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House Price Expectations

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ABSTRACT

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Utilizing new survey data collected between 2009 and 2014, this paper analyzes American households' subjective expectations on future home values. We explore the relationship between house price expectations, local economic conditions, and households' individual characteristics. We examine the heterogeneity in expectations based on panel data models. In particular, we estimate the individual- and time-specific subjective probability distributions for five-year-ahead home values. House price expectations vary significantly over time, and are positively related to past housing returns and perceived economic conditions. There is large variation in both the central tendency and the uncertainty of expectations on future home values across individuals, which is associated with several socio-economic and demographic factors. Comparing expectations and realizations shows that households only partially anticipated the large downward changes in home values in the time period 2009 – 2011.

JEL Classification: D84, R31, E31

Keywords: subjective expectations, house price, survey data

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1. Introduction

Housing is the dominant component of wealth for many households, and the housing sector is an important part of the economy. House price expectations are important for the functioning of the housing market and for life cycle decision making of consumers. Still, the literature on measurement and analysis of house price expectations is sparse. Little research has been done on how households vary in their forecasts of price movements, partly due to lack of data. Notable exceptions are the studies by Case and Shiller ((Case and Shiller, 1988), (Case and Shiller, 2003), and (Case et al., 2012)), who conducted surveys of home buyers in four metropolitan areas in the US in the year 1988 and annually from 2003 to 2012. However, still very little is known about subjective house price expectations at a national level.

In this paper we analyze households' expectations on house prices elicited from probabilistic questions in a national longitudinal survey from 2009 to 2014. We study the distribution of expectations across individuals, and link subjective expectations to local house price trends, state-level economic indicators, and individual and household characteristics. Furthermore, we fit the subjective distribution of future home values for each individual at each point in time and analyze how the central tendency and uncertainty of these distributions vary with household, regional, and business cycle characteristics. Finally, we compare expectations with subsequent realizations to examine how well individuals forecast their home values.

This study adds several empirical findings to the literature. At the state level, we find a certain level of momentum in one-year house price expectations: Recent changes in local house prices are positively related to expected changes in the near future. At the same time, there is evidence of mean-reversion in expectations: People in areas that experienced most dramatic house prices declines have higher expectations of future home value changes, especially for the long-run. Movements in general local economic conditions, measured by unemployment rates, are also positively related to expected changes in future home values. In addition, people with higher education levels are more responsive to changes in local house prices and unemployment rates than others, which is consistent with findings in the existing literature that reactions to macroeconomic news are heterogeneous.

At the individual level, expectations are related to current home values and vary across socio-economic groups. Males, higher income families and higher educated individuals are in general more optimistic than others. These associations may also reflect

correlations between some socio-economic variables and unobserved individual effects reflecting optimism or pessimism. After controlling for individual fixed effects to capture this, the characteristics that remain statistically and economically significant are related to perceptions of the personal financial situation, so-called "economic sentiment". In addition to the central tendency, we also find substantial heterogeneity in the subjective uncertainty about five-year-ahead home values across individuals and over time. In particular, female and younger respondents are more uncertain about their future home values. Finally, in all specifications, persistent unobserved individual effects account for around 50% of the unobserved variation in house price expectations.

We also compare expectations of future home values to subsequent realizations. Ex post, households appear to have been overoptimistic about future home values at both one-year and five-year horizons during the financial crisis. This can be due to irrational expectations or unanticipated macroeconomic shocks. For one year expectations, macroeconomic shocks are less likely to be the only explanation as the forecast errors were of the same sign in several consecutive years.

From a methodological point of view, our paper exploits the panel feature of the data and controls for fixed unobserved individual effects. This is different from previous studies on subjective expectations which mainly focus on cross-sectional data. Our panel data analysis is better in identifying and measuring the effects that are related to changes in expectations over time for a given individual. Besides, we use two methods to elicit the subjective distribution of future home values based on answers to probabilistic questions. The first method follows the line of thoughts in Dominitz and Manski (1997b) and fits a parametric distribution for each respondent separately. The second approach follows Bellemare et al. (2012) and uses spline interpolation to fit the subjective distribution non-parametrically, with weaker assumptions on the shape of the distribution. Using two different methods provides more robust inference.

Our paper is related to several strands of the literature. First, measurement and analysis of households' beliefs about future outcomes have attracted increasing attention over recent years. The literature has produced a fair amount of empirical findings on how expectations vary across individuals and over time. Examples are studies on survival expectations ((Hurd and McGarry, 1995)), future income ((Dominitz, 2001)), work status ((Stephens Jr, 2004)), inflation ((Bruine de Bruin and Manski, 2011)), pensions and retirement ages ((Bissonnette and Van Soest, 2012)), retirement income replacement rates ((De Bresser and van Soest, 2013b)), and returns on financial assets ((Dominitz and Manski, 2007)). See also Manski (2004) and Hurd (2009) for excellent

overviews. Particularly, household's subjective expectations on stock price have been investigated extensively. While participation in the stock market is limited, housing is widely owned and remains the most significant component of non-human wealth for most households. Still, the survey evidence on house price expectations is rare. The studies by Case, Shiller, and Thompson referred to above (e.g. (Case and Shiller, 1988), (Case and Shiller, 2003), and (Case et al., 2012)), include only a limited number of recent home buyers in selected geographic areas, while our study is representative of the US population. Moreover, our study controls for local economic factors and a rich set of respondent characteristics, as well as unobserved individual effects. Our paper therefore substantially extends the existing literature on house price expectations.

Second, this article is also related to a line of research that analyzes the segmentation in housing return and risk, especially along the dimensions of property values and income. For example, Kiel and Carson (1990) and Pollakowski et al. (1991) find that both low- and high-value homes appreciate more rapidly than middle-value homes do, whereas Seward et al. (1992) find that high-value homes have higher appreciation rates only during booming periods. In terms of risk, Peng and Thibodeau (2013) find that in the Denver metro area, house price risk is significantly higher for low-income households. While *ex-post* house price returns and risk have been discussed in a number of papers, our paper provides empirical findings on the heterogeneity in the *ex-ante* expected returns and risk along various dimensions.

Third, there has been a growing interest in understanding the formation of house price expectations. It has been found that in many areas households hold extrapolative expectations in the sense of believing that recent changes will continue in the future, but only a few papers provide direct evidence on such extrapolative expectations in housing. Case and Shiller found that expectations of future home values are higher for home buyers in periods and locations with larger house price increases, and the authors conjectured that optimistic expectations are an important force behind house price appreciations during booms ((Case and Shiller, 1988) and (Case and Shiller, 2003)). Using the Michigan Survey of Consumers, Piazzesi and Schneider (2009) also found that the proportion of individuals that expect rising house prices increased along with actual prices during the recent boom. Our paper links expectations of future home values to state-level house price changes in different time periods, showing that recent changes in local house prices are positively associated with short-term expectations, but have very weak impact on long-term expectations. Moreover, we find that people in places that experienced prolonged house price declines actually have higher expectations

of future home values. Apart from past house prices, we also found that expectations are positively related to local economic conditions and people's economic well-being, which indicates an association between house price expectations and the business cycle.

Finally, although this is something we do not address directly, the importance of housing as a component of household wealth implies that data on subjective house price expectations have the potential to make a substantial contribution to our understanding of life-cycle decisions. A large literature has documented a substantial impact of house prices on households' intertemporal choices, including, for example, housing demand ((Han, 2010)), consumption allocation ((Campbell and Cocco, 2007) and (Browning et al., 2013)), portfolio choice ((Cocco, 2004) and (Yao, 2004)), and fertility choice ((Lovenheim and Mumford, 2013)). Most papers focus on the impacts of realized house price changes. However, expectations of future values are likely to also play an important role, if decisions are made in an intertemporal context. Miller et al. (2011) first tested the impacts of expected future house price changes, proxied by the changes in the volume of home sales , on economic production. They argue that anticipated house price changes affect life time wealth, and thus have a similar economic impact as realized house price changes. Using subjective expectations data avoids assumptions on how expectations are formed. A number of studies have attempted to include subjective expectations data in the analysis of decisions under uncertainty. For example, Delavande (2008) combine data on probabilistic expectations about the realizations of method-related outcomes with observed contraceptive decisions to estimate a model of birth control choice; Armantier et al. (2013) find that subjective inflation expectations help explain individuals' investment choices; Arcidiacono et al. (2012) estimate a model of students' college major choice that incorporates their subjective expectations on future earnings; and Van der Klaauw (2012) uses respondents' expected future occupation to estimate a structural dynamic model of teacher career decisions under uncertainty. Besides, the analysis of housing wealth effects, or models of life-cycle decisions, might take into account the findings in our paper that house price expectations comove strongly with perceptions of economic conditions.

The remainder of the paper is organized as follows. Section 2 describes the data and the survey questions used in our analysis. Section 3 provides descriptive statistics. Section 4 describes the time patterns of expectations. Section 5 studies the heterogeneity in house price expectations at different horizons based on raw probabilistic answers. Section 6 elicits and analyzes the subjective distribution of five-year-ahead home values. Section 7 compares house price expectations with subsequent realizations. Section 8

concludes.

2. Data

2.1. House price expectations

The data in this paper is mainly from the Rand American Life Panel (referred as ALP hereafter), which is an ongoing online survey of American individuals aged 18 and over.[1] Respondents in ALP are invited to continue to participate in the surveys even if they miss one or more interviews, resulting in an unbalanced panel. In particular , in this paper we use the ALP Financial Crisis Surveys, which were distributed in the RAND American Life Panel to track the experience of American households during and after the Great Recession. These surveys were initiated, designed, and fielded by Susann Rohwedder and Michael Hurd. The first wave was administered in November 2008, and the second in February/March of 2009. Between May 2009 and April 2013 the ALP Financial Crisis Surveys were conducted every month. Every third interview was longer than other intervening monthly interviews to accommodate the collection of additional information every quarter. Since April 2013 the ALP Financial Crisis Surveys have been fielded quarterly.

The ALP Financial Crisis Surveys cover a broad range of topics and provides rich background information for each participant.[2] Of particular relevance for this paper are the questions on subjective home value expectations. For home owners, the survey asks expectations of the respondents' own home values. For renters, the questions are about local or national house prices. To maintain comparability, we restrict our analysis to home owners (more than 70% of the sample). There are six questions on expectations of house prices in each wave.[3] The first one asks the percent chance that home value increases by next year. We label it as Pr(H1>100). Asking expectations in "percent chance" format is shown to be a better way to elicit subjective probability distribution of an individual than, for instance, point expectations ((Manski, 2004)).[4] The other five are about expectations of the house price in five years. The second question asks the

[1] See https://mmicdata.rand.org/alp/index.php?page=main for details.

[2] See, for example, Hurd and Rohwedder (2010) for early work using this data.

[3] Detailed descriptions of the questions can be found in the appendix.

[4] After March 2011, the sample size was slightly reduced and a random sub-sample was not asked the subjective questions in percentage form but in the "bins and balls" format. See Delavande and Rohwedder (2008) for a discussion of eliciting subjective probabilities in different formats. We do not use there in the current paper.

percent chance that home value increases in five years ($Pr(H5 > 100)$). If $Pr(H5 > 100) > 0$, a third question asks the probability that the home value increases by more than 10% in five years ("Pr(H5>110)"). Similarly, if $Pr(H5 > 110) > 0$, a forth question asks the chance that home value increases by more than 20% in five years ($Pr(H5 > 120)$). And there are two questions about the chance that the home value decreases by 10% and more than 20% in five years ($Pr(H5 < 90)$ and $Pr(H5 < 80)$). For every question, if the respondent does not provide a value immediately, a follow-up question asks for the best guess. We draw on the 19 quarterly surveys that include questions on house price expectations and house values from February 2009 to January 2014.[5]

2.2. State-level variables

It is documented in the literature that financial attitudes and expectations are affected by personal experiences ((Malmendier and Nagel, 2011) and (Nagel, 2012)). The housing market is localized and spatially segmented. Local economic experiences might be particular important in shaping people's expectations on housing. The ALP provides the state of residence for each respondent, which enables us to link subjective expectations to a number of state-level economic variables. While there are potentially many local factors can affect people' expectations, considering that we only have state-level variations, we select only a few salient ones based on the literature.

Many empirical studies have found that future house price movements are influenced by past trends. We use the quarterly state-level house price index from the Office of Federal Housing Enterprise Ovesight (OFHEO) to construct measures of (quarterly) house price growth rates for each state during the sample period.[6]

Local economic conditions are also found to be correlated to actual house price dynamics ((Clapp and Giaccotto, 1994)), and may have a direct impact on house price expectations ((Favara and Song, 2014)). We therefore also link expectations to changes in local unemployment rates. Monthly state level unemployment rates are obtained from Bureau of Labor Statistics.[7]

[5]There was no data on five-year house price expectations in the second quarter of 2009. Besides, the sample size for the wave in the second quarter of 2013 is unusually small so we do not use data from this wave.

[6]See http://www.fhfa.gov/Default.aspx?Page=14 for details of the HPI. We cannot use the S&P/Case-Shiller Home Price Indices since they do not cover all states.

[7]http://www.bls.gov

Arizona, California, Florida, and Nevada, the four so-called sand states, are the states which were most hurt in the recent real estate collapse. There has been significant academic and media coverage of the situation in the sand states since the great recession. Expectations in these areas with severe house price cycles may have distinct features. Accordingly, we construct a dummy variable which is one if the respondent lives in one of these four states and zero otherwise.

2.3. Measures of individual sentiment

Research in psychology and behavioral economics indicates that economic expectations are related to sentiment or mood ((Kaplanski et al., 2013)). Motivated by this observation, we exploit questions that reflect individual sentiment in the survey and examine whether they are related to house price expectations. There are four questions on different aspects of satisfaction: life satisfaction, job satisfaction, total household income satisfaction, and economic situation satisfaction. Every question has a five-point scale from "Very satisfied" to "Very dissatisfied". We reverse the answers so that higher values indicate higher levels of satisfaction. In addition, two questions ask about the feelings during the past 30 days: "how much of the time have you felt worn out?" and "how much of the time have you been a happy person?". Both questions have answers on a six-point scale from "All of the time" to "None of the time". We label the former question "Wornout" and the latter "Happiness". Finally, one question asks the change in financial condition: "We are interested in how people are getting along financially these days. Would you say that you are better off or worse off financially than you were a year ago?". Answers are measured on a scale from 1 ("better-off") to 3 ("worse-off"). The variable "Better off financially" is constructed by reversing the scales so that higher scores correspond to better financial conditions.

Based on the individual measures defined above, we construct two composite measures of sentiment. The first one, "economic sentiment", is related to individuals' perceptions of their economic well-being, and consists of job satisfaction, total household income satisfaction, economic situation satisfaction and being better off financially. The second measure, "non-economic sentiment", is composed of life satisfaction, happiness, and wornout.[8]

[8]The procedure to construct a certain composite sentiment measure is as follows: First, we divide the score of each individual measure by the maximum possible scale to make it bounded between zero and one. Second, we average individual measures in the same group to make the corresponding composite measure of sentiment.

2.4. Other individual-level variables

The ALP provides a large amount of individual background information. We select a number of individual variables that, as suggested in previous studies, may be related to subjective expectations in general, or may affect people's perceptions on housing and the economy. We include age, gender, race, marital status, education, family income, health, house value, and work status. The variable "Age" is based on the birth month and year. "Female", "White", "Marriage", and "Bachelor" are binary variables corresponding to a respondent's gender, race, current marital situation, and education level, respectively. Self-reported health status is measured on a 1 to 5 scale. We reverse the answers so that higher values indicate better health, and label this variable "Health". "Home value" is based on the self-reported house value. We also include a group of binary variables that are related to the work status of the respondent ("unemployed", "retired", and "disabled").

The ALP measures annual family income on a categorical 14 point-scale from below \$5,000 to above \$75,000. For those with income more than \$75,000, a follow-up question is asked on a 4-point scale, from \$75,000-\$99,999 to \$200,000 or more. We combine the answers to the two questions and select the mid-point of each interval as our family income measure, with the maximum value of family income set to \$250,000. We then divide this figure by the number of total household members and label the constructed variable "Income per capita".

3. Sample selection and descriptive statistics

We exclude observations with missing or inconsistent responses with regard to the individual demographic characteristic variables.[9] We also exclude observations with missing values on all six subjective probability questions. In total, there are around 18,000 person-wave observations with non-missing values on at least one of the six variables on house price expectations, and complete information on the individual characteristics. To remove the impact of possible outliers, we drop observations with the top one percent or bottom one percent self-reported home values. Finally, to guarantee that house price expectations of the same household refer to the same house, we drop the small proportion of home owners who have moved since four months prior to the

[9] A small number of individuals report different genders or races across survey waves.

first wave of our data.[10]

One concern with subjective probability questions is the fraction of 50-50 responses. 50-50 responses might indicate co-called epistemic uncertainty, which is the tendency to choose the middle of a scale as the answer if the question is not understood. The fractions of 50-50 responses range between 6% and 21% in the six questions about house price expectations. Furthermore, for the question Pr(H1>100), a follow-up question is asked after a 50-50 answer, where participants could choose between 'equally likely' and 'unsure'. Almost 70% of the respondents chose 'equally likely'. Thus the fraction of epistemic uncertainty responses seems to be rather small in our sample and we will not accord for epistemic uncertainty in the models that we estimate.

Table 1 presents descriptive statistics for the house price expectations and individual characteristics in our main sample. The average subjective probability of an increase in the home value over the next year is 38%, which is far below the subjective probability of a gain in five years (55%). Besides, for five-year expectations, the average subjective probability of an increase above a given threshold is more than twice the probability of the corresponding decrease. The results imply that people on average believe that the house price will increase in the long run, but short-term expectations are more pessimistic. Given the combination of mean and standard variation, disagreement (dispersion) in short-term expectations seems also to be larger than its long-term counterpart. On average, subjective expectations are consistent with the monotonicity of the cumulative distribution in both sides. As we only include home owners, people in our sample are on average wealthier, older, and have higher levels of education compared to the US population.

4. Time patterns of house price expectations

Before further analysis, it is instructive to examine the time patterns of house price expectations during the sample period. To do so, we take at each wave the mean values

[10] We exclude people whose state of residence changed during the sample period. Besides, from October 2011, in every wave the following question is asked: "Looking back over the period since October 1st, 2008: Have you moved (i.e. changed primary residence) any time since October 1st, 2008?". We drop the observation if the answer is "Yes". In total, around 10% of observations are dropped. We could not exclude those home owners who moved within state between 2009 and 2011 and who only participated in the surveys prior to October 2011. However, given that the annual mobility rate of US home owners is around 0.03 ((Head and Lloyd-Ellis, 2012)) and that respondents are continuously invited in ALP, the number of such respondents is probably not big enough to affect our analysis.

Table 1: Descriptive statistics for expectations and individual specific characteristics

Variable	Mean	Std. Dev.	Min.	Max.	N
Pr(H1>100)	38.22	28.94	0	100	18010
Pr(H5>100)	54.6	30.95	0	100	17993
Pr(H5>110)	42.71	29.76	0	100	17975
Pr(H5>120)	23.71	23.33	0	100	17942
Pr(H5<90)	19	19.64	0	100	17946
Pr(H5<80)	12.04	16.53	0	100	17919
Female	0.57	0.5	0	1	18021
Age	56.03	12.53	19.5	94.25	17756
White	0.93	0.25	0	1	18021
Married	0.74	0.44	0	1	18021
Home value ($1000)	234.64	205.21	0.2	1300	17845
Income per capita ($1000)	56.72	46.17	0.31	250	17970
Household size	1.83	1.2	1	11	18021
Bachelor	0.47	0.5	0	1	18021
Unemployed	0.04	0.2	0	1	18021
Retired	0.26	0.44	0	1	18021
Disabled	0.04	0.2	0	1	18021
Non-Eco Sentiment	0.68	0.17	0	1	18014
Eco Sentiment	0.57	0.21	0	1	17853

of house price expectations. To check whether the time pattern in ALP is specific to this survey, we also examine average house price expectations in two other surveys during the similar period. The monthly Michigan Survey of Consumers is a nationally representative survey based on approximately 500 telephone interviews with adult U.S. people. The sample has a rotating panel feature. The Michigan survey began to ask the expected house price change over the next year in January 2007 and over the next five years in March 2007. The Fannie Mae National Housing Survey is a monthly survey implemented by Fannie Mae from June 2010. Each month approximately 1,000 telephone interviews with Americans of ages 18 and older are conducted. Every time a different sample is drawn by Random Digit Dialing telephone sampling. The sample represents the general population of the United States. This survey has a question on the expected percentage change in the one-year ahead house price, very similar to the one in the Michigan Survey of Consumers. Detailed wordings of the questions can be found in the appendix.

Time series of house price expectations in different surveys are plotted in figure 1. Visual inspection shows that time patterns across surveys are very similar. Moreover, expectations for different horizons show different time series properties: long-term expectations are always higher than short-term expectations and are less volatile along time. This feature is also manifested in different surveys. To sum up, expected one-year housing returns decreased dramatically during the financial crisis, then rose temporally from 2009 to 2010, fell until late 2011, and began to recover afterwards; expected five-year returns kept decreasing until late 2011, when a recovery started. For expectations data of annual-frequency, the temporal increase (only) in short-term house price expectations between 2009 and 2010 is also documented in Case et al. (2012).

The increase in short-term expectations between 2009 and 2010 is found in different surveys, accompanied by a recovery in house prices (as shown in the Case-Shiller 20-City Home Price Index) and a growth in short-term economic confidence.[11] This recovery stopped after 2010. Five-year expectations remained unchanged during this period. Similarly, Case and Shiller found in their annual home buyers survey that home buyers' expected one-year housing returns increased temporarily from 2009 to 2010, but expected ten-year returns did not ((Case et al., 2012)). They also found that the "home buyer tax credit" created by the American Recovery and Reinvestment Act in February

[11]The time patterns of short-term economic confidence can be examined by looking at relevant questions in the Michigan Survey of Consumers or the Gallup survey.

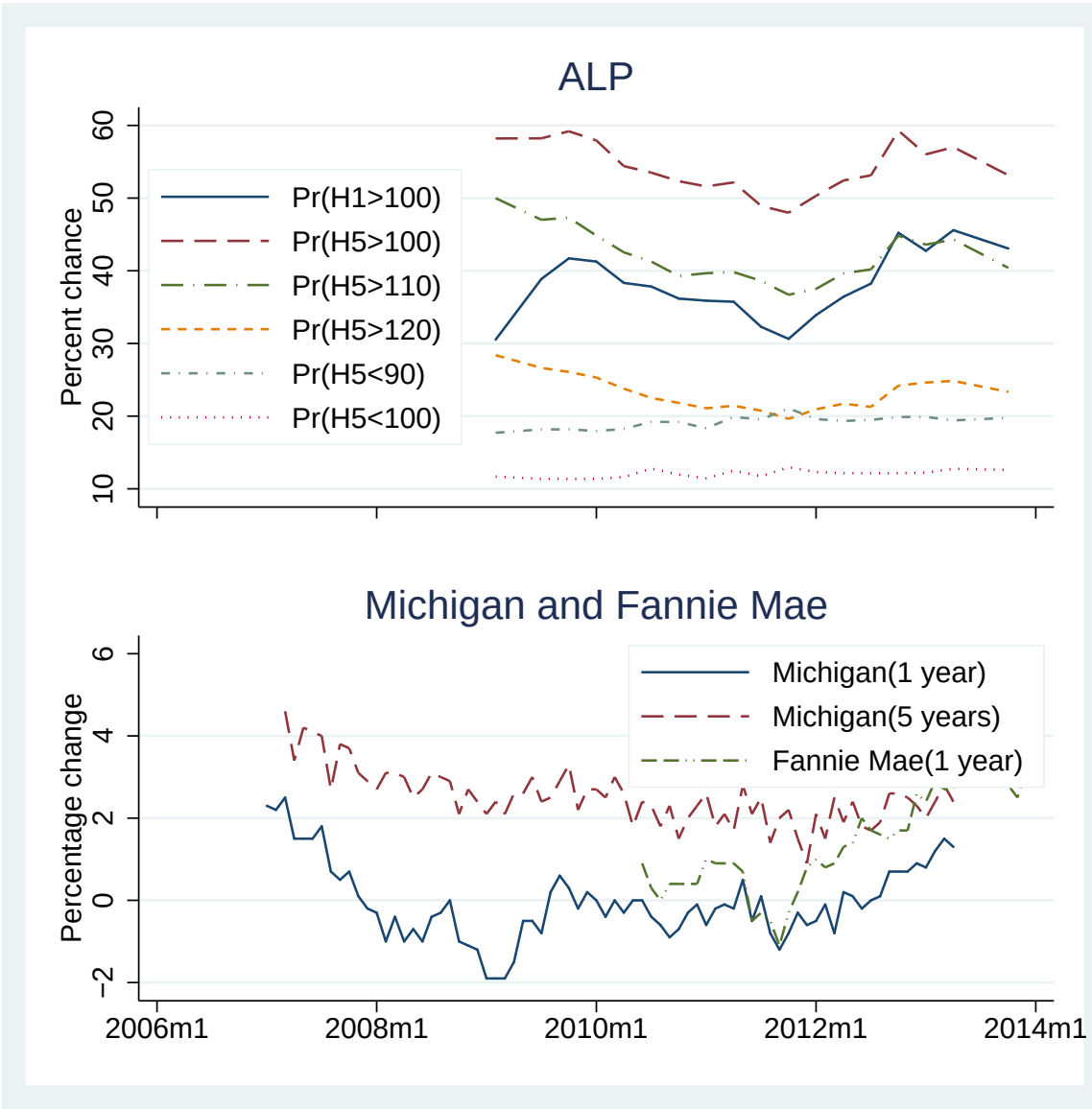


Figure 1: Time patters of house price expectations

2009 was often mentioned as the event that the home buyers thought changed the trend in home prices. The tax credit might lure home buyers into the market, and, in combination with other stimulus programs at the beginning of Obama's presidency (from January 20, 2009), created temporal optimism. This optimism in housing market was short-lived however, perhaps because there were no significant changes in underlying fundamentals and long-term expectations. On the other hand, the ongoing recovery of the housing market as well as the economy as a whole since 2012 has been widely discussed in the media. Some people believe that the recent recovery in housing market is largely driven by the monetary stimulus of the Federal Reserve, while others argue that it is due to the recovery of the economy as a whole. The data in the ALP indicate a recovery in both short-run and long-run expectations.

5. Heterogeneity in house price expectations: panel data analysis on probabilistic answers

In this section, we use panel data models to examine the impact of various observable factors on people's short-term and long-term house price expectations. We are mainly interested in the effects of two groups of variables. The first group of variables is related to the state where the respondent resides, as people's perception on housing market may be shaped by their local economic experiences. The second group includes individual demographic characteristics, which are found to be correlated to subjective expectations of different events.

There are six questions on house price expectations in the ALP, we index them $j = 1, 2, \ldots, 6$. Let $p_{j,it}$ denote the answer (percent chance) by individual i at time t for question j. Let k denote the state of residence for individual i. Formally, the specification corresponding to question j is:

$$p_{j,i(k)t} = z'_{k,t}\gamma_j + x'_{it}\beta_j + \tau_j D_t + \alpha_i + \epsilon_{it} \tag{5.1}$$

where $z_{k,t}$ is a vector of state-level variables, x_{it} is a group of individual-level variables, D_t is a time dummy, α_i is an unobserved individual effect, and ϵ_{it} is an idiosyncratic error term.

The state-level variables include an indicator of whether the state is one of the sand states, the quarterly percentage change in the unemployment rater, and the quarterly

percentage change in the house prices (HPI).[12] Changes in unemployment rates are based on data of the most recent three months before a wave, and changes in the house prices are based on data of the most recent two quarters before a wave. This guarantees that the state-level variables are publicly known before the survey date. The individual variables include the ones summarized in Table 1. We take the logarithm of some variables to mitigate the impact of outliers.

We use both Random Effects (RE) and Fixed Effects (FE) models to investigate the relationship between expectations and observed factors. Although the assumptions on unobserved individual effects are stronger, RE models are still helpful to show how expectations vary across different socioeconomic groups. In addition, time variations of many covariates are rather limited in high-frequency surveys, which makes FE models less precise. However, as some of the variables might capture unobserved individual effects in RE models, the coefficients should be interpreted with caution. On the other hand, FE models are able to control for any time-invariant unobserved factors. Table 2 show the estimation results for the questions $Pr(H1 > 100)$ and $Pr(H5 > 100)$.[13]

We start from examining the effects of state-level variables. Recent movements in state-level economic conditions are significantly related to one-year expectations only. This indicates that long-term expectations are less affected by temporal economic fluctuations. The effects of changes in unemployment rates are negative as expected, but rather weak. In contrast, recent house price changes have stronger effects. The standard deviation of the state HPI during this period is around 2.5, thus a one standard deviation increase in the quarterly house price growth rate is followed by approximately a 1 percent point increase in the subjective probability of a gain in one year. These results indicate a certain level momentum effect in short-run house price expectations. At the same time, during the sample period people in sand states on average have higher expectations of future changes in house prices, especially for the long-run. Those people might judge that current house prices are too far below the fundamentals and will

[12] The timing of the house price index values does not exactly match the timing of the ALP survey. In estimating the quarterly HPI, all observations within a given quarter are pooled. No distinction is made between transactions occurring in different months within a given quarter. In ALP, the surveys of house price expectations are taken mainly in the beginning of January, April, July, and October. For the January survey, we calculate the most recent growth rates in house prices as the percentage change between the index level in the third and fourth quarters of the previous year. House price growth rates in other quarters are calculated in a similar way.

[13] To save space, we do not report estimation results for the five-year expectations concerning the other thresholds, as the results are similar across the five five-year questions.

recovery in the end. "Momentum" and "mean-reversion" in expectations might coexist if people tend to extrapolate recent house price growth rates for short-term forecast horizons, while rely more on the gap between prices and fundamentals for long-run forecasts. Our empirical results are roughly consistent with this conjecture.

We now turn to the effects of individual-level variables. The effects of individual characteristics vary between expectations at different horizons, but there are some common patterns. People living in houses with higher values are more optimistic about changes in future house prices. Females tend to report lower changes of increases in future home values. For example, the probability that the house price will increase in one year is more than 5 percent points higher for males then for females. This is consistent with the empirical findings that men are more optimistic than women in a broad range of domains ((Jacobsen et al., 2014)). High income individuals, as well as people with higher level of educations, are also more optimistic. This is in line with findings in a number of subjective financial expectations. See, for example, Dominitz and Manski (2004) and Hurd et al. (2011). Many of the socio-economics variables are insignificant in the fixed effect specifications, suggesting that they actually capture unobserved heterogeneity rather than causal effects. One exception is household income, which is strongly positive and significant in both RE and FE models. While both non-economic sentiment and economic sentiment are positively related to expectations under the RE specification, only economic sentiment is significant in the FE specification. The magnitudes of sentiment measures are also economically significant. It seems that the economic sentiment index reflects more than merely a mood effect.

The estimate of ρ in the bottom row of the table shows that there is substantial unobserved heterogeneity, in spite of the large number of variables that are controlled for. Around 50% of the overall unexplained variation in the subjective probabilities are captured by unobserved individual effects.

Time dummies are included for all specifications and are jointly significant in all cases.[14] In the models we already control for local economic conditions and economic sentiment, which are expected to capture the impact of general economic conditions. Thus, shocks more specific to the housing market seem to play a role. Figure 2 plots the coefficients of time dummy variables for the FE specifications in table 2. The time patterns of expectations based on the regression results are similar to the ones using

[14]Many of the time dummies are highly significant individually as well. Results are not reported in the main text but are available on request.

Table 2: Heterogeneity in house price expectations: probabilistic answers

	Pr(H1>100)		Pr(H5>100)	
	RE	FE	RE	FE
Sand states	2.687*		5.315**	
	(1.126)		(1.289)	
Change in unemployment	-4.935+	-4.787+	3.022	2.802
	(2.602)	(2.666)	(2.153)	(2.167)
Change in house prices	0.369*	0.373*	0.061	0.094
	(0.154)	(0.155)	(0.117)	(0.115)
Age	-0.281**		-0.289**	
	(0.035)		(0.046)	
Female	-5.633**		-8.575**	
	(0.995)		(1.182)	
White	-2.039		0.547	
	(1.512)		(1.560)	
Log home value	0.538*	0.158	0.718**	0.260
	(0.252)	(0.259)	(0.251)	(0.265)
Log income per capita	2.838**	2.232*	4.913**	2.657*
	(0.675)	(1.020)	(0.776)	(1.007)
Household size	0.603+	0.709	1.543**	0.986
	(0.312)	(0.620)	(0.384)	(0.659)
Bachelor	3.941**	0.410	8.065**	-5.197
	(1.092)	(4.077)	(1.104)	(4.227)
Married	-0.373	-1.004	-0.095	-1.477
	(1.019)	(1.982)	(1.229)	(2.602)
Unemployed	2.125+	1.955	1.700	1.584
	(1.282)	(1.483)	(1.125)	(1.302)
Retired	0.056	-0.184	1.433	0.767
	(0.873)	(0.998)	(0.971)	(1.130)
Disabled	-0.452	-1.628	1.112	1.682
	(1.508)	(1.336)	(1.356)	(1.486)
Health	0.187	0.215	0.184	-0.308
	(0.405)	(0.483)	(0.416)	(0.501)
Non-Eco Sentiment	4.840*	2.841	5.375**	4.279*
	(2.317)	(2.566)	(1.733)	(1.654)
Eco Sentiment	9.864**	8.390**	8.602**	7.489**
	(1.815)	(2.171)	(1.429)	(1.689)
Constant	29.097**	17.066**	39.596**	42.512**
	(4.149)	(4.806)	(4.390)	(5.071)
Num.Obs	17455	17455	17445	17445
Num.Ind	2029	2029	2029	2029
ρ	0.451	0.524	0.551	0.640
Rej Time dummies = 0 ?	Yes**	Yes**	Yes**	Yes**

Constant term and time dummies are included. Standard errors are clustered at the state level. ρ is the fraction of the unsystematic variation due to unobserved heterogeneity. 'Num.Obs ' is the sample size. 'Num.Ind ' is the number of individuals. Statistical significance is indicated as follows: + p<0.10, * p<0.05, ** p<0.01.

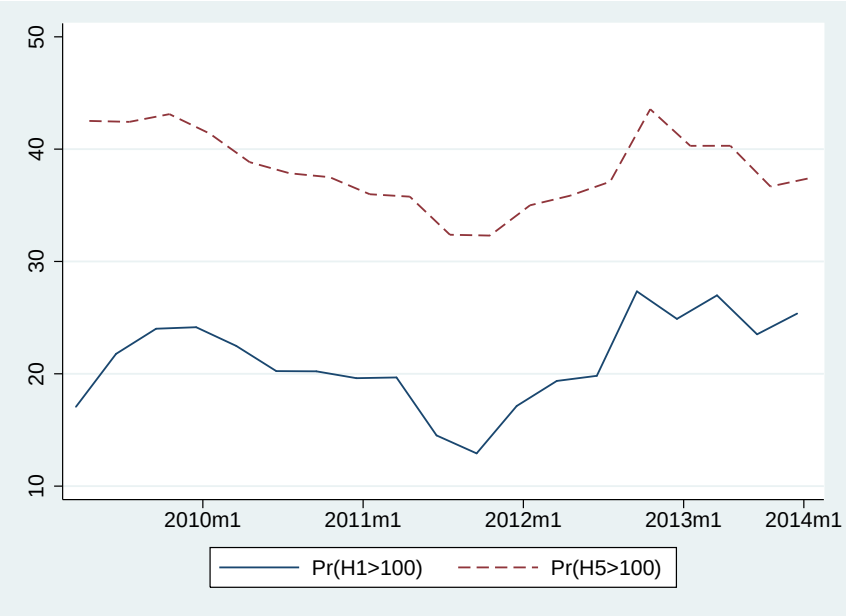


Figure 2: Time dummy coefficients from FE specifications in table 2

raw data shown in figure 1.

To test whether there is heterogeneity in the response to local economic conditions, table 3 adds an interaction terms between local economic conditions and an indicator for having bachelor degree.[15] There is indeed a stronger relationship between local economic conditions and one-year house price expectations for people with bachelor degrees. Only college graduates revise their expectations of home value changes upward in response to a decrease in the unemployment rates. Expectations in both the short-run and the long-run are also more responsive to recent movements of local house prices for people with a bachelor degree.

6. Modeling subjective distribution of five-year house price expectations

In this section we elicit the subjective probability distributions of future home values, $F_{i,t}(\xi) = Pr_{i,t}(Z \leq \xi)$, of a respondent i at time t from answers to the percent chance questions. Our inference is based on the answers to J probability questions of the type "what is the percent chance that Z is less (more) than or equal to ξ_j?", where ξ_j-s are the threshold values. As there is only one question about one-year expectations, we constrain our analysis to the five probabilistic beliefs about five-year changes. For these

[15] Other covariates are the same as in table 2 and corresponding coefficients are not reported.

Table 3: Education level and response to local economic indicators

	Pr(H1>100)		Pr(H5>100)	
	RE	FE	RE	FE
Change in unemployment	-1.159	-0.924	4.794+	4.842+
	(2.852)	(2.965)	(2.461)	(2.482)
× Bachelor	-9.086**	-9.289**	-4.358	-5.004
	(2.882)	(3.006)	(2.982)	(3.004)
Change in house prices	0.237	0.241	-0.045	-0.022
	(0.150)	(0.150)	(0.142)	(0.143)
× Bachelor	0.288+	0.289	0.229+	0.250+
	(0.169)	(0.175)	(0.124)	(0.127)

Constant term and time dummies are included. Standard errors are clustered at the state level. ρ is the fraction of the unsystematic variation due to unobserved heterogeneity. 'Num.Obs ' is the sample size. 'Num.Ind ' is the number of individuals. Statistical significance is indicated as follows: + p<0.10, * p<0.05, ** p<0.01.

data we have $J = 5$ and $(\xi_1, \ldots, \xi_5) = (0.8, 0.9, 1, 1.1, 1.2)$; see Section 2.1.

With some additional assumptions, the answers to the probability questions can be used to elicit the subjective distribution of each respondent at each time period. We use two approaches for this. The first follows Dominitz and Manski (1997b) and assumes that the subjective distributions all belong to the same parametric family, that of lognormal distributions. The second approach, avoiding this parametric assumption, is the flexible approach developed by Bellemare et al. (2012), based on cubic spline interpolation to get the subjective cumulative densities.

6.1. Modeling

6.1.1. The parametric approach

Following Dominitz and Manski (1997b), we assume that an individual answers the probabilistic question on future house prices according to a lognormal distribution, with individual- and time- specific mean and variance. The log-normality assumption is roughly consistent to observed house price dynamics and is used in many papers (e.g. (Li and Yao, 2007)).

Formally, denote $h_{i,t}$ the house price of individual i at time t, we assume that the subjective distribution of $h_{i,t+5}$ held by respondent i in year t is given by:

$$\ln\left(\frac{h_{i,t+5}}{h_{i,t}}\right) = \mu_{i,t} + \sigma_{i,t} u_{i,t} \tag{6.1}$$

where $\mu_{i,t}$ is the subjective expectation of the five years log housing return, $\sigma_{i,t}$ is the subjective standard deviation, and the $u_{i,t}$ are independent standard normally distributed error terms.

At time t the survey asks the probability that the home value of individual i will increase or decrease by a certain percentage over the five years, which gives the subjective probabilities that

$$\frac{h_{i,t+5}}{h_{i,t}} < \xi_j \tag{6.2}$$

where $j = 1, \ldots, 5$ and $\xi_j = 0.8, 0.9, 1.0, 1.1, 1.2$.

According to our model, the corresponding probabilities are

$$\begin{aligned} Pr_{it}\left(\frac{h_{i,t+5}}{h_{i,t}} < \xi_j\right) &= Pr_{it}\left(\ln\frac{h_{i,t+5}}{h_{i,t}} < \ln\xi_j\right) \\ &= Pr_{it}\left(\mu_{i,t} + z_{i,t} < \ln\xi_j\right) \\ &= \Phi\left(\frac{\ln\xi_j - \mu_{it}}{\sigma_{it}}\right) \end{aligned} \tag{6.3}$$

Denoting the answer of individual i at time t to the probabilistic question with threshold ξ_j by p_{jit}, we fit the subjective distribution for each respondent in each wave by nonlinear least squares:

$$\underset{\mu_{it},\sigma_{it}}{\text{Minimize}} \sum_{j=1}^{5}\left(p_{jit} - \Phi\left(\frac{\ln\xi_j - \mu_{it}}{\sigma_{it}}\right)\right)^2 \tag{6.4}$$

6.1.2. The flexible approach

Individual i at time t answers J probability questions, giving J points of the subjective distribution function $F_{i,t}(z)$, $(z_1, F_{i,t}(z_1)), \ldots, (z_J, F_{i,t}(z_J))$. We can approximate the complete function $F_{i,t}$ using cubic spline interpolation. To be specific, we assume that the function $F_{i,t}(z)$ is given by a polynomial $a_j + b_j z + c_j z^2 + d_j z^3$ on the interval $[z_{j-1}, z_j]$.

The objective is to estimate the $4(J-1)$ interval specific polynomial coefficients in the set $(a_i, b_i, c_i, d_i) : j = 1, \ldots J-1$. The estimation is based on $4(J-1)$ equations implied by three groups of restrictions:[16]

[16]See Bellemare et al. (2012) for details.

1. The distribution function is continuous on its support.
2. The first and second derivatives of $F_{i,t}(\cdot)$ are continuous at the interior thresholds.
3. The boundary conditions: $F''_{i,t}(z_1) = F''_{i,t}(z_J) = 0$.

6.2. Heterogeneity in subjective distributions of future house prices

To maintain comparability, we exclude a small number of observations (115, less than 1%) in each wave who answered "don't know" to at least one of the five long-term expectation questions. We also exclude observations with "50 percent chance" answers to all five questions. Finally, as some inconsistent probability answers result in implausible distributions (e.g. negative second moment), we add lower and upper bounds to the change in house prices, following the spirit in De Bresser and van Soest (2013a). Specifically, we assume that the subjective probability of a more than 90 percent decrease in five years is always zero (Pr(H5<10)=0) and that the subjective probability that prices increase by more than 150 percent is also zero (Pr(H5<250)=1).[17]

Table 4 shows the estimation results of a model with the same right hand side variables as (5.1) and with the elicited subjective median as the dependent variable. The results based on the parametric and flexible approaches are similar, and in line with the results using raw probabilistic answers. Living in one of the sand states is associated with a higher subjective median of the future house price change. Recent changes in state-level economic conditions are not much related to long-run expectations. Turning to the individual-level variables, we find that male and younger respondents and those with higher self-reported home values, higher income, higher education level, or more optimistic perceptions on personal financial conditions have higher subjective medians of the five-year house price change in the RE specifications. In the FE specifications, only the coefficients of economic sentiment variables remain strongly significant. Finally, time dummies are highly significant under all specifications, suggesting a strong influence of nation-wide shocks.

Table 5 shows how the subjective interquartile range(IQR), a measure of uncertainty, of the estimated subjective distribution, is related to the same set of explanatory variables. People in the sand states, having experienced dramatic declines in house prices,

[17]The bounds are based on historical distributions of five-year house price returns and house price depreciation rates: Five-year nominal housing net returns are in the range $[-55\%, 150\%]$ based on quarterly state-level house price index values from 1975 to 2013, and inflation adjusted net returns are in the range $[-60\%, 110\%]$. We can also take into account the depreciation rate for housing, which can be assumed to be 0.05 annually, as in Iacoviello and Pavan (2013). In any case, the interval $[10\%, 250\%]$ seems to be a reasonably conservative support for the subjective raw returns.

Table 4: Heterogeneity in house price expectations: elicited median

	Parametric approach		Flexible approach	
	RE	FE	RE	FE
Sand states	0.031**		0.043**	
	(0.007)		(0.009)	
Change in unemployment	0.001	-0.000	-0.004	-0.005
	(0.013)	(0.013)	(0.018)	(0.019)
Change in house prices	0.000	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Age	-0.001**		-0.001**	
	(0.000)		(0.000)	
Female	-0.019**		-0.010+	
	(0.005)		(0.006)	
White	0.000		-0.012	
	(0.009)		(0.011)	
Log home value	0.002	-0.001	0.001	-0.002
	(0.001)	(0.001)	(0.001)	(0.002)
Log income per capita	0.015**	0.006	0.013**	0.002
	(0.003)	(0.005)	(0.005)	(0.008)
Household size	0.002	-0.002	0.002	-0.000
	(0.002)	(0.003)	(0.003)	(0.004)
Bachelor	0.029**	-0.027	0.020**	-0.042
	(0.003)	(0.027)	(0.005)	(0.039)
Married	0.001	-0.008	0.005	-0.011
	(0.005)	(0.010)	(0.006)	(0.010)
Unemployed	0.006	0.004	0.008	0.004
	(0.005)	(0.007)	(0.007)	(0.010)
Retired	0.004	0.001	0.008	0.006
	(0.005)	(0.005)	(0.006)	(0.007)
Disabled	0.014	0.016	0.023	0.016
	(0.009)	(0.012)	(0.016)	(0.020)
Health	-0.000	-0.003	0.003	0.003
	(0.002)	(0.003)	(0.003)	(0.004)
Non-Eco Sentiment	0.015	0.003	0.019	0.008
	(0.011)	(0.010)	(0.015)	(0.016)
Eco Sentiment	0.043**	0.041**	0.037**	0.042**
	(0.007)	(0.008)	(0.011)	(0.012)
Constant	1.019**	1.079**	1.081**	1.128**
	(0.018)	(0.025)	(0.032)	(0.048)
Num.Obs	16774	16774	16774	16774
Num.Ind	2017	2017	2017	2017
ρ	0.478	0.570	0.402	0.496
Rej Time dummies = 0 ?	Yes**	Yes**	Yes**	Yes**

Constant term and time dummies are included. Standard errors are clustered at the state level. ρ is the fraction of the unsystematic variation due to unobserved heterogeneity. 'Num.Obs ' is the sample size. 'Num.Ind ' is the number of individuals. Statistical significance is indicated as follows: + p<0.10, * p<0.05, ** p<0.01.

seem to feel more uncertain about the future house price development. Moreover, females, the elderly, and less educated people have higher uncertainty, which is similar to the findings of subjective uncertainty in stock market expectations ((Hurd et al., 2011) and (Hudomiet et al., 2011)). Finally, the joint significance of the time dummies indicates that subjective uncertainty is also affected by nationwide shocks.

7. House price expectations and reported realizations

In this section, we compare expected home value changes with subsequent changes in self-reported home values over the same time-period, which may be interpreted as "realizations," where we use quotes because it should be noted that these self-reported home values are not necessarily identical to objective market values. Still, this comparison is worthwhile to get more insight in the nature of the subjective house price expectations. First, previous studies found that time patterns of self-reported home values and of transaction prices are quite similar ((DiPasquale and Somerville, 1995)). This is particularly relevant since our analysis focuses on changes rather than levels. Second, perceived house price changes can be more relevant than objective changes if households make decisions based on perceived rather than objective housing wealth. Lastly, self-reported home values are widely used in the literature to measure housing wealth and are the only measure available at the individual level in many cases. Out of the 19 quarterly waves, we can match 15 waves of expectations with corresponding "realizations" of home value changes in one year, and one wave with "realizations" of home value changes in five years.

7.1. Comparing expectations and "realizations" using raw probabilistic answers

If the unpredictable part of the realizations of future home values are independent across respondents (implying the absence of aggregate shocks), then under rational expectations, the average subjective probabilities should closely resemble the corresponding fractions of "realizations".[18] Figure 3 plots the differences between the average subjective probabilities that home values will increase over the next year and the (corresponding) fraction of respondents whose self-reported home value has increased over the same time period. The figure shows that expectations were consistently more positive

[18] In a similar way, Dominitz and Manski (1997a) and Manski (2004) compare expectations and realizations of health insurance, burglary, and job loss, though they use repeated cross-sectional data with one wave of realizations only.

Table 5: Heterogeneity in house price expectations: elicited IQR

	Parametric approach		Flexible approach	
	RE	FE	RE	FE
Sand states	0.039**		0.034**	
	(0.009)		(0.013)	
Change in unemployment	-0.033	-0.029	-0.069*	-0.061+
	(0.026)	(0.027)	(0.033)	(0.034)
Change in house prices	0.000	0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Age	-0.002**		-0.002**	
	(0.000)		(0.001)	
Female	0.019*		0.034**	
	(0.009)		(0.009)	
White	-0.017		-0.028*	
	(0.014)		(0.013)	
Log home value	0.001	-0.000	-0.004*	-0.005*
	(0.002)	(0.002)	(0.002)	(0.002)
Log income per capita	-0.000	-0.004	-0.008	0.001
	(0.007)	(0.010)	(0.007)	(0.011)
Household size	0.002	-0.001	0.001	0.009
	(0.004)	(0.006)	(0.005)	(0.007)
Bachelor	-0.009	0.042	-0.021*	0.066
	(0.006)	(0.051)	(0.010)	(0.072)
Married	0.016+	0.019	0.014	0.009
	(0.009)	(0.016)	(0.010)	(0.020)
Unemployed	0.023+	0.016	0.009	0.001
	(0.013)	(0.012)	(0.012)	(0.014)
Retired	0.003	0.013	0.001	0.011
	(0.009)	(0.009)	(0.008)	(0.010)
Disabled	0.023	0.038*	0.036+	0.033
	(0.015)	(0.019)	(0.022)	(0.030)
Health	-0.001	0.002	0.001	0.007
	(0.003)	(0.004)	(0.005)	(0.007)
Non-Eco Sentiment	-0.001	0.003	-0.011	-0.005
	(0.017)	(0.018)	(0.020)	(0.023)
Eco Sentiment	0.006	0.019	0.016	0.027
	(0.014)	(0.015)	(0.019)	(0.021)
Constant	0.365**	0.240**	0.492**	0.269**
	(0.042)	(0.054)	(0.054)	(0.069)
Num.Obs	16769	16769	16769	16769
Num.Ind	2017	2017	2017	2017
ρ	0.417	0.494	0.351	0.449
Rej Time dummies = 0 ?	Yes**	Yes**	Yes**	Yes**

Constant term and time dummies are included. Standard errors are clustered at the state level. ρ is the fraction of the unsystematic variation due to unobserved heterogeneity. 'Num.Obs ' is the sample size. 'Num.Ind ' is the number of individuals. Statistical significance is indicated as follows: + p<0.10, * p<0.05, ** p<0.01.

Table 6: Five-year expectations in Feb 2009 and "realizations" in Jan 2014

	Average subjective probabilities in 2009	Realized fractions in 2014
Pr(H5>100)	0.58	0.39
Pr(H5>110)	0.50	0.24
Pr(H5>120)	0.29	0.14
Pr(H5<90)	0.18	0.30
Pr(H5<80)	0.11	0.18

than realizations during and shortly after the recession period, and converged in more recent waves. In the period 2009-2011, subjective expectations were much better than the corresponding realizations. For example, in January 2010 the average subjective probability of a gain in home value over the next year is 40%, but the reported home value one year later was larger than the home value reported in January 2010 for only 25 percent of the sample. This implies that *ex post*, respondents were too optimistic in January 2010. Perhaps they did not have rational expectations, but it could also be that a nation-wide shock that could not be anticipated reduced home values. We do not fully disentangle these two explanations for the difference. However, even if negative shocks might be correlated during a recession, rational expectations should have taken this into account. The fact that the difference has the same sign in several consecutive years suggests the former explanation (non-rational expectations) is more likely than the latter (several unanticipated negative shocks in a row). Besides, a Newey-West test controlling for serial correlations up to one year rejects the null that the systematic part of the difference is zero.

Table 6 compares expectations and "realizations" over the five year period January 2009 - January 2014. It shows that the average subjective probabilities that home values in five years will increase, increase by more than 10%, increase by more than 20%, decrease by less than 10%, or decrease by less than 20%, are all much larger than the corresponding realized fractions of respondents reporting an increase in the value of their home, an increase by more than 10%, etc. Again, this suggests that realizations over the complete five year-period were worse than expected. Many people did not anticipate the negative influence of the crisis on the values of their home.

The above results imply that households are in general too optimistic about changes in future home values during and shortly after the financial crisis. While it is difficult to pin down the exact reasons behind this overoptimism, we note that similar patterns are found in pervious works concerning other financial expectations of households. For

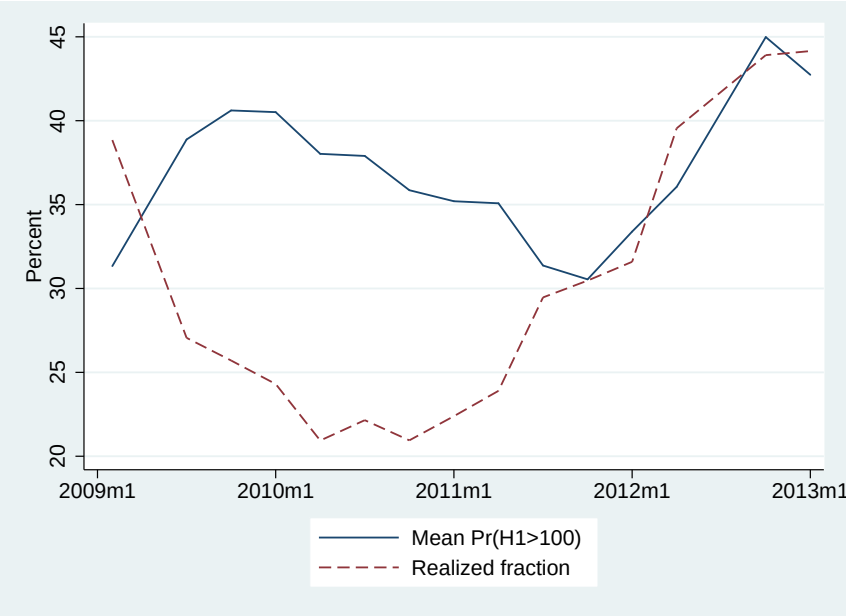


Figure 3: One-year house price expectations and "realizations"

example, Souleles (2004) found that individuals in the Michigan survey were repeatedly negatively surprised by recessions, in the sense that realizations of financial position, business condition, and income were systematically worse than expected around recessions.

7.2. Comparing expectations and "realizations" using elicited distributions

We can further investigate the relationship between expectations and realizations by using the entire subjective probability distribution of five-year expectations, along the lines of thought in Dominitz (1998) who examined earnings expectations and realizations. Around 1500 individuals reported home values and five-year house price expectations in February 2009. We base our analysis on the 653 among these who also reported home values in January 2014.

To obtain Table 7, we use the estimated 0.25, 0.50 and 0.75 quantiles of each respondent's subjective distribution, using the parametric as well as the flexible estimator from Section 6. We then compute for how many respondents the "realized" changes in the reported home values are below each given quantile. Under the joint hypothesis that expectations are rational, that there are no common shocks, and that the sample for which we can do these calculations is not selective with respect to expectations or reported realizations, approximately 25% of the respondents should have a "realization" below their subjective 25% quantile, approximately 50% should have a "realization" be-

Table 7: Probability that home values in 2014 ($Pr(HV_{2014})$ do not exceed selected subjective quantiles (q_α)

Subjective Quantile q_α	$Pr(HV_{2014} \leq q_\alpha)$					
	all		No Bachelor		Bachelor	
	Parametric	Flexible	Parametric	Flexible	Parametric	Flexible
0.25	0.48	0.52	0.49	0.52	0.48	0.53
0.50	0.67	0.71	0.66	0.69	0.68	0.73
0.75	0.78	0.80	0.77	0.78	0.80	0.82

Statistical significance is indicated as follows: + p<0.10, * p<0.05, ** p<0.01.

low their subjective median, and approximately 75% should have a "realization" below their 75% quantile. The numbers in the table show that this is not the case, particularly for the 0.25 quantile. About half of the respondents report an increase in home value below their subjective 25% quantile, suggesting that many respondents underestimated the chances of a negative outcome, that is, a substantial decrease of the value of their home over the five years period. On the other hand, the fractions of people with a realized change below their subjective 0.75 quantile is close to 75%, suggesting that the respondents anticipated the possibilities of home value increases much better. The results for the median are in between. Assuming that the underlying distribution is Bernoulli, Wald tests also reject the null that the calculated probabilities are not significantly different from the corresponding subjective quantile (0.25, 0.5, or 0.75). Overall, the results confirm that *ex post*, the majority of the respondents were over-optimistic, in line with what we saw in the previous subsection. As explained before, this may be due to non-rational expectations or to common shocks that could not be anticipated.

To see whether the performance of expectations varies across socio-economic groups, the final columns of the table present the same fractions separately for the subsamples of lower and higher educated respondents, as Dominitz (1998) did for earnings expectations. The outcomes for the two groups are actually very similar. Assuming that the probabilities for the high educated and the low educated people come from two independent Bernoulli distributions, they are not statistically different from each other based on Wald tests. In the previous section we saw that the higher educated have higher subjective medians (the random effects estimates in Table 4). The results in Table 7 show that this difference is reflected in the "realized" five-year changes so that *ex post*, both groups have been equally over-optimistic.[19]

[19] We have also experimented with separating people by gender and found no significant difference.

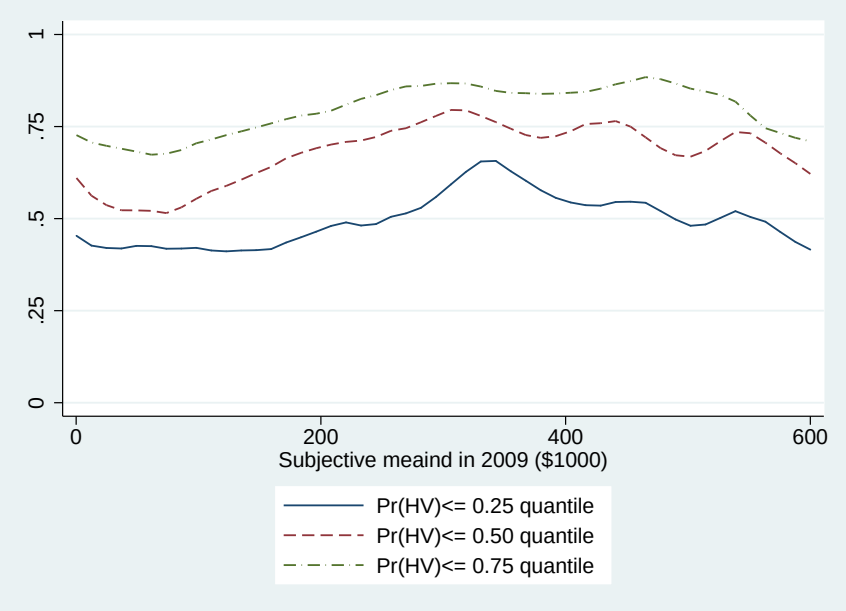
Figure 4 plots the same fractions of respondents whose realized change exceeds their subjective quantiles, but now as a function of the respondents' subjective median home value in 2009, using nonparametric kernel regressions. Again, if people have rational expectations and there are no macroeconomic shocks, we would expect the curves to be roughly constant at 0.25, 0.5, and 0.75, respectively. In contrast, the estimated conditional probabilities are almost always above the corresponding values, particularly for the 0.25 quantile. This is in line with what we saw in Table 7 and suggests that the respondents did not correctly anticipate the downward home value risk over the five-year period. The figure shows that this applies to all groups, irrespective of the anticipated value of their homes in 2014, although the problem is somewhat smaller for owners of houses with very low or very high value than for the intermediate group.

8. Conclusion

In this paper we have studied the expectations of US home owners of future changes in the values of their homes. The analysis was based on survey data that directly measure expectations. Our study contributes a number of empirical findings to the literature on subjective expectations in general and on house price expectations in particular.

We have documented a certain level of momentum in short-run house price expectations, but not in the long-run expectations. The long-run expectations seem to be characterized by mean-reversion effects, in that people living in sand states are particularly optimistic about five-year ahead home values. Our sample period however covers mainly the bust period. Using data over a longer period, Case et al. (2012) observed that home buyers are more optimistic about long-term house price changes than one-year changes in early 2000s. The mean-reversion effect seems to be absent during the boom period. Combing their findings with ours suggests some kind of asymmetry in expectations between the boom and the bust periods. Several facts might be related to these phenomena. Some studies found that house prices show downward rigidity during periods of decline ((Gao et al., 2009)). It might be the case that house price expectations also have downward rigidity: people are less likely to extrapolate downward trends during price decline than they extrapolate upward trends during price increase. Many people may believe that housing is a good investment in the long run. Alternatively, households might learned a more comprehensive picture of the house price dynamics after the bust and began to realize the potential mean-reversion. This is consistent with

(a) Parametric



(b) Flexible

Figure 4: Conditional probability that self-reported home values in 2014 (HV) do not exceed 0.25, 0.50, and 0.75 subjective quantiles in 2009

the findings in the lab experiment in Beshears et al. (2013), that for a process featured by short-run momentum and long-run mean reversion, individuals are more likely to realize the existence of mean reversion if the mean reversion dynamics unfold faster. Although these conjectures are interesting, we leave the detailed mechanism behind for future research.

Our findings show that house price expectations are strongly procyclical. At the state level, expectations and unemployment rates move oppositely. At the individual level, expectations comove with people's individual economic situations and economic sentiment, even when unobserved individual effects, nationwide shocks, and local economic conditions are controlled for. This indicates that economic expectations are influenced by personal economic experiences, as emphasized in Nagel (2012).

There is substantial heterogeneity across socio-economic groups in terms of both the central tendency and the uncertainty of subjective distributions of house price changes. The heterogeneity may represent the segmented nature of the housing market and the heterogeneity in outlooks of the economy, which deserves further studies. Besides, studies on wealth distributions might also take into account this heterogeneity, as expected changes in asset prices are related to perceived future wealth levels and housing is the dominant asset for most households.

Finally, future theoretical and empirical work may also try to set up a more structural model that explains expectations and fits the data, and may investigate how house price expectations can affect households' decisions on, for example, mortgage borrowing and consumption.

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Appendix: Survey Questions on House price Expectations

Rand American Life Panel

If the respondent owns the home in which he lives (answer "yes" to the home ownership question) and is willing to have probability questions, then the following questions are asked in sequence:

Pr(H1>100):

> On a scale from 0 percent to 100 percent where 0 means that you think there is no chance and 100 means that you think the event is absolutely sure to happen, what do you think are the chances that by next year at this time your home will be worth more than it is today?

Pr(H5>100):

> What are the chances that over the next 5 years your home will be worth more than it is today.

Pr(H5>110)(If Pr(H5>100)>0):

> What are the chances that 5 years from now the value of your home will have gone up by more than 10 percent?

Pr(H5>120)(If Pr(H5>110)>0) :

> What are the chances that 5 years from now the value of your home will have gone down by more than 20 percent?

Pr(H5<90)(If Pr(H5>100)<100):

> What are the chances that 5 years from now the value of your home will have gone up by more than 10 percent?

Pr(H5<80)(If Pr(H5>90)<100) :

> What are the chances that 5 years from now the value of your home will have gone down by more than 20 percent?

Michigan Survey of Consumers

From January 2007, the survey started to ask expected percentage chance in house prices. The question on one-year expectation reads:

> **[Michigan one year]** By about what percent do you expect prices of homes like yours in your community to go (up/down), on average, over the next 12 months?

The question on five-year expectation reads:

> **[Michigan five year]** By about what percent per year do you expect prices of homes like yours in your community to go (up/down), on average, over the next 5 years or so?

The Fannie Mae National Housing Survey

This survey has a question on the expected percentage change in house prices, very similar to the one in the Michigan Survey of Consumers, which reads:

> **[Fannie Mae one year]** By about what percent do you think home prices in general will go (up/down) on the average over the next 12 months?