Long-run Expectations of Households

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Abstract

The rational expectations assumption, e.g. in life-cycle models and portfolio-choice models, prescribes that all actions are in line with a well-structured and unbiased system of expectations. In reality, justification and identification of expectations are nontrivial, and we lack empirical evidence especially for the long run. This paper starts to fill this gap and elicits short-run and long-run expectations of a sample of households that is designed to be representative of the universe of German households. We focus on expectations about three highly welfare-relevant markets: the stock market, the labor market, and the housing market. We show that linear extrapolations of short-run expectations can approximate long-run expectations in the labor market, but not in financial or housing markets. In the latter two, long-run expectations of households are severely below linear price growth. Long-run price expectations in financial and housing markets are as well far below historical values and thus extremely pessimistic, while expectations for the labor market are fairly close to historical values. We document substantial heterogeneity of expectations by socio-economic background, for example we find in all markets that females are more pessimistic than males.

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1 Introduction

Many of the most important economic decisions of a household concern the long run. Accepting a job, buying a house, and choosing a retirement savings vehicle are three examples of such decisions. Their set of consequences is large and these consequences realize over a long period of time. The key decisions are only partly reversible, often made within a short decision time, and based on limited information about future prices and other economic outcomes. The long-run expectations about these outcomes are, correspondingly, of high welfare relevance.

This paper examines long-run price expectations of households in three important markets: financial market, labor market, and housing market. We study heterogeneity in expectations using rich background information and applying machine-learning techniques for variable selection. Our main contribution to the existing literature is that we study expectations about price developments over a longer period, adding to previous studies that have mainly focused on short-run or medium-run expectations. Towards this aim, we employ an extensive survey module in the Innovation Sample of the German Socio-Economic Panel (SOEP-IS), a large household panel study that is designed to be representative of the general population in Germany. With novel questions, we elicit price expectations for financial, labor, and housing markets for different time horizons, including one, two, ten, and thirty years. We use this data for a descriptive analysis that comprises three steps. First, we compare the elicited long-run expectations to their short-run analogues. Second, we compare the elicited expectations to the historically realized developments of the relevant economic variables. Third, and finally, we systematically study the heterogeneity and ask how expectations vary by important socio-demographic variables.

The following are the main findings: linear extrapolations of short-run expectations can approximate long-run expectations in the labor market, but not in financial or housing markets. In the latter two, long-run expectations of households are severely below linear price growth. Whereas short-run expectations are similar to historical realizations in all three markets, long-run expectations near historical realizations only in the labor market.

In financial and housing markets, long-run expectations are far below historical averages and thus can be considered pessimistic. Regarding the socio-demographic variables, we find that women have lower long-run expectation than men in all markets. Moreover, for the stock market, we find that socio-economic groups that are commonly more active in the market have systematically higher asset price expectations, even though their long-run expectations are also far too pessimistic. For the housing market, individual characteristics seem to matter less for expectations.

The finding that many long-run expectations are so far away from historical values raises the question why this appears. One possibility is that the respondents, when considering the long run, tend to exchange (or confuse) the two time horizons and replace the long-run expectation with the short-run expectation. This may be more likely to happen in a context where one has little experience. Making quantitative evaluations in such a context is harder than in one that is more familiar. All of this is consistent with the observation that expectations are much more accurate in the labor market: in everyday life, numerical information about wages may appear frequently and with much concreteness, and less so for the stock market or housing markets.[1]

Since the early 2000s, economists have increasingly engaged in eliciting, measuring, and analyzing subjective expectations. The concept of subjective expectations is essential for decision making under uncertainty and provides a useful framework for micro and macro models. In seminal early work on measuring expectations, Manski (2004) encourages researchers to collect survey data on subjective beliefs. The evidence that has emerged since then, in surveys and experiments, indeed finds a strong link between subjective beliefs and economic decisions (see e.g. Manski 2018, Schotter and Trevino 2014 for reviews). In addition, knowledge of subjective expectations helps to overcome an identification problem that arises in revealed-preference analyses: the standard practice of estimating both preferences and beliefs from the observed choice behavior often does

[1]This hypothesis, if true, would raise the question whether actual economic decisions are subject to the same pattern of replacing long-run beliefs with short-run beliefs. A test of this hypothesis goes beyond the scope of this paper. Consistent with this possible mechanism, Colasante et al. (2020) elicit individual expectations about the development of a price of a financial asset in a learning-to-forecast experiment. Their findings suggest that when reporting short-run and long-run expectations, individuals are more inclined to rely on the last realized price than on the fundamental value of the asset.

not provide a unique solution. One common way to address the identification issue is to rely on the assumption of rational expectations (Muth 1961) and to thereby impose additional structure on the model. An alternative way is to use data on stated expectations. We contribute to these studies by providing evidence on *long-run* expectations.

Related literature in behavioral economics identifies several classes of expectations biases that may arise. First, households may be misinformed or simply lack relevant information (e.g. Brandts et al. 2019). Second, they may process the information in a systematically biased way. In our context, the most directly applicable explanation for the bias is that households may underestimate exponential growth (Stango and Zinman 2009). Third, they may fail to optimize dynamically (Oprea et al. 2009), e.g. may neglect their own future decisions and therefore not collect the most relevant information to prepare them. While we cannot test these competing biases, we highlight their potential relevance across various domains. In particular, underestimations due to neglect of exponential growth are unable to explain the patterns that we observe alone, as we find households holding expectations below linear growth.

Our empirical analysis takes into account rich heterogeneity in the SOEP data. Analyzing heterogeneity by multiple comparisons often leads to a multiple-hypothesis-testing problem (see List et al. 2019) in the sense that standard p-values of classical (single) hypothesis tests are no longer valid. To overcome this problem, we rely on model selection approaches. In recent years, machine learning methods have become popular to conduct inference in large data sets more systematically (for a review, see Athey and Imbens 2017). In this paper, we apply a data-driven selection of relevant model specification by using the least absolute shrinkage and selection operator (lasso).

The remainder of the paper is organized as follows. Section 2 introduces the data and the survey design. Section 3 describes elicited expectations. Section 4 contrasts the expectations with the realized price developments in the relevant markets. Finally, Section 5 reports on heterogeneity and shows how long-run expectations vary between socio-economic groups.

2 Design and data

2.1 Design considerations

For the stock market, the model underlying our empirical design is the standard portfolio choice problem, where agents allocate their wealth between a safe asset and a risky asset. Depending on risk attitudes and (subjective) expectations, the agents determine the degree to which they expose themselves to risk. Previous studies by Dominitz and Manski (2011), Hurd (2009) and Hurd et al. (2011) detect substantial heterogeneity in short-run expectations and confirm that beliefs and actual investment behavior are connected. Breunig et al. (2021) implement the standard portfolio choice and elicit incentivized experimental choices in a wide-sample survey. They show that these choices, too, correlate with beliefs and with real-world investments.[2]

While the previous literature focused mainly on the short-run (annual) returns, this paper also studies the long-run horizon. Whereas short-term fluctuations of returns can be volatile, the long-run development may serve as a reasonable indicator of repeatable performance (Merton 1969). Investigating the long-run perspective, as perceived by households, can therefore lend additional insights into households' financial planning. Much more generally, and for a host of possible reasons, the long-run expectations may be of a very different nature (and level) than their short-run counterparts.

We also view the activities in other markets (labor market and housing market) through the lens of the standard portfolio choice problem. In each market, the agents make decisions with long-run consequences (e.g., owning versus renting an estate, seeking part-time versus full-time employment). The long-run return to the available choice options is uncertain and, for many of the relevant decisions, some choice options are naturally perceived as higher-risk-and-higher-mean than others. However, we acknowledge that the analogy is far from complete. The three markets differ in the distributions of the relevant variables, in the sources of uncertainty about long-run returns, and in their levels of observability from the perspective of the household. In the labour market,

[2]For a formal treatment of the standard portfolio choice problem and a more detailed discussion of the related literature, see Breunig et al. (2021).

most individuals have a rich set of first-hand experience about wage growth, rendering many possible outcomes as clearly more plausible than others. In the housing market, the structural value of one's own house, or that of close friends and family, may at least provide a possible orientation for one's subjective belief. The stock market, in turn, is the least accessible for most households, and information about it is arguably characterized by the largest volatility.

Besides differences in riskiness of perceived returns, an important set of differences concerns the salience of the long-run horizons for possible investments in the three markets. In the stock market, short-term investments may appear more natural to think about and household investors may never consider expectations about long-run returns. In the labor market, both short- and long-run considerations are salient. Most individuals remain "invested" in this market until retirement, so clearly both time horizons matter. In the housing market – at least in the German context – investments are of predominantly long-run nature. Investments in real estate come with high transactions costs and with loans whose repayment periods typically span more than a decade. We return to the discussion of these differences across markets when we present our results and discuss possible forms of biased beliefs.

2.2 Data

The analysis is based on data from the Innovation Sample of the Socio-Economic Panel (SOEP-IS). The SOEP-IS is designed to be representative of the German population (see Appendix A.1 for details about the central demographic characteristics). In addition to standard socio-economic questions, the SOEP-IS accommodates separate survey modules that target specific research areas. We obtained a permission to develop our own module and designed a questionnaire on short- and long-run expectations about price returns.[3] To elicit these expectations, we ask individuals to directly state their point predictions.

[3]See Richter and Schupp (2015) for further details on the SOEP-IS. Like the standard SOEP panel, the SOEP-IS is a longitudinal data set. Starting with the year 2016, individuals in our subsample provide information about price expectations on a yearly basis. In this paper, we focus on the first cross section of the data that covers the year 2016.

Specifically, for the stock market, individuals predict the development of the German stock market index DAX[4] in the next year, in two years, and in thirty years. For the housing market, individuals predict the development of the purchase price of residential property in their area in the next two and thirty years. For the labor market, employed individuals state their beliefs about their gross monthly earnings in the next year, in two years, and in ten years, assuming constant employment status. In Appendix A.2 we report and discuss the exact wording of the questions.

3 Results

3.1 Short-run and long-run expectations

Table 1 summarizes elicited expectations. The short-run expectations are relatively low for the stock market but high for the labor and housing markets. The average expected gain from a one-year investment in the DAX is 0.44 %, employed individuals expect that their gross monthly wage increases on average by 5.85 % in the next year, and the average expected growth of the house prices is 9.79 % over the next two years. [5]

When considering other moments of the short-run expectations, the picture looks similar. For the stock market, they are moderate at the median, negative at the 25th percentile and positive at the 75th percentile. For the labor market, we find zero effects at the 25th percentile, about 2 % increase in expected wage at the median, and 6.25 % increase at the 75th percentile. For the housing market, short-run expectations are higher and positive at most percentiles (5 % at the 25th percentile and 15 % at the 75th percentile).

The expected price changes over the longer time periods are, generally speaking, very low. The survey respondents expect that the average gain from investment in the DAX

[4]The DAX is a blue chip stock market index that summarizes economic development of 30 major German companies trading on the Frankfurt Stock Exchange. It started at a base value of 1000 index points on December 31, 1987.

[5]As a robustness check, in the Table A2 in the Appendix A.3, we replicate Table 1 but compute the summary statistics using the sample balanced at the market level. We observe that the key characteristics of the individual expectations do not change.

Table 1: Subjective expectations, SOEP-IS 2016

Expectation	Obs	Mean	St. Dev.	Q25	Q50	Q75	Min	Max
DAX index								
1 year	1045	0.44	13.36	−5.00	2.00	5.00	−100	102
2 years	1003	1.39	13.35	−5.00	2.00	6.00	−70	112
30 years	791	10.18	40.24	−5.00	5.00	20.00	−100	500
Wages								
1 year	629	5.85	18.01	0.00	1.78	6.25	−50	167
2 years	598	11.46	27.26	1.23	4.76	11.11	−50	233
10 years	500	30.87	64.56	9.52	17.08	31.58	−50	934
House prices								
2 years	1253	9.79	11.75	5.00	10.00	15.00	−50	110
30 years	1017	29.18	59.26	10.00	20.00	40.00	−95	1000

over the next thirty years is 10.18 % (with a median of 5 % and the 75th percentile at 20 %). The long-run expectations about the growth of house prices are somewhat larger than those of the stock market prices (mean 29.18 %, median 20 %, and 75th percentile 40 %). The labor market is the only market in which most long-run expectations are well in line with the short-run expectations. The median of the 10-years-ahead wage expectation (17.08 %) is very close to the linear extrapolation of the median short-run wage expectation. For the other moments, the long-run expectations are higher than in the short run but below linear growth.

As indicated in previous sections, there are several possible explanations why we find a different pattern for expectations on the labor market. Perhaps most importantly, the monthly wage is an essential statistic of everyday life for all employed individuals. Individuals can observe it at their own person-specific level and may have information about the analogous values of their colleagues and peers.[6]

To gauge the dynamics of price expectations, we consider two benchmark scenar-

[6]Respondents could also be prone to report both perceived risks and emotional responses together. Since the prices in stock markets and housing markets are more volatile, the perceived riskiness of their long-term investments could be amplified by severity of potential loss. Manski (2018) summarizes empirical evidence that is consistent with this hypothesis. For example, confounding beliefs and preferences may help to explain why teenagers overstate the risk of mortality or why adults overstate the risk of crime victimization.

ios. We take the short-run expectations of individuals as given and assume that prices continue to grow either by the same amount in each following year (linear growth) or exponentially. These two counterfactual scenarios are the main components of the exponential growth bias model (Levy and Tasoff 2016), arguably the leading model of biased long-run perceptions.[7] This model describes the tendency to partially neglect compounding and, therefore, perceive an asset with compounding interest to grow at a rate that is faster than linear but slower than exponential.

In our case, the long-run expectations of individuals imply a growth that is even lower than linear. Figure 1 compares the growth rates in all three markets, showing mean and median values.[8] We compare the expected price changes as stated by the respondents (the solid curve) to the price changes that follow linear growth (the dashed curve) and exponential growth (the dashed-dotted curve). In all three markets, both mean and median values of the long-run expectations are lower than those attained with linear or exponential growth. The effects are specifically pronounced for the stock market and the housing market. For example, if we take the average expected increase of the German house prices over the next two years (9.79 %) as the basis, the cumulative increase over the next thirty years, including compounding-growth effects, is 231.23 %. If we counterfactually impose that there is no compounding but that growth is linear, the price increase over the next thirty years would be 124.68 %, still much higher than the reported value of 29.18 %. Summing up these comparisons of long-run expectations with estimated counterparts, we find that individuals expect neither linear nor exponential growth.[9]

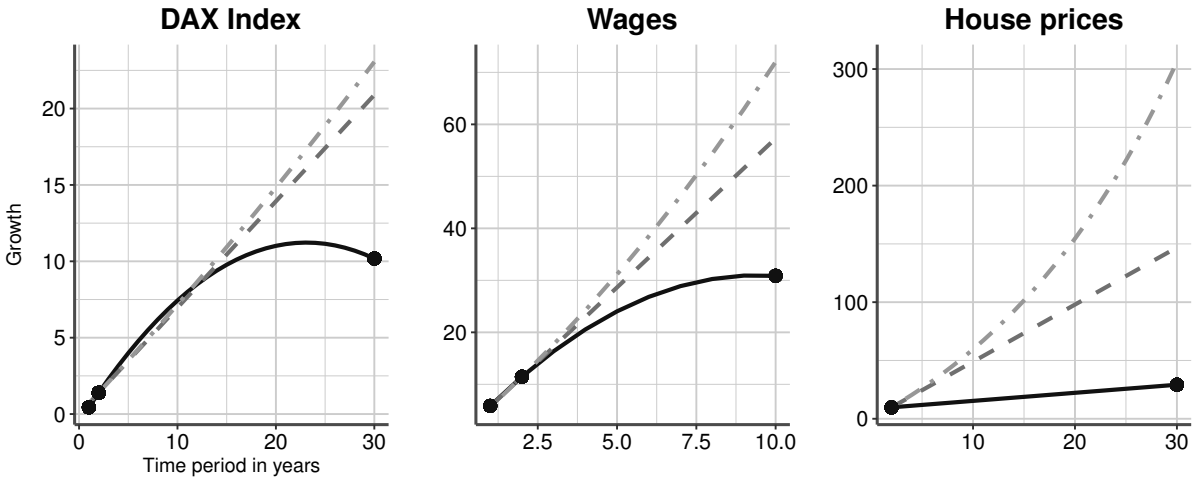
[7]Cohen et al. (2020) summarize regularities observed in studies investigating time preferences and provide an overview of discounted utility models that account for dynamic (in)consistency.

[8]Additional information about growth rates of other moments is provided in Appendix A.4.

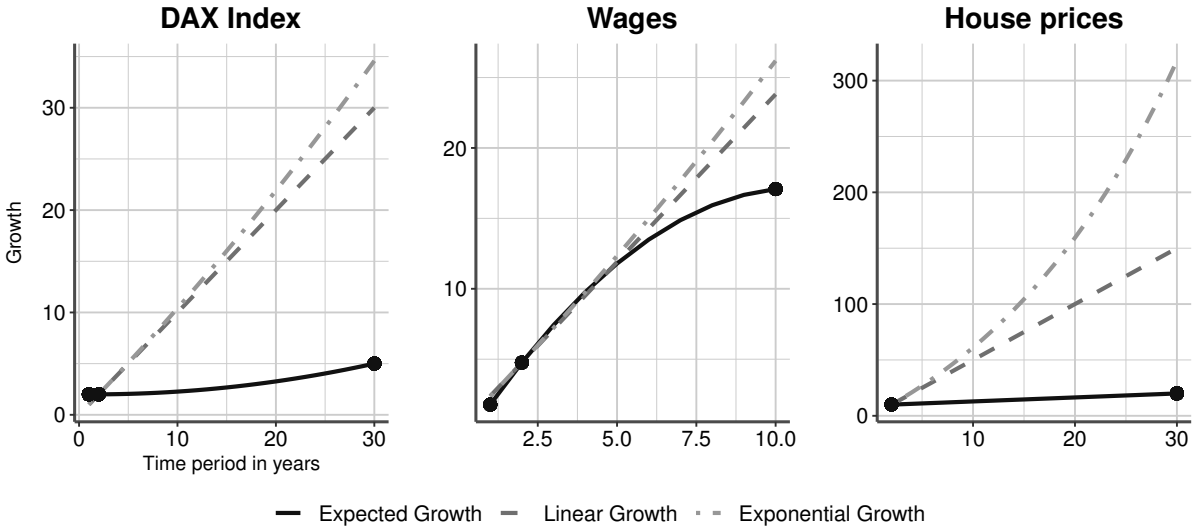
[9]In the stock market, 1.16 % of observations are consistent with linear growth and 0.52 % with exponential growth. In the labor market, the corresponding numbers are 11.65 % and 9.24 % including 4.62 % of individuals who do not expect neither short- nor long-run changes in their wages. In the house market, 0.60 % of individuals expect house prices to grow in a linear fashion, whereas 0.71 % of individuals expect exponential growth. The results allow for 10 % relative error.

Figure 1: Expected and estimated growth of prices over time

(a) Mean values



(b) Median values



Notes:
The black round markers correspond to the average (1a) and median (1b) expected price changes over the respective number of years. For convenience of presentation, we fit a polynomial curve to connect the markers. The curves that depict linear and exponential development assume an annual interest rate based on the two-years-ahead expectations. Namely, all three curves intercept in the second year.

3.2 Stability of expectations

We explore the persistence of expectations by investigating whether respondents' expectations about price growth in the short run are of similar magnitude in the long run. We group short-run (2-years-ahead) and long-run (10- or 30-years-ahead) expectations by quartiles and present expectation movements in transition matrices. Figure 2 depicts them for the three markets. Individuals with persistent expectations are located around the main diagonals. In all markets, most individuals hold persistent expectations: 46.8 % of respondents are on the main diagonal with respect to the quartiles of stock price expectations, 56 % regarding wage expectations, and 41.5 % regarding house price expectations.[10] Allowing for a transition into an immediately neighboring quartile, i.e. for slightly more optimistic/ pessimistic long-run expectations relative to short-run expectations, these numbers increase to 77.6 % (stock market), 92.4 % (labor market) and 82.7 % (housing market). While the pattern is similar in all markets, there are substantially fewer deviations in the labor market than in the other two markets. This is consistent with the underlying differences in the riskiness and in the salience of the long-run nature of the respective market that we highlighted in Section 2.1.[11]

Lastly, we also examine whether personal characteristics can predict stability of expectations. We estimate logit-regressions with a binary outcome variable that takes the value of one if an individual has stable expectations, i.e. has expectations on the main diagonal of Figure 2. In Table A4 in Appendix A.5, we present the results and find little evidence for predictable heterogeneity in the stability of expectations: across all regressions, only five out of thirty characteristics are significant at the ten percent level of statistical significance.

[10]These conclusions are confirmed by investigating the stability of expectations grouped by deciles, see Appendix A.5 and Figures A.1–A.3

[11]This finding is also helpful for understanding of potential inconsistencies in expectations. The fact that there are more deviations from the main diagonal in stock and housing markets than in the labor market indicates that stated long-run expectations differ from the short-run expectations, at least for a significant share of our respondents. As such, this is an evidence against the hypothesis that respondents simply exchange (or confuse) the two time horizons.

Figure 2: Stability of short- and long-run expectations

Notes:
The figures split short- and long-run expectations of individuals into quartiles. On the horizontal axis, there are quartiles of the short-run (two-years-ahead) expectations. The vertical axis represents quartiles of the long-run expectations: 30-years-ahead expectations for financial and housing markets, and 10-years-ahead expectations for the labor market. Each cell corresponds to a share of individuals (in percent) whose short- and long-run expectations fall into depicted quartile groups.

4 Expectations versus realizations

In this section, we assess the accuracy of elicited expectations by comparing them with historical realizations. Although developments in the future might differ from historical experience, the past is a relevant predictor for the future, especially if reliable forecasts do not exist. Therefore, historical realizations can serve as important benchmark.[12]

For the stock market, we use historical data on nominal yearly returns on the DAX performance index from 1951 to 2016.[13] For the labor market, we rely on the data on gross monthly earnings from the German Socio-Economic Panel (SOEP) for the 2004 to 2014 period.[14] For the housing market, we use the house price index from 1962 to 2016 available in the Jordà-Schularick-Taylor (JST) Macro-history Database (Jordà et al. 2017,

[12]Manski (2018) describes several approaches to evaluate the accuracy of elicited expectations. The most direct approach of following individuals over time and comparing their expectations with realized events is often out of reach but a comparison with historical realizations is much more often available. A further alternative is to ask for expert opinions. However, for our context, this would not be feasible as forecasts by experts tend to exist only for the short run, and not for the respondents' own wages. See Andre et al. (2019) for a comparison of short-run expectations about unemployment and inflation rate of households and experts.

[13]For years before the DAX's origination in 1988, we make use of the yearly return series from Stehle et al. (1996, 1999) who impute the index going back to 1948.

[14]See Goebel et al. (2019) for further details on the SOEP variables.

2019). In Appendix B, we provide more detail on the historical data and calculations of the realized price changes.

Figure 3 plots the means of price expectations and historical prices in each market over time. It summarizes the key finding of the paper: long-run expectations regarding the stock and housing markets are very pessimistic. In these two markets, expectations are much lower than historical realizations. The realized price development exhibits a strong and positive trend, particularly apparent in the development of the DAX index. Since 1951, the average 30-years gain of the DAX (calculated as an average of the 30-years periods that are already completed) amounts to more than 1700 %. This stands in stark contrast to the expectations of households. As documented in Table 1, the average subjectively expected 30-years return on investment in the DAX is close to 10 %, the median expectation is 5 %, and the the 75th percentile is 20 %. With respect to the housing market, we find a similar pattern: since 1962, the average increase in the German house prices over a 30-years period is 144.07 %, whereas the subjectively expected increases have a mean close to 30 %. In contrast, for the labor market, we find that long-run expectations are comparable to the realized values. On average, both expected and empirical gross monthly wage increases by approximately 30 % over a period of 10 years.

Figure 3: Expected and historical growth of prices over time (mean values)

Notes:
This figure compares the expected future growth to historical growth of prices in the three markets. The black square markers correspond to expected price developments whereas the grey round markers correspond to historical realizations over the years defined by horizontal axis. For convenience of presentation, the markers are connected with curves.

Although we elicit expectations in nominal terms, see Appendix A.2, some individuals might misinterpret the question. This leads to concerns that the difference between expectations and realizations might be driven by (mis-accounting of) inflation. These concerns may be particularly valid in the stock and housing markets where we elicit expectations in percentages. (In the labor market, we ask for the Euro amounts, thus directly implying a nominal interpretation.) In order to address these concerns, we conduct a separate analysis where we adjust the realized changes in the stock and the housing markets for inflation. The following paragraphs describe that this leaves the results qualitatively unchanged. Moreover, in Tables B1 and B2 in Appendix B.3, we provide further robustness about the findings for the stock market by focusing on realizations over different time periods (the 1951-2018 and 1988-2018 periods, in addition to the 1951-2016 period) and for the housing market by considering Germany separately from other countries.

For the stock market, the realized inflation-adjusted values in all considered time periods are far above the expected average changes of about 10 %. The most conservative average gain from the long-term investment is 592.53 % and corresponds to the case when historical returns are measured in real terms since the origination of the index. Even in this case, the realized gain is 58 times larger than the average of the subjectively expected gain – and it even exceeds the maximum of subjectively expected gains in the entire sample (500 %).

For a differentiation of housing markets in Germany versus other countries, Table B2 in Appendix B.3 includes information about the historical development of house prices separately for Germany and for the average of 14 advanced economies.[15] The historical price development in Germany differs from most other countries and was considerably lower until about 2010. Since then, house prices have experienced a strong increase.[16] In this respect, it is not obvious which time series is the most relevant measure of the realized price changes. When focusing on the nominal historical development, we find that average long-run expectations are well below the average realizations both in Germany and in the

[15]The countries include: Australia, Belgium, Canada, Denmark, Germany, Finland, France, Japan, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, and the United States.

[16]For a detailed discussion, see Knoll et al. (2017).

considered countries. With adjustment for inflation, the picture looks different: for the global price development, we still find a sizable increase but, in contrast, the German housing market shows hardly any real price increase over the relevant 30-year period.

5 Heterogeneity of Expectations

In the final section, we analyze the sensitivity of expectations relative to changes in socio-economic variables. We first show descriptive evidence by standard socio-economic variables, such as gender, age, gross monthly earnings, financial literacy, education, home ownership, and nationality (Tables 2, 3). Subsequently, we focus on the long-run expectations, and use the lasso approach to systematically account for heterogeneity among individuals.

5.1 Descriptive analysis

The descriptive analysis shows four main patterns. First, we find a strong gender effect in all markets: long-run expectations of women are much lower than those of men. The difference is particularly pronounced in the financial market (Table 2). On average, women only expect a price increase of 2.37 % over thirty years, while the corresponding expectations of men amount to 16.22 %. In the housing market, the average gender gap of long-run expectations is of similar size, at 13.8 percentage points. In the labor market (Table 3), the gender expectations gap is also sizable (about 10.5 percentage points). Interestingly, the empirical difference in realized wage growths, reported in the second half of the table, is far lower and only amounts to 1.49 percentage points. If the empirical or realized wage structure remains roughly stable over time, our results imply that women underestimate the long-run development of their wages, whereas men overestimate it.

Second, when focusing on the stock market, the results show that higher long-run expectations are related to well-documented characteristics of stock market participants. Educated, middle-aged males with high earnings and with a high level of financial literacy expect relatively higher returns on the stock market (Table 2). This profile matches well

Table 2: Average expectations about development of DAX index and growth of house prices by attribute

	DAX index			House prices	
Attribute	1 year	2 years	30 years	2 years	10 years
All respondents	0.44	1.39	10.18	9.79	29.18
Gender					
Female	−0.58	−0.17	2.37	10.02	22.12
Male	1.23	2.58	16.22	9.58	35.90
Age					
$\leqslant 35$	1.28	2.61	7.07	11.03	30.93
$36 - 45$	1.14	3.16	21.70	10.34	30.55
> 45	−0.01	0.53	8.50	9.23	28.12
Gross monthly earnings					
$\leqslant 1700$	0.16	0.12	2.99	10.36	27.00
$1700 - 2800$	0.58	3.18	11.24	9.42	24.58
> 2800	0.47	1.31	11.56	9.74	30.72
Financial literacy					
< 6 correct answers	0.04	0.81	4.78	10.34	27.29
$= 6$	1.16	2.44	18.97	8.62	32.81
Home owner					
Yes	0.60	1.52	9.97	8.37	25.75
No	0.34	1.33	10.46	11.54	32.60
Tertiary education					
Yes	1.85	2.86	22.89	9.14	29.82
No	0.14	1.07	7.52	9.93	29.06

the profile of an average German stockholder. According to Deutsches Aktieninstitut (2017), the majority of investors are between 40 and 59 years old, have relatively high level of education and above-average household income. Moreover, the hump-shaped age pattern of expectations matches the life-cycle pattern documented for stock market participation and for holding risky assets in the portfolio (Guiso et al. 2002; Fagereng et al. 2017). Individuals with sound financial literacy and tertiary education also have higher average expectations, which is consistent with the higher stock market participation of this group (van Rooij et al. 2011).[17]

[17]An interesting observation is that groups of respondents with relatively low expectations about the long-run development of the stock market prices often coincide with the groups that are prone to make time-inconsistent choices. Eisenhauer and Ventura (2006) estimate the proportion of hyperbolic discounters among Italian respondents and show that intertemporal choices of younger, poorer, low-educated,

Third, for the housing market we find - except for the gender difference mentioned above - relatively little variation by respondent characteristics (Table 2). Interestingly, long-run expectations for renters are higher than for homeowners. In more detail, homeowners predict a 25.75 % increase in house prices over the next 30 years whereas those individuals who rent their dwellings are more "optimistic" and expect prices to increase by 32.60 %. Individuals in different age groups or with different levels of education provide quite similar answers. Note again, we observe that short-run expectations are relatively high for all groups of individuals. This high expected return on house prices is in line with the German housing market boom of the late 2010s. However, the data imply that individuals do not expect that this level of growth is sustainable. Their long-run subjective expectations suggest far lower growth rates in the future.

Fourth and finally, Table 3 documents differences in expected wage growth by attributes and compares them to the empirical counterparts. Although expected and empirical wage growths are quite similar on average, we find important heterogeneity on how beliefs deviate from the empirical values. As mentioned above, women underestimate their long-run wage development, whereas men overestimate it. With respect to age, we observe that younger individuals expect higher wage growth on average. This difference in beliefs is in line historical data. Interestingly, there exists a strong difference between German and non-German respondents in that the average wage expectations of non-Germans are markedly higher than those of Germans. Germans underestimate their wage increase on average, while non-Germans overestimate it. The same pattern holds for median wages, though to a lesser extent (see Appendix C.1). Respondents with tertiary education expect higher wage growth than those without tertiary education, however they underestimate the realized growth (mean 37.93 % versus 45.13 %). In contrast, re-

low-skilled, and unemployed individuals are relatively better represented by hyperbolic-discounting models. Other authors have observed that hyperbolic discounters and individuals who show other deviations from the standard neoclassical model accumulate relatively less wealth. Levy and Tasoff (2016) explore the exponential growth bias in a representative sample of US population and find a negative association between the magnitude of the bias and total savings. Harrison et al. (2002) investigate time preferences among households in Denmark and discover that high-skilled, more educated individuals, respondents with high income as well as home owners have lower discount rates, and, thus, are oriented towards the longer term. Choi et al. (2014) test consistency with respect to utility maximization in a large representative sample in Netherlands. They find that high-income, high-wealth and highly-educated respondents, men and younger individuals make more consistent choices.

spondents without tertiary education expect lower wage increases and are more accurate in their predictions.

Table 3: Average expectations and historical realizations of wage growth by attribute

	Expected			Empirical		
Attribute	1 year	2 years	10 years	1 year	2 years	10 years
All respondents	6.00	11.53	32.23	4.56	8.54	31.32
Gender						
Female	4.97	10.64	26.41	4.87	9.78	30.58
Male	6.84	12.26	36.91	4.25	7.30	32.07
Age						
$\leqslant 35$	7.77	16.39	45.93	5.74	10.66	44.97
$36 - 45$	6.45	11.20	24.32	4.14	6.69	27.42
> 45	3.98	7.24	25.02	3.83	8.70	21.75
Nationality						
German	5.89	10.66	28.56	4.59	8.68	31.75
non-German	7.36	23.87	88.60	4.02	6.21	21.47
Tertiary education						
Yes	7.06	14.49	37.93	5.20	9.35	45.13
No	5.75	10.81	30.87	4.33	8.24	25.72

Notes:
The table compares the average expected wage growth, as reported by the respondents of the SOEP-IS, to the average empirical development of wages of the SOEP respondents over the 2004-2014 period. To enhance comparison of two samples, we correct the empirical development of wages for sample selection as described in the Appendix B.4.

Overall, our results for the labor market suggest that, although average expected wage growth is similar to its empirical counterpart, some groups of individuals perform much worse in terms of predicting their future wages. One specific example is remarkable and highly relevant for the current debate about female labor market participation: high-educated German women below the age of 45 years expect, on average, that their wages will increase by 20.80 % over the next 10 years. However, the average realized increase over the time period from 2004 to 2014 for this group was 63.97 %. The difference in the median values are lower but with 13.96 % (expected) and 33.08 % (realized), respectively, it is still very large. This gap is consistent with the lower employment rate and the high share of part time work, even amongst women with high education, which we observe in many countries and especially in Germany, see e.g. Goldin (2014) or Gallego-Granados

(2019).

5.2 Variable selection and multivariate analysis

We now consider the heterogeneity of long-run expectations more systematically with the help of robust statistical technique suitable for high-dimensional settings. We focus on a large set of possible determinants that are available in the SOEP-IS data. First, we use the lasso method to perform variable selection, reducing the complexity of the model and excluding controls with little predictive power. After selecting the relevant coefficients, we perform an ordinary least squares regression (post-lasso) and interpret the estimates in a multivariate analysis (see Belloni and Chernozhukov 2013).

Table C2 in Appendix C.2 shows the results of selection via the lasso procedure. The method performs reasonably well: many selected variables are among those that are often mentioned in the standard literature that examines individual behavior in the three markets. For example, for the long-run stock market expectations, variables like gender, the level of financial literacy, labor earnings, and tertiary education are among selected covariates. In addition, the lasso method selects the variable on the saving experience during the teenage years. Among selected covariates is also the presence of a second apartment, which may be interpreted as a measure of household wealth. For the other markets, similar variables are selected. As expected, regional variables and housing attributes are important determinants explaining housing market expectations. Note that the interpretation of selected coefficients as indication of the true model structure is only possible under further assumptions (see Mullainathan and Spiess 2017 for a further discussion). This can be seen for labor market expectations, where the gender variable is omitted. Instead, the lasso method selects variables that are highly correlated with gender, such as working history or risk aversion.

The multivariate analyses show expected results for all markets (see Table C3 in the Appendix C.2). Specifically, the coefficients have the expected signs and the effects are comparable to the findings of the previous section. For the stock market, we find a strong negative and significant gender effect, while the saving experience during the

teenage years has a sizable and significant positive effect.[18] [19]

The analysis for the housing market documents that women, risk averse individuals, and individuals who lived in the former GDR tend to be more pessimistic about the long-term development of housing prices. We find an interesting regional pattern that is consistent with the observed regional price developments of the late 2010s: expectations of individuals residing in Berlin and Bavaria are markedly higher than those of individuals in other regions. Finally, having a fixed rental contract is positively associated with expected price increases.

For the labor market, we observe that being a German citizen, having college or university education, a permanent working contract, or paying back a household loan is negatively related to the long-run expectations about development of wages. In contrast, being in the process of education, receiving income from one's partner, and being relatively more risk averse is positively related to the expected wage growth over the next ten years.

Finally, we analyze heterogeneity in long-run expectations with respect to home and stock ownership. The information about stock holdings is only included in the 2018 wave of the SOEP-IS. We, therefore, exploit the longitudinal dimension and link the long-run expectations of individuals observed in 2016 to the information about stock holdings. The regression results are presented in Table C5 in the Appendix C.2. We find that the long-run expectations of stock holders are clearly higher and the effect is significant (at the 5 % nominal level for the stock price expectations and at the 10 % nominal level for the house price expectations). In contrast, we do not find a significant effect of home ownership in the expectations about house prices.

[18]This finding goes in line with the evidence collected by Luehrmann et al. (2015) who show that a short financial education program on teenagers in German high schools raises their interest in financial matters, increases their financial knowledge, and improves their ability to properly assess the riskiness of assets.

[19]In table C4 in the Appendix C.2 we analyze heterogeneity of differences in expectations instead of focusing on the levels. Overall, the results are very similar. Although the magnitude of coefficients differs for several variables the general pattern of heterogeneity is the same.

6 Conclusion

In this paper, we document the long-run price expectations of households in three important markets: the financial market, the labor market, and the housing market. We extend the existing literature, which has mainly focused on short-run or medium-run expectations, by providing evidence about expectations over longer periods. This is relevant since many of the most important economic decisions of a household concern the long run.

For the analysis, we design an extensive survey module in the Innovation Sample of the German Socio-Economic Panel (SOEP-IS). Using a number of novel questions, we elicit price expectations for financial, labor, and housing markets in the short run and the long run. We compare expectations to realized price changes and systematically account for heterogeneity by using the lasso method for variable selection.

We find that long-run price expectations in financial and housing markets are extremely pessimistic, while expectations for the labor market are fairly close to historical values even in the long run. Linear extrapolations of short-run expectations can approximate long-run expectations in the labor market, but not in financial or housing markets. In the latter two, long-run expectations of households are severely below linear price growth. One possible explanation for this pattern is that labor market provides a far more tangible set of experiences and that many individuals find it hard to realize the importance of elapsing time in the other two markets. In all markets, short-run expectations of individuals are similar to historical values. Regarding the socio-demographic characteristics, we find that women have lower long-run expectation in all markets. For financial market, we also find that groups that are commonly found to be more active in the stock market have systematically higher price expectations, although their long-run expectations are also far too pessimistic.

Our results provide insights for studies that analyze long-run decisions of households, e.g. in life-cycle models and portfolio-choice models. They are mostly based on rational-expectation assumptions. Our results are not consistent with this and indicate pessimistic long-run expectations, specifically in the financial market and in the housing market. Im-

portantly, although we document sizable heterogeneity, the results for the stock market and the housing market show that even above-average expectations lie far below a hypothetical linear growth path, or the realized price paths of the past.

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Appendix A: Data on Expectations

Appendix A.1 Descriptive statistics

Table A1 provides information about main socio-demographic characteristics of the SOEP-IS sample. The sample consists of 51 % female and 49 % male respondents. Their age ranges from 17 to 94 years; 58 % of respondents are married. In terms of education, 23 % have Abitur qualification[20] and 16 % have completed tertiary education. The respondents differ with respect to their work situation represented by dummy variables (36 % work full-time; 13 % work part-time and 39 % are economically inactive). The average gross monthly wage is €1457.32.

Table A1: Summary statistics, SOEP-IS 2016

Attribute	Mean	Median
Female	0.51	1
Age	52.06	53
Married	0.58	1
Number of Children	1.09	0
Abitur	0.23	0
Tertiary Education	0.16	0
Financial Literacy	4.34	5
Gross Monthly Wage	1457.32	345
Full-Time Employee	0.36	0
Part-Time Employee	0.13	0
Economically Inactive	0.39	0
Lived in the GDR before 1989	0.19	0
Homeowner	0.47	0

Notes:
The table summarizes information about the SOEP-IS sample in the year 2016. We provide mean and median value by attribute.

[20] Abitur is a certificate of general qualification for university entrance granted by university-preparatory schools in Germany.

Appendix A.2 Wording of the survey questions

The wording of the questions in the SOEP-IS survey is as follows.

Labor Market

Suppose you continue to work full-time (part-time) in the next years, regardless of whether you are actually planning to reduce your working hours. Please think about full-time (part-time) jobs that you can perform with your qualification. What do you think is your monthly gross salary in one year (two years, 10 years)?

Financial Market

In the following, we would like to ask you several questions about the topic "Finance". This refers to the German Stock Index DAX, which summarizes the economic development of 30 major German companies. We would like to know how you assess the future performance of DAX, expressed in terms of gains or loss compared to today's value.

Let us talk about the next year (two years, 30 years), namely the next 12 (24, 360) months: Do you expect that the DAX will experience a gain or a loss in one year (two years, 30 years) compared to today's value? Expressed in numbers: What gain/ loss do you expect for the next year (two years, 30 years) overall in percent?

Housing Market

The following section concerns your expectation regarding the price development of residential property for sale in your area.

How will the purchase price of residential real estate develop in two years (30 years) compared to today? What do you think: by what percentage the purchase price in two years (30 years) will be higher/ lower than the purchase price today?

We have designed the questions to elicit expectations about nominal price developments. We do not specify this directly in the survey to avoid confusion that could arise from explaining the notion of inflation to participants. In contrast to, e.g., the S&P 500, the DAX is a performance index, which means that dividend payments are included in the return calculations. In case of expected development of wages, we are interested in the Euro amount of future wages, which directly implies nominal prices. Similar to the stock market, expectations about the housing market prices are elicited in percentages. Our design of measuring expectations leaves some room for misinterpretation, specifically in the stock market and in the housing market. Therefore, when comparing expectations with historical price changes in these two markets, we measure historical values in both real and nominal terms.

Our survey questions ask for the measure of central tendency. This method of belief elicitation has several drawbacks. Although point predictions express central tendency of beliefs, it remains unclear what specific measure of central tendency the respondents have in mind when answering the questions. Moreover, point predictions provide no information about the degree of uncertainty of the respondents. See Manski (2018) for discussion of the drawbacks of the point predictions. An alternative approach is to elicit the entire distribution either by asking for probabilities of an event lying above a certain threshold or by distributing a fix number of items with probability mass of one into a number of bins. Although probabilistic expectations allow for better interpersonal and intrapersonal comparisons of responses, we stick with eliciting point predictions for several reasons. The method has an advantage of being easy to understand and appeals to regular thinking. Moreover, Breunig et al. (2021) compare point estimates and expectations inferred from the probability distributions in the 2012 wave of the SOEP-IS and conclude that they are highly correlated.

Appendix A.3 Subjective expectations

Table A2 provides the short- and long-run expectations of the sample balanced at the market level. Comparing the resulting key characteristics with the values obtained for the full sample, we infer that the differences are minor and arrive at the same conclusions as in the case of the full sample.

Overall, we observe some number of missing responses in expectations' questions of the SOEP-IS. Respondents either skip the questions completely or are unwilling to provide estimates over longer time horizons. In case of the short-run expectations (one- and two-years-ahead forecasts), we are left with 65 % to 83 % of observations. The number of missing values is larger for the labor market due to the fact that we restrict the sample of interest to employed individuals. In general, percentage of observed values is in line with other studies measuring short-run expectations (Dominitz and Manski 2011).

Table A2: Subjective expectations balanced at the market level

Expectation	N	Mean	St. Dev.	Q25	Q50	Q75	Min	Max
DAX index								
1 year	767	1.06	13.42	−5.00	2.00	5.00	−100	102
2 years	767	1.93	13.36	−4.00	3.00	7.00	−70	104
30 years	767	9.94	40.28	−5.00	5.00	20.00	−100	500
Wages								
1 year	498	6.29	18.52	0.00	2.00	6.67	−50	167
2 years	498	11.69	26.91	1.67	4.94	12.00	−50	181
10 years	498	31.06	64.58	9.52	17.27	31.58	−50	934
House prices								
2 years	992	9.85	12.01	5.00	10.00	15.00	−50	110
30 years	992	29.14	59.67	10.00	20.00	40.00	−95	1000

Appendix A.4 Comparison of growth rates

Table A3: Comparison of growth rates

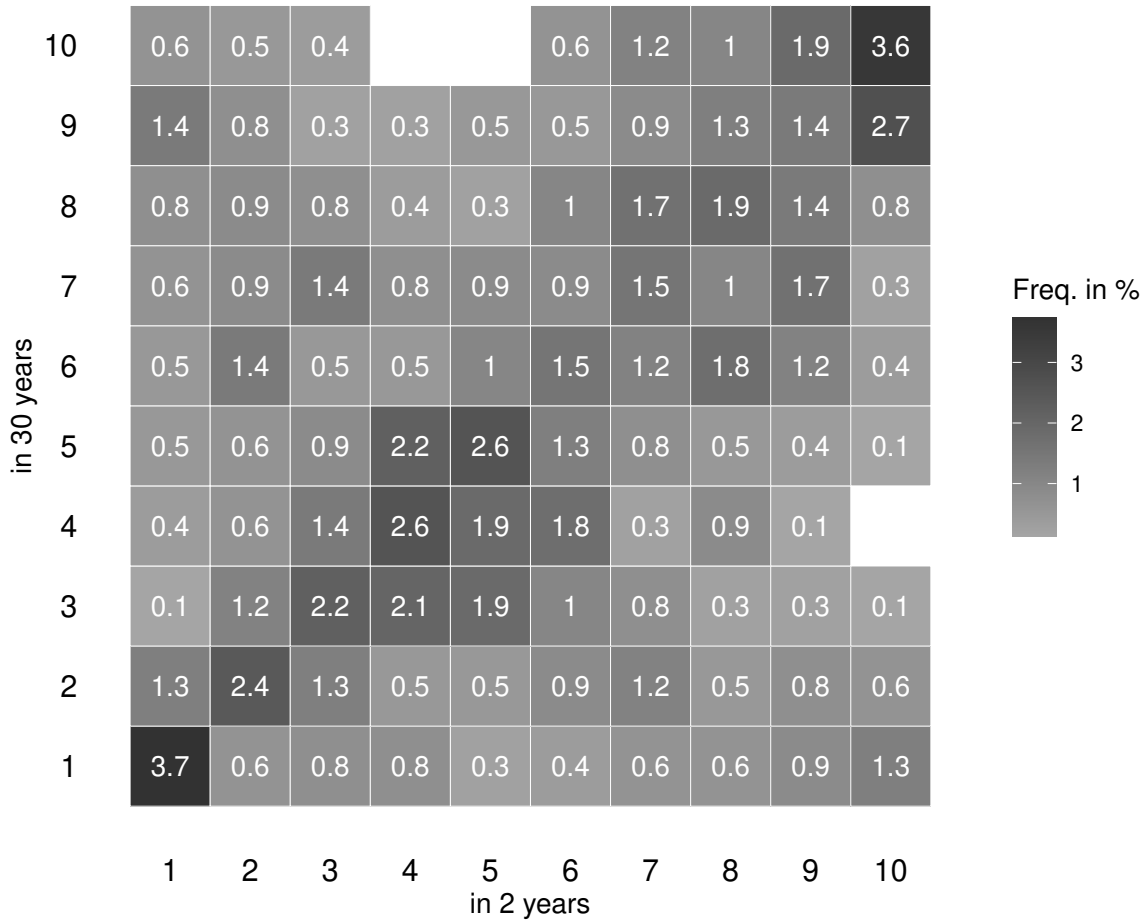
	Subjective Expectations				Linear Growth				Exponential Growth			
	Mean	Median	Q25	Q75	Mean	Median	Q25	Q75	Mean	Median	Q25	Q75
DAX index												
1 year	0.44	2.00	−5.00	5.00	0.70	1.00	−2.50	3.00	0.69	1.00	−2.53	2.96
2 years	1.39	2.00	−5.00	6.00	1.39	2.00	−5.00	6.00	1.39	2.00	−5.00	6.00
30 years	10.18	5.00	−5.00	20.00	20.89	30.00	−75.00	90.00	23.06	34.59	−53.67	139.66
Wages												
1 year	5.85	1.78	0.00	6.25	5.73	2.38	0.61	5.56	5.57	2.35	0.61	5.41
2 years	11.46	4.76	1.23	11.11	11.46	4.76	1.23	11.11	11.46	4.76	1.23	11.11
10 years	30.87	17.08	9.52	31.58	57.30	23.81	6.15	55.56	72.02	26.19	6.30	69.35
House prices												
2 years	9.79	10.00	5.00	15.00	9.79	10.00	5.00	15.00	9.79	10.00	5.00	15.00
30 years	29.18	20.00	10.00	40.00	146.91	150.00	75.00	225.00	306.15	317.72	107.89	713.71

Notes:
The table compares the moments of subjective expectations elicited in the SOEP-IS (the first four columns) to the moments of two counterfactual scenarios that simulate linear and exponential growth. For each market, we take the moment of the two-years-ahead expectations as given and calculate the long-run development of prices accordingly.

Appendix A.5 Stability of expectations

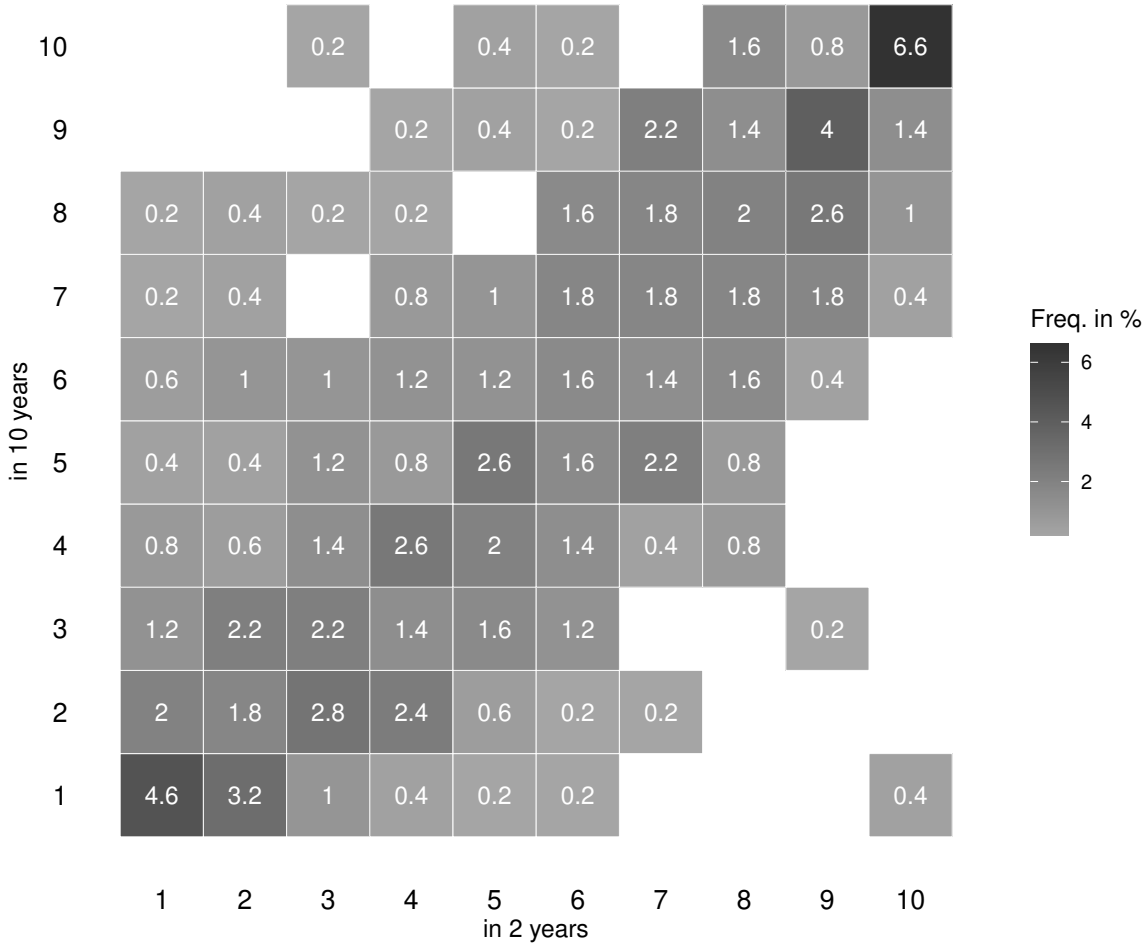
We explore persistence of expectations by investigating whether individuals who have relatively modest or high expectations about development of prices in the short-run possess expectations of a similar magnitude in the long run. In order to investigate the persistence, we group short-run (2-years-ahead) and long-run (10- or 30-years-ahead) expectations by deciles. Figures A.1–A.3 depict transition matrices for the three markets. Individuals with persistent expectations are located around the main diagonals.

Figure A.1: Expected gain from investment in the DAX by deciles



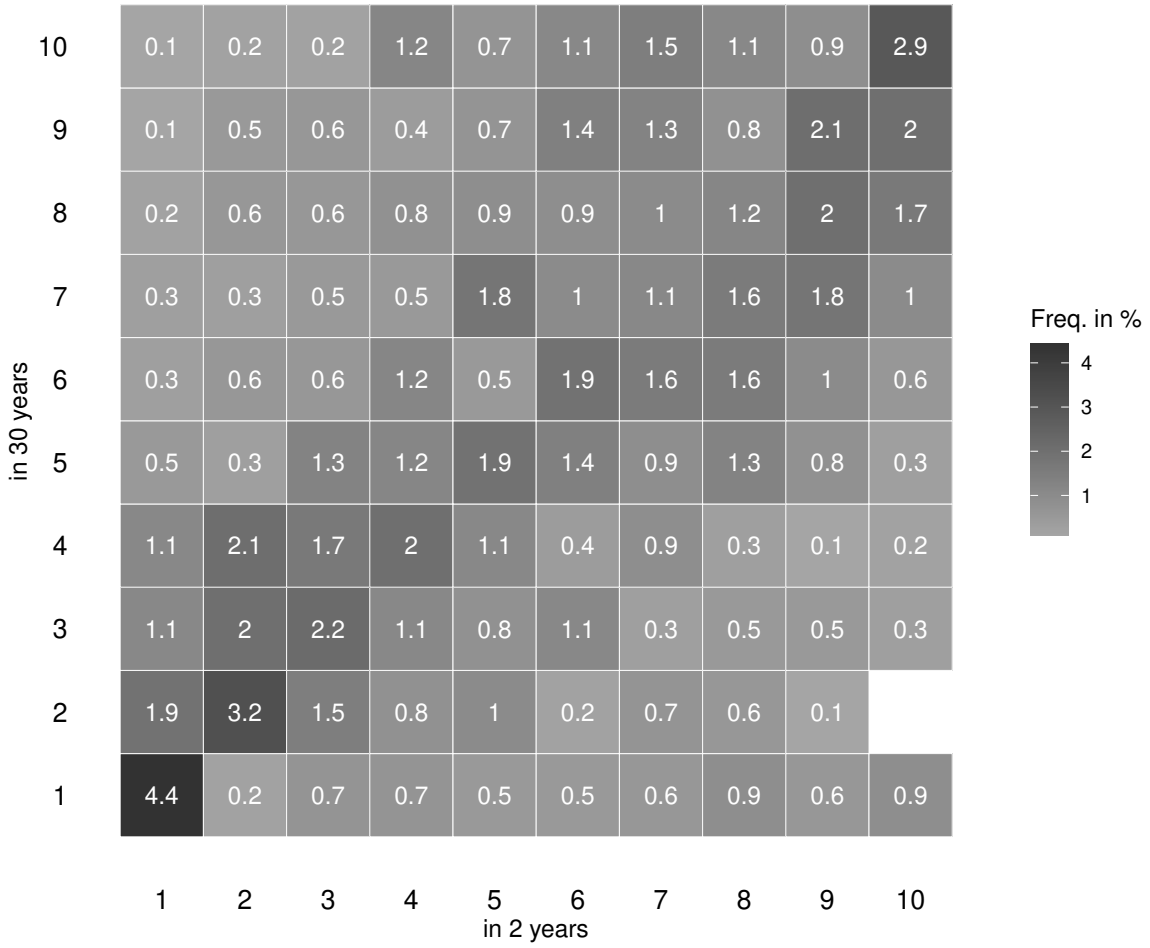
Notes:
The figure splits short- and long-run expectations of individuals about development of the DAX index into deciles. Each cell corresponds to a share of individuals (in percent) whose short- and long-run expectations fall into depicted decile groups.

Figure A.2: Expected wage growth by deciles



Notes:
The figure splits short- and long-run expectations of individuals about their wage growth into deciles. Each cell corresponds to a share of individuals (in percent) whose short- and long-run expectations fall into depicted decile groups.

Figure A.3: Expected development of house prices by deciles



Notes:
The figure splits short- and long-run expectations of individuals about development of house prices into deciles. Each cell corresponds to a share of individuals (in percent) whose short- and long-run expectations fall into depicted decile groups.

Table A4: Stability of expectations

	Dependent variable: Stability of expectations					
	Stock prices		Wages		House prices	
Female	0.093	(0.157)	0.313	(0.199)	0.004	(0.142)
Age	−0.003	(0.005)	0.002	(0.008)	−0.005	(0.004)
German	−0.347	(0.308)	−0.355	(0.397)	0.092	(0.273)
Tertiary education	0.004	(0.211)	0.286	(0.251)	−0.034	(0.195)
Financial literacy	−0.064	(0.090)	0.178*	(0.104)	−0.089	(0.069)
High financial literacy	0.391*	(0.232)	−0.339	(0.280)	0.325	(0.203)
Monthly wage	−0.0001*	(0.00004)	−0.00001	(0.0001)	−0.0001*	(0.00004)
Lived in East Germany before 1989	0.267	(0.193)	0.103	(0.244)	0.184	(0.171)
Home owner	−0.102	(0.158)	0.095	(0.195)	−0.066	(0.141)
Second apartment	−0.156	(0.334)	0.395	(0.437)	0.556*	(0.324)
Constant	0.585	(0.508)	−0.475	(0.629)	0.221	(0.417)
Observations	731		492		918	
Akaike Inf. Crit.	1,020.621		688.340		1,258.538	

*p<0.1; **p<0.05; ***p<0.01

Notes:
This table provides an output of logistic regression. The dependent variable is a binary variable that describes stability of expectations in the three markets. Expectations of individuals are persistent if the short-run (two-years-ahead) expectations are in the same quartile as the long-run (10- or 30-years-ahead) expectations. Standard errors are provided in parentheses.

Appendix B: Expectations versus realizations

Appendix B.1 Calculation of historical gains from investment

The nominal and real gain from investment in the DAX index made in the year t_0 over the next $T \in \{1, 2, 30\}$ years is calculated as:

$$G_T^{DAX}(s) = \left(\left(\prod_{t=t_0}^{t_0+T-1} (1 + \pi_t(s)/100) \right) - 1 \right) \cdot 100, \qquad s \in \{n, r\}, \tag{B.1}$$

where $\pi_t(n)$ is a nominal annual return and $\pi_t(r)$ is a real annual return on the DAX index in the year t. Specifically, we let $\pi_t(r) = \pi_t(n) - i_t$ with inflation rate $i_t = (cpi_t/cpi_{t-1} - 1) \cdot 100$, where cpi_t denotes the consumer price index in the year t. In order to adjust for inflation, we use the historical data on consumer price index from the JST Macrohistory Database.

Appendix B.2 Calculation of historical increases in house prices

Historical data on house prices originates from the JST Macrohistory Database and covers 1962 to 2016. We employ the data on nominal and real house price indices to calculate the development of prices in two and thirty years. The calculation of global price development relies on the average house prices of 14 advanced economies: Australia, Belgium, Canada, Denmark, Germany, Finland, France, Japan, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, and the United States.

The nominal and real increase in house prices starting from the year t_0 over the next $T \in \{2, 30\}$ years is calculated as:

$$G_T^H(s) = \left(\left(\prod_{t=t_0}^{t_0+T-1} (1 + \widetilde{\pi}_t(s)/100) \right) - 1 \right) \cdot 100, \qquad s \in \{n, r\}, \tag{B.2}$$

where $\widetilde{\pi}_t(n) = \big(hp_t(n) - hp_{t-1}(n)\big)/hp_{t-1}(n)$ is a relative change in the nominal house price index $hp_t(n)$ and $\widetilde{\pi}_t(r) = \widetilde{\pi}_t(n)/cpi_t \cdot 100$ is a relative change in the real house price index in the year t.

Appendix B.3 Expected and historical developments of stock and house prices

Table B1 specifies the average gain from investment in the DAX index over one, two, and thirty years. The values are expressed in percent. The first row describes expected gains, whereas the next rows present average historical gains in the specified time period. Historical development of stock prices is calculated both in nominal and real terms.

Table B2 specifies the average increase in house prices over two and thirty years in percent. The first row describes expected change, whereas the next rows present historical price development in Germany and aggregation over selected countries. Historical development of house prices is calculated both in nominal and real terms for the 1962-2016 period.

Table B1: Expected and historical development of stock prices

	Nominal			Real		
	1 year	2 years	30 years	1 year	2 years	30 years
Expected	0.44	1.39	10.18	0.44	1.39	10.18
1951 – 2016	15.02	30.77	1741.55	12.46	25.21	689.60
1951 – 2018	14.49	30.04	1708.35	11.95	24.55	684.62
1988 – 2018	12.22	23.46	1094.15	9.40	19.34	592.53

Table B2: Expected and historical development of house prices

	Nominal		Real	
	2 years	30 years	2 years	30 years
Expected	9.79	29.18	9.79	29.18
Germany	7.99	144.07	2.36	2.36
Global	12.72	480.91	4.36	72.31

Appendix B.4 Calculation of historical development of wages

In order to compare expected earnings from employment with their empirical counterparts, we use the German Socio-Economic Panel (SOEP), a rich longitudinal dataset with detailed information on individual's earnings. We focus on the period from 2004 to 2014 and restrict the sample to individuals who were younger than 55 in 2004, excluding individuals in retirement, self-employed, the military, and disabled. To enhance comparison of expectations and realizations as well as to account for selection effects, we apply quantile regression method to impute earnings for each individual and each year whenever they are not realized or there is a change in employment status.[21] In particular, we use an imputation-based method developed by Melly and Santangelo (2015) to correct for sample selection issues. This method is applied by Gallego-Granados (2019) based on the same data. We use information from a realized wage of an individual and, assuming the time invariance of unobservable characteristics conditional on observables, we impute the

[21]SOEP-IS respondents assess development of their future wages given their current employment status (full- or part-time employment) assuming that their employment status will not change over the assessment period. Therefore, it is reasonable to impute full- or part-time wage distributions whenever one of them is missing in the comparison sample.

wage whenever it is not realized or there is a change in individual's employment status.

The method of Melly and Santangelo (2015) extends the changes-in-changes model of Athey and Imbens (2006). Intuitively, Melly and Santangelo (2015) distinguish between subsamples with individuals who are observed working in two given periods (group 0) and subsamples of individuals that only work in one of these two periods (group 1). Observing how wages of group 0 evolve over time allows us to trace back the conditional wages of group 1 in the requested period accounting for both observable and unobservable characteristics of individuals. This imputation method relies on the identifying assumption that unobservables are invariant conditional on the observables.

Formally, Melly and Santangelo (2015) express the conditional wage distribution of those individuals not working in period $t = k$, but working in period $t = l$ as:

$$F^{-1}_{W|g=1,t=k,x}(\theta) = F^{-1}_{W|g=0,t=k,x}\left(F_{W|g=0,t=l,x}\left(F^{-1}_{W|g=1,t=l,x}(\theta)\right)\right) \tag{B.3}$$

for any θ quantile, by time invariance as main identification assumption. The wage equation is estimated as a linear conditional quantile regression model (Koenker and Bassett 1978): $\widehat{F}^{-1}_{W|g,t,x}(\theta) = x'\widehat{\beta}_{g,t}(\theta)$. Further, we estimate $\widehat{F}_{W|g,t,x}(w) = \int_0^1 \mathbb{1}\{\widehat{F}^{-1}_{W|g,t,x}(u) \leq w\}du$ where $\mathbb{1}\{\cdot\}$ denotes the indicator function. This yields an estimator of individual wages conforming $F^{-1}_{W|g=1,t=k,x_i}(\theta)$ given by:

$$\widetilde{w}_{ikl} = x_i'\widehat{\beta}_{g=0,t=k}\left(\int_0^1 \mathbb{1}\left\{x_i'\widehat{\beta}_{g=0,t=l}(u) \leq x_i'\widehat{\beta}_{g=1,t=l}(\theta)\right\}du\right). \tag{B.4}$$

In our application, group 0 consists of individuals who were employed both in 2004 and in one of the subsequent years $t \in \{2005, \ldots, 2014\}$ whereas group 1 consists of individuals whom we observe in 2004, but not in some of the subsequent years. We allow for different wage processes for men and women. Moreover, we allow the wage structure of full- and part-time employment to differ from each other in case of female employment and carry out imputation procedure separately for these two kinds of female employment. In case of male employment, we impute missing wages for the whole sample because there

are only few cases of male part-time employment. We use slightly modified estimators:

$$\widetilde{w}^{F,FT}_{ik,2004} = x_i' \widehat{\beta}_{g^{F,FT}=0,t=k} \left(\int_0^1 \mathbb{1}\left\{ x_i' \widehat{\beta}_{g^{F,FT}=0,t=2004}(u) \leq \bar{w}^{F,FT}_{i,t=2004} \right\} du \right), \tag{B.5}$$

$$\widetilde{w}^{F,PT}_{ik,2004} = x_i' \widehat{\beta}_{g^{F,PT}=0,t=k} \left(\int_0^1 \mathbb{1}\left\{ x_i' \widehat{\beta}_{g^{F,PT}=0,t=2004}(u) \leq \bar{w}^{F,PT}_{i,t=2004} \right\} du \right), \tag{B.6}$$

$$\widetilde{w}^{M,All}_{ik,2004} = x_i' \widehat{\beta}_{g^{M,All}=0,t=k} \left(\int_0^1 \mathbb{1}\left\{ x_i' \widehat{\beta}_{g^{M,All}=0,t=2004}(u) \leq \bar{w}^{M,All}_{i,t=2004} \right\} du \right), \tag{B.7}$$

where $\bar{w}_{i,t=2004}$ is the observed wage for person i in $t = 2004$ and replaces its estimated equivalent $x_i' \widehat{\beta}_{g=1,t=2004}(\theta)$ in expression (B.4) above.

The dependent variable, w_{it}, is the natural logarithm of the actual hourly wage and the set of independent variables, x_{it}, consists of an intercept, age (polynomial up to the third order), an indicator variable for an advanced degree, actual working experience (polynomial up to the third degree), and an indicator variable for having a residence in West Germany.

Appendix C: Heterogeneity of Expectations

Appendix C.1 Heterogeneity of expectations about wage growth

Table C1: Median expectations and historical realizations of wage growth by attribute

Attribute	**Expected**			**Empirical**		
	1 year	2 years	10 years	1 year	2 years	10 years
All respondents	2.13	5.09	17.65	1.55	3.59	21.90
Gender						
Female	1.43	4.84	16.42	1.23	3.35	21.18
Male	2.35	5.43	19.83	1.85	3.84	23.06
Age						
$\leqslant 35$	3.17	8.16	25.00	2.40	5.05	29.48
$36-45$	2.17	4.76	16.67	1.35	3.32	20.84
>45	1.43	4.15	15.69	0.98	2.50	18.13
Nationality						
German	1.96	5.00	16.77	1.59	3.67	22.22
non-German	3.07	11.76	29.74	0.69	2.35	16.67
Tertiary education						
Yes	1.91	4.73	20.00	2.19	4.71	29.89
No	2.22	5.26	16.67	1.30	3.17	19.15

Notes:
The table compares the median expected wage growth as reported by the respondents of the SOEP-IS to the median empirical development of wages of the SOEP respondents over the 2004-2014 period. To enhance comparison of two samples, we correct the empirical development of wages for sample selection as described in the Appendix B.4.

Appendix C.2 Variable selection and multivariate analysis

We use the lasso method to select the relevant heterogeneity in the SOEP-IS data set. The lasso estimator depends on penalization, and the amount of penalization is chosen via cross validation. For the purpose of robustness, the lasso is performed 1000 times, each time with different sample splits for the cross-validation procedure. The variables are ordered according to the frequency of their selection into the model and a threshold of 20 % is applied: covariates selected by the lasso more than 20 % of the time are considered for further analysis.

Table C2 presents the subset of variables selected by the lasso and frequencies of their selection. For the stock market, the dependent variable is the expected development of the DAX index over the next thirty years. The selection is based on 663 observations and 108 explanatory variables. For the labor market, the dependent variable is the expected wage growth over the next ten years. The selection is based on 389 observations and 90 explanatory variables. The initial set of covariates is different from the one used for the two other markets because we exclude the covariates that characterize unemployed individuals. For the housing market, the dependent variable is the expected development of the house prices over the next thirty years. The selection is based on 823 observations and 108 explanatory variables.

Table C3 summarizes the results of the ordinary least squares regression (post-lasso) with a set of covariates that was pre-selected by lasso.

Table C4 is constructed in the similar way to the Table C3, but the dependent variable is the difference between long- and short-run expectations.

Table C5 relates long-run expectations and personal experiences in stock and housing markets.

Table C2: Selected covariates that affect the long-run expectations in the three markets

Market	Selected variables	Frequency
Stock Market	Intercept	1000
	Female	1000
	Abitur	1000
	University education	1000
	Financial literacy	1000
	High financial literacy	1000
	Saving between 12 and 16	1000
	Monthly wage	1000
	Investment income	1000
	Fixed rental contract	1000
	Second apartment	1000
	Schleswig-Holstein	1000
	Sachsen	964
	Civil servant	817
	Household member requiring care provision	756
	Income from rent	680
	Size of apartment in sq. m.	408
	Brandenburg	266
	Parent of an infant	201
Labor Market	Intercept	1000
	College or university education	680
	In education	669
	German	671
	Permanent working contract	666
	Years employed at the current job	561
	Income from partnership	449
	Years from schooling	401
	Paying back household credit	378
	Hessen	378
	Relative risk aversion	322
	Monthly rent	299
	Second apartment	268
	Monthly wage	236
Housing market	Intercept	1000
	Female	991
	Fixed rental contract	984
	Bayern	736
	Berlin	736
	Second apartment	691
	Size of apartment in sq. m.	576
	German	525
	Lived in East Germany before 1989	420
	Brandenburg	316
	Number of children in the household	296
	Relative risk aversion	244
	Arithmetic abilities	244

Notes:
The table specifies the list of covariates selected by the lasso procedure. The dependent variables are the long-run expectations in the three markets.

Table C3: Post-lasso (OLS) for the long-run expectations

	Dependent variable: Long-run expectations					
	Stock prices		Wages		House prices	
Demographic characteristics						
Female	−10.725***	(3.165)			−15.699***	(4.301)
German			−48.638***	(14.355)	−12.922	(8.736)
Relative risk aversion			5.091**	(2.537)	−4.182***	(1.573)
Education						
Abitur	4.070	(4.265)				
College or university education			−41.729***	(13.388)		
University education	9.385*	(4.896)				
In education			33.179**	(15.335)		
Arithmetic abilities					4.978**	(2.418)
Financial literacy	1.411	(1.939)				
High financial literacy	7.680	(4.757)				
Experience						
Years from schooling			−0.216	(0.369)		
Years employed at the current job			−0.363	(0.440)		
Saving btw 12 and 16	10.688***	(3.637)				
Employment						
Monthly wage	0.002***	(0.001)	−0.004**	(0.002)		
Permanent working contract			−13.337	(9.389)		
Civil servant	−15.357*	(8.031)				
Income						
Income from partnership			78.663**	(33.259)		
Investment income	4.516	(3.519)				
Income from rent	−7.146*	(4.860)				
Household and housing characteristics						
Parent of an infant	−18.042*	(10.587)				
Number of children in the household					−4.096*	(2.404)
Household member requiring care provision	−16.436	(10.990)				
Monthly rent			0.013*	(0.008)		
Size of apartment in sq. m.	−0.062*	(0.037)			−0.082*	(0.049)
Paying back household credit			−16.010**	(6.987)		
Fixed rental contract	16.950*	(9.411)			35.634***	(12.589)
Second apartment	16.119**	(6.582)	29.367**	(14.299)	17.768*	(10.086)
Regional characteristics						
Schleswig-Holstein	15.090**	(6.646)				
Hessen			19.099*	(10.951)		
Bayern					15.063**	(6.872)
Berlin					24.815***	(8.906)
Brandenburg	−14.024	(10.662)			−22.260	(14.352)
Sachsen	−15.014**	(6.934)				
Lived in East Germany before 1989					−9.841*	(5.443)
Constant	−3.884	(8.769)	117.300***	(23.486)	69.133***	(12.620)
Observations	663		389		823	
R^2	0.145		0.211		0.080	
Adjusted R^2	0.121		0.183		0.067	
F Statistic	6.045*** (df = 18; 644)		7.697*** (df = 13; 375)		5.906*** (df = 12; 810)	

Notes:
Unstandardized coefficients reported with standard errors in parenthesis.
*p<0.1; **p<0.05; ***p<0.01

Table C4: OLS for the differences

	Dependent variable: △ between long- and short-run expectations					
	Stock prices		Wages		House prices	
Demographic characteristics						
Female	−5.021	(3.054)			−14.423***	(3.220)
German			−19.080**	(7.592)	1.136	(6.532)
Relative risk aversion			2.255*	(1.342)	−3.320***	(1.185)
Education						
Abitur	4.942	(4.072)				
College or university education			−13.538*	(7.097)		
University education	5.186	(4.670)				
In education			33.550***	(8.256)		
Arithmetic abilities					3.716**	(1.818)
Financial literacy	2.580	(1.859)				
High financial literacy	4.656	(4.583)				
Experience						
Years from schooling			−0.183	(0.195)		
Years employed at the current job			−0.018	(0.233)		
Saving btw 12 and 16	10.060***	(3.480)				
Employment						
Monthly wage	0.002***	(0.001)	−0.001	(0.001)		
Permanent working contract			−9.590*	(4.975)		
Civil servant	−13.220*	(7.657)				
Income						
Income from partnership			−7.209	(17.587)		
Investment income	2.068	(3.411)				
Income from rent	−5.987	(4.690)				
Household and housing characteristics						
Parent of an infant	−18.316*	(10.086)				
Number of children in the household					−2.896	(1.785)
Household member requiring care provision	−9.011	(10.472)				
Monthly rent			−0.002	(0.004)		
Size of apartment in sq. m.	−0.086**	(0.035)			−0.035	(0.036)
Paying back household credit			−6.088	(3.704)		
Fixed rental contract	7.009	(8.968)			30.429***	(9.727)
Second apartment	14.105**	(6.273)	12.381	(7.562)	19.714***	(7.468)
Regional characteristics						
Schleswig-Holstein	9.581	(6.333)				
Hessen			10.311*	(5.860)		
Bayern					13.343***	(5.098)
Berlin					12.070*	(6.600)
Brandenburg	−11.533	(10.162)			−13.943	(10.637)
Sachsen	−12.014*	(6.618)				
Lived in East Germany before 1989					−7.160*	(4.090)
Constant	−7.210	(8.376)	49.130***	(12.422)	35.853***	(9.496)
Observations	648		387		805	
R^2	0.109		0.162		0.086	
Adjusted R^2	0.084		0.133		0.072	
F Statistic	4.289*** (df = 18; 629)		5.549*** (df = 13; 373)		6.189*** (df = 12; 792)	

Notes:
Unstandardized coefficients reported with standard errors in parenthesis.
*p<0.1; **p<0.05; ***p<0.01

Table C5: Long-run expectations and personal experiences

	Dependent variable: Long-run expectations			
	Stock prices		House prices	
Holding stocks in 2018	14.054**	(5.477)	11.087*	(6.040)
Home owner	−1.192	(4.735)	−6.238	(4.123)
Planning to buy real estate by 2018	9.578	(8.494)	8.280	(7.423)
Female	−13.191***	(4.691)	−12.666***	(4.132)
Age	−0.035	(0.152)	0.086	(0.123)
German	11.483	(9.878)	−12.955*	(7.866)
Tertiary education	7.986	(6.077)	−3.462	(5.703)
Financial literacy	1.688	(2.762)	0.554	(2.026)
High financial literacy	9.569	(6.890)	4.344	(5.900)
Monthly wage	0.002*	(0.001)	−0.0001	(0.001)
Lived in East Germany before 1989	−5.862	(5.962)	−9.855**	(5.019)
Second apartment	19.981**	(9.594)	15.761	(9.636)
Constant	−11.493	(16.529)	41.986***	(12.287)
Observations	428		926	
R^2	0.130		0.036	
Adjusted R^2	0.105		0.023	
F Statistic	5.155*** (df = 12; 415)		2.850*** (df = 12; 913)	

*p<0.1; **p<0.05; ***p<0.01

Notes:
The table summarizes results of two linear regressions. The dependent variables are long-run (30-years-ahead) expectations about development of prices in the stock and housing market. In addition to socio-economic characteristic of individuals, the list of covariates includes variables related to individual experiences in the two markets. For the stock market, we include a proxy of intention to invest in stocks: whether individuals invested in stocks in 2018. For the housing market, we include variables that specifies home ownership and intention to buy residential real estate in the next two years.