Home Price Expectations and Behavior: Evidence from a Randomized Information Experiment*

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Abstract

Home price expectations are believed to play an important role in housing dynamics, yet we have limited understanding of how they are formed and how they affect behavior. Using a unique "information experiment" embedded in an online survey, this paper investigates how consumers' home price expectations respond to new information, and how they impact investment decisions. At the baseline, we elicit respondents' expectations for future home price changes in their zip code, as well as their perceptions about past home price changes. A random subset of respondents is presented with factual information about past (one- or five- year) local home price changes. We then re-elicit home price expectations from all respondents, thereby creating unique panel data that allow us to identify causal effects of this information. We find that the majority of respondents revise their expectations. However, it is primarily information about the immediate past one year (and not past five years) that leads to systematic revisions in home price expectations. On average, home price expectations are revised in a way consistent with perceived momentum in home prices at the short horizon. While the average respondent's updating behavior is broadly consistent with observed dependence in home prices, we uncover substantial and meaningful heterogeneity in respondents' updating behavior. We also present robust evidence of home price expectations impacting (actual and hypothetical) housing-related behavior, both in the cross-section and within-individual.

Keywords: housing, expectation formation, information experiment

*The views expressed in this paper are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

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1 Introduction

Home price expectations play a prominent role in many accounts of the housing boom that occurred during the early- to mid-2000s, both in the US and globally (e.g., Shiller 2005, Foote et al. 2012, Case et al. 2012, Glaeser et al. 2013). In this paper, we study how home price expectations are formed, and how they affect behavior. Specifically, we rely on a novel "information experiment" within an online household survey to test how respondents update their expectations about future house price growth in their local area when they are provided with objective information about recent house price growth. We furthermore embed an incentivized experiment in the survey, so that we can study the causal effect of expectations on a housing-related investment decision.

Our empirical design allows us to study two main questions. First, we test whether respondents revise their expectations after being provided with information that may differ from their priors about recent house price growth in their local area (over the past year or the past five years). For instance, if a respondent thought that prices had increased by 3% over the past year, and expects them to increase by 2% over the coming year before we provide her with the information, how does she react after learning that according to a house price index (HPI), prices had in fact increased by 6%? If she believes in momentum in house prices, we would expect her to adjust her future expectations upward, while a belief in mean reversion would lead her to revise her expectations of future growth downward.

We find that on average, respondents fall into the former camp when the provided information is for the past one year, and the elicited expectations for future growth are at the one-year horizon as well. We estimate that for each percentage point underestimation of past growth relative to the HPI, respondents adjust their expectations upward by 0.19 percentage points. In contrast, when we provide them with information about price growth over the previous five years, the past HPI growth (relative to their prior) does not have significant effects on their revised expectations (although directionally the respondents also extrapolate). Similarly, longer-term expectations (over the 2-5 year horizon) are on average not significantly affected by the information.

Comparing these observed updating patterns to actual serial correlation in measured house price growth suggests that respondents update their expectations in a sensible way. Unlike stock prices, for instance, house price growth exhibits strong positive autocorrelation at the one-year horizon (Case and Shiller, 1989); in contrast, at medium horizons (2-5 years) there is little correlation (if anything, high growth over the past 5 years predicts low growth 2-5 years in the future).

Thus, on average our respondents react in the right direction to updated information about recent one-year growth (and in fact, they may underreact on average), and are also broadly correct in not systematically changing their longer-term expectations and in not responding to past five-year growth.

We also study heterogeneity in updating behavior. Looking at one-year expectations, respondents who receive the information are much more likely to update their expectations than a control group. They are 12 percentage points more likely to be "extrapolators" (revising their expectations in the direction of the gap between revealed HPI growth and their prior about past growth) and about 5 percentage points less likely to be "mean reverters" (doing the opposite). Notably, the proportion of extrapolators is significantly higher in areas with relatively lower housing supply elasticity. The intervention also causes respondents who are less confident in their perceptions of past home price changes, and owners likely to sell their home over the next one year to revise their expectations and to extrapolate. Looking at longer-term expectations, many respondents update their forecasts after receiving information, even though empirically, realized growth has little predictive power for future long-term growth; this suggests an overreaction. Respondents with higher income or more education are more likely to not respond to the information.

Our second main question is how expectations affect behavior. We investigate this most directly by asking respondents to allocate a $1000 one-year investment between a housing market fund with returns tied to local house price growth and a risk-free savings account. We do so first before the information provision, in a hypothetical manner, and then again after the information provision, in an incentivized manner.[1] We find that expectations have an economically and statistically significant effect on respondents' investment allocation, both across respondents and within-respondent (meaning the change in the housing fund share between the hypothetical and incentivized rounds is related to the change in expectations following the information provision).

Outside the stylized investment experiment, we also study the relation between respondents' baseline expectations and stated intentions of buying a non-primary (vacation or investment) home and the likelihood of buying (rather than renting) their next primary residence if they were to move over the next three years. In addition, for current owners, we elicit the likelihood of making investments in the home over the next year, as well as putting their home on the market over the next year. In each case, we find a significant correlation between expectations and intended behavior. These findings suggest that survey measures of house price expectations have meaningful infor-

[1] Respondents were informed that two of them would be randomly chosen to be paid out the result of their investment, i.e. the $1000 plus the one year return.

mation content to understand behavior, and are therefore important variables to track for policy makers and housing market analysts.

While the survey design is discussed in more detail later in the paper, we point out a few noteworthy features here. First, we randomize our respondents into different frames when eliciting their perceptions and expectations to ensure that our results are not exclusive to a given frame. Specifically, half the respondents are asked for their perceptions and forecasts in terms of house price *levels* (from which we then calculate percent changes) while the others are directly asked about changes. Second, the information provision (and re-eliciation of expectations) does not happen immediately after the respondents' priors are elicited, but only after they have gone through various other (unrelated) survey questions. This makes it unlikely that the effects of the information are driven by "demand effects" or a desire to give the "correct" answer. Our design also features a control group that is not provided with information, so that we can control for the effects on expectations that merely completing the survey may have. Third, we test whether the information provision has persistent effects on our respondents' beliefs by re-eliciting them in a separate follow-up survey two months after the initial one. We find that indeed, the effect of the information remains almost the same, on average, as within the initial survey.

Our paper relates directly to other empirical work studying expectation formation. In the housing market, Case and Shiller (2003) and Case et al. (2012) measure expected future home price growth in a sample of recent homebuyers across four MSAs, and find evidence consistent with extrapolation even at longer horizons. Niu and van Soest (2014) study home price expectations in the American Life Panel, while Bover (2015) conducts a similar exercise in Spanish data. Kuchler and Zafar (2015) study how experienced local home price growth (as measured by a HPI) affects expectations about future national home price growth. Our work is unique in that we directly measure respondents' perception of recent local home price growth (or the past one and five years) and test changing this perception through information provision affects future expectations.

Other work has used surveys to study the properties of stock market expectations (e.g. Amromin and Sharpe 2014, Greenwood and Shleifer 2014) and inflation expectations (e.g. Malmendier and Nagel 2013; Madeira and Zafar 2015). The information experiment in our survey is related to other experimental work in lab settings (e.g. Schmalensee 1976, Haruvy et al. 2007, Rötheli 2010 , Beshears et al. 2013), in surveys (Armantier et al., 2014) and in the field (Cavallo et al., 2014).

On the theory side, the effects of different assumptions about expectation formation on price patterns have been extensively studied in the context of equity markets (e.g. DeLong et al. 1990,

Barberis et al. 1998, Barsky and DeLong 1993, Fuster et al. 2011, Barberis et al. 2015). More recent work has specifically studied models of expectations that can explain price and trading volume patterns in the housing market (e.g. Piazzesi and Schneider 2009, Burnside et al. 2014, Guren 2015, Glaeser and Nathanson 2015; Glaeser and Nathanson 2014 provide an excellent review). We provide data against which these theories can be (at least qualitatively) evaluated.

The remainder of the paper is organized as follows: the next section describes the design of the survey, how it is administered, and details about the respondent sample. Section 3 characterizes respondent's perceptions and expectations at the baseline (prior to the information provision). Section 4 studies the effects of the information provision on expected future house price growth. Section 5 studies the effect of expectations on behavior. Finally, Section 6 concludes with a discussion of our results.

2 Survey Design and Administration

Our data come from two original online surveys, both fielded as part of the Federal Reserve Bank of New York's Survey of Consumer Expectations (SCE).[2] The SCE is an internet-based survey of a rotating panel of approximately 1,200 household heads, with the goal of eliciting expectations about a variety of economic variables, such as inflation or labor market conditions. Respondents participate in the panel for up to twelve months, with a roughly equal number rotating in and out of the panel each month. Respondents are invited to participate in at least one survey each month.[3]

The first survey is a special module on housing, fielded in February 2015. Repeat panelists (that is, those who had participated in the survey in the prior eleven months) were invited to participate in the housing module. Out of a total sample of 1,383 household heads on the panel invited to participate in the survey, 1,205 did so, implying a response rate of 87 percent.

The housing module contains multiple blocks of questions, some differing between owners and renters. The respondents are asked, among other things, about their perceptions of past home price changes and expectations for future home prices, (current and future) financing conditions, past housing-related behavior (such as buying a home, and housing debt), and the future likelihood of buying a home. Respondents also provide information about their zip code location,

[2] See www.newyorkfed.org/microeconomics/sce.html for additional information.

[3] The survey is conducted over the internet by the Demand Institute, a non-profit organization jointly operated by The Conference Board and Nielsen. The sampling frame for the SCE is based on that used for The Conference Board's Consumer Confidence Survey (CCS). Respondents to the CCS, itself based on a representative national sample drawn from mailing addresses, are invited to join the SCE internet panel. The response rate for first-time invitees hovers around 55 percent. Respondents receive $15 for completing each survey.

their household income, and many other demographic variables. The median survey time was 34 minutes, with owners having a median completion time 7 minutes higher than renters, since they answered many more questions. When appropriate, questions had built-in logical checks (e.g., percent chances of an exhaustive set of events had to sum to 100). Item non-response is extremely rare, and never exceeds one percent for any question.

The second survey is the regular monthly SCE survey, and was fielded during April 2015. Respondents who still remained in the SCE rotating panel were invited to participate in a short follow-up module. Of the 978 household heads still in the panel, 856 did so, for a repeat response rate of 87.5 percent.

2.1 Survey Design

We next describe the relevant sections of the two surveys.

The experimental setup in the first survey consisted of three stages:

1. **Baseline Stage**: The first stage elicited respondents' perceptions about home price changes in their zip code over the past 12 months and the past 5 years. We also elicited respondents' expectations regarding home price changes in their zip code over the next 12 months, and the next 5 years (the precise questions will be discussed below). Respondents were also presented with a hypothetical investment scenario where they were asked to allocate $1,000 between a fund indexed to year-ahead home price growth in their local area, and a 2% risk-free interest savings account.[4]

2. **Treatment Stage**: A block of other housing-related questions taking roughly 15 minutes separated the baseline and treatment stages. In the treatment stage, respondents were randomly assigned to one of three groups:

    - *1-year Treatment (T1)*: Respondents were informed about the percentage change in home prices in their zip code over the 2014 calendar year. This information was based on the Zillow Home Value Index (ZHVI), which is freely available online.[5] We refer to this

[4]The exact question was: *"Consider a situation where you have to decide how to invest $1,000 for one year. You can choose between two possible investments. The first is a fund that invests in your local housing market, and pays an annual return equal to the growth in home prices in your area. The second is a savings account that pays 2% of interest per year. What proportion of the $1,000 would you invest in (1) the housing market fund, (2) the savings account?"*

[5]For more information on the construction of this index, see http://www.zillow.com/research/zhvi-methodology-6032/. The ZHVI estimates the market value of all homes in a geographic area, not just those that are actually sold, avoiding biases that may be associated with what type of homes are sold. We used the ZHVI as of January 2015, the month prior to the survey.

group as the "T1" group.

- *5-year Treatment (T5)*: Respondents were informed about the percentage change in home prices in their zip code over the past 5 years, from the beginning of 2010 to the end of 2014. We refer to this group as the "T5" group.
- *Control group*: Respondents in this group got no information on past house price changes.

3. **Final Stage**: This stage followed right after the treatment stage. All survey respondents were re-asked their expectations of zip code level home price changes at the one and five year horizons — the same forecast horizons for which expectations were initially elicited at the baseline stage. The investment scenario that respondents had seen in the first stage was also presented again. It was identical to the initial scenario, except that the decision was now incentivized—respondents were informed that two people taking the survey would be paid in a year's time depending on the return of their investments.[6]

The follow-up questions were fielded to respondents in the April 2015 SCE monthly survey. Respondents were asked their expectations of zip code level home price changes at the one and five year horizons.

Some additional features of the study design merit further discussion. We include treatments that provide information on short- and longer-term home price changes since home price changes tend to exhibit momentum in the short-term (Case and Shiller, 1989; Guren, 2015) and mean reversion over a longer horizon. The reason for including a control group was that the simple act of taking a survey about housing may make respondents think more carefully about their responses, and may lead them to revise their home price expectations even if they are not provided with any new information (see Zwane et al. 2011 for a discussion of how surveying people may change their subsequent behavior). Since we are interested in revisions in expectations that are directly attributable to the information, we identify them from differences between the treatment and control

The coverage of ZHVI is incomplete at the zip code level, so if we do not have zip code level information, we use the state-level ZHVI change (respondents were told *"In cases where zip code level information is not available, we use the state-level change in home prices (or, in very few cases where no state-level information is available, the national change)."* 70.3% of our respondents' reported zip codes were covered by the ZHVI. In the very rare cases where we do not have state-level data (Maine and Kansas), we report national changes; 14 of our 1,205 (1.16%) respondents were in this category.

[6]Respondents were told: "*Note that you have a chance of earning extra money by answering this question. At the end of the month, we will randomly pick 2 survey participants. These 2 participants will be paid in Spring 2016 according to the investment choice they made (that is, the $1,000 and the return on their choices). If you are chosen, your payment will depend on how you had invested the money, so answer this question carefully.*

To determine the return on the housing market fund, we will use the Zillow home price index for your current zip code. In cases where zip code level information is not available, we use the state-level index (or, if that is not available, the national index)."

groups' changes in expectations. The investment task allows us to investigate, in a direct fashion, whether home price change expectations impact both hypothetical and incentivized behavior, in the cross-section as well as at the individual level. Finally, the follow-up survey allows us to investigate whether the effect of the treatment, if any, persists beyond the initial survey horizon.

All respondents were first asked for the dollar value of a typical home in their zip code today. Home price perceptions (for the past one and five years) and expectations (for one-year and five-years ahead) were elicited in two different formats. Each respondent was randomly assigned to one of two "blocks" which determined how these questions were asked (and each respondent remained in the same block throughout both surveys). The two blocks were:

- **Block A**: The perception and expectation questions were asked in terms of house price *levels*. For example, past one year home price change perceptions were elicited as follows: "*You indicated that you estimate the current value of a typical home in your zip code to be [X] dollars. Now, think about how the value of such a home has changed over time. (By value, we mean how much that typical home would approximately sell for.). What do you think the value of such a home was one year ago (in February 2014)?*"

- **Block B**: The perception and expectation questions were asked in terms of *percent changes*. For example, when eliciting past one year home price change perceptions, respondents were first asked if they thought home prices had increased or decreased over the past one year, and next asked for the percentage change: "*By about what percent do you think the value of such a home has [increased/decreased] over the past 12 months? Please give your best guess.*"

These two approaches for eliciting perceptions and expectations were motivated by the finding of Glaser et al. (2007) that survey respondents' predictions of stock performance are influenced by whether they are asked to forecast future returns or future price levels. In the former case, expectations appear to be extrapolative, whereas when asked for levels, respondents appear to believe in mean reversion. We therefore want to study whether our findings are robust to the elicitation mode. In our analysis, we control for the block assignment whenever the analysis is done on the full sample. Where results qualitatively differ between the two, we also present the analysis separately for the two blocks.

Respondents, at the baseline stage, were also asked about their subjective distribution for both one- and five- year ahead home price expectations. This allows us to gauge the subjective uncertainty in respondents' forecasts. In the case of one-year ahead expectations, respondents were

asked to assign probabilities to four intervals that future year-ahead home price changes may lie in (less than -5%; between -5% and 0%; between 0% and 10%; more than 10%).[7]

2.2 Sample Characteristics

The first column of Table 1 displays the demographic characteristics of our sample. The sample aligns well with average demographic characteristics of the United States along most dimensions. For instance, our sample has an average age of 51.1 years, and 51.4% of our sample reports annual household income of less than $60,000, while the corresponding numbers among U.S. household heads are 53.7 years and 54.5%.[8] 70.8% of respondents are homeowners, compared to a national homeownership rate in 2015:Q1 of 63.7% according to the Census. One notable divergence between our sample and the U.S. population is in education. Our sample is significantly more educated than the overall population: 52% of our respondents have at least a Bachelors' degree, while only a third of the U.S. household heads fall in this category. This may partly be a result of differential internet access and computer literacy across education groups in the US population.

The table also shows some other demographic variables, such as labor force status, tenure in the respondent's town or city, numeracy,[9] and self-reported credit score. Columns (2)-(4) of the table show that the demographic characteristics are not statistically different across the three treatment groups (the only exception being the proportion of males). This should not be surprising, since random assignment should have largely preserved balance between the three groups.

The last column of Table 1 shows the characteristics of the follow-up sample. The only characteristics that significantly differ at $p < 0.05$ between this group and respondents in the initial survey is not being in the labor force, and having a low credit score; however, the differences are economically small.

3 Empirical Analysis

In general, we expect our information intervention to cause respondents to revise their home price expectations if i) their expectations are influenced by their beliefs about the measures we use in our

[7] Due to a programming error in the survey, Block B respondents were presented with non-contiguous bins (for increases) for year-ahead home price changes. Therefore, we are unable to use the one-year ahead density data for Block B respondents when data on the entire subjective density are needed (however, we have these data for all respondents for the five-year ahead horizon).

[8] The statistics on the United States population come from the 2014 ACS 1-year sample of household heads.

[9] We ask respondents when they enter our survey panel to answer 5 questions that evaluate their numeracy. The questions are taken from Lipkus et al. (2001) and Lusardi (2009). Those who answer at least 4 of the 5 numeracy questions correctly are classified as having high numeracy.

information treatments, i.e., past short- and long- term home price changes, and ii) respondents are not already fully informed about the true values of these quantities. We thus begin by studying baseline beliefs and ex-ante informedness.

3.1 Perceptions and Perception Gaps

At the baseline, respondents were asked for their perceptions of past home price changes in their zip code over the past twelve months and over the past five years. Block B respondents directly report their beliefs in percentage point terms, but for Block A respondents who report beliefs in levels, we compute percentage point changes. Summary statistics of respondents' perceptions of past home price changes are reported in the top panel of Table 2. Throughout the paper, perceptions and expectations are winsorized at the 2% level in order to limit to influence of outliers in our analysis. Respondents, on average, perceive that home prices in their zip code increased by 4% over the past 12 months. The perceived average change over the past five years, annualized, is 1.8%. The large standard deviations, and the fact that average absolute perceptions are meaningfully larger than the average perceptions, indicate that there is substantial heterogeneity in perceived home price changes. The average perceptions are similar across the three groups, which should not be surprising since assignment to groups is random.

A key ingredient in our analysis is a measure of respondents' ex-ante informedness about the treatment information. The measure we use to capture this is the difference between what respondent i believes the percentage point change in house prices was in her zip code over the past t years (which we denote as $\pi_{i,t}$), and what the realized percentage point change actually was in i's zip code based on the information source that we used (which we denote as π_t). Note that the objective information presented to the respondent is individual-specific and depends on her zip code. We refer to this difference as the "perception gap", $\alpha_{i,t} = \pi_t - \pi_{i,t}$, with a positive (negative) gap reflecting an underestimation (overestimation) of past home price changes relative to the Zillow measure. Note that for the five year horizon, the perception gap is annualized.[10]

Panel B of Table 2 shows that the mean perception gap in our sample is 1.1% for the one-year horizon, and -1.1% for the (annualized) five-year horizon. That is, the average respondent underestimates (overestimates) home price changes by about a percentage point at the one-year (five-year) horizon relative to the HPI. However, the corresponding standard deviations are 8.7% and 5.0%,

[10]We annualize the five-year perception gap as follows: $[1 + (\pi_5 - \pi_{i,5})]^{1/5} - 1$. We continue to use the notation $\alpha_{i,5}$ to refer to annualized five-year perception gap. The perception gap is annualized so that the analysis is comparable across the two horizons.

respectively, suggestive of substantial heterogeneity in the perceptions of our sample.

We next investigate the correlates of these perception gaps. Since positive and negative gaps may cancel each other out, we focus on absolute gaps. The average absolute gap for the one- (five-) year horizons in the sample is 6.5 (2.9) percentage points. The first two columns of Table 3 regress the absolute perception gaps on a rich set of demographic controls. College-educated respondents, on average, have smaller perception gaps at both horizons. High-numeracy individuals have smaller absolute gaps at the one-year horizon, while whites and homeowners have smaller absolute gaps at the five-year horizon. The regression shows that respondents who have lived longer in their town/city, those reporting being more confident in their past perceptions,[11] those who have checked housing websites over the past 12 months, those reporting a greater than 50 percent chance likelihood of buying a home over the next three years, and higher income respondents (those with a household income $\geq$ \$75,000), all have smaller absolute gaps, on average, at the one-year horizon as one might have expected; however, none of these estimates are significant at conventional levels. Notably, the R-squared of these two regressions indicate that less than 7% of the variation in perceptions can be explained by these controls.[12] Thus, the extent to which respondents are "surprised" by the provided information is largely orthogonal to demographics.

3.2 Local Home Price Expectations

As mentioned above, we elicit respondents' home price expectations (at the zip code level) for the next one year and five years. We would expect significant correlation between the five-year and year-ahead expectations simply because the five-year expectation is a combination of a respondent's expectations of year-ahead home price changes and 2-5 years ahead home price changes. We, therefore, separately analyze respondents' 2-5 year-ahead home price expectation. This is simply $y_{i,2-5} = \left[1 + \frac{(y_{i,5} - y_{i,1})}{(1+y_{i,1})}\right]^{1/4} - 1$, where $y_{i,h}$ is i's expectations about home price changes (in percent terms—with, for example, a percentage point change denoted as 0.01) at horizon h. We refer to these as "medium-term" expectations.

Panel C of Table 2 displays summary statistics of home price expectations at the baseline. We

[11] After reporting their past perceptions, respondents were asked: *"How confident are you in your answers?"* on a five-point scale, where 1 meant "Not at all confident" and 5 meant "Very confident". Those reporting 4 or more are classified as being confident in their perceptions.

[12] When looking at individual demographic characteristics in a univariate framework, Appendix Table A1 shows that non-Hispanic whites, higher-income respondents, college-educated individuals, high-numeracy respondents, married individuals, and homeowners have significantly smaller average absolute perception gaps at both the 1-year and 5-year horizons. In addition, for the one-year horizon, males and those who frequently check housing websites and other sources have smaller absolute gaps, on average.

see that respondents, on average, expect a 4% increase in house prices in their zip code over the next 12 months, 12.3% over the next five years, and an annualized change of 1.9% at the 2 to 5 year horizon. The sizable standard deviations highlight the substantial heterogeneity in beliefs in the sample.

The average expectations are almost identical to average past perceptions (reported in Panel A of the table), potentially suggestive of extrapolation. Indeed, we find a significant correlation between perceptions and expectations: the Spearman rank correlation between year-ahead home price expectations and past one-year perceptions is 0.363, and between year-ahead expectations and past five-year perceptions is 0.232. The correlations are also significant for five-year ahead expectations and past perceptions: 0.287 for past one-year, and 0.272 for past five years (all correlations significant at $p < 0.001$).

Finally, Panel D of the table shows the revisions in home price expectations between the baseline and the final stage. The average revision in the sample is a decrease of 0.3 percentage points at the one-year horizon, and of 0.8 percentage points for the 5-year forecast. While average revisions are similar across the three groups, absolute revisions tend to be larger in the treatment groups. The final two rows show the fractions of respondents that change their expectations in the final stage (relative to the baseline stage). While even in the control group a majority of respondents update their expectations, this fraction is significantly higher in the treatment groups, suggesting that the information provision does affect respondent expectations.

4 Experimental Analysis

We next move to the analysis of how expectations are revised as a result of the information intervention. How *should* individuals in the treatment groups respond to objective information about home price changes in the last one or five years? For this purpose, we estimate time series regressions of home price changes on lagged home price changes, over different time horizons. We follow the methodology of Guren (2015) to estimate autoregressive coefficients at the zip code level (results are qualitatively very similar at the county level). We use CoreLogic Home Price Index data that covers the years 1976 to 2015, to estimate the following model:

$$\Delta_x \log(HPI_{g,t}) = \alpha_g + \phi_g \Delta_y \log(HPI_{g,t-L)} + \varepsilon_{g,t}.$$

where $HPI_{g,t}$ is CoreLogic's Home Price Index in year t in zip code g, x is the horizon over which the change in the dependent variable is computed (i.e., one or two-five years ahead), y is the horizon over which the change in the independent variable is computed (one or five years), and L is the appropriate lag (i.e., one or five years) over which we estimate the AR(1) model. The parameter ϕ_g indicates persistence in home price growth for a given zip code g.[13] Table 4 reports various statistics (mean; standard deviation; median) of the estimates across the geographic areas, as well as proportion of the geographic area level estimates that are statistically estimated to be positive or negative. For example, the AR(1) coefficient of a regression of one-year home price change on lagged one-year home price changes, averaged over the zip codes of respondents in our sample, is 0.57 (the median is 0.59, and the standard deviation across the zip code level estimates is 0.12). The AR(1) coefficient is estimated to be significantly positive (at $p < 0.05$) for 96.5% of the zip codes in the sample. This indicates strong momentum in home price changes over short horizons, something that has been documented in the literature (Case and Shiller, 1989; Guren, 2015). On the other hand, the estimate of a regression of one-year home price changes on lagged five-year changes is zero (on average, as well as for more than 97% of zip codes in the sample).

Notice that the estimate of a regression of longer-term home price growth (that is, over 2-5 years) on lagged one-year changes, averaged across zip codes, is -0.18. The estimate is negative and different from zero for only 7.4% of zip codes (and is positive for just 1% of zip codes). This suggests some evidence of mean reversion in the medium term. Evidence of this is much stronger in the case of a regression of 2-5 year growth on lagged 5-year growth, where the average estimate is -0.24, and the estimate is statistically negative for 42% of zip codes. Notably, the estimate is not significantly different from zero for more than half of the zip codes in our sample.

If the average respondents' expectations evolved in a way consistent with actual movements in home prices, we would expect to see updating that is consistent with momentum in the T1 group for short-term expectations. That is, we would see an under- (over-) estimation of past one-year home price changes leading to an upward (downward) revision in year-ahead home price expectations. For our purposes, underestimations are signed as positive perception gaps. Therefore, in this case, year-ahead home price expectation revisions would be expected to be positively related to the one-year perception gap for T1 respondents. The relationship between medium-term expectation

[13]The *one-year* growth model on lagged *one-year* growth is estimated off of 38 observations per zip code; the *one-year* growth model on lagged *five-year* growth is estimated off of 34 observations per zip code; the *2-5* year growth model on lagged *one-year* growth is estimated off of 34 observations per zip code; the *2-5* year growth model on lagged *five-year* growth is estimated off of 30 observations per zip code. When determining statistical significance, the standard errors we use account for the correlation in error terms due to overlapping observations.

revisions and one-year perception gaps should be zero. Turning to the T5 treatment, updating that is consistent with realized changes should exhibit no systematic relationship between annualized five-year perception gaps and expectation revisions (though, a negative relationship may emerge for medium-term expectation revisions).

4.1 Non-Parametric Analysis

We first proceed with a non-parametric analysis of updating behavior. For this purpose, we look at the relationship between perception gaps and home price expectation revisions.

Panel A of Figure 1 shows the mean year-ahead home price expectation revisions for each of the three groups, conditional on one-year perception gap bins. While the one-year perception gap can be constructed for each respondent (since past perceptions are elicited from all respondents), the one-year past home price change is only revealed to the T1 group. Hence, we expect to observe a systematic relationship between revisions and the perception gap for the T1 group but not the other groups. That is exactly what we see in Figure 1. In addition, there is a clear monotonic relationship between year-ahead expectations and one-year perception gaps for the T1 group. The average revision for respondents with a perception gap of greater than 5 percentage points (that is, those with an underestimation of greater than 5 percentage points) is +1.8 percentage points, while for those with a perception gap of less than -5 percentage points (overestimation) is -2.4 percentage points. This pattern of updating suggests that respondents perceive momentum in the short-term, which is in fact what we see in realized home price changes as well.

Panel B of Figure 1 shows the average medium-term (that is, 2-5 years) home price expectation revisions, conditional on one-year perception gap bins. Again, for both the T5 and Control groups, we see no discernible relationship between house price expectations and perception gaps at the one year horizon. For T1, while we see a monotonic relationship, it is less acute: in fact, mean revisions are not statistically different from zero for any of the bins.

We next turn to the relationship between expectation revisions and (annualized) past five year perception gaps. The top panel of Figure 2 shows a weak monotonic relationship between perception gap bins and average year-ahead revisions, for T1 and T5. That we observe a relationship for T1 respondents may be somewhat surprising since the five-year perception gap is never revealed to them. However, this is likely because of the high level of correlation between one- and five- year perception gaps within respondents (Spearman rank correlation of 0.44, with a $p < 0.001$). Panel B of the figure shows the relationship in the case of medium-term expectation revisions. As one

would expect, there is no systematic relationship for the T1 and Control groups. We see a weak monotonic relationship for T5, though the error bars (that represent one standard error around the mean revision) include zero for each of the bins.

Overall, the analysis presented in this section suggests sensible updating, on average, when compared with actual dependence in home price changes. We next turn to a more precise, regression-based evaluation.

4.2 Regression Analysis

4.2.1 Baseline Model. Our baseline model for home price expectation updating is as follows:

$$\Delta y_i = \beta_0 + \beta_1 T_{1,i} + \beta_2 T_{5,i} + \beta_3 (T_{1,i} * \alpha_{i,1}) + \beta_4 (T_{5,i} * \alpha_{i,5}) + \beta_5 1_{BlockB,i} + \beta_6 \alpha_{i,1} + \beta_7 \alpha_{i,5} + \varepsilon_{i,t}, \quad (4.1)$$

where Δy_i is the revision in home price expectations; for simplicity, we drop the time subscript on $\Delta y_{i,t}$ (t is either one-year ahead, or 2-5 years ahead). Equation (4.1) is estimated separately for short- and medium-term home price expectation revisions. $T_{i,1}$ ($T_{i,5}$) is an indicator that equals 1 if respondent i is assigned to treatment T1 (T5); $\alpha_{i,H}$ is i's perception gap for the past H years, where $H = \{1, 5\}$; $1_{BlockB,i}$ is an indicator that equals 1 if i's expectations were elicited using Block B. The βs are the parameters of interest.

The constant term, β_0, captures the average revision for the Control group. $\beta_0 + \beta_1$, for example, reflects the average revision for respondents in the T1 group with a perception gap of zero. β_5 allows for the possibility that revisions may depend on the elicitation method. β_6 captures revisions related to the one-year perception gap for respondents in the control and T5 groups. Ex ante, there is no reason to believe that β_6 will be different from zero; in fact, Figure 1 suggests that is the case. The main coefficients of interest are β_3 and β_4. β_3, for example, is the mean revision in home price expectations with respect to the one-year perception gap for the T1 group- it provides an estimate of the causal effect of the one-year past information on home price expectation revisions. β_3 and β_4 will be different from zero if revisions are systematically driven by perception gaps. In addition, momentum-based updating at the short-term horizon would suggest that β_3 would be positive when the dependent variable is $\Delta y_{i,1}$.

Equation (4.1) is estimated using ordinary least squares, with robust standard errors.[14] Columns

[14] Demographics are not included in the specification because random assignment to treatment groups should ensure demographics are irrelevant to treatment effects. And indeed when we control for demographics (not shown), there is no notable difference in estimates.

(1) and (2) of Table 5 show the estimates for the short-term and medium-term expectation revision, respectively. In column (1), we see that the estimate of β_3 is positive and significant: the estimate of 0.19 implies that, for each percentage point underestimation (overestimation) of past one-year home price changes, T_1 respondents revise up (down) their year-ahead expectations by 0.19 percentage points. For comparison, the average AR(1) coefficient of house price growth in our respondents' zip code is 0.57 (see Table 4). This suggests that the average respondent, when forming her expectations, may undercorrect for momentum present in her local housing market.

The estimate of β_4 is 0.15 but not statistically different from zero. Note that the estimate has a large standard error, and the 95% confidence interval includes effects as large as an extrapolation of 0.35 percentage points and a reversion of -0.05 percentage points for a perception gap of a point. In contrast, the average AR(1) coefficient from regressing one-year growth in zip code house prices on lagged five year growth is $\phi = -.01$ (which is also not statistically different from zero). Thus, at least directionally, respondents on average overextrapolate relative to the lack of momentum of 1-year growth rates from 5-year lagged growth rates.

Looking at the other estimates in column (1), we see that β_1 and β_2 – parameters that capture the average updating attributable to the treatment group that is not explained by the perception gap (on top of the average updating of the control group) – are indistinguishable from zero. This suggests that there is no effect of the treatments on home price expectation revisions (relative to control group responses), other than what is explained by the size of respondents' perception gaps. Likewise, both β_6 and β_7 are small in magnitude and not significantly different from zero, as one would have expected (since only those in the corresponding treatment groups received this information). The estimate of β_0 indicates that control respondents, on average, revise their expectations down by nearly a percentage point; this may be attributable to the other questions asked in the survey as well as the mere act of taking the survey. β_5 is also estimated to be different from zero, that is, mean revisions for respondents in Block B are in fact different.[15]

Turning to column (2) in Table 5, we see no evidence of a systematic relationship between medium-term home price expectation revisions and perception gaps. Both β_3 and β_4 are small in magnitude and not statistically different from zero, while being fairly precisely estimated. This suggests that, on average, respondents find past information less relevant for home price expecta-

[15]In Appendix Table A2, we estimate the specification in equation (4.1) where we add interactions of all variables with a Block B assignment dummy. This allows us to test if the impact of information differs systematically by whether expectations are elicited in levels or changes. The main interaction terms are not statistically significant (that is, the variables $T_{1,i} * \alpha_{i,1}$ and $T_{5,i} * \alpha_{i,5}$ interacted with the dummy), suggesting that the baseline results are not being driven by a particular block.

tions further into the future. There is no evidence that on average, our respondents view higher past growth as predictive of lower future growth, even though this is at least directionally the case in actual home prices. (As shown in Table 4, in about 42% of zip codes there is a significant negative correlation between past 5 year house price growth and growth 2-5 years in the future.)

4.2.2 Additional Models.

We next consider variations of the baseline model.

Asymmetric Updating. The baseline specification imposes a linear relationship between perception gaps and revisions. While we stay within this linear framework, columns (3) and (4) of Table 5 report estimates of a specification where we allow the effect of the perception gap on revisions to be asymmetric (that is, we estimate separate β_4 and β_5 estimates for negative and positive perception gaps).[16] Column (3) shows notable asymmetry depending on the sign of the past year perception gap: Those who overestimate past one-year house price changes have an estimate that is nearly twice as large as the estimate for those who underestimate past year changes (though the estimates are not statistically different from each other). We see a significant positive impact of the past five-year perception gap on one-year ahead revisions for respondents in the T5 group who overestimated the gap—a result that is not consistent with the lack of dependence in actual one-year growth rates from 5-year lagged growth rates in Table 4. As to why respondents with negative perception gaps (overestimations) exhibit greater responsiveness to information in their revisions is not entirely clear. There is a literature on asymmetric updating, which finds that beliefs tend to be relatively more responsive to "good" news (Eil and Rao, 2011; Mobius et al., 2011). However, in the current context, it is not entirely clear what exactly constitutes "good" news. Column (4) again shows no evidence that medium-term home price expectations are related to perception gaps.

Subjective Measure of Informativeness. As an additional piece of evidence that the short-term expectation revisions of T1 respondents are, in part, driven by the presented information, we turn to respondents' subjective assessment of how close their perceptions of past home price changes were to the given information.[17] Momentum-based updating would imply that respondents in the

[16] There is a fairly balanced distribution between positive and negative perception gaps among our respondents. 39% of T1 respondents have negative one-year perception gaps (overestimate past changes), while 58% of T5 have negative five-year perception gaps.

[17] Respondents assigned to T1 and T5 groups were asked immediately after the treatment how the displayed information compared to how they had thought home prices had changed in their zip code, and are then asked to select one of the following options (shown here for the case where home prices according to Zillow had increased): *(i) I had thought home prices had increased by more; (ii) This is about what I thought about how home prices had changed; (iii) I had thought home prices had increased by less (or that they had decreased).*

treatment groups who reported overestimating (underestimating) past changes should respond more negatively (positively) in their expectation revisions, relative to those who reported that the treatment information was close to their perceptions. Columns (5) and (6) of Table 5 report the estimates of a specification restricted to respondents in the treatment groups. Relative to the baseline specification, here we do not restrict the relationship between past home price perceptions and future expectations to be linear, and instead test differences in mean revisions between groups delineated by their response to the post-treatment subjective assessment of the provided information. The excluded group in the specification is the set of treatment respondents who reported their perceptions were close to the information given (45.6% of treated respondents). Relative to them, we see that average revisions are in a direction consistent with momentum based updating for all groups for year-ahead home price expectations (though only three of the four estimates are significant at $p < 0.1$). The average revisions are sizable: overestimators decrease their year-ahead home price expectations by 1.3-2.3 percentage points (relative to those who responded that their past price perceptions were close to the information treatment). Column (6) shows little evidence of systematic updating for medium-term expectations, with one exception: T5 respondents who overestimated past five year home price changes decrease their medium term expectations by 0.8 percentage points on average.

Subjective Uncertainty. In a Bayesian framework, ceteris paribus, respondents who are more uncertain about future home price changes should be more responsive to the treatment information. Since we collect data on respondents' subjective distribution of future home price expectations at both horizons (as mentioned in Section 2.1), we investigate this next.

Following the approach developed by Engelberg et al. (2009), we fit a generalized beta distribution to each respondent's stated probabilistic beliefs (or a uniform distribution if the respondent assigns all her mass to a single bin). We then generate the variance of the respondent's fitted distribution, and define a dummy variable, *High Uncertainty*, that equals 1 if the respondent's baseline variance for that horizon is above the sample median.

We augment the baseline specification by adding in this dummy, and its interactions with the $T_{1,i} * \alpha_{i,1}$ and $T_{5,i} * \alpha_{i,5}$ terms. Bayesian-consistent updating would predict these interaction terms to be different from zero. Estimates are presented in the last two columns of Table 5. Note that the uncertainty dummy is based on the subjective uncertainty in the forecast for that horizon. Column (7)—year-ahead revisions—is restricted to Block A respondents, since there was a programming

error in the question that elicited subjective density data for year-ahead expectations for Block B respondents.

Column (7) shows that T1 respondents with low year-ahead uncertainty revise their year-ahead home price expectations upward (downward) by 0.14 percentage points for a percentage point underestimation (overestimation) of past one-year home price changes. The corresponding estimate for high-uncertainty T1 respondents is nearly twice as large (0.141 + 0.157), suggestive of greater momentum in revisions of higher uncertainty respondents. While neither estimate is statistically significant from zero (or from each other), directionally the estimates are consistent with Bayesian updating. The estimate $T_{5,i} * \alpha_{i,5}$ interacted with *High Uncertainty* is negative, but small.

Column (8) also shows a notable result. The interaction term of high-uncertainty respondents with the $T_{5,i} * \alpha_{i,5}$ term is now negative and significantly different from zero. The estimates imply that, for a perception gap of one percentage point, T5 respondents with high-uncertainty in their five-year ahead forecast revise their medium-term expectations by -0.05 (0.096-0.147) percentage points in a direction that is consistent with mean reversion (the estimate is not statistically different from zero).

Robustness Checks. The appendix reports and discusses a series of robustness checks. For example, we run the baseline specification restricting the sample to only treatment respondents to rule out the possibility that idiosyncratic revisions in the Control group are driving our results. Similarly, to ensure that our results are not being driven by outliers, we trim the sample, dropping respondents with perception gaps and home price expectations at the 2% level of both ends (instead of winsorizing those observations as we have done in the main analysis). We also restrict the sample to those respondents who are able to recall their baseline perceptions accurately (as measured by the qualitative question about subjective informedness). And we also report results from a falsification exercise. The results are robust across these checks, and corroborate out baseline findings reported in the first two columns of Table 5.

In summary, our results suggest that the average respondent perceives momentum in home price changes over short horizons—she responds to the gap in her perceptions when revising her year-head expectations, but primarily for information that is relatively recent. Average revisions at the one-year horizon are generally consistent with observed momentum in actual home price changes. If anything, the average respondent seems to undercorrect for the actual momentum.

While we do not find robust systematic patterns for revisions of medium-term expectations,

the average respondent does not seem to believe in mean reversion present in medium-term home price changes relative to 5-year lagged growth rates. However, as shown in Table 4, the AR coefficients are not different from zero for more than half of the zip codes in the case of 2-5 year growth. Therefore, the average revision is not inconsistent with realized dependence (or lack thereof) in home price changes.

Overall, we conclude that the average updating patterns in expectations are broadly consistent with actual dependence in local home price movements. In addition, updating appears directionally consistent with Bayesian updating.

4.3 Update Heterogeneity

The previous analysis may mask substantial heterogeneity in how individuals update. While the average respondent seems to update in a way consistent with momentum-based updating for short-term changes, some respondents may not update their expectations at all, and others may update in a fashion suggestive of a belief in mean reversion in house price changes. Our within-subject design allows us to investigate this.

We denote the individual's updating type by $v_{i,t}$, where t denotes the horizon over which the respondent is forecasting (one year ahead, or 2-5 years ahead). That is, we allow the respondent to exhibit different behavior at different horizons (for example, extrapolation for short-term expectations, and mean reversion for long-term expectations).

The three update types are:

- **Non-Updater**: This type does not update following treatment:

$$v_{i,t} = \text{NU if } \Delta y_{i,t} = 0.$$

- **Extrapolator**: This type updates in a way consistent with momentum in home prices. If the perception gap, α_i, is positive (negative) — that is, the respondent under-estimated (over-estimated) past home price changes relative to the Zillow index — she revises up (down) her home price expectations. Formally, the definition is:

$$v_{i,t} = \text{ E if } (\alpha_i > 0, \Delta y_{i,t} > 0) \text{ or } (\alpha_i < 0, \Delta y_{i,t} < 0).$$

- **Mean Reverter**: This type updates in a way consistent with mean reversion in home prices.

For example, if she learns that prices in the past actually increased by more than previously thought (that is, $\alpha_i > 0$), she revises her future forecast downward. Formally:

$$v_{i,t} = \text{MR if } (\alpha_i > 0, \Delta y_{i,t} < 0) \text{ or } (\alpha_i < 0, \Delta y_{i,t} > 0).$$

For every respondent, we observe whether she updates. However, conditional on updating, we can assign the updating type for T1 and T5 respondents only. This is because whether a respondent is a mean reverter or an extrapolator is based on the respondent's perception gaps as revealed by their information treatment (that is, the one-year (five-year) perception gap for T1 (T5) respondents). For this analysis, we assign updaters in the Control group equally to the two updating types (extrapolators and mean reverters) since, in principle, their revisions should be noise. In the analysis that follows, we show the type distribution relative to that of the Control group.

The first row of Table 6 shows the updating types for the treatment sample, separately for the year-ahead and 2-5 year ahead expectations. In the case of short-term expectations, treatment respondents are 7.2% less likely to be non-updaters than Control group respondents, and about 12% more likely to be extrapolators. For medium-term expectations, the qualitative patterns are similar, but less stark.

The remaining rows of the table show the types for various cuts of the sample. We also report the p-value from the Pearson χ^2 statistic to test independence of the updating types for each of the paired demographic comparisons. We focus on the more interesting subsamples for updating types at the one-year horizon.

The differences in the type distributions based on the housing supply elasticity of the respondent's location are quite substantial. We use the Saiz (2010) measure of housing supply elasticity that is based on land topology factors. Treated respondents residing in below-median supply elasticity areas are substantially more likely to be extrapolators (and less likely to be mean reverters) than corresponding Control group respondents. For individuals in above-median supply elasticity areas, the difference between the treated and control respondents is much smaller. Overall, our intervention leads a substantially higher proportion of treatment respondents residing in below-median supply elasticity areas to update in a way consistent with momentum (and less likely in a way consistent with mean-reversion); the type distributions are statistically different (p-value = 0.006). This aligns with the intuition that momentum in home prices should arguably be higher in

areas with relatively inelastic supply.[18]

Individuals who have had negative experiences in the housing market (a short sale, negative equity, or foreclosure in the past) are much more likely to update. Respondents who report being less confident in their perception of past home prices, unsurprisingly, are more likely to update their expectations, particularly for the short horizon.

Owners who report a high likelihood of selling their home in the next one year are more likely to update, and be extrapolators. Along the same lines, individuals who expect to be active in housing market—those who assign a probability of more than 50% to buying a home in the next 3 years—are less likely to be mean reverters.

The updating distributions do not differ by treatment group allocation, gender, homeownership, tenure in the home, or the sign of the respondent's perception gap (that is, underestimation or overestimation), for revisions at either horizon. We do not find differential updating or extrapolation by age either, as would be predicted by models of age-dependent updating (as in Malmendier and Nagel 2013). The updating type distribution also does not differ by subjective uncertainty in one's baseline year-ahead forecast. Lower-income, lower-numeracy, and less-educated respondents in the treatment groups are, interestingly, less likely to be non-updaters relative to their non-treated counterparts.

Appendix Table A3 presents the updating type analysis in a multivariate framework. More specifically, we estimate a model where the respondent first decides whether to update her expectation. And then, conditional on updating, decides whether to extrapolates or not (that is, mean revert). We estimate the two equations jointly, allowing for a correlation between the two stages. This allows us to control for selection (on observables) into updating. We estimate both equations as bivariate probits.[19]

Table A3 reports marginal effects. We focus on the updating patterns for the year-ahead revisions, reported in the first two columns. Less-educated and lower-income respondents, and those less confident in their recall of past price changes, those with negative housing market experiences, and those reporting a high likelihood of selling their home are all more likely to update. Conditional on updating, those residing in low supply elasticity areas are more likely to extrapolate, and those with negative housing market experiences are less likely to extrapolate. Overall, the re-

[18]That said, empirically the difference is small: we find that the average AR(1) estimate for a regression of 1-year home price changes on one-year lagged home price changes for below-median elastic zip codes is 0.58, only slightly higher than the estimate of 0.55 for above-median elasticity zip codes.

[19]The model is equivalent to a Heckman selection model, where in the first stage we model selection into updating. Also note that the model is identified only by functional form, and so the estimates do not have a causal interpretation.

sults are consistent with the univariate updating patterns presented in Table 6, although only few individual coefficients are statistically significant.

The picture that emerges, overall, reveals interesting heterogeneity in updating in our sample.

4.4 Follow-up

A natural question to ask is whether our results dissipate in the longer run, and whether they are driven by anchoring. For this purpose, as described in Section 2.1, we re-elicited respondents' home price expectations in April 2015, about two months after the original survey.

We refer to the gap between the expectations elicited in the follow-up survey and the baseline stage in the initial survey as "follow-up" revisions, opposed to the (within-survey) "initial" revisions in the first survey. Follow-up revisions are systematically correlated with the initial revisions: the Spearman rank correlation between the two for one-year home price expectations is 0.43, 0.35, and 0.27 for the T1, T5, and Control groups, respectively (all correlations statistically significant). That is, the persistence is the strongest for the T1 group and weakest for the Control group, as one would expect if the impact of information was long-lasting. In the case of the medium-term (2-5 years) home price expectations, the rank correlation is 0.28, 0.32, and 0.24 for the three groups, again consistent with the revisions persisting over time.

We next move to a systematic analysis of persistence of the information intervention, restricting the analysis to revision of year-ahead home price expectations (since we found no systematic impact of the intervention on medium-term expectations in the initial survey). Column (1) of Table 7 reports estimates of equation (4.1), restricting the sample to those respondents who also take the follow-up survey. The β_3 estimate for this subsample is 0.21, about the same magnitude and precision as the full sample. We next estimate the same specification as in equation (4.1), except that the dependent variable now is the follow-up revision. If the impact of the intervention is long-lasting, we expect the estimate of β_3 to be qualitatively similar. Estimates for this specification are presented in column (2) of Table 7. We see that β_3 is significant at the 10% level and positive. The point estimate declines in magnitude, but is indistinguishable from the corresponding estimate in column (1) of the table. This indicates that the information intervention has persistent effects on our respondents' beliefs.

This result also directly addresses a potential concern with our design, namely that our information intervention may cause respondents to simply anchor their revised forecasts to the statistic presented to them in the treatment (Tversky and Kahneman, 1974), thereby explaining the correla-

tion we find (at least for one-year information and expectations). Given that the information effect persists in the medium-term according to the follow-up survey, it is unlikely that one can attribute the effect of information entirely to anchoring. Also, anchoring alone should be equally strong for T1 and T5 and both expectations horizons, not consistent with the differences in treatment effects that we find.

4.5 Ex-post Accuracy

Another interesting question is whether our intervention impacts the ex-post accuracy of respondents' expectations. For this purpose, we compute the absolute distance between the respondents' year-ahead home price expectations and the realized local home price change between February 1, 2015 and January 31, 2016 (according to the Zillow zip code level data).This analysis is restricted to respondents for whom Zillow zipcode level data are available (81.5% of the sample).[20] We refer to this as the "ex-post forecast gap." Caution is warranted in using an ex-post realized outcome as a benchmark for accuracy of ex-ante expectations, since (1) home price changes are uncertain, and (2) respondents' point forecasts may refer to various statistics (i.e. mean, median, mode, or others) of their subjective probability distributions (Engelberg et al. 2009). Nevertheless, we find such a comparison useful as suggestive evidence for whether information helps respondents form more accurate expectations.

Panel A of Figure 3 shows the cumulative density plot of the absolute ex-post forecast gap for the Control and Treatment respondents (combining the T1 and T5 groups). We see that the distribution for the control group is shifted to the right, indicative of our treatment moving respondents closer to the ex-post realized outcome. In fact, we reject the null that the two distributions are identical (p-value of a Kolmogorov-Smirnov test for equality of distributions is 0.069). We find that 27% [60%] of treatment respondents are within 2 [5] percentage points of the ultimately realized home price change (versus 22% [52%] for the control group). The average absolute ex-post forecast gap is also smaller for for the treatment group (5.66%, versus 6.23% for the control group; the p-value of a t-test for equality of means is 0.156). Thus, we find that the treatment seems to cause respondents' forecasts to become more accurate, based on the criterion above.

[20] The Zillow HPI coverage of our respondents' zip codes slightly increased between 2015 and 2016.

5 Expectations and Behavior

Our interest in home price expectations stems from the belief that they influence individuals' current and planned economic activity and economic outcomes. In this section, we investigate the link between home price expectations and intended as well as actual choices. While expectations play a key role in economic models of decision-making under uncertainty, there is surprisingly little empirical evidence on how subjective expectations impact choices.[21] This is partly because few datasets exist that collect data on both behavior and expectations.

5.1 Investment in Housing Fund

As explained in Section 2.1, respondents were presented with a hypothetical investment choice in the baseline stage where they were asked to allocate $1,000 for a year between a risk-free savings account (with a 2% annual return) and a housing fund that pays an annual return equal to the one-year growth in home prices in the respondent's area. While clearly a stylized choice scenario, this offers a clean setup to test the link between expectations and behavior.

The dependent variable of interest is the share (on a 0-100 scale) that is allocated to the housing fund. At the baseline, respondents, on average, allocate 53% of the $1,000 to the housing fund. The standard deviation of the housing share is 34%, meaning there is substantial heterogeneity. We are interested in whether the housing share is systematically related to respondents' year-ahead home price expectations.

Column (1) of Table 8 reports OLS estimates of a regression of the housing share onto year-ahead home price expectations (reported in the baseline) as well as an extensive set of controls. We see that the housing share is significantly and positively related with baseline home price expectations: the estimate indicates that a percentage point increase in year-ahead home price expectations is associated with a 0.74 percentage point higher investment in the housing fund.[22] To put this estimate into context, an increase of $10,000 in respondents' income is associated with a 1.07 percentage point higher investment in the housing fund.[23] Thus, the estimated effect size is economi-

[21] For the effects of inflation expectations on actual or intended behavior, see for instance Armantier et al. (2015), Bachmann et al. (2015), Crump et al. (2015), and D'Acunto et al. (2015).

[22] Because the dependent variable is not continuous but a fraction, Appendix Table A4 presents estimates of a fractional probit regression, following the methodology of Papke and Wooldridge (1996). The table reports the average marginal effect. The fractional probit specification yields estimates that are almost identical to the OLS model: we see that a percentage point increase in baseline home price expectations yields a 0.74 percentage point increase in the amount assigned to the housing share.

[23] The coefficient on income of 1.07 per $10,000 is for a specification where we do not control for other demographics; if we do (as in Table 8), the coefficient on income is lowered to 0.57. In that specification, a one standard deviation increase

cally meaningful. Coefficient estimates on other controls are also sensible: individuals who report being confident in their perception of past home prices, those who report having checked home prices in the past, and those below-median risk averse invest a higher share in the housing fund. Column (2) of the table reports estimates from the same specification as in column (1), except that we now also include respondents' perceived downside risk in year-ahead home price changes as an additional covariate.[24] Baseline home price expectations continue to be a significantly correlate of the housing share (though the estimate declines to 0.57), and a higher perceived downside home price risk is associated with a lower share allocated to the housing fund. Column (3) augments the column (1) specification with the High Uncertainty dummy (for above-median baseline uncertainty in year-ahead forecast) and its interaction with home price expectations. The sample here is restricted to Block A respondents because of the data issues mentioned earlier. We see that higher-uncertainty respondents assign a lower share to the housing fund, and a percentage point increase in year-ahead home price expectations for this group is associated with an increase of 0.5 points in the housing fund (versus 0.83 points for their lower-uncertainty counterparts; the estimates are not statistically different though). That higher-uncertainty respondents act on their expectations to a lesser extent is quite sensible.

Recall that survey respondents were presented with the investment choice again, towards the end of the survey, after the information experiment. While the scenario is identical to the one in the baseline, the difference now is that the choice is incentivized—respondents are told that two of them will be compensated in a year's time based on their investments (that is, the winners receive $1,000 plus or minus the return on their investment). Column (4) of Table 8 reports estimates from the same specification as in column (1) of the table, except that we now use the revised housing share as the dependent variable and revised year-ahead home price expectations as the covariate. The estimate is remarkably similar to that in column (1) of the table. That the link between expectations and behavior is equally strong in the incentivized and hypothetical investment choices suggests that hypothetical settings could be quite informative to investigate the role of expectations in decision-making. Column (5) supplements this specification by adding in controls for both the baseline housing share and an indicator for whether this share was a corner solution (that is, zero or 100). The coefficient on expected home price growth declines in magnitude, but remains significant.

in baseline home price expectations is associated with a 4 percentage point increase in the housing share, while a one standard deviation increase in household income results in a 2.5 percentage point increase in the housing share.

[24]Here, we sum the probabilities that respondents assign to year-ahead home price changes being less than -5% and being between -5% and 0%. We have these data for the full sample, since the programming error for Block B respondents only impacts the positive bins.

Columns (1)-(5) investigate the link between expectations and the housing share in the cross-section, controlling for an extensive set of demographic variables. However, one might be concerned about unobservable differences across individuals confounding the analysis. The pseudo-panel on investment choices and home price expectations, generated as a result of our information experiment, allows us to investigate whether the relationship between home price expectations and behavior holds within-individual. The last two columns of Table 8 report estimates of a regression of the within-individual change in the housing share onto changes in year-ahead home price expectations. While the estimate is smaller in magnitude, it continues to be positive and statistically different from zero: the estimate suggests that a percentage point increase in home price expectations leads to a 0.24 percentage point increase in the housing share.

To understand the within-individual changes in the allocation to the housing fund, we next investigate the direct impact of the information treatment on housing share revisions. We use the same specification as in equation (4.1), except that the dependent variable is the change in the share allocated to the housing fund (and we now also include demographic controls). Column (1) of Table 9 shows that, for T1 respondents, a percentage point increase in the past one-year perception gap (that is, a 1 point underestimation of past one-year home price changes) leads to a 0.63 percentage point increase in the share assigned to the housing fund. T5 respondents exhibit an effect that is similar in magnitude for the five year perception gap, but the estimate is not statistically significant. Controlling for the baseline housing share as well as for corner solutions at the baseline, in column (2), yields qualitatively similar estimates.[25] The fractions of respondents who update their housing share in the final stage (relative to the baseline stage) is also significantly different across treatments (at $p < 0.01$): it is 38.7% in the Control but 47.2% in T1 and 48.8% in T5. Taken together, this is strong evidence that our information treatment not only impacts (certain) home price expectations, but also directly impacts housing-related behavior.

In Section 4.5, we found that the information treatment tended to increase the ex-post accuracy of our respondents' forecasts. A related question is then whether the treatment leads respondents to make better investment choices, as measured by ex-post returns in the incentivized housing investment choice scenario. Panel B of Figure 3 presents the cumulative density of ex-post returns for the treatment and control groups. We see that the return distribution for the treatment group is shifted to the right. The two distributions are, however, not statistically different (p-value = 0.777

[25] One could imagine an instrumental variable version of columns (6) and (7) of Table 8, using the treatment indicators times the perception gap as instruments for the expectations revision. Doing this leads to an estimated treatment effect of expectations that is larger than in the OLS version, but the first-stage F-statistic suggests that the instruments may not be strong enough for reliable inference.

for a Kolmogorov-Smirnov test). The average return for the treatment group is 4.3%, slightly higher than the average returns of 4.1% for the control group (difference not statistically different from zero; p-value = 0.427). Likewise, the share of respondents in the treatment group with a return of less than 2% is 19.1%, slightly lower than the 20.5% in the control group (difference again not statistically different from zero; p-value = 0.5515). In sum, the treatment seems to yield a modest improvement in respondents' ex-post returns, but the effect is not statistically significant.

5.2 Other Housing-related Behavior

While the investment choice allows us a clean setting to investigate the role of home price expectations, its stylized setup arguably makes the role of home prices overly salient, relative to real-world choices. We next investigate how home price expectations are related to stated choices in some "realistic" scenarios. The trade-off, however, is that real-world choices may be impacted by several other constraints and confounds that we are unable to exhaustively control for.

Respondents were asked the probability of buying a non-primary home over the next 3 years (on a 0-100 scale).[26] The average response to this question is 9, with a standard deviation of 18. Column (1) of Table 10 shows that year-ahead home price expectations are positively and significantly related to the reported likelihood of buying a non-primary home, even after controlling for an array of demographics. The estimate indicates that a percentage point increase in year-ahead home prices is associated with a 0.26 percentage point higher reported likelihood of buying a home, a sizable impact on an average baseline likelihood of 9 percentage points. Other covariates, such as risk preferences and liquid savings, are meaningfully related to the choice. Perhaps surprisingly, perceived downside risk in home prices is positively related to the reported likelihood (though the estimate is small economically and only marginally significant). In column (2), we include medium-term home price expectations in addition to year-ahead home price expectations; only the latter are found to be a significant correlate.

We next look at the reported likelihood of buying a home, conditional on moving over the next 3 years.[27] Columns (3)-(4) of Table 10 show that this choice is positively related to year-ahead home price expectations, though the estimate is not significant. Perceived downside risk in home prices

[26] Specifically, respondents were asked *"What is the percent chance that over the next 3 years (February 2014 to February 2017) you will buy a home that you would NOT use as your primary residence (meaning you would use it as a vacation home, or as an investment property, etc.)?"*

[27] Respondents are asked the probability they will move in the next three years; for those who respond that there is at least a 5 percent chance they will move, we ask this follow up question: *"And if you were to move to a different primary residence over the next 3 years, what is the percent chance that you would buy (as opposed to rent) your new home?"*. The average reported probability is 63.

is strongly negatively related with the reported likelihood of buying a home, as one would expect.

We also ask respondents who currently own a home for the reported likelihood of selling their home over the next year.[28] The average reported likelihood is 14%. We regress the probability of selling one's home on both one year expectations, and one and two-to-five year expectations jointly, with our standard set of controls. Column (5) of Table 10 shows there is no systematic relationship between short-term expectations and this likelihood. However, when we also include 2-5 year ahead home price expectations in column (6), we see a strong negative relationship between medium-term expectations and the likelihood of selling one's home within the next year. That is, respondents with less favorable longer-term home price expectations are more likely to report a higher likelihood of selling their home now.

Finally, we asked homeowners the likelihood of making investments in their home over the next twelve months.[29] The average reported likelihood is 27.3%. Columns (7) and (8) regress this likelihood on both one year expectations, and one and two-to-five year expectations jointly, respectively. We see that short-term expectations significantly impact the likelihood of making investments in one's home. Perceived downside risk in home prices is not significantly correlated with this likelihood.

Overall, these results show that home price expectations impact intended and actual housing-related behavior, both in the cross-section as well as within-individual.

6 Discussion and Conclusion

The next step in our research process will be to compare our empirical findings to the predictions of different models of house price expecations formation. Given the existing evidence from other settings, it may be surprising that there is relatively little evidence for "excessive" extrapolation based on our information experiment. However, as discussed in Section 3.2, when we elicit their baseline beliefs, our respondents do display a systematic (and economically quite strong) correlation between their perceptions of past growth and their expectations for future growth. This pattern, together with the evidence from our experiment, may suggest that they could extrapolate "fundamentals" that drive house price growth (such as population growth) while not believing in (much) persistence of "pure" price movements that may be independent of fundamentals.

[28] Respondents were asked: *"What is the percent chance that you will put your primary residence up for sale in the next 12 months?"*

[29] Respondents were asked: *"[W]hat do you think is the percent chance that, over the next 12 months (until February 2016), you will make any investments in your home costing more than $5,000 total?"*

Furthermore, we note that the housing market is unique in that short-term extrapolation (for instance, from past-year growth to year-ahead growth) is actually rational; in other financial markets, momentum is much weaker or inexistent. Thus, it is not clear whether the (directionally rational) short-term extrapolation we observe in response to our information provision is in fact a rational response to the patterns in house prices, or simply a manifestation of a more general "extrapolation bias" that just happens to be correct in the housing market.

In any event, given the link from expectations to behavior that we also document, further studying expectation formation in this market remains a priority for future research, and we believe that survey-based information experiments such as the one implemented in this paper provide a powerful tool to do so.

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A Robustness Checks

Table A5 reports various robustness checks.

Our main analysis uses the annualized 5-year perception gap. Column (1) of Table A5 reports estimates for equation (4.1) for year-ahead revisions using the unannualized 5-year perception gap. Results are qualitatively similar to those in column (1) of Table 5.

Columns (2) and (3) report estimates of the baseline specification where we restrict the sample to treatment respondents. The goal is to see if idiosyncratic updating patterns in the Control group are driving our main results. The estimates of interest (the perception gap interacted with the treatment dummies) are qualitatively similar to those in the baseline.

Columns (4) and (5) show that our results are not being driven by outliers. Trimming the sample, instead of winsorzing the top and bottom 2% of observations for the perception gaps and home price expectations, yields estimates that are qualitatively similar. For T1 respondents, in the case of year-ahead home price expectations, we get a precisely estimated 0.147 for a unit perception gap (compared with the estimate of 0.194 in the baseline). For 2-5 year ahead revisions, we now also see significant evidence of extrapolation for T1 respondents—the estimate is positive and precisely estimated, but small in magnitude.

The next two columns of the table restrict the sample to control respondents and those treatment respondents who are able to consistently recall their perceptions of past home price changes. This is based on the qualitative question about subjective informedness, described in Section 4.2.2. Here we drop treatment respondents who reported that they thought past realized home price changes were lower than their perceptions, when in fact they had overestimated home price changes (and the converse). This drops 44 of the 402 respondents in the T1 block, and 53 of the 401 respondents in the T5 block. We see that the estimates, excluding these respondents, are qualitatively similar to those in the baseline specification. In fact, in the case of year-ahead revisions, T5 respondents are now also found to significantly (at $p < 0.1$) revise their expectations up (down) by an average of 0.22 percentage points for a unit under-estimation (over-estimation) of past annualized 5-year growth.

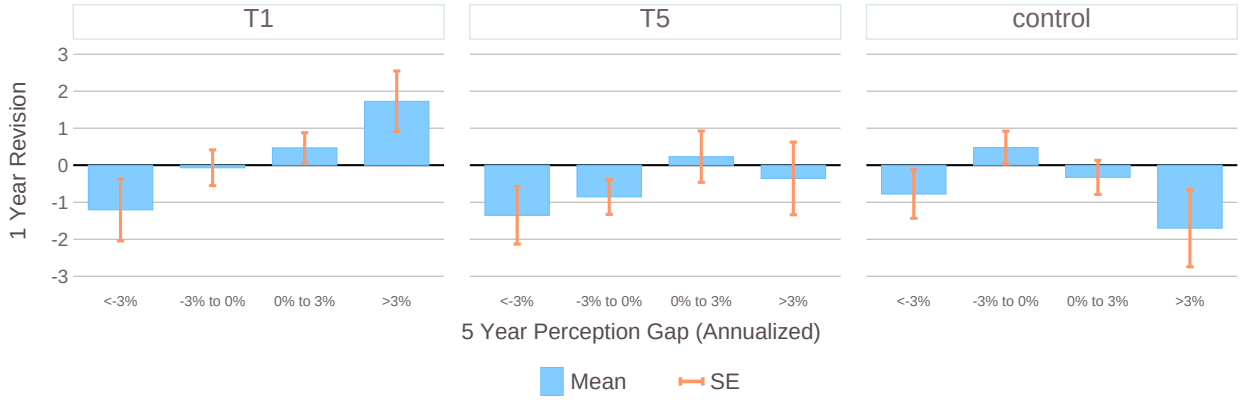
Finally, we perform a falsification test of our specification by switching the interactions between perception gaps and treatment group assignment:

$$\Delta y_{i,t} = \beta_0 + \beta_1 T_{1,i} + \beta_2 T_{5,i} + \beta_3 (T_{1,i} * \alpha_{i,5}) + \beta_4 (T_{5,i} * \alpha_{i,1}) + \beta_5 1_{BlockB,i} + \beta_6 \alpha_{i,1} + \beta_7 \alpha_{i,5} + \varepsilon_{i,t}.$$

The interactions terms, β_3 and β_4, should not be different from zero, since theoretically T5 respondents should have no information about their one year perception gap, and vice versa for T1 respondents. This is indeed what we see in columns 8 and 9 of Table A5, where estimates of both interaction terms are indiscernible from zero. The uninteracted past one year perception gap coefficient for year-ahead expectations is now significant and positive because the original treatment effect on T1 respondents is embedded within this coefficient.

Figure 1. Average Revision in Home Price Expectations, conditional on 1-year Perception Gaps.

Figure 2. Average Revision in Home Price Expectations, conditional on 5-year Perception Gaps.



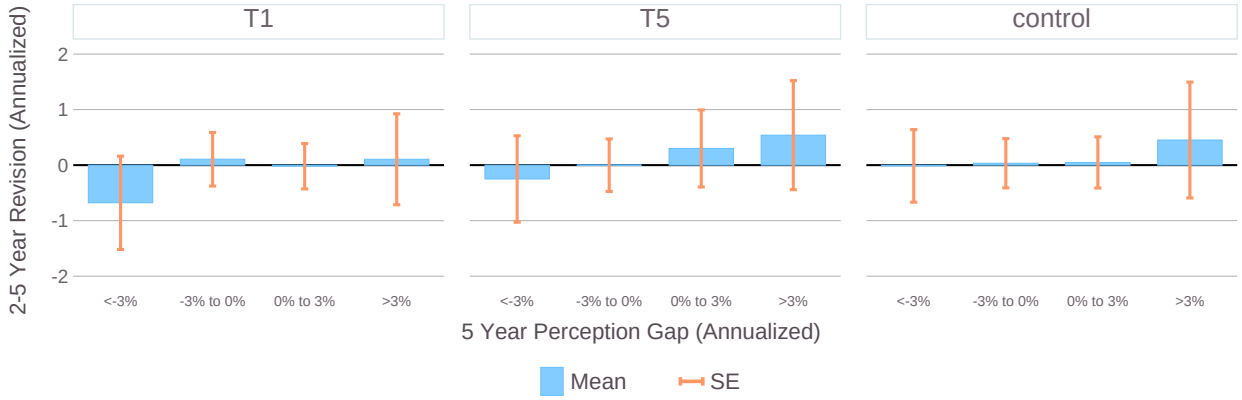
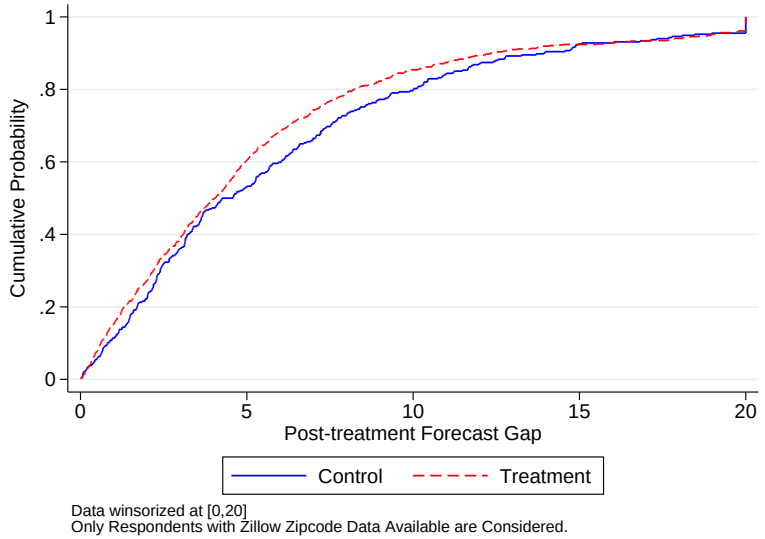
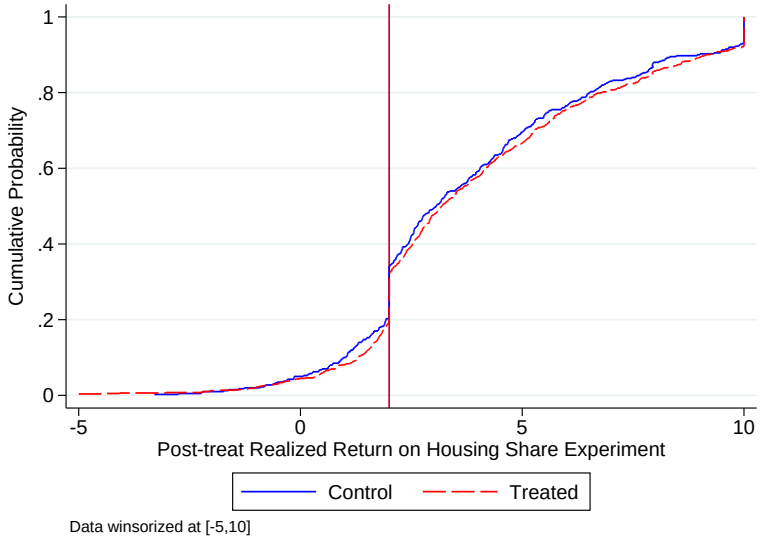


Figure 3. Empirical Cumulative Distribution Functions of Post-Treatment Expectations and Realizations



(a) Forecast Gaps



(b) Returns from Incentivized Housing Share Experiment

Table 1: Sample Characteristics

	Full Sample	Control	T1	T5	P-value[a]	Follow-up[b]
	(1)	(2)	(3)	(4)	(5)	(6)
Observations	1205	402	402	401		856
Age (in years)	51.1	50.8	53.0	49.6	.303	51.4
	(31.2)	(15.4)	(49.7)	(14.9)		(15.1)
Male	52.4%	55.0%	55.2%	47.0%	.029	52.9%
White & Non-hispanic	76.4%	74.4%	78.5%	76.3%	.389	77.3%
Married or living as a partner	66.6%	64.7%	66.2%	68.8%	.451	65.5%
Homeowner	70.8%	70.1%	67.9%	74.3%	.129	72.2% *
Tenure in town/city (in yrs)	19.2	19.9	18.9	18.9	.627	19.8*
	(16.5)	(16.7)	(16.8)	(16.0)		(16.9)
Bachelor's Degree or More	52.0%	51.0%	51.5%	53.4%	.778	52.1%
HH Income $<$ \$60,000	51.4%	50.0%	50.2%	53.9%	.472	50.7%
HH Income $<$ \$30,000	22.7%	22.4%	23.1%	22.7%	.968	22.2%
High Numeracy[c]	70.8%	71.1%	71.4%	69.8%	.872	71.7%
Credit Score Below 720	34.0%	36.5%	31.8%	33.5%	.402	32.0% **
Employed	66.0%	64.2%	66.4%	67.3%	.625	64.5% *
Unemployed	4.0%	5.5%	3.7%	2.7%	.135	3.7%
Not in the Labor Force	28.5%	28.6%	29.6%	27.4%	.793	30.3% **
Census region location:						
Midwest	20.8%	21.9%	19.9%	20.7%	.773	20.6%
Northeast	15.5%	13.5%	16.2%	17.0%	.359	15.9%
South	39.4%	38.4%	40.3%	39.4%	.86	38.6%
West	24.3%	26.2%	23.6%	22.9%	.53	25.0%

Means of continuous variables reported. Standard deviations in parentheses for continuous variables

[a] P-value of one-way ANOVA test of equality of each row variable across the three groups (Control, T1, T5). Significant at *p$\leq$0.10,**p$\leq$0.05, ***p$\leq$0.01.

[b] Follow-up is the sample that participates in the follow-up survey. Stars in follow-up column test equality of variables in follow-up sample and complete, original sample.

[c] High Numeracy indicates correctly answered 4 or more of five survey questions testing respondent's numeracy

Table 2: Home Price Perceptions and Expectations

	Full Sample	Control	T1	T5	P-value[a]
	(1)	(2)	(3)	(4)	(5)
Panel A: Perceptions					
Past 1 year HP change	4.07	3.90	3.89	4.42	0.507
	(7.33)	(7.36)	(7.11)	(7.51)	
	[5.94]	[5.89]	[5.69]	[6.25]	
Past 5 year HP change	1.82	1.76	1.80	1.89	0.872
(annualized)	(3.57)	(3.56)	(3.67)	(3.49)	
	[3.11]	[3.06]	[3.16]	[3.11]	
Panel B: Perception Gaps					
1 year Perception Gap	1.16	1.36	1.07	1.05	0.850
	(8.71)	(9.00)	(8.60)	(8.54)	
	[6.50]	[6.78]	[6.40]	[6.32]	
5 year Perception Gap	-1.07	-1.14	-1.09	-0.99	0.910
(annualized)	(5.03)	(4.97)	(5.29)	(4.83)	
	[3.56]	[3.47]	[3.74]	[3.46]	
Panel C: Expectations					
Baseline 1 year exp. HP change	4.05	3.84	4.13	4.16	0.666
	(5.65)	(5.67)	(5.52)	(5.77)	
	[4.78]	[4.75]	[4.66]	[4.94]	
Baseline 5 year exp. HP change	12.33	11.07	13.50	12.42	0.043
	(13.75)	(13.40)	(14.33)	(13.43)	
	[13.57]	[12.83]	[14.33]	[13.54]	
Baseline 2-5 year exp. HP change	1.87	1.67	2.10	1.84	0.036
(annualized)	(2.37)	(2.31)	(2.46)	(2.33)	
	[2.16]	[2.03]	[2.33]	[2.13]	
Panel D: Expectation Updates					
(Final - Baseline) 1 year forecast update	-0.30	-0.41	0.13	-0.63	0.227
	(6.43)	(6.03)	(6.34)	(6.88)	
	[3.62]	[3.21]	[3.67]	[3.98]	
(Final - Baseline) 5 year forecast update	-0.76	-0.67	-1.09	-0.53	0.816
	(13.04)	(10.32)	(13.21)	(15.16)	
	[6.94]	[5.51]	[6.67]	[8.64]	
(Final - Baseline) 2-5 year forecast update	0.02	0.09	-0.13	0.10	0.323
(annualized)	(2.42)	(2.33)	(2.40)	(2.51)	
	[1.36]	[1.27]	[1.32]	[1.47]	
Percent that update 1 year forecasts	64.67%	59.75%	67.50%	66.75%	0.041
Percent that update 5 year forecasts	69.78%	65.00%	67.25%	77.14%	0.000

Mean reported in each cell. Standard deviation in parantheses. Mean absolute value in square brackets.
[a] P-value of one-way ANOVA test of equality of each row variable across the three groups (Control, T1, T5)

Table 3: Correlates of Perception Gaps and Anchoring

	Abs. Perception Gap[a]		Anchor
	1yr	5yr annualized	Distance[b]
	(1)	(2)	(3)
Male	-0.400	0.0427	1.566**
	(0.352)	(0.146)	(0.716)
Lived in current town/city for 15+ years	-0.217	-0.0271	0.160
	(0.382)	(0.154)	(0.732)
Checked housing websites[c]	-0.320	-0.0267	0.868
	(0.373)	(0.154)	(0.723)
Confident in recalled price change[d]	-0.0999	0.0410	0.697
	(0.367)	(0.158)	(0.777)
Likely to buy or sell home in future[e]	0.287	0.246	0.483
	(0.464)	(0.203)	(0.936)
White	-0.817*	-0.454**	-2.423**
	(0.427)	(0.185)	(0.965)
Age $<$ 50	-0.265	-0.200	-0.202
	(0.388)	(0.169)	(0.768)
Income $\geq$ 75,000 USD	-0.612*	-0.211	-0.211
	(0.370)	(0.164)	(0.788)
Bachelor's Degree or More	-0.958***	-0.393**	-0.138
	(0.359)	(0.158)	(0.717)
Homeowner	-0.538	-0.474***	-1.868**
	(0.425)	(0.178)	(0.868)
Married or living as a partner	-0.599	-0.0490	0.394
	(0.399)	(0.165)	(0.767)
Employed	0.0242	0.279	0.878
	(0.413)	(0.174)	(0.769)
Unemployed	-0.0685	0.222	0.787
	(1.050)	(0.346)	(1.958)
High Numeracy[f]	-1.623***	-0.0752	-1.122
	(0.424)	(0.175)	(0.817)
T1	-0.341	0.223	
	(0.405)	(0.172)	
T5	-0.431	0.0601	4.322***
	(0.412)	(0.173)	(0.673)
Constant	10.62***	3.785***	9.323***
	(0.774)	(0.318)	(1.473)
Observations	1197	1196	1588
R-Squared	0.0664	0.0414	0.0644
Joint sig of covariates[g]	0	0	.013
Mean of dep. variable	6.507	3.005	9.942

OLS estimates reported. Robust standard errors in parentheses. Significant at *p$\leq$0.10, **p$\leq$0.05, ***p$\leq$0.01.
[a] The absolute gap between the perceived and actual zip code home price change. All gaps annualized.
[b] The absolute gap between respondent's revised forecast (of home price percent change) and information revealed in the treatment. Two observations per treated respondent, for each of the two horizon expectations.
[c] Dummy that equals 1 if respondent reports consulting websites about home prices in past 12 months.
[d] Dummy that equals 1 if respondent reports being confident in their recall of past home price changes (i.e. answers 4 or more on a 1-5 scale, where 5 is very confident).
[e] Probability of buying home in 3 years is $\geq$ 50% or probability of selling home in 1 year is $\geq$ 50%.
[f] Dummy that equals 1 if respondent correctly answered 4 or more of 5 questions measuring numeracy.
[g] F-test on equality of all covariates to zero (excluding constant). P-value shown.

Table 4: Dependence in Actual Home Price Changes

	Survey Sample[a]			National Sample[a]		
	Estimates	Percent Positive[b]	Percent Negative[b]	Estimates	Percent Positive[b]	Percent Negative[b]
Regression of 1yr growth on lagged 1yr growth	0.57	96.5%	0.0%	0.57	96.0%	0.0%
	(0.12)			(0.13)		
	[0.59]			[0.59]		
Regression of 1yr growth on lagged 5yr growth	-0.01	2.5%	0.2%	-0.01	1.6%	0.4%
	(0.05)			(0.05)		
	[-0.01]			[-0.01]		
Regression of 2-5yr growth on lagged 1yr growth	-0.18	1.1%	7.4%	-0.17	1.1%	6.5%
	(0.29)			(0.29)		
	[-0.18]			[-0.17]		
Regression of 2-5yr growth on lagged 5yr growth	-0.24	1.1%	42.1%	-0.25	0.7%	42.0%
	(0.20)			(0.19)		
	[-0.26]			[-0.26]		

Table shows Prais-Winsten estimations of regressions of home price changes on lagged changes. Means displayed in first cell. Standard Deviation shown in parentheses. Median in square brackets.

[a] "Survey Sample" corresponds to zip codes with at least one survey respondent and an available CoreLogic HPI (N=889). "National Sample" includes all zip codes in the United States covered by Corelogic (N=7133).

[b] Indicates percent of local home price change coefficients either statistically significantly positive or negative at the 5% level.

Table 5: Home Price Expectation Revisions and Perception Gaps

	Home Price Expectation Revisions at horizon:							
	1 year	2-5 year	1 year	2-5 year	1 year	2-5 year	1 year	2-5 year
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T1	0.367	-0.274	0.756	-0.221			1.024	-0.267
	(0.447)	(0.167)	(0.545)	(0.202)			(0.707)	(0.167)
T1 * 1yr Perception Gap	0.194***	0.0308					0.141	0.0337
	(0.0619)	(0.0234)					(0.114)	(0.0290)
T5	-0.0624	0.00450	0.387	-0.142	-0.330	0.493**	-0.365	0.0206
	(0.468)	(0.178)	(0.556)	(0.224)	(0.659)	(0.250)	(0.812)	(0.179)
T5 * 5yr Perception Gap	0.146	0.00523					0.117	0.0955*
	(0.102)	(0.0464)					(0.157)	(0.0492)
1yr Perception Gap	0.00122	-0.0133	0.00230	-0.0131			-0.0422	-0.0150
	(0.0372)	(0.0148)	(0.0370)	(0.0148)			(0.0555)	(0.0148)
5yr Perception Gap	-0.0485	0.0420	-0.0547	0.0407			-0.0771	0.0360
	(0.0660)	(0.0308)	(0.0648)	(0.0303)			(0.0816)	(0.0306)
Block B	0.982***	-0.368***	0.925**	-0.348**	0.756	-0.285		
	(0.373)	(0.140)	(0.373)	(0.142)	(0.466)	(0.174)		
T1*1yr Perc Gap*(Gap<0)			0.259**	0.0397				
			(0.112)	(0.0326)				
T1*1yr Perc Gap*(Gap≥0)			0.135*	0.0232				
			(0.0793)	(0.0320)				
T5*5yr Perc Gap*(Gap<0)			0.241*	-0.0232				
			(0.125)	(0.0605)				
T5*5yr Perc Gap*(Gap≥0)			-0.0449	0.0742				
			(0.208)	(0.0831)				
T1 * Perceptions above actual					-1.357	0.0426		
					(0.946)	(0.331)		
T1 * Perceptions below actual					1.954***	0.343		
					(0.673)	(0.282)		
T5 * Perceptions above actual					-2.346***	-0.794***		
					(0.877)	(0.300)		
T5 * Perceptions below actual					1.453*	0.214		
					(0.748)	(0.294)		
High Uncertainty[a]							-0.866	-0.0481
							(0.635)	(0.140)
T1*Gap*High Uncertainty							0.157	0.00653
							(0.136)	(0.0328)
T5*Gap*High Uncertainty							-0.0780	-0.147**
							(0.204)	(0.0641)
Constant	-0.973**	0.348**	-0.952**	0.336**	-0.522	-0.107	-0.732	0.185
	(0.402)	(0.159)	(0.402)	(0.160)	(0.430)	(0.176)	(0.576)	(0.143)
Observations	1199	1196	1199	1196	800	798	599	1190
R-Squared	0.02945	0.01696	0.03191	0.01823	0.04729	0.01948	0.03183	0.01917
Joint sig of covariates[b]	.001	.033	.002	.061	0	.013	.05	.02
Mean of dep. variable	-0.3019	0.02300	-0.3019	0.02300	-0.2488	-0.01214	-0.7613	0.02637
Sample	All	All	All	All	Treated	Treated	Block A	All

OLS estimates reported. Robust standard errors in parentheses. Significant at *p≤0.10, **p≤0.05, ***p≤0.01. Perception gaps are defined as Zillow HPI growth minus respondent's perceived growth. 5 year perception gap and 2-5 year home price change expectations are annualized.

[a] High Uncertainty is defined as above median baseline uncertainty of future 1 [5] year home price changes for column 7 [8] in the table.

[b] F-test on equality of all covariatesto zero (excluding constant). P-value shown.

Table 6: Heterogeneity in Updating at both Horizons

	Sample Size	1 year Home price Expectations: Non Updater	Extra-polator	Mean Reverter	P-value[a]	2-5 year Home price Expectations: Non Updater	Extra-polator	Mean Reverter	P-value[a]
Full Sample (T1+T5)	803	-7.18%	11.9%	-4.76%		-3.3%	6.62%	-3.32%	
T5	401	-6.88%	9.72%	-2.84%	.349	-5.25%	6.92%	-1.67%	.298
T1	402	-7.47%	14.1%	-6.67%		-1.35%	6.32%	-4.96%	
Renter	232	-11.3%	15.7%	-4.32%	.244	-4.68%	9.08%	-4.4%	.638
Homeowner	571	-5.48%	10.4%	-4.93%		-2.73%	5.61%	-2.88%	
More than HS	700	-5.37%	10.9%	-5.51%	.018	-2.49%	5.99%	-3.5%	.263
HS Diploma or less	103	-19.5%	19%	.42%		-8.9%	10.9%	-2.05%	
Income $<$ 75k USD	508	-12.6%	15.2%	-2.68%	0	-5.93%	8.05%	-2.13%	.034
Income $\geq$ 75k USD	295	1.98%	6.3%	-8.28%		1.19%	4.17%	-5.36%	
Below Median Saiz Supply Elasticity	252	-9.1%	18.4%	-9.34%	.006	-4.03%	8.76%	-4.73%	.74
Above Median Saiz Supply Elasticity	253	-4.71%	4.96%	-.26%		-2.63%	5.33%	-2.7%	
High Numeracy[b]	567	-4.53%	11.2%	-6.71%	.027	-1.93%	5.86%	-3.93%	.274
Low Numeracy	236	-13.6%	13.6%	-.06%		-6.6%	8.45%	-1.85%	
No Negative Housing Market Experience	728	-5.84%	11.7%	-5.88%	.018	-2.96%	7.03%	-4.08%	.366
Foreclosure, Short Sale, or Underwater Mortgage	75	-20.1%	14%	6.02%		-6.57%	2.62%	3.95%	
Not confident in past price perceptions	553	-10.7%	13.2%	-2.47%	.004	-4.94%	7.4%	-2.46%	.179
Confident in past price perceptions[c]	250	.68%	9.14%	-9.81%		.34%	4.89%	-5.23%	
Pr(Buy Home | Move in 3 Years) $\leq$50%	465	-9.83%	12.2%	-2.37%	.09	-5.96%	6.57%	-.62%	.034
Pr(Buy Home | Move in 3 Years) $>$50%	338	-3.55%	11.6%	-8.02%		.34%	6.68%	-7.01%	
Pr(Sell Home in 1 Year) $\leq$ 50%	746	-6.67%	11%	-4.3%	.14	-3.12%	6.5%	-3.38%	.889
Pr(Sell Home in 1 Year) $>$ 50%	57	-13.7%	24.4%	-10.7%		-5.61%	8.16%	-2.55%	
Has Lived In Locality $<$ 15 years	390	-5.94%	12.9%	-6.98%	.368	-1.51%	4.51%	-3%	.336
Has Lived In Locality 15+ years	413	-8.34%	11%	-2.66%		-4.99%	8.61%	-3.62%	
Female	391	-10.7%	14.1%	-3.43%	.123	-4.1%	7.62%	-3.52%	.795
Male	409	-3.84%	9.93%	-6.08%		-2.66%	5.52%	-2.86%	
Age $\geq$50	425	-5.69%	9.36%	-3.67%	.296	-3.27%	3.89%	-.62%	.202
Age $<$ 50	378	-8.85%	14.8%	-5.98%		-3.32%	9.68%	-6.36%	
Positive Perception Gap	411	-9.51%	14.6%	-5.1%	.244	-4.8%	6.48%	-1.68%	.423
Negative Perception Gap	392	-4.76%	9.16%	-4.4%		-1.74%	6.75%	-5.01%	

Table reports proportion of respondents in treatment groups of different update types, relative to corresponding fractions in control group.
[a] P-value tests independence of demographic split on distribution of update types.
[b] Dummy that equals 1 if respondent correctly answered 4 or more of 5 questions measuring numeracy.
[c] Dummy that equals 1 if respondent reports being confident in their recall of past home price changes (i.e. answers 4 or more on a 1-5 scale, where 5 is very confident).
[d] Above median zipcode home price volatility over the past five years, as measured by Corelogic's HPI.

Table 7: Persistence in the Impact of Information

Dependent Variable: Revision in one year-ahead HP expectations		
	Final - Baseline	Followup - Baseline
	(1)	(2)
T1	0.389	-0.122
	(0.514)	(0.595)
T5	-0.000143	-0.00888
	(0.00550)	(0.00618)
T1 * 1yr Perception Gap	0.206***	0.142*
	(0.0724)	(0.0838)
T5 * 5yr Perception Gap	0.0663	-0.0714
	(0.116)	(0.115)
1yr Perception Gap	-0.0235	-0.00252
	(0.0435)	(0.0497)
5yr Perception Gap	-0.0349	0.0618
	(0.0718)	(0.0826)
Block B	1.232***	0.926*
	(0.433)	(0.474)
Constant	-1.181**	-0.158
	(0.488)	(0.527)
Observations	840	840
R-Squared	0.0306	0.0225
Joint sig of covariates[a]	.007	.035
Mean of dep. variable	-0.351	-0.0101

OLS estimates of a regression of one year-ahead HP change expectations. Standard errors in parentheses. Significant at *p≤0.10, **p≤0.05, ***p≤0.01.
[a] F-test on equality of all covariates to zero (excluding constant). P-value shown.

Table 8: Investment in Housing Fund and Expectations

Dependent Variable: Housing fund share (on a 0-100 scale)	Baseline			Post-treatment (Final)		Revision (Final-Baseline)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Baseline 1-yr exp. HP change	0.737***	0.565***	0.830***				
	(0.164)	(0.167)	(0.310)				
Pr(Decrease in HP next year)[a]		-0.133***					
		(0.0351)					
High Uncertainty[b]			-1.525				
			(3.341)				
High Uncertainty*1yr exp. HP change			-0.318				
			(0.403)				
Final 1-yr HP change exp.				0.705***	0.310***		
				(0.150)	(0.114)		
(Final - Baseline) 1-yr HP revision						0.239*	0.232**
						(0.127)	(0.116)
Baseline Share in Housing Fund					0.735***		-0.254***
					(0.0358)		(0.0354)
T1	2.769	3.266	1.974	3.089	1.126	0.370	1.263
	(2.334)	(2.332)	(3.253)	(2.334)	(1.653)	(1.784)	(1.644)
T5	1.971	2.430	-1.239	1.717	0.0747	-0.512	0.171
	(2.349)	(2.338)	(3.422)	(2.361)	(1.556)	(1.649)	(1.555)
Confident in recalled price change[c]	3.866*	3.058	2.371	1.570	-0.859	-1.935	-0.734
	(2.142)	(2.134)	(3.021)	(2.130)	(1.491)	(1.618)	(1.488)
Above-median risk aversion[d]	-7.750***	-7.650***	-7.093**	-7.385***	-1.728	0.514	-1.776
	(1.977)	(1.966)	(2.794)	(1.962)	(1.390)	(1.485)	(1.391)
Checked housing websites[e]	7.937***	7.799***	9.919***	9.578***	4.040***	1.740	4.003***
	(2.120)	(2.114)	(3.067)	(2.114)	(1.518)	(1.609)	(1.523)
Block B	2.787	1.329		2.166	0.650	-0.0305	0.539
	(1.930)	(1.973)		(1.923)	(1.368)	(1.492)	(1.381)
Constant	37.73***	43.62***	43.95***	44.62***	15.70***	6.309*	16.13***
	(4.653)	(5.062)	(6.505)	(4.608)	(3.828)	(3.675)	(3.863)
Demographics	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Initial Corner Solutions Controlled For [f]	No	No	No	No	Yes	No	Yes
Observations	1194	1188	596	1189	1188	1188	1188
R-Squared	0.103	0.115	0.120	0.108	0.565	0.0162	0.161
Joint sig of covariates[g]	0	0	0	0	0	.646	0
Mean of dep. variable	52.88	52.90	51.61	57.61	57.66	4.737	4.737

OLS estimates of a regression of share assigned tohousing fund (on a 0-100 scale). Robust standard errors in parentheses. Significant at *p≤0.10, **p≤0.05, ***p≤0.01.
All regressions include binary indicators for owning a home, household income ≥ 75,000 USD, numeracy, age<50 , ethnicity, gender, marital status, education, labor force status, and census region as controls.
[a] The probability (on a 0-100 scale) that respondent assigns to year-ahead home prices decreasing.
[b] High Uncertainty is defined as above median baseline uncertainty of future year home price changes.
[c] Dummy that equals 1 if respondent reports being confident in their recall of past home price changes (i.e. answers 4 or more on a 1-5 scale, where 5 is very confident).
[d] Dummy that equals 1 if respondent reports a 4 or less (on 1-10 scale) to question about willingness to take risks in financial matters, where 10 is very willing.
[e] Dummy that equals 1 if respondent reports consulting websites about home prices in past 12 months.
[f] Indicators for whether respondent assigned 0% or 100% to the housing fund in the baseline.
[g] F-test on equality of all covariates to zero (excluding constant). P-value shown.

Table 9: Impact of Information on Housing Fund Decision

Dependent Variable: Change in Share in Housing Fund (Final - Baseline)		
	(1)	(2)
T1	0.0888	0.604
	(1.748)	(1.624)
T5	0.220	0.534
	(1.616)	(1.525)
T1 * 1yr Perception Gap	0.540***	0.523***
	(0.199)	(0.182)
T5 * 5yr Perception Gap	0.635	0.554
	(0.397)	(0.365)
1yr Perception Gap	-0.0417	-0.0929
	(0.105)	(0.100)
5yr Perception Gap	0.0812	0.0691
	(0.188)	(0.176)
Baseline Share in Housing Fund		-0.224***
		(0.0342)
Block B	-0.272	0.485
	(1.429)	(1.336)
Constant	4.921***	16.00***
	(1.302)	(2.252)
Demographics	Yes	Yes
Initial Corner Solutions Controlled For [a]	No	Yes
Observations	1201	1201
R-Squared	0.0179	0.149
Joint sig of covariates[b]	.029	0
Mean of dep. variable	4.736	4.736

OLS estimates of a regression of share assigned tohousing fund (on a 0-100 scale).
Robust standard errors in parentheses. Significant at *p≤0.10, **p≤0.05, ***p≤0.01.
All regressions include binary indicators for owning a home, household income ≥ 75,000 USD,numeracy, age<50 , ethnicity, gender, marital status, education, labor force status,and census region as controls.
[a] Includes Indicators for whether respondent assigned 0% or 100% to the housing fund in baseline question.
[b] F-test on equality of all covariates to zero (excluding constant). P-value shown.

Table 10: Housing-related Behavior and Home Price Expectations

	Pr(Buy non-primary home)[a]		Pr(Buy home)[b]		Pr(Sell home)[c]		Pr(Invest in home)[d]	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1-year ahead exp. HP change	0.262***	0.264***	0.0923	0.0652	-0.00898	0.0446	0.376*	0.375*
	(0.0971)	(0.0982)	(0.207)	(0.211)	(0.162)	(0.160)	(0.203)	(0.205)
2-5 year ahead exp. HP change[e]		-0.0196		0.372		-0.812**		0.0157
		(0.196)		(0.491)		(0.408)		(0.493)
Pr(Decrease in HP next year)[f]	0.0323*	0.0322*	-0.0884**	-0.0868**	0.0439	0.0429	0.0206	0.0206
	(0.0189)	(0.0189)	(0.0430)	(0.0430)	(0.0341)	(0.0340)	(0.0383)	(0.0383)
Above median risk aversion [g]	-4.176***	-4.178***	-4.771**	-4.754**	-3.785*	-3.941**	-5.961***	-5.959***
	(1.169)	(1.169)	(2.214)	(2.214)	(2.008)	(2.007)	(2.243)	(2.245)
Liquid Savings (in $1,000s)	0.00837***	0.00838***	0.000744	0.000651	-0.00145	-0.00107	0.00768*	0.00768*
	(0.00280)	(0.00280)	(0.00542)	(0.00544)	(0.00373)	(0.00374)	(0.00434)	(0.00434)
Equity in Home	0.0130**	0.0130**	0.0391**	0.0396**	0.0253***	0.0242***	0.00914	0.00916
	(0.00611)	(0.00613)	(0.0184)	(0.0183)	(0.00704)	(0.00749)	(0.0128)	(0.0129)
Observations	1184	1184	809	809	844	844	848	848
R-Squared	0.08226	0.08227	0.2727	0.2733	0.06679	0.07083	0.07771	0.07771
Joint sig of covariates[h]	0	0	0	0	.002	.001	0	0
Mean of dep. variable	9.20	9.20	63.8	63.8	14.5	14.5	27.3	27.3

Table shows OLS estimates of a regression of the dependent variable on correlates. Robust standard errors in parentheses. Significant at *p≤0.10, **p≤0.05, ***p≤0.01. All regressions include binary indicators for owning a home, household income ≥ 75,000 USD, numeracy, age<50 , ethnicity, gender, marital status, education, labor force status, and census region as controls. Pr(Sell home) and Pr(Invest in home) include home age, unit type, and area type as controls.

[a] Probability of buying a non-primary home in the next three years (on a 0-100 scale).

[b] Probability of buying a home, conditional on moving in the next three years (on a 0-100 scale).

[c] Probability of putting home up for sale in the next twelve months (on a 0-100 scale).

[d] Probability of investing 5,000 USD in your home in next 12 months (on a 0-100 scale).

[e] Annualized expected home price change in zip code 2-5 years ahead.

[f] The probability (on a 0-100 scale) that respondent assigns to year-ahead home prices decreasing.

[g] Dummy that equals 1 if respondent reports a 4 or less (on 1-10 scale) to question about willingness to take risks in financial matters, where 10 is very willing.

[h] F-test on equality of all covariates to zero (excluding constant). P-value shown.

Table A1: Univariate Correlates of Perception Gaps and Anchoring

	Abs. Perception Gap[a]		Anchor
	1yr	5yr annualized	Distance[b]
Male	6.05***	2.97	10.3
Female	7.03	3.04	9.49
Has Lived In Locality 15+ years	6.57	3.01	9.79
Has Lived In Locality $<$ 15 years	6.43	2.99	10.1
Checked housing websites[c]	6.11***	2.91	10.2
Did not check housing websites	7.1	3.14	9.48
Confident in recalled price change[d]	6.32	3.02	10.7*
Not confident in recalled price change	6.58	2.99	9.59
Likely to buy or sell home in future[e]	6.6	3.15	10.3
Unlikely to buy or sell home in future	6.48	2.97	9.83
White & Non-Hispanic	6.16***	2.86***	9.27***
Non-White	7.58	3.45	12.2
Age $<$ 50	6.34	2.96	10.2
Age $\geq$50	6.64	3.03	9.67
Income $\geq$ 75k USD	5.44***	2.72***	10
Income $<$ 75k USD	7.15	3.16	9.89
Bachelors Degree or More	5.67***	2.76***	9.97
Less than Bachelors Degree	7.4	3.25	9.87
Homeowner	6.13***	2.81***	9.48**
Renter	7.39	3.45	11
Married	6.07***	2.9*	10
Not Married	7.36	3.19	9.75
Employed	6.31	3.02	10.2**
Not Employed	6.76	2.89	8.95
High Numeracy[f]	5.8***	2.89**	9.56*
Low Numeracy	8.21	3.26	10.8

OLS estimates reported. Robust standard errors in parentheses. Significant at *p$\leq$0.10, **p$\leq$0.05, ***p$\leq$0.01.
[a] The absolute gap between the perceived and actual zip code home price change. All gaps annualized.
[b] The absolute gap between respondent's revised forecast (of home price change) and information revealed in the treatment. Two observations per treated respondent, for each of the two horizon expectations.
[c] Dummy that equals 1 if respondent reports consulting websites about home prices in past 12 months.
[d] Dummy that equals 1 if respondent reports being confident in their recall of past home price changes (i.e. answers 4 or more on a 1-5 scale, where 5 is very confident).
[e] Probability of buying home in 3 years is $\geq$ 50% or probability of selling home in 1 year is $\geq$ 50%.
[f] Dummy that equals 1 if respondent correctly answered 4 or more of 5 questions measuring numeracy.

Table A2: Home Price Expectation Revisions and Perception Gaps, by Block

Dep. Variable: Home Price Expectation revisions at horizon:	1 year	2-5 year
	(1)	(2)
T1	1.085	-0.494*
	(0.714)	(0.276)
T5	-0.321	-0.00616
	(0.806)	(0.318)
T1 * 1yr Perception Gap	0.216**	0.0461
	(0.0872)	(0.0330)
T5 * 5yr Perception Gap	0.0713	-0.0114
	(0.136)	(0.0630)
1yr Perception Gap	-0.0389	-0.0278
	(0.0553)	(0.0219)
5yr Perception Gap	-0.0797	0.0569
	(0.0829)	(0.0401)
T1 * Block B	-1.323	0.476
	(0.879)	(0.330)
T5 * Block B	0.505	0.0281
	(0.954)	(0.365)
(T1 * 1yr Perception Gap)*Block B	-0.0565	-0.0317
	(0.120)	(0.0440)
(T5 * 5yr Perception Gap)*Block B	0.145	0.0573
	(0.200)	(0.0811)
(1yr Perception Gap)*Block B	0.0681	0.0360
	(0.0712)	(0.0284)
(5yr Perception Gap)*Block B	0.157	-0.0523
	(0.127)	(0.0514)
Block B	1.357**	-0.595**
	(0.648)	(0.255)
Constant	-1.221**	0.449**
	(0.523)	(0.219)
Observations	1199	1196
R-Squared	0.0423	0.0222
Joint sig of covariates[a]	0	.103
Mean of dep. variable	-0.302	0.0230

OLS estimates reported. Robust standard errors in parentheses. Significant at *p≤0.10, **p≤0.05, ***p≤0.01.
[a] F-test on equality of all covariates to zero (excluding constant). P-value shown.

Table A3: 2-stage Model for Updating Type

	1 year exp. HP change		2-5 year exp. HP change	
	Pr(Update)	Pr(Extrapolate | Update)	Pr(Update)	Pr(Extrapolate | Update)
	(1)	(2)	(3)	(4)
Homeowner	-0.00484	-0.0330	-0.00694	-0.0246
	(0.0412)	(0.0485)	(0.0311)	(0.0422)
Lived in current town/city for 15+ years	0.0404	-0.0379	0.0313	0.0729*
	(0.0358)	(0.0458)	(0.0284)	(0.0383)
HS Diploma or less	0.106*	0.0227	0.0307	0.0464
	(0.0551)	(0.0721)	(0.0454)	(0.0556)
Income $\geq$ 75,000 USD	-0.104***	-0.0283	-0.0496*	-0.0305
	(0.0362)	(0.0708)	(0.0273)	(0.0396)
Male	-0.0201	-0.00741	0.0127	-0.00824
	(0.0336)	(0.0430)	(0.0272)	(0.0368)
Age $<$ 50	0.0595	0.0424	0.0303	0.0896**
	(0.0362)	(0.0555)	(0.0285)	(0.0388)
High Numeracy[a]	-0.0307	0.0351	-0.0290	-0.0108
	(0.0395)	(0.0473)	(0.0306)	(0.0413)
T1	-0.000658	0.0455	-0.0608**	-0.00588
	(0.0338)	(0.0430)	(0.0275)	(0.0368)
Checked housing websites[b]	0.0182	0.00541	-0.0172	-0.0259
	(0.0354)	(0.0443)	(0.0283)	(0.0387)
Confident in recalled price change[c]	-0.0970***	0.0450	-0.0478*	-0.00876
	(0.0348)	(0.0573)	(0.0278)	(0.0389)
Negative Perception Gap	-0.0328	-0.0176	-0.0444	-0.00190
	(0.0335)	(0.0453)	(0.0275)	(0.0367)
Pr(Buy | Move in 3 Yrs) $>$ 50%	-0.0270	0.0453	-0.0405	0.0176
	(0.0350)	(0.0442)	(0.0270)	(0.0380)
Pr(Sell Home in 1 Yr) $>$ 50%	0.129*	0.142	0.0637	0.0269
	(0.0663)	(0.114)	(0.0532)	(0.0720)
Negative Housing Market Experience [d]	0.150**	-0.0896	0.0241	-0.0480
	(0.0600)	(0.0739)	(0.0479)	(0.0608)
Above Median Elasticity[e]	-0.0539	-0.169**	0.00250	-0.0190
	(0.0439)	(0.0751)	(0.0346)	(0.0470)
Volatile Local Home Market [f]	-0.0405	0.0343	0.00210	0.0542
	(0.0400)	(0.0514)	(0.0312)	(0.0432)
Perception Gap Magnitude	0.00497*	-0.00428	0.00136	-0.0000103
	(0.00297)	(0.00370)	(0.000943)	(0.00124)
N	794	794	792	792

Table reports average marginal effects from a two stage probit selection model, modeling respondents to first choose whether to update and then whether or not to extrapolate. Delta method standard errors in parentheses. Significant at *p$\leq$0.10, **p$\leq$0.05, ***p$\leq$0.01.
[a] Dummy that equals 1 if respondent correctly answered 4 or more of 5 questions measuring numeracy.
[b] Dummy that equals 1 if respondent reports consulting websites about home prices in past 12 months.
[c] Dummy that equals 1 if respondent reports being confident in their recall of past home price changes (i.e. answers 4 or more on a 1-5 scale, where 5 is very confident).
[d] Has experienced a foreclosure or a short sale, or is currently underwater on mortgage.
[e] Above median home price elasticity according to Saiz's elasticity instrument
[f] Above median zipcode home price volatility over the past five years, as measured by Corelogic's HPI resale index.

Table A4: Investment in Housing Fund and Expectations (Fractional Probit Estimates)

Dependent Variable: Housing fund share (on a 0-1 scale)	Baseline			Post-treatment (Final)	
	(1)	(2)	(3)	(4)	(5)
Baseline 1-yr exp. HP change	0.00736***	0.00563***	0.00840***		
	(0.00164)	(0.00167)	(0.00318)		
Pr(Decrease in HP next year)[a]		-0.00132***			
		(0.000345)			
High Uncertainty[b]			-0.0142		
			(0.0327)		
High Uncertainty*1yr exp. HP change			-0.00329		
			(0.00410)		
Final 1-yr HP change exp.				0.00697***	0.00324***
				(0.00147)	(0.00109)
(Final - Baseline) 1-yr HP revision					
Baseline Share in Housing Fund					0.00607***
					(0.000315)
T1	0.0279	0.0330	0.0196	0.0306	0.00996
	(0.0231)	(0.0230)	(0.0318)	(0.0230)	(0.0167)
T5	0.0197	0.0244	-0.0122	0.0167	0.000446
	(0.0233)	(0.0232)	(0.0334)	(0.0233)	(0.0157)
Confident in recalled price change[c]	0.0391*	0.0311	0.0235	0.0165	-0.00863
	(0.0212)	(0.0211)	(0.0295)	(0.0212)	(0.0152)
Above-median risk aversion[d]	-0.0769***	-0.0758***	-0.0700***	-0.0732***	-0.0185
	(0.0193)	(0.0192)	(0.0271)	(0.0192)	(0.0139)
Checked housing websites[e]	0.0783***	0.0769***	0.0979***	0.0938***	0.0390***
	(0.0207)	(0.0206)	(0.0296)	(0.0204)	(0.0148)
Block B	0.0278	0.0132		0.0219	0.00392
	(0.0190)	(0.0195)		(0.0190)	(0.0138)
Demographics	Yes	Yes	Yes	Yes	Yes
Initial Corner Solutions Controlled For [f]	No	No	No	No	Yes
Observations	1194	1188	596	1189	1188
Joint sig of covariates[g]	0	0	0	0	0
Mean of dep. variable	0.529	0.529	0.516	0.576	0.577

Average Marginal Effects from estimates of fractional probit regression reported.
Delta method standard errors in parentheses. Significant at *p≤0.10, **p≤0.05, ***p≤0.01.
All regressions include binary indicators for owning a home, household income ≥ 75,000 USD, numeracy, age<50 , ethnicity, gender, marital status, education, labor force status, and census region as controls.
[a] The probability (on a 0-100 scale) that respondent assigns to year-ahead home prices decreasing.
[b] High Uncertainty is defined as above median baseline uncertainty of future year home price changes.
[c] Dummy that equals 1 if respondent reports being confident in their recall of past home price changes (i.e. answers 4 or more on a 1-5 scale, where 5 is very confident).
[d] Dummy that equals 1 if respondent reports a 4 or less (on 1-10 scale) to question about willingness take risks in financial matters, where 10 is very willing.
[e] Dummy that equals 1 if respondent reports consulting websites about home prices in past 12 months.
[f] Indicators for whether respondent assigned 0% or 100% to the housing fund in the baseline.
[g] F-test on equality of all covariates to zero (excluding constant). P-value shown.

Table A5: Home Price Expectation Revisions (Robustness Checks)

	Home Price Expectation Revisions at horizon:								
	All	Treated		Trimmed		Consistent Recall[b]		Falsification	
	1 year	1 year	2-5 year	1 year	2-5 year	1 year	2-5 year	1 year	2-5 year
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
T1	0.374			0.105	-0.148	0.224	-0.293*	0.770*	-0.213
	(0.448)			(0.325)	(0.124)	(0.446)	(0.169)	(0.424)	(0.166)
T1 * 1yr Perception Gap	0.189***	0.206**	0.0354	0.147***	0.0370**	0.177***	0.0244		
	(0.0623)	(0.0808)	(0.0355)	(0.0494)	(0.0160)	(0.0668)	(0.0250)		
T5	-0.137	-0.477	0.281	-0.0267	0.164	-0.0835	0.0534	-0.0908	0.0219
	(0.463)	(0.479)	(0.177)	(0.354)	(0.136)	(0.486)	(0.185)	(0.470)	(0.174)
T5 * 5yr Perception Gap		0.0897	0.00542	0.100	0.0188	0.217*	0.0152		
		(0.121)	(0.0630)	(0.0819)	(0.0298)	(0.111)	(0.0519)		
1yr Perception Gap	0.00106	-0.0415	-0.0187	0.0191	-0.00280	-0.00164	-0.0130	0.0832***	0.00126
	(0.0372)	(0.0643)	(0.0223)	(0.0316)	(0.00948)	(0.0399)	(0.0161)	(0.0313)	(0.0159)
5yr Perception Gap		0.0389	0.0443	-0.00319	0.0176	-0.0346	0.0528	-0.0448	0.0376
		(0.0904)	(0.0521)	(0.0539)	(0.0193)	(0.0686)	(0.0322)	(0.0621)	(0.0251)
Block B	0.977***	0.760	-0.302*	0.587**	-0.186*	1.031***	-0.353**	0.924**	-0.378***
	(0.372)	(0.467)	(0.171)	(0.281)	(0.108)	(0.387)	(0.147)	(0.373)	(0.141)
T5 * 5yr Perception Gap (Unannualized)	0.0270								
	(0.0227)								
5yr Perception Gap (Unannualized)	-0.00830								
	(0.0141)								
T1 * 5yr Perception gap								0.156	0.0215
								(0.109)	(0.0442)
T5 * 1yr Perception gap								-0.0891	-0.0172
								(0.0703)	(0.0271)
Constant	-0.942**	-0.372	0.0459	-0.325	0.00319	-0.978**	0.352**	-1.049***	0.328**
	(0.398)	(0.417)	(0.164)	(0.287)	(0.123)	(0.410)	(0.164)	(0.404)	(0.158)
Observations	1199	799	797	1114	1112	1104	1101	1199	1196
R-Squared	0.02859	0.03788	0.01866	0.03794	0.02200	0.02939	0.02090	0.02306	0.01597
Joint sig of covariates[a]	.001	.001	.073	0	.041	.001	.029	.008	.058
Mean of dep. variable	-0.3019	-0.2491	-0.01154	0.05581	-0.1036	-0.3778	0.02427	-0.3019	0.02300
Sample	All	Treated	Treated	Trimmed	Trimmed	Consistent Recall	Consistent Recall	All	All

OLS estimates reported. Robust standard errors in parentheses. Significant at *p≤0.10, **p≤0.05, ***p≤0.01.

[a] F-test on equality of all covariatesto zero (excluding constant). P-value shown.

[b] Excludes respondents who reported to a subjective question that information treatment was higher (lower) than their perception, but had a negative (positive) perception gap

Five Year Perception Gap and 2-5 year home price change expectations are annualized, unless otherwise indicated.