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Niklas Gohl (DIW Berlin and University of Potsdam)
Peter Haan (DIW Berlin, FU Berlin and Netspar)
Claus Michelsen (DIW Berlin and Leuphana University Lueneburg)
Felix Weinhardt (European University Viadrina and DIW Berlin)

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Spokesperson: Prof. Georg Weizsäcker, Ph.D., Humboldt University Berlin, 10117 Berlin, Germany
info@rationality-and-competition.de

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Niklas Gohl[†], Peter Haan[‡], Claus Michelsen[§] and Felix Weinhardt[¶]

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Abstract

This study examines short-, medium-, and long-run price expectations in housing markets. We derive and test six hypothesis about the incidence, formation, and relevance of price expectations. To do so, we use data from a tailored household survey, past sale and rental offerings, satellites, and from an information RCT. As novel findings, we show that price expectations exhibit mean reversion in the long-run. Moreover, we do not find evidence for biases related to individual housing tenure decisions or regret aversion. Confirming existing findings, we show that local market characteristics matter for expectations throughout, as well as aggregate price information. Lastly, we corroborate existing evidence that expectations are relevant for portfolio choice.

Keywords: housing markets, price expectations

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[†]DIW Berlin, University of Potsdam, ngohl@diw.de

[‡]DIW Berlin, FU Berlin, Netspar, phaan@diw.de

[§]DIW Berlin, Leuphana University Lueneburg, cmichelsen@diw.de

[¶]European University Viadrina, DIW Berlin, CESifo, IZA, CEP/LSE, weinhardt@europa-uni.de

1 Introduction

The behavior of housing markets has macroeconomic consequences. The sector itself constitutes a sizeable share of GDP. Moreover, movements in house prices also have non-negligible spillovers into other markets, e.g. on business investment or private consumption, but also to the banking sector (see i.e. Iacoviello and Neri (2010); Duca et al. (2021)). The housing market also has direct effects on the micro level. From the individual perspective, housing decisions are the most important financial decisions in the lives of most people. As a result, understanding determinants of tenure decisions and housing markets generally has long been in the focus of both micro- and macro- economists. For example it is well understood that housing markets are characterized by short-run momentum (Case and Shiller, 1989) and long-run mean reversion (Glaeser and Gyourko, 2006). However, in contrast to the evidence about observed house market prices, the evidence about the incidence and formation of price expectations is scare and speaks to the short or medium run, see e.g. Armona et al. (2019) or Kindermann et al. (2021). Armona et al. (2019) document momentum-effects in price expectations for periods up to five years. While five years is a long period to form expectations over, in terms of housing cycles, five years is rather short. Therefore, it is also important to understand long run price expectations.

This paper systematically examines the incidence, formation, and relevance of price expectations over a period that captures a full housing cycle. Specifically, we study price expectations over comprehensive periods relevant for housing markets: in the short-run (2 years), medium-run (10 years), and the long-run (30 years). In the next section, we derive six hypothesis regarding: (1) mean reversion, (2) individual characteristics such as financial literacy, (3) tenure decisions, (4) local housing markets, (5) aggregate information, and (6) the relevance of expectations for portfolio choice, which we the empirically test in the data. The key finding of the paper is that while different factors matter for price expectations over different time dimensions (discussed in detail below), there is clear evidence for mean reversion in the long-run. Thus, we show that there is no tension between price expectations

and market cyclicality.

At the heart of our analysis is the design and inclusion of specific and novel housing-related questions in a representative household panel survey, the Innovation Sample of the German Socio Economic Panel (SOEP IS). We elicit beliefs and preferences, alongside a rich set of individual and household characteristics, including detailed information about current tenure and past tenure decisions. Specifically, in the survey, we ask representative households about their expectations about the development of house prices in their current neighborhood over a horizon of 2, 10, and 30 years, respectively. Besides these novel questions, respondents also complete the SOEP-core questions, meaning that we have access to an unusually large set of individual- and household-level background characteristics that might affect the formation of price expectations, including measures of educational background and financial literacy. For our analysis, we augment the survey-information further and merge with a number of additional data sets: local data on housing prices, as well as satellite data and remotely sensed terrain data to construct an index of housing supply in the spirit of Saiz (2010). These additional data allow us to study how price expectations correlate with local housing market characteristics. Finally, we conduct a randomized information treatment in which one part of the respondents is given information about historical housing price developments. We use this setup to study causal effects of information provision on expectations and on a hypothetical portfolio choice outcome.

Our first important finding is that there exists strong evidence for mean reversion of price expectations in the long-run. For short time-horizons, our results confirm the existing empirical literature on momentum-effects. However, for the horizon of thirty years individuals do not expect a long run increase in house prices. Notably, these expectations can be reconciled with mean reversion in markets Glaeser and Gyourko (2006) and the historical incidence of cycles: Bracke (2013) shows that housing cycles have become longer over time, with the last global cycle lasting for about twenty years. Our further findings show that individual characteristics have a modest effects on expectations. This holds for the short run, the medium run,

and the long run. Females are more conservative and the well-educated have slightly lower expectations for the short run but higher expectations in the longer term. We refute our third hypothesis related historical decisions and regret aversion: we find that the own tenure status does not correlate with expectations. On the other hand, consistent with Kindermann et al. (2021), our results show that renters who have experienced a recent rental rise have higher price expectations. Examining the role of local markets, we find that local price trends have very strong predictive power for local expectations in the short term. Over the long term, land supply, as stipulated by housing market theories, plays a key role in predicting expectations. However, in line with recent empirical literature, our findings also document that individuals factor in more aggregate, distant information, such as past aggregate OECD-level trends, when forming expectations. This fifth hypothesis is tested using an information RCT that presents data on past (averaged) price developments of OECD countries. Finally, we show that this information RCT also shows effects on a portfolio choice question.

This paper is related to a new and quickly growing literature that examines how price expectations are formed in the housing market and if these affect individual behavior. In particular, Kuchler and Zafar (2019) show that individuals use regional price trends to form expectations about future prices at the national level. In a different context, Bailey et al. (2018) show that housing decisions of distant friends on Facebook have effects on local behavior. Niu and van Soest (2014) show that medium run expectations are positively related to past house price developments and perceived economic conditions. Kindermann et al. (2021), focusing on short term price expectations in Germany, find that renters have higher and more accurate price expectations. In a quantitative model, they explain the difference and show that renters are relatively well informed about house prices. Most closely related to this study, Armona et al. (2019) study how local market conditions and information affect the formation of price expectations. They find that local markets have strong effects on individual's expectations in the short- and medium-run, without any evidence for mean reversion. Moreover, they show that information about markets affects expectations and stated invest-

ment decisions. So far, most studies consider price expectations in the short- or medium-run. For example, Armona et al. (2019) find evidence for momentum-effects over one-year periods, with no evidence for mean-reversion for periods of up to five years. While five years is a long period to form expectations over, in terms of housing cycles, five years might not be long enough.[1] Whether evidence for psychological driven volatility or momentum-effects (Shiller, 2015, e.g.) persists in price expectations also over longer time-horizons is an open question. Moreover, there exists no evidence how individual characteristics, such as education, numeracy, or tenure type, or local housing market characteristics affect the price expectations over such a longer horizons. This study starts filling this gap.

The paper is structured as follows: the next section describes the hypotheses tested in this study in more detail. Section 3 gives a brief overview of the German housing market and introduces the data sets used in the paper. Section 4 describes the empirical setting of our study. In section 5 and 5.2 we present our results and robustness checks, respectively. Lastly, section 6 concludes.

2 Formation of expectations: derivation of hypothesis

First hypothesis: Mean reversion in the long run The existing literature (Armona et al., 2019) finds evidence for momentum-effects for price expectations in the short-run (i.e. after one-year) with no evidence for mean-reversion for periods of up to five years (medium-run). However, there is ample evidence that housing cycles exist and that markets show mean-reversion over longer periods, i.e. (Wheaton, 1999; Glaeser and Gyourko, 2006). Given the duration of the most recent cycles (Bracke, 2013), we do not necessarily expect to see evidence for mean reversion over ten years -but certainly over the thirty-year period momentum-effects should not dominate. Therefore we hypothesize that we will find evidence for mean reversion in long-run expectations.

[1] Forming expectations over such a long period is not problematic *per se*: answering to a very similar question on wages individuals are able to form accurate expectations over thirty years.

Second hypothesis: The role of individual characteristics Individual characteristics can influence expectations in the short-, medium-, and long-run. A large literature documents gender-differences in willingness to take financial risks (Charness and Gneezy, 2012; Almenberg and Dreber, 2015, e.g.). Applied to the formation of expectations, we hypothesize that males are more likely to hold large and positive price expectations, see e.g. Breunig et al. (2021). A second individual factor that may influence the formation of expectations is the level of education. More highly educated individuals should be better in processing information for the formation of price expectations. Behavioral biases, such as not compounding interests and financial illiteracy, are shown to diminish with better education, see e.g. Lusardi (2008). We test this hypothesis using educational information (the highest educational degree obtained) and information about the financial literacy and self-assessed numeracy of the individual.

Third hypothesis: The role of housing and tenure The own housing and the tenure situation may affect the expectations of prices. In particular, owner-occupiers could be more optimistic compared to renters - simply because they partly select into the respective housing tenure based on their expectations. Equally, reference point theory would suggest that past decisions could have additional influences on the formation of expectation: Individuals who have purchased a home (owner-occupiers) might not downward-adjust expectations to rationalize past decisions ex-post, see e.g. Lamorgese and Pellegrino (2019); Genovese and Mayer (1997). More generally due to an "endowment effect," (List, 2011) homeowners might attach a greater value to their home, see e.g. Goodman et al. (1992); Chan et al. (2016); Bao and Gong (2016). Similarly, homeowners who decide against selling at times of relatively high housing prices might experience regret aversion and, consequently, would rather not consider selling their house, see e.g. Seiler et al. (2008). On the other hand, individuals who decided against buying might be reluctant to enter the market at higher prices, to avoid the feeling of regret of not having bought earlier at lower prices. For renters, having experienced rental rises might lead to higher expectations. In sum, selection into owner-occupation as well as

behavioral biases (endowment effects, regret aversion) would suggest that owner-occupiers should hold more positive price expectations compared to renters. Expectations of renters, on the other hand, could be affected by recent rental rises. This, in turn, could lead to higher price expectations of renters (Kindermann et al., 2021).

Fourth hypothesis: The role of local housing markets We explore the hypothesis that local housing markets matter for the formation of expectations in the short-, medium-, and long-run by testing the effect of past local prices trends and the effect of local housing supply on expectations. The hypothesis is motivated by previous literature, as studies show that past local prices trends to positively affect price expectations for periods of up to five years; see e.g. Case et al. (2012); Niu and van Soest (2014); Armona et al. (2019). In addition, the elasticity of land is shown to play a key role for long-run housing supply and house price developments (Saiz, 2010). In theory, more available land for residential development should dampen future price increases. This could also be the case when examining price expectations, in particular for the long-run.

Fifth hypothesis: The role of aggregate information The literature highlights that information, such as housing decisions of distant friends on Facebook, affects local behavior; see e.g. Bailey et al. (2018). Further, Kuchler and Zafar (2019) show that local price trends significantly shape national, aggregate house price expectations. We hypothesize that information on past aggregate house price development affects expectations. Specifically, we test if information on residential real estate prices in 14 different countries, including Germany and the United States, that on average approximately quadrupled since 1945, has a positive effect on individual house price expectations. We test this using an RCT, which we describe further in Section 3.

Sixth hypothesis: The relevance of expectations for investment decisions In the final hypothesis, we move beyond the formation of expectations and directly test if expecta-

tions about house prices affect planned investment. To provide a causal answer to this question, we estimate if information on past aggregate house price developments (see hypothesis five), which we provide using an RCT, affects stated investment decisions of individuals.

3 Institutional Background and Data

3.1 The German Housing Market

In comparison to most OECD countries, the German housing market has a relatively low share of homeownership, with owner-occupied dwellings accounting for less than half of all occupation forms (Voigtlaender, 2010). In rural and suburban areas, especially in eastern Germany, the housing market is relatively stable. In contrast, in urban agglomerations and student cities, severe housing shortages dominate the local housing markets, ultimately putting upward pressure on housing prices in these areas (Kholodilin et al., 2016). However, even within big cities, substantial variations in local housing markets exist (BMF, 2017, .5). The regional differences in the German housing market are, in turn, reflected in rent and house price developments. Particularly, since 2007/2008, housing prices have strongly increased in popular urban areas, including the Big Seven cities[2] but stagnated or only increased marginally in many rural areas. The German context hence offers rich variation, making it a relevant setting for the study of the formation of price expectations.

3.2 Data

3.2.1 The German Socioeconomic Panel Innovation Sample

SOEP-IS For the analysis, we use a range of different data sets. The main data set is the German Socioeconomic Panel's innovation sample (SOEP IS). The SOEP IS an annual representative survey providing information on a large set of socioeconomic and demographic

[2]Berlin, Hamburg, Munich, Cologne, Duesseldorf, Frankfurt am Main, and Stuttgart

variables and specific survey modules, see Richter and Schupp (2015) and Goebel et al. (2019). As part of the SOEP IS waves in 2016-2018, we were able to design a specific module of questions to elicit price expectations of households. For this analysis, the questions on the short-, medium-, and long-term formation of house price expectations of individuals are of central interest. In all waves, we ask for expectations of local housing prices over a two and thirty year horizon. More precisely, individuals were asked the following question:

The following section focuses on your expectations of house price developments in your area. In your opinion: How will house prices develop in comparison to today?

Participants then had the option to state whether prices will fall, rise, remain the same or not answering at all. Depending on their answer individuals were asked *By how much - in percent- do you think prices will fall/rise.* For the 2017 wave, we additionally asked for expectations over a ten year horizon. Crucially, the survey is regionally representative, sampling individuals from a total of 183 postal codes covering 75 out of 90 residential postal code regions in Germany (see Figure A.3).

In addition, the SOEP IS data provides a wide range of socioeconomic variables. For example, individuals were asked to assess their own math skills as rather proficient or rather bad. Further, individuals received several questions testing their financial literacy. Based on the answer, we construct a measure of financial literacy; see Grohmann et al. (2019).[3]

[3]More precisely, individuals were asked the following three questions:

1. Assume the interest of your savings account is 1% per year and the inflation rate is 2% per year. What do you think: One year from now, could you buy the same, more, or less than today with the credit at your savings account (Answer options: More, less, the same, I do not know).
2. Assume that you have a 100 euros deposit in your savings account. This credit bears interest at 2% per year and you leave it on this account for 5 years. How much credit will your savings account have after 5 years? (Answer options: More than a 102 euros, less than a 102 euros, Exactly a 102 euros, I do not know)
3. Is the following statement correct or wrong? The investment into shares of one company is less risky than into an equity fund.

3.2.2 RCT on past aggreagate price trends

To test the importance of aggregate house price information, we designed a randomized controlled information trial that we could implement within the SOEP IS household survey. As part of the RCT, we provide randomly selected survey participants with background information on past aggregate housing price developments, see Figure A.1. Additionally, the treatment group received the information that the graph depicts the development of average prices in residential real estate in 14 different countries, including Germany and the United States, and that prices on average approximately quadrupled since 1945. In the 2018 wave of the SOEP IS, we repeated the RCT for the same individuals.

In the 2018 wave, individuals were additionally asked to allocate assets between different investment options. More precisely, participants were asked the following:

Suppose you have some spare money and have decided to invest this money. How would you in per cent allocate your money between the following investment options? The given options were stocks, real estate, state bonds, savings account, and gold.

3.2.3 Postal code, house price and land supply data

We use three additional data sets to obtain information on regional demographics and housing markets. First, we use the *Empirica* housing data bank for the years 2012 to 2016 (pre-period) to derive postal code specific hedonic regional house price trends. The *empirica ag* databank contains all listings and deals from 2012 to 2016 conducted through Germany's largest online real estate platforms such as *Immoscout* and *immowelt/immonet*, newspapers and local online platforms. In total, the data bank provides 484,604 observations for rental and non-rental properties over the given time period. Table A.1 provides summary statistics of the observed transaction prices. In addition, the data base offers a wide range of background information on the listed properties such as the dwelling's size, age, state, room number and equipment . We use this information to construct hedonic, quality-adjusted average annual

house price trends for each postal code over the 2012-2016 period[4]. The quality-adjusted trends are one indicator that we employ to assess how local housing markets impact housing expectations.

As a second indicator, we construct a postal code specific developable land index that serves as a proxy for local housing supply elasticity. For this, we use Corine Land Cover 2018 data to identify land that is potentially developable. The Corine Land Cover data is based on 100m resolution satellite data that, via remote sensing, provides the basis for over 37 land cover and land use categories, such as *Sports and Leisure Facilities* or *wetlands*. Using this information, we construct an index of developable land supply for Germany similar to Saiz (2010).[5] As an example, Figure 1 depicts the index as constructed for Berlin and surroundings. The pink areas show land that is potentially developable. As expected, more land is developable in the rural areas surrounding Berlin, whereas within the city itself developable land is relatively scarce. Lastly, in order to control for postal code specific characteristics, such as population density, we use Census data.[6]

4 Empirical Approach

The empirical approach follows directly from the hypotheses presented in Section 2. The first set of results that we use to test the first hypothesis is descriptive in nature and we take great care in establishing representativeness of our respondents.

In order to test the relation between house price expectations and the impact of individual characteristics, housing/tenure, information, as well as local housing markets, respectively, we adopt the empirical framework described in Equation 1. Y_i are the two, ten, and thirty

[4]Figure A.3 in the Appendix depicts the hedonic price trends for each postal code region in Germany.

[5]We abstract from zoning decisions due to a lack of data, but see these as potentially malleable in the long run anyway. Accordingly, we classified as developable all categories that could be used for supply, in principle: Non-irrigated arable land; Vineyards; Fruit trees and berry plantations; Pastures; Complex cultivation patterns; Land principally occupied by agriculture, with significant areas of natural vegetation; Agro-forestry areas; Broad-leaved forest; Coniferous forest; Mixed forest; Natural grasslands; Moors and heathland; Transitional woodland-shrub; Beaches, dunes, sands; Bare rocks; Sparsely vegetated areas.

[6]Note that the last Census was conducted in 2011. Data on population size is available.

year expectation outcomes, respectively. Depending on the hypothesis we seek to test, we separately include sets of different explanatory variables.

First, in order to assess the role of individuals characteristics, we regress the expectation outcomes on C_i, which is a matrix of individual characteristics, like the level of education, gender, as well as variables measuring financial literacy and self-assessed numeracy skills.

Secondly, we regress the expectation outcomes on housing and tenure characteristics contained in H_i, such as the tenure choice and past rental increases.

Thirdly, we test the impact of local housing market experiences and run the regression on measures for the local housing market (i.e. L_i) at the postal code level, such as an average hedonic price trend and the land supply index described above.

Finally, in order to analyze the role of information, we regress the expectation outcomes on a variable indicating whether the individual received the information treatment, I_i. Here, we naturally restrict our sample to the years in which the RCT was conducted, i.e. 2017 and 2018. In addition, we use a portfolio choice question asked in 2018 as another outcome variable to complement the analysis and to test if expectations have an effect on behavior.

$$Y_i = \beta_0 + C_i'\beta_1 + H_i'\beta_2 + \beta_3 I_i + L_i'\beta_4 + \beta_5 + \sum_{y}^{Y} \eta_y + \sum_{r}^{R} \theta_r + u_i \tag{1}$$

Depending on the specification, we control for the year of the survey by including year fixed effects, η_y. Further, in order to control for potential unobserved regional variation in expectations and housing markets, we include commuting zone fixed effects, i.e. θ_r. Commuting zones are based on the so called *Raumordnungsregionen* provided by the German government. In total there are 96 of these regions across Germany. Crucially, the commuting zones are larger than postal codes in Germany, which, in turn, allows us to exploit the within commuting zone variation whilst controlling for time-invariant unobservables at the commuting zone level. This is crucial since there might be unobservable characteristics that simultaneously are correlated to price expectations and local housing market performance. Further, we control for a range of individual and postal code covariates contained in X. More

precisely, when appropriate, we control for the information treatment half of the participants in the 2017 and 2018 samples received. In addition we control for age, personal income, and the postal code log population density.

5 Results

5.1 Main Results

Price expectations and mean reversion in the long run (H1) Table 1 provides summary statistics for house price expectations in two, ten, and thirty years. As previously described, expectations over ten years were only part of the survey in 2017. Thus, observation numbers are smaller by construction for this outcome. For the two and thirty year outcomes, it is important to note that more individuals (2687 vs. 2079) answered the question over the shorter time frame than over the long horizon. In order to ensure that there is no systematic difference in the expectation outcomes stated by those who answered only one question, in addition to the summary statistics for all observations (Panel A), we provide results for survey participants who only answered the questions on two and thirty year expectations (Panel B).

On average individuals expect house prices to increase by just under 10 percentage points in the next two years, which corresponds to an average annual growth rate of just under 5 percentage points. Over a ten year horizon individuals on average expect an increase of more than 16 percentage points. This corresponds to an annual growth rate of approximately 1.6 percentage points. Over a thirty year frame, the survey participants expect prices to increase by only about 30 percentage points with an annual growth rate of about one percent. Crucially, there is no substantial difference between the results of Panels A and B. Thus, we continue our analysis using the answers of all respondents.

Examining the annual growth rates in Table 1, it is immediately clear that the longer the time horizon over which the expectations are given, the lower the corresponding annual

growth rate. Figure A.4 represents this finding graphically and depicts hypothetical linear growth trajectories based on the respective annual growth rates derived from the different time frames over which expectations were collected. Crucially, we assume a constant annual growth to calculate the growth trajectories. For example, based on an annual growth rate of just under five percent derived from the two year time frame, the corresponding 30 year ahead forecast under the assumption of constant annual growth is a 147.35. Asked over a ten year time frame, the 30 year ahead forecast is reduced to less than a third of the answer, i.e. 49.15, and for a time frame of 30 years, we obtain an average forecast of just under 30 percent. The black triangle indicates the actual expectations stated when directly asked about the relevant time frame and, hence, corresponds to the mean values stated in Panel A of Table 1. Most importantly, we see that the growth trajectories become flatter the longer the time horizon over which expectations are elicited. Therefore, the results suggest patterns of mean reversion in the long term house price expectations, a result that is frequently shown empirically for actual house prices, see e.g. Gao et al. (2009), and is consistent with findings of elastic housing supply responses in the long run, see e.g. Green et al. (2005); Saiz (2010); Glaeser et al. (2014).

In Table A.2 in the Appendix, we provide heterogeneous results by different characteristics such as gender, education, and tenure type. Most importantly, patterns of mean reversion hold across all types.

The role of individual characteristics (H2) Table 2 depicts regressions of the different house price expectation outcomes on a range of individual socioeconomic variables frequently suggested in the literature to be central for the formation of price expectations (see Section 2). More precisely, Table 2 depicts the regression results for the different expectation outcomes on a female dichotomous variable, a college indicator variable, and a numeracy dummy. The numeracy dummy indicates whether individuals would classify their math skills as rather proficient. Further, we include three variables testing financial literacy. Depending on the specification, we include the potential explanatory variables without controls or we include

the full set of control variables and the commuting zone and year fixed effects.

Individuals with a college degree, on average, have significantly lower short-run expectations of about 1.74 percentage points when including the full set of controls. Conversely, women appear to be less optimistic in the medium- to long-run, with significantly lower expectations over the ten and thirty year horizon. The self-assessed numeracy skill is significant over the medium- and long-run. The Financial Literacy indicator, shows a slightly significant point estimate in the short term, indicating that individuals who grasp the concept of compound interest have slightly lower expectations in the short term. The estimate, however, is only significant at the ten percent level. All in all, there is limited evidence that individuals with higher self-assessed math skills, expect higher increases in house prices. Surprisingly, only the financial literacy indicator for the interest rate question is significant at the ten percent level, indicating that individuals who answered the question correctly expect prices to increase less strongly over the 2 year horizon.

Our findings overall are in line with previous findings that document more pessimistic expectations amongst women. Further, they support the hypothesis that, to a limited extent, education, financial literacy, and numeracy play a role in shaping expectations, which is consistent with Kindermann et al. (2021).

The role of housing and tenure (H3) In Table 3, we focus on the effect of housing and tenure features and regress the respective expectation outcomes and whether the monthly rental payment was increased during the last four years. The tenure type, i.e. owning or renting, does not appear to play a role in explaining differences in expectations. The results are at odds with frequently documented endowment effects for different markets, including the housing market. For example, homeowners are shown to over-estimate the value of their homes (see Kahneman et al. (1990), Goodman et al. (1992), Bao and Gong (2016), Chan et al. (2016)). In light of this literature, we would expect a higher expected house price change by homeowners. However, the results in Table 3 show that there does not appear to be a significant difference in homeowners and tenants expectations regardless over which

time frame.

In turn, tenants who experienced a rental increase in the past four years, have higher expectations. However, when including the full set of covariates, only the point estimate for the ten year horizon is statistically significant.

The role of local housing markets (H4) In a next step, we test if local housing market conditions affect future housing price expectations. In Table 4, we regress house price expectation on the measures of local housing market performance described above. The average yearly postal code specific hedonic price trend as well as the postal code specific housing supply index constructed from satellite data are significant in predicting short term expectations when not including control variables. When including controls and fixed effects only, the coefficient of the price trend remains significant at the five percent level. This estimate is in line with findings of Kuchler and Zafar (2019), who, depending on the specification, present estimates for one year ahead expectations of about 0.886, albeit for a regression of local price changes on nationwide house price expectations. When looking at the 10 and 30 year house price expectations, the supply index gains in absolute size and significance, particularly over the long-term horizon of 30 years. In contrast, when including fixed effects and control variables, the price trend point estimate no longer is significantly different from zero. The sizable and significant effect of the supply index is consistent with theories and empirical evidence assuming housing supply to be elastic in the long-run, see e.g. Saiz (2010). In our context, an increase of the land supply index by one percentage point indicates more developable land in the respective postal code and, hence, a more elastic supply response in the housing market. Thus, standard theory would suggest lower house prices as a consequence of a more elastic supply response. This is confirmed by our results. Overall, the results suggest that individuals observe local market conditions and take them into consideration when forming expectations. Particularly, the supply index appears to be relevant for long-run expectations. Past price developments, as indicated by our regression results, in turn, appear to play only a role in the short-run.

The role of information on expectations (H5) In Panel A of Table 5, we report regression results of the expectation outcomes on the randomly assigned information treatment. The treatment showed aggregate and long-run price developments. The results show that individuals in the treatment group, on average, expect stronger price increases in the short- and long-run. However, the coefficients of the treatment variable in the short-run specification are statistically insignificant with p-values above the 10 percent level of significance. The coefficient in the long-run specification, however, is significant at the ten percent level. When including the additional control variables and fixed effects, the point estimate decreases and is no longer significant. Overall, the results suggest that, on average, treated individuals approximately expect higher long-run price changes. Thus, in the long-run aggregate long-run information appears to matter when forming expectations about future house price developments, although not very much. The result confirms findings, see e.g. Bailey et al. (2018), that, in addition to local information, individuals also factor in more distant, aggregate information, such as pooled average OECD, long-run price developments used as an information treatment in our setting. However, such effects do not appear strong enough to counter-act the mean reversion observed in the long-run.

The relevance of expectations for stated decisions (H6) As described in Section 2, we also use the RCT to test the relevance of expectations on a hypothetical portfolio investment question that was asked in 2018. Panel B in Table 5 depicts the regression results for this new outcome.

The key finding is that, on average, individuals who received the information treatment invest relatively more in housing. However, the estimated coefficient is no longer significant when including commuting zone fixed effects, which might be due to the relatively small number of observations and, hence, a low within commuting zone variation. Overall, our findings provide slightly imprecise, albeit causal, evidence that long term expectations can matter for investment decision, thereby confirming findings of Kuchler and Zafar (2019).

5.2 Robustness checks

In the Appendix, we provide robustness checks for all hypothesis tests. First, we repeat our estimations for standard errors clustered at the commuting zone level. Secondly, we seek to shed light on whether the expectation outcomes can be interpreted in nominal or real terms. Our results are robust to clustering decisions as well as to interpretations of questions regarding inflation.

6 Discussion and conclusions

In this paper, we test six sets of hypothesis regarding price expectations over different time horizons. To do this, we develop survey questions to elicit information on how individuals form house price expectations. Specifically, we design questions focusing on the long-run expectations in thirty years, a time horizon that is crucial for investment/tenure decisions and that is not extensively studied in the literature on house price expectations.

As our key finding, the empirical analysis shows that, in the long-run, individual house price expectations show patterns of mean reversion. Further, we show that most tenure decisions are not significantly correlated with future price expectations, whereas individual characteristics, such as gender and education, as well as local housing market experiences, play a key role. A land supply proxy constructed from satellite data is strongly correlated with (long-term) price expectations.

We also replicate a range of empirical findings from the literature, mostly from the US, in the context of Germany. This shows that Germans in the short- to medium-run behave similarly when forming house price expectations. Most importantly, we document short-run momentum effects. All in all, our findings are generally consistent with empirically observed and theoretically formulated models of housing cycles that document short-run momentum effects and long-run mean reversion.

Tables

Table 1: Summary Statistics: House Price Expectations

Expectations	2 years	10 years	30 years
Panel A: All observations			
Mean	9.8232	16.3846	29.8322
Median	10	10	20
25th Percentile	5	10	10
75th Percentile	15	20	40
Annual Growth Rate	4.9116	1.6385	0.9944
N	2687	754	2079
Panel B: Only obs. that answered 2/30 year questions			
Mean	9.8840	16.1357	29.8080
Median	10	10	20
25th Percentile	7	7	10
75th Percentile	20	20	40
Annual Growth Rate	4.942	1.6136	0.9936
N	1992	561	1992

Notes: Mean values derived controlling for RCT and year effects. Source: SOEP Innovation Sample 2016-2018; 10 year expectations only exist for 2017 sample.

Table 2: The role of individual characteristics

Expectations:	2 years		10 years		30 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.1989	-0.2368	-3.8077***	-2.0868	-12.3752***	-11.4228***
	(0.5283)	(0.5417)	(1.4500)	(1.4449)	(2.8185)	(3.1706)
Numeracy	0.0454	0.2142	3.8800***	4.1656***	4.2601	5.2521**
	(0.5338)	(0.5262)	(1.4257)	(1.4655)	(2.6643)	(2.6285)
College	-1.7405***	-2.0410***	0.9081	-1.9550	-3.2307	-3.6680
	(0.6176)	(0.7162)	(2.5233)	(2.0794)	(3.2327)	(3.7368)
Financial Lit.: Inflation	-0.3403	-0.3506	-0.3452	3.1015	2.0407	1.0672
	(0.7646)	(0.9305)	(2.7511)	(2.8309)	(4.4558)	(5.4256)
Financial Lit.: Investment	0.2698	0.3420	-0.6958	0.6512	4.9368*	2.0668
	(0.5922)	(0.6058)	(1.8898)	(1.6934)	(2.7910)	(2.7780)
Financial Lit.: Interest	-1.5466*	-1.5222*	-2.5334	-3.9767*	5.2439*	3.8937
	(0.9039)	(0.8969)	(2.2850)	(2.3636)	(3.0220)	(3.2932)
Year FX	No	Yes	No	Yes	No	Yes
Commuting Zone FX	No	Yes	No	Yes	No	Yes
Control Variables	No	Yes	No	Yes	No	Yes
Observations	2658	2522	752	711	2052	1961

Notes: Significance levels: $*$ p 0.10, $**$ p 0.05, $***$ p 0.01; Standard errors clustered at individual level. Source: SOEP Innovation Sample 2016-2018, own calculations. All of the above regressions control for individuals receiving RCT in 2017 and 2018 wave.

Table 3: The role of tenure and housing characteristics

Expectations:	2 years		10 years		30 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Owner-Occupier	-0.8692	-0.3494	-1.5984	-1.0333	0.1352	0.0056
	(0.6565)	(0.6406)	(1.6055)	(1.8482)	(2.6351)	(2.6370)
Rental Raise	1.3561*	0.1455	7.7947***	6.2101**	13.3461*	9.8927
	(0.7183)	(0.7935)	(2.6497)	(2.9529)	(7.3353)	(7.1188)
Year FX	No	Yes	No	Yes	No	Yes
Commuting Zone FX	No	Yes	No	Yes	No	Yes
Control Variables	No	Yes	No	Yes	No	Yes
Observations	2687	2551	754	713	2079	1988

Notes: Significance levels: $*$ p 0.10, $**$ p 0.05, $***$ p 0.01; Standard errors clustered at individual level. Source: SOEP Innovation Sample 2016-2017, own calculations. All of the above regressions control for individuals receiving RCT in 2017 wave. Price trend and supply index are derived ta the postal code level which are smaller regional units than the commuting zones used as fixed effects.

Table 4: The role of local housing markets

Expectations:	2 years		10 years		30 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Price Trend	0.2897***	0.3221**	0.3694*	0.2778	0.7095	0.0442
	(0.0811)	(0.1380)	(0.2043)	(0.3701)	(0.4477)	(0.8652)
Supply Index	-0.0373***	-0.0322	-0.1025***	-0.0530	-0.1953***	-0.2875**
	(0.0118)	(0.0249)	(0.0290)	(0.0420)	(0.0545)	(0.1228)
Year FX	No	Yes	No	Yes	No	Yes
Commuting Zone FX	No	Yes	No	Yes	No	Yes
Control Variables	No	Yes	No	Yes	No	Yes
Observations	2678	2542	751	710	2071	1980

Notes: Significance levels: $*$ p 0.10, $**$ p 0.05, $***$ p 0.01; Standard errors clustered at individual level. Source: SOEP Innovation Sample 2016-2018, own calculations. All of the above regressions control for individuals receiving RCT in 2017 and 2018 wave. Price trend and supply index are derived ta the postal code level which are smaller regional units than the commuting zones used as fixed effects.

Table 5: The role of information

Panel A: Information and house price expectations

	2 years		10 years		30 years	
	(1)	(2)	(3)	(4)	(5)	(6)
RCT	0.8523	1.0335	0.3634	1.0317	8.7056**	6.1480
	(0.8309)	(0.9037)	(1.4855)	(1.4755)	(3.9326)	(4.6829)
Year FX	No	Yes	No	Yes	No	Yes
Commuting Zone FX	No	Yes	No	Yes	No	Yes
Control Variables	No	Yes	No	Yes	No	Yes
Observations	1426	1361	754	713	1054	1013

Panel B: Information and investment decisions

	(1)	(2)	(3)
RCT	4.4021*	4.4063*	2.3359
	(2.4490)	(2.4099)	(2.4223)
Year FX	No	Yes	Yes
Commuting Zone FX	No	No	Yes
Control Variables	No	Yes	Yes
Observations	797	769	769

Notes Panel A: Significance levels: ∗ p 0.10, ∗∗ p 0.05, ∗ ∗ ∗ p 0.01; Standard errors clustered at individual level.Source: SOEP Innovation Sample 2016-2018, own calculations. All of the above regressions control for individuals receiving RCT in 2017 and 2018 wave. Price trend and supply index are derived ta the postal code level which are smaller regional units than the commuting zones used as fixed effects.
Notes Panel B: Significance levels: ∗ p 0.10, ∗∗ p 0.05, ∗ ∗ ∗ p 0.01; ; Heteroskedasticity Robust Standard errors. Control group mean lies at 33.71 per cent.
Source: SOEP Innovation Sample 2018, own calculations.

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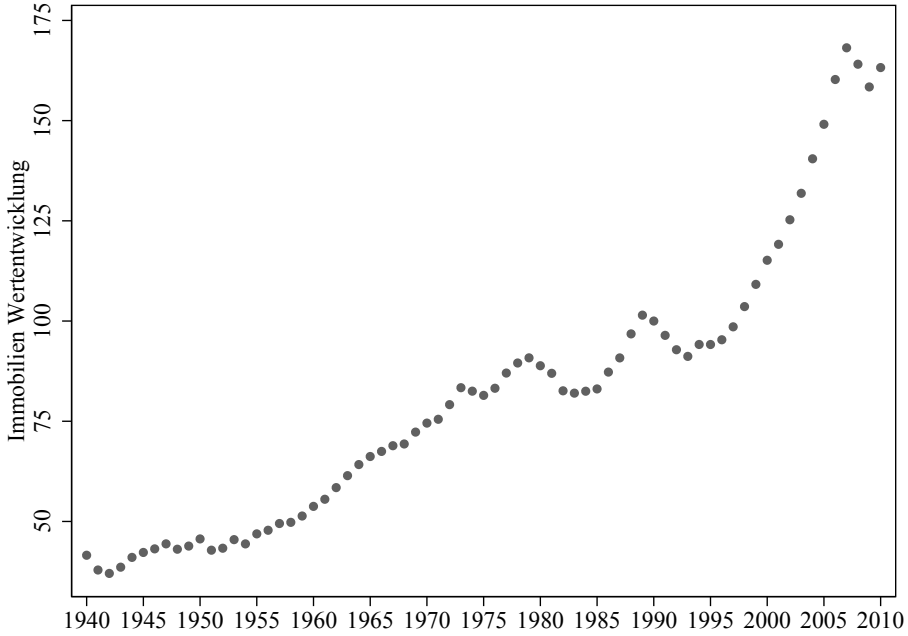
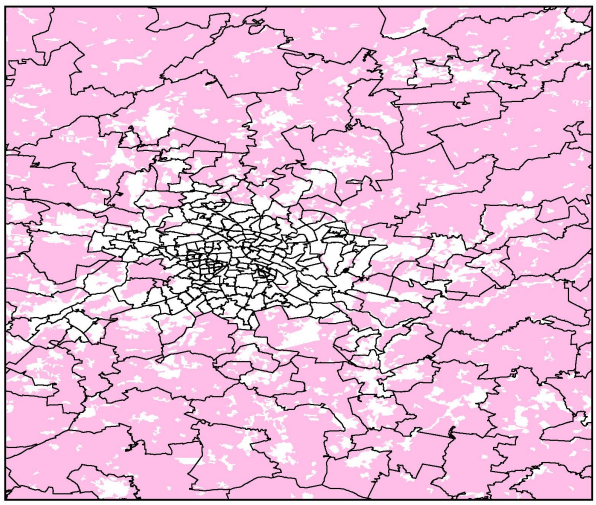
Appendix: Figures and Tables

Figure A.1: Real House Prices in the OECD



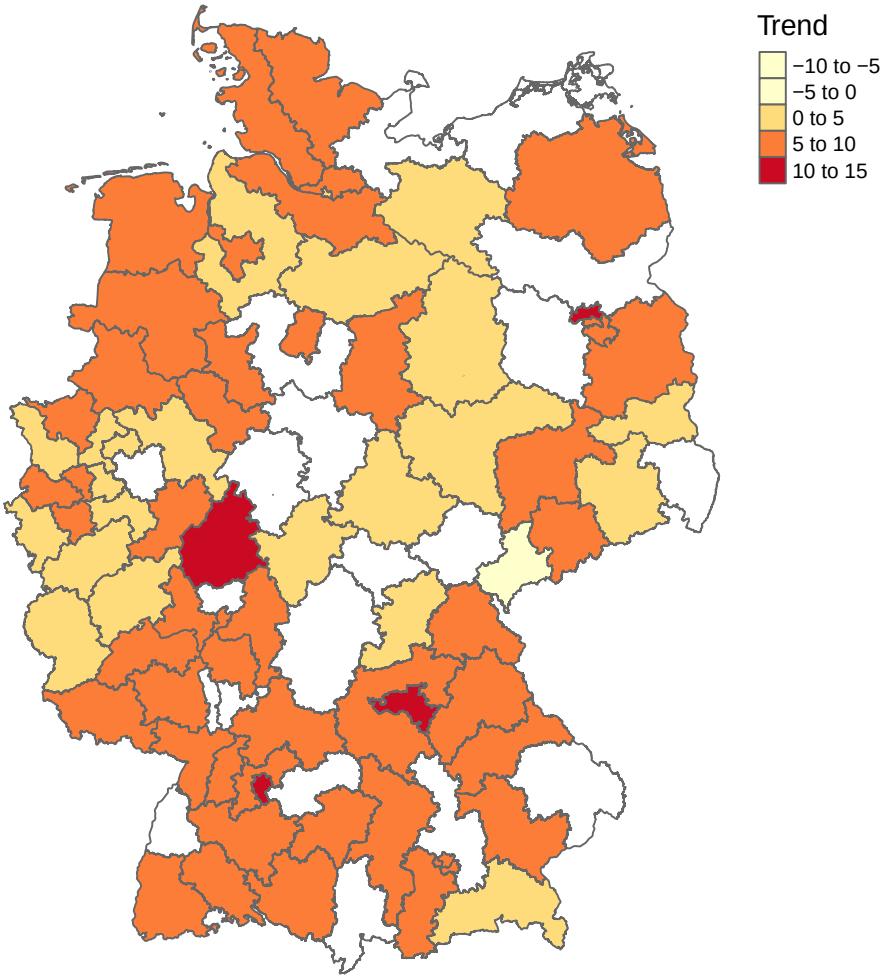
Note: Graph is based on Knoll et al. (2017).

Figure A.2: Developable Land Index Berlin



Source: Corine Land Cover database 2018, photointerpretation of satellite imagery

Figure A.3: Average Yearly Price Change: POSTAL Code Region



Note: The figure depicts the average yearly price change between 2012-2016 across postal coded regions in Germany. Postal code regions are characterized by the first two digits of each postal code.

Figure A.4: Growth trajectories based on the annual growth rates for 2/10/30 year expectations assuming constant annual growth

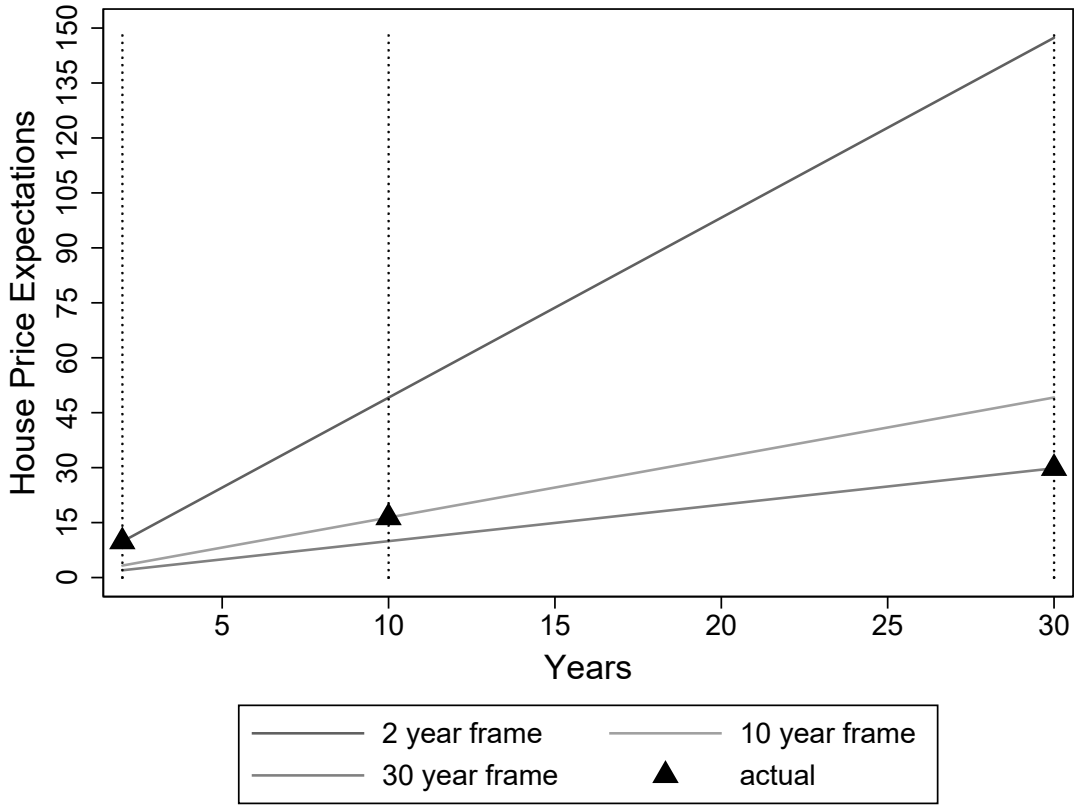


Table A.1: Summary Statistics: Housing Data

Variable	**Mean**	**Min.**	**Max.**	**N**
Price per sqm	2,283.943	35	182,03.881	172,328
Rental Price per sqm	7.772	1.02	66	309,079

Table A.2: Average house price expectations by type

Expectations	2 years	10 years	30 years
Men	9.6646	18.3696	37.2011
Observations	1384	383	1072
Women	9.9934	14.4922	22.0341
Observations	1303	371	1007
College	9.0734	19.0189	29.7000
Observations	413	105	318
No College	9.9799	15.9537	29.8585
Observations	2272	647	1759
Owner-Occupier	8.3000	15.6522	27.5849
Observations	933	277	695
Tenant and other	10.5452	16.8075	30.8430
Observations	1754	477	1384

Notes: Mean values derived controlling for RCT and year effects. Source: SOEP Innovation Sample 2016-2018; 10 year expectations only exist for 2017 sample.

Table A.3: The role of individual characteristics

Expectations:	2 years		10 years		30 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Female	-0.1912	-0.2261	-3.8077***	-2.0868	-12.3915***	-11.6244***
	(0.5281)	(0.5420)	(1.4500)	(1.4449)	(2.8169)	(3.1952)
Numeracy	0.0427	0.2110	3.8800***	4.1656***	3.8664	4.9749*
	(0.5371)	(0.5261)	(1.4257)	(1.4655)	(2.6320)	(2.5865)
College	-1.3572**	-1.7388***	0.9081	-1.9550	3.1824	1.8321
	(0.5891)	(0.6625)	(2.5233)	(2.0794)	(5.3061)	(5.9270)
Financial Lit.: Inflation	-0.3324	-0.3409	-0.3452	3.1015	1.9388	0.9331
	(0.7645)	(0.9305)	(2.7511)	(2.8309)	(4.4470)	(5.4245)
Financial Lit.: Investment	0.2709	0.3500	-0.6958	0.6512	4.4511	1.7765
	(0.5951)	(0.6062)	(1.8898)	(1.6934)	(2.7341)	(2.7495)
Financial Lit.: Interest	-1.5594*	-1.5202*	-2.5334	-3.9767*	4.8736	3.6429
	(0.9043)	(0.8959)	(2.2850)	(2.3636)	(3.0055)	(3.2890)
Year FX	No	Yes	No	Yes	No	No
Commuting Zone FX	No	Yes	No	Yes	No	Yes
Control Variables	No	Yes	No	Yes	No	Yes
Observations	2658	2522	752	711	2052	1961

Notes: Significance levels: $*$ p 0.10, $**$ p 0.05, $***$ p 0.01; Standard errors clustered at commuting zone level.
Source: SOEP Innovation Sample 2016-2018, own calculations. All of the above regressions control for individuals receiving RCT in 2017 and 2018 wave.

Table A.4: The role of tenure and housing characteristics

Expectations:	2 years		10 years		30 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Owner-Occupier	-0.8647	-0.3516	-1.5984	-1.0333	0.1644	0.0199
	(0.7252)	(0.6644)	(1.7252)	(1.9177)	(2.7268)	(2.8754)
Rental Raise	1.3583**	0.1568	7.7947**	6.2101	13.4563**	10.0164
	(0.6581)	(0.8660)	(3.0052)	(3.9017)	(6.5027)	(6.2379)
Year FX	No	Yes	No	Yes	No	Yes
Commuting Zone FX	No	Yes	No	Yes	No	Yes
Control Variables	No	Yes	No	Yes	No	Yes
Observations	2687	2551	754	713	2079	1988

Notes: Significance levels: $*$ p 0.10, $**$ p 0.05, $***$ p 0.01; Standard errors clustered at commuting zone level.
Source: SOEP Innovation Sample 2016-2018, own calculations. All of the above regressions control for individuals receiving RCT in 2017 and 2018 wave. Price trend and supply index are derived ta the postal code level which are smaller regional units than the commuting zones used as fixed effects.

Table A.5: The role of information

Expectations:	2 years		10 years		30 years	
	(1)	(2)	(3)	(4)	(5)	(6)
RCT	1.0048	1.1857	0.3634	1.0317	9.0660**	6.3764
	(0.8260)	(0.9843)	(1.4855)	(1.3693)	(3.9293)	(4.6620)
Year FX	No	Yes	No	Yes	No	Yes
Commuting Zone FX	No	Yes	No	Yes	No	Yes
Control Variables	No	Yes	No	Yes	No	Yes
Observations	1426	1361	754	713	1054	1013

Notes: Significance levels: $*$ p 0.10, $**$ p 0.05, $***$ p 0.01; Standard errors clustered at commuting zone level.
Source: SOEP Innovation Sample 2016-2018, own calculations. All of the above regressions control for individuals receiving RCT in 2017 and 2018 wave. Price trend and supply index are derived ta the postal code level which are smaller regional units than the commuting zones used as fixed effects.

Table A.6: The role of local housing markets

Expectations:	2 years		10 years		30 years	
	(1)	(2)	(3)	(4)	(5)	(6)
Price Trend	0.2920***	0.3262**	0.3694	0.2778	0.7107	0.0487
	(0.1053)	(0.1348)	(0.2510)	(0.4205)	(0.5335)	(1.1139)
Supply Index	-0.0371***	-0.0321	-0.1025***	-0.0530	-0.1954***	-0.2875**
	(0.0106)	(0.0193)	(0.0273)	(0.0366)	(0.0556)	(0.1230)
Year FX	No	Yes	No	Yes	No	Yes
Commuting Zone FX	No	Yes	No	Yes	No	Yes
Control Variables	No	Yes	No	Yes	No	Yes
Observations	2678	2542	751	710	2071	1980

Notes: Significance levels: $*$ p 0.10, $**$ p 0.05, $***$ p 0.01; Standard errors clustered at commuting zone level.
Source: SOEP Innovation Sample 2016-2018, own calculations. All of the above regressions control for individuals receiving RCT in 2017 and 2018 wave. Price trend and supply index are derived ta the postal code level which are smaller regional units than the commuting zones used as fixed effects.

Appendix: Robustness

Clustering of standard errors In the main specification, we cluster standard errors at the individual level, as standard errors are likely to be correlated within multiple observations for the same individual. However, standard errors might also suffer from heteroskedasticity at larger regional clusters. Thus, we repeat our estimations for standard errors clustered at the commuting zone level. Tables A.3 to A.6 in the Appendix show that the results hardly change across the different specifications and that the interpretation remains the same. Note, however, that standard errors for the local market measures marginally increase for the two year expectation outcome implying insignificant point estimates when including controls and fixed effects. However, the estimate for the price trend remains borderline significant, at the fifteen percent level with a p-value of 0.13.

Nominal vs. real expectations As described above, individuals received the following text when asked about their expectations: *The following section focuses on your expectations of house price developments in your area. In your opinion: How will house prices develop in comparison to today?* Participants then had the option to state whether prices will fall, rise, remain the same, or not answering at all. Depending on their answer individuals were asked *By how much - in percent- do you think prices will fall/rise.* From this question alone it does not become clear whether individuals state their expectations in real or in nominal terms. Therefore as a follow-up in 2019 we asked whether individuals interpret the question in nominal or real terms. More precisely in an additional question participants were asked:

In the previous section we asked you several questions about your expectations of house price developments in your area. When answering the questions did you factor in general price developments, i.e. inflation? Please be aware that it is also correct if you did not.

The majority of participants (close to 60 percent) states that they did indeed factor in

inflation whereas over 40 percent state that they did not.

When regressing house price expectations on an indicator whether individuals state that they factored in inflation, we do not find a significant difference in long term and short term expectations between both groups (see Table A.7 below).

Table A.7: Expectations and Inflation

Expectations:	2 years		30 years	
	(1)	(2)	(3)	(4)
Inflation Indicator	-0.0291	-0.9555	6.3316	6.8777
	(0.9196)	(1.0781)	(5.8150)	(7.7347)
Year FX	No	Yes	No	Yes
Commuting Zone FX	No	Yes	No	Yes
Control Variables	No	Yes	No	Yes
Observations	619	596	445	430

Notes: Significance levels: $*$ p 0.10, $**$ p 0.05, $***$ p 0.01; Standard errors clustered at individual level.
Source: SOEP Innovation Sample 2019, own calculations.

All in all, there is suggestive evidence that individuals appear to state their expectations in real terms, however, a relatively large proportion, i.e. approximately 40 percent, state that they did not. Interestingly there is no significant difference in the expectations in the short- or long-run between those who self-report that they factored in inflation and those who did not. One potential explanation could be that individuals do not fully grasp the concept of inflation as well as how nominal and real price developments differ. Alternatively, individuals could expect relatively low general price appreciation, which potentially explains why expectations between both groups do not significantly differ.