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* Views expressed are those of the authors and do not necessarily reflect official positions of De Nederlandsche Bank.

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The Housing Wealth Effect: a comparative study of Italy and the Netherlands

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Abstract

This paper tests whether disregarding home-improvements biases the housing wealth effect, the marginal propensity to consume out of housing wealth. The housing wealth effect is decomposed in its endogenous and exogenous component by filtering out previously stated expectations of house prices and accounting for endogenous home improvements. Results of the empirical analysis show that the size of the bias is zero, due to the zero correlation between home-investments and changes in house values. Our results are consistent with a lifecycle model with exogenous home improvements. The use of a comparative empirical approach excludes that these are only internally valid.

Keywords: Housing wealth effect, Expectations, maintenance, renovations, home improvements
JELcodes: G51

1 Introduction

This paper studies the housing wealth effect, i.e. the marginal propensity to consume (MPC) or save (MPS) out of housing wealth.

The housing wealth effect is an important parameter for the transmission of monetary policy and financial stability. Monetary policies ultimately affect households via income and wealth effects, and housing represents the main asset in household portfolios. Large estimates of the MPC imply sizable consumption responses to monetary policy shocks. Also, large housing wealth effects imply substantial fluctuations of consumption over the business cycle. This often motivates the adoption of macro-prudential policies aimed at stabilizing the real estate cycle.

Despite both the macroeconomic and microeconomic literature focused on this topic, the two approaches returned different estimates and conclusions. The macroeconomic literature identifies a strong relationship between house prices and consumption at the aggregate level. The microeconomic literature instead finds a milder relationship.

Using time series and aggregate data for the U.S., Bhatia (1987), Hendershott and Peek (1989) and Skinner (1996) estimate MPCs of around 5%. Attanasio and Weber (1994) study the role of housing in the consumption boom of the UK in the late 1980's and find that housing market developments account for much of the increase in consumption by the older cohorts. Also Campbell and Cocco (2007) and Carrol et al (2011) find positive effects on consumption. On the other hand, microeconomic studies on consumption such as Attanasio et al. (2009) and Browning et al (2013) find MPC lower than 1%. Regarding savings, Rouwendal and Alessie (2002) and Engelhardt (1996) find a negative MPS in the Netherlands and the U.S., while Suari Andreu (2020) and Disney (2010) find zero or mild effects.

The literature divide is mostly due to methodological differences in the estimate of the housing wealth effect. While it is the case that the correlation between consumption growth and house price growth is high in aggregate data (Case et al. 2005), the microeconomic literature has focused on the causal relation, and thus on excluding competing channels (e.g. expectations or income shocks) that could potentially make the relation spurious.

In this paper, we isolate the causal effect of house price shocks on household saving decisions. To obtain a causal estimate of the housing wealth effect, the change in house value must be not only *unexpected* but also *exogenous*, meaning that it is important in empirical work to distinguish changes in prices (exogenous wealth effect) from changes in asset allocations (endogenous wealth effect). For financial wealth, Paiella and Pistaferri (2017) propose a decomposition that takes previously stated expectations, together with lagged portfolio weights, to disentangle the exogenous and unanticipated change in financial wealth. For housing wealth, the endogenous component can certainly be attributed to home improvements, which can substantially increase the market value of a house, but are inherently unobservable due to the *indivisibility* of houses. The first contribution of the paper is to show the role of home improvements as an endogenous factor in the estimation of the housing wealth effect. Using a stylized theoretical model, we decompose the housing wealth effect in its endogenous and exogenous components. Also, we show that the role of home improvements for the housing wealth effect depends, crucially, on the assumption made on house values. If house values mostly reflect the value of land or key characteristics such as house size, type and location, then home improvements cannot affect future home equity. If instead house values reflect characteristics such as energy and thermal efficiency, living technologies and the presence of amenities, home improvements are endogenous to the dynamic of home equity. In this case, a shift in the expectations on future house prices increases the expected return out of home improvements that, if performed, affect the quality and the value of houses. In the empirical part, we extend the approach of Paiella and Pistaferri (2017) to housing wealth, and we decompose the change in house value in its exogenous and unanticipated component. Differently from previous studies, this is elicited not only by filtering out previously stated expectations from changes in housing wealth, but also accounting for possible endogenous components of housing wealth changes due to home improvements. Our result shows that, despite the theoretical relevance, not considering home improvements does not bias the estimation of the housing wealth effect, due to the mild correlation between expenses in home improvements and changes in house values observed in the data. A second contribution is to use a comparative empirical approach to estimate the housing wealth effects in two different countries, using comparable survey data on household income and wealth. The advantage of our approach is to make sure that differences in the estimates are not the result of different specifications or sample selections. The two countries that we investigate are Italy and the Netherlands. Despite differences in housing market characteristics and credit conditions, we show how housing wealth effects are very similar, and also relatively small. Our results suggest that a 1% unexpected and exogenous increase in housing wealth causes a reduction in active savings in both countries by 0.03% (85 euro in the Netherlands, 55 euro in Italy). Our result points toward the use of different sample selections, empirical methodologies and data used in the literature, which likely explains part of the substantial heterogeneity in the size of the estimated MPC/MPS.The remaining of the study is organized as follows. Section 2 discusses a stylized model with housing and endogenous home improvements. Section 3 presents the data and methodology. Section 4 presents the empirical analysis. Section 5 concludes.

2 Theoretical Framework

This section shows the implications for the housing wealth effect of different assumptions posed on home values and home investments. The proposed model is a stylized version of Piazzesi and Schneider (2016), which preserves two key features. First, houses are assets that provide a non-tradable dividend - the housing service - which is a consumption good. Second, houses are technologies that depreciate if essential maintenance is not performed. Since the focus is on the maintenance, we consider homeowners and we do not investigate house purchase decisions. The utility of a household living in a house of quality H_t is:

$$V_t = U(g(c_t, s_t(H_t))) + \beta E_t[V(w_{t+1})] \tag{1}$$

Where U and V are the strictly concave current functions and g is an aggregator that allows distinguishing substitution across goods from substitution across periods. Households derive utility from consumption and the housing service, which depends on the overall housing quality H_t. A house of quality H_t has a value of $p_t H_t$ and provides a housing service $s_t(H_t)$ which is increasing in housing quality, that is $s_t'(H_t) > 0$. Households have expectations over future prices $E_t[p_{t+1}]$. Eventually, to obtain a closed-form solution for the housing wealth effect, we use specific functional forms for the utility functions. For the sake of simplicity, we assume logarithmic current and future utilities U and V, and a Cobb-Douglas aggregator g[1].

2.1 Exogenous maintenance expenses

As a first step, we assume that house qualities are discrete and homeowners are endowed with a house of quality $H \in \mathcal{H}$, where $\mathcal{H}$ is the discrete set of house qualities. Also, home improvements cannot change the quality stock a homeowner is endowed with. This is the case if, for example, house values reflect mostly the value of land. In this case, house quality is endogenous in house purchase decisions but not to home improvements decisions. Therefore, we introduce maintenance as a periodic expense aimed at contrasting the depreciation of houses. Households face the following decision problem:

$$max_{c_t} \quad U(g(c_t, s_t(H))) + \beta E_t[V(w_{t+1})] \tag{2}$$

$$s.t. \quad c_t + \kappa(H)\varepsilon_t = y_t - a_t$$

[1] All analytical derivations are in the appendix.

$$w_{t+1} = Ra_t + y_{t+1} + p_{t+1}H$$

Where $\kappa(H)\varepsilon_t$ represent maintenance expenses, which depend on house quality and on a random shock $\varepsilon_t \sim IID(1, \sigma^2)$. Intuitively, bigger and higher quality houses are generally more expensive to maintain, but periodic expenses also depend on random damages that require substitution or repair. The Euler equation is:

$$U'(g(c_t; H))g'(c_t; H) = \beta R\, E_t[V'(w_{t+1})] \tag{3}$$

From which, using the assumed functional forms of U,V and g, we obtain the optimal saving rate:

$$a_t^* = \frac{\beta R(y_t - \kappa(H)\varepsilon_t) - \alpha(y_{t+1} + p_{t+1}H)}{R(\alpha + \beta)} \tag{4}$$

The corresponding housing wealth effect on savings, i.e. the change in savings due to a permanent shift in expectations of future house prices, is given by:

$$\frac{\partial a_t^*}{\partial E_t(p_{t+1})} = -\frac{\alpha}{\alpha + \beta} R^{-1} H \tag{5}$$

The change in savings equals a fraction of the present excess house value, which depends on agents' preferences towards inter-temporal allocation (β) and the consumption of goods relative to housing service (α).

2.2 Endogenous home improvements

Next, we introduce endogenous home improvements by assuming that, instead, house quality is continuous and additive. If property values depend on house characteristics such as energy efficiency, living technologies and amenities, then house values can be endogenous to home improvement decisions, other than house purchase decisions. We assume again that houses depreciate if essential maintenance is not performed but, in addition to that, house values can appreciate if home improvements are undertaken. Homeowners are endowed with a housing stock H_{t-1} and undertake maintenance such that:

$$H_t = H_{t-1}(1 - \delta) + h_t \tag{6}$$

Where h_t denotes maintenance undertaken, H_t is total stock of housing quality after maintenance and δ is a depreciation rate. If $h_t = \delta H_{t-1}$ only ordinary maintenance is performed and housing quality remains constant[2]. The optimization problem becomes:

[2]The last period stock of housing quality is $H_T = H_{T-1}(1 - \delta)$.

$$max_{c_t,h_t} \quad U(g(c_t, s_t(H_t))) + \beta_i E_t[V(w_{t+1})] \tag{7}$$
$$s.t. \quad c_t + \kappa h_t = y_t - a_t$$
$$w_{t+1} = Ra_t + y_{t+1} + p_{t+1}H_t$$
$$s.t. \quad H_t = H_{t-1}(1-\delta) + h_t$$

In words, households choose consumption and the home investment that maximize utility. The period t budget constraint states that consumption and home investments are financed using labour income y_t. Here, κ is the (unitary) cost of the home investment, relative to the price of numeraire consumption. The next period value of wealth is given by savings, future labour income and housing wealth. Since the housing services are always proportional to house qualities, following Piazzesi and Schneider (2016) we assume that the housing service is simply equal to its quality, that is $s_t(H_t) = H_t$. The first-order conditions are:

$$\begin{cases} U'(g(c_t; H_t))g'_c(c_t; H_t) = \beta R\, E_t[V'(w_{t+1})] \\ \kappa U'(g(c_t; H_t))g'_c(c_t; H_t) = U(g(c_t; H_t))g'_h(c_t; H_t) + [\beta(1-\delta)E_t(p_{t+1})V'(w_{t+1})] \end{cases} \tag{8}$$

The first optimality condition is equivalent to the Euler equation in the case of full certainty. The second optimality condition states that when deciding whether and how much to invest, one trades off additional housing services and increasing home equity against less current consumption and savings. Combining the FOCs, we obtain:

$$U(g(c_t; H_t))g'_h(c_t; H_t) = \beta R\, [\kappa - R^{-1}(1-\delta)E_t(p_{t+1})]E_t[V'(w_{t+1})] \tag{9}$$

This condition governs home improvement decisions: households are indifferent, at the margin, between saving and doing home improvements, as long as the marginal benefit of the home investment equals its marginal cost. The growth in consumption is inversely proportional to the net present value of the home investment. Under the assumed utility functions, optimal consumption is equal to:

$$c_t^* = y_t - \kappa h_t^* - a_t^* = \frac{\alpha}{1-\alpha}[R^{-1}(1-\delta)E_t(p_{t+1}) - \kappa](H_{t-1}(1-\delta) + h_t^*) \tag{10}$$

As evident, consumption is inversely related to optimal maintenance h_t^* and is increasing in the expectation on future house prices $E_t(p_{t+1})$, as agents rationally incorporate future wealth changes in their consumption decisions. The resulting housing wealth effect on consumption (MPC), i.e. the change in consumption due to an unexpected change in house prices (or on the expectations thereof), equals:

$$\frac{\partial c_t^*}{\partial E_t(p_{t+1})} = \underbrace{\frac{\alpha}{1-\alpha}[R^{-1}(1-\delta)](H_{t-1}(1-\delta)+h_t^*)}_{\text{exogenous component}} + \underbrace{\frac{\alpha}{1-\alpha}[R^{-1}(1-\delta)E_t(p_{t+1})]\frac{\partial h_t^*}{\partial E_t(p_{t+1})}}_{\text{endogenous component}} \tag{11}$$

The first term of eq. (11) is the change in consumption attributable to changes in house prices (exogenous component). It is a pure wealth effect, and equals the expected present value of the increase in home equity. The second term is the part attributable to home improvements (endogenous component) and equals the expected present value of the increase in house quality. Intuitively, when house prices are expected to increase, investments in home equity are more profitable. Home improvements then endogenously increase the value of houses, leading to a new increase in consumption via a wealth effect. Rearranging the budget constraint, we obtain the corresponding housing wealth effect on savings (MPS):

$$\frac{\partial a_t^*}{\partial E_t(p_{t+1})} = y_t - \kappa\frac{\partial h_t^*}{\partial E_t(p_{t+1})} - \frac{\partial c_t^*}{\partial E_t(p_{t+1})} \tag{12}$$

When house price increase, savings decrease not only via a wealth effect that leads to a revision of the optimal consumption and saving path, but also via a simple budget effect due to increasing home investments induced by increasing house prices.

2.3 Quality-specific pricing

Assume now that house prices are increasing in quality. As an example, energy-efficient houses are more expensive than otherwise identical houses having low energy labels. If house prices are quality specific, then home improvements such as energy saving investments can increase the unitary value (e.g. the price per square meter) of the whole property. We introduce a price function $p_t(H_t)$ such that $p_t'(H_t) > 0$. We can write the $t+1$ property value as:

$$p_{t+1}(H_{t+1}(h_t))H_{t+1}(h_t) \tag{13}$$

Similarly, we introduce a cost function $\kappa(H_t)$, such that also the cost of the investment depends on its size. As an example, important renovations that modify the original building structure may require demolitions, together with the acquisition of permits or the payment of taxes, on top of the cost of the investment. Under these assumptions eq. (9) becomes:

$$U'(g(c_t;H_t))g_h'(c_t;H_t) = \tag{14}$$

$$= \beta R \underbrace{\left[\kappa'(H_t) - R^{-1}(1-\delta)\left(p_{t+1}'(H_{t+1}(h_t))H_{t+1} + p_{t+1}(H_{t+1}(h_t))\right)\right]}_{\text{Expected Net Present Value of Home Investments}} E_t[V'(w_{t+1})]$$

as $H_{t+1}'(h_t) = 1-\delta$ and $H_t'(h_t) = 1$. This last equation is conceptually identical to eq (9). The only difference is that, under the assumption of quality-specific pricing, investing in home maintenance is not always convenient. In fact, while the assumption of quality specific pricing implies that home improvements increase house values more than proportionally, households' investment decisions depend on the net present value of the investment, which also depend on the cost. This net present value may not necessarily be a non-linear or a monotonic function of the investment size, and may not necessarily be positive in the entire function domain.

The model shows one simple result: house price shocks not only affect consumption via a traditional wealth effect, but induce agents to undertake more home improvements as these become, *ceteris paribus*, relatively more convenient than saving. As agents invest in home improvements, the value of houses increase due to the increase in house quality. Home improvements therefore endogenously affect the dynamics of home equity. Following this result, the empirical implications we draw are that home improvements have (i) a direct impact on savings, via a simple budget effect and (ii) an indirect impact on savings via a wealth effect. However, part of the the impact via a wealth effect is endogenous as home investments directly increase the quality and the value of houses and, following the investment, rational agents would revise their expectations over the future value of their property accordingly. Therefore, to estimate the MPC/MPS out of housing wealth, it is important to disentangle the effect of home improvements.

3 Data, Descriptive statistics and Methodology

3.1 Data and Descriptive statistics

For a description of Italian and Dutch household portfolios, we use the Household Finance and Consumption Survey (HFCS). The HFCS is an initiative coordinated by the ECB based on 84,000 interviews conducted in 18 euro-area countries. In the empirical analysis, we use two surveys on which the HCSF is based. These describe the same populations participating to the HFCS, but contain several additional and similar questions that allow testing our hypothesis without concerns of methodological differences.

For the Netherlands, we use the DNB Household Survey (DHS). The DHS is an annual survey representative of the Dutch speaking population and contains information on income and wealth, as well as on all the psychological aspects of financial behavior. For Italy, we use the Survey on Household Income and Wealth (SHIW) administrated by Bank of Italy, which is a biannual survey on income and wealth of a representative sample of Italian households. Italy and the Netherlands are characterized by substantial differences in the characteristics of household portfolios. Table 1 reports comparative descriptive statistics on households portfolios: while home-ownership and the value of the main residence are comparable across countries, mortgage debt is more prevalent among Dutch respondents who also have, on average, higher asset holdings (savings, mutual funds, life insurance policies).

Table 1: Descriptive statistics

	dependent variable:					
	Ownership (%)		**Mean values**		**Median values**	
	(IT)	(NL)	(IT)	(NL)	(IT)	(NL)
Main residence	71%	74%	244 970	296 205	200 000	255 000
Other real estate properties	3%	0%	158 765	240 639	99 000	127 500
Business wealth	18%	5%	160 557	152 041	20 000	80 000
Deposits	26%	87%	14 452	34 523	6 808	14 676
Mutual funds	7%	23%	40 676	33 569	20 000	10 724
Bonds	17%	8%	43 735	38 728	20 627	17 000
Voluntary pension/life insurances	14%	51%	14 560	48 884	10 000	19 474
Mortgage debt	9%	55%	71 923	154 337	50 000	127 000
Other debts	17%	31%	16 206	36 768	5 600	12 669
Credit lines/overdraft	3%	18%	5 275	6 807	2 500	2 000

Note: Descriptive statistics of Italian and Dutch households' portfolios. Mean and median values are conditional on ownership. Source: HFCS.

3.2 Methodology

To estimate the exogenous and unanticipated component of housing wealth changes, information on home investments and house price expectations must be observed. In the DHS, expectations on house prices are available from 2003, while questions about maintenance and home improvements have been asked since 2012. In the SHIW, respondents of the 2010 and 2012 wave are asked about their expectations on future house prices, while the question on extraordinary maintenance has always been present.

To develop a comparative approach, we focus on the 2012-2018 waves in which the questions are present in both surveys, and we overcome a few issues related to these questions. A first issue concerns obtaining the expectations from the two surveys. In the DHS, the question is straightforward and asks *"How much percentage points a year will they increase/decrease on average?"*. In the SHIW instead, respondents of the 2010 questionnaire of have been asked the following questions:

- "*On a scale from 0 to 100, what is the probability that house prices will drop in the next 12 months?*"
- "*And what is the probability they will drop by more than 10%?*".

Let Ω_t be the agent's information set at time t. Following Paiella and Pistaferri (2017), and assuming that expectations follow a standard normal distribution, it is possible to retrieve the first two moments (mean and variance) of the distribution of expectations by solving the following system of equations:

$$\begin{cases} pr(r_{t+1} < A|\Omega_t) = \Phi\left(\frac{E_t(r_{t+1})-\mu}{\sigma}\right) \\ pr(r_{t+1} < B|\Omega_t) = \Phi\left(\frac{E_t(r_{t+1})-\mu}{\sigma}\right) \end{cases} \tag{15}$$

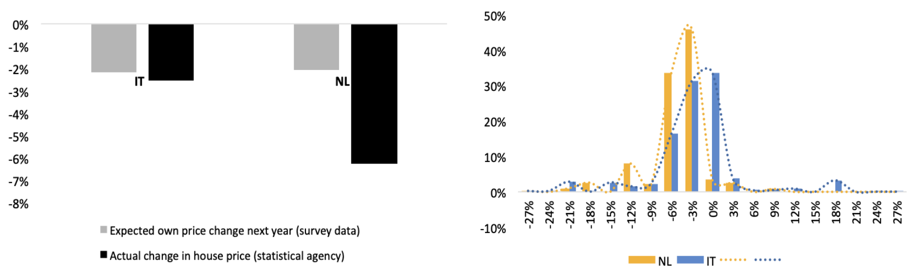
Where Φ denotes the Cumulative Density Function (CDF) of the Standard Normal Distribution, and A and B are the returns mentioned in the two expectation questions, $pr(r_{t+1} < A|\Omega_t)$ and $pr(r_{t+1} < B|\Omega_t)$ are the observed data points. The unknowns of this system of equations are the mean $E_t(r_{t+1})$ and the standard deviation σ of the distribution. In the 2012 wave, by means of randomization, the same question was asked to a 50% subsample of respondents, while to the other 50% subsample was asked to distribute 100 points among the possibilities that in the next 12 month house prices will be (i) much higher (more than 10%), (ii) slightly higher (between 2% and 10%), (iii) about the same (between -2% and 2%), (iv) slightly lower (between -2% and -10%) or (v) much lower than today (less than -10%). In this case, we obtain the corresponding expectation by assigning the elicited probability weights to the midpoints of each answer category, that is:

$$E_t(r_{t+1}) = \sum_k p_k r_k \tag{16}$$

Figure 1 shows the distribution of subjective expectations in the two surveys, as well the mean expected and realized housing wealth change. A second issue is that the SHIW data is a biannual survey but the expectation question asks respondent to elicit their one-year-ahead beliefs. The (biannual) expected change in the value of the property is equal to:

$$E_t(W_{t+2}) = W_t E_t(1 + r_{t,t+1})(1 + r_{t+1,t+2}) \tag{17}$$

Figure 1: Expected and Realized changes in house value



(a) (b)

Note: The figure in panel (a) shows the mean expected and realized wealth change in Italy and the Netherlands. The figure in panel (b) shows the distribution of subjective expectations.

However, due to the observational gap $E_t(r_{t,t+1})$ is observed while $E_t(r_{t+1,t+2})$ is not. We assume that individuals have AR(1) expectations, such that $E_t(r_{t+1,t+2}) = \rho E_t(r_{t,t+1})$ where ρ is the autoregressive parameter. Under this assumption:

$$E_t(W_{t+2}) = W_t(1 + E_t(r_{t,t+1}))(1 + \rho E_t(r_{t,t+1})) \tag{18}$$

Suari Andreu (2020) and Brauning et al (2013) show that self-reported expectations closely match data generated via an AR(1) process. Since the time series dimension is not long enough to estimate ρ, we follow Paiella and Pistaferri (2017) and assume an autoregressive parameter equal to one, due to the high persistence of house prices relative to the price of financial assets. A final issue is that, unlike for financial wealth, it is not possible to decompose the housing wealth effect in the endogenous and exogenous component. In fact, the change in the value of a portfolio composed by J different assets can be written as:

$$\begin{aligned}\Delta W_{t,t+1} &= \sum_j W^j_{t+1} - \sum_j W^j_t \\ &= \sum_j p^j_{t+1}(A^j_{t+1} - A^j_t) + \sum_j (p^j_{t+1} - p^j_t)A^j_t\end{aligned}$$

The change in the value reflect changes in the value of the constituents as well as portfolio reallocations. This equation can be easily estimated, as price changes and changes in allocation can be observed. Similarly, we can write the change in housing wealth as:

$$\Delta W_{t,t+1} = p_{t+1}H_{t+1} - p_t H_t = (p_{t+1} - p_t)H_t + p_{t+1}h_{t+1} \tag{19}$$

Where $p_{t+1}h_{t+1}$ is the value of the home improvement of quality h_{t+1}, which is inherently unobservable due to the indivisibility of house qualities and values.

4 Empirical Analysis

To obtain an unbiased estimate of the housing wealth effect, the change in house value must be unexpected and exogenous. The anticipated and unanticipated component can be disentangled using previously stated expectations and realization of house price changes. Instead, disentangling the exogenous and endogenous component is not possible because of the indivisibility of house qualities and values. What we observe is a proxy represented by the cost of the home investment (κh_t, following the notation of section 2). The literature mostly relies on the following estimating equation:

$$\Delta S_{i,t} = \alpha + \beta_u \left(lnW_{i,t} - ln(E_{t-1}(W_{i,t}) \right) + \beta_e \, ln(E_{t-1}(W_{i,t})) + \mathbf{X}_{i,t}\gamma + \epsilon_{i,t} \tag{20}$$

Where $S_{i,t}$ represents active savings of household i in wave t, which is elicited by asking respondents how much money has been put aside in the last 12 months. Active savings is a measure of savings that is not attributable to capital gains. The two right-hand side variables are the unexpected and expected change in housing wealth, respectively. The expected change in wealth is computed as in eq. (19), while the realized wealth change is computed as the difference in the self-reported house values between two waves. $\mathbf{X}_{i,t}$ are control variables.

The advantage of specification (20) is that, by filtering out the expected change in housing wealth from realized changes, it allows to estimate the housing wealth effect. According to the life-cycle model in fact, only unexpected changes in the value of wealth should translate into corresponding changes in consumption or savings. The disadvantage of specification (20) instead is that does not consider the endogenous component of housing wealth changes, represented by home improvements. To account for this, we treat the previous specification as subject to an omitted-variable problem, and we augment it to account for home improvements:

$$\Delta S_{i,t} = \alpha + \beta_u \left(lnW_{i,t} - ln(E_{t-1}(W_{i,t}) \right) + \beta_e \, ln(E_{t-1}(W_{i,t})) + \delta m_{i,t-1} + \mathbf{X}_{i,t}\gamma + \epsilon_{i,t} \tag{21}$$

Where $m_{i,t-1}$ denotes maintenance undertaken between waves $t-1$ and t. Adding maintenance as a conditioning variable is consistent with our model: maintenance expenses affect savings directly via the budget constraint and indirectly affect changes in house values via quality accumulation. Due to the indivisibility of house quality and value, the increase in value due to home investments cannot be identified, but if these systematically translate into changes in house values, price changes and maintenance expenses would then be correlated. We use the cost of home-improvements κh_t as a proxy of the value of home-improvement $p_{t+1}h_t$ which, following eq. (19), would allow us to perfectly disentangle the endogenous component of the wealth change.

If the true population model is given by eq. (21), estimating eq. (20) without taking into account maintenance can possibly lead to a bias in the estimated housing wealth effect. The bias is:

$$E(\widehat{\beta}_u) - \beta_u = \left(\frac{1}{n}\sum_i(\Delta W^u_{i,t} - \overline{\Delta W^u_t})^2\right)^{-1}\frac{1}{n}\sum_i(\Delta W^u_{i,t} - \overline{\Delta W^u_t})\delta(m_{i,t-1} - \overline{m}_{t-1}) \qquad (22)$$

Where $\Delta W^{u'}_{i,t} = (lnW_{i,t} - ln(E_{t-1}(W_{i,t}))$. According to our model, the covariance is supposed to be either positive or zero. If home improvements translate into increases in house qualities, then $\widehat{\beta}_u$ is overestimated. Instead, if home improvements do not increase the quality of houses, maintenance expenses and wealth changes are orthogonal, and the parameter is consistently estimated.

To verify this hypothesis, we present estimates of the housing wealth effect based on eq. (20) and (21). In particular, we study whether neglecting the role of home improvements returns sistematically different results.

Table 2 reports the result estimated on both the SHIW and the DHS data. In specification (a), we estimate the traditional equation for the housing wealth effect, as in Paiella and Pistaferri (2017). In specification (b), we account for the cost of home improvement. Specification (c) is analogous to (b), but uses a proxy of the value (instead of the cost) of the home investment. This is obtained by compounding the cost of maintenance with the elicited change in house prices. In specifications (d) and (e), we re-estimate specifications (b) and (c) by instrumenting the cost and the value of maintenance. The reason to instrument the proxies of the value of maintenance is that, if measurement error is of classical form (as assumed also in Juster et al. (2005)), this results in an attenuation bias in the associated OLS coefficient of the direct effect of maintenance on savings, while 2SLS consistently estimates it. For Italy, we take advantage of a tax benefit that allows deducting 55% of expenses in energy saving investments, and 36% of maintenance expenses, and we instrument maintenance expenses with the amount of tax deducible expenses. The instrument exploits difference in the deduction rates and the maximum deductible amount across investment types[3]. For the Netherlands, we use a dummy equal to one if the household head states that the home improvement "*will reflect fully in an increase of the property value in the case of a sale*". While the two instruments are different

[3]The law establishes a 55% deduction for energy saving investments up to 100.000 euro, 55% up to 60.000 for thermal insulation investments, and a 55% up to 30.000 for heating systems and a 36% deduction for home improvements up to 48.000 euro. Figures refer to 2012.

in nature, they are conceptually very similar: lower maintenance costs (via tax deductions) as well as a higher expected return out of the investment (via expectations) increase the expected net present value of the investment, which increases households' propensity to undertake home improvements. Therefore, the instruments should positively correlate with maintenance expenses, while being uncorrelated with the error term and only indirectly affecting savings.

Table 2: Results

Panel I: the Netherlands	**Dep. variable**: Change in Active Savings				
	(a)	(b)	(c)	(d)	(e)
Expected change in housing wealth	0.00890	0.00929	0.00926	0.00509	0.00554
	0.0105	0.0106	0.0106	0.0138	0.0131
Unexpected change in housing wealth	-0.0272***	-0.0273***	-0.0273***	-0.0257***	-0.0257***
	0.00917	0.00918	0.00918	0.00979	0.00977
Value of maintenance		-0.0475		0.456	
		0.122		1.066	
Cost of maintenance			-0.0489		0.456
			0.122		1.067
Estimate	OLS	OLS	OLS	2SLS	2SLS
First stage F stat.	-	-	-	38.9	38.9
Observations	2950	2950	2950	2950	2950

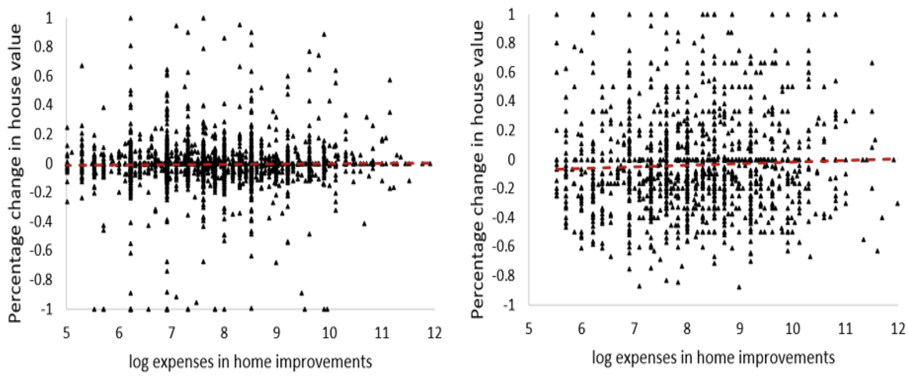
Panel II: Italy	**Dep. variable**: Change in Active Savings				
	(a)	(b)	(c)	(d)	(e)
Expected change in housing wealth	-0.0496***	-0.0496***	-0.0503***	-0.0495***	-0.0517***
	0.0155	0.0155	0.0155	0.0155	0.0156
Unexpected change in housing wealth	-0.0340***	-0.0341***	-0.0339***	-0.0343***	-0.0337***
	0.0129	0.0129	0.0129	0.0129	0.0130
Value of maintenance		-0.523***		-1.407	
		0.175		1.223	
Cost of maintenance			-0.493***		-1.498
			0.174		1.305
Estimate	OLS	OLS	OLS	2SLS	2SLS
First stage F stat.	-	-	-	56.9	49.6
Observations	2741	2741	2741	2741	2741

Note: Standard errors in brackets. The symbols *, **, and *** denote ten, five and one percent statistical significance levels, respectively.

There are three main results in Table 2. The first is that despite differences between the two countries, similar MPS emerge. These are also relatively small: a 1% unexpected increase in housing wealth causes a 0.03% reduction in active savings in both countries. Our back of the envelope calculations suggest that this corresponds to a reduction in active savings of about 85 euro in the Netherlands and 55 euro in Italy. The size of these estimates is in between those found in the micro and macro literature, which typically range from 0% to 3%, and from 5% to 7%, respectively. This result is in line with the evidence that housing wealth effects are smaller than financial wealth effects, as (i) there are few market instruments that allow households to efficiently consume home equity (ii) houses are consumption goods, other than assets, which make households less sensible to fluctuations in prices.

The second result is that, when we consider home improvements in (b) and (c), the estimated housing wealth effect does not change in magnitude. This suggests that home improvements did not translate into significant increases in the quality and the value of houses, and that the size of the bias in eq. (22) is very mild, if not zero. Our model offers two interpretations for this result. The first is that the value of houses mostly reflect the value of land, and maintenance activities are simply exogenous to the evolution of home equity. The second is that most of the home investments performed were aimed at contrasting depreciation, rather than increasing the quality and the value of houses. This can be the case if the net expected present value of home improvements is negative especially for large investments and major renovations. Indeed, figure 2 shows the correlation between expenses in home improvement and changes in house values is close to zero in the data.

Figure 2: Correlation between home improvements and changes in house value



(a) (b)

Note: Sample correlation between percentage change in house value and log maintenance expenses the Netherlands (a) and Italy (b).

The third result is that, when instrumenting the two proxies for maintenance, the estimated MPS again does not change. Instead, the point estimate of the instrumented variable becomes larger. This suggests that measurement error in the proxy of the value of home improvements is likely to be of classical form, and that the error term does not correlate with changes in house values. Eventually, results also show a negative and significant effect of expected wealth changes in Italy. This, despite being in contradiction with the life-cycle model (Deaton, 1992), is in line with the findings of Paiella et al (2017) on the same data. They justify this result appealing to credit constraints.

4.1 Heterogeneity Analysis

This section reports the result of the heterogeneity analysis. Given the limited amount of observations, most subgroups are formed on the basis of median values. Results are reported in Table 3 and show substantial heterogeneity. Higher wealth effects are found for younger respondents and among respondents with lower housing wealth to income ratios. The main difference between the two countries emerges when comparing the estimated MPS on those who make home improvements or not. In the Netherlands, the MPS is significant only for those who invest in home improvements. In Italy, the MPS is negative only among respondents that don't invest in home improvements. Eventually, less wealthy respondents have larger MPS in Italy, while the opposite is found for the Netherlands.

Table 3: Heterogeneity analysis

	Unexpected Change in Housing Wealth			
	Italy		**The Netherlands**	
	coef.	*S.E.*	*coef.*	*S.E.*
All (baseline)	-0.0339***	0.0129	-0.0273***	0.00918
No home improvement	-0.0379***	0.0136	-0.0311*	0.0167
Home improvement	-0.0228	0.0380	-0.0242**	0.0110
Housing wealth to income, below median	-0.0355*	0.0184	-0.0385*	0.0204
Housing wealth to income, above median	-0.0269	0.0192	-0.0225**	0.0103
Financial wealth below median	-0.0289*	0.0160	-0.0338**	0.0147
Financial wealth above median	-0.0498**	0.0204	-0.0201*	0.0113
Age below median	-0.0484***	0.0187	-0.0334**	0.0149
Age above median	-0.0231	0.0179	-0.0224**	0.0110

Note: The table reports the coefficient and the standard error of the estimate housing wealth effect, using specification (c) of Table 2 and 3. The symbols *, ** and *** denote conventional statistical significance levels.

5 Conclusions

This paper investigates the role of maintenance, renovations and home improvements for the estimation of the housing wealth effect. Using a stylized model with housing and endogenous home improvements, we decompose the housing wealth effect in its exogenous and endogenous component: positive house price shocks increase consumption via a wealth effect, and increase the net present value of home improvements. If these are undertaken, agents increase the quality of their property and they influence the dynamics of home equity. In the empirical part, we test whether disregarding home improvements biases the estimated wealth effect. The unanticipated and exogenous part is elicited not only by filtering out previously stated expectations of house prices, but also accounting for endogenous home-improvements. Our results show that the size of the bias, which is proportional to the covariance between home investments and changes in housing wealth, is zero due to the virtually zero correlation between expenses in home investments and changes in house values. Results indicate, for both countries, a wealth effect on savings of three cents per (exogenous and unexpected) euro increase in house value. The use of a comparative empirical approach excludes that differences in the results are due to different methodologies being used, and allows to exclude that results are not only internally valid on a single case.

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