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The Effect of Declining House Prices on Household Savings

A Theoretical and Empirical Study of the Dutch Case

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Abstract

In this paper I analyse the effect of a decrease in house prices on the savings of households. A simplified version of the life cycle model with housing predicts that homeowners will compensate an unexpected decrease in home equity by increasing their savings. In addition, the model predicts that the effect becomes stronger as the age of the household increases. To test these hypotheses I use data from the Dutch Central Bank Household Survey (DHS) for the period between 2003 and 2013. This sample period allows me to exploit the variation in house prices associated with the last years of the housing boom and the 2008 bust. The results of the econometric analysis show that homeowners do not react neither to self-reported measures of house price changes nor to their own expectations about future house prices. However, I do find a significant effect, with the expected sign, when the observed market price change in the second hand housing market is employed. The latter result implies that households are more sensitive to general market conditions than to the value they assign to their own house. The effect becomes stronger with age and it appears to be asymmetric, meaning that households react to negative changes much more than they react to positive changes in house prices.

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1 Introduction

Since the year 2008 the Dutch housing market has experienced a continued yearly decline in property prices. This decline followed continued yearly increases that lasted for nearly two decades. During the years of house price increases different actors in the Dutch society, *i.e.* consumers, private business, financial sector and government, contributed to one of the most prominent housing bubbles in Europe. The convincement that house prices would never stop increasing gradually diverted a lot of resources towards the construction sector. Therefore, the burst of the bubble has had consequences at many levels. In this paper I focus on the consequences for household finances. I am interested in studying how households have reacted to the decline in house prices in terms of their consumption and savings. Since I do not have data available on consumption I restrict the empirical analysis to the effect of house price changes on household savings.

Thinking at the household level, buying a house is anything but an easy decision to make. That is because housing is both a consumption good and an investment good. Therefore, when an average household decides to become a homeowner it is investing a big share of its wealth on a single asset. That makes the decision to buy a house one of the most important in the life of many individuals. The decision is easier if one expects that house prices will increase in the future. However, there is always a risk and it has been proven by the evolution in house prices in the last six years, not only in the Netherlands but in many other countries.

The existing literature has pointed out two main channels through which a change in house prices can affect savings and consumption of households. The first one is known as the wealth effect, which means that changes in house prices affect permanent income and thus they imply changes in savings and consumption. It is reasonable to assume that this effect gets stronger with age, since the shorter is the expected life horizon the less time there is to smooth shocks to permanent income. The second channel is known as the borrowing constraints effect, which means the house price changes affect borrowing constraints by affecting the value of an asset that can potentially be used as a collateral. It is reasonable to assume that this effect is stronger for younger households, since they are the ones that are more likely to be liquidity constrained.

In this paper I focus on studying the wealth channel. To do so I set up a simplified version of the life cycle model with housing and study what the theory predicts about how the savings of homeowners react to a decline in house prices. The version of the model that I present is rather simple and thus allows me to study housing without the complications that it usually entails. The model predicts that households will offset an unexpected loss in home equity by increasing savings. The intuition is that the households want to increase savings to be able to smooth the drop in consumption implied by the shock to permanent income. In addition, the model predicts that the effect will increase with age. That is because older households have simply less time smooth the shock in consumption. These results rely in several assumptions, the most important of which are the substitutability between home equity and liquid savings, and the absence of a bequest motive. Furthermore, the change in house price must be unexpected and permanent to have a contemporaneous effect on savings.

To test these hypotheses I employ data from the Dutch National Bank Household Survey (DHS) and from the Dutch statistical services (CBS in its Dutch acronym). The DHS dataset follows Dutch households between 1993 and 2013 and contains diverse information on economic and psychological aspects of household behaviour. Since the data are longitudinal they allow me to apply panel regression techniques. One of the main advantages of the DHS dataset is that it contains data on house price expectations. These data allow me to compute measures of the unexpected change in house prices in a way that has not been done in the literature so far. I do so by subtracting the expected house price change from self-reported measures of the house price change. Therefore, only the unexpected part of the change is left. In addition, I employ as well measures of the price change in the second hand housing market as observed by CBS. This measure is available both at the national level and at the province level.

The results show that households do not react neither to self-reported measures of the change in house prices nor to the unexpected change in house prices. This might be because, although promising, the measure of unexpected house price changes that I employ has still a few shortcomings. The most important one is that the data are on one-year expectations, while perhaps long term expectations are more important, especially for households who expect to stay in the current residence still for a long time. Furthermore, there is not much variation in self-reported measures of house price changes. According to the DHS data set, households start recognizing losses in home equity three years after CBS starts reporting declines in house prices. An interpretation is that households are reluctant to recognize a loss in the value of their property. On the other hand, I do find a statistically and economically significant negative effect on savings of the house price change as observed by CBS. I find as well that the effect increases with age. In addition, I find that the effect is asymmetrical since households appear to react to a greater to extent to negative changes as compared to positive changes.

The rest of the document is structured as follows. Section 2 gives a general overview of the evolution of the Dutch housing market in the last years. Section 3 reviews the relevant literature. Section 4 presents the model. Section 5 provides a description of the dataset and some preliminary evidence. Section 6 explains the methodology I employ to test the hypothesis derived from the model. Section 7 provides the results of the empirical analysis. Section 8 rounds up the paper by giving a conclusion and some additional discussion of the results. Appendices provide additional data description, summary statistics and a longer and more detailed version of the model in section 4.

2 The Dutch Housing Market

From the 1990s up until 2007 the Dutch economy experienced a period of rapid growth accompanied by a salient housing price boom. During the peak of the housing boom, between 1996 and 2001, the Dutch economy grew at a yearly average of 3.7% while housing prices did so at 13.2%.[1] These figures were coupled with a considerable surge in housing construction and homeownership. Agnello and Schuknecht (2011), point at international liquidity and financial deregulation as significant factors in explaining housing booms in developed countries between the 1980s and 2008. Accordingly, Attanasio and Weber (1994) point out that financial liberalization relaxes borrowing constraints and thus tends to increases homeownership and house prices as a consequence. Even though these are very relevant factors to understand the developments in the Dutch housing market during the last decades, there are three factors that make the Dutch case rather special.

The first one is the role that the government played in further stimulating the housing boom. During the 1990s the Dutch government gradually implemented several policies to stimulate homeownership. The clearest example is the introduction of a national mortgage guarantee (Nationale Hypoteekgarantie) that applies if a homeowner, under certain unfavourable circumstances (e.g. unemployment, divorce or work incapacity), must sell his/her house below the original price. Such a policy implies a reduction of the risk associated with price volatility that potential buyers face, which, as empirically confirmed by Turner (2003), provides an incentive for homeownership. Another of such policies is the provision of tax advantages for homeowners, which in the Dutch case implies the possibility of deducting up to 52% of the interest linked to mortgage repayment. In the Netherlands, tax incentives for mortgages are in fact greater than tax incentives for savings (DNB, 2013). The intuitively suggestive positive effect of mortgage interest tax deductions on homeownership has been empirically confirmed by Poterba (1992) and more recently by Hanson (2012).

The second differential factor of the Dutch housing market is the diversity of mortgage arrangements. During the housing boom the most popular were the so called interest-only mortgages (Aflossingsvrije Hypotheken) which need only be redeemed at maturity. The household pays only interests during the loan period, while the principal is not repaid until the very end of such period. A popular alternative are the so called endowment mortgages (Spaarverzekering Hypotheken), which also need only be redeemed at maturity, but they are coupled with a savings account to ensure the accumulation of funds for the repayment of the principal. These products, together with very high loan to value ratios allowed by banks, give very clear incentives for households to become homeowners rather than renters. In addition, van Ooijen and van Rooij (2013) argue that limited understanding

[1] House price changes are given in nominal terms while economic growth is given in real terms. Data are provided by CBS.

by potential buyers of this particular types mortgage contracts has as well contributed to the surge in homeownership in the Netherlands.

Last but not least, a relevant differential factor of the Dutch housing market is given by the human and physical geography of the country. Scarce land, strict regulations and high population density provide conditions for a tight housing market in the Netherlands, especially during times of economic boom (Vermeulen and Rouwendal, 2007). These factors imply a rather sluggish housing supply, which results in house price increases when demand rises at a faster pace.

After a period of continued house price increases lasting nearly two decades, the Dutch housing market started to become weak in 2008. This was mainly due to the global financial meltdown and the following economic crisis which resulted in a loss of consumer confidence and a slowdown in the housing market. As figure 1 shows, average house prices in the second hand market still experienced a considerable increase between 2003 and 2008. However, there was a very clear turning point in 2008, after which house prices have been declining up to the present moment. This turning point clearly coincided with a downturn in the rate of economic growth, which partially recovered afterwards. In 2009 house prices decreased by 3.4%, while in 2010 and 2011 the decrease moderated to around 2.3% in both years. However in 2012 and 2013 house prices clearly decreased again by around 6.5% in both years.[2]

During the years of the housing boom, the Netherlands gradually became an over-mortgaged nation, with a mortgage debt to GDP ratio among the highest in Europe. The consequence of this can be seen in figure 2, which depicts household gross debt to income ratio in the Netherlands compared to the EU-27 average. In the Netherlands, this measure reached in 2010 a worrying maximum of 250%, only surpassed by Denmark. Since the turning point of 2008, Dutch households have had to adapt to the a situation with lower growth rates and declining house prices. This is the case especially for homeowners since they have suffered a significant decrease in their housing wealth, which is in most cases a major component of their total wealth.

3 Literature Review

Almost all of the academic studies on the effect of house price changes on household consumption and savings have done so within the framework of the lifecycle model. In a skilful review of the large literature on the life cycle model, Attanasio and Weber (2010) pay some attention to the strand of the literature focused on studying housing decisions. They warn about the difficulties that entails the consideration of illiquid durable goods. The main issue is that the consumption of this type of goods cannot be studied with the usual Euler equation approach since the associated transaction costs lead to infrequent

[2]The percentage changes refer to the evolution of average house prices as depicted in figure 1.

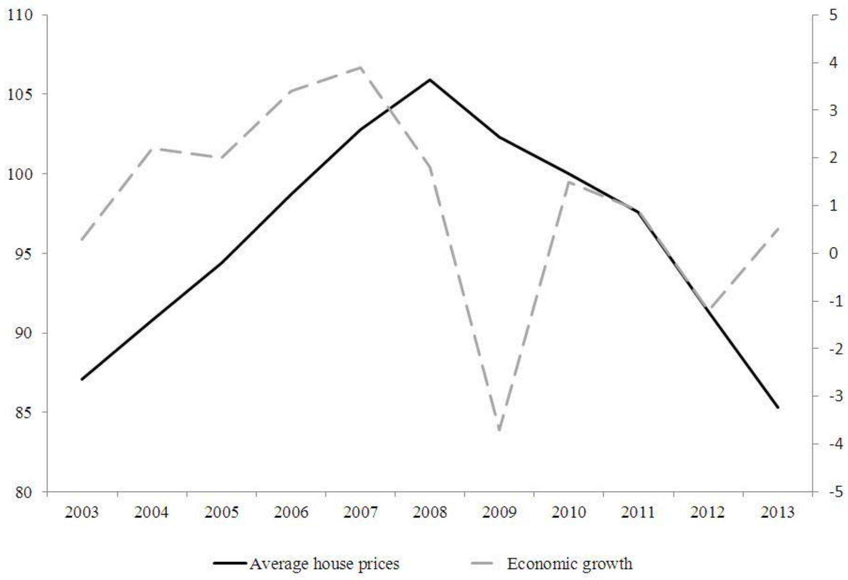

Figure 1 Evolution of House Prices and Economic Growth

Source: CBS; Notes: The solid line reflects the evolution of average nominal house prices in the second hand Dutch housing market. The year 2010 is taken as a reference. The dashed line reflects the evolution of the real rate of GDP growth, in terms of 2005 prices. The left axis measures house prices, while the right axis measures economic growth.

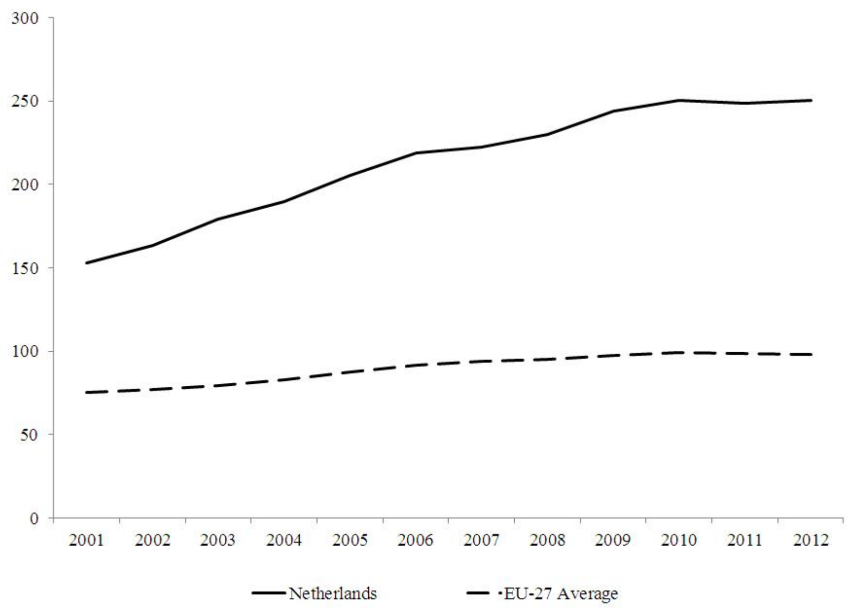

Figure 2 Household Gross Debt to Income Ratio

Source: Eurostat; Notes: Gross debt to income ratio of households is defined as loans and liabilities divided by gross disposable income with the latter being adjusted for the change in the net equity of households in pension funds reserves. Detailed data and methodology on site http://ec.europa.eu/eurostat/sectoraccounts.

adjustments. Nevertheless, there has been several attempts to introduce the housing asset in the framework of the life cycle model.

The first to employ the life cycle model to study the housing decision were Artle and Varaiya (1978), who performed an analysis of the effects of tenure (homeownership versus rental), and its timing, on the optimal life cycle consumption profile. In a model with complete certainty, they study the optimum renter and owner profiles separately, ignoring the possibility of changes in house prices. They predict that homeowners will have a higher consumption level throughout their lives, with the exception of the early stages of the life cycle due to the down payment constraint. That is because, in their model, it is cheaper to buy than to rent a house. More recently, Li and Yao (2007) extended the model in Artle and Varaiya (1978) by incorporating uninsurable labour income, endogenizing tenure decisions, and allowing for the possibility of borrowing against the housing asset. In addition, they study the effects of house price increases on consumption by parametrizing the model and performing simulations. They find old homeowners are more likely to transform housing wealth gains into consumption due to their shorter expected life horizon. Young homeowners also take an advantage by increasing the value of collateral and thus relaxing their borrowing constraints. These results are in accordance with Sinai and Souleles (2005) who point out that middle-aged homeowners are less likely to be liquidity constrained and they still face a long expected life horizon. They are thus less likely to respond to changes in house prices.

One of the latest attempts to study the theory of housing decisions through the life-cycle has been conducted by Attanasio *et al.* (2012). Their main contributions are the interaction between housing services and nondurable consumption in the utility function, uncertainty about earnings and about house prices, and a clear separation between the extensive margin (owning or not) and the intensive margin (size and characteristics of the house). By performing simulations they find that positive house price shocks lead to consumption booms especially among the old. Even though both Li and Yao (2007) and Attanasio et al. (2012) study only the effects of house price increases, they suggest that exactly the inverse effects would be found in case of house price decreases. However, Engelhardt (1996) and Chen et al. (2009) warn against this reasoning by arguing that the behavioural response to house prices may be asymmetric.

On the empirical front, studies employing micro level data have yielded very diverse results.[3] One of the first studies to employ micro data was conducted by Engelhardt (1996), who, employing cross sectional data from the Panel Study of Income Dynamics (PSID) and measuring house capital gains as the change is self-reported home value, finds

[3]Studies using aggregate data, *e.g.* Peek (1983), Bhatia (1987), Skinner (1989), Case *et al.* (2005) and Carroll *et al.* (2011), have consistently shown evidence of a strong positive link between house prices and consumption behaviour. However, it seems difficult to account for all variables affecting aggregate consumption and house prices at the same time. Therefore, it is questionable to take a stand on a causal relationship between these two variables at the aggregate level.

that housing wealth gains offset non-housing savings. More interestingly, he finds that most of the effect comes from those households that experienced housing wealth losses. The interpretation is that, during the period of analysis, most households expected housing wealth gains, hence only those who suffered losses were truly surprised. On the other hand, these asymmetric responses may be explained by loss aversion, a concept introduced by the literature in behavioural economics (*e.g.* Kahneman and Tversky, 1979).

In one of the few studies that focuses on the Dutch case, Rouwendal and Alessie (2002) use data from the Dutch socio-economic panel for the period 1987-1994. Those were years during which the Dutch housing bubble was beginning to take off, hence they aim at using the increase in house prices to identify the effect of house price changes on household savings. For house prices they use data of the Dutch Association of Realtors and they measure savings as the yearly change in reported wealth. Their main result is a negative and significant effect of house price increases on the savings of homeowners. They do not find a significant effect on the savings of renters.

In a more recent contribution, Campbell and Cocco (2007) construct a pseudo-panel from a time series of cross sections and find considerable heterogeneity in the response of household consumption to house price changes. They estimate a large positive effect for the cohort of old homeowners and an effect that is close to zero for the younger ones. This gives empirical support to the wealth hypothesis, which applies more to older households, while it does not support the borrowing constraints hypothesis, which applies more to young and liquidity constrained households. The age heterogeneity pointed at by Campbell and Cocco (2007), which is in line with the theoretical paper by Li and Yao (2007), has very relevant implications since it suggests that as population ages, aggregate consumption and savings may become more responsive to house prices.

In contrast to the findings by Campbell and Cocco (2007), Attanasio et al. (2009) find that the relationship between house prices and consumption is stronger for younger than for older households, which contradicts the wealth channel. They reach these conclusions by using the UK's Family Expenditure Survey (FES) data and thoroughly exploiting both the time series and cross section dimensions of the data. More recently, Disney et al. (2010) performed a similar analysis using the British Household Panel Survey (BHPS). They conduct a panel data analysis and find very small, but positive and significant, propensity to consume out of housing wealth. In contrast to Campbell and Cocco (2007) and Attanasio et al. (2009) they find little heterogeneity in the responses of young and old homeowners. Similar to Engelhardt (1996), they find asymmetric responses to house price rises and falls.

In one of the most recent contributions to the literature, Browning *et al.* (2013) aim at performing a direct test of the presence of a wealth effect explaining the positive influence of house prices on consumption. They do so by using Danish panel data and exploiting changes during the early 1990's in institutional restrictions limiting the use of house wealth gains for consumption loans. They find no evidence of a wealth effect. This result adds to the diversity of findings in the literature. Due to this variety in the results, it is hard to establish a general relation at the micro level between house prices and household savings and consumption. In that sense, if policy recommendations are to be prescribed, every country and period deserves its own detailed analysis.

4 Life Cycle Model With Housing

In this section I introduce a formal description of life cycle savings and consumption in the presence of housing.[4] The intention is to study the effect of a decline in the value of the housing asset on savings and consumption. Furthermore, I want to see how this relation is contingent on the stage of the life cycle. The focus here is on the effect of house prices through their effect on household wealth. I follow Artle and Varaiya (1978) in the sense that I study the renter and the homeowner cases separately, *i.e.* without endogenizing the tenure decision. I am indebted as well to Engelhardt (1996), Li and Yao (2007) and Campbell and Cocco (2007) from who I borrow several modelling aspects related to the treatment of housing. Regarding the non-housing aspects of the model, I follow the work of Deaton (1992) and of Attanasio and Brugiavini (2003). Following the latter, I use a four period framework and I do not include neither lifetime nor income uncertainty. I consider the rate of change in house prices as the only source of uncertainty. This stripped down version of the life cycle model allows me to show how an unexpected decrease in housing wealth implies a decrease in consumption and an increase in non-housing savings. This implication crucially relies on four assumptions.

First, the change in the value of the house must be unanticipated and perceived as permanent by the household. Expected changes would have no effect at the time of occurrence. Second, housing wealth must be complementary to other forms of wealth. That means households should not treat housing differently from other assets such as stocks, bonds, etc. Third, households must be able to liquidate housing wealth so it can actually be a substitute to other forms of wealth. This can be accomplished through the sell of the house (upon the payment of a transaction cost) or through financial vehicles such as reverse mortgages or second mortgages. Fourth, there must not be a bequest motive or altruism towards the younger generation. If the bequest motive is present, changes in housing wealth can lead to changes in the bequest itself, rather than on savings and consumption of the household.

Bearing the above assumptions in mind, consider a household that lives for four periods

[4]For a more detailed and lengthy description of the model, see appendix 2.

and maximizes the following CRRA utility function

$$U(C_t^\tau, H) = \sum_{t=1}^{4} \frac{1}{(1+\rho)^{t-1}} \left(\frac{(C_t^\tau)^{1-\gamma}}{1-\gamma} + \theta \frac{(H(1+\lambda))^{1-\gamma}}{1-\gamma} \right), \tag{1}$$

where C_t^τ is consumption in period t as planned in period τ, H is constant housing, ρ is the rate of time preference, γ is the rate of realtive risk aversion, θ denotes the preference for housing and λ represents the utility gain from owning the occupied house. This implies $\lambda = 0$ for a renter and $\lambda \geq 0$ for an owner. In the latter case, the value of λ depends on the household preference for owning.

In the case of a homeowner, I assume that the house is purchased at the beginning of the second period since it is usually required to have previous income to be able to obtain a mortgage. In the Netherlands, this is the only restriction, since households can borrow close to 100% of the value of a house and hence there is no down payment restriction. In addition, the house will be sold at the beginning of the last period due to the lack of a bequest motive. Therefore, the household is a renter in the first and fourth periods. The intertemporal budget constraint for a homeowner is thus given in the first period by

$$\varOmega^1 + E_1 \frac{\alpha_4 H(1-\phi)}{(1+r)^3} = \varTheta^1 + K_1 + E_1 \left(\frac{M r^M}{(1+r)} + \frac{M(1+r^M)}{(1+r)^2} + \frac{K_4}{(1+r)^3} \right), \tag{2}$$

where $\varOmega^1$ and $\varTheta^1$ are lifetime income and consumption as evaluated in period 1, is lifetime consumption as evaluated in period one,[5] α_t is the real price of housing, ϕ is the transaction cost incurred to sell the house, K_t is the cost of renting in period t, M is the amount borrowed to purchase the house, r^M is the constant interest rate on the mortgage and r is the constant interest rate that determines the return on savings. The household borrows 100% of the value of the house, hence $M = \alpha_2 H$ since the house is purchased at the beginning of the second period. K_1 and K_4 feature in the budget constraint because the household rents in the first and fourth periods. I assume the rental price to be a function of the house price given by $K_t = \kappa + \delta \alpha_t H$, where κ is a constant and δ is the sensitivity to the house price.

The second term on the left hand side of (2) denotes the amount the household is expecting to receive when the house is sold at the beginning of the fourth period. The expectation is due to the uncertainty related to the rate of change in house prices, which, in turn, implies uncertainty in future house prices, mortgage payments and rental prices. I assume the household expects the rate of change in house prices to be positive and constant. The expectation on the right hand side of (2) includes the mortgage interest payments in periods two and three, the principal of the mortgage loan, which must be

[5] A numerical superscript indicates the period at which a particular variable is evaluated. Except for consumption and savings, in which case a numerical superscript indicates the period at which they where planned.

repaid in period three, and the expected rental payment in period four. The rental payment in the first period is out of the expectation since its value is already realized in period one.

At the beginning of period one the household sets an optimal plan by maximizing (1) subject to (2). Due to the separability between consumption and housing in the utility function, the marginal utility of consumption is not affected by housing. This feature simplifies the matter since it allows studying changes in the value of housing solely as an income effect. A closed form solution for planned consumption can be found by combining (2) with the first order conditions[6] derived from the maximization problem, which yields

$$C_t^{1*} = \frac{\Omega^1 + E_1 \Xi^1}{\Lambda_t^1}, \tag{3}$$

where Λ_t^1 is the factor containing ρ and r that distributes permanent income among the four periods and Ξ^1 is what I call the owning factor. The owning factor represents the present value the share of permanent income derived from housing. It contains the expected value of the house at the selling period minus all the lifetime housing related expenses. It can be easily seen that any change in the owning factor that is known in the planning period will be distributed among the four periods according to the Λ_t^1 factors.

If the expectation regarding the rate of change in house prices is fulfilled in all periods, the house will be sold at the beginning of the fourth period at the expected price. I consider now the event of a one period negative surprise in the house price rate of change that can take place in periods either two, three or four. I assume the information about the realized rate of house price change becomes available at the beginning of each period. In addition, I assume the negative surprise takes place only in a particular period, while in the rest of the periods the expectation about the rate of house price change is fulfilled. Realized consumption in a period with a negative surprise is be given by

$$C_t^* = C_t^{1*} + \eta_t, \tag{4}$$

where η_t is the forecast error equal to the difference between actual consumption, C_t^*, and the consumption plan set in period one, C_t^{1*}. The forecast error occurs as a direct consequence of the lower-than-expected house price change rate, and realized consumption is the result of the reoptimization the household undertakes when the new information is available. As can be seen in (4), a negative forecast error will imply a reduction in consumption.

The negative surprise implies that the household will sell the house in the last period for a lower price compared to what was planned in period one. A crucial aspect is

[6]The first order conditions of the maximization problem derive into a standard Euler equation. See appendix 2 for details.

that the contemporaneous effect on consumption will be higher the closer the household is to selling the house. If the surprise takes place in period two, the household still has two more periods to smooth the shock, whereas if it happens in period four the whole shock to permanent income has to be absorbed in just one period. Therefore, the contemporaneous effect on consumption of the negative housing surprise will be higher the older the household is.

The result for consumption in (4) can be easily given in terms of savings. Since I am especially interested on the savings of a household who is a homeowner, I use the unconsolidated budget constraints of periods two and three (in periods one and four the household is not a homeowner) to find expressions for savings. The contemporaneous effect on the stock of savings of a change in house prices in periods two and three is given by

$$S_2^* = S_1^*(1+r) + Y_2 - C_2^{1*} - Mr^M - \eta_2 \tag{5}$$

and

$$S_3^* = S_2^*(1+r) + Y_3 - C_3^{1*} - M(1+r^M) - \eta_3 \tag{6}$$

respectively, where S_t is the stock of savings at the end of period t. The negative sign in front of the forecast error implies that a negative surprise in house prices will imply an increase in savings. The intuition behind this result is that the household will increase savings to offset the decline in housing wealth and smooth the drop in consumption. The later in life, the less periods there are to smooth consumption so the higher has to be the compensatory increase in savings. Therefore, the contemporaneous effect on savings of the negative housing surprise will be higher (in absolute value) the older the household is.

In the case of a household that rents the house it occupies, I find an expression very similar to (3), but with a renting factor instead of an owning factor. The renting factor includes the present value of lifetime rental payments. To the extent that rental prices are positively linked to housing prices, *i.e.* $\delta > 0$, a negative surprise in house prices will have a positive effect on the consumption of renters, and a corresponding negative effect on savings. The intuition behind this is simply that a decrease in lifetime rental payments implies a positive shock to permanent income, which leads to higher consumption and lower savings. In the empirical section below I estimate the effect of house price changes on savings both for homeowners and for renters.

5 Data and Preliminary Evidence

To estimate the relations that derive from (5) and (6) I use data from the Dutch National Bank Household Survey (DHS), which provides a unique data set facilitating the study of both economic and psychological aspects of household behaviour. This panel survey

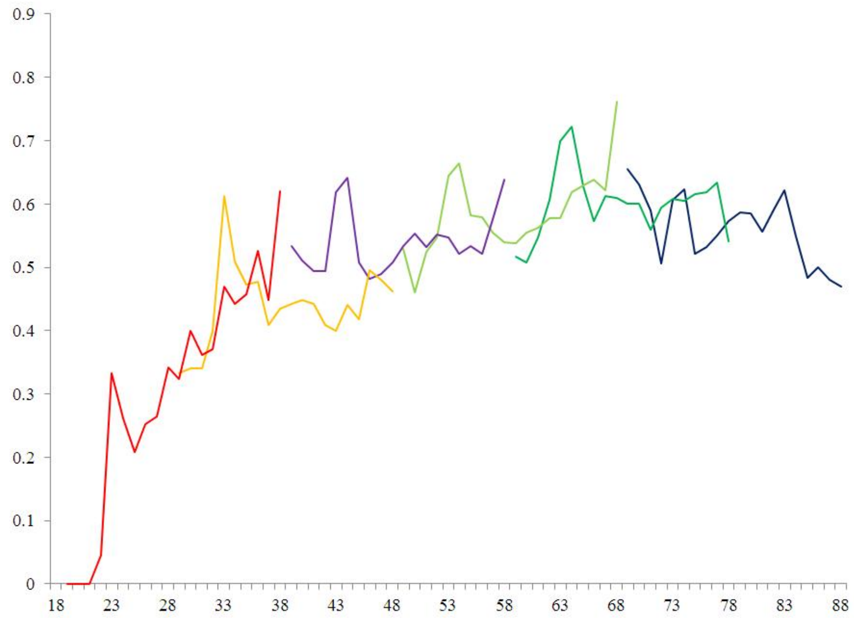

Figure 3 Evolution of Homeownership Through Life

Source: DHS; Notes: Data between 2003 and 2013 are employed. Each one of the lines depicts a particular cohort. There are six ten year cohorts born between 1925 and 1984. The vertical axis measures cohort specific homeownership rate, while to horizontal axis measures age.

contains information on a variety of topics (e.g. work, income, pensions, demographics, etc.) for around 2000 Dutch households between 1993 and 2013. Therefore, the structure of the data allows for the implementation of panel regression techniques. One of the biggest advantages of this dataset is that it contains an extensive section on accommodation and mortgages, which includes questions about self-reported house value and house price expectations. The data on house price expectations allows to compute a proxy for the forecast error, η_t. Since data on expectations are available only since 2003, I use data for the eleven years running between 2003 and 2013, both included.

Figure 3 shows the relation between homeownership and age as found in the DHS dataset. The data are divided in six cohorts of ten years. Each one of the lines depicts the evolution the average homeownership rate for a particular cohort. The figure shows a very steep increase in homeownership rates for younger cohorts. For the middle aged cohorts the increase is more moderate and for the last two cohorts there is a slight decrease in homeownership over time. In light of this graph, the assumption implying homeowners will sell their house towards the end of their life seems far fetched. However, the idea behind the assumption is not generating a realistic prediction but more capturing the financial security that households obtain by possessing an asset that can eventually be sold later in life.

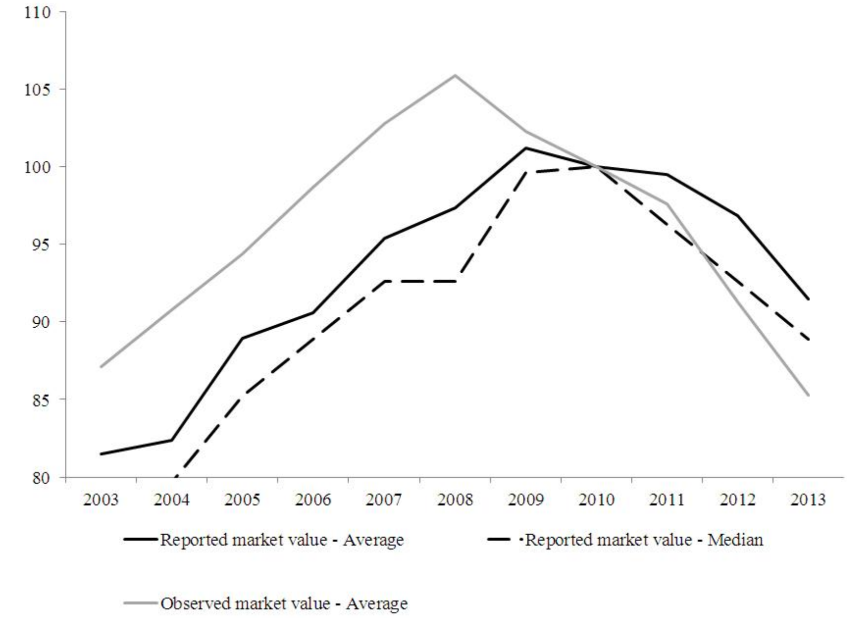

Figure 4 Evolution of House Prices: Reported vs Observed

Source: DHS and CBS; Notes: Reported value of the house is asked only to homeowners and refers to the nominal value of the house. The grey line is the same as depicted in figure 1. The year 2010 is taken as a reference.

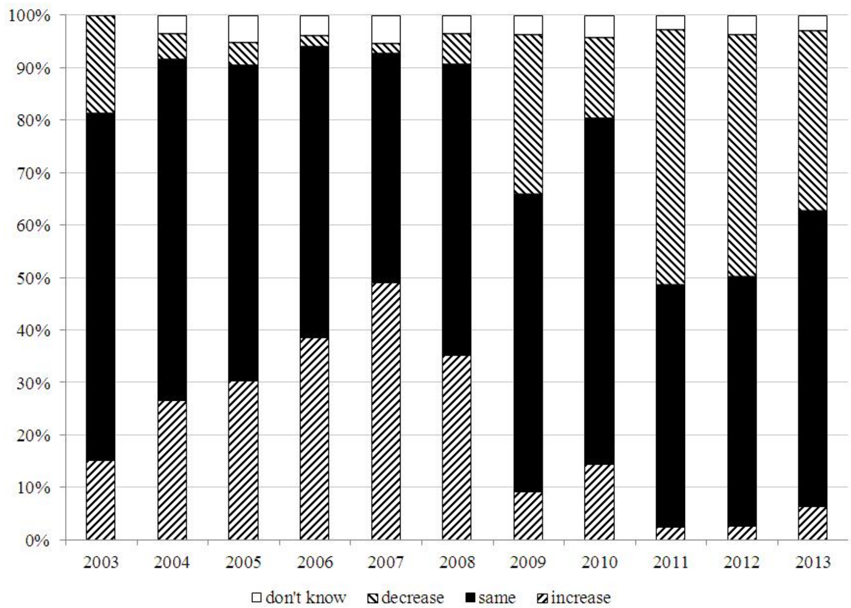

Figure 5 Expected Price Development Own Home (Two Years)

Source: DHS; Notes: The question is asked only to homeowners and refers to expected nominal changes in two years from the moment when the question is asked.

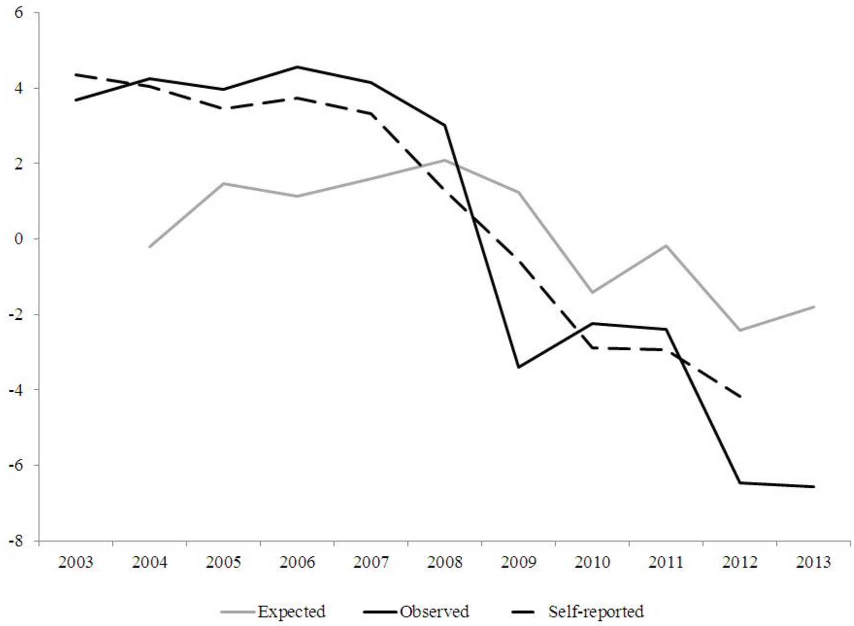

Figure 6 Expected, Self-reported and Observed House Price Changes

Source: DHS and CBS; Notes: Changes are given in percentages. Expected and self-reported values are measured at time $t-1$ and $t+1$ respectively. Both questions are asked only to homeowners and refer to nominal changes. Data on the self-reported change in house prices are not available for 2013. Data on house price expectations are not available for 2003. The observed change reflects the evolution of observed house prices as depicted in figures 1 and 4.

Figure 4 plots the trend of the yearly average and median of self-reported house prices and compares it to the trend of the average price for which houses are sold in the Dutch second hand housing market. According to this figure, DHS respondents have started reporting a decline in house prices three years later than observed by CBS. A plausible interpretation is that homeowners are reluctant to recognize a depreciation of their house, which is in line with the results provided by van der Cruijsen *et al.* (2014). The latter employ DHS data and find that homeowners hold an over-optimistic view of the value of their house. In addition, figure 4 shows that both the average and the median of reported house prices follow the same trend. This means that the evolution of average reported house prices is not determined by the presence of extreme values.

Regarding house price expectations, figure 5 gives a very clear picture of their evolution over the sample period. This figure provides the yearly answers to the question "Do you expect your house to increase or decrease in value, or do you expect the price to remain the same in the next two years?". Between 2003 and 2007 there is a rise of the share of respondents who expect their house to increase in value. After 2008, this tendency is reversed and from then onwards there is a gradual rise of the share of respondents who expect their house to decrease in value. This evolution is in accordance with the results of Niu and van Soest (2014) who, employing American data, find a positive correlation between house price expectations with both past housing returns and perceived economic conditions.

According to the predictions of the model in section 4, changes in housing wealth will have a contemporaneous effect on consumption and savings only if they are unexpected. Since it provides both the expected and the self-reported change in house prices, the DHS dataset allows to measure the unexpected change in house prices. Figure 6 plots together the averages of the expected, the self-reported and the observed yearly changes in house prices. The figure shows clearly how during the years before 2008 there is a positive surprise, meaning that the observed and reported changes in house prices are above what was expected for a particular year. However, in the years after 2008 there is a negative surprise since then homeowners persistently overestimate the change in house prices. This provides some very useful variation to identify the relation between house price changes and saving behaviour in the Netherlands.

The survey provides as well an interesting measure of savings, since it asks respondents every year how much money have they put aside in the past 12 months. This measure of savings is much less noisy and more accurate than other measures employed in the literature.[7] The DHS question on money put aside provides respondents with seven intervals that range from “Less than 1.500 Euros” to “More than 75.000”. To compute the average I take the midpoint of each interval. Figure 7 shows a clear increase in average savings between 2005 and 2009. After 2009, savings stay at a higher level than before but with yearly fluctuations. The dashed line shows that the percentage of respondents reporting zero money put aside has remained rather constant over time between 30% and 40%. Figure 8 plots the same variable over time but for different age groups. All the three lines together picture a general increase in average savings. However, for the group of households with a household head above 65 years of age, the increasing tendency shows a clear reversal from the year 2011 onwards. For the younger group, the evolution of savings shows strong volatility. Nevertheless, it has a very clear increasing trend from 2007 onwards. The percentage of respondents reporting zero savings is stable over time for the three groups and it increases with age.

The descriptive statistics provided so far show that, during the sample years, house prices decline while savings increase. However, the negative correlation between these two variables becomes even more clear when plotting them together against time as shown in figure 9, which plots together average savings and the unexpected and observed changes in house prices. I calculate the unexpected change in house prices by taking the yearly difference between perceived and expected house price changes as reported by DHS re-

[7] Engelhardt (1996) and Rouwendal and Alessie (2002) employ the change in assets as a measure of savings. This measure is very easily contaminated since it is rather difficult to disentangle active savings from capital gains and losses.

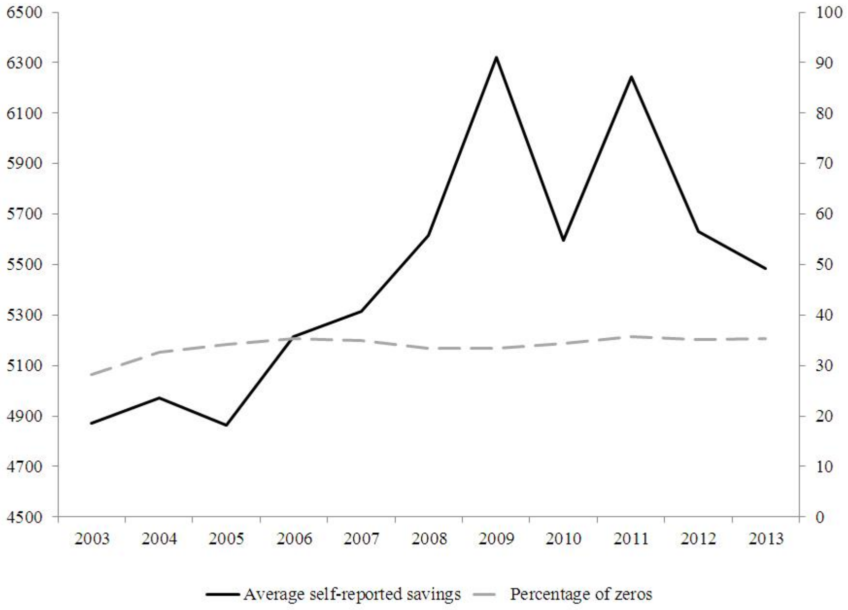

Figure 7 Average Self-repoted Savings

Source: DHS; Notes: The question refers to the nominal value of savings. Respondents are given seven intervals that range from "Less than 1.500 Euros" to "More than 75.000". To compute the average I take the midpoint of each interval. For the highest interval I take the value of 75.000 Euros. The left axis measures average savings while the right axis measures the percentage of zeros.

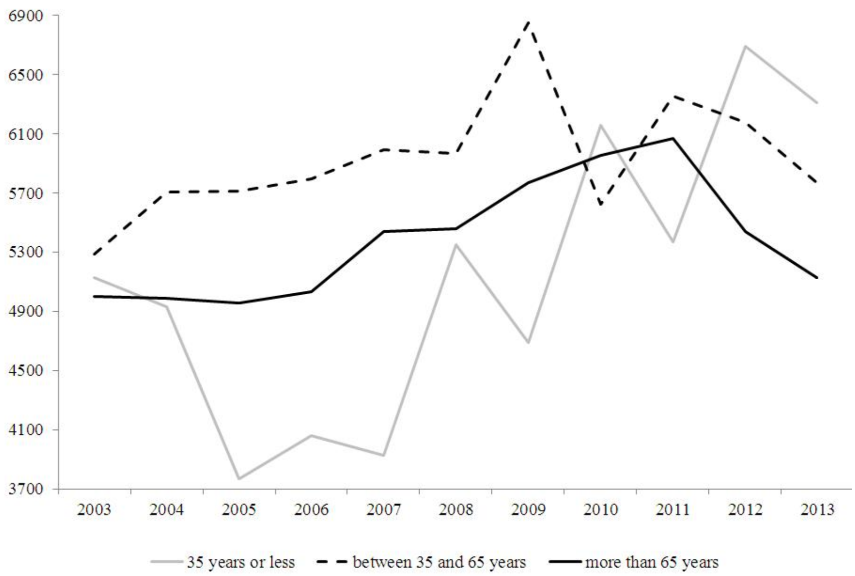

Figure 8 Average Self-repoted Savings by Age Group

Source: DHS; Notes: The question refers to the nominal value of savings. Respondents are given seven intervals that range from "Less than 1.500 Euros" to "More than 75.000". To compute the average I take the midpoint of each interval. For the highest interval I take the value of 75.000 Euros. The respondents who reported zero money put aside are not included in the graph.

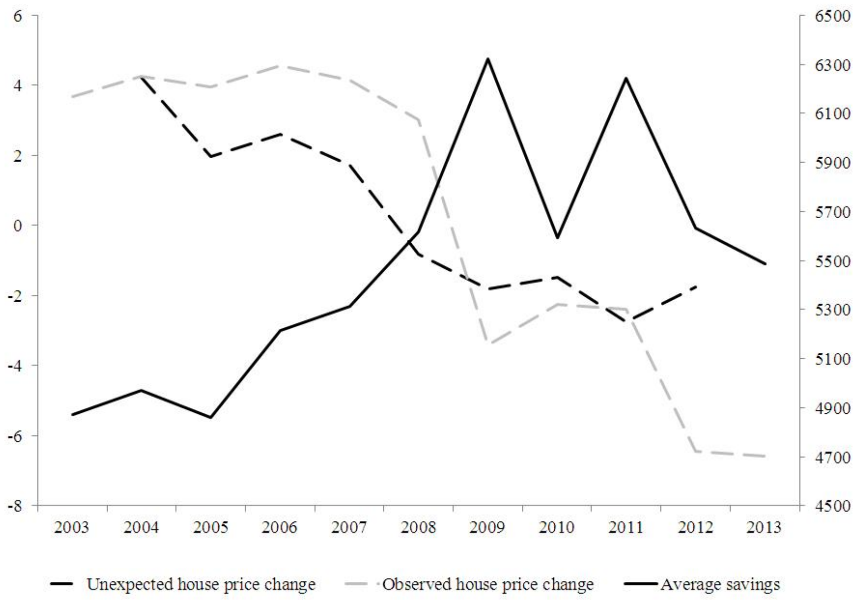

Figure 9 Savings and the Change in House Prices

Source: DHS and CBS; Notes: Unexpected change in house prices is the reported change minus the expected change for every year. Observed house price change is the same as reported in figure 6. Average savings is the same as reported in figure 7. Data on the unexpected change are unavailable for 2003 and 2013. The respondents who reported zero money put aside are not included in the graph. The left axis measures house price changes while the right axis measures savings.

spondents, which is the difference between the dashed line and the grey line in figure 6. Figure 9 shows a clearly negative relationship between house price changes and average savings. When the change in house prices is high savings are low and vice versa. The correlation over time between average savings and unexpected house price changes is as high as -0.85. A similar correlation coefficient is obtained if I use house price changes as observed by the CBS to calculate the unexpected change in house prices.

It must be taken into account that these correlations are computed at the aggregate level, and thus they do not exploit the micro variation at the household level. Another issue is that the savings increase takes place at the same time that the Dutch economy was hit by the financial crisis. Hence there might be other factors that drive the evolution of savings other than the change in house prices. As pointed out by Attanasio *et al.* (2009) it is very likely that, especially at the aggregate level, both house prices and savings are driven by common factors. In that sense, it might be that the evolution of the change in house prices is simply a proxy for the business cycle. With this caveat in mind, I separate average savings of homeowners and renters to see if the negative correlation is still observed.

Figure 10 plots average savings of homeowners and the change in house prices. The average savings of homeowners show a very similar time pattern as the one observed in

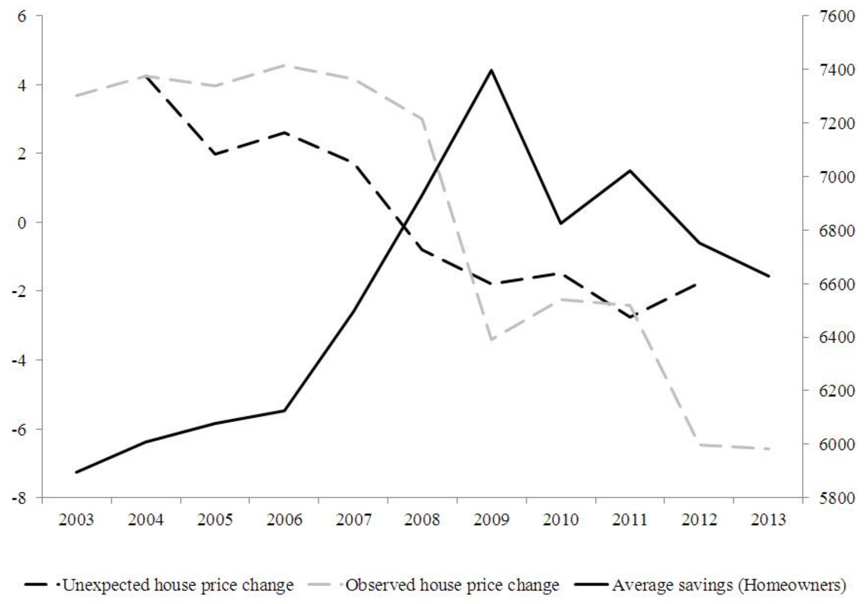

Figure 10 Savings and the Change in House Prices (Homeowners)

Source: DHS and CBS; Notes: Unexpected change in house prices is the reported change minus the expected change for every year. Observed house price change is the same as reported in figure 6. Data on the unexpected change are unavailable for 2003 and 2013. The respondents who reported zero money put aside are not included in the graph. The left axis measures house price changes while the right axis measures savings.

Figure 11 Savings and the Change in House Prices (Renters)

Source: DHS and CBS; Notes: Unexpected change in house prices is the reported change minus the expected change for every year. Observed house price change is the same as reported in figure 6. Data on the unexpected change are unavailable for 2003 and 2013. The respondents who reported zero money put aside are not included in the graph. The left axis measures house price changes while the right axis measures savings.

figure 7. The correlation between average savings of homeowners and the unexpected house price change is of -0.91. Figure 11 is the same as figure 10 but with the savings of renters instead of homeowners. In this case the negative relation between average savings and house price changes becomes less clear. The savings of renters do not show a clear increasing time pattern, like the savings of homeowners do. This is in accordance with the results of Rouwendal and Alessie (2002), who, employing Dutch data, do not find an effect of house prices on the savings of renters, while they do find a negative effect for homeowners.

Even though the preliminary evidence presented in this section is quite suggestive, it is only based on correlations (which, indeed, do not imply causation) at the aggregate level, thus its robustness should be confirmed by microeconometric analysis if any casual claim is to be made. It is likely that savings are highly conditioned by the business cycle, while, in turn, the latter is highly conditioned by the presence of the financial crisis in the sample period. Therefore, it is necessary to disentangle the effect of declining house prices from the effect of the general economic conditions. In addition, there are several variables that should be controlled for. Variables as income, risk aversion, family structure, etc., can potentially generate bias problems if they are not taken into account, an aspect that I take into account in the microeconometric analysis.

6 Methodology

To investigate the effect of the change in house prices on the savings of homeowners and renters, I apply a reduced form method. Therefore, I derive an equation for savings and follow a regression approach. For that matter, the interesting equations from the model are those that describe the effect of the change in house prices on savings, *i.e.* (5) and (6). I focus on equation (6) since, besides mortgage interest payments, it includes the repayment of the principal and thus is more comprehensive. Moving lagged savings to the left of the equality and plugging in planned consumption allows to rewrite (6) as

$$\mathit{\Delta} S_3^* = S_2^* r + Y_3 - \frac{\mathit{\Omega}^1 + E_1 \Xi^1}{\mathit{\Lambda}_3^1} - M(1 + r^M) - \eta_3, \tag{7}$$

where $\mathit{\Delta} S_3^* = S_3^* - S_2^*$ is the change in the stock of savings from one period to another.

To approximate the relations suggested by (7), which applies only to homeowners, I set up the following linear regression equation

$$\mathit{\Delta} S_{it} = \beta_0 + \beta_1 HPC_{it} + \mathbf{X}_{1it} \boldsymbol{\psi} + \mathbf{X}_{2it} \boldsymbol{\varphi} + c_i + \varepsilon_{it}, \tag{8}$$

where i and t are household and year indices respectively. The βs are the unknown coefficients that I want to estimate, $\mathit{\Delta} S_{it}$ is the change in the stock of savings, $\mathbf{X}_{1it}$ is a vector containing economic variables (*i.e.* value of the house, household income, yearly mortgage expenditures and remaining mortgage debt), $\mathbf{X}_{2it}$ is a vector containing demographic, personal and psychological characteristics of the household (*i.e.* household structure, level of education and risk aversion), and $\boldsymbol{\psi}$ and $\boldsymbol{\varphi}$ are vectors containing the coefficients that correspond to the variables in $\mathbf{X}_{1it}$ and $\mathbf{X}_{2it}$ respectively. In addition, c_i is an unobserved individual household effect and ε_{it} is the error term, which captures the unobserved effects that vary across households and over time.

Even though (8) does not have exactly the same form as (7), it provides an empirical strategy to estimate the relation between house price changes and savings that derives from (7). I add demographic, personal and psychological variables to avoid running into an omitted variables problem, which would render my estimates inconsistent. To measure the change in the stock of savings I use the DHS question on the yearly amount of money put aside (see figure 7), while for the change in house prices I use alternative measures, *i.e.* self-reported change, expected change and observed change (see figure 6). In addition, I subtract expected changes from self-reported and observed changes to compute different versions of the unexpected change in house prices. These different measures of house price changes provide proxy variables for the forecast error in (7), which appears directly as a consequence of the change in house prices.[8]

To estimate the coefficients in (8) I employ several panel regression techniques. I start by ignoring the panel structure and pooling all of the observations together to perform pooled OLS regressions. This technique requires the computation of standard errors clustered by household since, due to c_i, the different observations within a household will display serial correlation. It is also appropriate to consider the so called random effects method. The latter assumes that c_i is a random variable with zero expectation and constant variance. This assumption derives in a given structure for the variance covariance matrix of the composite error term, the latter being defined as $u_{it} = c_i + \varepsilon_{it}$, which allows for a generalized least squares (GLS) type of transformation of the data.

The problem with the two above mentioned techniques is that, to achieve consistency, they rely on a crucial assumption stating that c_i is uncorrelated with the explanatory variables. This is a rather strong assumption since the individual unobserved effect is very likely to be correlated with the explanatory variables. The self-reported house value and the expected house price change are likely to be affected by personal characteristics such as the degree of pessimism/optimism. However, when using observed measures of house price changes provided by CBS it makes sense to assume that they are uncorrelated with the individual household effect. In that case, one can estimate β_1 using the random effects technique.

To deal with the problem implied by the correlation between c_i and the explanatory variables I employ the Mundlak estimator, which was introduced by Mundlak (1978) and

[8]Tables A1 and A2 in appendix 1 provide descriptions and summary statistics for all the variables I employ in the empirical analysis.

is usually employed in panel regression analyses. It is the same as the random effects technique but it adds to the regression equation the time average of the explanatory variables. In that way, it solves the omitted variable problem originated by c_i since the time averages control for the factors that generate a correlation between the explanatory variables and c_i. The resulting estimates of the βs exploit only the variation that takes place within households, since the between-household variation is captured by the time averages. I introduce the time averages of only those variables potentially correlated with c_i. In that way, the resulting method is a hybrid between the random effects and fixed effects methods which is equivalent to employing the time averages as instruments for the explanatory variables that correlate with c_i (Hausman and Taylor, 1981).

Since the dependent variable is coded in intervals (see note in figure 7), I consider, in addition to the above mentioned techniques, estimation of the parameters in (8) by interval regression, which is the same as ordered probit but with known thresholds for the intervals. The main advantage is that it takes into account the interval structure in the dependent variable. As explained in section 5, the measure of savings I employ corresponds to the question "How much money did your household put aside in the last 12 months?". Respondents are given seven intervals that range from "Less than 1.500 Euros" to "More than 75.000". In addition, respondents can also answer that they put zero money aside. Figure 7 shows that the share of respondents that report zero money put aside is constant between 30% and 40%.

A possibility to deal with such a variable consists of taking the midpoint of each interval and employing linear regression techniques. This option assigns a value of zero to the observations with zero money put aside and a value of 75.000 to the observations in the top interval. The problem is that those who are coded with a zero may have actually dissaved and those coded with 75.000 may have actually saved more than that. As an alternative, interval regression estimation consists of defining a likelihood function that takes into account the interval structure of the data. It does so by defining the probability that savings falls in each of the intervals as a function of the unknown parameters in (8). Then maximum likelihood can be employed to estimate the parameters. In contrast to binary probit, the resulting estimates are directly interpretable *as if* a continuous dependent variable had been observed (Wooldridge, 2010). This technique can be applied in a panel data context, and it allows for pooled methods as well as for the application of the above described Mundlak method.

7 Results

Since the Hausman test reveals that there is a significant correlation between the individual effect, c_i, and the explanatory variables, I report directly the results that I obtain when using the Mundlak method. In addition, due to the interval structure of the dependent variable, I directly report the results of the interval regression estimation. Accordingly, Tables 1 and 2 report the results that I obtain for homeowners when using interval regression with Mundlak terms.[9]. Table 1 reports the effects of total changes in house prices, which includes self-reported, expected and observed measures of the house price change. Table 2 reports the effects of unexpected changes (total changes minus expected changes) in house prices.

Regarding the total change in house prices, table 1 shows that the estimate for β_1 has the expected sign only when using house price changes as observed by CBS in the second hand housing market, *i.e.* Observed_1 and Observed_2. When national level data is employed (Observed_1) the estimate is -199.941 while, when data at the province level is employed (Observed_2) the estimate is -160.462. Both are significant at the 1% level. These estimates tell by how much savings change when the change in house prices increases by one percentage point. The average house price change at the national level has gone from 4.24% to -6.57% between 2004 and 2013 (see figure 6), which, according to the estimate in column 5 of table 1, implies an average household savings increase of 2161.362 Euros. The latter amount represents close to 2/3 of the yearly average money put aside, as reported in the first row of table A2 in appendix 1.

Table 2 shows that, when using any of the different versions of the unexpected change in house prices, the estimate of β_1 is always negative. However, the estimated effect is rather low and hardly significant. Only in columns 5 and 6 I obtain significance at the 10% level. The results in columns 1 to 4 of table 2 are rather striking since, according to the model in section 4, one would expect a clear negative effect of the unexpected change in house prices. These results are in line with columns 1 to 4 in table 1, which show that house price expectations and self-reported measures of house price changes do not have a clearly significant effect on household savings.

The model in section 4 predicts that the effect of house price changes on savings increases with age. Table 3 reports the results I obtain when testing this hypothesis. The estimation technique is the same as in tables 1 and 2 but I add interactions between age group dummies and the change in house prices. A clear and significant conditionality on age is observed only when I use the change in house prices as observed by CBS. In that case I find that indeed the coefficient estimate increases (in absolute value) with age. There is no significant effect for the young group (younger than 35), while the estimates for the middle aged group (between 35 and 65) and for the older group (above 65) are close to the ones found in columns 5 and 6 of table 1.

Tables 1 to 3 show that house price expectations and unexpected house price changes have no clearly negative and significant effect on household savings. A plausible interpretation is that household savings may not be sensitive to one year expectations in house prices. Long run house price expectations may play a more important role, especially

[9] Mundlak terms refer to the average of the explanatory variables

Table 1 Savings of Homeowners: Interval Regression with Mundlak Terms

- Total Change in House Prices -

	(1)	(2)	(3)	(4)	(5)	(6)
Income	0.091***	0.083***	0.082***	0.081***	0.060***	0.057***
	(0.019)	(0.016)	(0.015)	(0.015)	(0.012)	(0.012)
House value	0.432	-1.356	-0.601	-0.639	-0.345	-0.304
	(2.572)	(2.052)	(1.870)	(2.011)	(0.990)	(0.972)
Mortgage debt	-4.034	-5.167	-4.277	-4.144	-3.738	-3.492
	(3.726)	(3.741)	(3.167)	(3.182)	(3.029)	(3.026)
M. expenditures	-0.048	-0.072	-0.036	-0.025	-0.043	-0.046
	(0.079)	(0.077)	(0.065)	(0.064)	(0.065)	(0.065)
Age2	124.178	-41.989	-168.068	-33.340	-1.113	40.660
	(622.224)	(558.266)	(502.137)	(511.944)	(494.254)	(495.046)
Age3	-1640.114**	-1864.21***	-1588.116**	-1550.126**	-1550.739**	-1478.956**
	(785.478)	(696.549)	(660.196)	(667.124)	(640.023)	(639.370)
University	869.209*	1334.338**	946.840*	1008.875*	1078.211**	1106.960**
	-461.201	(610.322)	(562.927)	(554.650)	(537.776)	(537.263)
N. of children	-761.917***	-785.937***	-661.613***	-660.254***	-669.296***	-670.331***
	(196.257)	(190.408)	(167.814)	(170.551)	(164.775)	(165.076)
Partner	28.951	660.715	31.780	20.562	128.101	127.408
	(517.692)	(483.106)	(451.948)	(453.186)	(430.199)	(430.422)
Risk aversion	0.455	-4.471	-3.678	-9.095	12.562	14.628
	(92.601)	(89.610)	(75.741)	(77.802)	(72.483)	(72.759)
Growth					107.396*	59.781
					(60.610)	(57.847)
Reported_1	0.146					
	(2.512)					
Reported_2		27.483				
		(28.117)				
Expected_1			74.925**			
			(35.949)			
Expected_2				60.918		
				(40.469)		
Observed_1					-199.941***	
					(49.659)	
Observed_2						-160.462***
						(46.707)
Constant	-5639.33***	-5858.26***	-5524.68***	-5610.21***	-4906.88***	-4797.945***
	(1536.352)	(1392.308)	(1338.193)	(1347.216)	(1271.226)	(1271.126)
Year dummies	Yes	Yes	Yes	Yes	No	No
Observations	3551	3346	4275	4280	4557	4556
Households	909	893	1128	1129	1171	1171

Notes: Standard errors, clustered by household, are reported in parentheses. Dependent variable is money put aside in the last 12 months, including all the zero responses. Mortgage expenditures are rescaled. Time averages are included for all variables except for Age2, Age3, University, Partner, Growth, Observed_1 and Observed_2. Times dummies are always included except for when CBS data are employed. In the latter cases, the rate of economic growth is included as a proxy for the business cycle. *** significant at the 1 % level, ** significant at the 5 % level, * significant at the 10 %level. For variable definitions and summary statistics, refer to tables A1 and A2 in appendix 1.

Table 2 Savings of Homeowners: Interval Regression with Mundlak Terms

- Unexpected Change in House Prices -

	(1)	(2)	(3)	(4)	(5)	(6)
Income	0.095***	0.093***	0.048***	0.048***	0.052***	0.052***
	(0.019)	(0.021)	(0.016)	(0.015)	(0.016)	(0.016)
House value	0.823	-0.105	0.006	0.075	-0.309	-0.222
	(2.608)	(2.000)	(2.124)	(2.125)	(2.263)	(2.258)
Mortgage debt	-3.584	-4.146	-3.717	-3.541	-4.620	-4.404
	(3.869)	(4.270)	(3.733)	(3.709)	(3.732)	(3.708)
M. expenditures	-0.038	-0.030	-0.057	-0.058	-0.039	-0.041
	(0.080)	(0.087)	(0.074)	(0.074)	(0.071)	(0.071)
Age2	15.773	264.989	112.645	117.247	131.167	144.576
	(628.754)	(651.057)	(618.206)	(617.673)	(621.888)	(622.355)
Age3	-1722.378**	-1820.440**	-1528.520**	-1511.516**	-188.513**	-1559.306**
	(794.007)	(825.700)	(771.022)	(769.960)	(771.549)	(771.153)
University	660.083	1062.354*	773.855	798.300	981.506*	1007.151*
	(637.902)	(580.853)	(630.933)	(630.073)	(501.082)	(549.219)
N. of children	-799.074***	-964.777***	-806.291***	-803.528***	-788.820***	-786.961***
	(198.276)	(222.658)	(196.564)	(196.834)	(201.287)	(201.563)
Partner	23.864	880.119	124.238	117.034	132.232	124.661
	(536.059)	(573.659)	(528.558)	(528.209)	(538.345)	(538.023)
Risk aversion	8.518	-66.039	-4.203	-5.289	14.037	12.943
	(92.952)	(109.221)	(92.013)	(92.088)	(97.924)	(97.969)
Growth			-77.763	-83.825	-56.967	-66.427
			(61.093)	(58.746)	(63.680)	(61.043)
Surprise_1	-1.015					
	(2.804)					
Surprise_2		-35.570				
		(25.169)				
Surprise_3			-38.201			
			(42.400)			
Surprise_4				-36.023		
				(38.328)		
Surprise_5					-75.659*	
					(44.067)	
Surprise_6						-62.851*
						(39.769)
Constant	-5607.51***	-5935.51***	-4947.52***	-4930.89***	-4774.34***	-4777.28***
	(1576.522)	(1938.239)	(1509.697)	(1510.490)	(1518.554)	(1518.485)
Year dummies	Yes	Yes	No	No	No	No
Observations	3360	2582	3415	3414	3405	3404
Households	881	705	896	896	896	896

Notes: Standard errors, clustered by household, are reported in parentheses. Dependent variable is money put aside in the last 12 months, including all the zero responses. Mortgage expenditures are rescaled. Time averages are included for all variables except for Age2, Age3, University, Partner, Growth, Surprise_1 and Surprise_2. Times dummies are always included except for when CBS data are employed. In the latter cases, the rate of economic growth is included as a proxy for the business cycle. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. For variable definitions and summary statistics, refer to tables A1 and A2 in appendix 1.

Table 3 Conditionality on Age

	Coefficient Estimate	p-value		Coefficient Estimate	p-value		Coefficient Estimate	p-value
Reported_1	-8.491	0.708	Reported_2	55.614	0.187	Expected_1	102.325	0.403
Reported_1×Age2	8.804	0.926	Reported_2×Age2	-46.541	0.406	Expected_1×Age2	-16.446	0.128
Reported_1×Age3	8.564	0.932	Reported_2×Age3	-20.315	0.187	Expected_1×Age3	-56.845	0.572
Expected_2	144.852	0.192	Observed_1	-73.316	0.780	Observed_2	9.250	0.963
Expected_2×Age2	-87.353	0.207	Observed_1×Age2	-127.439	0.001	Observed_2×Age2	-160.416	0.012
Expected_2×Age3	-92.024	0.330	Observed_1×Age3	-129.030	0.027	Observed_2×Age3	-205.911	0.028
Surprise_1	-4.032	0.868	Surprise_2	49.530	0.533	Surprise_3	89.211	0.403
Surprise_1×Age2	3.474	0.970	Surprise_2×Age2	-84.478	0.487	Surprise_3×Age2	-91.881	0.693
Surprise_1×Age3	2.182	0.936	Surprise_2×Age3	-121.253	0.353	Surprise_3×Age3	-178.460	0.304
Surprise_4	74.374	0.482	Surprise_5	-60.607	0.640	Surprise_6	-51.050	0.680
Surprise_4×Age2	-68.687	0.781	Surprise_5×Age2	26.738	0.732	Surprise_6×Age2	29.845	0.834
Surprise_4×Age3	-183.397	0.212	Surprise_5×Age3	-86.986	0.112	Surprise_6×Age3	-110.492	0.068

Notes: Coeffient estimates are obtained by interval regression, in the same way and with the same samples as in tables 1 and 2. Coefficient estimates for control variables are not reported but are available on request. P-values of interaction effects are obtained by means of Wald tests of the null hypothesis that both coefficients of the house price change and the interaction with age are zero. The coefficient on the house price change (without the interaction) corresponds to the younger group. For variable definitions refer to table A1.

when a household is planning to stay in the current residence still for a long period. The DHS dataset provides a possible solution to this issue since it contains information on long run house price expectations. More specifically, it contains the question "What do you consider to be a normal percentage increase *per year* for house prices in ten years?". Table A2 shows that the average response for this variable is 3.43, which is much higher than the average one-year expectation. Only in the last years of the sample households start reporting negative values for their 10-year house price change expectations. However, just like in the case of the one-year expectations, I do not find an effect of the 10-year expectation on household savings.[10] These results indicate that households do not react to house price expectations, which means that further work on how households form expectations and react to them needs to be done to understand exactly what is going on.

In section 2 I mention the national mortgage guarantee as a distinctive feature of the Dutch housing market. This is an aspect to take into account in this section since it could change my results. Households with a national mortgage guarantee may feel less pressured to increase their savings when their residence in property loses value. To test this, I interact the house price changes as given in tables 1 and 2 with a dummy indicating the presence of a national mortgage guarantee. Table 4 shows that when using the house price change as observed by CBS there is indeed a much lower effect on savings for households with a mortgage guarantee. Taking into account only households without guarantee, the effect of the house price change at the national level (Observed_1) and at the province

[10]The regression I run for the long run expectation is the same as reported in column 4 of table 1 but with long run expectations instead of the one-year expectation. Results are available on request.

Table 4 Conditionality on National Mortgage Guarantee (NMG)

	Coefficient Estimate	p-value		Coefficient Estimate	p-value		Coefficient Estimate	p-value
Reported_1	-0.215	0.947	Reported_2	64.293	0.026	Expected_1	57.801	0.158
Reported_1×nmg	0.819	0.993	Reported_2×nmg	-75.962	0.077	Expected_1×nmg	99.940	0.158
Expected_2	48.924	0.247	Observed_1	-245.978	0.000	Observed_2	-200.471	0.000
Expected_2×nmg	61.206	0.247	Observed_1×nmg	124.939	0.000	Observed_2×nmg	108.580	0.000
Surprise_1	-1.036	0.769	Surprise_2	-8.687	0.771	Surprise_3	-43.770	0.372
Surprise_1×nmg	-.349	0.917	Surprise_2×nmg	-85.374	0.180	Surprise_3×nmg	99.688	0.272
Surprise_4	43.136	0.350	Surprise_5	-108.142	0.022	Surprise_6	-98.873	0.023
Surprise_4×nmg	88.933	0.330	Surprise_5×nmg	127.571	0.038	Surprise_6×nmg	114.635	0.048

Notes: Coeffient estimates are obtained by interval regression, in the same way and with the same samples as in tables 1 and 2. Coefficient estimates for control variables are not reported but are available on request. P-values of interaction effects are obtained by means of Wald tests of the null hypothesis that both coefficients of the house price change and the interaction with the guarantee are zero. The coefficient on the house price change (without the interaction) corresponds to households without guarantee. For variable definitions refer to table A1.

Table 5 Symmetry of the House Price Effect

	Coefficient Estimate	p-value		Coefficient Estimate	p-value		Coefficient Estimate	p-value
Reported_1	-1.644	0.588	Reported_2	18.625	0.507	Expected_1	40.401	0.496
Reported_1×neg	14.797	0.754	Reported_2×neg	212.987	0.172	Expected_1×neg	58.247	0.352
Expected_2	55.825	0.430	Observed_1	-268.935	0.344	Observed_2	59.748	0.563
Expected_2×neg	-18.949	0.577	Observed_1×neg	-299.975	0.000	Observed_2×neg	-594.258	0.000
Surprise_1	-3.100	0.349	Surprise_2	-73.392	0.120	Surprise_3	-77.948	0.258
Surprise_1×neg	26.589	0.408	Surprise_2×neg	219.896	0.118	Surprise_3×neg	90.424	0.515
Surprise_4	-34.193	0.579	Surprise_5	-108.142	0.122	Surprise_6	-79.887	0.159
Surprise_4×neg	36.972	0.856	Surprise_5×neg	4.607	0.137	Surprise_6×neg	-11.987	0.320

Notes: Coeffient estimates are obtained by interval regression, in the same way and with the same samples as in tables 1 and 2. Coefficient estimates for control variables are not reported but are available on request. P-values of interaction effects are obtained by means of Wald tests of the null hypothesis that both coefficients of the house price change and the interaction with the dummy for negative values are zero. The coefficient on the house price change (without the interaction) corresponds only to positive changes. For variable definitions refer to table A1.

level (Observed_2) are of -245.978 and -200.471 respectively. When taking into account the interaction with the presence of a mortgage guarantee, these coefficients are roughly halved.[11] These results are significant at the 1 % level. In addition, when computing the unexpected change using CBS data and house price expectations at the market level (*i.e.* Surprise_5 and Surprise_6) I find as well a negative and significant effect (at the 5% level) for households without a guarantee. Table 4 shows how this effect vanishes when I consider only households with a guarantee.

In section 3 I mention that some authors in the literature, *e.g.* Engelhardt (1996), Chen *et al.* (2009) and Disney *et al.* (2012), have stated that the effect of house price changes on household savings and consumption may display asymmetry between positive and negative changes. This connects with the literature in behavioural economics, *e.g.* Kahneman and Tversky (1979), which points out that individuals tend to give higher weight to losses than to gains, a phenomenon known as *loss aversion.* Table 5 shows the results I obtain when I interact the house price change measures in tables 1 and 2 with a dummy indicating negative changes in house prices. Once more, only Observed_1 and Observed_2 display significant coefficient estimates, which confirms the absence of an effect for measures of house price expectations and of the unexpected change in house prices. Restricting the attention to the variables Observed_1 and Observed_2, table 5 shows how the estimates in columns 5 and 6 of table 1 come strictly from negative changes in house prices. In fact, when using only negative changes the estimated effect is much larger than in table 1.[12] When using only positive changes, the effect is not significant.

Regarding the effect of house price changes for renters, columns 1 and 2 of table 6 show that there is no significant effect of the CBS observed measures of house price changes on the savings of renters. To estimate the effect I use the same model as in (8) but I exclude mortgage related variables and I include yearly renting expenditures. The absence of an effect for renters suggests that the increase in average savings of homeowners during the sample period (recall figures 10 and 11) is due to the decrease in house prices. In addition, columns 3 and 4 of table 6 show the results I obtain when interacting the house price change with a dummy indicating whether the household is saving to buy a house. The results are interesting since they show that the effect for renters who are saving to purchase a house is clearly negative and significant. This suggests that, when house prices decline renters are incentivized to save for a house. However, the sample I use to obtain the results in columns 5 and 6 is very small, slightly below the 600 observations. That is because very few households actually responded the DHS question on saving to buy a

[11] When using Observed_1 the estimated effect for households with a guarantee is $-245.978 + 124.939 = -121.039$ while when using Observed_2 it is $-200.471 + 108.580 = -91.891$. These coefficients are significant at the 1% level.

[12] When using Observed_1 the estimated effect with only negative changes is $-268.938 - 299.975 = -568.913$ while when using Observed_2 it is $59.748 - 594.258 = -534.510$. These estimates are significant at the 1% level.

Table 6 Savings of Renters: Interval Regression with Mundlak Terms

	(1)	(2)	(3)	(4)
Income	0.037***	0.036***	0.028	0.031
	(0.012)	(0.012)	(0.026)	(0.027)
Rent	-0.006	-0.006	-9.302	-9.077
	(0.015)	(0.015)	(5.976)	(6.029)
Age2	-500.769	-483.408	2042.569**	1968.369**
	(407.139)	(408.238)	(839.930)	(832.589)
Age3	-1352.543**	-1330.200**	3112.037	3135.276
	(536.112)	(538.178)	(2508.000)	(2573.091)
University	1325.714*	1314.000*	2728.829***	2738.604***
	(684.825)	(688.338)	(873.610)	(869.738)
N. of children	-374.978***	-394.878***	-311.978***	-395.978***
	(130.942)	(131.789)	(128.139)	(142.257)
Partner	1626.666*	1617.075*	2466.129	2527.306
	(894.948)	(892.270)	(2078.881)	(2122.060)
Risk aversion	114.508*	114.939*	265.433	258.022
	(63.479)	(63.559)	(199.085)	(199.375)
Growth	-90.641	-119.937	215.171	131.515
	(84.892)	(87.362)	(175.728)	(161.242)
Saving			3171.536***	3210.865***
			(677.378)	(698.051)
Observed_1	-0.877		10.503	
	(51.655)		(151.128)	
observed_2		17.569		52.813
		(49.357)		(135.000)
Observed_1*Saving			-508.104***	
			(157.429)	
Observed_2*Saving				-480.728***
				(155.665)
Constant	-3837.374***	-3791.242***	-4281.436**	-4169.853**
	(956.975)	(950.204)	(1946.616)	(1937.239)
Year dummies	No	No	No	No
Observations	3303	3291	589	584
Households	895	891	262	262

Notes: Standard errors, clustered by household, are reported in parentheses. Dependent variable is money put aside in the last 12 months, including all the zero responses. Time averages are included for all variables except for Age2, Age3, University, Partner, Growth, Looking, Observed_1 and Observed_2. The rate of economic growth is included as a proxy for the business cycle. *** significant at the 1% level, ** significant at the 5% level, * significant at the 10% level. For variable definitions and summary statistics, refer to tables A1 and A2 in appendix 1.

house. Therefore, even though the results are suggestive, further work remains to be done to understand how renters who are saving for a home react to house price changes.

8 Conclusions and Discussion

In this paper I look at the effect of house price changes on household savings. In doing so, I contribute to the existing literature in a number of ways. First, I provide a version of the life cycle model with housing that is simpler from the versions that can be found in the literature. In that way, I provide a very straightforward theoretical framework that allows to study the housing asset without many of the difficulties that it usually entails. This framework can be further extended to study other issues related to the one this paper is concerned with. Second, I employ different measures of the change in house prices. In doing so, I exploit the data on house price expectations that the DHS dataset provides. On the one hand I employ measures of the total change in house prices (*i.e.* self-reported measures, observed measures and measures of the expected house price change) and, on the other hand, I employ measures of the unexpected change in house prices (by subtracting expectations to self-reported and to observed measures of the house price change). Third I introduce a different measure of savings as the one employed in the literature. I use savings as money put aside, whereas previous authors employ the yearly change in household assets. The latter measure makes very difficult to separate active savings from capital gains and losses. Fourth, I exploit both the cross section and the time dimensions of the data by using the Mundlak method. More specifically, I add to the regression equation the time average of only those variables that are potentially correlated with the individual household effect c_i. The resulting method is a hybrid between a random effects and a fixed effects method.

The model in section 4 predicts that households will offset losses in housing wealth by increasing their savings. In addition, it predicts that there will only be an effect if the change in house prices is unexpected and that such effect increases with age. These predictions are partially confirmed by the results I obtain. However, there are two aspects about my results that are rather striking and thus warrant some discussion. The first is that households do not appear to react to self-reported measures of the change in house prices, whereas the they do react to observed measures (as reported by CBS) of the same variable. A plausible explanation is that, as shown in figure 4, there is more variation in observed measures than in self-reported measures of house price changes. Therefore, it can be that there is not enough variation in self-reported measures to identify the relation of interest. This lack of variation stems from the fact that the turning point in the self-reported measures of house price changes occurs later than 2008. Therefore, there are very few years with negative changes, which according to table 5 are the main responsible for a negative relation between house price changes and savings.

The question is thus why households start reporting negative changes in house prices three years later than it was observed by CBS. Part of the answer may be found in the field of behavioural economics. Authors in that field such as Feldstein and Yitzhaki (1978) and Hersh and Meir (1985) pointed out already a few decades ago that financial investors are reluctant to recognize a loss in the value of their portfolio. Applying the same idea to the housing asset, one can think that homeowners are reluctant to recognize a loss in the value of their house. Actually, van der Cruijsen *et al.* (2014) use DHS data to show that homeowners hold an overoptimistic view of the value of their house. They find a positive relation between self-reported home values and measures of loss aversion. Applying this view to interpret the results of the present study, one could say that homeowners do not react to self-reported house price changes because they are reluctant to recognize a loss in home equity. However, they are aware of the evolution in house market prices and act in accordance to them.

The second aspect about my results that is worth discussing is the fact that households react to observed changes in house prices but they do not react neither to house price expectations nor to the unexpected change in house prices. Measuring expectations is a really difficult endeavour. Nevertheless, the measures I present in this paper are really promising. The problem is perhaps that they still do not capture house price expectations in an accurate manner. On the one hand, it is likely that households react only to very long run expectations. Especially those that still plan to stay in their current residence for a long time. On the other hand, the only households that are truly surprised by a house price change are those that are willing to sell their house in the short term. Therefore it would be interesting to focus on how old households who are willing to liquidate their house react to a loss in home equity. In addition, it can be that households are inconsistent in their expectations and/or that they report the mode instead of the expectation when asked about future changes in house prices. In that sense, more work needs to be done to understand how households form their expectations, how they report them and how they react to them.

Focusing on the part of my results that are significant, I do find a clearly negative effect of price changes in the house market as observed by CBS. I find similar results when I use changes at the national level and at the province level. I find that the negative effect on savings increases with age. This result is interesting since it means that as population ages aggregate savings may become more sensitive to house price changes. Furthermore, I find a lower effect for households with a national mortgage guarantee. This is a relevant result since this type of guarantee is quite popular in the Netherlands. Table A2 shows that 1/3 of the homeowners in my sample have a national mortgage guarantee. In addition, I find that the effect comes from negative changes in house prices. That means households respond asymmetrically to positive and negative changes. This connects with the idea introduced by Kahneman and Tversky (1979) which states that individuals assign higher weight to losses than to gains. Regarding the effect of house price changes on the savings of renters, I do not find a significant effect. This implies that assuming $\delta = 0$ in the model in section 4 may be a reasonable assumption. This result for renters suggests that the observed increase in the savings of homeowners (see figures 10 and 11) is due to the decrease in house prices. I do find an effect when I focus on renters who are saving to buy a house. However, the sample I use to arrive to that result is really small. Therefore, more work needs to be done to understand well how changes in house prices affects renters who are saving for a house, and how they affect the incentives to buy a house.

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Appendix 1: Additional Tables

Table A1. Variable Definitions and Sources

Variable	Definition	Source
Savings	Money in Euros put aside in the past 12 months.	DHS
Income	Total net income of the household in Euros.	DHS
House value	Amount in thousands of Euros the household expects to get for their residence if sold at the second hand housing market (first residence).	DHS
Mortgage debt	Amount in thousands of Euros of the mortgage loan that is still to be paid (first residence).	DHS
Mortgage expenditure	Yearly amount in Euros of mortgage related expenditure (first residence).	DHS
Age1, Age2, Age3	Dummies indicating age of the household head. Age1: 35 or younger, Age2: between 35 and 65, Age3: above 65.	DHS
University	Dummy indicating university education.	DHS
Number of children	Number of children living in the household.	DHS
Partner	Dummy indicating the presence of a partner.	DHS
Risk aversion	Index variable indicating how much household heads agree with having save investments with guaranteed returns. 1: totally disagree, 7: totally agree.	DHS
Guarantee	Dummy indicating the presence of a national mortgage guarantee.	DHS
Rent	Yearly amount spent in Euros in renting the first residence.	DHS
Saving	Dummy indicating whether a renter is saving to buy a house.	DHS
Growth	Growth rate of real GDP (prices 2005).	CBS
Reported_1	Yealry percentage change in the self-reported house value.	DHS
Reported_2	Reported percentage change in the house value.	DHS
Expected_1	Expected percentage change in the house value for the next year.	DHS
Expected_2	Expected percentage change in house market prices for the next year.	DHS
Longexp	Expected yearly percentage change in property prices in 10 years.	DHS
Observed_1	Average observed percentage change in second hand house market prices at the national level.	CBS
Observed_2	Average observed percentage change in second hand house market prices at the province level.	CBS
Surprise_1	Reported_1 minus lagged Expected_1.	DHS
Surprise_2	Reported_2 minus lagged Expected_1.	DHS
Surprise_3	Observed_1 minus lagged Expected_1.	DHS and CBS
Surprise_4	Observed_2 minus lagged Expected_1.	DHS and CBS
Surprise_5	Observed_1 minus lagged Expected_2.	DHS and CBS
Surprise_6	Observed_2 minus lagged Expected_2.	DHS and CBS

Notes: House value, Mortgage debt, Mortgage expenditure, Guarantee and all of the DHS house price changes variables are only available for homeowners. Rent and Saving are only available for renters. DHS stands for Dutch National Bank Household Survey and CBS is the Dutch acronym for the national statistical services.

Table A2. Summary Statistics

Variable	Mean	Median	Std. Dev.	Min.	Max.
Savings	3763.900	3250	6424.423	0	75000
Income	45357.240	56000	20348.030	5000	75000
House value	278.148	240	166.679	0	5500
Mortgage debt	90.368	75	70.458	0	750
Mortgage expenditure	398.730	0.002	2097.407	0	12000
Age_1	0.156	-	-	-	-
Age_2	0.623	-	-	-	-
Age_3	0.222	-	-	-	-
University	0.143	-	-	-	-
Number of children	0.684	0	1.052	0	7
Partner	0.707	-	-	-	-
Risk aversion	5.080	6	1.806	1	7
Guarantee	0.329	-	-	-	-
Rent	515.911	440	1676.816	0	81714
Saving	0.398	-	-	-	-
Growth	2.520	2.515	2.520	-3.583	5.850
Reported_1	3.623	0	40.219	-100	1163.158
Reported_2	1.174	0	6.011	-29.167	41.667
Expected_1	-0.009	0	3.966	-45	75
Expected_2	-0.487	0	4.118	-50	50
Longexp	3.427	3	4.71	-40	100
Observed_1	0.465	3.016	4.266	-6.572	4.555
Observed_2	0.493	2.437	4.399	-7.306	7.740
Surprise_1	3.611	0	39.158	-100	1163.158
Surprise_2	0.633	0	5.965	-29.1667	49.667
Surprise_3	0.297	0.555	5.007	-78.399	42.752
Surprise_4	0.289	0.469	5.104	-79.478	42.847
Surprise_5	0.748	1.016	5.138	-53.399	47.600
Surprise_6	0.734	0.943	5.245	-54.478	47.500

Notes: All data correspond to the household head of each household. House value, Mortgage debt, Mortgage expenditure, Guarantee and all of the DHS house price change variables are only available for homeowners. Rent and Saving are only available for renters. Savings and income are coded in intervals. In both cases I take the midpoint of each interval to compute summary statistics.

Appendix 2: Model (Extended Version)