SAVING BEHAVIOR AND HOUSING WEALTH:

EVIDENCE FROM GERMAN MICRO DATA

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ABSTRACT

Housing property is the most important position in a household's wealth portfolio. Even though there is strong evidence that house price cycles and saving patterns behave synchronously, the underlying causes remain controversial. The present paper examines if there is a wealth effect of house prices on savings using household-level longitudinal data from the German Socio-Economic Panel for the period 1996-2012. We find that young renters increase and young homeowners decrease their savings in response to unanticipated house price shocks, whereas old households only hardly respond to house price changes. We interpret this as evidence of a housing wealth effect.

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1 Introduction

Owing to an increased activity on housing markets the relation between the housing market and the economy as a whole has achieved rising attention in the last decade. According to the augmented life-cycle theory, a channel through which house prices and the economy are related is the stimulus of consumption and saving in response to windfall gains in housing wealth - the housing wealth effect.[1] Due to the fact that immovable properties usually present the largest fraction of the national fixed capital stock, and the largest position in household's wealth portfolios, dramatic downturns do not only decrease housing wealth but also consumption, and this, in turn, might impact the overall growth rate, decelerate economic activity, and by implication, destabilize financial markets too.

However, decreasing house prices also lead to shrinking housing costs for tenants who in turn increase their non-housing consumption and conceivably this may offset the arisen housing wealth effect in the aggregate. Indeed, empirical studies such as (Case et al., 2005) and (Carroll et al., 2010) find heterogeneous effects by means of aggregated data. The empirical evidence of the relation between changes in house prices and saving behavior remains controversial too. Whereas several studies based on data at the household level find empirical evidence in favor of a housing wealth effect, such as (Skinner, 1989), (Campbell et al., 2007), (Disney et al., 2010), others find only little or even contradicting evidence, such as (Browning et al., 2013) and (Attanasio et al., 2009).[2] Beside the housing wealth effect, (Campbell et al., 2007) suggest that the empirical relation may rather stem from common factors or the financial liberalization that led house prices and consumption to rise simultaneously and may depend on the methodology that is used as well (Cristini et al., 2014). Moreover, households should be neither liquidity nor borrowing constrained as only those households who are able to increase their level of consumption by using their current level of additional savings or by reducing housing property as collateral are fully affected by unexpected gains in wealth.

Furthermore, household's saving behavior is highly heterogeneous and bears various saving motives, such as old-age provision, precautionary saving, bequest, and the motive to purchase a house, whose importance also changes along the life-cycle (Schunk, 2009). This demands a more differentiated consideration of the relation of saving motives and the role of housing wealth. In addition, owing to the specific characteristics of housing, such as high transaction costs for searching and moving, financial and down payment constraints, housing wealth may not be treated as other assets within a household's asset portfolio. Accordingly, the study by (Levin, 1998) shows that responses in consumption behavior also depend on the composition of household's wealth portfolios.

[1] Just recently, (Jorda et al., 2015) show how loose monetary conditions lead to booms in lending which in turn increases the risk of house price bubbles. They note the relation of house price dynamics and household spending as a "top research priority". However, this field of research has been limited particularly on the Anglo-Saxon housing markets so far.

[2] Although most economic theories suggest that consumption and saving represent two sides of one coin, the relation remains ambiguous at least from an empirical point of view. As previous studies treat saving as counterpart to consumption, we do so in the literature review as well. Nonetheless, we concentrate solely on saving behavior in the rest of the paper. We use saving data for the empirical analysis for three reasons: Firstly, saving behavior is much more important in the light of current economic dynamics, such as aging population and its influence on the state pension provision. Secondly, saving data is available in the survey data at a higher level of accuracy stemming mostly from the diverse appearances of consumption. Thirdly, consumption expenditures seem to reveal a higher diversity. For example, housing capital gains may not be completely observable in non-housing consumption as an increase in overall consumption is also concealed by a rising housing quality (Gyourko et al., 2006). Accordingly, estimates may be biased if one does not control for housing expenditures.

Additionally, (Juster et al., 2006) find that savings respond more strongly to changes in corporate equities than to changes in housing wealth.

Empirical studies considering the German housing market are scarce. (Hamburg et al., 2008) show empirically that changes in German private consumption can be predominantly attributed to permanent shocks to income rather than to wealth.[3] Thus, these findings are in stark contrast to previous findings from Anglo-Saxon countries. In consequence of substantial differences in the financial system and the institutional background at the housing market, notably in lending conditions, regulation of the rental market, homeownership rate, and role of housing in retirement, German house price dynamics also differ widely in international comparison. After decades of stagnation, the German housing market is concurrently experiencing a positive surge in house prices that has renewed interest into the channel through which house price changes and the economy as a whole are interrelated. The relation of house price changes and consumption respectively saving behavior is thereby of particular importance. Firstly, this is due to the fact that the increase in regional house price disparities is likely to grow in the future owing to the ongoing structural change at the labor market with its re-urbanization tendency. And secondly, the demographic shrinkage, and notably the aging population, has a strong influence on the state pension provision, letting private retirement become more and more important for young households and therewith housing equity as an additional pension asset.

Against this background, this paper examines the marginal propensity to save in response to changes in housing wealth by the use of microeconomic survey data from the German Socio-Economic Panel (GSOEP). Our primary issue under consideration is whether evidence for the housing wealth effect can be found in German micro-data controlling for common factors.[4] More precisely, we regress the changes of households' saving rates on unanticipated and anticipated changes in house prices and incomes as well as on other household characteristics, such as human capital respectively educational level, socio-demographic characteristics, as well as liquidity constraints to overcome problems that are related to selection and identification. According to (Campbell et al., 2007) and (Browning et al., 2013) unexpected house price and income changes can be constructed by estimating external house price and income processes. Following previous studies, we also differentiate among tenants and owner-occupiers as well as among different age cohorts to allow for heterogeneity in saving effects. The present paper improves upon earlier studies by using a much more sophisticated examination of the house price process in order to differentiate among expected and unexpected changes in housing wealth using external regional house price data as instrument for changes in property prices. Owing to the high persistence in house price changes as well as in monetary policy and demographic dynamics, we suggest to use additional exogenous determinants to estimate the regional house price process. According to the behavioral life-cycle model as well as due to the dual characteristic of housing property, housing property may be primarily perceived as consumption good, and thus treated differ-

[3] The study by (Hamburg et al., 2008) contains financial wealth as well as residential housing wealth data stemming from 60 German cities. However, in contrast to the present paper, they use aggregated data with the empirical methodology proposed by (Lettau et al., 2004) relying on the consumption-wealth ratio.

[4] The German SOEP is a representative sample of the German population. Contrary to previous work, such as by (Campbell et al., 2007), that relies on pseudo panel data, the German SOEP is a true household-level panel data set with long temporal dimension.

ently. In such a case households are unlikely to perceive changes in wealth stemming from house price changes. For this reason, we use self-reported housing values to control for households' subjective perception of changes in wealth.

We find that an unexpected increase in house prices has a positive effect on the savings behavior of young renters, whereas young homeowners significantly lower their savings in response to unanticipated changes in their housing wealth. Moreover, we find the strongest absolute effect for young renters which can be attributed to the down payment saving motive. This means that with increasing house prices, young renters have to increase their savings, either to be able to purchase own equity or due to a permanent rise in housing cost in the future notably in retirement phase. Accordingly, the results are mostly consistent with the implications of either the life-cycle model or the precautionary savings model. Furthermore, old homeowners and renters only hardly respond to changes in house prices. The cause indeed is ambiguous. However, the low utilization of second-mortgages as well as the fact that households do no tap into housing wealth with age is at odds with the old-age provision motive. Notwithstanding, the results might be in line with the precautionary savings model, particularly if the precautionary savings motive decreases in importance over the life-cycle as recently suggested by (Le Blanc et al., 2014). In addition, we find that households only significantly respond to innovations to house prices that are unexpected. Thus, we conclude that highly persistent dynamics at the monetary market respectively mortgage interest rates, as well as regional developments in demographics, used in estimating the regional house price process, are likely to be anticipated by households and in turn included into household's saving behavior. Moreover, controlling for households' subjective perception of changes in property values we find no systematic distortion that is based on socio-economic characteristics in particular age. Thus, we can eliminate subjective perception of changing housing wealth as the driver of the results. This is important as in Germany housing is traditionally rather be seen as consumption than as an investment good.

The rest of the paper is organized as follows. In the next Section (Section 2), we present the theoretical background of the relationship between saving behavior and housing wealth, restrictions therein and outline the underlying assumptions. Section 3 provides a more detailed description of the institutional background and the German housing market. Section 4 presents the methodology and the results for the estimated income and house price processes. The data from the GSOEP as well as the regional house price data used in the empirical analysis is described in full length in Section 5. Section 6 presents the empirical results and Section 7 concludes.

2 The Relation of Saving Behavior and Housing Wealth

The housing wealth effect considers the relation between changes in housing wealth and saving respectively consumption. In the conventional life-cycle consumption hypothesis[5], changes in wealth stemming from windfall gains in house prices result in a decreasing level of savings as homeowners aim to smooth their consumption to

[5]Going back to (Modigliani et al., 1954), (Ando et al., 1963), later extended by (Friedman, 1957)'s permanent income hypothesis.

keep the marginal utility of consumption constant over their life-time. Consequently, as a result of depreciating house prices homeowners are cutting their spendings in order to increase savings and to substitute directly for the losses in housing wealth.

However, the theoretical life-cycle hypothesis is linked to several assumptions and constraints that have to be true to obtain these responsive dynamics in individual saving behavior. In addition, saving behavior is highly heterogeneous, bears different saving motives, such as old-age provision, precautionary saving, bequest motive, or the motive to purchase a house, and changing importances over a household's life-cycle (Browning et al., 1996). The "old-age provision" motive, i.e. old homeowners tap into their housing equity to finance retirement consumption while their housing demand decreases, bears to be the most important saving motive within the framework of the life-cycle theory. Moreover, the saving behavior may not only change over the life-cycle but also with home ownership status by a housing wealth effect. Owing to the importance of housing wealth in household's asset portfolios a number of studies has investigated the housing wealth effect empirically by the use of household level data.[6] However, the empirical evidence is highly ambiguous and a more differentiated consideration of the relation of saving behavior and housing wealth is needed. For the purpose of isolating the literature within a coherent line of reasoning, the following discussion refers to the literature that considers the housing wealth effect with regard to the inherent characteristics of housing wealth, assumptions and constraints of the life-cycle hypothesis, and heterogeneity in saving motives and behavior.

Heterogeneity over the Household's Life-Cycle and by Homeownership Status: Firstly, as a permanent increase in house prices today is related to higher housing costs in the future, the housing wealth effect implies distributional effects: While tenants who wish to acquire housing property in the future will additionally face higher down payments and adjust their savings behavior upwards due to an increased target and unchanged accumulation phase, own-occupiers may lower their savings (Browning et al., 1996).[7] Even without a strict incentive to purchase a house, young tenants face higher housing costs in form of higher rental payments if the arbitrage condition in the user-costs holds.

Besides the differences in saving behavior related to home ownership status, changes in house prices will also lead to inter-generational heterogeneity: If house price inflation is stemming from unanticipated but persistent increases in productivity, young homeowners should respond more strongly to changes in wealth as they will benefit from these changes for a much longer time (Browning et al., 2013, p. 402). On these grounds, (Campbell et al., 2007) question the homogeneity and propose to differentiate the empirical effects by age cohorts as well as by homeownership status.[8]

[6] In the following section, we attempt to survey solely the literature that considers the housing wealth effect by means of household-level data.

[7] (Artle et al., 1978) extend the basic life-cycle model by adding the motive to purchase a house. They examine theoretically the effect of a housing motive on saving and consumption behavior under down payment constraints. By implication, the "down payment saving effect" for young tenants will be even stronger in countries with strong mortgage regularities, such as in Germany.

[8] The study by (Campbell et al., 2007) examines the response in household consumption to house price changes by the use of a pseudo-panel constructed from household-level data from the UK family expenditure survey (FES). Their primary

Borrowing, Liquidity Constraints, and Debt: Secondly, only those own-occupiers who can immediately increase their level of consumption by reducing their current level of additional savings, or by using housing property as collateral to borrow against, are significantly affected by unexpected gains in wealth as they are able to optimally adapt their consumptions respectively savings (Campbell et al., 2007). Thus, homeowners should be neither liquidity nor borrowing constrained. Controlling for related common factors, (Browning et al., 2013) find that young home owners in Denmark are significantly affected by credit constraints as they react to the credit market reform in 1992 that opened up the possibility to use their equity to borrow against. In order to generate income from own-occupied housing property several financial vehicles exist, such as reverse mortgages or second mortgages. Alternatively, households in retirement can spend down their accumulated housing capital by downsizing, which means that households gradually reduce housing space by selling. However, a sale of housing property comes along with high monetary transaction costs, in particular for searching and moving, taxation from capital gains, as well as social cost for moving. However, in Germany neither downsizing nor reverse mortgages are in widespread use so far. In addition, the "retirement consumption puzzle" states that in contrast to the implications of the life-cycle theory, households' non-housing consumption level drops with retirement age, whereas housing consumption increases monotonically and concavely (Yang, 2009).

Consequently, in the presence of liquidity and borrowing constraints and a deficiency in incentives and possibilities to use up housing wealth, savings may respond asymmetrically to changes in housing wealth and marginal propensities to save may vary significantly in strength by households' net wealth situation. Thus, owing to the leverage effect households that are indebted may be less sensitive to unexpected capital gains than households that are free of debt (Mian et al., 2011).

Mental Accounting: Thirdly, according to the life-cycle consumption theory, wealth's assets must be fungible, meaning treated as being equivalent to each other within a households' asset portfolio. However, there is a long line of literature that argues that housing wealth is different.[9] First of all, considering the dual characteristic of housing property (Poterba, 1984), housing equity may be regarded predominantly as a consumption rather than as an investment good. In this case, any wealth effects resulting from housing capital gains should be only of second-order importance even in the presence of the conventional life-cycle model (Buiter, 2008). Additionally, owing to high search costs and informational asymmetries, measuring changes in housing wealth is not a straightforward and costless issue (Case et al., 2005). According to the behavioral life-cycle model (Shefrin et al., 1988), wealth that comes along with high financial transaction and psychological costs may be held in different mental accounts, is framed differently, and by implication households' marginal propensity to consume out of those assets might

issue is to use micro data to distinguish wealth effects from other effects such as collateral and precautionary savings, myopic behavior and to identify those households for whom the housing wealth effect is largest. Controlling for regional effects, changes in income, as well as household demographics, they find the largest absolute effect of house price changes for older homeowners, and the smallest effect for young renters (Campbell et al., 2007, p. 594).

[9] Residential property is an indivisible and tangible asset that is mainly characterized by its spatial fixity.

differ significantly. Accordingly, any windfall gain in non-fungible housing equity is unlikely to have any effect on consumption and saving behavior. In such a case, housing wealth represents solely a "sideshow" and changes in housing equity will not have any effect on own occupier's saving behavior (Skinner, 1996, p. 243).

(Levin, 1998) examines whether anomalies in consumption pattern may be better explained by the behavioral life-cycle model and states several empirical findings that provide evidence in favor of the behavioral life-cycle model: Firstly, consumption is only less sensitive to changes in housing wealth (Levin, 1998, p. 82); secondly, the effects of liquidity constraints on consumption behavior are more consistent with the existence of either financial or psychological transaction costs; and thirdly, the spendings on different goods do not only depend on the level of assets but also on its composition (Levin, 1998, p. 82). The study by (Juster et al., 2006) considers the wealth effect stemming from different asset types. They find that the spending responses to capital gains strongly depend on the asset type. More precisely, savings respond more strongly to changes in corporate equities than to changes in housing assets (Juster et al., 2006, p. 20).

Different Saving Motives: Bequest Motives: Fourthly, if households follow life-cycle patterns according to the permanent-income hypothesis, there must be no bequest motive or any other kind of altruistic behavior that opens up the opportunity that housing capital gains are passed along to younger generations rather than used to smooth own current consumption pattern (Engelhardt, 1996). However, (Hurd, 1987) extends the conventional life-cycle hypothesis by a bequest motive. In the case of bequest motives, young households spend housing windfalls from their received inheritances, whereas any windfall gains in own housing equity will be set aside for further generations. However, as suggested by (Skinner, 1996, p. 243) only few younger households will have enough liquid wealth for their own retirement phase, and thus to bequeath at death.

Different Saving Motives: Precautionary Saving: Fifthly, concerning the large degree of uncertainty during retirement age, it is also conceivable that housing property is held for emergency cases only. Hence, the channel through which saving behavior and housing wealth are related may be theoretically explained by means of the precautionary saving model.[10] This model states that housing wealth is used solely as a self-insurance preserved for the case of bad states during retirement age. Thus, windfall gains in housing capital will decrease savings among young and middle-aged homeowners as the increasing value of housing equity reduces the need for other kinds of precautionary savings (Skinner, 1996, p. 243). (Skinner, 1996) examines the effect of changes in housing wealth on real non-housing savings and states that median and young homeowners reduce their savings, whereas old homeowners do not significantly change their saving in response to an increase in house prices (Skinner, 1996, p. 242). Comparing the empirical findings with the implications of the life-cycle model with financial and moving constraints, the bequest motive model, as well as the precautionary model, he concludes that his findings are consistent only with the latter. Additionally, assuming that households are risk adverse and losses are valued with more weight than gains considering the precautionary saving motive, unanticipated changes in housing wealth will have asymmetric effects on saving pattern.[11] Thus, savings are less sensitive to unanticipated house price gains which might be regarded only as "add-ons", whereas depreciation in housing value will stimulate additional savings in order to compensate experienced losses. (Engelhardt, 1996) finds an asymmetric effect in saving responses to both unanticipated and anticipated house price changes. Hence, only households experiencing real housing capital losses do significantly change their saving behavior. However, from a theoretical point of view, he left the asymmetric effect in the savings responses unexplained. As only a small fraction of homeowners have to tap into their housing equity, the precautionary savings model is also easily reconciled with the bequest model, meaning, if the case of bad state did not occur during retirement, households aim to bequeath their housing equity at death.

3 Housing and Institutional Background in Germany

The relatively low rate of owner-occupied houses in Germany in comparison with other countries is substantially caused by the primary design of social housing that was brought forward by the German government by means of direct subsidies, guarantees, tax-privileged housing construction given the shortage of suitable living space after the second world war (Voigtlaender, 2009). Moreover, the relative liberal rental market, strong tenant protection, and fewer subsidies for the construction of self-occupied housing concurrently act upon the homeownership rate as well. Homeownership rates differ widely among rural and urban areas. While in metropolitan areas only about 23 percent of households live in self-occupied houses, in rural areas this rate exceeds the amount of 50 percent. These differences are illustrated by Figure 1. However, the share of own-occupied houses increases constantly. During

[10] Empirical evidence on the precautionary motive based on micro data can be found in (Skinner, 1989), among others.

[11] Such a weighting scheme of gains and losses is consistent with the prospect theory (Kahneman et al., 1979). Using the life-cycle, permanent income hypothesis, (Shea, 1995) finds that the effects to predicted income declines are larger than the effects to predictable income gains and links these findings with loss aversion.

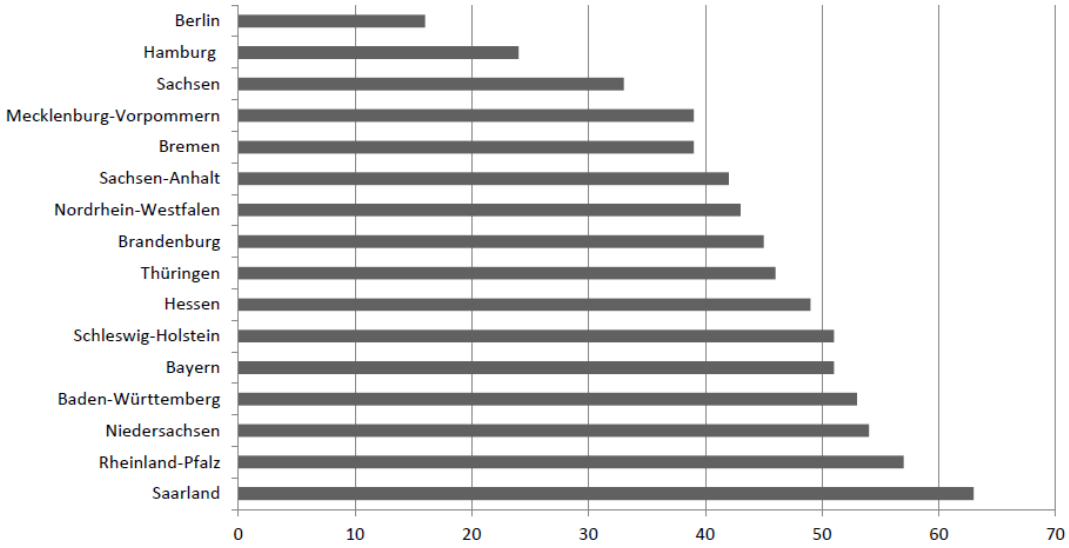

Figure 1: Homeownership rates in % for German states. Statistisches Bundesamt (2014).

the period from 1993 to 2002, the number of owners increased by 2.384 million households while the number of tenants rose only slightly (52.520). Hence, while only about 39 percent of all households lived in self-occupied property by the year 1993, this rate rose to 42 per cent in the year 2002, and to 46 per cent in the year 2011.[12]

Housing financing takes place by means of mortgage banks that use the borrowers' property as collateral value for the mortgage loan. The German mortgage market is characterized by relatively strong borrowing conditions and the utilization of mortgage interest rates that are usually fixed over a period of 5-10 years. German mortgage banks finance on average an amount of 60-80 percent of the long-term collateral value which is commonly 10-15 percent beneath the purchase price. Hence, households have to put up a comparable high amount of equity. By implication, these strong restrictions in mortgage regulation also exclude low-income households from purchasing housing wealth. Furthermore, absolute values of own-occupied houses are relatively high as compared to international standards. This is in particular because of notably high-quality standards in building construction. On this account, German own-occupier usually represent "one-time buyer", thus only a few households increase their housing wealth by improving successively their housing property over the life-cycle. In consequence of substantial differences in institutional background, German house price dynamics differ widely in international comparison (Figure 2). In the period from 1994 to 2008, the German real house price index stagnated or even depreciated, while house prices in other countries, such as in the United Kingdom, United States, or Denmark[13], experienced tremendous growth, developed more homogeneously, and additionally are marked by a higher volatility. (Kholodilin et al., 2007) conclude that growth in German house prices have long remained weak because of low income growth caused by a lackluster development of the economy and a relatively low degree of urbanization.

Furthermore, one can argue that a decentralized planning system, such as in Germany, facilitates competition among municipalities and thus leads to a higher total number of building permissions. Moreover, (Ortalo-Magne

[12]Data is provided by the Jahrbuch Statistisches Bundesamt 2014.
Datafile: https://www.destatis.de/DE/Publikationen/StatistischesJahrbuch/StatistischesJahrbuch2014.pdf
[13]These countries are selected as most other studies investigate the housing wealth for these countries.

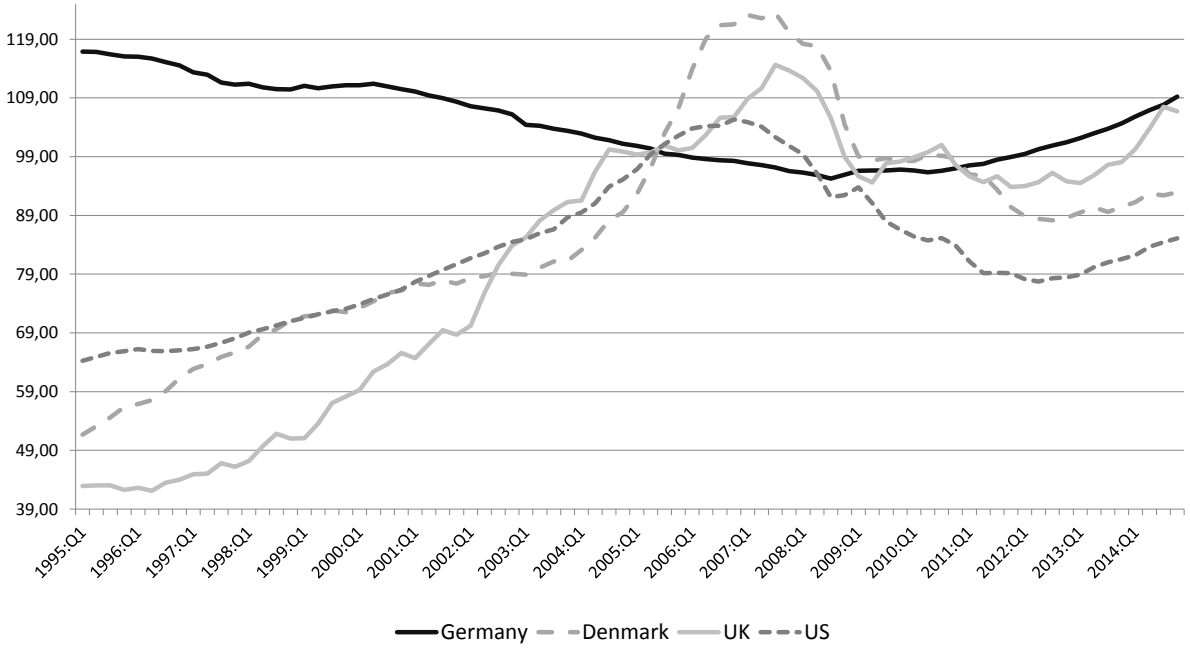

Figure 2: Quarterly real HPI for selected countries. Time period: 1975-2013 (base 2005=100). Datafile: http://www.dallasfed.org/institute/houseprice/

et al., 2007) suggest that those countries with a high number of self-occupied houses tend to regulate housing supply more strongly in order to sustain growth in national housing wealth. However, the German housing market is marked by significant growth since 2009. Due to (Meulen et al., 2013) current house price growth stems mainly from an increasing demand for housing which is caused by the positive surge in economic development, expensive monetary policy, changing risk awareness, and an increasing number of households, notably a larger share of middle-aged population (Kajuth et al., 2013), as well as agent's expectations about future demographic developments and current differences in income (Bischoff, 2012). However, house price dynamics differ regionally. Current migration patterns show a clear trend towards the big cities, particularly for young people, that may stem from structural changes in the labor market, an increasing knowledge-intensive service sector along with a shrinking employment in the industrial sector, as well as an increased preference for urban amenities. The increased number in disposable income as well as the positive surge in households in tandem with changes in demographic composition led house prices to increase in urban areas while house price growth is still low in rural areas.

Notwithstanding, recent dynamics raise the question whether the current growth in house prices in major urban areas may be the result of distinct misalignments, or rather the result of a long-term adjustment process. Empirical studies show that current growth in prices can be mainly assigned to permanent dynamics in house price fundamentals.[14] Furthermore, housing equity was traditionally considered as consumption rather than as an investment good in Germany. However, due to demographic shrinkage and resulting consequences of the reform of the German pension system[15], private retirement provision becomes more and more important for young households and

[14] As households should only respond to changes in wealth that are unanticipated and permanent, the underlying causes of house price dynamics are of importance for the identification of a housing wealth effect. We use the findings of previous empirical studies instead of empirical statistics to validate that current dynamics are of permanent character.

[15] "The reform [2001] moves the rather monolithical and very generous system that provides almost all retirement income

therewith housing equity as an additional pension asset. In accordance with the increasing rates of self-occupied houses, (Helbrecht et al., 2010) find that there is an unambiguous tendency in young households' propensity to use housing wealth as an additional asset for private retirement provision.

4 An Empirical Model of Saving Behavior

The empirical model of saving behavior used in the analysis is based on an Euler equation deduced from the permanent income hypothesis.[16] Our empirical specification is therewith similar to that proposed by (Campbell et al., 2007), and in line with the empirical model specifications recently used by (Browning et al., 2013) and (Disney et al., 2010). The base line model is given by equation 4.1.

$$\Delta s_{i,t} = \pi_0 + \pi_1 r_{i,t} + \pi_2 E(\Delta y_{i,t})^j + \pi_3 \theta_{i,t}^{y,j} + \pi_4 E(\Delta p_{i,t})^j + \pi_5 \theta_{i,t}^{p,j} + \pi_6 Z_{i,t} + \lambda_t + u_{i,t} \tag{4.1}$$

Hereby, $s_{i,t}$ is the log of total savings and $r_{i,t}$ is the interest rate of household i at time t. $E(\Delta y_{i,t})$ is the expected change in disposable income of household i between $t-1$ and t, whereas $\theta_{i,t}^{y} = \Delta y_{i,t} - E(\Delta y_{i,t})$ represents the unanticipated change in disposable income that occurs from subtracting the expectation at time $t-1$ from the realized change in income at time t. Accordingly, $E(\Delta p_{it})$ represents the expected change between $t-1$ and t in housing wealth, while $\theta_{i,t}^{p} = \Delta p_{i,t} - E(\Delta p_{i,t})$ denotes the difference between the realized and the expected change in house prices. All variables with a superscript j enter the regression without interaction term, interacted with a dummy for old, with a dummy for owners and with both dummies simultaneously. Thus, we allow for heterogeneous saving behavior among subgroups and consequently, for different effects. The processes for income and house prices have to be estimated separately under the consideration of several concerns. The method of derivation of these processes are described in detail in the next subsections. The vector $Z_{i,t}$ entails several demographic variables, such as age, educational level of the household head and number of children in the household. Moreover, we control for region-specific effects λ_t, which occur at time t. $u_{i,t}$ represents the independent error term.

Changes in wealth cannot only occur due to active saving. Real wealth can also change due to passive saving which occurs if there are real capital gains or losses on existing assets in the household's portfolio. We abstract from including a direct measure of passive savings in our empirical model due to several concerns. As we control for changes in the interest rate which reflect opportunity costs of holding assets and as asset price changes are likely to correlate with house price changes, we might get biased parameter estimates. Moreover, due to high volatility

within a single public pay-as-you-go-framework to a three-pillar system, in which private and occupational pensions will have an increasingly important role. Accordingly, the importance of private saving for old age has increased in recent years." (Schunk, 2009).

[16] As the analyses of (Campbell et al., 2007) and (Attanasio et al., 2009) end up with opposite findings although the same microlevel survey data is used, the study by (Cristini et al., 2014) compare both studies in more detail. They find out that the differences in estimates can be mainly attributed to the use of either a reduced form life-cycle model of consumption, as used by (Attanasio et al., 2009), or an estimated Euler equation model, (Campbell et al., 2007). However, they also state that a deeper understanding of the relative importance of the functional form of the consumption function remains unknown (Cristini et al., 2014). We decide to use an Euler equation- based empirical specification as this is in line with recent empirical studies, (Disney et al., 2010), and (Browning et al., 2013).

of asset prices, household's are likely to face an identification problem of asset price changes, so that they do not adapt their saving behavior accordingly.

4.1 House Price Process

The estimation of the house price process should be closely related to the way households form their expectations. Conventional life-cycle theory suggests that agents form rational expectations in a forward looking manner. This rational expectation hypothesis implies that households predict future house prices with the knowledge of how the sub-markets' economy is structured and how market players' behavior is interrelated. However, in the last decades, several publications in stock market research showed that expected returns are moving equably with the current performance of the stock market, and thus are not consistent with the rational expectation hypothesis. In consequence, the rational expectation formation in a forward-looking manner has been discarded increasingly in favor of near-rational, moving-average, or extrapolation expectation formation, notably because of the costly accessibility and availability of information. Just recently, (Greenwood et al., 2014) discard the rational expectation formation in favor of extrapolation techniques to model investors' expectations. By the same token, affirmative evidence has been found by related references from housing market research as well. By means of survey data, (Case et al., 1990) and (Piazzesi et al., 2009) demonstrate that home buyers expect higher long-term house price appreciation if the underlying market reveals a strong increase in value at the same time. Furthermore, (Gelain et al., 2014) confirm existing evidence by pointing out that a simple moving-average forecast rule is able to cover all the features of survey studies. Unfortunately, for Germany neither an equivalent study nor an equivalent survey data set exists. Owing to high search costs, market imperfections, and the unfamiliarity with market structure, evidence from previous literature bears out that agents at the housing market might be likely tempted to rely on past prices to form expectations.[17]

Taking into consideration the previous findings from international survey data, we assume that households use past prices and simple autoregressive models in order to describe the stochastic process of house prices, and accordingly, to distinguish between unanticipated and anticipated changes. Moreover, we use permanent drivers of house price growth that have been previously identified by German house price studies, discussed in more detail in Section 3, in order to control for anticipated and unanticipated changes in exogenous fundamentals that affect long-term developments in house prices. On these grounds, we control for dynamics in demographic variables and mortgage interest rates that are likely to be anticipated. The base-line model which represents the specified house price process is given as follows:

$$p_{i,t} = \rho p_{i,t-1} + \beta_1 H_{i,t} + \beta_2 H_{i,t-1} + \beta_3 mr_t + \beta_4 mr_{t-1} + \beta_5 Y_{i,t} + \beta_6 Y_{i,t-1} + \mu_i + \tau_t + e_{i,t} \qquad (4.2)$$

[17] Recently, empirical studies considering housing wealth effects make use of simple autoregressive models. Just recently, (Browning et al., 2013) uses a simple first-order autoregressive model to model the house price process. Moreover, (Disney et al., 2010) make use of a second-order autoregressive model to deduce unanticipated house price effects on county-level basis. (Campbell et al., 2007) also control for unpredictable changes in house prices by the use of instrumental variables. For this purpose, they use the second lag of house price changes as an instrument. (Attanasio et al., 2009) analyze the effect of unexpected house price changes, but do not state any equation of used specification nor empirical results.

Whereby $p_{i,\,t}$ is the natural log of the regional house price index in region i at time t; $i \in [1, .., R]$ indexes the regional housing market areas[18]. The vector H_i represents the regional number of households, mr_i the nominal 10-year mortgage rate, and Y_i the regional GDP. Accordingly, ρ represents the coefficient of the temporal lag of the dependent variable. In addition, we control for time-invariant, individual fixed effects that belong to the single regions, μ_i, and for time-variant effects, τ_t, that vary over time but not over the considered regions. We use temporal lags to control for the temporal autoregression representing the high persistence in the underlying variables. In order to control for endogeneity, we estimate the fixed effects dynamic panel model by the generalized method of moments estimation procedure proposed by (Blundell et al., 1995).[19]

Table 1: Estimation Results: House Price Process

	$p_{i,t-1}$	$Y_{i,t}$	$Y_{i,t-1}$	$H_{i,t}$	$H_{i,t-1}$	mr_t	mr_{t-1}
(1)	0.8003***	0.0022***	0.0006	-0.0110	0.01262*	-6.7875*	11.2128***
	(0.04463)	(0.0008)	(0.0006)	(0.0058)	(0.0058)	(3.0424)	(3.5404)
(2)	0.8597***		0.0010*		0.0018*	-5.9567*	
	(0.0370)		(0.0006)		(0.0008)	(3.0625)	
N=1116	n=62	T=18					

Notes: * p<0.1, *** p<0.01. Balanced panel. Includes region dummies which are not reported. Standard errors in parentheses.

The estimation results are presented in Table 1. The estimated coefficients of the exogenous variables have the expected signs and are statistically significant. We decide to use specification 2 containing only the temporal lags of the regional household number and the regional gross domestic product in order to avoid any endogeneity problem. In conclusion, changes in housing wealth can be assigned to an anticipated and an unanticipated part that are deduced from an estimated house price process: $\theta^p_{it} = \Delta p_{it} - \mathbb{E}(\Delta p_{it})$. The actual as well as the derived expected and unexpected changes in average house prices are illustrated in Figure 3.

4.2 Subjective Perception of Changing House Prices

Households may not be able to perceive changes in wealth due to the difficulty of measuring changes in house prices caused by high search costs and informational asymmetries. Additionally, according to the behavioral life-cycle model as well as to the duality characteristic of housing, changing housing values may be perceived, but treated differently within the households' wealth portfolio. In order to prevent that the housing wealth effect is solely a question of subjective perception, there is a need to control for households' subjective perception of changing house prices and appropriate measuring.

[18] All housing market areas used are listed in table A1.

[19] The lags of the dependent variable are used as additional GMM instruments. For the estimation, a two step procedure with regenerated weighting matrix with time dummies and fixed effects is used. In addition, robust standard errors are used for deriving inferences.

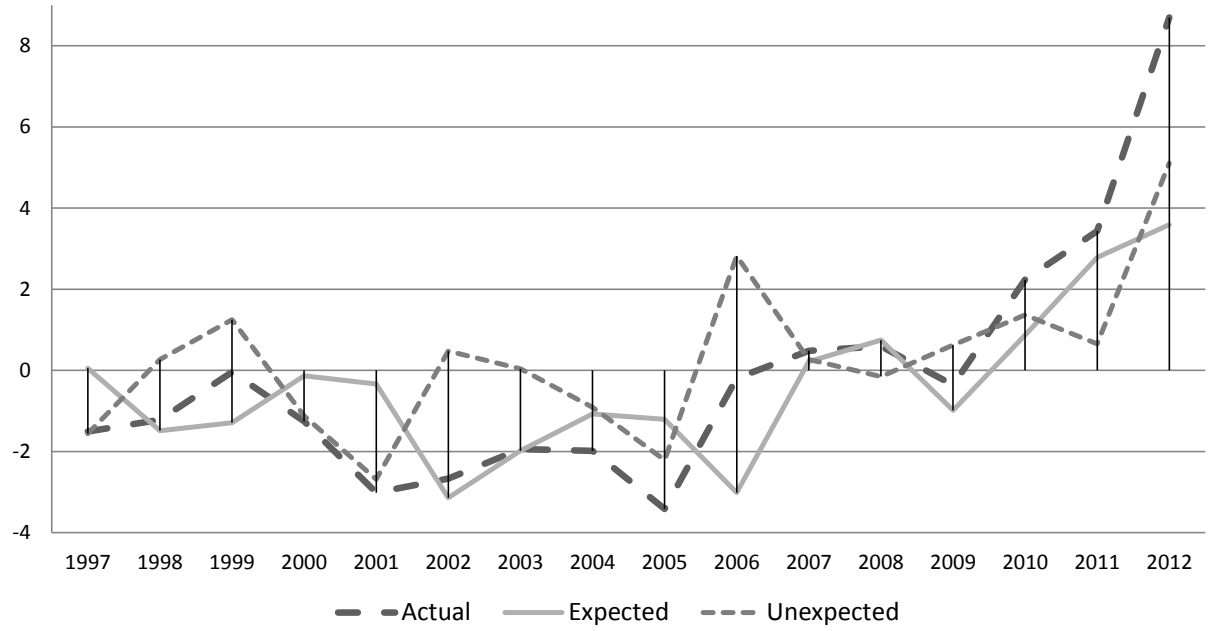

Figure 3: Actual, expected, and unexpected house price changes, based on regional house price indexes for Germany, covering the period 1996-2012.

Individual housing capital gains can be either measured by the deflated transaction price, comparable house prices based on regional indexes, or self-reported values of the housing property. However, according to (Engelhardt, 1996) measuring real housing capital gains is difficult due to a lack of sufficient data. Against this backdrop, (Browning et al., 2013) suggest that households assess changes in their housing wealth using past transaction prices of dwellings in their municipality. However, the use of regional price indexes does not consider the whole heterogeneity of houses and its intra-regional differences in appreciation. According to (Archer et al., 1996) among others, a large amount of intra-regional variation in appreciation rates stems from influences that are caused by the individual property itself and its immediate surrounding. Moreover, (Engelhardt, 1996) shows that housing properties appreciate differently within a municipality due to differences in physical deterioration and obsolescence, and thus due to individual redevelopment and maintenance efforts, as well as by moving behavior (Disney et al., 2010). On the contrary, individual self-reported values might be biased as well as they encompass individual beliefs and household's individual perception of changes in housing wealth.

In order to control for household's subjective perception without neglecting possible heterogeneity in intraregional house price dynamics, we form a set of perception dummy variables that allow for different amounts of variance between self-reported growth in housing values and growth in regional house prices.

4.3 Income Process

In this subsection we estimate the income process in order to derive predictions of expected and unexpected income changes. We assume that households expect their incomes for the next period to be strongly related to the income in the past period. Thus, we follow the tradition in economic life-cycle models where the income process is most

often modeled as a simple first order autoregressive process (AR(1)) plus a transitory shock (Hubbard et al., 1995), (Huggett, 1996). The base-line model is given as follows:

$$y_{i,t} = \gamma y_{i,t-1} + (1-\gamma)\mu_i + \phi z_{i,t} + \kappa_t + u_{i,t}. \tag{4.3}$$

The dependent variable, $y_{i,t}$, is the natural log of current yearly household net income deflated to 2006 Euro. It is the income that is disposable after deduction of tax and national insurance contributions. Regular payments such as rent subsidy, child benefit, government grants, subsistence allowances, amongst others, are included. Explanatory variables include the lag of the households' net income, $y_{i,t-1}$, and a vector of household characteristics, $z_{i,t}$, namely the household heads' log age as well as log age squared and the number of children in the household. Moreover, equation 4.3 contains household-specific fixed effects that are constant over time, μ_i, and time fixed effects, κ_t, which vary over time but do not vary over the considered households. κ_t contains year dummies so that we control for year-specific common national shocks. Lastly, $u_{i,t}$ is an independent error term.
The income process is estimated using the Arellano Bover linear dynamic panel-data estimator. The estimation results are shown in Table 2. The autoregressive parameter estimate is 0.33 and all coefficients are highly significant. As described above, based on the estimation results, we calculate expected and unexpected income changes which are then used in the total savings equation.

Table 2: Estimation Results: Income Process

	Income_{t-1}	Children	Age	Age2
income	0.326***	0.0344***	4.774***	-0.609***
	(0.0108)	(0.00504)	(0.574)	(0.0782)
N	143187			

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The regression includes year dummies which are not reported. Standard errors in parentheses. GSOEP, own calculations.

5 Data

We use household level longitudinal data taken from the GSOEP. The GSOEP is a repeated panel survey of around 12,000 private households in the Federal Republic of Germany and has been conducted annually since 1984. The panel contains detailed information on savings, wealth, income and on personal as well as household characteristics.[20] We utilize 17 waves of data covering the period from 1996 to 2012. The information used is confined to this

[20] For a detailed description of the GSOEP, see (Haisken-DeNew et al., 2005).

Table 3: Active saving by homeownership status 1996-2012

	Percent of households with active saving		Mean active saving (2006 Euro per month)		Mean active saving relative to mean income	
Year	HO	Renters	HO	Renters	HO	Renters
1996	73.51	58.58	255.71	133.42	0.13	0.10
1997	71.65	58.84	266.21	137.21	0.13	0.10
1998	74.04	55.44	258.15	129.61	0.13	0.09
1999	73.79	55.81	277.18	129.99	0.13	0.09
2000	72.8	57	265.10	133.23	0.12	0.09
2001	74.76	57.99	278.36	138.93	0.12	0.09
2002	69.39	53.45	273.07	131.68	0.12	0.08
2003	69.75	53.61	286.57	131.2	0.12	0.08
2004	68.15	52.23	291.63	126.46	0.12	0.07
2005	70.3	53.91	303.28	143.69	0.12	0.08
2006	67.49	50.36	311.80	143.38	0.12	0.08
2007	69.06	51.76	322.30	151.25	0.12	0.08
2008	69.44	51.91	339.41	163.21	0.12	0.09
2009	69.05	52.64	340.51	170.69	0.12	0.09
2010	67.02	52.32	338.76	170.05	0.11	0.08
2011	72.11	52.75	380.37	188.57	0.12	0.09
2012	71.13	53.98	401.36	207.52	0.12	0.09
All years	70.71	54.25	307.98	148.73	0.12	0.09

Source: GSOEP, own calculations.

period due to limited availability of external house price data.

5.1 Savings

Following (Engelhardt, 1996), (Juster et al., 2006), and (Disney et al., 2010), we use household active saving as dependent variable.[21] Active saving is defined as the fraction of current income that is not used for consumption but for asset purchases, thus raising financial wealth (Engelhardt, 1996), (Disney et al., 2010). The precise form of the question that each individual aged 17 years and older in the household answers is: "Do you usually have money left over at the end of the month that you can put aside for larger purchases, emergencies, or to build savings? If so, how much?". Household active saving is the sum of these saving amounts across all household members. We deflate active saving to the year 2006 using the consumer price index (CPI). Summary statistics on active saving by homeownership status for each wave of 1996 to 2012 can be found in Table 3.

One can observe that the fraction of homeowners that saves, 71 percent, is significantly larger than that of renters, which only amounts to 54 percent. Besides, the average monthly amount of savings of homeowners, 308 Euro, is more than twice as large as that of renters, 149 Euro. This observation is confirmed by the savings rate which is defined as mean active saving divided by mean income, thus controlling for possible differences in income for owners and renters: It amounts to 12 percent for homeowners and to 9 percent for renters.

[21] By using household savings instead of household consumption we rule out biased estimates due to ignored changes in housing consumption. Indeed, running a regression of house price shocks on housing expenditures, we find that an unexpected housing capital gain increases housing consumption (reinvestment, operation and/or maintenance), so that an increase in consumption would be concealed by an increase in housing quality.

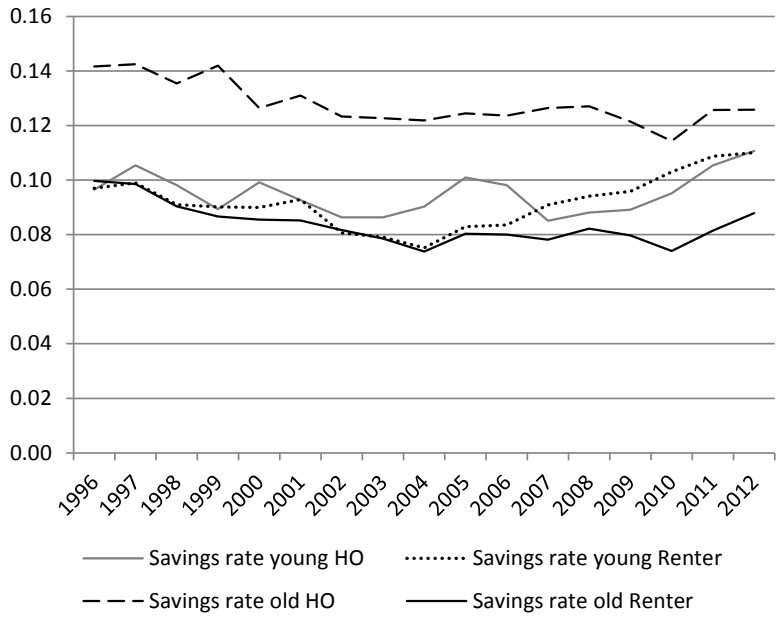

Figure 4: Saving rates by homeownership status and age. GSOEP, own calculations.

The savings rate does not only differ among owners and renters but also among age cohorts. Young and old households are defined as having a household head aged 40 or younger and aged over 40, respectively. Figure 4 shows saving rates by homeownership of young and old households during the sample period. One can see that old homeowners by far have the largest savings rate lying between 12 to 14 percent, meaning that old homeowners save the highest amount relative to their income.

5.2 Wealth

The GSOEP provides information on household wealth for the years 2002, 2007 and 2012. Total household wealth in the GSOEP is composed of eight components: Owner-occupied property, other property (both including debts), financial assets, building loan contracts, private insurances, business assets, tangible assets and consumer debts. Total net wealth in each of the 2002, 2007 and 2012 waves of the GSOEP is the sum of all wealth components, i.e. gross wealth minus liabilities, in the respective year. It can also be written as the sum of net housing wealth and net non-housing wealth, where net housing wealth is defined as the sum of net owner-occupied property and net other property. Net non-housing wealth is simply the sum of the six remaining wealth components. Summary statistics on net housing wealth, net non-housing wealth and total net wealth for the years 2002, 2007 and 2012 for the whole sample and by homeownership status are displayed in Table A3 and Table 4, respectively.

Average net household wealth amounts to approximately 150,000 Euro in 2002, 2007 and 2012. Of this, housing wealth is by far the most important wealth component of German households: Approximately 62 percent of total net wealth is held as housing wealth (Table A3). In the years considered, the average value of net housing equity for homeowners amounts to approximately 220,000 Euro[22] and their average value of total net wealth amounts

[22]Note that the amount of housing equity of renters is not negligible. It largely stems from "other property".

Table 4: Summary statistics on net (housing) wealth by homeownership status

	2002		2007		2012	
	HO	Renter	HO	Renter	HO	Renter
Observations	6047	6645	5674	6015	5970	6352
Percentage of sample	47.64	52.36	48.54	51.46	48.45	51.55
Net housing wealth						
Mean	222983	6760	213126	11568	212195	9187
% of total net wealth	65.95	25.11	65.73	35.63	67.25	24.84
Mean NHW/Mean income	7.45	0.33	6.71	0.53	6.06	0.39
Net non housing wealth						
Mean	88950	22235	98960	24943	86514	23399
% of total wealth	34.05	74.89	34.27	64.37	32.75	75.16
Mean NNHW/Mean income	2.97	1.08	3.12	1.15	2.47	0.99
Total net wealth						
Mean	311933	28995	312085	36511	298709	32586
Mean NW/Mean income	10.42	1.41	9.83	1.69	8.53	1.37

Source: GSOEP, own calculations.

to around 300,000 Euro (Table 4). Given that in Germany housing wealth plays such an important role in the wealth accumulation process, it is not surprising that homeowners are much wealthier than renters. The average value of total net wealth for renters only adds up to around 30,000 Euro, thus being ten times lower than that of homeowners. Homeowners have a ratio of mean wealth to mean income which lies between 9 to 10 percent in 2002, 2007 and 2012, whereas that of renters only amounts to around 1.5 percent.

5.3 House Prices

For the estimation of the house price process, we use a panel dataset that contains house price indexes of 62 metropolitan areas on its cross-sectional dimension and that covers a period from 1995-2012.[23] The grey bold line in Figure 5 displays the changes in these house price indexes for all 62 metropolitan areas used in the analysis. The black bold line displays changes in house price indexes for the top seven cities only.[24] In contrast to (Browning et al., 2013) we do not use micro data based on transactions, rather we rely on quality-adjusted regional house price indexes (prices per square meter) that are also based on transaction data.

Apart from using aggregated regional house price data, we also use household's self-reported home values from the GSOEP to control for subjective perception of changes in property values. This distinguishes our study from earlier ones e.g. (Campbell et al., 2007) and (Attanasio et al., 2009) that have relied on aggregate house price information only.[25] As mentioned above, the GSOEP provides detailed information on housing wealth for the years 2002, 2007 and 2012. In these years, homeowners report the annual estimate of the current market value of the housing property they live in and the annual estimate of the current market value of other housing or land

[23] Regional house price data are obtained from the BulwienGesa AG, leading provider for house price data. The data is also used by the Deutsche Bundesbank among others.

[24] The dashed lines display changes in regional house price indexes based on single-family houses. The data stems from the German Federal Institute for Research on Buildung, Urban Affair and Spatial Development. As the data is limited to the period from 2005 to 2010, we abstract from using it for our analysis.

[25] The great advantage of self-reported house price changes is that the household's perception of a housing capital gain or loss is more informative about saving behavior than those gains or losses actually realized.

properties. Additionally, they report outstanding mortgage debt for both types of property, so that data on gross and net housing wealth is available.

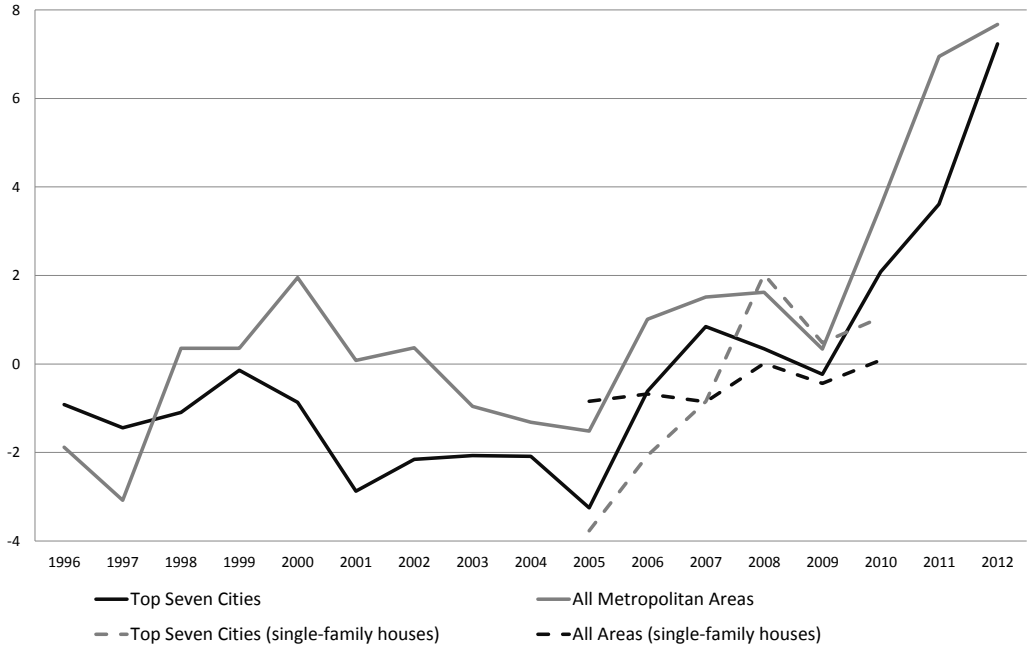

Figure 5: Changes in House price indexes. The bold lines display changes in regional house price indexes based on own-occupied dwelling houses and the dashed lines display changes in regional house price indexes based on single-family houses.

6 Empirical Evidence

This section is devoted to examine the link between anticipated and unanticipated house price changes and household saving behavior while controlling for a set of common factors including anticipated and unanticipated income changes among others, as well as for socio-economic variables.

6.1 Baseline Regressions

On the basis of (Browning et al., 2013), Table 5 reports a set of baseline regressions in order to provide a first idea of the relation between the main variables used in the total saving equation.[26]

Column (1) in Table 5 shows the results from a regression of the first difference of log active savings on the first difference of log house prices. The parameter estimate is highly significant and amounts to 0.28, so that an increase in house prices by 1 percent increases savings by 0.28 percent. Given that the average house price was about 1,473 Euro per square meter and the average level of active saving was 2,175.12 Euro in 1996, an increase in house prices per square meter of 1 percent amounts to 14.73 Euro and a 0.28 percent increase in savings amounts to an annual increase of 5.87 Euro. Adding the first difference of log net household income to the regression (column (2) of

[26] As we do not have regional house price data for all 97 spatial planning regions in Germany, the baseline regressions as well as all following regressions are restricted to a subsample of households living in specific metropolitan areas. See table A1 in the appendix for the list of the 62 regional areas that are included in the regression.

Table 5), the estimated house price parameter is lowered by nearly 25 percent. The estimated income coefficient amounts to 0.86 and is statistically significant on the 1 percent level, confirming a strong positive correlation between income and savings.

Table 5: Baseline Regressions

	(1)	(2)	(3)	(4)	(5)	(6)
	Δs_{it}	Δs_{it}	Δs_{it}	Δs_{it}	Δs_{it}	Δs_{it}
Δp_{it}	0.275***	0.210***		0.265	0.151	0.456**
	(0.0884)	(0.0798)		(0.175)	(0.113)	(0.198)
Δy_{it}		0.856***		0.939***	0.909***	0.926***
		(0.0219)		(0.0336)	(0.0284)	(0.0346)
$E(\hat{\Delta} p_{it})$			0.00342***			
			(0.00123)			
$\hat{\theta_{it}^{p}}$			0.00196**			
			(0.000858)			
$\Delta p_{it}, old$				-0.0961		-0.416*
				(0.197)		(0.238)
$\Delta p_{it}, ho$					0.00501	-0.551
					(0.158)	(0.402)
$\Delta p_{it}, old, ho$						0.714
						(0.446)
N	59554	57862	59554	57153	57153	57153

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The regression reported in column (4) includes a dummy variable which is one for old households, an interaction term of the income change with the dummy for "old", as well as controls for the interest rate, education and the number of children in the household. The baseline group in this regression is young households. The regression in column (5) is the same specification as in (4) except that the dummy for old is replaced by a dummy which is one for homeowning households. The baseline group in (5) is renting households. The regression reported in column (6) includes a dummy variable which is one for old households, a dummy variable which is one for homeowners, the interaction of both dummy variables, an interaction term of the income changes with the dummy for "old", another one with the dummy for "homeowners" and one with both dummies at once. Again, additional controls are the interest rate, education and the number of children in the household. The baseline group in this regression is young renters. Standard errors in parentheses. GSOEP, own calculations.

According to the life-cycle hypothesis, households only react to unexpected house price changes. Hence, for testing the wealth hypothesis, it is essential to distinguish between anticipated house price innovations and those which were not anticipated by consumption-smoothing households. For this purpose, we regress active savings on the expected and unexpected house price innovations calculated on the basis of the estimated house price process

reported in Section 4. Estimation results (column (3) of Table 5) show that both the anticipated and unanticipated house price coefficients are positive and statistically significant, whereas the second one is smaller in magnitude.

According to theoretical considerations discussed in Section 5, housing wealth effects may differ for different subgroups of the population, especially for households at different stages of the life-cycle and by homeownership status meaning whether the household is own-occupier or renter. To begin with, column (4) investigates heterogeneity in saving responses of young and old households. The parameter estimate of the house price change, now measuring the response of young households, remains positive and nearly as large as in specification 1, meaning that young households increase their savings in response to an expected positive house price increase. The parameter estimate of the interaction term (-0.096) measures the additional effect for old households, so that old households also increase their savings, but by less than younger ones. These results can be explained by the high percentage of renters in Germany, so that in the aggregate, the response of renters has more weight. As an increase in house prices is associated with higher rental costs in the future, the overall response is an increase in savings. However, standard errors are quite large and both parameter estimates are statistically insignificant. The regression reported in column (5) allows responses to differ between homeowners and renters. In this regression, the default group is renters, for which the estimated coefficient of an expected house price change still is positive but has decreased in magnitude by nearly 50 percent compared to the first specification. Homeowners seem to increase their savings even by a larger amount than renters which is at odds with the implications of the conventional life-cycle model. In column (6), we investigate the effects of age and homeownership status at the same time. Therefore, we interact house price changes with a dummy variable for "old" and with a dummy variable for "own-occupiers" simultaneously. In this case, the default group is young renters for which a highly significant positive relationship between house price changes and savings is confirmed: A 1 percent increase in house prices leads young renters to increase their savings by 0.46 percent. The estimated interaction parameter of house price changes with the dummy for old amounts to -0.42 and is statistically significant on the 10 percent level. To get the response of old renters, one has to sum up these two parameter estimates ($\Delta p + \Delta p, old$). Estimation results show that old renters only hardly respond to house price changes. This can be explained first, by the housing purchase motive which is likely to be more important for young renters and second, by a leverage effect i.e. that young renters are affected by house price changes for a longer time. Both of the estimated coefficients for renters are statistically significant, at least at the 10 percent level, whereas both parameter estimates for homeowners are insignificant and standard errors are quite large.

6.2 Basic Regression

In this subsection we estimate our baseline model (4.1) aiming at exploiting life-cycle patterns, effects of homeownership and effects of anticipated and unanticipated house price changes at once. Our main interest lies in the effect of anticipated and unanticipated house price innovations interacted with age and homeownership status on

changes in savings. The empirical model is estimated by pooled OLS[27] for the period from 1996 to 2012. All standard errors are robust. In contrast to (Browning et al., 2013) our regression sample is not restricted to homeowners, but also contains renters. Estimation results are reported in Table 6.

It is striking that all parameter estimates of unanticipated house price shocks are statistically significant, whereas those of anticipated house price innovations are not. Hence, as suggested by the life-cycle hypothesis, households solely respond to unexpected house price changes so that we restrict our interpretation on the effects of unanticipated house price changes on savings behavior.[28]

The baseline group in the basic regression is young renters, so that the estimated coefficient on $\hat{\theta}^{\hat{p}}_{it}$ measures the effect of unanticipated house price changes on savings of young renters. The parameter estimates on the interaction terms measure the additional effects of unanticipated house price innovations on savings for the particular subgroups defined by the dummy variables. Our results as well as the reported Wald tests (2) in the bottom of Table 6 reveal significant heterogeneity in the savings responses to unanticipated house price changes across the different groups.

For young renters, we find a positive statistically significant relationship between unanticipated house price innovations and saving behavior: A 1 percent increase in house prices that was not anticipated by households is associated with a 0.003 percent increase in savings. This result is consistent with the basic life-cycle model with old-age provision savings motive, since an increase in house prices leads to an increase in the price of future housing needs. It is the strongest absolute effect and can be attributed to the "down payment saving motive". Either young renters plan to acquire housing property in the future and will face higher down payments as the accumulation phase remains constant but the target increases (housing purchase motive), or they continue to rent and face higher rental payments if the arbitrage condition in the user-costs holds. In contrast to young renters, old renters do not appear to react to unanticipated house price changes ($\hat{\theta}^{\hat{p}}_{it} + \hat{\theta}^{\hat{p}}_{it}, old$). According to the basic life-cycle theory, we would have expected that old renters also increase their savings, although by less than young renters. However, there are several restrictions which reconcile the response of old renters with theory: Rent increases for elderly people are limited to a certain fixed amount and their housing demand rather decreases due to reduced family size. For young homeowners ($\hat{\theta}^{\hat{p}}_{it} + \hat{\theta}^{\hat{p}}_{it}, ho$), we observe a negative highly statistically significant relationship between unanticipated house price shocks and saving behavior: A 1 percent increase in house prices is associated with a 0.004 decrease in savings. This is the response we would have expected according to the life-cycle theory of consumption. Young homeowners benefit from an increase in housing wealth. In order to keep the marginal utility of consumption constant over the life-time, they decrease their savings.

[27] Household specific fixed effects are eliminated due to estimation in first differences.

[28] Note, however, that the sum of the coefficients of the unanticipated house price changes is not significantly different from zero (see Wald tests (1) in Table 6).

Table 6: Basic Regression

	(1)
	Δs_{it}
$E(\hat{\Delta} p_{it})$	0.00171
	(0.00239)
$E(\hat{\Delta} p_{it}), old$	-0.00442
	(0.00299)
$E(\hat{\Delta} p_{it}), ho$	-0.00548
	(0.00424)
$E(\hat{\Delta} p_{it}), old, ho$	0.00623
	(0.00484)
$\theta^{\hat{p}}_{it}$	0.00333*
	(0.00180)
$\theta^{\hat{p}}_{it}, old$	-0.00403*
	(0.00209)
$\theta^{\hat{p}}_{it}, ho$	-0.00691**
	(0.00323)
$\theta^{\hat{p}}_{it}, old, ho$	0.00759**
	(0.00359)
Wald tests (1)	p-value
$\theta^{\hat{p}}_{it} + \theta^{\hat{p}}_{it}, old = 0$	0.557
$\theta^{\hat{p}}_{it} + \theta^{\hat{p}}_{it}, ho = 0$	0.161
$\theta^{\hat{p}}_{it} + \theta^{\hat{p}}_{it}, old + \theta^{\hat{p}}_{it}, ho + \theta^{\hat{p}}_{it}, old, ho = 0$	0.982
Wald tests (2)	p-value
$\theta^{\hat{p}}_{it}, old - \theta^{\hat{p}}_{it} = 0$	0.047
$\theta^{\hat{p}}_{it}, old, ho - \theta^{\hat{p}}_{it}, ho = 0$	0.029
$\theta^{\hat{p}}_{it}, ho - \theta^{\hat{p}}_{it} = 0$	0.025
$\theta^{\hat{p}}_{it}, old, ho - \theta^{\hat{p}}_{it}, old = 0$	0.025
$(\theta^{\hat{p}}_{it}, old, ho - \theta^{\hat{p}}_{it}, ho) - (\theta^{\hat{p}}_{it}, old - \theta^{\hat{p}}_{it})$	0.021
N	57153

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The baseline model includes dummies for old, for homeowners and their interactions. In addition, it controls for educational qualification of the household head, the number of children in the household, the interest rate and includes year as well as region dummies. The change of expected and unexpected income is also included with the same interactions as for the house price parameters. The baseline group in this regression is young renters. Robust standard errors are in parentheses. An extended table containing also the estimated coefficients for anticipated and unanticipated income changes can be found in the appendix (Table A4). Wald tests (1) test the null hypothesis that the sum of parameter estimates is different from zero. Wald tests (2) test the null hypothesis that estimated coefficients do not differ from each other. Standard errors in parentheses. GSOEP, own calculations.

The conventional life-cycle model suggests that old homeowners should also decrease their savings and by an even larger amount than younger ones. This is due to the fact that increasing house prices do not only generate increasing housing wealth but also lead to an increase in the price of future housing needs for homeowners. Given the shorter remaining life-time, old homeowners are less affected by these higher prices. However, we do not find any reaction of old homeowners to unanticipated house price innovations ($\hat{\theta}^{\hat{p}}_{it} + \hat{\theta}^{\hat{p}}_{it}, old + \hat{\theta}^{\hat{p}}_{it}, ho + \hat{\theta}^{\hat{p}}_{it}, old, ho$).[29] The low utilization of second-mortgages as well as the fact that households do not tap into housing wealth with age is not consistent with the old-age provision motive either. Notwithstanding, the results are in line with the precautionary savings model which is an extension of the conventional life-cycle model with old-age provision savings motive.[30] The precautionary savings model captures the inherent uncertainty associated with retirement (Skinner, 1989) and states that housing wealth is solely used as a mean for self-insurance against bad states in later life. (Le Blanc et al., 2014) show that the importance of the precautionary savings motive monotonically decreases with age. Hence, an unanticipated increase in the value of housing equity reducing the need for other kinds of precautionary savings, results in a decrease of savings particularly among young and middle-aged, but less so among old homeowners.

Summing up, young renters increase and young homeowners decrease their savings in response to unanticipated house price shocks which is in line with both the basic life-cycle model with old-age provision motive and the life-cycle model with precautionary savings motive. Old households, irrespective of whether they are homeowner or renter, do not react to unanticipated house price changes.[31] This is consistent with the precautionary savings motive only. As we find that 51.6 percent of young and 61.8 percent of old homeowners follow the dynamics at the housing market and perceive changes in housing wealth correctly, we may rule out subjective perception of changes in property values as a driver of our results.[32] Hence, we interpret our results as evidence for the precautionary savings model and accordingly, for the existence of a wealth effect in Germany.[33]

[29] Note, that there is a broad strand of literature finding evidence that, opposed to the predictions by the basic life-cycle model with old-age provision motive, most of the elderly households do not use up their accumulated wealth after retirement, see (Schunk, 2009) among others.

[30] Under standard assumptions, the classical life-cycle theory captures an old-age provision savings motive since it presumes that households save during the working years to finance their consumption after retirement. The basic model then has been extended to include various saving motives, amongst others the precautionary savings motive, the housing and the bequest motive (Schunk, 2009).

[31] Owing to the fact that old households are defined as having a household head aged over 40 years, the absence of a response of old households might be the result of an aggregation of the saving effects of the working-aged households (40-65 years) and those who already are in retirement (>65 years). In order to rule out this explanation, we run the basic regression with 3 age groups, where young households are defined as households with a household head aged 40 or younger, middle aged households as having a household head aged over 40 and <= 65 and old households as having a household head aged over 65. Results are quantitatively and qualitatively unchanged. The parameter estimates for middle-aged and old households, for homeowners and renters, are approximately the same meaning that neither middle-aged nor old households do respond to unanticipated changes in house prices.

[32] Our results reveal that at least some cohorts respond to changes in house prices, thus providing evidence against the behavioral life-cycle model that states that housing wealth is not fungible.

[33] The difference with regard to the "conventional" wealth effect lies in the functioning of wealth. Whereas in the conventional life-cycle model with old-age provision motive wealth is used to smooth consumption over the lifetime, in the life-cycle model capturing the precautionary savings motive, housing wealth is held for emergency cases only.

6.3 Liquidity Constraints and Asymmetric Behavior

In order to rule out the existence of liquidity constraints as explanation for the correlation of house prices and saving behavior, in this section we explore the "constraints explanation" in more detail. According to the "constraints hypothesis", house prices and consumption respectively saving behavior are correlated because house price increases generate additional housing equity which can be used for additional borrowing. It is likely that young homeowners are more affected by liquidity shortages since they still have to bear interest and mortgage payments, whereas old homeowners are likely to already have paid off their credit burdens. Therefore, we run the basic regression for a split sample, namely for low and high liquid households separately, so that we are able to separate the savings responses of households that are less and more likely to be affected by credit constraints. Following (Browning et al., 2013), households with a low level of liquid assets are defined as households with tangible asset holdings less than 1.5 months of disposable income. Accordingly, high liquid asset households are defined as those with equal or more than 1.5 months of disposable income. Estimation results are presented in Table 7 and suggest that only low liquid asset households are significantly sensitive to house price innovations. The sign and the magnitude of the parameter estimates for low liquid households remain unchanged compared to those of the basic regression for the full sample. All parameter estimates for high liquid asset households are insignificant. This result provides support for the lifting of credit constraints.

Table 7: The role of liquidity constraints

	(1)	(2)
	Δs_{it}, low liquidity	Δs_{it}, high liquidity
$E(\hat{\Delta}p_{it})$	0.00301	0.00171
	(0.00234)	(0.00435)
$E(\hat{\Delta}p_{it}), old$	-0.00563*	-0.00162
	(0.00296)	(0.00512)
$E(\hat{\Delta}p_{it}), ho$	-0.00506	0.00173
	(0.00428)	(0.00819)
$E(\hat{\Delta}p_{it}), old, ho$	0.00529	-0.00225
	(0.00497)	(0.00908)
$\theta_{it}^{\hat{p}}$	0.00436**	0.00195
	(0.00185)	(0.00368)
$\theta_{it}^{\hat{p}}, old$	-0.00494**	0.000942
	(0.00215)	(0.00436)
$\theta_{it}^{\hat{p}}, ho$	-0.00746**	0.00634
	(0.00329)	(0.00647)
$\theta_{it}^{\hat{p}}, old, ho$	0.00751**	-0.00909
	(0.00363)	(0.00727)
N	52305	12514

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The models are that of the basic regression. In column (1), the basic regression is estimated for low liquid asset households and in (2) for high liquid asset households. A low level of liquid assets is defined as having tangible asset holdings less than 1.5 months of disposable income. High liquid asset households are defined as those with equal or more than 1.5 months of disposable income. Standard errors in parentheses. GSOEP, own calculations.

Table 8: The role of asymmetric effects

	(1)	(2)	(3)
	Δs_{it}	Δs_{it}	Δs_{it}
$\hat{\theta^p_{it}}$	0.00105	0.00277	0.00497**
	(0.000909)	(0.00206)	(0.00241)
$\hat{D\theta^p_{it,loss}}$	0.0143*	0.0647***	0.0221
	(0.00822)	(0.0205)	(0.0213)
$D_{negativeequity}$		-0.0309	
		(0.0582)	
$\hat{\theta^p_{it}}$ x $D_{negativeequity}$		0.0137*	
		(0.00824)	
$\hat{D\theta^p_{it,loss}}$ x $D_{negativeequity}$		-0.0415	
		(0.0993)	
$\hat{\theta^p_{it}}, old$			-0.00540*
			(0.00290)
$\hat{\theta^p_{it}}, ho$			-0.00859**
			(0.00419)
$\hat{\theta^p_{it}}, old, ho$			0.0105**
			(0.00474)
$\hat{D\theta^p_{it,loss}}, old$			-0.0175
			(0.0275)
$\hat{D\theta^p_{it,loss}}, ho$			-0.0227
			(0.0437)
$\hat{D\theta^p_{it,loss}}, old, ho$			0.0395
			(0.0494)
N	57153	12109	57153

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. The three regressions investigate the asymmetric behavior between unexpected house price gains and losses. Unlike the regressions before, the parameter estimates of the anticipated house price shocks and its interactions are not reported here. Specification (1) is our basic regression described in Section 4 without interactions of the price and income parameters with age and homeownership status respectively. It includes a dummy which is one if the house price shock is negative. Specification (2) additionally controls for negative equity by including a dummy which is one for households that have negative net wealth and its interaction with the unexpected house price gains and losses. Specification (3) abstracts from controlling for negative equity. Instead, it interacts surprise gains and losses with age and homeownership status. Standard errors in parentheses. GSOEP, own calculations.

In the presence of liquidity and borrowing constraints, savings may respond asymmetrically to changes in hous-

ing wealth depending on the household's current level of savings. For this reason, we investigate asymmetries in saving responses to house price gains and losses. Estimation results are presented in Table 8. Specification (1) is our basic regression without interactions of the price and income parameters with age and homeownership status respectively, but including a dummy which is one in the case of negative house price shocks. We find evidence for an asymmetric response to unexpected house price gains and losses: The estimated coefficient of an unexpected house price loss is substantially larger than that of a gain. However, only the parameter estimate of a house price loss is statistically significant on the 10 percent level. The result of a stronger and significant response to negative price shocks remains unchanged when we additionally control for negative equity (specification (2)). Specification (3) abstracts from controlling for negative equity. Instead, it interacts windfall gains and losses with age and homeownership status. Again, all the estimated coefficients in response to surprise losses are larger than those of surprise gains. But given that only the estimated coefficients on surprise gains are significant, we are tempted to conclude that asymmetric behavior and hence credit constraints at least are not the main driver of our results.

7 Conclusion

Demographic shrinkage in tandem with re-urbanization tendencies lead to regional divergent house price developments in Germany. Given that housing wealth and savings are two essential factors of an economy which are highly linked with economic growth, it is particularly important to examine household-specific responses in saving behavior to changes in housing costs. For this reason, we investigate the empirical relationship between housing wealth and saving behavior in Germany. As the augmented life-cycle theory suggests that households should only respond to unexpected changes in both wealth and income, we divide house price and income changes into an anticipated and an unanticipated component respectively. Therefore, we use external regional house price data as instrument for changes in property prices controlling for additional exogenous determinants influencing the house price and income expectation formation. Using the resulting estimates, we regress changes in household savings on expected and unexpected changes in house prices. Hereby, we allow for heterogeneity in savings behavior across age cohorts and between home-owning and renting households.

We find that households solely respond to unanticipated house price innovations as suggested by the life-cycle hypothesis. Responses to expected house price changes are empirically insignificant. We conclude that highly persistent dynamics at the money market, mortgage interest rates, and regional demographic developments, which are used to estimate household's expectations of house prices, are fully anticipated and that households have already adjusted their saving patterns accordingly. This might also explain the strikingly small effects in household's saving responses to unanticipated house price shocks. As far as the effects of unexpected house price changes are concerned, we find significant heterogeneity in the savings responses across the considered subgroups: Young homeowners decrease and young renters increase their savings, thus providing evidence in favor of a housing wealth effect in Germany. The responses are in line with either the conventional life-cycle model with old-age

provision motive or the precautionary savings model. Old households only hardly respond to house price changes which is still consistent with the precautionary savings model, especially if precautionary savings become less important over the life-cycle as recently found by (Le Blanc et al., 2014). Moreover, controlling for household's subjective perception of changes in property values, we find no systematic distortion depending on socio-economic characteristics. Thus, we can rule out subjective perception of changing housing wealth as the driver of our results. This is important as in Germany, housing is traditionally rather seen as consumption than as investment good. As we can rule out competing explanations such as credit constraints as main driver of our results too, we conclude that the wealth effect is likely at play in Germany, although relatively low at magnitude. This has important implications not only for public policy but also with regard to the wealth distribution and inequality.

Due to the structural change at the labor market we observe a clear trend, in particular for young households, towards urban areas and the big cities, where house prices are high and steadily increasing. As homeownership rates in urban areas are strikingly low, the majority of households living in urban areas are young renters. In case of unanticipated positive house price shocks, they will increase their savings or decrease their consumption respectively, due to a surge in housing costs. This might have a bearing on the overall growth rate on condition that the effect exceeds the decrease in savings of homeowners. Hereby, it would be interesting to aggregate the microeconomic effects in the savings rate of homeowners and renters in order to get the magnitudes of the aggregated effects on savings which could be done as an expansion of our study. Moreover, unexpected house price shocks are likely to increase wealth inequality: Whereas homeowners experience a gain in their housing wealth, renters loose. As current migration patterns and demographic developments raise the expectation for more and more renters in the big cities, the wealth gap is expected to increase in case of positive house price shocks. In order to counteract these developments, the public could foster homeownership especially for young households in urban areas, for example by using tax policy and providing subsidies for the construction of new dwellings. As we expect house prices in urban areas to continue to rise, newly build housing equity could also serve as additional retirement coverage for young households.

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8 Appendix

8.1 Figures and Tables

Table A4: Basic Regression - Estimated coefficients of income changes

	(1)
	Δs_{it}
$E(\hat{\Delta} y_{it})$	0.87778***
	(0.03902)
$E(\hat{\Delta} y_{it}), old$	0.01082
	(0.05839)
$E(\hat{\Delta} y_{it}), ho$	0.00722
	(0.08311)
$E(\hat{\Delta} y_{it}), old, ho$	-0.10864
	(0.09951)
$\hat{\theta_{it}^{y}}$	0.94297***
	(0.03468)
$\hat{\theta_{it}^{y}}, old$	-0.04890
	(0.05564)
$\hat{\theta_{it}^{y}}, ho$	0.05340
	(0.08482)
$\hat{\theta_{it}^{y}}, old, ho$	-0.14245
	(0.09857)
N	57153

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Basic regression, same specification as in Table 6. Standard errors in parentheses. GSOEP, own calculations.

8.2 Robustness Checks

In order to check the robustness of our empirical results, we changed the specification of our basic regression in a number of ways. None of these give significantly different results. The results are reported in Table A5. First, we perform sensitivity tests with regard to alternative age splits. In our basic regression, the sample is split at an age of 40 years. In columns (1) and (2) of Table A5 we split the sample at an age of 45 as in (Disney et al., 2010) and 50 years respectively. Apart from the fact that some of the estimated coefficients are no longer significant at least on the 10 percent level, the results do not change at all.

Second, following (Browning et al., 2013), in columns (3) and (4), we restrict the sample to homeowners and renters respectively. Again, the parameter estimates become insignificant but we do not get significantly different results. The only deviation from our main estimation results is that old homeowners now do react in response to

Table A1: List of metropolitan areas

Value label since 1996	Name
1, 102	Schleswig-Holstein Nord
3, 101	Schleswig-Holstein Mitte
4, 103	Schleswig-Holstein Ost
6, 201	Hamburg
7, 1304	Westmecklenburg
8, 1302	Mittleres Mecklenburg/Rostock
11, 401	Bremen
12, 312	Ost-Friesland
13, 303	Bremerhaven
16, 310	Oldenburg
18, 311	Osnabrueck
22, 301	Braunschweig
27, 1203	Oderland-Spree
28, 1202	Lausitz-Spreewald
29, 1201	Havelland-Flaeming
30, 1101	Berlin
32, 1504	Magdeburg
34, 1503	Halle/Saale
35, 511	Muenster
36, 503	Bielefeld
39, 506	Dortmund
40, 509	Emscher-Lippe
41, 507	Duisburg/Essen
42, 508	Duesseldorf
43, 504	Bochum/ Hagen
44, 510	Koeln
46, 505	Bonn
48, 602	Nordhessen
51, 604	Rhein-Main
52, 605	Starkenburg
54, 1601	Mittelthueringen
55, 1604	Suedthueringen
56, 1603	Ostthueringen
57, 1404	Westsachsen
58, 1401	Oberes Elbtal/ Osterzgebirge
60, 1403	Suedsachsen
62, 701	Mittelrhein-Westerwald
63, 704	Trier
64, 702	Rheinhessen-Nahe
65, 705	Westpfalz
66, 703	Rheinpfalz
68, 812	Unterer Neckar
69, 803	Heilbronn-Franken
70, 805	Mittlerer Oberrhein
71, 807	Nordschwarzwald
72, 810	Stuttgart
74, 904	Donau-Iller
77, 811	Suedlicher Oberrhein
80, 903	Bayerischer Untermain
81, 918	Wuerzburg
82, 909	Main-Rhoen
83, 912	Oberfranken-West
84, 911	Oberfranken-Ost
86, 906	Industrieregion Mittelfranken
88, 902	Augsburg
89, 907	Ingolstadt
90, 915	Regensburg
91, 905	Donau-Wald
92, 908	Landshut
93, 910	Muenchen
95, 901	Allgaeu
97, 916	Suedostoberbayern

Table A2: Variables: House Price Process

Variable	Definition	Source
House Prices 1*	Regional house price index based on own-occupied dwelling houses (€ per sq m)	BulwienGesa AG
Household Number*	Total number of households	German Federal Institute for Research on Building, Urban Affair and Spatial Development
Gross Domestic Product*	Real GDP (€ per capita)	Regional database at the National Statistical Office
Mortgage interest rate*	10-year nominal mortgage rate	Banking data statistics German Bundesbank
House Prices 2**	Regional house price index based on single-family houses (€ per sq m)	German Federal Institute for Research on Building, Urban Affair and Spatial Development

*) N=62, T=18. Period: 1995-2012. **) N=412, T=7. Period: 2004-2011.

Table A3: Summary statistics on net (housing) wealth

	2002	2007	2012
Net housing wealth			
% of households with positive net housing wealth	50.4	50.82	64.75
Mean	97791.56	96344.83	101164.5
Total	1.55E+09	1.40E+09	1.25E+09
% of total net wealth	61.79	62.21	62.51
Net non housing wealth			
% of households with positive net non-housing wealth	75.49	75.93	88.6
Mean	50322.45	56074.93	51994.65
Total	9.56E+08	8.53E+08	7.51E+08
% of total net wealth	38.21	37.79	37.49
Total net wealth			
% of households with positive total net wealth	81.07	81.62	94.46
Mean	148114	152419.8	153159.1
Total	2.50E+09	2.26E+09	2.00E+09

Source: GSOEP, own calculations.

unanticipated house price increases: They also decrease their savings but by half the amount young homeowners do.

Finally, we change the dependent variable and regress an imputed expenditure measure[34] on anticipated and unanticipated house price changes (column (5)). The sign of the parameter estimates changes in almost all cases with the exception of that for old renters. Old renters slightly increase their consumption. But the other results are not affected at all.

Table A5: Robustness checks

	(1)	(2)	(3)	(4)	(5)
	Δs_{it}, 45 years	Δs_{it}, 50 years	Δs_{it}, HO	Δs_{it}, Rent	Δc_{it}
$E(\hat{\Delta p}_{it})$	0.00103	-0.000347	-0.000908	0.00227	-0.0000237
	(0.00208)	(0.00201)	(0.00289)	(0.00251)	(0.000369)
$E(\hat{\Delta p}_{it}), old$	-0.00399	-0.00217	-0.00223	-0.00418	0.000606
	(0.00271)	(0.00277)	(0.00310)	(0.00307)	(0.000450)
$E(\hat{\Delta p}_{it}), ho$	-0.00405	-0.00431			0.0000308
	(0.00336)	(0.00321)			(0.000768)
$E(\hat{\Delta p}_{it}), old, ho$	0.00522	0.00674*			-0.000532
	(0.00399)	(0.00382)			(0.000828)
$\theta_{it}^{\hat{p}}$	0.00160	0.000395	-0.000836	0.00220	-0.000205
	(0.00163)	(0.00150)	(0.00226)	(0.00175)	(0.000289)
$\theta_{it}^{\hat{p}}, old$	-0.00158	0.000457	0.000493	-0.00237	0.000337
	(0.00204)	(0.00205)	(0.00235)	(0.00195)	(0.000358)
$\theta_{it}^{\hat{p}}, ho$	-0.00463*	-0.00452**			0.000384
	(0.00260)	(0.00228)			(0.000622)
$\theta_{it}^{\hat{p}}, old, ho$	0.00499	0.00560*			-0.000571
	(0.00315)	(0.00293)			(0.000708)
N	57153	57153	29632	27521	107120

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Model (1) and model (2) perform a robustness check with regard to alternative age splits. (1) splits the sample at an age of 45 years and (2) splits the sample at an age of 50 years. Regressions (3) and (4) restrict the sample to homeowners and renters, respectively. In column (5), we regress expected and unexpected house price changes on an imputed value of total expenditure. Standard errors in parentheses. GSOEP, own calculations.

[34] Based on (Browning et al., 2013), total household expenditure in a year is calculated as the difference of total disposable (net) income and savings in that year. Both figures are deflated to 2006 EURO using the CPI. The dependent variable in specification (5) is the first difference of the logarithmic imputed expenditure measure.

Table A6: Basic Regression with 3 age categories

	(1)
	Δs_{it}
$\hat{\theta^p_{it}}, young, R$	0.00313*
	(0.00180)
$\hat{\theta^p_{it}}, middle, R$	-0.00413*
	(0.00238)
$\hat{\theta^p_{it}}, old, R$	-0.00348
	(0.00241)
$\hat{\theta^p_{it}}, young, HO$	-0.00654**
	(0.00322)
$\hat{\theta^p_{it}}, middle, HO$	0.00716*
	(0.00386)
$\hat{\theta^p_{it}}, old, HO$	0.00774*
	(0.00406)
N	57153

Notes: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Basic regression, same specification as in Table 6, except that we differentiate between 3 age groups. "Young": household head aged <= 40 years, "middle": household head aged >40 and <= 60 years, "old": household head aged >65 years. Standard errors in parentheses. GSOEP, own calculations.