Are Stated Expectations Actual Beliefs?  
New Evidence for the Beliefs Channel of Investment Demand

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The views expressed are ours and do not necessarily reflect those of the Federal Reserve Bank of New York or the Federal Reserve System.
Believe what I say when it’s what I do

- Explosion of empirical research on beliefs in behavioral macrofinance, real estate, corp fin
- But do **stated** beliefs reflect **actual** beliefs used in investment decisions?
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• But do **stated** beliefs reflect **actual** beliefs used in investment decisions?

Maybe Yes...

• Stated expectations $\Rightarrow$ Investment
• Armantier et al. (2015) Armona et al. (2018) Giglio et al. (2020) ...
• Large structural lit combines stated expectations and actions
• Beliefs code individual-specific private info (Hendren 2013, 2017)
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Maybe No...

- Rounding (Dominitz & Manski 1997)
- Level- vs. change-framing effects
- Cognitive psych lit on numerical representation
- Beliefs vs. preferences (Cochrane 2011)
** Weak empirical correlation between investment and beliefs
“There has, nevertheless, been awareness that the willingness and ability of respondents to report probabilistic expectations does not imply that persons regularly think probabilistically and use subjective probability distributions to make decisions. It has long been known that survey respondents are willing and able to respond to questions seeking point predictions of uncertain events or verbal assessments of likelihood. Yet persons need not use point predictions or verbal assessments of likelihood to make decisions.”

-Manski (2018, *NBER Macroeconomics Annual*)
Where we come in

• Measure local house price forecasts (mean and distributions) using NY Fed Survey of Consumer Expectations

• Measure other individual-level belief factors, including beliefs about fundamentals and perceived past returns to local housing

• Measure other demand factors (risk aversion, income, wealth, etc.)

• Offer respondents a derivative split ($\phi$) between a 2% savings account and whatever their zip code housing index returns this year + random chance at proceeds

• Abstracts away from demand factors, transactions costs
Stated beliefs not a sufficient statistic for beliefs channel

Punchlines

1. **Stated** beliefs don’t fully capture **actual** expectations used in investment decisions
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Are Stated Expectations Actual Beliefs?

Motivation

Stated beliefs not a sufficient statistic for beliefs channel

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1. **Stated** beliefs don’t fully capture **actual** expectations used in investment decisions
2. Some belief factors also have *independent* effects on investment
   - Focus on past returns given extrapolation and momentum in real estate prices
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4. Robust to accounting for risk aversion, demand correlates, measurement error, multicollinearity, misspecification.
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4. Robust to accounting for risk aversion, demand correlates, measurement error, multicollinearity, misspecification.

5. Consistent with model of cognitive uncertainty extended to allow for risk aversion
Theory has no independent role for $\hat{r}_t$

Simplest asset allocation model Merton (1971):

- single risky asset with normally distributed return, share $\phi$

$$\phi = \frac{\hat{E}_t[r_{t+1}] - R_f}{\alpha \hat{\sigma}^2_t}$$
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single risky asset with normally distributed return, share $\phi$

$$
\phi = \frac{\hat{E}_t[r_{t+1}] - R_f}{\alpha \hat{\sigma}_t^2}
$$

- Factor such as perceived past returns $\hat{r}_t$ could affect $\phi$ through $\hat{E}_t[r_{t+1}]$, $\hat{\sigma}_t$, and $\alpha$. 

Empirics support interpreting $\hat{r}_t$ as another component of beliefs channel.
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$\rightarrow$ After flexibly controlling for $\hat{E}_t[r_{t+1}]$, $\hat{\sigma}_t$, and $\alpha$, belief factors like $\hat{r}_t$ do not enter $\phi$. 
Theory has no independent role for \( \hat{r}_t \)

Simplest asset allocation model Merton (1971): single risky asset with normally distributed return, share \( \phi \)

\[
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- Factor such as perceived past returns \( \hat{r}_t \) could affect \( \phi \) through \( \hat{E}_t[r_{t+1}] \), \( \hat{\sigma}_t \), and \( \alpha \).

→ After flexibly controlling for \( \hat{E}_t[r_{t+1}] \), \( \hat{\sigma}_t \), and \( \alpha \), belief factors like \( \hat{r}_t \) do not enter \( \phi \).

- Contrast: we show \( \hat{r}_t \) important predictor of \( \phi \) even conditional on these factors.
- Empirics support interpreting \( \hat{r}_t \) as another component of beliefs channel.
Usual approach to beliefs channel

\[ \phi = \frac{\hat{E}_t[r_{t+1}] - R_f}{\alpha \hat{\sigma}_t^2} \]

Because \( \hat{E}_t[r_{t+1}] \) and \( \hat{\sigma}_t \) are treated as sufficient statistics for past info, typical expectation paper features “divide-and-conquer” approach:

- **Stage 1. Expectation Formation:**
  \[ \hat{r}_t, X, Z \ldots \Rightarrow \hat{E}_t[r_{t+1}] \]

- **Stage 2. Expectations Affecting Behavior:**
  \[ \hat{E}_t[r_{t+1}] \text{ (without } \hat{r}_t, \ldots) \Rightarrow \text{behavior } (\phi) \]
Usual approach to beliefs channel

\[ \phi = \frac{\hat{E}_t[r_{t+1}] - R_f}{\alpha \hat{\sigma}_t^2} \]

Because \( \hat{E}_t[r_{t+1}] \) and \( \hat{\sigma}_t \) are treated as sufficient statistics for past info, typical expectation paper features “divide-and-conquer” approach:

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  \[ \hat{E}_t[r_{t+1}] \text{ (without } \hat{r}_t, \ldots \text{) } \Rightarrow \text{ behavior (} \phi \text{)} \]

\[ \rightarrow \text{ Contrast: we show } \hat{r}_t \text{ not fully incorporated into } \hat{E}_t[r_{t+1}]; \text{ still matters in Stage 2.} \]
Aside: focus on past returns especially in housing market

- Theory: nothing particularly special about past returns.
- However, plausible and measurable factor in expectations formation, especially given that:
  
  (a) Momentum important feature of housing market price dynamics (Glaeser et al. 2014, DeFusco et al. 2017, Guren 2018)
  
  (b) Strong role for extrapolative beliefs (Piazzesi Schneider 2009, Glaeser Nathanson 2017, Armona et al. 2018, Barrero 2020)
  
  (c) Literature on personal experience effects (e.g., Malmendier Nagel 2011)
Puzzle: Expectations Effect ⇐ Experience Effect

Evidence for stated expectations ⇒ investment: statistically significant but magnitude small

Example: Giglio et al. (2020)
- 1 p.p. increase in expected return ⇒ 0.8 p.p. higher equity share
- “...one order of magnitude smaller than implied by standard model...”
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Past experience ⇒ behavior: Larger magnitude.
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Past experience ⇒ behavior: Larger magnitude.
  • Malmendier Nagel (2011) +1 p.p. in experienced stock return ⇒ +1.7 p.p. equity share

If we believe past experience ⇒ stated expectations ⇒ behavior...
...reconciling magnitudes requires extreme (> 2) extrapolation...
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If we believe past experience $\Rightarrow$ stated expectations $\Rightarrow$ behavior...

...reconciling magnitudes requires extreme ($>2$) extrapolation... but MN find $\sim0.62$. 
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If we believe *past experience ⇒ stated expectations ⇒ behavior...*

...reconciling magnitudes requires extreme (> 2) extrapolation... but MN find ~0.62.

→ Solution: maybe past experience directly affects investment, too (bypassing stated beliefs)
Are Stated Expectations Actual Beliefs?

Explanation? Cognitive Uncertainty + Risk Aversion

Enke and Graeber (2020)

- People respond to cognitive noise ("cognitive uncertainty") and shrink their beliefs towards "mental defaults"
- Stress response triggered by [complex or ambiguous or risky] situations to revert to default

\[\text{weights on belief factors will be different in stating beliefs vs. using beliefs}\]

- We extend model to allow for risk aversion when facing fraught decisions
- Example: shrinking investment allocation towards 50:50 split between risky and risk-free

\[\text{Our context: last year’s returns are a mental default on which investors base investments}\]
Cognitive uncertainty in our context: $\hat{r}_t$ serves as a mental anchor

- When asked about home price forecast, the investor uses all available information

$$\hat{E}[r_{t+1}] = \beta_r \hat{r}_t + \beta_{GDP} \hat{E}[GDP] + \beta_{rent} \hat{E}[rent growth] + \cdots = 11\%$$
Cognitive uncertainty in our context: $\hat{r}_t$ serves as a mental anchor

- When asked about home price forecast, the investor uses all available information
  \[
  \hat{E}[r_{t+1}] = \beta_r \hat{r}_t + \beta_{GDP} \hat{E}[GDP] + \beta_{rent} \hat{E}[rent~growth] + \cdots = 11\%
  \]

- But when actually making an investment choice, she kicks the tires on that forecast.
- Key: $\hat{r}_t$ feels relatively salient and certain and the investor doesn’t discount it.
Cognitive uncertainty in our context: $\hat{r}_t$ serves as a mental anchor

- When asked about home price forecast, the investor uses all available information

\[ \hat{E}[r_{t+1}] = \beta_r \hat{r}_t + \beta_{GDP} \hat{E}[GDP] + \beta_{rent} \hat{E}[\text{rent growth}] + \cdots = 11\% \]

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*What do I know about GDP? Why 11% and not 8% or 15%?*  
*After all, I’m pretty sure last year’s returns were 5%...*
Cognitive uncertainty in our context: \( \hat{r}_t \) serves as a mental anchor

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*What do I know about GDP? Why 11% and not 8% or 15%? After all, I’m pretty sure last year’s returns were 5%...*

\[\Rightarrow\] Discounts other signals, shrinks her 11% forecast towards 5%, and bases decisions on 7%
Empirically checking for cognitive uncertainty behavior

- Stated forecast
  \[
  \hat{E}[r_{t+1}] = \beta_r \hat{r}_t + \beta_{GDP} \hat{E}[GDP] + \beta_{rent} \hat{E}[\text{rent growth}] + \cdots
  \]

- Actual expectations used in investment decision
  \[
  \tilde{E}[r_{t+1}] = \tilde{\beta}_r \tilde{r}_t + \tilde{\beta}_{GDP} \tilde{E}[GDP] + \tilde{\beta}_{rent} \tilde{E}[\text{rent growth}] + \cdots
  \]

  \[
  \tilde{\beta}_r > \beta_r, \quad \tilde{\beta}_{GDP} < \beta_{GDP}, \quad \tilde{\beta}_{rent} < \beta_{rent} \cdots
  \]
Data and Descriptive Evidence
Survey Questions: Perception and Expectation of Home Prices

Housing module of the NY Fed Survey of Consumer Expectations: 2015-2020

- **Perceived** home price growth in local zip code over **past** 12 months
- **Expected** home price growth in local zip code over **next** 12 months
- Demographic variables: age, education, income, liquid savings, married, homeownership, race, gender, numeracy, census region, urban or rural
- Risk tolerance measure
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:

*(Please note: The numbers need to add up to 100.)*

The housing market fund

The savings account

**TOTAL**

0
Can we trust this hypothetical investment measure?

- Without real stakes, how externally valid is this measure?

- Give respondents small chance at receiving gross return of their own constructed derivative (Armona Fuster Zafar 2018)

- Results robust to using only the incentivized subsample

- See also “proper scoring rules” literature (Shuford Albert Massengill 1966, Savage 1971, Armantier et al. 2015)
Other Survey Measures of Investment

- Probability of buying an investment property within the next 3 years.

- Probability of moving within the next 3 years
  \[ \rightarrow \text{If } \Pr(\text{moving}) \geq 5\% \text{ we ask } \Pr(\text{owning \ conditional on moving}) \]

- View housing as a good investment (1-5 scale)

\[ \rightarrow \text{Theoretical prediction: ceteris paribus, higher beliefs } \Rightarrow \uparrow \Pr(\text{invest}) \]
# Beliefs and Investment Actions Summary Statistics

<table>
<thead>
<tr>
<th>Belief/Action Description</th>
<th>Response Count</th>
<th>Mean</th>
<th>Std. Dev.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected HPA in the Next 12 months</td>
<td>5,869</td>
<td>0.04</td>
<td>0.05</td>
</tr>
<tr>
<td>Perceived HPA in the Past 12 months</td>
<td>5,866</td>
<td>0.04</td>
<td>0.06</td>
</tr>
<tr>
<td>Confidence in Recalled Price Change (1-5)</td>
<td>5,865</td>
<td>3.21</td>
<td>0.90</td>
</tr>
<tr>
<td>Actual HPA in the Past 12 months</td>
<td>5,785</td>
<td>0.05</td>
<td>0.04</td>
</tr>
<tr>
<td>Share Invested in a Housing Fund (2015)</td>
<td>1,012</td>
<td>0.54</td>
<td>0.34</td>
</tr>
<tr>
<td>Share Invested in a Housing Fund (2020)</td>
<td>808</td>
<td>0.61</td>
<td>0.32</td>
</tr>
<tr>
<td>Probability of Moving within 3 years</td>
<td>5,862</td>
<td>0.30</td>
<td>0.34</td>
</tr>
<tr>
<td>Probability of Buying a Primary Residence</td>
<td>3,858</td>
<td>0.67</td>
<td>0.33</td>
</tr>
<tr>
<td>Probability of Buying an Investment Property</td>
<td>5,861</td>
<td>0.09</td>
<td>0.18</td>
</tr>
</tbody>
</table>
# Beliefs Incorporate Past Returns

<table>
<thead>
<tr>
<th>Dependent Variable: 1-year HP Expectation</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-year Perceived HPA</td>
<td>0.28***</td>
<td>0.27***</td>
<td>0.25***</td>
<td>0.24***</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.02)</td>
</tr>
<tr>
<td>Forecasted Rent Growth</td>
<td>0.16***</td>
<td>0.16***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.012)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forecasted Inflation</td>
<td>0.06***</td>
<td>0.05***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.017)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Individual Controls</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Forecasted Fundamentals</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>5,816</td>
<td>5,389</td>
<td>5,816</td>
<td>5,389</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.12</td>
<td>0.15</td>
<td>0.17</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Notes: Fundamentals include respondent expectations of general inflation, mortgage rate changes, rent inflation, future economic conditions, and future credit availability.
Regression Evidence
Demographics as Omitted Demand Factors

\[ Y_{it+1} = \alpha + \beta_1 \hat{r}_{it} + \beta_2 \hat{E}_t[r_{it+1}] + X'_i \phi + \varepsilon_{it+1} \]

- \( Y_{it+1} \) is an investment outcome of interest.
- \( \hat{r}_{it} \) is respondent \( i \)'s perception of home price growth over the last 12 months.
- \( \hat{E}_t[r_{it+1}] \) is respondent \( i \)'s expected home-price growth over the next 12 months.
- \( X_i \) is a rich set of demographic controls (age, education, income, liquid savings, married, homeownership, race, gender, numeracy, census region, urban or rural)
\( \hat{r}_{i,t} \) predicts investment better than \( \hat{E}_t[r_{i,t+1}] \)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \hat{E}<em>t[r</em>{i,t+1}] )</td>
<td>1.00***</td>
<td>0.44</td>
<td>0.81***</td>
<td>0.41</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(0.29)</td>
<td>(0.31)</td>
<td>(0.29)</td>
<td>(0.30)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \hat{r}_{i,t} )</td>
<td>1.18***</td>
<td>1.06***</td>
<td></td>
<td>0.93***</td>
<td>0.83***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.20)</td>
<td>(0.22)</td>
<td></td>
<td>(0.21)</td>
<td>(0.22)</td>
<td></td>
</tr>
<tr>
<td>Demographics</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>1,012</td>
<td>1,012</td>
<td>1,012</td>
<td>1,012</td>
<td>1,012</td>
<td>1,012</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.01</td>
<td>0.03</td>
<td>0.04</td>
<td>0.12</td>
<td>0.13</td>
<td>0.13</td>
</tr>
</tbody>
</table>

Dependent Variable: Share in a Housing Fund (2015 Experiment)
What’s to say \( \hat{r}_t \) effect is about beliefs? Alternative Explanations

\[
\phi = \frac{\hat{E}_t[r_{t+1}] - R_f}{\alpha \hat{\sigma}_t^2}
\]

1. \( r_t \) correlated with distribution of expected returns (\( \hat{\sigma}_t^2 \))
2. \( r_t \) correlated with risk aversion (\( \alpha \))
3. \( r_t \) correlated with omitted demand factors
4. Multicollinearity between \( \hat{E}_t[r_{t+1}] \) and \( \hat{r}_t \)
5. Measurement error in survey stated expectations \( \hat{E}_t[r_{t+1}] \)
1. More than just mean expected returns should matter...

Alternative story #1:

- $\hat{r}_t \Rightarrow \text{Downside risk} \Rightarrow \text{Behavior.}$
- Importance of $\hat{r}_t$ could be driven by investors’ consideration of downside risk.

- Inspired by Engelberg Manski Williams (2009), SCE collects beliefs about distribution:
  - $\Pr(HPA > 10\%)$
  - $\Pr(0\% < HPA \leq 10\%)$
  - $\Pr(-5\% < HPA \leq 0\%)$
  - $\Pr(HPA \leq -5\%)$
### Robustness to Controlling for the Forecasted Distribution of Returns

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<td>$\hat{E}<em>t[r</em>{i,t+1}]$</td>
<td>0.20</td>
<td>0.17</td>
<td>0.13</td>
</tr>
<tr>
<td></td>
<td>(0.30)</td>
<td>(0.31)</td>
<td>(0.31)</td>
</tr>
<tr>
<td>$\hat{r}_{i,t}$</td>
<td>0.75***</td>
<td>0.74***</td>
<td>0.66***</td>
</tr>
<tr>
<td></td>
<td>(0.22)</td>
<td>(0.22)</td>
<td>(0.22)</td>
</tr>
<tr>
<td>Pr(HP Decreases)</td>
<td>-0.12***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.04)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HPA Bin Probabilities</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probabilities Cubic</td>
<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Demographics</td>
<td>X</td>
<td></td>
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</tr>
<tr>
<td>Observations</td>
<td>1012</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.137</td>
<td>0.138</td>
<td>0.150</td>
</tr>
</tbody>
</table>
3. Does $r_t$ reflect beliefs or demand shocks?

- Our interpretation of $r_t$ as a belief factor only holds if $r_t$ isn’t also correlated with non-belief demand factors.
- Otherwise, coefficient on $r_t$ may not be telling us about the beliefs channel.
- Plausible that past returns affect demand: wealth, risk aversion, spatial sorting, affordability, credit constraints...
- Key point: for the derivative in our experiment, none of these correlations should matter.
- Supporting evidence: results hold across real estate investment outcomes.

Results
5. Address Potential Measurement Error in $\hat{E}_t[r_{t+1}]$

- Popular explanation for weak relationship between surveyed expectations and outcomes: measurement error
- If stated beliefs on surveys are simply noisy, then could load onto a belief factor
- Address several ways:
  1. Instrument for $E_t[r_{t+1}]$ with other belief factors
  2. Instrument for $E_t[r_{t+1}]$ with higher-order moments following Lewbel (1997)
  3. Demonstrate that weights on belief factors change (consistent with cognitive uncertainty)
  4. Direct survey measures of belief factors
## Evidence Consistent with Cognitive Uncertainty

<table>
<thead>
<tr>
<th>Dependent Variable:</th>
<th>Expected HPA (1)</th>
<th>Housing fund share (2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected HPA in the Next 12 months</td>
<td>0.26 (0.32)</td>
<td></td>
</tr>
<tr>
<td>Perceived HPA in the Past 12 months</td>
<td>0.21*** (0.030)</td>
<td>0.57** (0.22)</td>
</tr>
<tr>
<td>Expected Rent Growth</td>
<td>0.11*** (0.034)</td>
<td>-0.22 (0.27)</td>
</tr>
<tr>
<td>Expected Rate of Inflation</td>
<td>0.13*** (0.036)</td>
<td>-0.34 (0.28)</td>
</tr>
<tr>
<td>Probabilities Cubic</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
<td>1,012</td>
<td>1,012</td>
</tr>
<tr>
<td>R-Squared</td>
<td>0.26</td>
<td>0.19</td>
</tr>
</tbody>
</table>
Direct Measure of Decision Factors
Why do I do what I do? Just ask!

• We reran the hypothetical $1,000 investments, but before asking for investment allocation, we ask treatment group whether they consider...
  1. their return forecasts just stated on survey or
  2. their memory of past home-price growth

  more when making investment decisions

• Control group asked about investment decisions without the extra question

• See other fields’ reliance on qualitative research + e.g., Choi and Robertson (2020)
Self-Reflection Experiment

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.

Which factor do you consider more when making this investment decision?

- Expected return on the local housing market over the next 12 months
- Realized return on the local housing market over the past 12 months

What proportion of the $1,000 would you invest in:

(Please note: The numbers need to add up to 100.)

The housing market fund: %
The savings account: %
TOTAL: %
Explicitly ask whether people rely more on $r_t$ or $r_{t+1}$

- 41% of respondents report relying more on $\hat{r}_t$ than their stated $\hat{E}_t[r_{t+1}]$
- Theoretically, everyone should use $\hat{E}_t[r_{t+1}]$ weakly more than $\hat{r}_t$ if stated beliefs measure what we think they do.
- Risk-loving and college-educated respondents more likely to rely on $r_{t+1}$ instead of $r_t$.
- For both forward- and backward-looking, asking about decision induces less reliance on expected returns.
- While opposite to our ex-ante hypothesis, consistent with cognitive uncertainty.
- Further evidence for cognitive uncertainty:
  1. belief factor weights change
  2. overall results strongest for respondents who don’t check housing websites (see also Andries et al. 2020)
Conclusion

- Do stated beliefs elicited by expectation surveys reflect the actual beliefs used in investment decisions? Only partially...
- We document systematic gap between forecasted price growth and actual beliefs
- Perceived past returns robustly improve action prediction, strengthen beliefs channel
- Beliefs matter! But would underappreciate if using stated beliefs as sufficient statistic
- Evidence consistent with form of cognitive uncertainty: setting induces investors to rely on signals they are more certain about
Might measurement error in $r_{it+1}$ lead to a spurious estimate of $\beta_2$?

\[ Y_{it+1} = \beta_1 r_{it+1} + \beta_2 r_{it} + \epsilon_{it+1} \]

- Imagine expected returns are measured with error

\[ r_{it+1} = r_{it+1}^* + \eta_{it+1} \]

- Then even if past returns have no independent effect on investment ($\beta_2 = 0$) but are a belief factor

\[ r_{it+1}^* = \pi r_{it} + \nu_{it+1} \]

they will have a positive estimated coefficient
Simulation Evidence on Instrumenting

Solution: instrument stated beliefs with another belief factor, e.g., forecasted rent growth $Rent_{it+1}$

\[
Y_{it+1} = \beta_1 r_{it+1} + \beta_2 r_{it} + \varepsilon_{it+1}
\]

\[
r_{it+1} = \pi_1 r_{it} + \pi_2 Rent_{it+1} + \nu_{it+1}
\]

\[\hat{\beta}_2 \text{ without instrumenting} \quad \hat{\beta}_2 \text{ with instrumenting}\]
## Results Robust to Instrumenting for Stated Beliefs

<table>
<thead>
<tr>
<th>Dependent Variable: Housing fund share (0-100)</th>
<th>(4)</th>
<th>(5)</th>
<th>(10)</th>
<th>(11)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimator</td>
<td>OLS</td>
<td>2SLS</td>
<td>OLS</td>
<td>2SLS</td>
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<tr>
<td>$HPA_{i,t}$</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.70***</td>
<td>0.86**</td>
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<tr>
<td></td>
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<td>(0.22)</td>
<td>(0.39)</td>
</tr>
<tr>
<td>$HPA_{i,t+1}$</td>
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<td></td>
<td>0.80***</td>
<td>0.66</td>
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<tr>
<td></td>
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<td></td>
<td>(0.29)</td>
<td>(1.09)</td>
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<tr>
<td>Individual Controls</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>First Stage F-stat</td>
<td>30.22</td>
<td>21.66</td>
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<tr>
<td>Observations</td>
<td>1,012</td>
<td>1,012</td>
<td>1,012</td>
<td>1,012</td>
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</table>
## Results Robust to Controlling for Risk Tolerance

<table>
<thead>
<tr>
<th>Dependent Variable: Share in a Housing Fund (2015 Experiment)</th>
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<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
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</thead>
<tbody>
<tr>
<td>Risk Tolerance (1-10)</td>
<td>3.38***</td>
<td>3.18***</td>
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</tr>
<tr>
<td></td>
<td>(0.49)</td>
<td>(0.94)</td>
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<td></td>
</tr>
<tr>
<td>( \hat{E}<em>t[r</em>{i,t+1}] )</td>
<td>0.13</td>
<td>0.12</td>
<td>0.09</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.31)</td>
<td>(0.31)</td>
<td>(0.31)</td>
<td></td>
</tr>
<tr>
<td>( \hat{r}_{i,t} )</td>
<td>0.66***</td>
<td>0.64***</td>
<td>0.58***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.22)</td>
<td>(0.22)</td>
<td>(0.22)</td>
<td></td>
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<tr>
<td>Risk Tolerance Score Fixed Effects</td>
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<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Probability Cubic</td>
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<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Demographics</td>
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<td>X</td>
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</tr>
<tr>
<td>Observations</td>
<td>1,012</td>
<td>1,012</td>
<td>1,012</td>
<td>1,012</td>
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<tr>
<td>R-Squared</td>
<td>0.048</td>
<td>0.150</td>
<td>0.160</td>
<td>0.169</td>
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### Individual Characteristics Summary Statistics

<table>
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<th>Characteristic</th>
<th>Response Count</th>
<th>Mean</th>
<th>Std. Dev.</th>
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<tbody>
<tr>
<td>Age</td>
<td>5,836</td>
<td>51.2</td>
<td>15.3</td>
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<tr>
<td>Male Indicator</td>
<td>5,835</td>
<td>0.54</td>
<td>0.50</td>
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<tr>
<td>Minority Indicator</td>
<td>5,828</td>
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<td>0.37</td>
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<tr>
<td>Married Indicator</td>
<td>5,836</td>
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<td>0.48</td>
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<tr>
<td>Homeowner Indicator</td>
<td>5,816</td>
<td>0.76</td>
<td>0.42</td>
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<td>College Graduate Indicator</td>
<td>5,835</td>
<td>0.57</td>
<td>0.50</td>
</tr>
<tr>
<td>1(Household Income $\geq 100K)</td>
<td>5,779</td>
<td>0.29</td>
<td>0.45</td>
</tr>
<tr>
<td>1(Liquid Savings $\geq 75K)</td>
<td>5,481</td>
<td>0.66</td>
<td>0.47</td>
</tr>
<tr>
<td>Numeracy Score (1-5)</td>
<td>5,836</td>
<td>4.06</td>
<td>1.04</td>
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<td>Risk Loving (1-10)</td>
<td>5,875</td>
<td>4.41</td>
<td>2.20</td>
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</tbody>
</table>

→ Results robust to using nationally representative survey weights
Address Forecasted and Past HPA Multicollinearity

- Given importance of extrapolative beliefs, expected and past HPA highly correlated.
  \[ \Rightarrow \] Challenging to separately interpret coefficients for expected and past home price growth.
Address Forecasted and Past HPA Multicollinearity

- Given importance of extrapolative beliefs, expected and past HPA highly correlated.  
  \[ \Rightarrow \] Challenging to separately interpret coefficients for expected and past home price growth.

- Should bias away from individual significance. Emphasize significance of \( r_t \)
- Further address nonlinearities by being more nonparametric in controls for forecasted HPA
- Within fine bins of \( \hat{E}_t[r_{t+1}] \), respondents have approx. same forecast
- Even matching on forecasted returns, past returns still strong predictor of investment
### Addressing Multicollinearity between $r_t$ and $E_t[r_{t+1}]$

<table>
<thead>
<tr>
<th>Dependent Variable: Housing fund share (on a 0-100 scale)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
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</thead>
<tbody>
<tr>
<td>Baseline 1-year HP Expectation</td>
<td>0.21</td>
<td>0.28</td>
<td>0.36</td>
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<td></td>
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<tr>
<td></td>
<td>(0.31)</td>
<td>(0.32)</td>
<td>(0.32)</td>
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<tr>
<td>Baseline 1-year Perceived HPA</td>
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<td></td>
<td></td>
<td>0.62***</td>
<td>0.62***</td>
<td>0.64***</td>
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<tr>
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<td></td>
<td>(0.23)</td>
<td>(0.23)</td>
<td>(0.23)</td>
</tr>
<tr>
<td>Bin FEs for Perceived HPA</td>
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<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bin FEs for Expected HPA</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Number of Bins Specified</td>
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<td>100</td>
<td>200</td>
<td>10</td>
<td>100</td>
<td>200</td>
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<tr>
<td>Number of Actual Bins</td>
<td>9</td>
<td>46</td>
<td>71</td>
<td>9</td>
<td>44</td>
<td>64</td>
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<tr>
<td>Bin Probabilities Cubic</td>
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<td>X</td>
<td>X</td>
<td>X</td>
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<td>1006</td>
<td>1012</td>
<td>1012</td>
<td>1008</td>
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<tr>
<td>R-Squared</td>
<td>0.171</td>
<td>0.207</td>
<td>0.233</td>
<td>0.162</td>
<td>0.177</td>
<td>0.195</td>
</tr>
</tbody>
</table>
## Perceived Past HPA Improves Action Prediction for Other Outcomes

<table>
<thead>
<tr>
<th></th>
<th>Pr(Buy investment prop. next year)</th>
<th>Pr(Buy home)</th>
<th>Viewing Housing Good Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pr(Buy investment)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>$\hat{E}<em>t[r</em>{i,t+1}]$</td>
<td>0.12***</td>
<td>0.19**</td>
<td>-0.53**</td>
</tr>
<tr>
<td></td>
<td>(0.029)</td>
<td>(0.052)</td>
<td>(0.18)</td>
</tr>
<tr>
<td>$\hat{r}_{i,t}$</td>
<td>0.092*</td>
<td>0.074*</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>(0.041)</td>
<td>(0.030)</td>
<td>(0.15)</td>
</tr>
<tr>
<td>Pr(HP Decreases)</td>
<td>0.005</td>
<td>-0.033</td>
<td>-0.027***</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.035)</td>
<td>(0.0032)</td>
</tr>
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<td>Demographics</td>
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<td>X</td>
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<tr>
<td>Distribution of HP</td>
<td>X</td>
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<tr>
<td>Observations</td>
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<td>5,375</td>
<td>3,575</td>
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<tr>
<td>R-Squared</td>
<td>0.002</td>
<td>0.089</td>
<td>0.005</td>
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<td></td>
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</table>
Self-reflection reduces reliance on \( r_{t+1} \)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \hat{E}<em>{t}[r</em>{i,t+1}] )</td>
<td>1.46***</td>
<td>1.39**</td>
<td>1.21**</td>
<td>1.17**</td>
</tr>
<tr>
<td></td>
<td>(0.56)</td>
<td>(0.55)</td>
<td>(0.59)</td>
<td>(0.60)</td>
</tr>
<tr>
<td>( \hat{r}_{i,t} )</td>
<td>0.98***</td>
<td>0.82**</td>
<td>0.96***</td>
<td>0.80**</td>
</tr>
<tr>
<td></td>
<td>(0.37)</td>
<td>(0.38)</td>
<td>(0.36)</td>
<td>(0.37)</td>
</tr>
<tr>
<td>( \hat{E}<em>{t}[r</em>{i,t+1}] \times \text{Treated} )</td>
<td>-1.47**</td>
<td>-1.40**</td>
<td>-1.35*</td>
<td>-1.30*</td>
</tr>
<tr>
<td></td>
<td>(0.71)</td>
<td>(0.68)</td>
<td>(0.74)</td>
<td>(0.72)</td>
</tr>
<tr>
<td>( \hat{r}_{i,t} \times \text{Treated} )</td>
<td>0.49</td>
<td>0.57</td>
<td>0.38</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td>(0.52)</td>
<td>(0.53)</td>
<td>(0.52)</td>
<td>(0.52)</td>
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<tr>
<td>Treated</td>
<td>4.36</td>
<td>4.08</td>
<td>4.71</td>
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<td>(3.18)</td>
<td>(3.15)</td>
<td>(4.76)</td>
<td>(4.67)</td>
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<tr>
<td>Distribution of Expected Return</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Individual Controls</td>
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<tr>
<td>R-Squared</td>
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<td>0.166</td>
<td>0.083</td>
<td>0.178</td>
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