealth from our measure of net wealth and the elimination of the top 5% of the wealth distribution to account for possible oversampling of wealthy households.

The paper also explores the possible effects of self-reported house price valuation on consumption expenditures. Evidence across euro area countries is mixed, but for the euro area as a whole higher self-assessed house prices are associated with a mild increase in consumption expenditures.

7. References

Adelino, M., A. Schoar and F. Severino, 2018, Perception of House Price Risk and Homeownership, manuscript

Agarwal, S., 2007, Why do Homeowners Misestimate their House Value?, Real Estate Economics, Vol. 35 (2), 35-154.

Albacete, N., P. Fessler and P. Lindner, 2016, The distribution of residential property price changes across homeowners and its implications for financial stability in Austria, Financial Stability Report, Oesterreichische Nationalbank (Austrian Central Bank), issue 31, pages 62-81.

Armona, L., A. Fuster and B. Zafar, 2016, Home Price Expectations and Behavior: Evidence from a Randomized Information Experiment, Federal Reserve Bank of New York Staff Reports, no. 798, October.

Benítez-Silva, H., S. Eren, F. Heiland and S. Jiménez-Martín, 2015, How well do individuals predict the selling prices of their homes?, Journal of Housing Economics, Elsevier, vol. 29(C), pages 12-25.

Borio, C. and P. McGuire, 2004, "Twin Peaks in Equity and Housing Prices?" BIS Quarterly Review, Vol. 7 (March), pp. 79–96.

Bover, O., 2015. Measuring expectations from household surveys: new results on subjective probabilities of future house prices, SERIEs, Vol.6(4), pp.361-405

Bracke, P., 2011, How Long Do Housing Cycles Last? A Duration Analysis for 19 OECD Countries. Place of Publication Not Identified: International Monetary Fund, 2011. Web.

Bry, G. and C. Boschan, 1971, Cyclical Analysis of Time Series: Selected Procedures and Computer Programs, NBER Technical Paper, No 20.

Bucks, B. and K. Pence, 2006, Do Homeowners Know Their House Values and Mortgage Terms? Federal Reserve Board of Governors Finance and Economics Discussion Series January.

Bucchianeri, G. W. and T. Miron-Shatz. 2010. Taking stock of housing wealth: reported home values.

Bucks B. and K. Pence, 2006, Do Homeowners Know Their House Values and Mortgage Terms?

Cameron, A.C. and P.K Triverdi, 2010, Microeconometrics using Stata. Revised edition, Texas: Stata Press.

Campbell, J. Y. and J. F. Cocco, 2007, How do house prices affect consumption? Evidence from micro data, Journal of Monetary Economics, Elsevier, vol. 54(3), pages 591-621, April.

Chan, S., S. Dastrup and E. Gould, 2016, Do Homeowners Mark to Market? A Comparison of Self-Reported and Estimated Market Home Values During the Housing Boom and Bust, Real Estate Economics, July 2016, Vol.44(3), pp.627-657

Choi, J. H. and G. Painter, 2018, Self-Reported vs. Market Estimated House Values: Are Homeowners Misinformed or Are They Purposely Misreporting? Real Estate Economics, June 2018, Vol.46(2), pp.487-520

Corradin, S., J. Fillat and C. Vergara-Alert, 2017, Portfolio Choice with House Value Misperception, Federal Reserve Bank of Boston, Research department working paper no 17-16

Davis, M. A. and E. Quintin, 2017, On the nature of self-assessed house prices, Real Estate Economics, July , Vol.45(3), pp.628-649

Disney, R., S. Bridges and J. Gathergood, 2006. Housing Wealth and Household Indebtedness: Is there a Household 'Financial Accelerator'? Unpublished manuscript. University of Nottingham, Nottingham.

ECB, 2016, The Eurosystem Household Finance and Consumption Survey: methodological report for the second wave. ECB Statistics Paper Series n 17 December.

ECB, 2018, The state of the housing cycle in the euro area, Economic Bulletin, Issue 7.

Gerdesmeier, D., A. Lenarčič and B. Roffia, 2015, An alternative method for identifying booms and busts in the Euro area housing market, Applied Economics, 47:5,499-518.

Gonzalez-Navarro, M. and C. Quintana-Domeque, 2009, The reliability of self-reported home values in a developing country context, Journal of Housing Economics, Vol.18(4), pp.311-324

Goodman, JL. Jr. and J. B. Ittner, 1992, The Accuracy of Home Owners' Estimates of House Value, Journal of Housing Economics, 2(4):339-57, December.

Guerrieri, C. and M. Caterina, 2018, Wealth Effects in the Euro Area, ECB Working Paper No. 2157, June.

HFCN 2016a, The Household Finance and Consumption Survey: results from the second wave, ECB Statistics Paper Series, No. 18, December.

HFCN 2016b, The Household Finance and Consumption Survey: methodological report for the second wave, ECB Statistics Paper Series, No. 17, December.

Ihlanfeldt, K.R. and J. Martinez-Vazquez, 1986, Alternative value estimates of owner-occupied housing: Evidence on sample selection bias and systematic errors. Journal of Urban Economics 20: 356-369.

Juster, F., J Lupton, J Smith and F Stafford, 2004, The Decline in Household Saving and the Wealth Effect, Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series No 2004-32.

Kennickell, A. B. and M. Starr-McCluer, 1997, Household Saving and Portfolio Change: Evidence from the 1983-89 SCF Panel, Review of Income and Wealth, Series 43, No. 4, 381-400 December.

Kiel, K. A. and J. E. Zabel, 1999, The Accuracy of Owner-Provided House Values: The 1978-1991 American Housing Survey, Real Estate Economics 27(2): 263-98.

Kish, L. and J. B. Lansing, 1954, Response Errors in Estimating the Value of Homes, Journal of the American Statistical Association 49.267, 520-38.

Klyuev, V and P. Mills, 2006, Is Housing Wealth an "ATM"? The Relationship Between Household Wealth, Home Equity Withdrawal, and Saving Rates, IMF Staff Papers, 54, issue 3, p. 539-561.

Koenker, R, and G. W. Bassett, 1978. Regression Quantiles. Econometrica, Vol. 46, pp 33–50.

Koenker, R., 2005. Quantile Regression. New York: Cambridge University Press.

Harding, D. and A. Pagan, 2002, Dissecting the Cycle: A Methodological Investigation, Journal of Monetary Economics, 49(2), 365–81.

Lamont, O. A and R. Thaler, 2003. Anomalies: The Law of One Price in Financial Markets, Journal of Economic Perspectives, 17 (4): 191-202.

Liao, W.-C. and X. Wang, 2010 Hedonic house prices and spatial quantile regression, IRES Working Paper Series, IRES 2010-009, IRES, Singapore

Lusardi, A. and O. S. Mitchell, 2006, Financial Literacy and Planning: Implications for Retirement Wellbeing, Pension Research Council Working Paper 2006-1.

McMillen, D. P., 2008, Changes in the distribution of house prices over time: structural characteristics, neighborhood, or coefficients?, Journal of Urban Economics, 64, 573–89. doi:10.1016/j.jue.2008.06.002

Nocera, A. and M. Roma, 2018, House Prices and Monetary Policy in the Euro Area: Evidence from Structural VARs, USC-INET Research Paper No. 18-13. Available at SSRN: https://ssrn.com/abstract=3256380 or http://dx.doi.org/10.2139/ssrn.3256380

Mathä, T.Y., A. Porpiglia and M. Ziegelmeyer, 2017, Household wealth in the euro area: The importance of intergenerational transfers, homeownership and house price dynamics, Journal of Housing Economics 35: 1-12

Sousa, J. and J. Ferreira Machado, 2006, Identifying asset price booms and busts with quantile regressions, Working Papers w200608, Banco de Portugal, Economics and Research Department

Zietz, J., E. N. Zietz, and G. S. Sirmans, 2008, Determinants of house prices: a quantile regression approach, The Journal of Real Estate Finance and Economics, 37, 317–33.

Kain, F. J. and M. Q. Quigley, 1972, Housing Market Discrimination, Home-Ownership, and Savings Behavior, The American Economic Review, vol. 62, no. 3, pp. 263–277. JSTOR, www.jstor.org/stable/1803375.

Annex 1: Data

The Household Finance and Consumption Survey

Table A1: Main characteristics of the survey

Country	Number of households	Number of obs.	Type of sampling design	Oversampling of wealthy	Time of interview
Euro area	144,410,643	74,935[a]	-	-	-
AT	3,862,526	2,997	2-stage stratified sampling	no	2014[1]
BE	4,796,647	2,238	1-stage stratified sampling	yes	2014[1]
CY	303,242	1,289	1-stage stratified sampling	yes	2014
DE	39,672,000	4,461	3-stage stratified sampling*	yes	2014
EE	571,857	2,220	1-stage stratified sampling	yes	2013
ES	17,429,813	6,106	2-stage stratified sampling**	yes	2011[2]
FI	2,622,499	11,030	1-stage stratified sampling	yes	2014
FR	29,017,678	12,035	2-stage stratified sampling	yes	2014[1]
GR	4,266,745	3,003	2-stage stratified sampling	yes	2014
IE	1,690,073	5,419	2-stage stratified sampling	yes	2014
IT	24,694,122	8,156	2-stage stratified sampling**	no	2015
LU	210,965	1,601	1-stage stratified sampling	yes	2014
LV	828,907	1,202	2-stage stratified sampling	yes	2014
MT	159,427	999	1-stage sampling	no	2014
NL	7,590,228	1,284	1-stage sampling	no	2014
PT	4,017,981	6,207	2-stage stratified sampling	yes	2013
SI	820,541	2,553	2-stage stratified sampling	yes	2014
SK	1,855,392	2,135	2-stage stratified sampling	yes	2014

Source: HFCS, 2nd wave.
Notes: the second wave of the HFCS also includes data for Hungary and Poland that we exclude from our analysis, focusing only on the euro area.
[a] the number of observations for the euro area covers both owner and tenant households. It differs from the number reported in our regressions, which only takes into account data on homeowners.
* in Germany, three stages for households living in municipalities with over 100,000 inhabitants, two stages for others.
** In Spain and Italy, one stage for households living in municipalities with over 100,000 and 40,000 inhabitants respectively, two stages for others.
[1] interviews were conducted between 2014 and 2015, with a majority of them in 2014.
[2] interviews were conducted between 2011 and 2012, with a majority of them in 2011.

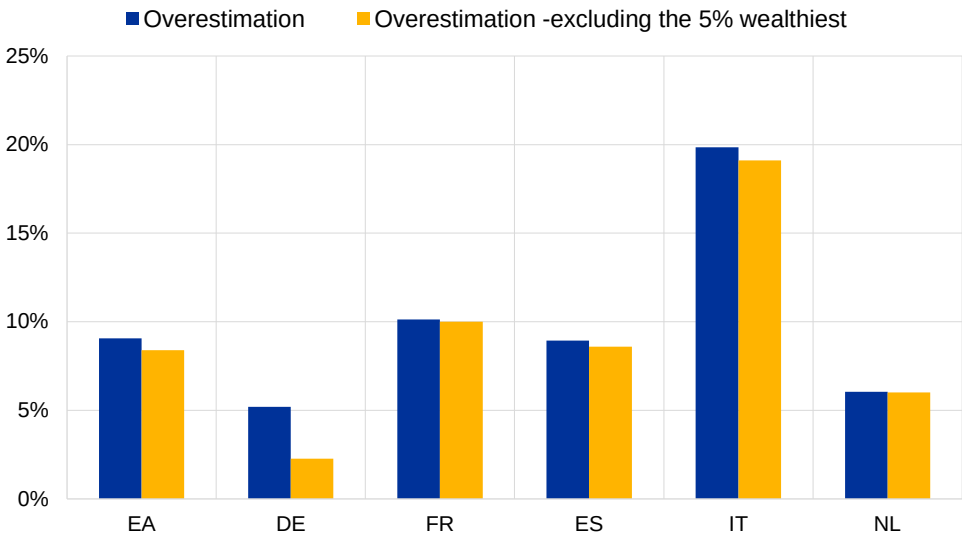
Weight and sampling

In wealth surveys, sampling strategies face a double challenge: the sample must be representative of the population as a whole and also be representative of the overall wealth.

In this respect, over-sampling of the wealthy is of importance in wealth surveys because overall wealth is unequally distributed and is specially skewed on the upper tail of the distribution. Furthermore, it has been shown that response rates are lower for wealthy households. A pure random sampling could lead to squeeze households with large wealth. To prevent this, fourteen out of eighteen countries oversample wealthy households, enriching the sample with a higher proportion of households with high asset values (see Table A.1, and for further details refer to HFCN 2016a).

As a consequence, we proceed to a robustness check, excluding the households belonging to the top 5% net wealth, first to assess the average rate of overestimation and secondly to carry out our regressions. In both cases, results are broadly unchanged compared to our baseline (see chart A1 and Table A13).

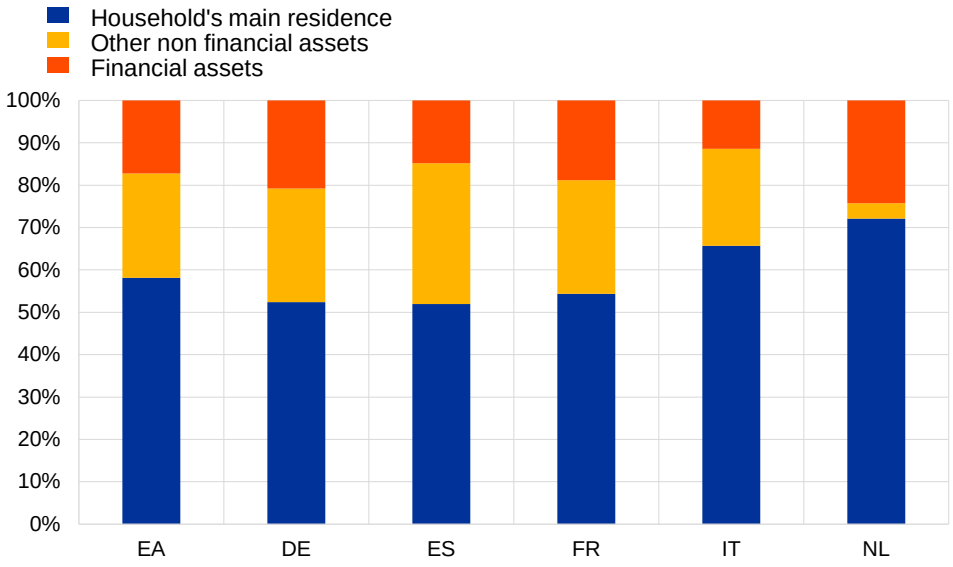
Chart A1: Over/underestimation of household main residence by country
(percentage)



Source: HFCS and own calculations.

Descriptive statistics

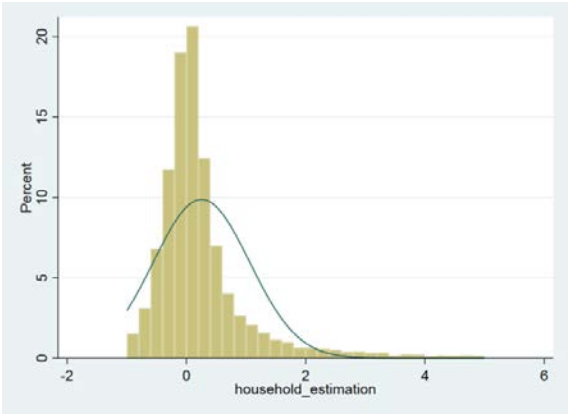
Chart A2: Composition of households' assets
(percentage)



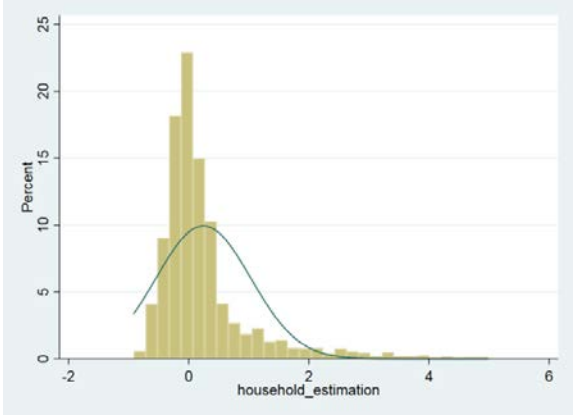
Source: HFCS and own calculations.

Chart A3: Distribution of over/undervaluation by country
(percentage)

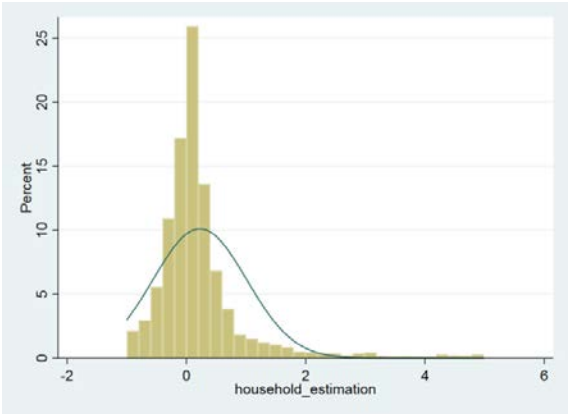
Euro area



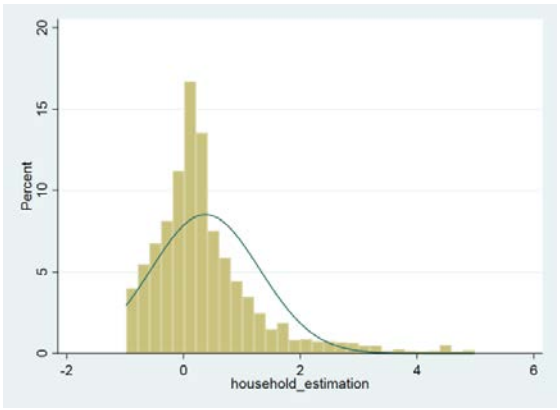
Germany



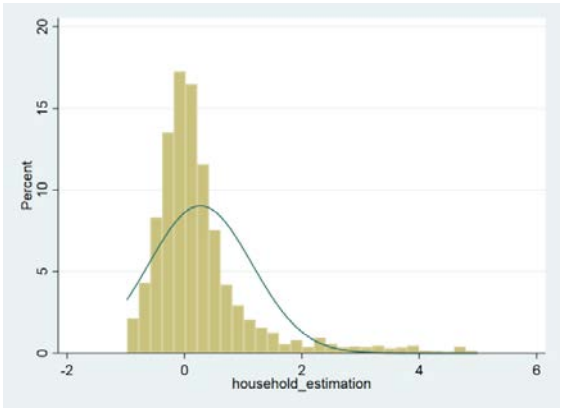
France



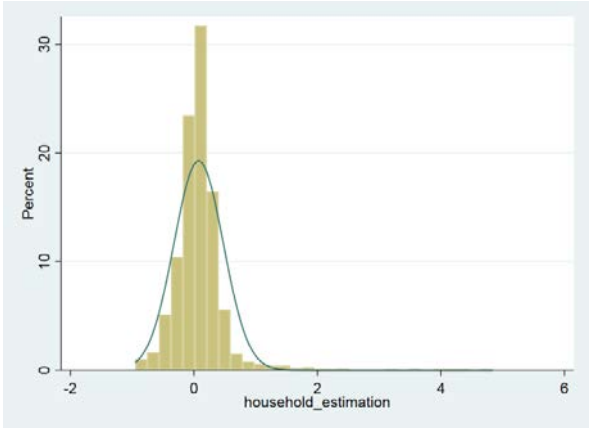
Italy



Spain



The Netherlands



Source: HFCS and own calculations.

Table A2: Summary statistics: share of the main variables of importance

Variable (in percentage)		Euro area	Germany	France	Italy	Spain	The Netherlands
Size of household main residence	0-30 sqm	1.9	0.2	0.5	0.2	0.1	32.2
	30-40 sqm	2.5		1.2	1.0	0.9	31.8
	40-50 sqm	3.3	1.6	2.9	2.8	1.5	18.6
	50-60 sqm	4.4	2.9	3.3	5.0	4.1	8.8
	60-80 sqm	18.5	17.3	16.7	21.8	22.8	4.9
	80-100sqm	23.1	19.7	25.9	28.1	31.5	1.0
	100-120 sqm	15.4	18.3	18.4	17.5	13.5	1.2
	120-150 sqm	12.0	18.6	12.1	10.4	9.3	0.8
	150-200 sqm	11.9	14.3	8.3	8.3	9.3	0.4
	>200sqm	4.4	7.2	2.3	4.8	7.1	0.2
	missing	2.4		8.2			0.2
Year of property acquisition	<1970	7.8	7.6	4.1	12.1	8.8	2.3
	1970-1975	5.7	5.5	4.0	7.4	7.6	2.5
	1975-1980	6.2	6.1	5.8	6.7	7.0	4.7
	1980-1985	8.5	8.0	7.1	11.2	9.6	5.2
	1985-1990	8.1	7.4	8.3	8.6	9.0	8.0
	1990-1995	9.4	9.0	7.4	10.1	10.2	11.2
	1995-2000	12.4	13.9	10.2	10.9	16.8	13.6
	2000-2005	14.3	15.1	13.3	12.5	18.0	13.3
	2005-2010	14.5	15.5	17.0	12.2	11.4	23.4
	≥2010	9.5	11.4	16.0	8.4	1.8	15.8
	missing	3.6	0.3	6.7			
Type of dwelling	Individual house	37.4	57.7	59.4	29.1		
	Semi-detached house	16.0	20.7	21.8	22.5		
	Flat/apartment	21.8	14.1	18.7	46.3		
	Other kind of dwelling	1.4	4.8	0.1	1.1		
	missing	23.5	2.7		1.0	100.0	100.0
Education of reference person	ISCED <= 2	32.9	6.9	29.9	49.6	51.8	22.5
	ISCED 3	35.3	50.1	40.3	35.7	16.5	13.2
	ISCED >=4	31.8	43.0	29.8	14.7	31.7	64.3
Age of reference person	<40 year	15.1	10.9	15.6	10.5	19.4	21.1
	40-64 year	51.5	56.5	49.1	50.0	50.1	53.6
	>64 year	33.3	32.6	35.3	39.5	30.4	25.2
Household type	One adult	24.9	27.4	28.7	25.1	18.8	24.9
	2 adults w/o children	33.0	40.8	34.3	28.3	29.1	35.7
	3 or more adults w/o children	9.5	7.8	4.5	14.5	12.7	3.9
	Single parent with children	2.8	2.1	3.5	2.4	2.9	2.5
	Two adults with children	25.1	19.3	26.4	23.7	29.4	30.7
	3 or more adults with children	4.7	2.5	2.7	5.9	7.0	2.3
Net wealth quintile	1	3.6	2.9	0.8	0.4	9.2	9.2
	2	12.0	2.1	7.9	14.8	21.6	6.7
	3	24.0	18.7	27.1	27.6	22.9	19.3
	4	29.7	36.6	31.6	28.4	23.0	31.1
	5	30.6	39.7	32.2	28.7	23.3	33.7
	missing	0.1		0.5			
Income quintile	1	13.1	9.3	11.2	14.1	17.6	8.8
	2	16.8	15.0	15.3	17.6	19.0	15.7
	3	19.9	19.8	19.9	19.3	20.0	19.9
	4	23.5	24.4	24.9	23.1	21.3	27.6
	5	26.8	31.6	28.7	26.0	22.1	27.9

Source: HFCS and own calculations.

Table A3: Summary statistics: median of Unit Average Changes

Variable (in percentage)		Euro area	Germany	France	Italy	Spain	The Netherlands
Size of household main residence	0-30 sqm	3.1	0.0	4.4	1.6	13.9	1.6
	30-40 sqm	3.1		5.0	4.7	8.1	2.8
	40-50 sqm	3.1	2.3	3.6	0.0	6.7	2.9
	50-60 sqm	3.7	4.2	3.1	2.5	7.9	2.8
	60-80 sqm	4.3	1.8	3.8	4.1	7.6	2.6
	80-100sqm	4.2	1.5	4.0	4.2	6.5	0.8
	100-120 sqm	4.0	2.1	4.1	4.1	7.3	0.3
	120-150 sqm	3.8	1.9	4.8	4.6	7.5	0.5
	150-200sqm	4.0	2.5	4.9	4.9	7.5	3.4
	>200sqm	4.7	2.1	5.2	5.6	6.5	1.7
	missing	10.6					0.0
Year of property acquisition	<=1975	5.5	2.5	5.3	5.6	10.0	4.6
	1975-1980	4.9	1.9	4.9	5.2	8.7	3.8
	1980-1985	4.8	2.0	4.4	4.9	7.8	4.1
	1985-1990	4.6	2.3	4.4	4.6	7.1	4.4
	1990-1995	4.3	1.1	4.8	4.1	6.4	4.5
	1995-2000	4.2	1.3	5.4	4.0	6.5	3.0
	2000-2005	2.6	1.6	4.1	2.6	4.6	0.8
	2005-2010	1.8	2.8	2.5	1.5	0.0	-0.3
	>2010	3.5	5.0	4.1			
Type of dwelling	Individual house	3.4	2.0	4.4	5.2		
	Semi-detached house	3.8	2.1	4.6	4.4		
	Flat/apartment	3.2	1.4	3.4	3.9		
	Other kind of dwelling	5.1	4.9	0.9	5.7		
	missing	5.7	2.1		3.4	7.1	2.5
Education of reference person	ISCED <= 2	5.4	1.3	4.4	5.0	7.8	3.3
	ISCED 3	3.5	2.0	4.6	3.9	6.3	2.9
	ISCED >=4	3.4	2.2	3.9	3.4	6.4	1.8
Age of reference person	<40 year	2.8	2.6	3.8	1.9	5.2	0.0
	40-64 year	3.9	1.9	4.3	3.8	6.6	2.9
	>64 year	4.7	2.1	4.5	5.3	9.1	3.6
Household type	One adult	3.9	2.1	4.1	4.6	8.1	2.2
	Two adults w/o children	4.1	2.0	4.6	4.9	7.8	3.2
	Three or more adults w/o children	4.9	2.5	4.3	4.5	7.6	3.3
	Single parent with children	3.4	1.0	3.7	3.0	6.1	1.5
	Two adults with children	3.6	1.8	4.2	3.3	5.8	1.5
	Three or more adults with children	4.7	1.9	4.6	4.0	6.5	4.3
Net wealth quintile	1	0.0	0.0	0.2	-2.1	1.6	0.0
	2	4.0	0.3	2.0	2.8	6.6	1.2
	3	4.1	1.3	3.8	3.8	7.2	1.8
	4	4.0	1.9	4.5	4.4	7.5	2.7
	5	4.4	2.5	4.8	5.4	7.9	3.6
	missing	4.6		4.6			
Income quintile	1	5.1	2.6	4.9	4.5	8.4	2.6
	2	4.3	2.3	4.5	5.0	7.3	3.6
	3	4.0	1.4	4.4	4.2	6.9	1.9
	4	3.8	2.1	4.2	4.3	6.5	2.8
	5	3.7	2.0	4.2	4.0	6.7	1.4

Source: HFCS and own calculations.

Note: The Unit Average Change (UAC) is based on the homeowner declarations of the value of their main residence. This indicator is a yearly average rate of return of owing a given household's real estate asset, from the year of purchase to the time of the interview (see Section 2.2).

Annex 2: House prices of transactions

A key assumption of our study is that house value misperception is zero at the time of purchase; that is households report accurately the price of purchase. A way to assess the consistency of this hypothesis is to compare the average price of the transactions (ATI) reported in the HFCS with the hedonic index of house prices.

Derived from micro data, the average price of transactions are computed by Albacete et al. (2016), as follows:

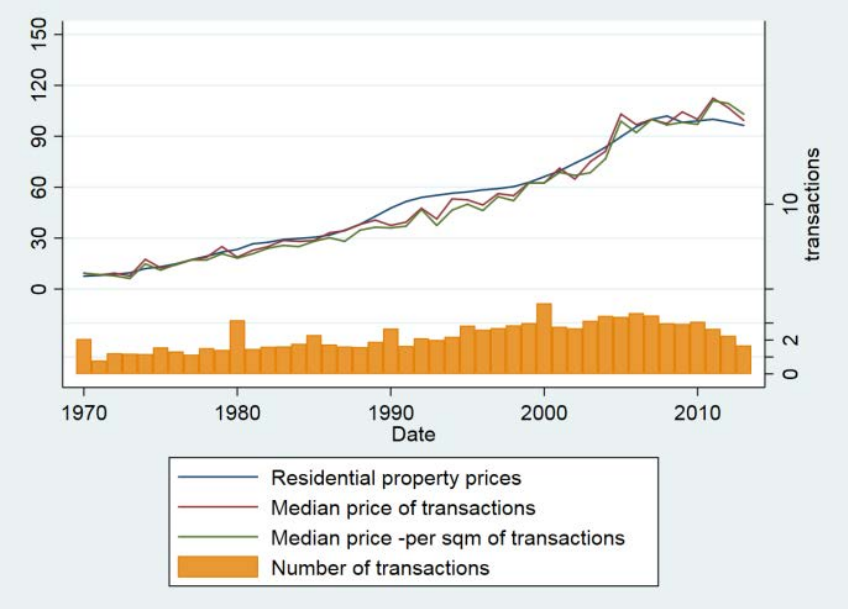
$$ATI_t = \frac{\sum_{it} P_{it}}{n_t}$$

Where n_t is the number of houses purchased in year t and P_{it} is the price of purchase for the house bought by the household i in year t. The ATI can be equated with a hedonic price index, referring to different objects from a period to the next one.

We amend the methodology developed by Albacete et al. (2016), by adjusting the price of purchase by the size of the residence (expressed in square meters) and by replacing the average of the transaction prices by the median. In the rest of the section, we use the term of MTI (median price of transactions).

Chart A4: Median price of transactions in the euro area

(percentage)



Source: HFCS and own calculations. Note: on the left hand scale, we report house prices as an index (= 100 in 2010). On the right hand scale, we show the proportion of transactions reported in the survey.

We investigate both the long-term and the short term relationships between the MTI, based on the micro data, and the official hedonic house prices. The general idea behind these regressions is to check whether prices of the transactions reported by households map those building the house price index.

Short run relationship between MTI and the hedonic price index

For each year between 1971 and 2018, we regress the annual change of the MTI on the annual change of the hedonic index of house prices.

The short-term relationships between MTI and the hedonic price index in Germany and Italy are rather loose. By contrast, data fits much better in the Netherlands, at the euro area level and to a lesser extent in France and in Spain (see Table A4).

Table A4: Short-term relationships between ATI and the hedonic price indices

	Euro Area	Germany	France	Italy	Spain	The Netherlands
$dlog(houseprices)$	1.213***	1.029	0.745*	0.315	0.763*	1.011***
	(0.324)	(1.115)	(0.307)	(0.199)	(0.301)	(0.248)
Number of observations	43	43	43	44	40	43
Adjusted R2	0.232	-0.003	0.102	0.033	0.119	0.266
Sample	1971-2013	1971-2013	1971-2013	1971-2014	1972-2011	1971-2013

Note: dependent variable is the percentage change of the median of transaction (MTI). Robust standard errors are given in parentheses.
(*), (**) and (***) denote 10%, 5% and 1% significance level, successively.

Long run relationship between MTI and the hedonic price index

To establish a long-run relationship between the index of house prices and (MTI, we carry out a co-integration analysis. The Augmented Dickey-Fuller unit root tests presented in Table A5 accept the null hypothesis that both series contain one unit-root. Both series are I(1) and are stationary once we differentiate them.

Table A5: Unit root tests for log(house prices) and log(MTI)

log(house prices)

	Euro area		Germany		France		Italy		Spain		The Netherlands	
H0	ADF t-statistic	Prob	ADF t-statistic	Prob	ADF t-statistic	Prob	ADF t-statistic	Prob	ADF t-statistic	Prob	ADF t-statistic	Prob
log(house prices) has a unit root	0.52	0.82	1.54	0.97	0.75	0.87	0.49	0.82	0.56	0.83	1.32	0.95
D(log(house prices)) has a unit root	-2.05	0.04	-2.28	0.02	-1.80	0.07	-1.86	0.06	-2.11	0.03	-2.78	0.01

log(MTI)

	Euro area		Germany		France		Italy		Spain		The Netherlands	
H0	ADF t-statistic	Prob	ADF t-statistic	Prob	ADF t-statistic	Prob	ADF t-statistic	Prob	ADF t-statistic	Prob	ADF t-statistic	Prob
log(MTI) has a unit root	3.30	1.00	1.60	0.97	3.79	1.00	2.46	1.00	1.86	0.98	2.46	1.00
D(log(MTI)) has a unit root	-9.86	0.00	-5.84	0.00	-2.16	0.03	-7.86	0.00	-3.61	0.00	-8.97	0.00

In a second step, we regress the log(house prices) on log(MTI), using ordinary least squares, in order to check the stationarity of the residual and validate the cointegrating relationship.

$$\log(house\ prices_t) = \beta.\log(MTI_t) + e_t$$

We can reject the null hypothesis of the non-stationarity of the residuals. The cointegrating relationship between house prices and MTI is valid (see Table A6).

Table A6: Unit root tests for the residual of the long-run relationship

	Euro area		Germany		France		Italy		Spain		The Netherlands	
H0	ADF t-statistic	Prob	ADF t-statistic	Prob	ADF t-statistic	Prob	ADF t-statistic	Prob	ADF t-statistic	Prob	ADF t-statistic	Prob
et has a unit root	-5.55	0.00	-5.63	0.00	-5.42	0.00	-3.38	0.00	-5.67	0.00	-5.07	0.00

Annex 3: Empirical results

Determinants of over/undervaluation – median regressions

Table A7: Estimation results of equation (A)

	Euro area	Germany	France	Italy	Spain	The Netherlands
Type of dwelling [base: individual house]						
Semi-detached house	0.0364*	0.0669	0.0203	-0.0620		
	(0.0172)	(0.0510)	(0.0162)	(0.0590)		
Flat/apartment	-0.0458**	0.00724	-0.00915	-0.0842		
	(0.0157)	(0.0432)	(0.0179)	(0.0508)		
Other kind of dwelling	0.218	0.207	-0.126	0.378		
	(0.232)	(0.182)	(0.164)	(0.955)		
Size of household main residence [base: first quintile]						
Second quintile	-0.00744	0.0267	0.00601	0.0168	-0.0757	-0.00230
	(0.0154)	(0.0603)	(0.0203)	(0.0376)	(0.0424)	(0.0229)
Third quintile	-0.0179	0.0360	-0.0243	-0.0158	-0.0659	-0.0190
	(0.0148)	(0.0512)	(0.0197)	(0.0414)	(0.0407)	(0.0216)
Fourth quintile	0.0208	0.0713	0.0707**	0.0277	-0.0227	0.00179
	(0.0183)	(0.0652)	(0.0232)	(0.0416)	(0.0562)	(0.0286)
Fifth quintile	0.0578**	0.105	0.0554*	0.184**	-0.00623	0.0357
	(0.0187)	(0.0573)	(0.0225)	(0.0615)	(0.0510)	(0.0260)
Year of property acquisition [base: before 1975]						
1975-1985	0.150***	0.0370	0.252***	0.581***	-0.107	-0.00370
	(0.0407)	(0.141)	(0.0686)	(0.0612)	(0.0784)	(0.0695)
1985-1995	0.328***	0.0313	0.437***	0.936***	0.247***	0.0217
	(0.0399)	(0.152)	(0.0668)	(0.0560)	(0.0664)	(0.0607)
1995-2000	0.259***	0.00811	0.306***	0.912***	0.110	0.105
	(0.0371)	(0.134)	(0.0624)	(0.0621)	(0.0603)	(0.0582)
2000-2005	0.291***	-0.0469	0.342***	0.844***	0.196**	0.223***
	(0.0365)	(0.135)	(0.0623)	(0.0507)	(0.0630)	(0.0606)
2005-2010	0.344***	-0.0401	0.468***	0.879***	0.291***	0.261***
	(0.0360)	(0.132)	(0.0605)	(0.0454)	(0.0628)	(0.0562)
2010-2015	0.320***	-0.0213	0.463***	0.771***	0.182	0.160*
	(0.0361)	(0.132)	(0.0605)	(0.0529)	(0.226)	(0.0640)
Number of observations	31280	2459	6667	3799	4562	867

Note: median regression coefficients with robust standard errors given in parentheses. (*), (**) and (***) denote 10%, 5% and 1% significance level, successively. The dependent variable is the household over/undervaluation expressed in percentage. All explanatory variables are indicator variables. The regression for the euro area includes dummy variables for country-fixed effects that are not reported in the table. Coefficients are marginal effects from a baseline set in brackets. It represents the discrete change from the base level (dy/dx).

Table A8: Estimation results of equation (B)

	Euro area	Germany	France	Italy	Spain	The Netherlands
Age at the year of purchase [base: <30 years]						
30-45 years	-0.00599	-0.0531	-0.0419**	0.0506	0.0609	0.000974
	(0.0127)	(0.0500)	(0.0137)	(0.0344)	(0.0336)	(0.0232)
>45 years	0.0307*	-0.0693	0.0260	0.183***	0.0601	0.0775**
	(0.0145)	(0.0542)	(0.0165)	(0.0432)	(0.0454)	(0.0268)
Education [base: Low (ISCED1 and 2)]						
Middle (ISCED 3-4)	-0.0221	0.0371	0.00698	-0.0622	-0.106*	0.00276
	(0.0188)	(0.0473)	(0.0181)	(0.0411)	(0.0476)	(0.0358)
High (ISCED 5-6)	-0.0306	0.00937	-0.0360*	-0.130**	-0.0319	-0.0154
	(0.0181)	(0.0456)	(0.0178)	(0.0440)	(0.0404)	(0.0323)
Labor market status [base: employee]						
Self-employed	-0.0346	0.0598	0.0202	-0.188***	-0.113	0.0300
	(0.0210)	(0.0654)	(0.0223)	(0.0479)	(0.0671)	(0.0741)
Unemployed	0.00862	0.277	0.00106	-0.0128	0.0573	-0.0625
	(0.0314)	(0.336)	(0.0258)	(0.0419)	(0.0632)	(0.112)
Retired	-0.102***	-0.00234	-0.159***	-0.188***	-0.0279	-0.198***
	(0.0170)	(0.0460)	(0.0187)	(0.0441)	(0.0510)	(0.0296)
Other	-0.0577*	-0.0350	0.0485	-0.0610	-0.0295	-0.175*
	(0.0251)	(0.0363)	(0.0837)	(0.0585)	(0.0450)	(0.0683)
Net wealth quintile [base: first quintile]						
Second quintile	0.154***	0.240*	0.0826***	0.202**	0.169*	-0.0276
	(0.0207)	(0.118)	(0.0201)	(0.0737)	(0.0838)	(0.0290)
Third quintile	0.206***	0.301***	0.153***	0.348***	0.209**	-0.00506
	(0.0218)	(0.0581)	(0.0215)	(0.0724)	(0.0779)	(0.0356)
Fourth quintile	0.271***	0.438***	0.211***	0.465***	0.225**	0.0124
	(0.0216)	(0.0608)	(0.0229)	(0.0739)	(0.0774)	(0.0338)
Fifth quintile	0.355***	0.552***	0.248***	0.666***	0.315***	0.0760*
	(0.0218)	(0.0629)	(0.0227)	(0.0795)	(0.0786)	(0.0367)
Loan to value [base: LTV = 0]						
[0-0.9]	-0.0103	-0.0510	0.0121	0.0795**	0.0699	-0.0306
	(0.0128)	(0.0343)	(0.0151)	(0.0301)	(0.0399)	(0.0326)
[>0.9]	0.175***	0.278***	0.160***	0.366***	0.185***	0.0945**
	(0.0158)	(0.0517)	(0.0182)	(0.0385)	(0.0384)	(0.0303)
Number of observations	**31280**	**2459**	**6667**	**3799**	**4562**	**867**

Note: median regression coefficients with robust standard errors given in parentheses. (*), (**) and (***) denote 10%, 5% and 1% significance level, successively. The dependent variable is the household over/undervaluation expressed in percentage. All explanatory variables are indicator variables. The regression for the euro area includes dummy variables for country-fixed effects that are not reported in the table. Coefficients are marginal effects from a baseline set in brackets. It represents the discrete change from the base level (dy/dx).

Table A9: Estimation results of equation (C)

	Euro area	Germany	France	Italy	Spain	The Netherlands
Type of dwelling [base: individual house]						
Semi-detached house	0.0287	-0.000176	0.00893	-0.0405		
	(0.0183)	(0.0538)	(0.0150)	(0.0521)		
Flat/apartment	-0.0553***	-0.0158	-0.0252*	-0.113*		
	(0.0133)	(0.0365)	(0.0113)	(0.0457)		
Other kind of dwelling	0.208	0.351	-0.146	0.415		
	(0.243)	(0.252)	(0.290)	(0.884)		
Year of property acquisition [base: before 1975]						
1975-1985	0.135***	0.00973	0.226***	0.495***	-0.118	0.0494
	(0.0377)	(0.104)	(0.0523)	(0.0451)	(0.0664)	(0.0805)
1985-1995	0.306***	0.0168	0.416***	0.898***	0.192**	0.0409
	(0.0391)	(0.111)	(0.0556)	(0.0489)	(0.0628)	(0.0567)
1995-2000	0.249***	-0.0239	0.290***	0.885***	0.0726	0.156**
	(0.0373)	(0.101)	(0.0480)	(0.0445)	(0.0617)	(0.0600)
2000-2005	0.300***	-0.0457	0.330***	0.839***	0.247***	0.306***
	(0.0368)	(0.0978)	(0.0477)	(0.0446)	(0.0642)	(0.0564)
2005-2010	0.378***	-0.0132	0.470***	0.913***	0.406***	0.352***
	(0.0359)	(0.0944)	(0.0454)	(0.0428)	(0.0712)	(0.0564)
2010-2015	0.377***	0.0237	0.488***	0.864***	0.606	0.239***
	(0.0362)	(0.101)	(0.0453)	(0.0466)	(0.612)	(0.0581)
Net wealth quintile [base: first quintile]						
Second quintile	0.151***	0.217	0.124***	0.268***	0.261***	-0.00324
	(0.0151)	(0.162)	(0.0133)	(0.0676)	(0.0450)	(0.0275)
Third quintile	0.227***	0.281**	0.210***	0.404***	0.297***	0.0537
	(0.0158)	(0.102)	(0.0176)	(0.0665)	(0.0397)	(0.0311)
Fourth quintile	0.295***	0.435***	0.288***	0.502***	0.336***	0.0951**
	(0.0171)	(0.104)	(0.0197)	(0.0670)	(0.0438)	(0.0337)
Fifth quintile	0.376***	0.530***	0.321***	0.681***	0.398***	0.161***
	(0.0149)	(0.103)	(0.0182)	(0.0753)	(0.0428)	(0.0368)
Loan to value [base: LTV = 0]						
[0-0.9]	-0.0527***	-0.0633	-0.0276	-0.0984**	-0.0938*	-0.0562*
	(0.0131)	(0.0328)	(0.0146)	(0.0342)	(0.0452)	(0.0246)
[>0.9]	0.149***	0.272***	0.140***	0.148**	0.0696	0.114***
	(0.0166)	(0.0774)	(0.0172)	(0.0519)	(0.0398)	(0.0258)
Number of observations	**31280**	**2459**	**6667**	**3799**	**4562**	**867**

Note: median regression coefficients with robust standard errors given in parentheses. (*), (**) and (***) denote 10%, 5% and 1% significance level, successively. The dependent variable is the household over/undervaluation expressed in percentage. All explanatory variables are indicator variables. The regression for the euro area includes dummy variables for country-fixed effects that are not reported in the table. Coefficients are marginal effects from a baseline set in brackets. It represents the discrete change from the base level (dy/dx).

Determinants of over/undervaluation – regressions at the 25% and 75% percentiles of the dependent variable

Table A10 Estimation results of equation (C)

	Euro area		Germany		France		Italy		Spain		The Netherlands	
Type of dwelling [base: individual house]	**q=0.25**	**q=0.75**	**q=0.25**	**q=0.75**	**q=0.25**	**q=0.75**	**q=0.25**	**q=0.75**	**q=0.25**	**q=0.75**	**q=0.25**	**q=0.75**
Semi-detached house	0.0359***	0.0170	0.0363	-0.0384	0.0112	-0.00489	-0.0250	-0.115				
	(0.0108)	(0.0326)	(0.0227)	(0.102)	(0.0108)	(0.0305)	(0.0286)	(0.116)				
Flat/apartment	2.22e-16	-0.183***	-0.0455	-0.0689	-0.00794	-0.117***	-0.0474*	-0.279**				
	(0.0103)	(0.0261)	(0.0528)	(0.118)	(0.0118)	(0.0264)	(0.0238)	(0.0946)				
Other kind of dwelling	0.124***	1.033	0.143*	1.726	-0.508	-0.177	0.00724	1.012				
	(0.0191)	(1.041)	(0.0586)	(1.184)	(0.659)	(0.261)	(0.0713)	(1.200)				
Year of property acquisition [base: before 1975]												
1975-1985	0.208***	0.237**	0.00763	0.142	0.215**	0.378**	0.305***	0.732***	-0.0689	-0.000974	0.0461	0.148
	(0.0297)	(0.0739)	(0.0892)	(0.260)	(0.0739)	(0.119)	(0.0306)	(0.0987)	(0.0630)	(0.265)	(0.0620)	(0.135)
1985-1995	0.370***	0.400***	0.0330	0.163	0.375***	0.676***	0.655***	1.140***	0.201**	0.297	0.110*	0.0347
	(0.0282)	(0.0657)	(0.0854)	(0.192)	(0.0735)	(0.147)	(0.0450)	(0.118)	(0.0611)	(0.230)	(0.0501)	(0.117)
1995-2000	0.411***	0.189**	0.0111	-0.0235	0.320***	0.298**	0.787***	1.060***	0.236***	-0.0125	0.210***	0.0423
	(0.0299)	(0.0626)	(0.0977)	(0.192)	(0.0735)	(0.109)	(0.0364)	(0.103)	(0.0641)	(0.236)	(0.0535)	(0.117)
2000-2005	0.468***	0.162**	0.0529	-0.168	0.408***	0.240*	0.803***	0.937***	0.378***	0.0743	0.346***	0.190
	(0.0286)	(0.0577)	(0.0891)	(0.149)	(0.0726)	(0.100)	(0.0267)	(0.102)	(0.0671)	(0.231)	(0.0484)	(0.117)
2005-2010	0.582***	0.222***	0.141	-0.224	0.589***	0.294**	0.902***	1.011***	0.505***	0.278	0.426***	0.242*
	(0.0278)	(0.0579)	(0.0856)	(0.134)	(0.0718)	(0.0969)	(0.0303)	(0.0920)	(0.0723)	(0.263)	(0.0464)	(0.116)
2010-2015	0.594***	0.178**	0.178*	-0.0991	0.638***	0.265**	0.817***	0.854***	0.827***	0.348	0.293***	0.139
	(0.0292)	(0.0593)	(0.0883)	(0.179)	(0.0717)	(0.0982)	(0.0287)	(0.0968)	(0.227)	(1.249)	(0.0535)	(0.131)
Wealth net quintile [base: first quintile]												
Second quintile	0.112***	0.215**	-0.0265	1.310**	0.0568*	0.173***	0.227***	0.562	0.167*	0.399***	0.0390	0.0462
	(0.0234)	(0.0664)	(0.230)	(0.411)	(0.0226)	(0.0418)	(0.0340)	(0.699)	(0.0747)	(0.0993)	(0.0401)	(0.0576)
Third quintile	0.153***	0.317***	0.165**	0.640*	0.132***	0.369***	0.306***	0.677	0.223**	0.472***	0.0185	0.0786
	(0.0219)	(0.0681)	(0.0578)	(0.264)	(0.0216)	(0.0327)	(0.0359)	(0.698)	(0.0705)	(0.0928)	(0.0247)	(0.0417)
Fourth quintile	0.221***	0.351***	0.259***	0.652***	0.191***	0.407***	0.363***	0.812	0.215**	0.454***	0.0797**	0.136***
	(0.0225)	(0.0672)	(0.0651)	(0.183)	(0.0235)	(0.0372)	(0.0422)	(0.699)	(0.0762)	(0.106)	(0.0253)	(0.0332)
Fifth quintile	0.293***	0.487***	0.384***	0.860***	0.230***	0.498***	0.471***	1.156	0.315***	0.401***	0.0788*	0.222***
	(0.0222)	(0.0705)	(0.0611)	(0.186)	(0.0230)	(0.0438)	(0.0391)	(0.699)	(0.0727)	(0.0981)	(0.0313)	(0.0384)
Loan to value (LTV) [base: LTV=0]												
[0-0.9]	-0.00821	-0.181***	-0.0173	-0.202*	0.0300**	-0.111***	-0.0774**	-0.312***	-0.0398	-0.269***	-0.0352	-0.00160
	(0.00932)	(0.0265)	(0.0271)	(0.0906)	(0.0110)	(0.0288)	(0.0285)	(0.0720)	(0.0370)	(0.0705)	(0.0376)	(0.0308)
[>0.9]	0.153***	0.134***	0.221***	0.433	0.156***	0.181***	0.167***	0.248	0.0999**	-0.0333	0.110**	0.162***
	(0.0108)	(0.0335)	(0.0341)	(0.256)	(0.0130)	(0.0366)	(0.0306)	(0.183)	(0.0369)	(0.0866)	(0.0361)	(0.0339)
Number of observations	**31280**	**31280**	**2459**	**2459**	**6667**	**6667**	**3799**	**3799**	**4562**	**4562**	**867**	**867**

Note: Robust standard errors are given in parentheses, (*), (**) and (***) denote 10%, 5% and 1% significance level, successively. The dependent variable is the household over/undervaluation expressed in percentage. All explanatory variables are indicator variables. The regression for the euro area includes dummy variables for country-fixed effects that are not reported in the table. Coefficients are marginal effects from a baseline set in brackets. It represents the discrete change from the base level (dy/dx). The first/second columns show estimation results of quantile regression at the 25th/75th percentiles, respectively.

Determinants of over/undervaluation - regressions excluding housing wealth

Table A11: Estimation results of equation (B)

	Euro area	Germany	France	Italy	Spain	The Netherlands
Age at the year of purchase [base: <30 years]						
30-45 years	0.00903	-0.0369	-0.0325*	0.0880**	0.0441	0.00400
	(0.0109)	(0.0565)	(0.0155)	(0.0302)	(0.0336)	(0.0241)
>45 years	0.0320*	-0.0642	0.0349	0.187***	0.0543	0.0824**
	(0.0126)	(0.0566)	(0.0181)	(0.0453)	(0.0458)	(0.0302)
Education [base: Low (ISCED1 and 2)]						
Middle (ISCED 3-4)	0.00416	0.0565	0.0320	0.00628	-0.0915*	0.00260
	(0.0178)	(0.0717)	(0.0195)	(0.0398)	(0.0441)	(0.0367)
High (ISCED 5-6)	0.00641	0.0795	0.00223	0.00931	-0.0120	-0.00366
	(0.0177)	(0.0715)	(0.0191)	(0.0450)	(0.0397)	(0.0345)
Labor market status [base: employee]						
Self-employed	0.0203	0.0677	0.0614**	-0.122**	-0.0780	0.0988
	(0.0162)	(0.0704)	(0.0203)	(0.0421)	(0.0665)	(0.0875)
Unemployed	0.00562	0.312	0.0160	0.00489	0.0436	-0.0350
	(0.0236)	(0.301)	(0.0438)	(0.0425)	(0.0522)	(0.0432)
Retired	-0.0746***	0.00909	-0.142***	-0.132**	0.0136	-0.158***
	(0.0164)	(0.0509)	(0.0194)	(0.0456)	(0.0482)	(0.0263)
Other	-0.0455	-0.0491	0.0266	-0.0798	-0.0291	-0.148**
	(0.0243)	(0.0416)	(0.0918)	(0.0520)	(0.0477)	(0.0523)
Net wealth quintile [base: first quintile]						
Second quintile	0.0185	-0.0671	-0.0117	0.105*	0.0802	-0.0579
	(0.0216)	(0.128)	(0.0276)	(0.0469)	(0.0588)	(0.0405)
Third quintile	0.0160	0.0530	-0.0232	0.116*	-0.0234	-0.0419
	(0.0151)	(0.118)	(0.0257)	(0.0478)	(0.0465)	(0.0303)
Fourth quintile	0.0174	0.0712	-0.0273	0.157***	-0.0404	-0.0685*
	(0.0149)	(0.117)	(0.0245)	(0.0476)	(0.0568)	(0.0288)
Fifth quintile	0.0171	0.0718	-0.0443	0.167***	0.0573	-0.0737*
	(0.0140)	(0.117)	(0.0246)	(0.0476)	(0.0513)	(0.0305)
Loan to value [base: LTV = 0]						
[0-0.9]	-0.0387***	-0.0603	-0.0156	-0.0407	0.0401	-0.0560
	(0.0114)	(0.0333)	(0.0150)	(0.0303)	(0.0393)	(0.0307)
[>0.9]	0.0679***	0.147*	0.0658***	0.182***	0.0756	0.0354
	(0.0148)	(0.0581)	(0.0165)	(0.0471)	(0.0397)	(0.0229)
Number of observations	**31280**	**2459**	**6667**	**3799**	**4562**	**867**

Note: median regression coefficients with robust standard errors given in parentheses. (*), (**) and (***) denote 10%, 5% and 1% significance level, successively. The dependent variable is the household over/undervaluation expressed in percentage. All explanatory variables are indicator variables. The regression for the euro area includes dummy variables for country-fixed effects that are not reported in the table. Coefficients are marginal effects from a baseline set in brackets. It represents the discrete change from the base level (dy/dx).

Table A12: Estimation results of equation (C)

	Euro area	Germany	France	Italy	Spain	The Netherlands
Type of dwelling [base: individual house]						
Semi-detached house	0.0200	0.0351	0.00148	-0.0870		
	(0.0180)	(0.0375)	(0.0185)	(0.0521)		
Flat/apartment	-0.0660***	-0.0521	-0.0407**	-0.136***		
	(0.0156)	(0.0289)	(0.0130)	(0.0408)		
Other kind of dwelling	0.180	0.360	-0.200	0.601		
	(0.233)	(0.266)	(0.669)	(1.082)		
Year of property acquisition [base: before 1975]						
1975-1985	0.153***	-0.0371	0.241***	0.545***	-0.0856	0.0384
	(0.0443)	(0.110)	(0.0570)	(0.0494)	(0.0834)	(0.0787)
1985-1995	0.339***	-0.0269	0.429***	0.921***	0.254***	0.0399
	(0.0435)	(0.116)	(0.0559)	(0.0432)	(0.0761)	(0.0697)
1995-2000	0.281***	-0.0740	0.315***	0.893***	0.140	0.135
	(0.0409)	(0.103)	(0.0490)	(0.0534)	(0.0757)	(0.0714)
2000-2005	0.310***	-0.105	0.338***	0.861***	0.272***	0.279***
	(0.0403)	(0.0981)	(0.0507)	(0.0508)	(0.0776)	(0.0678)
2005-2010	0.365***	-0.107	0.449***	0.870***	0.348***	0.300***
	(0.0398)	(0.0945)	(0.0482)	(0.0466)	(0.0850)	(0.0660)
2010-2015	0.350***	-0.0846	0.456***	0.784***	0.339	0.177*
	(0.0403)	(0.0947)	(0.0486)	(0.0475)	(.)	(0.0695)
Net wealth quintile [base: first quintile] -excluding housing wealth						
Second quintile	0.0108	-0.0777	0.0160	0.0410	0.0706	-0.0243
	(0.0249)	(0.141)	(0.0331)	(0.0520)	(0.0554)	(0.0311)
Third quintile	0.0208	0.0788	-0.0146	0.0684	-0.00745	-0.0167
	(0.0214)	(0.139)	(0.0315)	(0.0508)	(0.0579)	(0.0305)
Fourth quintile	0.0224	0.111	-0.00727	0.113*	-0.0452	-0.0240
	(0.0218)	(0.136)	(0.0297)	(0.0496)	(0.0538)	(0.0220)
Fifth quintile	0.0308	0.0779	-0.0166	0.0869	0.0120	0.00458
	(0.0210)	(0.136)	(0.0301)	(0.0493)	(0.0554)	(0.0239)
Loan to value [base: LTV = 0]						
[0-0.9]	-0.0642***	-0.0631*	-0.0276	-0.129***	-0.116*	-0.0717**
	(0.0130)	(0.0264)	(0.0165)	(0.0370)	(0.0488)	(0.0260)
[>0.9]	0.0448**	0.157*	0.0481**	0.0868	-0.0527	0.0479*
	(0.0159)	(0.0685)	(0.0177)	(0.0722)	(0.0369)	(0.0209)
Number of observations	**31280**	**2459**	**6667**	**3799**	**4562**	**867**

Note: median regression coefficients with robust standard errors given in parentheses. (*), (**) and (***) denote 10%, 5% and 1% significance level, successively. The dependent variable is the household over/undervaluation expressed in percentage. All explanatory variables are indicator variables. The regression for the euro area includes dummy variables for country-fixed effects that are not reported in the table. Coefficients are marginal effects from a baseline set in brackets. It represents the discrete change from the base level (dy/dx).

Determinants of over/undervaluation - regressions excluding the top 5% wealth quintile

Table A13: Estimation results of equation (C)

	Euro area	Germany	France	Italy	Spain	The Netherlands
Type of dwelling [base: individual house]						
Semi-detached house	0.0290	-0.0251	0.0130	-0.0126		
	(0.0190)	(0.0595)	(0.0176)	(0.0502)		
Flat/apartment	-0.0517***	-0.0395	-0.0251*	-0.0885*		
	(0.0147)	(0.0380)	(0.0124)	(0.0430)		
Other kind of dwelling	0.0939	0.137	-0.496	1.027		
	(0.116)	(0.177)	(0.588)	(1.171)		
Year of property acquisition [base: before 1975]						
1975-1985	0.145***	0.0826	0.229***	0.506***	-0.142*	0.0664
	(0.0372)	(0.125)	(0.0560)	(0.0452)	(0.0628)	(0.0705)
1985-1995	0.317***	0.0601	0.423***	0.911***	0.187**	0.0637
	(0.0392)	(0.122)	(0.0615)	(0.0488)	(0.0609)	(0.0615)
1995-2000	0.267***	0.0615	0.290***	0.893***	0.0606	0.176**
	(0.0368)	(0.113)	(0.0521)	(0.0509)	(0.0593)	(0.0626)
2000-2005	0.320***	0.0349	0.326***	0.843***	0.240***	0.327***
	(0.0364)	(0.114)	(0.0499)	(0.0458)	(0.0615)	(0.0608)
2005-2010	0.404***	0.0726	0.477***	0.918***	0.396***	0.376***
	(0.0358)	(0.110)	(0.0491)	(0.0446)	(0.0725)	(0.0604)
2010-2015	0.406***	0.107	0.499***	0.894***	0.595	0.257***
	(0.0362)	(0.119)	(0.0492)	(0.0470)	(0.458)	(0.0642)
Net wealth quintile [base: first quintile] -excluding top 5% quintile						
Second quintile	0.153***	0.213	0.109***	0.274**	0.262***	0.000504
	(0.0171)	(0.172)	(0.0163)	(0.0982)	(0.0440)	(0.0336)
Third quintile	0.230***	0.284**	0.199***	0.420***	0.305***	0.0509
	(0.0170)	(0.101)	(0.0193)	(0.0987)	(0.0439)	(0.0317)
Fourth quintile	0.299***	0.429***	0.271***	0.517***	0.342***	0.0995**
	(0.0175)	(0.104)	(0.0202)	(0.0983)	(0.0468)	(0.0332)
Fifth quintile	0.369***	0.510***	0.305***	0.644***	0.407***	0.158***
	(0.0158)	(0.103)	(0.0193)	(0.106)	(0.0470)	(0.0382)
Loan to value [base: LTV = 0]						
[0-0.9]	-0.0560***	-0.0581	-0.0256	-0.0924*	-0.0862	-0.0548*
	(0.0147)	(0.0383)	(0.0147)	(0.0373)	(0.0486)	(0.0256)
[>0.9]	0.135***	0.249***	0.131***	0.163***	0.0707	0.112***
	(0.0167)	(0.0691)	(0.0172)	(0.0468)	(0.0410)	(0.0260)
Number of observations	**26987**	**1957**	**5294**	**3537**	**3398**	**789**

Note: median regression coefficients with robust standard errors given in parentheses. (*), (**) and (***) denote 10%, 5% and 1% significance level, successively. The dependent variable is the household over/undervaluation expressed in percentage. All explanatory variables are indicator variables. The regression for the euro area includes dummy variables for country-fixed effects that are not reported in the table. Coefficients are marginal effects from a baseline set in brackets. It represents the discrete change from the base level (dy/dx). The number of observations is slightly lower than in tables A7 to A12, because of the exclusion of the 5% wealthiest households.

Effects of overvaluation on consumption

Table A14: Effect of overvaluation on consumption

	Euro area	Germany	France	Italy	Spain	The Netherlands	Euro area	Germany	France	Italy	Spain	The Netherlands
log(overvaluation)	0.0405***	0.0257	0.0188*	0.0265*	0.0477***	0.0259	0.0395***	0.0170	0.0293**	0.0349**	0.0215	0.0563
	(0.00622)	(0.0203)	(0.00933)	(0.0105)	(0.0125)	(0.0482)	(0.00672)	(0.0211)	(0.00906)	(0.0113)	(0.0145)	(0.0394)
Second wealth quintile							-0.0216	-0.998	-0.292***	-0.444	0.166	-0.497*
							(0.0818)	(.)	(0.0692)	(0.791)	(0.124)	(0.219)
Third wealth quintile							-0.0741	-1.042**	-0.394***	-0.497	0.137	-0.443**
							(0.0765)	(0.350)	(0.0476)	(0.789)	(0.116)	(0.139)
Fourth wealth quintile							-0.126	-1.347***	-0.454***	-0.635	0.00327	-0.101
							(0.0737)	(0.334)	(0.0486)	(0.789)	(0.113)	(0.128)
Fifth wealth quintile							-0.268***	-1.316***	-0.479***	-0.819	-0.249*	-0.396**
							(0.0749)	(0.334)	(0.0508)	(0.789)	(0.121)	(0.143)
Constant	-0.801***	-1.606***	-0.926***	-0.739***	-0.775***	-1.116***	-0.666***	-0.329	-0.494***	-0.108	-0.811***	-0.829***
	(0.0108)	(0.0377)	(0.0185)	(0.0152)	(0.0224)	(0.0945)	(0.0727)	(0.329)	(0.0418)	(0.788)	(0.110)	(0.128)
Number of observations	16857	1401	2845	2460	2477	484	16857	1401	2845	2460	2477	484

Note: median regression coefficients with robust standard errors given in parentheses. (*), (**) and (***) denote 10%, 5% and 1% significance level, successively. The dependent variable is the ratio of consumption over income. All explanatory variables are indicator variables, except for the household overvaluation. The regression for the euro area includes dummy variables for country-fixed effects that are not reported in the table. The number of observations is slightly lower than in tables A7 to A12, because we exclude households who undervalue the price of their house.

Cyclicality of self-assessed house prices

Table A15: Cyclicality of self-assed house prices (dummy variable)

	Five largest euro area countries	Germany	France	Italy	Spain	The Netherlands
Position in the housing cycle at the year of purchase [base: purchase in a downturn]						
Purchase in an upturn	-0.597	-1.400	-2.155	2.610	0.0497	-5.077*
	(1.163)	(3.664)	(1.348)	(2.583)	(3.534)	(2.131)
Number of observations	18354	2459	6667	3799	4562	867

Table A16: Cyclicality of self-assed house prices (percentage of upturns experienced in the past)

	Five largest euro area countries	Germany	France	Italy	Spain	The Netherlands
Experienced upturns	-0.218***	-0.0591	-0.309***	-0.207**	-0.379***	-0.485***
	(0.0340)	(0.0672)	(0.0219)	(0.0672)	(0.0919)	(0.0464)
Number of observations	18354	2459	6667	3799	4562	867

Table A17: Cyclicality of self-assed house prices (percentage of upturns and year of property acquisition)

	Five largest euro area countries	Germany	France	Italy	Spain	The Netherlands
Year of property acquisition [base: before 1975]						
1975-1985	16.47***	2.936	24.93***	52.75***	-11.07	0.422
	(4.539)	(11.14)	(5.533)	(5.175)	(7.717)	(6.859)
1985-1995	33.68***	4.435	42.66***	87.95***	20.62**	3.628
	(4.392)	(12.54)	(5.383)	(4.782)	(7.132)	(6.185)
1995-2000	27.60***	-0.718	31.96***	87.62***	9.934	10.22
	(4.137)	(10.71)	(4.949)	(5.714)	(6.269)	(5.775)
2000-2005	29.38***	-8.289	34.20***	77.00***	15.00*	21.81***
	(3.990)	(10.23)	(4.975)	(5.279)	(7.170)	(6.207)
2005-2010	33.77***	-11.51	47.50***	75.65***	6.632	23.32***
	(4.080)	(14.21)	(5.121)	(11.62)	(14.14)	(6.772)
2010-2015	29.79***	-14.55	47.92***	62.34***	-2.851	14.60*
	(4.134)	(15.57)	(6.334)	(13.04)	(.)	(6.020)
Experienced upturns	-0.176***	0.174	0.0388	-0.167	-0.371	-0.107
	(0.0351)	(0.243)	(0.0822)	(0.263)	(0.257)	(0.107)
Number of observations	18354	2459	6667	3799	4562	867

Note: median regression coefficients with robust standard errors given in parentheses. (*), (**) and (***) denote 10%, 5% and 1% significance level, successively. The dependent variable is the household over/undervaluation expressed in percentage. All explanatory variables are indicator variables, except for the experienced upturns, which is a ratio expressed in percentage. As housing cycles are relatively long, the regression for the euro area includes only the five largest euro area countries for which sufficiently long time series are available. This regression includes dummy variables for country-fixed effects that are not reported in the table. Coefficients are marginal effects from a baseline set in brackets. It represents the discrete change from the base level (dy/dx).

Acknowledgements

We would like to thank Chiara Osbat, Thomas Westermann, Jirka Slacalek, Miguel Ampudia and participants to a ECB's Housing Market Team presentation for useful comments and suggestions. We would also like to thank an anonymous referee and the Editorial Board of the ECB Working Paper Series for their very useful comments and suggestions which we incorporated into this paper. The usual disclaimers apply.

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PDF ISBN 978-92-899-3897-6 ISSN 1725-2806 doi:10.2866/96418 QB-AR-19-109-EN-N