Expectations with Endogenous Information Acquisition: An Experimental Investigation

Andreas Fuster[1] Ricardo Perez-Truglia[2] Mirko Wiederholt[3] Basit Zafar[4]

[1]Swiss National Bank

[2]UCLA - Anderson

[3]Sciences Po

[4]Arizona State University

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Introduction

- Consumer expectations play a central role in macroeconomic models.
- Stylized fact: wide dispersion in consumer expectations
- What is the source of the heterogeneity in expectations?
- Various approaches in the literature to depart from full-information rational expectations and generate such heterogeneity in expectations:
  - Noisy rational expectations models
  - Sticky information
  - Rational inattention
  - Heterogeneity in forecasting functions
- These approaches differ in terms of the stage of belief formation where heterogeneity emerges.

Introduction

- Stages of belief formation:
  - prior
  - information selection
  - information acquisition
  - information processing
  - posterior
- Our contribution:
  - Use survey experiments in the context of home price expectations to provide new micro-level evidence on information acquisition and processing.
- Main results:
  - Lowering the cost of information does not reduce heterogeneity in beliefs, because individuals choose to acquire different pieces of information.
  - An individual's numeracy and prior uncertainty is correlated with behavior at each stage of the expectation formation process.

Overview of experimental design

- Setting: online household survey (NY Fed Survey of Consumer Expectations)
  - $\sim$1,400 hh heads from across US, broadly representative of US population
  - Special annual module on housing-related issues – here Feb 2017

- Respondents are asked to forecast one-year national home price growth
  - Research design applicable to all sorts of expectations (inflation, GDP growth, etc).

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- Elicit priors at beginning of survey (point forecast and uncertainty)
- Later asked to forecast again, now with "high" or "low" incentives for accuracy
- Before providing their final forecast, they can acquire one of three pieces of information
  - 1-year past home price growth, 10-year past home price growth, or expert forecast
- Elicit valuation (WTP) using multiple-price list method with 11 scenarios ($0.01 - $5, in $0.50 increments)
- Depending on WTP and randomness, some are shown their preferred piece of information; then all provide final forecast

“Quality” of the information sources

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Naively using the information source historically would have yielded the following RMSE (in %):

- Experts’ forecast: 2.8
- Last year: 3.2
- Last ten years: 7.9

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Signals very different across the three sources:

- Last year home price change: +6.8% (Zillow Home Value Index)
- Annualized HP change in last ten years: −0.1% (ZHVI)
- Average forecast of experts: +3.6% (Zillow Home Price Expectations Survey)

Ranking of pieces of information

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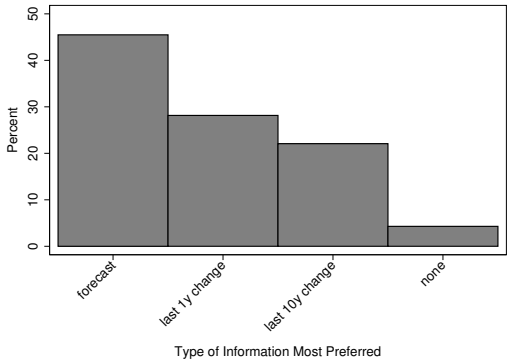
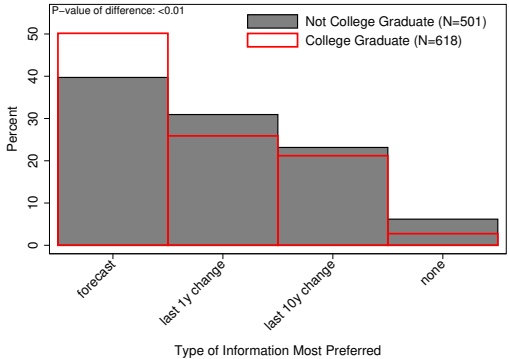
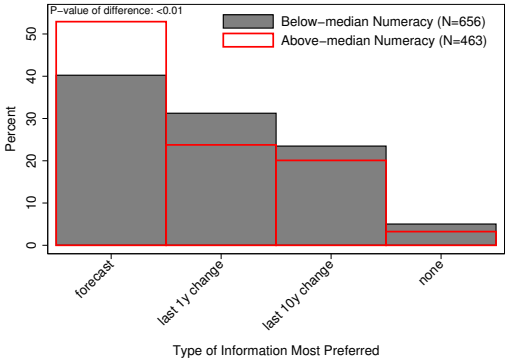
- “Only” 45.5% choose expert forecast (28% past 1 yr, 22% past 10 yrs)



Ranking of pieces of information

- "Only" 45.5% choose expert forecast (28% past 1 yr, 22% past 10 yrs)
- More educated/numerate respondents more likely to choose expert forecast
  - Numeracy: 5-item test from Lipkus et al. (2001) and Lusardi (2009)

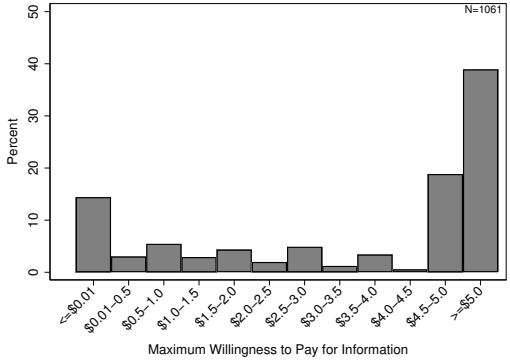




- Robust to adding other controls in regression framework (few other sig. coeff.)

Valuation of information

Valuation of information



- Median valuation between $4.5 and $5; mean valuation estimated at $4.17 (incl. respondents who said “no info” as valuation=0)

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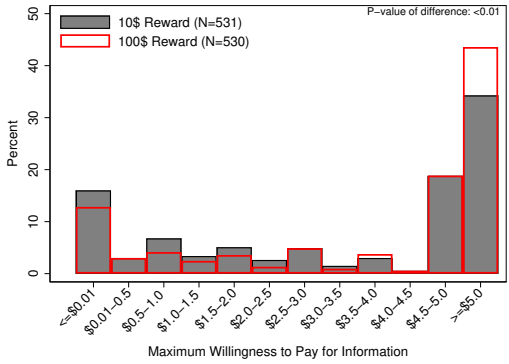

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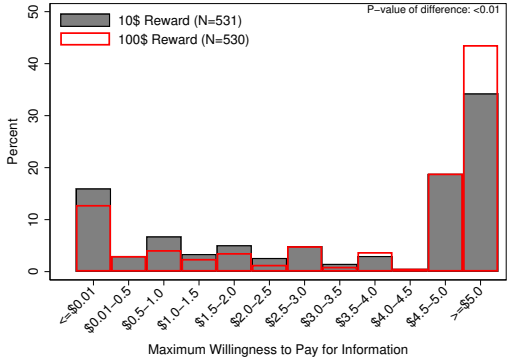

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Cross-sectional correlates of high valuation:

- Lower uncertainty in prior belief
- Having looked for HP info in the past
- Being confident in knowledge of local housing market

  $\Rightarrow$ suggests "selection" / heterogeneous "taste" for information

Updating

Two measures: **Updating of forecast** and time spent on forming posterior forecast.

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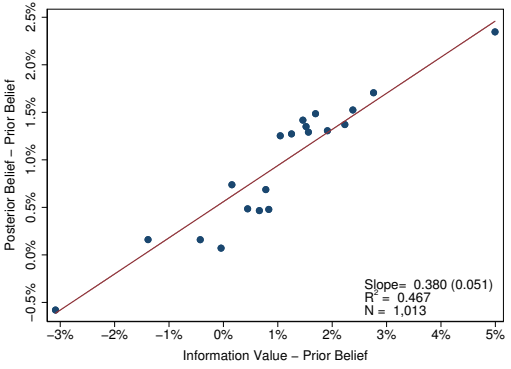
Exploit that, conditional on one's WTP, whether the respondent sees the information ($S_i = 1$) is determined randomly.

We estimate $\hat{\alpha} = 0.38$, meaning respondents on average put substantial weight on signal.



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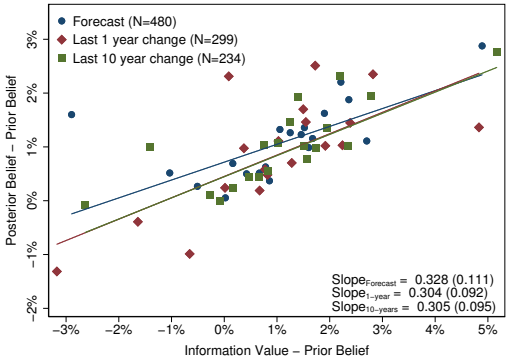

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- No differences across information sources
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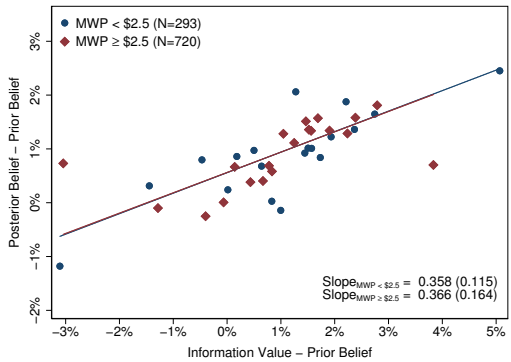
  (but: higher WTP $\rightarrow$ spend more time)



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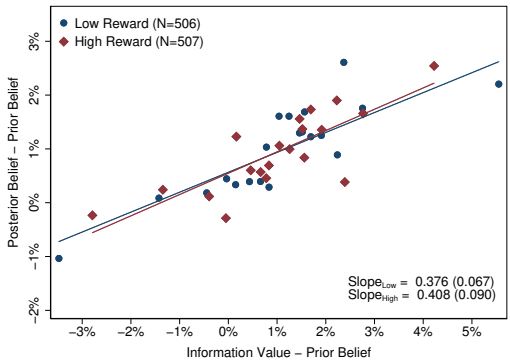

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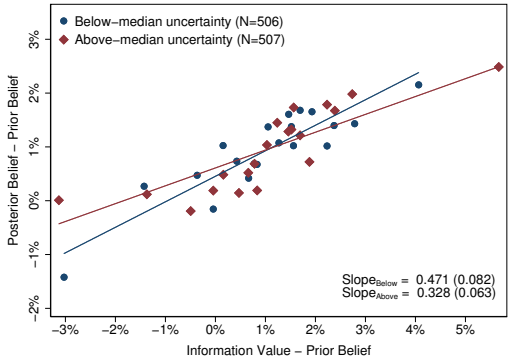

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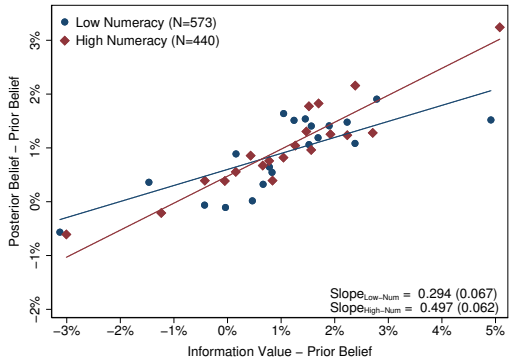
- Stronger updating by those with higher numeracy (+ spend weakly more time)



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Obtained Signal (%)	86.19	65.41	0.00
Mean Absolute Deviation in Point Forecasts:			
Prior	2.06 (0.098)	2.04 (0.100)	0.88
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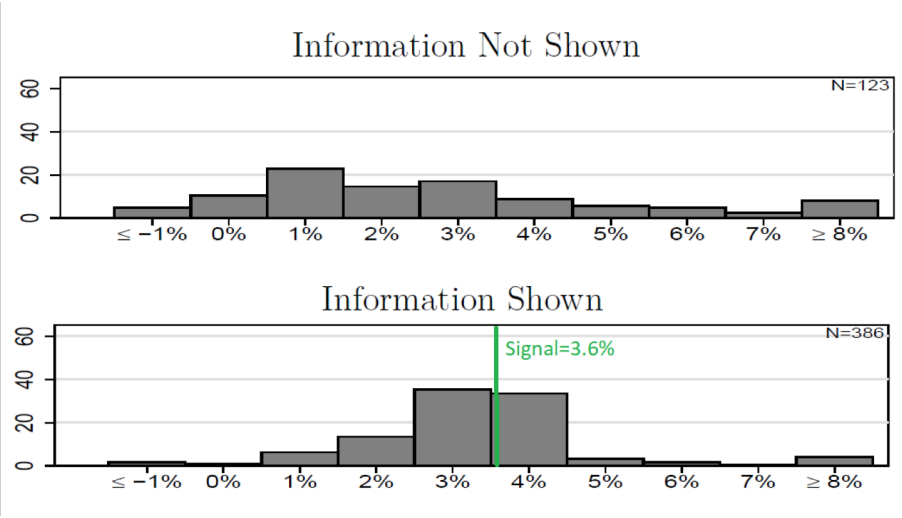
$\Rightarrow$ Lowering the cost of information does not reduce heterogeneity in beliefs. Why?

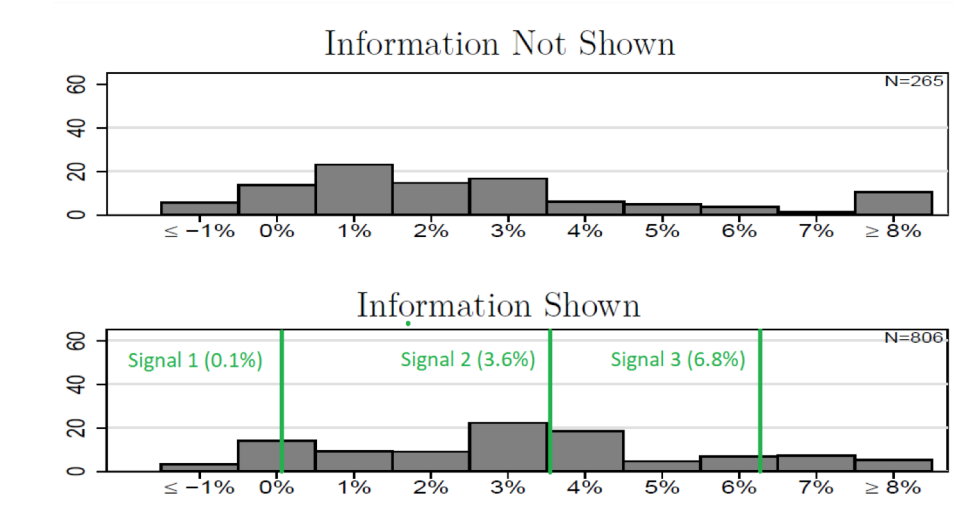
Heterogeneity in posterior beliefs

- **Conditional on information source** (in this case, expert forecast), posterior beliefs converge for the group that sees information (though some dispersion remains)



Heterogeneity in posterior beliefs

- **Across all individuals:** within information types, dispersion goes down. But overall, it does not, due to endogenous info selection.



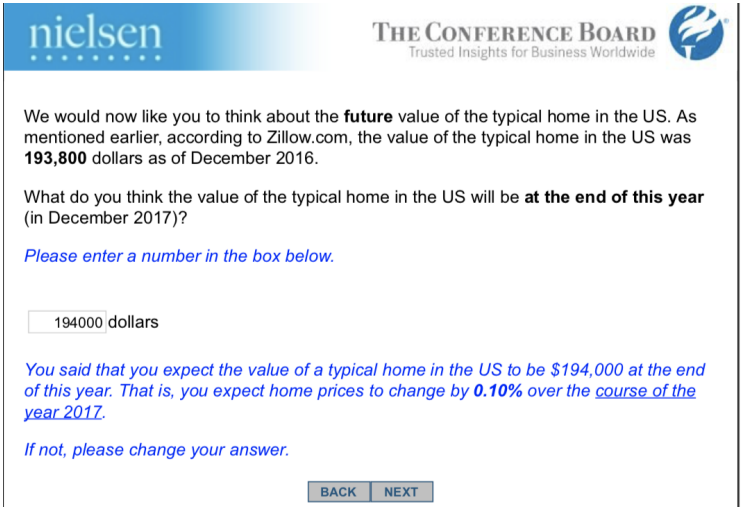
Conclusion

- New micro-level evidence on information acquisition and processing by consumers.
- Model that can match most of the empirical findings.
- Implications for modeling:
  - Heterogeneity in information selection and in information processing are important sources of heterogeneity in posterior beliefs.
- Implications for information disclosure – more info w/o guidance could be harmful

Additional slides

Stage 1: Prior belief about year-ahead national home prices

- Elicit both point estimate and density (uncertainty)



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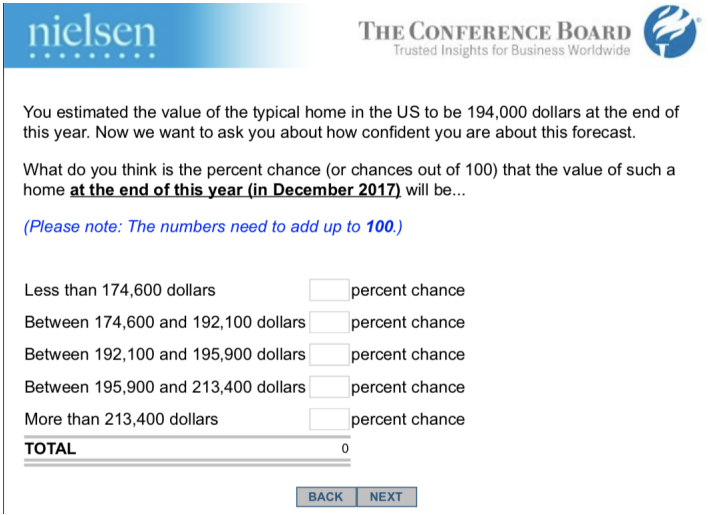
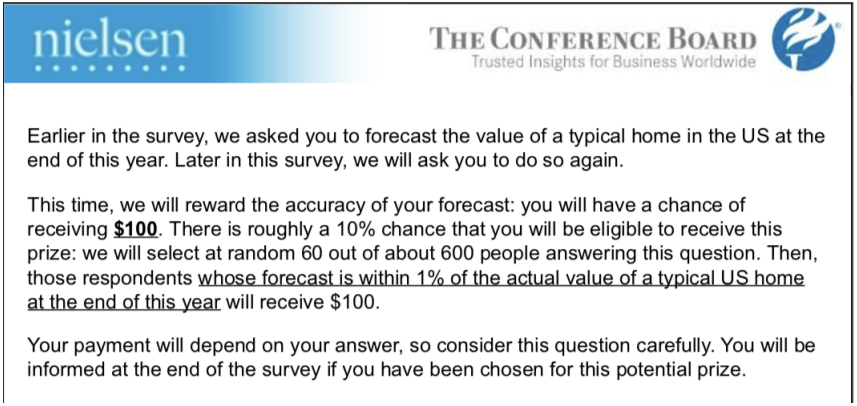


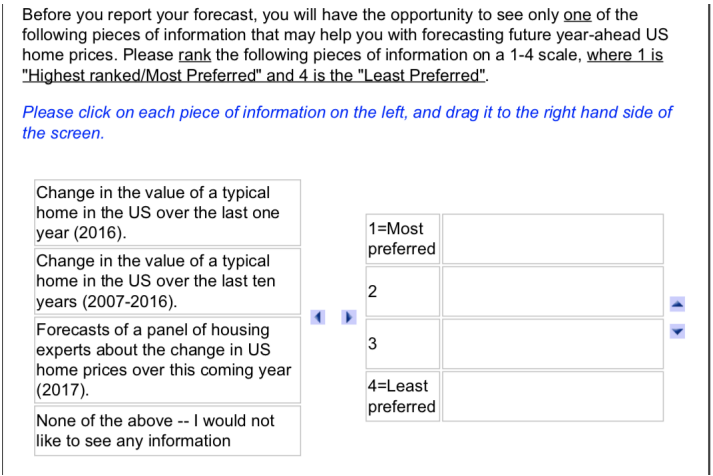
Stage 2: Information preferences

- About 15 min after Stage 1
- First informed about potential prize in case of accurate forecast ($10 or $100, randomized)



Stage 2: Information preferences

- Then asked to rank three possible information sources



Stage 3: Willingness-to-pay for preferred information

- Elicit the WTP for the most preferred information source using the multiple list price method. Choose between the info or a monetary payoff [$0.01, $5] in $0.50 increments (11 scenarios).

You said that you would most prefer seeing information on the change in the value of a typical home in the US over the last one year (2016). Now we want to assess how much you would value this information.

You will next be presented with 11 scenarios. In each scenario, you will be given the choice of either seeing information about the change in the value of a typical home in the US over the last one year (2016) OR receiving extra money with the check that you will be getting for completing this survey. The amount of money that you will be offered in these scenarios is pre-determined, and goes from $0.01 to $5. For instance, in *Scenario 1*, you will need to choose between seeing information or receiving $0.01; and in *Scenario 11*, you will need to choose between seeing information or receiving $5.

We will draw one of these 11 scenarios at random for you. Your choice in the randomly chosen scenario will then be implemented. That is, you will have to make 11 choices, but only one of those choices will be implemented.

Since one scenario will be picked at random, your choices will not affect which scenario will be chosen.

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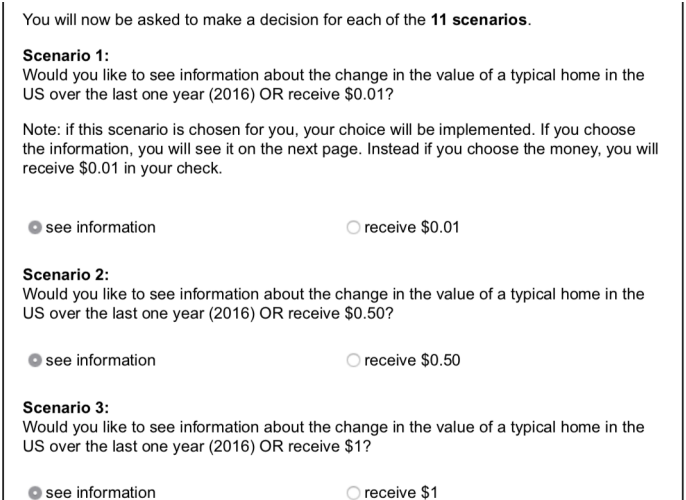


You will now be asked to make a decision for each of the **11 scenarios**.

Scenario 1:
Would you like to see information about the change in the value of a typical home in the US over the last one year (2016) OR receive $0.01?

Note: if this scenario is chosen for you, your choice will be implemented. If you choose the information, you will see it on the next page. Instead if you choose the money, you will receive $0.01 in your check.

◉ see information ○ receive $0.01

Scenario 2:
Would you like to see information about the change in the value of a typical home in the US over the last one year (2016) OR receive $0.50?

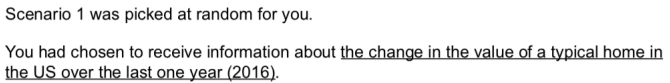
◉ see information ○ receive $0.50

Scenario 3:
Would you like to see information about the change in the value of a typical home in the US over the last one year (2016) OR receive $1?

◉ see information ○ receive $1

Stage 4: Posterior belief

- Depending on the scenario picked at random in Stage 3 and the respondent's choice, she might see one of the information sources.
- HP expectations are re-elicited from all respondents



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Scenario 1 was picked at random for you.

You had chosen to receive information about the change in the value of a typical home in the US over the last one year (2016).

According to the Zillow Home Value Index, the value of a typical home in the US increased by 6.8% over the last one year (December 2015 - December 2016). That means a typical home in the US that currently has a value of **193,800** dollars would have had a value of **181,500** dollars in December 2015. If home values were to increase at a pace of 6.8% next year, that would mean that the value of a typical home would be **206,978** dollars in December 2017.

Earlier in the survey, you reported that you thought the value of the typical home in the US at the end of this year (in December 2017) would be 194,000 dollars.

We would now like to ask you again about the future value of a typical home in the US **at the end of this year**.

What do you think the value of the typical home in the US will be at the end of this year (in December 2017)?

Please enter a number in the box below.

dollars

Cross-sectional correlates of WTP

	Bivariate		Multivariate	
High Reward (0/1)	0.776***	[0.228]	0.832***	[0.224]
Income $>$ \$60,000 (0/1)	0.699***	[0.234]	0.600**	[0.272]
College Graduate (0/1)	0.295	[0.233]	0.102	[0.251]
Age	0.030***	[0.007]	0.033***	[0.008]
Female (0/1)	-0.286	[0.230]	0.115	[0.248]
Married (0/1)	0.368	[0.243]	0.038	[0.271]
White (0/1)	0.188	[0.313]	-0.160	[0.325]
Numeracy (0-5)	0.184*	[0.111]	0.042	[0.121]
Uncertainty in Prior Belief (Std)	-0.254**	[0.116]	-0.130	[0.115]
Median House Value in State (Std)	0.219*	[0.117]	0.147	[0.125]
House Value Volatility in State (Std)	0.232**	[0.114]	0.178	[0.116]
Looked for Info in Past (0/1)	0.679***	[0.232]	0.428*	[0.245]
Homeowner (0/1)	0.789***	[0.262]	0.250	[0.298]
Conf. in Past Recall (1-5)	0.266*	[0.140]	0.098	[0.145]
Prob Move and Buy in 3 Years	0.057	[0.403]	0.402	[0.435]

Robust standard errors in square brackets.

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- Higher WTP in high stakes treatment

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Uncertainty in Prior Belief (Std)	-0.254**	[0.116]	-0.130	[0.115]
Median House Value in State (Std)	0.219*	[0.117]	0.147	[0.125]
House Value Volatility in State (Std)	0.232**	[0.114]	0.178	[0.116]
Looked for Info in Past (0/1)	0.679***	[0.232]	0.428*	[0.245]
Homeowner (0/1)	0.789***	[0.262]	0.250	[0.298]
Conf. in Past Recall (1-5)	0.266*	[0.140]	0.098	[0.145]
Prob Move and Buy in 3 Years	0.057	[0.403]	0.402	[0.435]

Robust standard errors in square brackets.

- Income and age strongly positively correlated with WTP; relation with numeracy and education also positive (but statistically weak)

Cross-sectional correlates of WTP

	Bivariate		Multivariate	
High Reward (0/1)	0.776***	[0.228]	0.832***	[0.224]
Income > $60,000 (0/1)	0.699***	[0.234]	0.600**	[0.272]
College Graduate (0/1)	0.295	[0.233]	0.102	[0.251]
Age	0.030***	[0.007]	0.033***	[0.008]
Female (0/1)	-0.286	[0.230]	0.115	[0.248]
Married (0/1)	0.368	[0.243]	0.038	[0.271]
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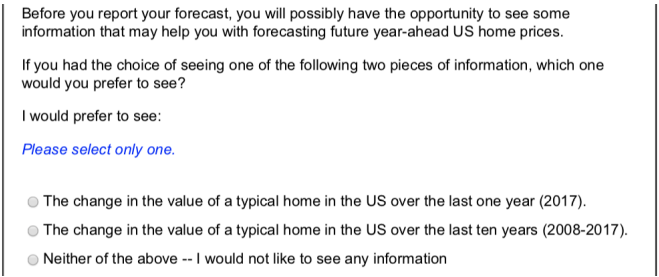
- Higher WTP by those who already know *more* — suggests "selection" / heterogeneous "taste" for information

Allowing for multiple signals

▸ Skip

- One concern with last result: “unrealistic” restriction to only see 1 signal
- Supplementary experiment embedded in 2018 SCE Housing survey (new panelists)
- Same basic setup (priors in Stage 1; randomly assigned to high/low incentive)
- Information choice:



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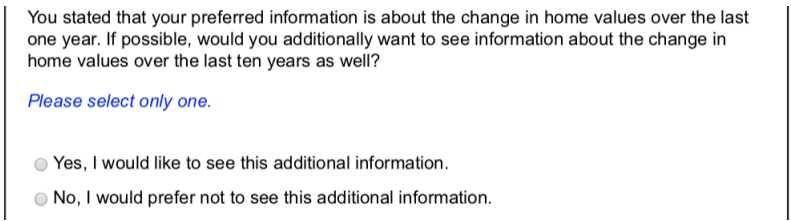

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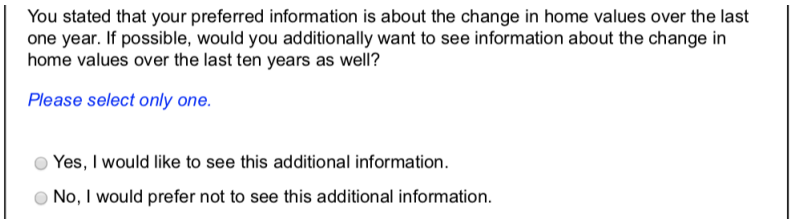

- With $p = 1/3$ each, get assigned (i) no info, (ii) preferred info, or (iii) both pieces of info (unless said that don’t want to see any info)
  - Signals: +6.5% (past one year); +0.7% (average over past 10 years)

Allowing for multiple signals – effects on dispersion

	Prior	Posterior
Both Pieces of Info (N=338)		
Mean	2.42 (0.176)	3.86 (0.200)
MAD	2.17 (0.130)	2.54 (0.145)
Uncertainty	3.68 (0.155)	2.67 (0.134)
Disagreement (%)	13.48 (1.42)	22.89 (1.67)
One Piece of Info (N=327)		
Mean	2.35 (0.190)	3.28 (0.194)
MAD	2.11 (0.150)	2.55 (0.133)
Uncertainty	3.90 (0.156)	2.83 (0.146)
Disagreement (%)	11.56 (1.31)	22.67 (1.61)
Control – No Info (N=338)		
Mean	2.58 (0.210)	3.00 (0.216)
MAD	2.39 (0.165)	2.54 (0.166)
Uncertainty	3.63 (0.154)	3.29 (0.149)
Disagreement (%)	13.11 (1.39)	16.06 (1.54)

- Similar increase in MAD and disagreement with 1 or 2 signals (and more than w/o info) $\Rightarrow$ Supports role of information processing constraints

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- Fewer "yes" among less educated/numerate
- These groups also agree less strongly with two further follow-up questions:
  - "Housing market experts can forecast future house price growth with high accuracy."
  - "In general, I trust the credibility of people referred to as experts."

$\Rightarrow$ Distrust of experts likely explains some of the disagreement

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- Posterior beliefs follow from Bayesian updating, taking into account $\sigma^2_{\varepsilon,j}(i)$ and $\sigma^2_\psi(i)$

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Furthermore, assume that numeracy is a good proxy for having low cost of attention

- Would imply a negative correlation of prior uncertainty with numeracy. Indeed, the correlation in the data is -0.13

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- (Possibly) higher WTP and stronger updating among those with more precise priors (because higher $\phi \rightarrow$ pay more attention) (✓)
- Lowering cost of information does not necessarily reduce dispersion in beliefs (✓)
  - heterogeneous choice of signals
  - individual-specific noise $\Rightarrow$ dispersion even within group

Summarizing model under different assumptions

	All individuals choose the same information source?	Relationship between prior precision and learning rate?	Is numeracy and reward relevant? (conditionally on info displayed)
Data	**No**	**Positive**	**Yes**
Model			
Common prior about information sources	Yes	Negative	No
Heterogeneous priors about information sources	No	Negative	No
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Only a model with heterogeneous beliefs about precision of information sources and costs of attention can reconcile (most) experimental results