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Abstract

The rational expectations assumption, e.g. in life-cycle models and portfolio-choice models, prescribes agents to have model-consistent beliefs and to avoid systematic prediction errors. In reality, justification and identification of expectations are nontrivial. One way to solve this problem is to elicit expectations collecting survey data. We utilize the German SOEP Innovation Sample to analyze short-run and long-run expectations of households in three different domains: stock market, labor market and housing market. Our main contribution to the existing literature is that we study expectations about price developments over longer periods, which is of central relevance since many important economic decisions of households concern the long run. Previous studies have mainly focused on short-run or medium-run expectations. We document that while expectations about wages are similar to historical values, the long-run expectations about the developments of the stock market index and about house prices are strongly pessimistic. In the case of the stock market, respondents expect only a small percentage of historical growth. We also observe substantial heterogeneity of expectations by socio-economic background.

Key words: Long-run expectations, Biased beliefs, Returns to education.

JEL classification: D63; H23; I24; I38; J22; J31.

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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, choosing a retirement savings vehicle are examples of such decisions. Their set of consequences is large, realizing over a long period of time. The decisions are only partly reversible and are 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 therefore 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. Previous studies have mainly focussed on short-run or medium-run expectations. To do so, we design an extensive survey module in the Innovation Sample of the German Socio Economic Panel (SOEP-IS), a large and representative household panel study in Germany. Using a number of novel questions, we elicit price expectations for financial, labor and housing markets over different periods: one, two, ten or thirty years. We use this data for a descriptive analysis that consists of three steps: First, we compare the elicited long-run expectations to their short-run analogues. In a second step, we compare the elicited expectations to the historically realized developments of the relevant economic variables. Third and finally, we exploit the rich information from the household survey to study the heterogeneity in expectations, i.e. how expectations vary by important socio-demographic variables. We select these variables using a data-driven lasso-approach.

We derive the following main findings: Long-run price expectations in financial and housing markets are extremely pessimistic, while expectations for 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 labor market, but not in financial or housing market. In the latter two, long-run expectations of households are severely below linear price growth. In all markets, short-run expectations of individuals are similar to historical values. Regarding the socio-demographic variables, 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. For housing market, individual characteristics, including age and the level of education, seem to matter less.

Over the last several decades, 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 macroeconomic models. In the seminal work on measuring expectations, Manski (2004) encouraged researchers to collect survey data on subjective beliefs. The survey and experimental evidence

that has emerged since then indeed finds a strong link between subjective beliefs and economic decisions (see e.g. Manski 2018, Schotter and Trevino 2014 for reviews). In addition to improvements in understanding and predicting individual decisions, knowledge of subjective expectations helps to overcome an identification problem that arises in revealed preference analysis: the standard practice of estimating both preferences and beliefs from the observed choice behavior does not provide a unique solution. One common way to address the identification issue and to obtain unique estimates of model parameters is to rely on rational expectations (Muth 1961), thereby imposing additional structure on the model. An alternative way is to use data on stated expectations. We aim to contribute to these studies by providing evidence on subjective long-run expectations for three important markets.

Related literatures in behavioral economics identify several classes of expectations biases that may arise. First, households may be mis-informed or simply lack relevant information. Second, they may process the information in a systematically biased way. For instance, they may under-estimate exponential growth (Stango and Zinman 2009). Third, they may fail to optimize dynamically, e.g. may neglect their own future influence on the available information and/or on their economic situation. While we cannot explicitly test these competing underlying assumptions, we highlight the potential relevance of such biases across various domains. In particular, underestimations due to neglect of exponential growth are unable to explain the patterns that we observe, as we find households holding expectations below linear growth.

The following Section presents the data and the survey design. Section 3 contrasts the expectations with the realized prices developments in the relevant markets. Finally, Section 4 reports on heterogeneity and show how long run expectations vary between socio-economic groups.

2 Data on Expectations

The analysis is based on data from the Innovation Sample of the Socio-Economic Panel (SOEP-IS). The SOEP-IS is a representative household survey 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.[1]

We design and implement a survey module to elicit price expectations of individuals in the short and in the long run. We focus on three markets in which long-run expectations are essential for individual decision making: the stock market, the housing market and the labor market. The SOEP-IS is a longitudinal data set. Starting with the year 2016, individuals 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.

[1] See Richter and Schupp (2015) for further details on the SOEP-IS.

To elicit price expectations, we ask individuals about their short- and long-run beliefs. Specifically, for the stock market, individuals assess the development of the German stock market index DAX[2] 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 provide the exact wording of the questions and a discussion about the specification of the questions.

In Table 1 we show the short-run expectations and the long-run expectations of individuals in the different markets. The short-run expectations are relatively moderate for the stock market but households expect meaningful price changes on the labor market and the housing market. Specifically, 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. This high expected rate of return is fully in line with the current development of the German housing market: according to the OECD data, the actual price increase over the 2016–2018 period is 9.81 %.

When considering other moments of the short-run expectations, the picture looks similar. The median values in the short run are moderate for the stock market. The expectations about stock-market returns are 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, expectations in the short run are higher and positive over the full distribution (5 % at the 25th percentile and 15 % at the 75th percentile).

The expected price changes over the longer time periods are surprisingly low. Individuals expect that the average gain from investment in the DAX over the next thirty years is 10.18 %. In other words they assume that investment of €100 today would result in €110.18 in thirty years. The long run expectations about the growth of house prices are larger than those of the stock market prices (mean 29.18 %, median 20 % and 75th percentile 40 %). The picture for the labor market is different: this is the only market in which the long-run expectations are somehow comparable to the short-run expectations. For the median, we find nearly a linear relationship for the short run and the long run. For the other moments, the long-run expectations are clearly higher than in the short run but still below linear growth. There exist several explanations why we find a different pattern for expectations on the labor market. Most important, the gross monthly wage is an essential statistic of everyday life for all employed individuals. Individuals can observe their own wage development or have information about

[2]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 31 December 1987.

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

Notes:
The table provides summary statistics of the short- and the long-run subjective expectations of individuals in three different markets. The summary statistics is based on the complete set of observations. As a robustness check, in the Appendix A.3, we 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.

the development of their colleagues and peers. Thus, they possess information that is more accurate compared to the other markets.

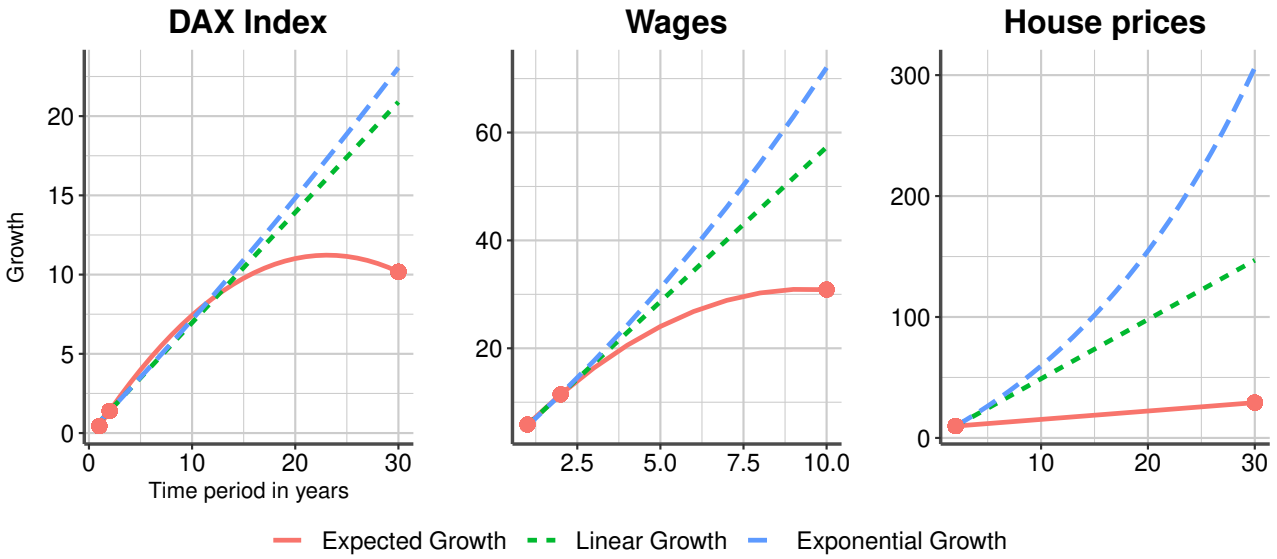
To enhance understanding of development of price expectations over time, we consider two counterfactual scenarios. We take the short-run expectations of individuals as given and assume that prices continue to grow either by the same amount in each following year (linear growth) or exponentially. These two benchmarks are the main components of the exponential growth bias model (Levy and Tasoff 2016), the leading model of the long-run perceptions. This model refers to the tendency of individuals 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 rate that is even lower than the linear growth rate. Figures 1 and 2 compare the growth rates in all three markets for mean and median values[3]. We compare the expected price changes as stated by the respondents (the red curve) to the price changes that follow the linear growth (the green curve) and the exponential growth (the blue curve). In all three markets, both mean and median values of the long-run expectations are lower than those attained with the linear or exponential growth. The effects are specifically pronounced for the stock 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 estimated increase over the next thirty years is 231.23 %. If we assume that

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

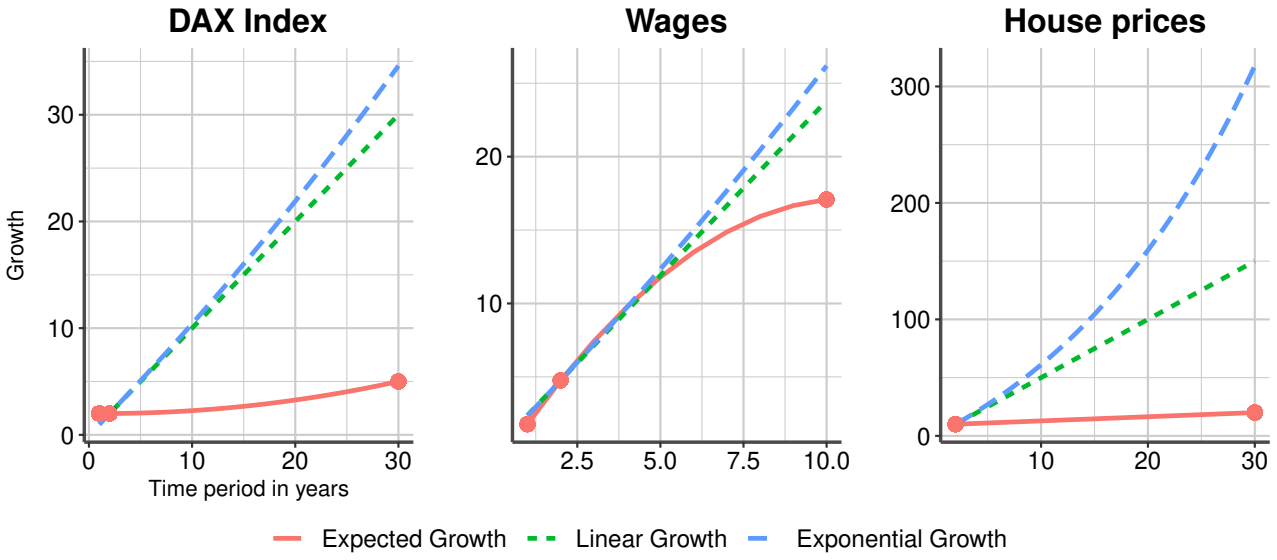
there is no compounding and that the growth is linear, the estimated price increase over the next thirty years is 124.68 %, much higher than the reported value of 29.18 %. Comparing the long-run expectations with estimated counterparts, we conclude that individuals assume neither linear nor exponential growth when predicting the long-run development of prices.

Figure 1: Expected and estimated growth of prices over time (mean values)



Notes:
The red markers correspond to the average expected price change over the respective amount 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.

Figure 2: Expected and estimated growth of prices over time (median values)



Notes:
This figure is constructed in a similar way as the Figure 1. The only difference is that here we depict the median values of expectations instead of the means.

3 Expectations vs Realizations

In the following section, we assess the accuracy of elicited expectations by comparing them with historical realizations. For the stock market, we use historical data on nominal yearly returns on the DAX performance index from 1951 to 2016.[4] For the labor market, we rely on the data on gross monthly earnings from the German Socio-Economic Panel (SOEP) in the period 2004 to 2014[5]. 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, 2019). In Appendix B, we provide more detail on the historical data and calculations of the realized price changes.

Figure 3 shows the historical price movements against the expectations. It summarizes the key finding of the paper: long-run expectations on the stock and the housing are very pessimistic. In particular, expectations are much lower than historical realizations. The realized price development exhibits a strong and positive trend, which is particularly apparent in the development of the DAX index. We find that since 1951, the average gain from investment in the DAX over the thirty years' period amounts to more than 1700 %. This stands in stark contrast to the expectations of households. As documented in Table 1, the expected average gain from investment in the DAX over the next thirty years is close to 10 %, the median expectation is 5 % and the expectation at 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 the thirty years' period is 144.07 %, whereas the expected increase is 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 ten years.

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 price effects. These concerns are particularly valid in the stock and the housing market when we elicit expectations in percentages. In the labor market, we are interested in the Euro amount which directly implies nominal interpretation. In order to address these relevant concerns, we adjust the realized changes for the stock and the housing market for inflation. Moreover, in Tables 2 and 3 we provide further robustness about the findings for these two markets by focusing on realizations over different time periods and regions.

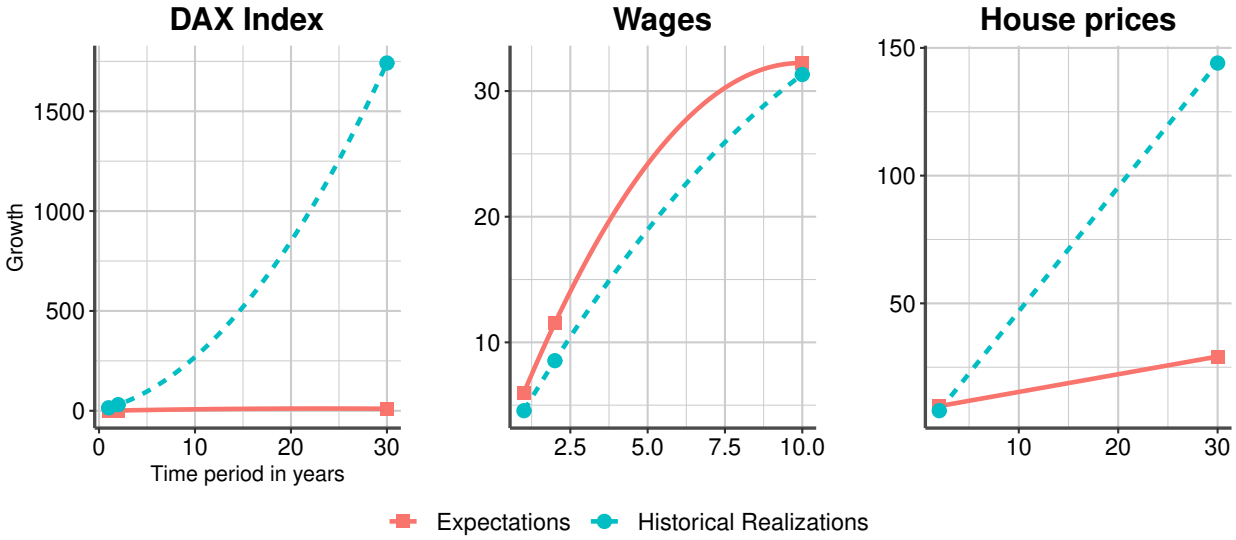
For the stock market we consider, in addition to the time period 1951–2016, also the period 1951–2018, and 1988–2018[6]. For all three cases, the realized values are far above the expected average changes of about 10 %. This holds also for the inflation-adjusted values, which are

[4]We construct historic series similarly to Huck et al. (2015). For all years since the DAX's origination in 1988, we use the actual yearly returns. For all previous years we make use of the yearly return series from Stehle et al. (1996, 1999), who impute the index going back all the way to 1948.

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

[6]The baseline period from 1951 to 2016 covers publicly available information at the time when expectations are elicited. The period from 1951 to 2018 specifies the annual DAX returns available at the moment. Whereas the sub-period from 1988 to 2018 covers the time since the foundation of the index.

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 three markets. The red square markers correspond to expected price developments whereas the round blue markers correspond to historical realizations over the years defined by horizontal axis. For convenience of presentation, the markers are connected with curves.

considerably lower than the nominal values. The most conservative average gain from the long-term investment is 592.53 % and corresponds to the case when historical returns are measured in the real terms since the origination of the index. Even in this case, the realized gain is 58 times larger than the average expected gain and exceeds the maximum expected gain of 500 %.

Table 2: 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

Notes:
The values specify the average gain from investment in the DAX index over one, two and thirty years and 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 3 includes information about the historical development of house prices only for Germany and for the average of 14 advanced economies[7]. The historical price development in Germany differs from most other countries and has been considerably lower until about 2010.

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

In the last decade, however, house prices have seen a strong increase[8]. In this respect, it is not obvious which time series is the more relevant measure of the realized price changes. When focusing on the nominal historical development, we find that average long-run expectations are clearly lower than the realizations in Germany and for the average of the considered countries. With price adjustment, the picture looks different: for the global price development, we still find a sizable increase. In contrast, for the German housing market we see hardly any real price increase over the last 30 years.

Table 3: 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

Notes:
The values specify 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 time period 1962–2016.

4 Heterogeneity of Expectations

In the final section, we concentrate on the long-run expectations in three markets and how they vary by 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 4–6). We then move on and use a lasso approach to select the relevant covariates in a multivariate regression.

4.1 Descriptive analysis

The descriptive analysis shows several important 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 very pronounced in the financial market (Table 4). On average women only expect a price increase of 2.37 % while the elicited expectations for men amount to 16.22 %. In the housing market (Table 5), the average gender gap of long run expectations is with 13.78 percentage points of similar size. In the labor market (Table 6), the gender difference

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

in the average expectations is as well sizable (about 10.5 percentage points). Interestingly, the empirical difference which is reported in the second half of the table, is far lower and only amounts to 1.49 percentage points. 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. Specifically, educated, middle-aged male, with high earnings and with a high level of financial literacy expect higher returns on the stock market (Table 4). This profile matches well 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. 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). Moreover, individuals with sound financial literacy and tertiary education have higher average expectations which is consistent with the higher stock market participation of this group (van Rooij et al. 2011).

Table 4: Average expectations about development of DAX index by attribute

Attribute	1 year	2 years	30 years
All respondents	0.44	1.39	10.18
Gender			
Female	−0.58	−0.17	2.37
Male	1.23	2.58	16.22
Age			
$\leqslant 35$	1.28	2.61	7.07
$36-45$	1.14	3.16	21.70
>45	−0.01	0.53	8.50
Gross monthly earnings			
<1700	−0.95	0.50	4.90
$1700-2800$	0.76	3.16	11.66
$\geqslant 2800$	1.56	2.25	18.65
Financial literacy			
<6 correct answers	0.04	0.81	4.78
$=6$	1.16	2.44	18.97
Tertiary education			
Yes	1.85	2.86	22.89
No	0.14	1.07	7.52

Third, for the housing market we find - except for the gender difference mentioned above - relatively little variation (Table 5). 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 current boom of the German housing market. 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.

Table 5: Average expectations about growth of housing prices by attribute

Attribute	2 years	30 years
All respondents	9.79	29.18
Gender		
Female	10.02	22.12
Male	9.58	35.90
Age		
$\leqslant 35$	11.03	30.93
$36-45$	10.34	30.55
>45	9.23	28.12
Home owner		
Yes	8.37	25.75
No	11.54	32.60
Tertiary education		
Yes	9.14	29.82
No	9.93	29.06

Finally, in Table 6 we document the mean expectations about wage growth by attributes and compare them to the empirical counterparts. Although, on average, expected and empirical wage growth are quite similar, we find important heterogeneity on how beliefs deviate from the empirical values. As mentioned above, over the next ten years, women predict lower wage growth than men; we find that women underestimate their long-run wage development, whereas men underestimate it. With respect to age, we observe that younger individuals expect higher wage growth on average. This finding is also confirmed by historical data. Interestingly, there exists a strong difference between German and non-German citizens. The average wage expectations of non-Germans are markedly higher than those of Germans. At the same time, Germans on average underestimate their wage increase, while non-Germans overestimate it. The same pattern holds for median wages, though to a lesser extend (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, respondents without tertiary education expect lower wage increases and are more accurate in their predictions.

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

Table 6: 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 time period 2004–2014. Imputation-based method of Melly and Santangelo (2015) is used to correct for sample selection.

the next 10 years. However, the average realized increase over the time period from 2004 to 2014 for this group has been 63.97 %. The difference in the median values are lower but with 13.96 % and 33.08 % respectively is still very large. This huge gap is consistent with the lower employment rate and the high share of part time work amongst women even with high education which we observe in most countries including Germany, see e.g. Goldin (2014) or Gallego-Granados (2019).

4.2 Variable selection and multivariate analysis

We 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 which reduces the complexity of the model and excludes irrelevant controls. After selecting all the substantial coefficients, we then perform the ordinary least squares regression (post-lasso) and can interpret the estimates in a multivariate analysis (Belloni and Chernozhukov 2013).

Tables C2–C7 in Appendix C.2 specify the results of the lasso procedure. As expected, the method selects standard variables as considered in the previous section. For example, for the expected development of the DAX index over the next thirty years, such variables as gender, the

level of financial literacy, labor earnings and tertiary education are among selected covariates. In addition to these variables, the method selects covariates that are otherwise omitted in the literature. Importantly, we find that saving experience during the teenage years has a positive effect on the long-run expectations. The presence of a second apartment is also included in the final model. For the other markets, similar variables have been selected. Interestingly, according to the lasso approach, the gender variable is not an important determinant for the expectations on the labor market. Instead working history or risk aversion have been selected which are strongly correlated to gender. As expected, regional variables and housing attributes are important determinants to explain expectations on the housing market.

The multivariate analyses show expected results for all markets (see Tables C5–C7 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 childhood has a sizable and significant positive effect.

The analysis for the housing market documents that women, risk averse individuals and individuals with a GDR experience are more pessimistic about long-term development of housing prices. We find an interesting regional pattern which is consistent with the recent observed regional price development: expectations of individuals residing in Berlin and Bavaria have markedly higher expectations than individuals in other regions. Finally, individuals with a fixed renting contract expect a clearly stronger price increase and this effect is highly significant.

For the labor market, we observe that being a German citizen, having tertiary degree, unlimited working contract or paying back the household credit has a negative effect on the long run expectations about development of wages. In contrast, being currently in education, receiving income from partnership or being relatively more risk averse has a positive effect on the expected wage growth over the next ten years.

5 Conclusion

In this paper, we study the long-run price expectations of households in three important markets: financial market, labor market, and 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 extension is of central relevance 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 study heterogeneity applying lasso technique for variable selection.

We document several findings. We show that long-run price expectations in financial and housing markets are extremely pessimistic, while expectations for 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 labor market, but not in financial or housing market. In the latter two, long-run expectations of households are severely below linear price growth. 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. For housing market, individual characteristics, including age and the level of education, seem to matter less.

Our results provide important insights for studies that analyze long-run decisions of households, e.g. in life-cycle models and portfolio-choice models, and which are in general based on the rational expectation assumption. Our results are not consistent with the rational expectation assumption. In contrast, we show that households have extremely pessimistic long-run expectations which are not in line with the realized price changes, specifically in the financial and in the housing market. Importantly, although we document sizable heterogeneity, the results for the stock and the housing market show that even the expectations which are significantly higher than the mean expectations of households are far below the linear growth or realized price changes.

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Appendix A: Data on Expectations

Appendix A.1 Descriptive statistics

In Table A1 we provide 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 and 16 % have completed tertiary education. The respondents differ with respect to their work situation (36 % work full-time; 13 % work part-time and 39 % are economically inactive). The average gross monthly wage is €1457.

Table A1: Summary Statistics, SOEP-IS 2016

Attribute	Obs	Mean	Median	Min	Max
Female	1556	0.51	1	0	1
Age	1556	52.06	53	17	94
Married	1554	0.58	1	0	1
Number of Children	1556	1.09	0	0	7
Abitur	1556	0.23	0	0	1
Tertiary Education	1556	0.16	0	0	1
Financial Literacy	1489	4.34	5	0	6
Gross Monthly Wage	1468	1457.32	345	0	18000
Full-Time Employee	1556	0.36	0	0	1
Part-Time Employee	1556	0.13	0	0	1
Economically Inactive	1554	0.39	0	0	1
Lived in the GDR before 1989	1554	0.19	0	0	1
Homeowner	1554	0.47	0	0	1

The table summarizes information about the SOEP-IS sample in the year 2016. We provide number of observations, mean, median, minimum and maximum value by attribute.

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". They refer 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 while 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 1 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 appeal to regular thinking. Moreover, Huck et al. (2015) 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 (balanced sample)

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.

Table A2: Subjective Expectations, balanced at domain 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

Overall, we observe some amount 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 amount 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).

Appendix A.4 Comparison of growth rates

Table A3: Comparison of Growth Rates

	Subjective Expectations				Linear Growth				Exponential Growth			
Expectation	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 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:

$$G_T^{DAX}\{n, r\} = \left(\left(\prod_{t=t_0}^{t_0+T-1} (1 + r_t^{\{n,r\}}/100) \right) - 1 \right) \cdot 100,$$

where r_t^n is a nominal annual return on the DAX index in the year t; r_t^r is a real annual return: $r_t^r = r_t^n - i_t$ and inflation rate is expressed as $i_t = (cpi_t/cpi_{t-1} - 1) \cdot 100$. 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 the time period 1962-2016. 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:

$$G_T^H\{n, r\} = \left(\left(\prod_{t=t_0}^{t_0+T-1} (1 + rh_t^{\{n,r\}}/100) \right) - 1 \right) \cdot 100,$$

where rh_t^n is a realtive change in the nominal house price index hp_t^n: $rh_t^n = (hp_t^n - hp_{t-1}^n)/hp_{t-1}^n$; rh_t^r is a realtive change in the real house price index with $hp_t^r = hp_t^n/cpit_t \cdot 100$.

Appendix B.3 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 below 55 years old in 2004 excluding individuals in retirement, self-employed, the military and disabled. To enhance comparison of expectations and realizations and 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 [9]. In particular, we use an imputation-based method developed by Melly and Santangelo (2015) to correct for sample selection issues. This method has been 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 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 that 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:

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

[9] 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.

and derive individual wages conforming $F^{-1}_{W|g=1,t=k,x}(\theta)$ as:

$$\tilde{w}_{ikl} = x_i\hat{\beta}_{g=0,t=k}\left(\int_0^1 \mathbb{1}\left(x_i\hat{\beta}_{g=0,t=l}(u) \leq x_i\hat{\beta}_{g=1,t=l}(\theta)\right)du\right), \tag{1}$$

where $\hat{\beta}_{g,t}(\theta)$ are the wage equation coefficients for quantile θ estimated with conditional quantile regression.

In our application, group 0 consists of individuals who were employed both in 2004 and in one of the subsequent years $t \in \{2005, .., 2015\}$ 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 imputation algorithm:

$$\tilde{w}^{F,FT}_{ik,2004} = x_i\hat{\beta}_{g^{F,FT}=0,t=k}\left(\int_0^1 \mathbb{1}\left(x_i\hat{\beta}_{g=0,t=2004}(u) \leq \bar{w}^{F,FT}_{i,t=2004}\right)du\right),$$

$$\tilde{w}^{F,PT}_{ik,2004} = x_i\hat{\beta}_{g^{F,PT}=0,t=k}\left(\int_0^1 \mathbb{1}\left(x_i\hat{\beta}_{g=0,t=2004}(u) \leq \bar{w}^{F,PT}_{i,t=2004}\right)du\right),$$

$$\tilde{w}^{M,All}_{ik,2004} = x_i\hat{\beta}_{g^{M,All}=0,t=k}\left(\int_0^1 \mathbb{1}\left(x_i\hat{\beta}_{g=0,t=2004}(u) \leq \bar{w}^{M,All}_{i,t=2004}\right)du\right),$$

where $\bar{w}_{i,t=2004}$ is the observed wage for person i in $t = 2004$ and replaces its estimated equivalent $x_i\hat{\beta}_{g=1,t=2004}(\theta)$ in expression (1) above.

The wage equation is estimated as a linear conditional quantile regression model (Koenker and Bassett 1978):

$$Q(\theta)(w_{it}|x_{it}) = x'_{it}\beta_t(\theta).$$

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 time period 2004–2014. Imputation-based method of Melly and Santangelo (2015) is used to correct for sample selection.

Appendix C.2 Variable selection and multivariate analysis

The lasso method selects the most important covariates out of a number of variables available in the SOEP-IS data set. The selected covariates tend to have a considerable impact on the long-run expectations about the development of prices. For the purpose of robustness, the lasso is performed 1000 times, each time with a different random partition of observations during the cross-validation procedure. The selected variables are presented in the Tables C2–C4. The variables are ordered according to the frequency of their selection into the model. We provide additional information about the average value of each estimated coefficient and its standard deviation. Tables C5–C7 summarize the results of the ordinary least squares regression (post-lasso) with a set of covariates that was pre-selected by lasso.

Table C2: Selected covariates that effect the long-run expectations at the financial market

N	Variable	Scale	Frequency	Mean	SD
1	Intercept		1000	-1.991	0.759
2	Female	0-1	1000	-7.185	0.470
3	Financial literacy	0-6	1000	1.176	0.018
4	High financial literacy	0-1	1000	4.587	0.352
5	Saving btw 12 and 16	0-1	1000	4.641	0.757
6	Abitur	0-1	1000	1.055	0.385
7	Tertiary education	0-1	1000	5.606	0.425
8	Monthly wage		1000	0.002	0.000
9	Hh investment income	0-3	1000	1.006	0.398
10	Second apartment	0-1	1000	7.980	1.138
11	Limited tenancy agreement	0-1	1000	7.086	1.633
12	Schleswig-Holstein	0-1	1000	5.086	1.309
13	Sachsen	0-1	964	-2.829	1.324
14	Civil servant	0-1	817	-2.502	1.324
15	Hh member requiring care provision	0-1	756	-2.064	1.338
16	Income from rent in 2015	0-1	680	-0.975	0.587

Notes:
The table specifies the list of covariates selected by the lasso procedure to explain the expected development of the DAX index over the next thirty years. The selection is based on 616 observations and 120 explanatory variables.

Table C3: Selected covariates that effect the long-run expectations at the labor market

N	Variable	Scale	Frequency	Mean	SD
1	Intercept		1000	72.932	30.123
2	In education	0-1	669	6.131	0.480
3	Tertiary education	0-1	680	-30.787	6.065
4	German	0-1	671	-25.148	8.045
5	Unlimited working contract	0-1	666	-8.322	2.466
6	Years employed at the current job	0-1	561	-0.223	0.087
7	Income from partnership	0-1	449	21.398	12.225
8	Years from schooling		401	-0.0527	0.027
9	Paying back hh credit	0-1	378	-3.715	2.516
10	Hessen	0-1	378	4.594	2.727
11	Relative risk aversion	0-10	322	0.906	0.661
12	Monthly rent		299	0.003	0.002
13	Second apartment	0-1	268	5.253	4.509
14	Monthly wage		236	-0.001	0.001

Notes:
The table specifies the list of covariates selected by the lasso procedure to explain 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 that we are using for the financial and the housing market. We exclude the covariates that characterize unemployed individuals.

Table C4: Selected covariates that effect the long-run expectations at the housing market

N	Variable	Scale	Frequency	Mean	SD
1	Intercept		1000	34.576	3.917
2	Female	0-1	991	-6.260	1.995
3	Limited tenancy agreement	0-1	984	10.259	5.168
4	Bayern	0-1	736	3.893	2.190
5	Berlin	0-1	736	5.250	3.398
6	Second apartment	0-1	691	4.428	2.526
7	Size of apartment in sq m		576	-0.016	0.011
8	German	0-1	525	-2.526	1.661
9	Lived in East Germany before 1989	0-1	420	-1.784	1.080
10	Brandenburg	0-1	316	-3.711	1.891
11	N of children in the hh		296	-0.660	0.310
12	Relative risk aversion	0-10	244	-0.465	0.251
13	Arithmetic abilities	0-3	244	0.645	0.282

Notes:
The table specifies the list of covariates selected by the lasso procedure to explain the expected development of the house prices over the next thirty years. The selection is based on 823 observations and 109 explanatory variables.

Table C5: Post-lasso (OLS) for the long-run expectations at the financial market

Female	-10.809^{***}	(3.173)
Financial literacy	1.195	(1.943)
High financial literacy	7.167	(4.761)
Saving btw 12 and 16	10.024^{***}	(3.620)
Abitur	3.921	(4.274)
Tertiary education	8.654^{*}	(4.902)
Monthly wage	0.002^{***}	(0.001)
Hh investment income	4.007	(3.506)
Second apartment	16.660^{**}	(6.572)
Limited tenancy agreement	19.553^{**}	(9.370)
Schleswig-Holstein	14.399^{**}	(6.645)
Sachsen	-13.235^{*}	(6.918)
Civil servant	-15.746^{*}	(8.035)
Hh member requiring care provision	-16.062	(11.016)
Income from rent	-8.760^{*}	(4.724)
Constant	-8.687	(8.354)
R^2	0.135	
Adjusted R^2	0.115	
F Statistic	6.743^{***} (df = 15; 647)	

Notes:
Dependent variable: expected development of the DAX index over the next thirty years.
Unstandardized coefficients reported with standard errors in parenthesis.
*p<0.1; **p<0.05; ***p<0.01

Table C6: Post-lasso (OLS) for the long-run expectations at the labor market

In education	33.179**	(15.335)
Tertiary education	−41.729***	(13.388)
German	−48.638***	(14.355)
Unlimited working contract	−13.337	(9.389)
Years employed at the current job	−0.363	(0.440)
Income from partnership	78.663**	(33.259)
Years from schooling	−0.216	(0.369)
Paying back hh credit	−16.010**	(6.987)
Hessen	19.099*	(10.951)
Relative risk aversion	5.091**	(2.537)
Monthly rent	0.013*	(0.008)
Second apartment	29.367**	(14.299)
Monthly wage	−0.004**	(0.002)
Constant	117.300***	(23.486)
R^2	0.211	
Adjusted R^2	0.183	
F Statistic	7.697*** (df = 13; 375)	

Notes:
Dependent variable: expected wage growth over the next ten years.
Unstandardized coefficients reported with standard errors in parenthesis.
*p<0.1; **p<0.05; ***p<0.01

Table C7: Post-lasso (OLS) for the long-run expectations at the housing market

Female	−15.699***	(4.301)
No open-ended tenancy agreement	35.634***	(12.589)
Bayern	15.063**	(6.872)
Berlin	24.815***	(8.906)
Second apartment	17.768*	(10.086)
Size of apartment in sq m	−0.082*	(0.049)
German	−12.922	(8.736)
Lived in East Germany before 1989	−9.841*	(5.443)
Brandenburg	−22.260	(14.352)
# of children in the hh	−4.096*	(2.404)
Relative risk aversion	−4.182***	(1.573)
Arithmetic abilities	4.978**	(2.418)
Constant	69.133***	(12.620)
R^2	0.080	
Adjusted R^2	0.067	
F Statistic	5.906*** (df = 12; 810)	

Notes:
Dependent variable: expected development of the house prices over the next thirty years.
Unstandardized coefficients reported with standard errors in parenthesis.
*p<0.1; **p<0.05; ***p<0.01