BANCA D'ITALIA

EUROSISTEMA

Temi di discussione

(Working Papers)

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Number 1248

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Number 1248 - November 2019

ISSN 1594-7939 (print)
ISSN 2281-3950 (online)

Printed by the Printing and Publishing Division of the Bank of Italy

LOSS AVERSION IN HOUSING PRICE APPRAISALS AMONG ITALIAN HOMEOWNERS

by Andrea Lamorgese* and Dario Pellegrino*

Abstract

Several stylized facts, such as the correlation between house prices and sales volumes, suggest the existence of downward price rigidity in real estate markets. In this paper we explore a potential explanation for this behaviour by testing whether initial purchase prices and homeowners' appraisals of their dwellings show reference dependence. Using data from a sample of Italian households, we test whether − conditional on both observable and unobservable characteristics − homeowners appraise the value of their main dwelling differently depending on the price at which they purchased it. We find that homeowners expecting a loss do not adjust their appraisals significantly in response to downward market conditions while, for those expecting a gain, the appraisals are independent of the price at which they bought the home. While loss aversion is mildly higher among poorer and less educated households, we find strong evidence of it across all demographic groups in our sample.

JEL Classification: L10, R21, R31.
Keywords: Loss aversion, prospect theory, housing market.
DOI: 10.32057/0.TD.2019.1248

Contents

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1 Introduction*

The hypothesis of downward price rigidity in housing markets is corroborated by several stylized facts. Indeed, prices and transactions are usually correlated over the economic cycle, which is at odds to what is predicted by standard asset theory. Furthermore, during market downturns, housing units take longer to be sold, while the gap between ask prices and transaction prices widens.

What could be behind such price rigidity? Preferences characterized by loss aversion are one possible explanation (Genesove and Mayer, 2001). Indeed, homeowners decision to sell may not be the sheer outcome of the current opportunity cost, but also depend on the difference between current market price respect to previous buying price. During downturns the market value of many houses is often way below the price they have been paid for by the current owner. Owners who are loss-averse have an incentive to reduce this expected loss by setting a reservation price that exceeds the current value of the unit and is closer to the price they have paid. Therefore, ceteris paribus, they set higher asking prices, which are less likely to match a potential buyer in the market. A lower number of transactions, longer time to sale and higher asking-final price spread follow it.

In this paper, using data on a sample of Italian households, we test whether, conditional on both observable and unobservable housing characteristics, homeowners evaluate differently the market value of their main dwelling according to the price at which they bought it. To rule out spurious correlation due to unobserved housing characteristics, first we regress previous sale prices on observed characteristics at the time of sale, and then take the residual, i.e. the difference between sale price and estimated price based on observed characteristics at the time of sale, as a proxy of latent quality.

We find that homeowners subject to estimated losses almost do not adjust their assessment in response to downward market condition, while their evaluation is independent of the previous sale price in case of expected gain. We document some heterogeneity in loss aversion according to observable characteristics of the household: while loss aversion is mildly stronger among poorer and less educated households, there is a strong case for loss aversion accross all demographic characteristics we accounted for.

The existence of downward housing price rigidity we document in this paper has relevant implications for policy debate, mainly because it amplifies

*We wish to thank Antonio Accetturo, Matteo Gomellini, Vernon Henderson, Tiziano Ropele, Stefano Schiaffi, Paolo Sestito, two anonymous referees of Temi di discussione della Banca d'Italia, and seminar participants at the "Workshop on Urban Economics", Rome March 2016, at the HFCN Conference, Krakow June 2019 and at the AREUEA Conference, Milan June 2019. The usual disclaimer applies. The views expressed herein are those of the author are not necessarily those of Bank of Italy.

the effects of negative economic shocks.

Our findings contribute to the strand of empirical literature on loss aversion in housing markets, documenting that it arises not only when considering asking or transaction prices, but also when taking into account the household market evaluation of their asset. To our knowledge, this is the first analysis focusing on such data and thus it has the big advantage of showing the extent to which loss aversion is rooted in an ex-ante cognitive distortion, prior to any decision on whether to put or not the asset on the market and before the owner might be influenced by the real estate agent's valuation (which would reflect in the ask price) or by the match with the demand in the real estate market (which would reflect in the transaction price).

A second contribution of the paper is to document heterogeneity in loss aversion among households by exploring its interplay with demographic characteristics. In particular our rich database allows us to distinguish very precisely which household characteristics are more related with loss aversion. For instance, we show that the correlation between anchoring to previous sale price and a large loan to value ratio, documented by previous literature, disappears when the overall household wealth is controlled for.

From the policy perspective, loss aversion has important implications on the understanding of housing market dynamics, as it explains transaction freeze during downturns. Our focus on household evaluation adds to the literature along two different policy relevant dimensions. First, estimates of real wealth based on survey data on household wealth would be systematically upward biased during market downturns, since our results imply that householders in expected loss overvaluate their real assets. Second, along the business cycle, the consumption and saving decisions might be asymmetrically influenced by the incorrect valuation of housing wealth by the households (Agarwal, 2007).

2 Related literature

A widely documented stylized fact in real estate markets —both at country and urban level— is the correlation between trading volumes and prices, (Clayton et al., 2010; de Wit et al., 2013; Westerfeld et al., 2014). For instance, the number of residential sales in Italy fell by around 50 percent in the period between the peak in housing prices in 2007 and 2014.[1] Such finding is at odds with standard asset price theory, which predicts orthogonality between volumes and prices (Lucas, 1978): assuming efficient and frictionless markets, rational agents and an exogenous stock of assets with stochastic returns, productivity shocks would only affect asset prices, not the

[1] In 2007-2014 transactions were falling when prices were falling as well whereas transactions were increasing between 2004 and 2007 when prices were hiking.

number of times such assets change ownership. While such finding hinges on the hypothesis of a fixed number of assets, housing stock is expected to adjust sluggishly with respect to positive demand shock (due to permits and construction times), and to be almost sticky with respect to negative shocks. Thus, price-volumes correlation calls for theoretical explanations beyond baseline microeconomic modeling.

Another remarkable empirical regularity is that during market downturns housing units take longer to be sold: in Italy, between 2008 and 2014 the number of months needed to grant a sale rose on average from 6.7 to 9.5.[2] At the same time, the gap between asking prices and transaction ones widens: in 2008, during the boom of the real estate cycle, in almost two thirds of the transactions, the final price was smaller than the initial asking prices by no more than 10 per cent; the same figure dropped to less than a third of transactions in 2014, at the trough of the real estate cycle.

These three findings (correlation between prices and quantities, longer time to sell and wider ask-bid gap in downturns) suggest that sellers reservation prices are more sluggish to adjust downward than buyers ones, a fact which finds support in Genesove and Han (2012), which empirically confirm the hypothesis that sellers in the housing market react with a lag to demand shocks, and that such lag is larger than the one of buyers.

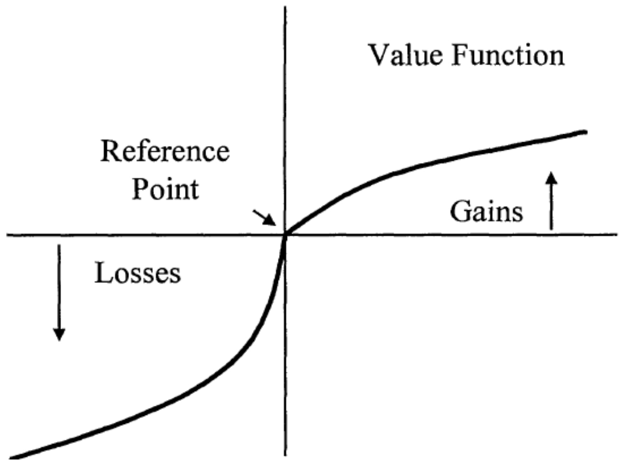
Three main microeconomic channels have been proposed in order to explain the documented downward price stickiness.

First, housing price movements affect the net equity of homeowners and thus their ability to switch dwelling, as the sale of their existing home might be the main source of down payment requirements to buy a new one (Stein, 1995; Genesove and Mayer, 1997). Second, searching and matching frictions can also generate downward price rigidity (Wheaton, 1990; Berkovec and Goodman, 1996; Ngai and Tenreyro, 2014). Third, downward price rigidity can be explained by assuming reference dependent preferences and loss averse agents: in such setting, households whose expected home selling price is lower than the one they purchased at —and therefore exposed to a net loss — are expected to ask higher prices compared to the ones with a net expected gain.

The last hypothesis draws from Tversky and Kahneman (1991)'s prospect theory, who propose a preference setting where i) utility does not depend on the absolute level of a good but rather on the difference with respect to a "reference point"; ii) preferences feature "loss aversion", that is utility increases with gains, i.e. positive differences with respect to the reference points, less than what it decreases due to an equivalent sized loss; iii) sensitivity to marginal gains and losses is decreasing in absolute value. These three assumptions determine a value function like the one in figure 1, whose

[2] Bank of Italy, Osservatorio Immobiliare italiano and Tecnoborsa Survey on Real Estate Agents (Banca d'Italia, 2016).

Figure 1: Loss aversion vs. gain attachment



Source: Genesove and Mayer (2001).

slope is higher to the left of the reference point than to the right, and which is concave with respect to gains and convex with respect to losses. Note that, under standard preference setting, such value function would be flat along the horizontal axis, since the relative distance with respect to the reference point does not matter.

In our analysis, as in most of the literature hinging on this theory, we consider the previous selling price as the reference point.[3]

Loss aversion yields interesting implications for asset markets. In financial markets, the decline in utility that comes from obtaining losses leads investors to hold their losses longer than their gains, even if there is no mean reversion, so past losses have no correlation with future gains (Shefrin and Statman, 1985; Odean, 1998). In their seminal paper, Genesove and Mayer (2001) provide empirical evidence also for real assets: in Boston condominium market, sellers with expected loss ask for higher prices, leave their housing units more on the market, and obtain higher final prices. Loss aversion among sellers has been confirmed also by further research, in particular Einiö et al. (2008), Anenberg (2011) and Bokhari and Geltner (2011)). The latter argue how, at aggregate housing market level, loss aversion effect is particularly strong in the first parts of economic downturn, while it attenuates with time, as the lack of buyers become more evident. Other analysis

[3]The reference point needs not to be univocal, and it might correspond to other past prices, expectations, agents aspirations, or to a linear combination of them.

have found effects also in terms of reduced household mobility (Engelhardt, 2003) and increased price dispersion (Leung and Tsang, 2013a,b).

Furthermore, concerning policy implications, downward housing price rigidity also yield asymmetries on the impact of of monetary policy (Tsai, 2013).

Moreover, downward housing price rigidity should also yield asymmetry in the impact of monetary policy (Tsai, 2013).

A few analysis focus on how individual characteristics affect loss aversion (for a full review, see Hjorth and Fosgerau, 2011): higher education, being a male and lower age have been associated with lower loss aversion, even though such findings are not always statistically significant (Johnson et al., 2006; Gächter et al., 2007; Booij and van de Kuilen, 2009). Genesove and Mayer (2001) find lower, but still significant, loss aversion among professional sellers of housing units. Conversely, according to findings of Bokhari and Geltner (2011), professional sellers are even more loss averse than non professionals. Nevertheless, to our knowledge, there is yet no empirical evidence of heterogeneity in loss aversion among homeowners. Exploring agents heterogeneity is also useful in order to check for potential confounding factors from equity constraints. However, empirical analysis for the US found that the relative magnitude of such channel is quite small, compared to the behavioral one, even though American households exhibits high levels of loan to value on housing mortgages (Genesove and Mayer, 2001; Engelhardt, 2003).

3 Empirical design

Our aim is to detect whether, ceteris paribus, a homeowner i at time t evaluates her property potential market value depending on the price she paid to purchase it (henceforth, the reference price) at time $t-k$.

The simplest model one could use to test this hypothesis is one where one's property market evaluation (P_{it})[4] depends on its prediction $(\hat{P}_{it})$ — based on observable dwelling's characteristics and municipal market prices[5]— and some function of the reference price (P^s_{it-k}), which at this stage can be considered as linear:

$$P_{it} = \alpha_1 \hat{P}_{it} + \beta P^s_{it-k} + \epsilon_{it}.$$

Since we are interested in understanding whether gains and losses with respect to the reference price affect the current evaluation differently, we may

[4]The question as stated in the survey is: "What price could you ask for your main dwelling on the market".

[5]$\hat{P}_{it}$ is the predicted value of a regression equation where the evaluation the homeowner provides of her property (P_{it}) is regressed on the average price of real estate located in the same area and a set of characteristics of the dwelling.

replace the reference price with its difference with respect to the expected evaluation based on observables, and estimate the effect of a generic reference dependence —whether gain or loss with respect to the reference price— on the current evaluation:

$$P_{it} = \alpha \hat{P}_{it} + \beta \left(P^s_{it-k} - \hat{P}_{it} \right) + \epsilon_{it}. \tag{1}$$

where $\alpha = \alpha_1 + \beta$. Since prospect theory suggests that gains and losses have an asymmetric effect on the current evaluation of the asset, we might distinguish whether the current market evaluation based on observable exceeds the reference price, so we rather estimate:

$$P_{it} = \alpha \hat{P}_{it} + \beta_1 \left(P^s_{it-k} - \hat{P}_{it} \right) + \beta_2 |P^s_{it-k} - \hat{P}_{it}|^+ + \epsilon_{it} \tag{2}$$

where $|P^s_{it-k} - P_{it}|^+$ is equal to $P^s_{it-k} - P_{it}$ if $P^s_{it-k} - P_{it} > 0$ and 0 otherwise. According to this empirical model, the estimate of $\beta_1 + \beta_2$ turns out to be an estimate of the average elasticity of the homeowners valuation of their properties with respect to the a current loss in the value of the property, that is with respect to a situation in which the current market value is lower than the reference price. β_1 provides an estimate of the elasticity of the current valuation with respect to a current gain in the value of the property, when the current market value exceeds the reference price. It follows that β_2, the difference in the two elasticities, provide a measure of how much on average homeowners revise their valuation facing a loss relatively to what they do facing a gain.

3.1 Challenges to the identification

The main challenge to the identification of our empirical model (2) is the presence of an omitted variable bias due to unobservable housing quality. A secondary challenge is the possible selection of homeowners.

An omitted variable bias may arise since we cannot control for all housing features which could potentially influence market price. Such unobservable quality is expected to affect positively both household evaluation and previous sale prices, thus generating an upward bias of the OLS estimates for β_1 and β_2.

Our strategy to tackle this issue is to include the difference between the sale price and the estimated market price at the time of the sale ($P^s_{it-k} - \hat{P}^s_{it-k}$) as an additional term in equation; under the prior that unobservable quality is a time invariant characteristic of the property, the lagged value of the difference between estimated market value and price is a reasonable proxy of unobservable quality (Genesove and Mayer, 2001; Beggs and Graddy, 2009). Even if the unobservable quality of the property is not time invariant, but has changed from $t - k$ to t, its inclusion should not yield inconsistent estimates, as the change in latent quality affects household's evaluation at time t but not the previous buying price at $t-k$. In other words, unpredicted changes in unobserved housing quality, being not correlated with previous sale price, should safely enter into the error term of the equation.

Nevertheless, a further omitted variable issues might emerge if unobservable quality changes from t-k are correlated to market price dynamics, in particular if the choice to renovate the housing unit is strategic with respect to the latter.[6] We believe this is not the case, at least in our sample. Indeed, the latter refers to housings which have been bought in the recent years to be the main dwelling for the households. In this case, major renovation works is usually done just after having purchased the units and before starting to inhabit it, and it might be done after a few years because of the needs of the households, arguably unconnected to speculative thoughts. As a further check for this, in the robustness section we restrict the maximum time since the sale, making the likelihood of renovation works even more remote.

A minor identification issue is the selection of homeowners. In other words we may find evidence of asymmetric revision of one own property's valuation as a consequence of an expected loss or a gain with respect to the reference price just because we are observing a selected sample of homeowners who have biased perception because of their observable or unobservable characteristics. To tackle this issue, we control for a large set of households characteristics, which could be connected to risk attitude or financial constraints.

Hence our baseline model is:

$$\begin{aligned} P_{it} =& \alpha \hat{P}_{it} + \beta_1 \left(P^s_{it-k} - \hat{P}_{it} \right) + \beta_2 |P^s_{it-k} - \hat{P}_{it}|^+ \\ &+ \beta_3 (P^s_{it-k} - \hat{P}^s_{it-k}) + \gamma_x X_{it} + \epsilon_{it} \end{aligned} \tag{3}$$

$P^s_{it-k} - \hat{P}^s_{it-k}$ is the difference between the reference value and the predicted market value of the dwelling at the time it was transacted,[7] and X_{it} are reported household's characteristics, namely loan to value dummy (LTV = 1 if LTV >70%), log of the years of schooling, log of real income, log of real wealth, household size (number of members), class of size of the munic-

[6] Families might decide it is not worthy to invest in housing units whose value is depreciating. In that case, unobservable quality and prices dynamics would be negatively correlate sign. A positive spurious correlation between $P^s_{it-k} - \hat{P}_{it}$ and unobservable quality, and therefore an underestimation of β_1 and β_2 might thus follow. If, conversely, owners invest more in housing units in order to compensate for the loss of value, the spurious correlation is of the opposite sign, therefore we might overestimate of β_1 and β_2.

[7] $\hat{P}^s_{it-k}$ is the predicted value of a regression equation where the price paid to purchase the real estate at time t-k (P^s_{it-k}) is regressed on the average price of real estate located in the same area and a set of characteristics of the dwelling.

ipality, class of age of the homeowner, macro-region dummy, and years since last sale.[8]

As a single household might have been interviewed in several waves, observations belonging to the same household has been clustered in order to account for their autocorrelation.

Regarding the interpretation of the estimated coefficients of equation (3), $\alpha - (\beta_1 + \beta_2)$ represents the elasticity of the homeowner's current evaluation of her property to a change in its market evaluation based solely on observed characteristics.[9] Notice that, since the reference price P^s_{it-k} is predetermined from the point of view of the homeowner, a change in $\hat{P}_{it}$ which leads to a 1% loss with respect to the reference price will lead to a downward revision in the homeowner valuation of her property of $\alpha - (\beta_1 + \beta_2)$ per cent. On the other hand a change in $\hat{P}_{it}$ which leads to a 1% gain with respect to the reference price will lead to a upward revision in the homeowner valuation of her property of $\alpha - \beta_1$ per cent. Therefore β_2 represents a measure of how more concerned is the homeowner by a loss than by a gain in the value of her property when it comes to revise her own valuation of the property.[10]

4 Data

The empirical design we have laid down in the previous section requires data for each housing unit, which belonged in t to an homeowner who has bought it at time $t - k$ by the household, on: i) the property's value estimates reported by the household at time t, ii) the market evaluation at time t and $t - k$, iii) the purchase price at time $t - k$ and the house's and household's characteristics.

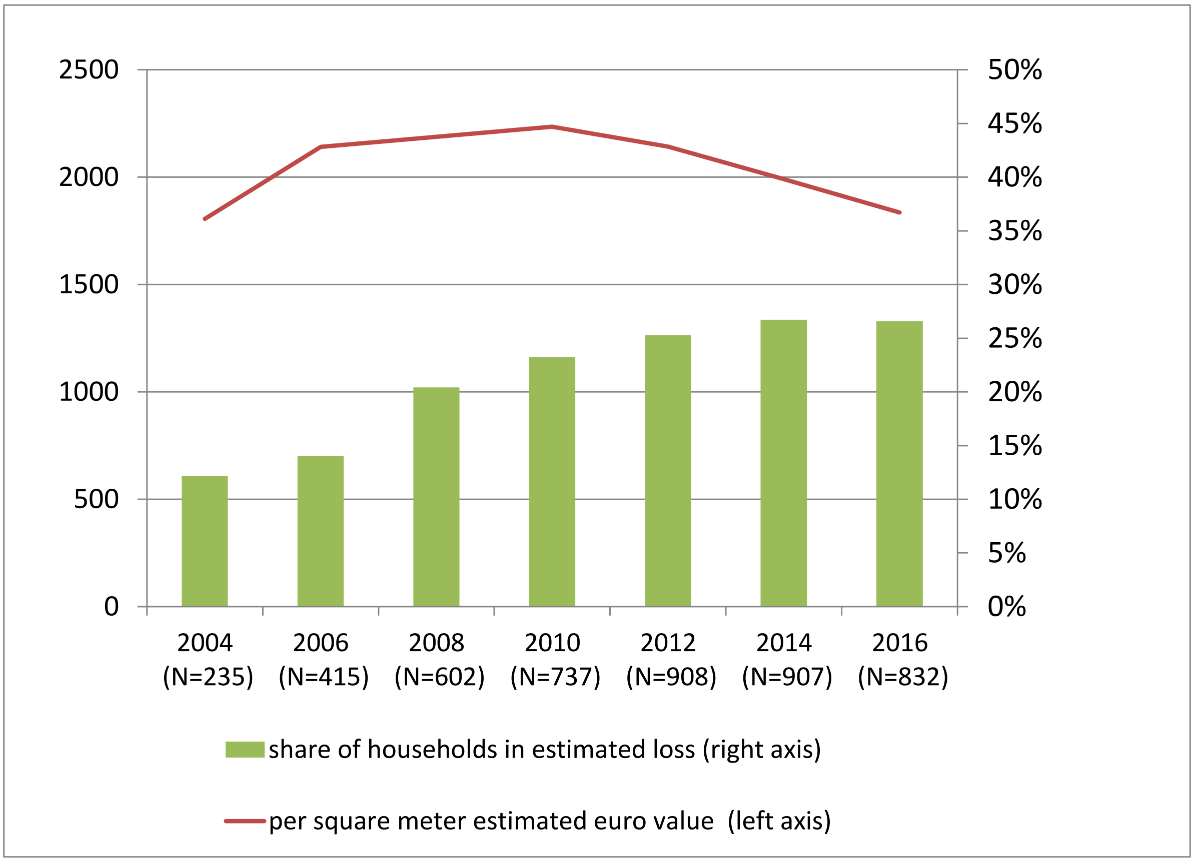
We obtain the above information from a blend of data from two data sources. We take all the characteristics of the house and the household, including current and previous evaluation of the property and the purchase price from the Bank of Italy Survey on Household Income and Wealth (SHIW), which gathers data on incomes and savings of Italian households every two years. Each wave encompasses a stratified sample of more of 8,000 Italian households. Considering the six waves between 2004 and 2016, we selected households who owned their main dwelling during this time range and bought it from 2002 onward (the starting year of our market price data).

[8] Adding a dummy for the urban vs. non urban location does not alter our results.

[9] More precisely, a change in component $\hat{P}_{it}$ of her evaluation P_{it}, which depends solely on the characteristics of the house and the household.

[10] An alternative interpretation is that $\beta_1 + \beta_2$ represents the (semi-)elasticity of the homeowner's current evaluation of her property to a change in the reference price. That if the homeowner i has paid a purchase price 1% larger than the one paid by homeowner j for a property having the same observable characteristics and the two homeowners live in comparable households, the property evaluation of homeowner i (P_{it}) is going to be $\beta_1 + \beta_2$ per cent as large as the one of homeowner j (P_{jt}).

Figure 2: Household's characteristics



This implies that the sample of properties available each year is increasing with time, namely from 235 in 2004 to 832 in 2016 (Figure 2).

Our sample is based on households who bought their dwelling relatively recently. Indeed, as descriptive statistics in Table 1 show, such households are characterized by younger and more educate householders, higher aggregate income, and are more likely to have a relevant part of the value of their house covered by mortgages. The wealth of these "recent" homeowners is higher than the full sample of households but lower than the full sample of homeowners.

Each household in our sample is asked to provide an estimate for the market value of her dwelling. This is our dependent variable. Additional information are provided, such as the previous buying price, the size, the location within the municipality (center/semi-periphery/periphery), the number of bathrooms, and the outstanding value of the mortgage, if any.

Market data on residential transactions come from the the Osservatorio sul mercato Immobiliare (OMI) of the Italian Revenue Agency. Such data are available from 2002 at municipal level with a sub-municipal breakdown, namely center (downtown), semi-periphery, periphery[11]. These aggregate prices has been matched both with dwelling assessment at the time of the interview (t) and at the time when it has been bought ($t-k$). $\hat{P}_{it}$ is the computed as the prediction of P_{it} on both market prices and observable housing characteristics[12]

to provide the market based valuation based on observables of the property price at time t and $t-k$.

Our analysis hinges on the reliability of previous sale price, but the further apart is this value from its estimate based on observables, the higher the likelihood that the observation might have been affected by some reporting errors. Thus, we regress sale prices on housing characteristics and municipal market prices, after dropping outliers in the top and bottom percentiles of the distribution of residuals of this regression.[13]

One may observe that the valuation per square meter provided by the households is on average significantly higher than the average of municipal transaction prices, even for the representative samples of households. This could be explained both by overvaluation of market values by households (for instance, see Benítez-Silva et al., 2015) or by differences between quality of sold houses and our sample of dwellings. But this overvaluation is not crucial to our analysis: the aim of our analysis is not to estimate an average bias with respect to market values but rather —more narrowly— to detect whether homeowners evaluate differently their housing according to the initial buying price.

5 Results

Table 2 presents the estimates of the baseline model. As the theory section shows we are interested in two quantities: the revision of the homeowner evaluation of her properties when the actual market evaluation exceeds the reference price (and the homeowner is recording a gain), that is $\alpha - \beta_1$,

[11]We are not certain that the SHIW and OMI classification in zoning always overlap.

[12]Namely, the regressors included are: the average municipal price, the average municipal market price for center/semi-center/periphery interacted with the location dummy provided by Survey dataset, the interaction between construction time and municipal market prices, dwelling size and its square, number of bathrooms, construction time. Construction time is given by discretizing the construction year in the following periods: before 1946, 1946-1961, 1962-1981, 1982-2001, after 2001.

[13]This is the reason why the sample presented in Table 1 is larger than the one showed in regression tables. Our findings are nevertheless robust to alternative cutoff of the outliers, namely cutoffs on the top and bottom 0.5%, 5% and 10%.

Table 1: Descriptive statistics

	est. sample (N=3,636)(1)				homewowners (N=39,195)				full sample (N=55,436)			
	mean	sd	min	max	mean	sd	min	max	mean	sd	min	max
wealth (thous. euro)	253	312	-79	4850	306	470	-755	25844	226	422	-755	25844
income (thous. euro)	37.5	21.7	-2.5	398.0	33.1	23.7	-20.0	840.0	29.1	22.4	-34.1	840.0
household size	2.9	1.3	1.0	12.0	2.5	1.2	1.0	12.0	2.4	1.3	1.0	12.0
LTV>70%	0.1	0.3	0.0	1.0	0.0	0.1	0.0	1.0	0.0	0.1	0.0	1.0
years of schooling	11.8	5.2	1.0	29.0	9.7	5.0	1.0	29.0	9.4	4.9	1.0	29.0
age	49.1	13.6	18.0	97.0	60.9	14.9	17.0	104.0	59.0	15.8	17.0	104.0
dwelling size (sqm)	105.6	48.9	25.0	630.0	111.2	54.1	11.0	1000.0	102.3	50.4	10.0	1000.0
municipal mkt price (per sqm)	1711	799	396	4331	1576	777	384	4765	1601	782	0	4765
dwelling estimation (per sqm)	2180	1117	100	12766	2050	1186	15	28170	1971	1165	10	28170

Source: Survey of Household Income and Wealth; transactions come from the Italian Revenue Agency.
Notes: (1) Estimation sample refers to all homeowners who bought their dwellings since 2002.

and same revision when the actual market evaluation is below the reference price (and the homeowner is recording a loss), that is $\alpha - (\beta_1 + \beta_2)$. Loss averse agent would revise their valuation by a higher amount of the change in the market value when in gains rather than in losses, that is: $\alpha - \beta_1 > \alpha - (\beta_1 + \beta_2) \gtrsim 0$. All in all our results points exactly in this direction in all specifications.

Column (1) provides estimates of the simplest possible model (1), where only a control for the "number of years since the last sale" has been added. The homeowner evaluation changes almost 1-to-1 with the market evaluation based on observable characteristics: a 10% change in the market evaluation ($\hat{P}_{it}$) induces a 7.27%(=(1.011-0.284) $\cdot$ 10%=$(\alpha - \beta_1) \cdot 10\%$) revision in the homeowner's valuation. The homeowner valuation also shows a significant reference dependence: a 10% deviation across the reference prices of two comparable properties purchased by two homeowners from two comparable households leads to 2.84% gap in the current valuation of the property.

Column (2) provides an estimate of model (2), where we distinguish the effect on the current homeowner's valuation of the property of a gain of the market valuation with respect to the reference point from the effect of a loss. Our result points to a higher conditional correlation of the current valuation on gains than on losses: a 10% gain of the current market valuation of a property with respect its reference price induces a 8.24%(=(1.022-0.198) $\cdot$ $10\% = (\alpha - \beta_1) \cdot 10\%$) upward revision of the current evaluation, whereas a 10% loss induce a smaller downward revision of the homeowner's valuation of her property, namely 1.2% (that is (1.022-0.198-0.944) $\cdot$ (-10%) = $(\alpha - \beta_1 - \beta_2) \cdot (-10\%)$).

Table 2: Baseline

	(1)	(2)	(3)	(4)	(5)	(6)
Predicted price (α)	1.011***	1.022***	1.014***	1.016***	0.959***	0.959***
	(0.015)	(0.015)	(0.015)	(0.015)	(0.018)	(0.018)
reference dependence (β_1)	0.284***	0.198***	0.044	0.034	0.058*	0.061*
	(0.014)	(0.016)	(0.034)	(0.034)	(0.035)	(0.035)
loss aversion (β_2)		0.944***	0.956***	1.336***	0.885***	1.006***
		(0.054)	(0.054)	(0.103)	(0.055)	(0.064)
unobserved quality (β_3)			0.174***	0.177***	0.148***	0.145***
			(0.035)	(0.035)	(0.035)	(0.035)
years since last sale	0.004**	0.008***	0.003	0.003	0.004*	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
LTV > 70%					0.022	0.022
					(0.016)	(0.016)
years since last sale X loss						-0.028**
						(0.014)
Household characteristics (1)	no	no	no	no	yes	yes
Observations	4526	4526	4526	4526	4525	4525
R^2	0.671	0.694	0.698	0.698	0.712	0.712

Source: Survey of Household Income and Wealth (2004-2016); transactions come from the Italian Revenue Agency.
Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Standard errors clustered at the household level. All specifications include controls for the wave of the SHIW database when the homeowner is interviewed. (1) Households characteristics are: log of the years of schooling, log of real income, log of real wealth, household size (number of members), class of size of the municipality, class of age of the homeowner, and a macro-region dummy.

The estimate shown in column (2) is likely to be affected by endogeneity, since the homeowner valuation may depend on the unobserved housing quality which might in turn have influenced the purchased price at $t-k$. To tackle this problem, column (3) adds the control for unobserved quality. Reference dependence coefficient shrinks below statistical significance, the effect being consistent with a correction for the expected positive spurious correlation. On the other side, the coefficient on losses is still significant: a 10% gain of the current market valuation of a property with respect its reference price induces a 9.7%(=(1.014-0.044) $\cdot$ 10% $= (\alpha - \beta_1) \cdot 10\%$) upward revision of the current evaluation, whereas a 10% loss induce a negligible 0.14%(=[1.014-(0.044+0.956)] $\cdot$ (-10%) $= (\alpha - \beta_1 - \beta_2) \cdot (-10\%)$) downward revision of the homeowner's valuation of her property.

Column (4) adds controls for households characteristics, that is log of homeowner's years of schooling, log of real income, log of real wealth, household size (number of members), class of size of the municipality, class of age of the homeowner, and a macro-region dummy. Results hold almost unchanged: a (10%) gain in the current market valuation of a property with respect its reference price induces a almost complete upward revision of the homeowner valuation of her property (9.01%), whereas a loss leaves the valuation unchanged (-0.1%) .

Column (5) adds an interaction between the loss and time since last sale, since we expect the effect of the former to decay gradually over time. Indeed, we find a moderate negative coefficient for the interaction. According to our point estimates along the inter-quartile range of the variable "years since last sale" the loss aversion coefficient (β_2) would diminish from to 0.95 to 0.78.[14] The intuition is that as long as the purchase of the real estate gets further apart in time, the reference price is discounted more and more and its influence on the current evaluation of the homeowner decreases.

6 Robustness checks

Table 3 reports the results of the many robustness checks we performed.

As a first robustness concern we ask ourselves whether household's evaluation is expressed in real or nominal terms, i.e. whether losses may be reduced or amplified by price dynamics. We test it by measuring loss in real terms rather than in nominal ones, that is by deflating losses using a CPI deflator. Column (1) in Table 3 reports the estimates: a 10% gain of the current market valuation of a property with respect its reference price induces a 9.32%(=[0.962-(0.030)] $\cdot$ 10% = $(\alpha - \beta_1) \cdot 10\%$) upward revision of the current evaluation, whereas a 10% loss induce a 1.70%(=([0.963-(0.030+0.762)] $\cdot$ 10% = $(\alpha - \beta_1 - \beta_2) \cdot 10\%$) downward revision of the homeowner's valuation of her property. Loss aversion holds even when measured in real terms: homeowners revise their valuation 1-to-1 with upward market based revision, while their revision downward are much more sluggish.

When both real loss and nominal loss are included in the regression, the former turns out to be larger in magnitude (and more precisely estimated) than the latter, but the remaining coefficients stay unchanged, suggesting that money illusion does not seem to play a major role.

Our second concern relates to the households we consider in the regression sample of the baseline exercise. One of the major advantages of the SHIW data is the little attrition of the households, implying that we follow the same households over time. For the sake of our baseline regression, this means that we repeatedly consider the same households in different points in time.

Even if we had clustered regression errors at household's level in the baseline exercise, we check for robustness by considering here one observation per household, namely the last one in time. This means that if an house-

[14] In our sample, "years since last sale" is 2 at the 25^{th} and 8 at 75^{th} one.

hold enters in three waves, e.g. 2010, 2012 and 2014, we only consider her in 2014 and we drop we remaining observations of this household. Column (3) shows the estimates. The number of observation drops by 1/3, but results are confirmed.

A 10% gain of the current market valuation of a property with respect its reference price induces a 9.11%(=[0.972-(0.061)] $\cdot$ 10% = $(\alpha - \beta_1) \cdot 10\%$).

The third robustness exercise relates to the possibility that homeowners get information about the market value of their property with some lag. If this is the case, our computed market value component ($\hat{P}_{it}$) considers the wrong market value information. To take this possibility into account, we add lagged municipal residential prices in the regression, thus allowing for the property valuation to adjust sluggishly to changing market conditions.[15] Estimates in column (4) show virtually unchanged results (the upward revision when in a 10% gain is 9.12% —compared to a 9.01% of the baseline, column (4) in table 2; the downward revision when in a 10% loss is 0.32% compared to a 0.10%): lag in information do not seem to be relevant for loss aversion.

Finally, where a sizable sample is available, we estimate the model for single waves of the SHIW, that is for 2010, 2012, 2014, and 2016. This exercise is useful to check whether results are correlated with specific years contingencies: for instance, in 2010 average prices were still close to 2008 peak, while four years later they had significantly dropped. In both cases, results hold basically unchanged.

We argued in chapter 3 that it is unlikely that our findings are biased by unobservable housing quality due to strategic renovation choices. As a further check, in column 10 we show estimates on the sample of households who bought the unit in the last 5 years. This a short time span in which the likelihood of renovation works for a main dwelling is small, not to say that they are done strategically with respect to market price dynamics. Results are unchanged.

In last column, we control for a polynomial of the unobserved quality proxy up to the fourth degree. The rationale is to check for eventual non linearities in the omitted variable bias in the estimation of β_1 and β_2 without imposing any structure to it. Results are qualitatively similar to the one of the linear control: the elasticity of the evaluation to purchase price in case of losses is around 0.75 ($\beta_1 + \beta_2$), while in case of gains, although statistically significant, is still very small.

[15]SHIW surveys are conducted in the first semester following the reference year, thus already allowing households to have some time to update their knowledge.

Table 3: Robustness

Dependent variable	real loss	real loss	once per family	lagged prices	2010	2012	2014	2016	recently bought	polynomial
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Predicted price	0.962***	0.962***	0.972***	0.973***	0.918***	0.972***	0.985***	0.972***	0.929***	0.972***
	(0.018)	(0.018)	(0.020)	(0.021)	(0.030)	(0.033)	(0.032)	(0.031)	(0.025)	(0.018)
real reference dependence	0.030	0.035								
	(0.035)	(0.036)								
real loss aversion	0.762***	0.584***								
	(0.048)	(0.121)								
reference dependence			0.061*	0.061*	0.090	0.006	-0.006	0.015	0.051	0.146***
			(0.036)	(0.036)	(0.067)	(0.051)	(0.049)	(0.056)	(0.052)	(0.040)
loss aversion		0.228*	0.879***	0.880***	0.842***	1.024***	1.023***	0.681***	0.934***	0.616***
		(0.134)	(0.062)	(0.062)	(0.107)	(0.106)	(0.099)	(0.114)	(0.070)	(0.075)
LTV > 70%	0.021	0.022	0.028	0.028	-0.016	0.089**	0.093**	0.021	0.007	0.025
	(0.015)	(0.015)	(0.019)	(0.019)	(0.048)	(0.043)	(0.046)	(0.049)	(0.018)	(0.015)
unobserved quality	0.154***	0.153***	0.138***	0.137***	0.171**	0.151***	0.143***	0.177***	0.159***	0.217***
	(0.035)	(0.035)	(0.033)	(0.034)	(0.070)	(0.049)	(0.048)	(0.059)	(0.050)	(0.043)
years since last sale	-0.001	-0.000	0.002	0.002	0.008	0.008**	0.008**	0.001	0.019***	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)	(0.004)	(0.003)	(0.003)	(0.005)	(0.002)
Observations	4525	4525	2932	2932	717	886	889	813	2098	4525
R^2	0.713	0.713	0.721	0.721	0.794	0.715	0.738	0.731	0.732	0.718
Household characteristics (1)	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

Source: Survey of Household Income and Wealth (2004-2016); transactions come from the Italian Revenue Agency.

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors clustered at the household level. (1) Households characteristics are: loan to value dummy (LTV = 1 if LTV >70%), log of the years of schooling, log of real income, log of real wealth, household size (number of members), class of size of the municipality, class of age of the homeowner, macro-region dummy, and years since last sale.

7 Heterogeneity

One advantage of using survey data is the rich information set we have on households social and economic characteristics. In this section we explore whether loss aversion is heterogeneous across groups of homeowners according to their observable characteristics. To do so we interact our proxy of loss aversion ($|P^s_{it-k} - \hat{P}_{it}|^+$ in equation (3)) with a set of discretized household's characteristics.[16]

[16] Each one of the household's characteristics which are in turn interacted with the proxy for loss aversion also enter the regression equation directly. Overall households characteristics which we add as linear controls are: loan to value dummy (LTV = 1 if LTV >70%), income top 75% (=1 if real income > fourth quartile of real income), real income, wealth top 75% (=1 if real wealth > fourth quartile of real wealth), real income,

Broadly speaking, we are interested in heterogeneity along two dimensions, preferences and economic constraints. Our idea is that agents can be more reluctant to downward revise their price evaluation for two reasons, one is that their preferences might be characterized to a different extent by a cognitive bias, the other is that they can be more or less constrained by their budget. The former case does not need further explanation, while in the latter the ideas is that being budget constrained may amplify the cognitive bias leading to loss aversion. In particular, if the value of the loss an agent records when the market evaluation falls below the reference price is large with respect to her income flow or her overall wealth it is likely the she will be more reluctant to put the asset on the market thus realizing the loss. The revisions of her valuation of asset will thus lag behind those of the market. Being more or less well-off might thus hamper or magnify the cognitive bias of loss averse agents. Furthermore, as pointed out beforehand, significant outstanding debt on property may be a relevant driver of pricing decisions in case of market value losses. The effect of loan to value (LTV) on the main dwelling on its reservation price has been found by Genesove and Mayer (1997), and attributed to the squeezing of the net equity, which impairs the ability to switch to another home. In this regard, we add to this analysis by assessing the role of overall household economic conditions, namely overall wealth and income. These variables are arguably correlated with LTV, and thus could be the omitted variables behind findings on LTV interaction with loss.

Regarding the heterogeneity in loss aversion related to heterogeneous preferences we wonder whether the level of education plays a role and provides agents with instruments shielding them from this cognitive bias. Other dimensions of heterogeneity we explore are householder age and geographic location (North vs. South of Italy and urban vs. non urban one).

While we cannot attribute strict causality to these controls, we still think that such analysis may provide us a few insights about loss aversion. Table 4 reports our results.

Column (1) introduces the interaction between loss aversion and a dummy which takes value 1 if loan to value (LTV) ratio of the property exceed a threshold level that we set at 70%.[17] Loss aversion is mildly higher for owners whose LTV exceeds 70% and the others, but such different is not statistically significant, meaning that this kind of financial constraint seems to play at most a very limited role.[18] Column (2) introduces the interaction

high school diploma attainment (=1 if the individual attained the high school diploma), college graduate (=1 if college graduate), age, age above median (=1 if age > median age), urban (=1 id individual lives in a urban area), South (=1 if individual lives in one of Italian southern regions).

[17]Stein(1995) set it at 80%, while we choose to include a larger share of households among in the "high-debt" dummy. Nevertheless, results holds within the 60-80% span.

[18]The presence of heterogeneous effects of the reference price on the homeowner's eval-

between loss aversion and a dummy which takes value 1 if the homeowner is in the top quartile of the income distribution. Better off homeowners show to be less affected by loss aversion: they are less prone to bias the evaluation of their property toward the price they paid when the market evaluation of a similar property has reduced than a comparable homeowner whose income is below the top quartile of the income distribution. Nevertheless, even for them we find a very high loss aversion coefficient, around 0.75.

Column (3) checks a similar kind of heterogeneity, testing whether being in the top quartile of the wealth distribution affects loss aversion differently than being in the lower quartiles of the same distribution. Not surprisingly richer homeowners are less affected by loss aversion and the coefficient is similar in magnitude and precision with respect to the interaction of loss with the top quartile of the income distribution: being well off makes a difference for what loss aversion is concerned, but being well off because of income or wealth does not make any difference.

Column (4) introduces two interactions of loss aversion with a proxy for school attainment. The first one interacts loss aversion with a dummy which takes value 1 if the homeowner as attained a high school diploma; the second one interacts loss aversion with a dummy which takes value 1 if the homeowner is a college graduate. While having attained a high school diploma does not change loss aversion with respect to non having attained it, being a college graduate is associated with lower loss aversion: more educated homeowners are less prone to keep the price they paid for their property as a reference for its actual value. Similarly loss aversion is smaller for older homeowners, as column (5) documents. Whether the cognitive bias connected with loss aversion be larger or smaller for the elders is debatable, older people in Italy are certainly on average less financial constrained than younger ones, have on average larger wealth and are more likely to lie in the rightward part of the income distribution.

Column (6) introduces an interaction with urban residence, which we may regard as a proxy for thicker housing markets, where prices might be more elastic. Nevertheless, loss aversion does not seem to be affected by this characteristic.

Finally, column (7) introduces an interaction with a dummy which takes value 1 if the homeowner is resident in a Southern region. Such homeowners show to be more loss averse than homeowners in regions of the Center of of the North of Italy.

The variables with which we interacted our main regressor are expected

uation has been checked also by splitting the sample into a sample with LTV $\leq 70\%$ and a sample with LTV $> 70\%$ and results are qualitatively the same. Also the remaining heterogeneous effects estimated in column (2)–(8) have been checked by splitting the sample and all results hold by and large unchanged.

Table 4: Heterogeneous effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Predicted price (α)	0.959***	0.958***	0.947***	0.958***	0.960***	0.961***	0.958***	0.947***	0.945***
	(0.018)	(0.018)	(0.019)	(0.018)	(0.018)	(0.018)	(0.018)	(0.019)	(0.019)
reference dependence (β_1)	0.058*	0.056	0.060*	0.054	0.059*	0.056	0.056	0.060*	0.058*
	(0.035)	(0.035)	(0.034)	(0.035)	(0.035)	(0.035)	(0.035)	(0.031)	(0.031)
loss aversion (β_2)	0.873***	0.972***	1.002***	0.940***	0.991***	0.906***	0.847***	0.994***	1.085***
	(0.058)	(0.062)	(0.074)	(0.086)	(0.065)	(0.066)	(0.059)	(0.084)	(0.101)
unobserved quality (β_3)	0.148***	0.147***	0.138***	0.149***	0.148***	0.148***	0.148***	0.138***	0.139***
	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)
years since sale	0.004*	0.004*	0.004*	0.003	0.004*	0.004*	0.004*	(0.004*)	(0.004*)
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
LTV>70%	0.017	0.022	0.022	0.019	0.022	0.022	0.022	0.021	0.021
	(0.017)	(0.015)	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)	(0.015)
loss aversion X LTV>70%	0.145							0.048	
	(0.105)							(0.115)	
loss aversion X income top 75%		-0.224**							-0.030
		(0.088)							(0.100)
loss aversion X wealth top 75%			-0.265***					-0.257***	-0.168*
			(0.084)					(0.091)	(0.096)
loss aversion X high school diploma attainment				0.041					0.027
				(0.106)					(0.096)
loss aversion college graduate				-0.189*					-0.164
				(0.105)					(0.107)
loss aversion X age above median					-0.192**				-0.184**
					(0.082)				(0.085)
loss aversion X urban						-0.066			
						(0.086)			
loss aversion X South							0.225**		0.172
							(0.094)		(0.108)
Household characteristics (1)	yes	yes	yes	yes	yes	yes	yes	yes	yes
P-value of main effect + interaction	0.000	0.000	0.000	0.000	0.000	0.000	0.000		
Observations	4525	4525	4525	4525	4525	4525	4525	4525	4525
R^2	0.712	0.712	0.713	0.713	0.712	0.712	0.712	0.713	0.714

Source: Survey of Household Income and Wealth (2004-2016); transactions come from the Italian Revenue Agency.

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Robust standard errors clustered at the household level. (1) Households characteristics are: loan to value dummy (LTV = 1 if LTV >70%), log of the years of schooling, log of real income, log of real wealth, household size (number of members), class of size of the municipality, class of age of the homeowner, macro-region dummy, and years since last sale.

to be correlated, therefore it is worth checking whether there is among them some relevant single predictive factor.

In column (8) we test jointly for heterogeneity in LTV and wealth, as we expect the need to raise debt to buy a dwelling is negatively associated to wealth. It is noteworthy that the coefficient of LTV interaction, falls from 0.145 to 0.05 respect to column (1). In our opinion, this may raise doubts about the nexus between LTV and downward sticky reservation prices found by Genesove and Mayer (1997) and Anenberg (2011): the proper driver of this association could be not so much the magnitude of the loan but rather household overall economic conditions.

Column (9) introduces jointly all the interaction which, taken individually, we have found to be statistically significant. Results are qualitatively unchanged, but the significance of the estimates is lower. In particular, wealth appears as a rather robust covariate in explaining loss aversion coefficient. Age above the median remains negative and significant and the Southern location loses both in magnitude and precision, both reflecting correlation with wealth.

All in all, our results on heterogeneity provide a picture of loss aversion as a general feature which is mildly hampered by wealth and education. Heterogeneity is low across groups of agents and loss aversion is strong besides demographic, socio-cultural and economic characteristics.

8 Concluding remarks

In this paper we test the existence of reference dependence between the purchase price and the homeowner's evaluation of her dwelling. We find strong evidence of it in case of estimated loss. We deem that this finding can explain downward price rigidity in housing markets, an hypothesis which is suggested by a set of stylized facts. According to our results, this relationship is conditional both on observed and unobserved estimated housing characteristics. Loss aversion estimated elasticities are within the 0.9-1.0 range, and still above 0.7 even within the least loss averse demographic groups.

It might worth to add a few words about external validity. Our data and empirical strategy allow to test for recently bought primarily dwellings, but the potential case for housing loss aversion is much larger. First, our educated guess is that findings would be qualitatively confirmed also on other residential and commercial estates. For instance, Bokhari and Geltner (2011) show how loss aversion in commercial housing is of similar magnitude to the one in dwellings. Second, as Tversky and Kahneman (1991) point out, the "reference point" is not necessarily or only the previous buying price, but could be other points, or a linear combination of them. It is plausible to think for instance that, as reference dependence on previous buying price decays, an alternative reference points rise out, like an average of market prices in the last years.

Housing market plays a major mediating role of local economic shocks.

Since Roback (1982) housing supply rigidities have been found to hinder the translation of positive shocks into actual economic growth. On the other hand, after economic downturns, troubles may stem from rigidities of prices rather than quantities. Indeed, downward price elasticity would mitigate negative shocks on economic activity, as cheaper renting costs for workers and firms could attenuate decreases in local competitiveness. Our analysis suggests that homeowners could be very reluctant to adjust reservation prices below their previous sale prices. Therefore, after a negative shock in housing demand, the share of homeowners in expected loss might rather keep their real assets idle rather than selling it below their reference price. Higher resulting vacancy rates could thus yield housing shortages even under a wide potentially available housing stock. Overall, loss aversion preferences would then imply, ceteris paribus, that a negative economic shock would generate a stronger decrease in the economic activity and a lower housing price contraction respect to standard preferences case.

Generally speaking, urban planning faces a relevant trade-off between housing availability and land use externalities. That is particularly binding in highly populated countries like Italy. A higher use of existing housing stock would thus allow for a more efficient trade-off between these two policy objectives. Mechanics like the documented loss aversion could thus explain a large share of increase in housing vacancy rate occurring during economic downturns.

Behind its economic implication, we believe our findings are a useful caveat for research based on real wealth data assessed from household surveys, pointing to a potential source of bias.

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