Betting on the House
Subjective Expectations and Market Choices

Nicolas Bottan
Cornell University

Ricardo Perez-Truglia
University of California, Berkeley

March 2021
Introduction

- Home price expectations considered key input in homeowners decision making in economic theory.
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- However, little direct evidence that:
  - Expectations *cause* real market decisions.
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  - Magnitude of that effect.
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However, little direct evidence that:
- Expectations cause real market decisions.
- Magnitude of that effect.

Our contribution: provide direct causal evidence from a large-scale, high-stakes field experiment.
Thought Experiment

+2%
Thought Experiment

Heads

Tails

+2% +4% 

+2% +10%
Our Contribution

- Conducted a field experiment that gets close to this ideal experiment.
  - Full design pre-registered in AEA RCT Registry (#0003663).

- In a nutshell:
  1. Contact 57,910 individuals who recently listed a property.
  2. Randomize non-deceptive information to create exogenous shocks to their home price expectations.
  3. Measure if shocks to expectations affect the subsequent sales probability.
Preview of Findings

- Expectations have a significant effect on decision to sell the home.
  - Favorite estimate (TOT): ↑ 1 pp expectation causes 2.44 pp ↓ in probability of selling the home within six months.

The results are robust to a number of checks. E.g. binned scatterplots, event-study analysis, falsification tests.

Evidence of optimization frictions.

Non-owner occupied are three times as elastic as owner-occupied.
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- The results are robust to a number of checks.
  - E.g. binned scatterplots, event-study analysis, falsification tests.

- Evidence of optimization frictions.
  - Non-owner occupied are three times as elastic as owner-occupied.
Related Literature

- Home price expectations in macroeconomics, finance and real estate (Shiller, 2005; Glaeser & Nathanson, 2015; Bailey et al., 2018; Gennaioli & Shleifer, 2018; Armona et al., 2019; Kaplan et al., 2019).

Broader literature on macroeconomic expectations and information-provision experiments (e.g., Coibion et al., 2015, 2018, 2020; Armantier et al., 2016; Cavallo et al., 2017; Fuster et al., 2018).
Related Literature

- Home price expectations in macroeconomics, finance and real estate (Shiller, 2005; Glaeser & Nathanson, 2015; Bailey et al., 2018; Gennaioli & Shleifer, 2018; Armona et al., 2019; Kaplan et al., 2019).

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Research Design
4-Step Recipe

1. Identify a sample of properties on the market.
Step 1: Identify Recent Listings
Step 1: Identify Recent Listings

1408 NE 17th Ave
Fort Lauderdale, FL 33304
Status: Active

$380,000
2 Beds
1 Bath
1,026 Sq. Ft.
$370/Sq. Ft.
4-Step Recipe

1. Identify a sample of properties on the market.
2. Identify the name and address of the owner.
## Step 2: Identify Their Owners

### Public Facts for 1408 Northeast 17th Ave

<table>
<thead>
<tr>
<th>Home Facts</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Beds</td>
<td>—</td>
</tr>
<tr>
<td>Baths</td>
<td>—</td>
</tr>
<tr>
<td>Finished Sq. Ft.</td>
<td>1,026</td>
</tr>
<tr>
<td>Unfinished Sq. Ft.</td>
<td>—</td>
</tr>
<tr>
<td>Total Sq. Ft.</td>
<td>1,026</td>
</tr>
<tr>
<td>Stories</td>
<td>1</td>
</tr>
<tr>
<td>Lot Size</td>
<td>6,750 Sq. Ft.</td>
</tr>
<tr>
<td>Style</td>
<td>Single Family Residential</td>
</tr>
<tr>
<td>Year Built</td>
<td>1951</td>
</tr>
<tr>
<td>Year Renovated</td>
<td>1968</td>
</tr>
<tr>
<td>County</td>
<td>Broward County</td>
</tr>
<tr>
<td>APN</td>
<td>494234019540</td>
</tr>
</tbody>
</table>

### Step 2: Identify Their Owners

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<td></td>
</tr>
</tbody>
</table>

Step 2: Identify Their Owners

ASSESSOR’S OFFICE

Online Services | Dispute Assessment | Assessment Roll Search

Assessment Roll Search

Parcel #: 494234019540

Or

Street #: 
Street Name: 
City: 

Search  Reset
## Step 2: Identify Their Owners

### Assessment Roll Search

<table>
<thead>
<tr>
<th>Parcel #</th>
<th>494234019540</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>1408 NE 17th Ave, Fort Lauderdale, FL 33304</td>
</tr>
<tr>
<td>Owner/s</td>
<td>Axel Foley</td>
</tr>
<tr>
<td>Mailing Address</td>
<td>1408 NE 17th Ave, Fort Lauderdale, FL 33304</td>
</tr>
<tr>
<td>School District</td>
<td></td>
</tr>
<tr>
<td>Status</td>
<td>Active</td>
</tr>
<tr>
<td>Zoning Code</td>
<td>RE4</td>
</tr>
<tr>
<td>Total size</td>
<td>1,026</td>
</tr>
<tr>
<td>Assessed Value</td>
<td>$350,000</td>
</tr>
</tbody>
</table>
Step 2: Identify Their Owners

**Assessment Roll Search**

<table>
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4-Step Recipe

1. Identify a sample of properties on the market.
2. Identify the name and address of the owner.
3. Mail information on home prices to the owner.
Step 3: Mail Information to Owners

Research Project c/o Ricardo Perez-Truglia
405 Hilgard Ave.
Los Angeles, CA 90095-9000

T1 P1 AUTO**SCH 5-DIGIT 32080
Axel Foley
9816 Easton Drive
Beverly Hills, CA 90210
Dear Axel Foley,

We are researchers at UCLA and we are reaching out to you as part of a research study about decision making of homeowners.

According to our records, you may be considering selling a property. We know these decisions can be difficult, so we want to share some information that we hope can be helpful:
4-Step Recipe

1. Identify a sample of properties on the market.
2. Identify the name and address of the owner.
3. Mail information on home prices to the owner.
4. Track whether the house was sold and when.
### Step 4: Track Sales Outcome

#### Property History for 1408 Northeast 17th Ave

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec 29, 2019</td>
<td>Sold (Public Records)</td>
<td>$382,000</td>
</tr>
<tr>
<td>Nov 29, 2019</td>
<td>Listed (Active)</td>
<td>$380,000</td>
</tr>
</tbody>
</table>

See all property history

---

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Betting on the House

March 2021 15 / 50
### Property History for 1408 Northeast 17th Ave

#### Today

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Nov 29, 2019</td>
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</tr>
</tbody>
</table>

See all property history ▼
Goal: use randomization to induce exogenous “information shocks.”

Two sources of exogenous variation:
1. Source-randomization.
Source-Randomization

Signal 1
(ΔPrice last year)

1.5%

...
\[ \Delta = +1.7\% \]

Signal 1
(\(\Delta\)Price last year)

\[ 1.5\% \]

Signal 2
(\(\Delta\)Price last 2 years)

\[ 3.2\% \]
Source-Randomization

$\Delta = +1.7\%$

Signal 1
(DPrice last year)

1.5%

Signal 2
(DPrice last 2 years)

3.2%
Source-Randomization

$\Delta = +3.6\%$

Signal 1  
($\Delta$Price last year)  

1.5%

Signal 2  
($\Delta$Price last 2 years)  

3.2%

Signal 3  
(Forecast Model 1)  

5.1%
\[ Y_{i}^{\text{post}} = \nu_0 + \nu_1 \cdot (E_{i}^{j^*} - E_{i}^{1}) + \sum_{j} \beta_j \cdot E_{i}^{j} + \varepsilon_i \]

- \( Y_{i}^{\text{post}} \): post-treatment outcome.
- \( E_{i}^{j} \): signal from source \( j \).
- \( j^*_i \): source selected for \( i \).
- See paper for general case.
Los Angeles, May 31st 2019

Dear Ricky Fort,

We are researchers at UCLA and we are reaching out to you as part of a research study about decision making of homeowners.

According to our records, you may be considering selling a property. We know these decisions can be difficult, so we want to share some information that we hope can be helpful:

<<INFORMATION>>

If you would like to help us with our study, we kindly ask you fill out the following 2-minute survey:

Visit [www.surveyhousing.com](http://www.surveyhousing.com) and enter validation code

Participation is voluntary and responses are 100% confidential. The results of this study can provide valuable insights to homeowners across the country. Your participation in the survey is greatly appreciated.

<<INFORMATION DETAILS>>

Your household was randomly chosen to receive this letter. We will not send you any more letters in the future.

If you have any questions about the study, you can find contact information on our website: [www.anderson.ucla.edu/housingstudy](http://www.anderson.ucla.edu/housingstudy).

Thank you for your attention!

Ricardo Perez-Truglia
Assistant Professor of Economics
University of California, Los Angeles

Nicolas Bottan
Post-Doctoral Associate
Cornell University

If you have questions about your rights as a research subject, or you have concerns or suggestions and you want to talk to someone other than the researchers, you may contact the UCLA Office of the Human Research Protection Program by phone: (310) 206-2640; by email: participants@research.ucla.edu or by mail: Box 951406, Los Angeles, CA 90095-1406.

Methodological Notes:

Ricky Fort
123 Sunscreen Dr
Miami, FL 33155
## Median Price

<table>
<thead>
<tr>
<th>2-bedroom home in ZIP Code 33308</th>
<th>May 2018: $339,000</th>
<th>May 2019: $343,000</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>+1.2%</td>
<td></td>
</tr>
</tbody>
</table>

**Notes:** for more details, see the notes in the back of this page.
## Median Price

### 2-bedroom home in ZIP Code 33308

<table>
<thead>
<tr>
<th>Year</th>
<th>Price</th>
<th>Change</th>
<th>Annual Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2017</td>
<td>$320,000</td>
<td>+5.9%</td>
<td></td>
</tr>
<tr>
<td>May 2018</td>
<td>$339,000</td>
<td>+1.2%</td>
<td>+3.6%</td>
</tr>
<tr>
<td>May 2019</td>
<td>$343,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Notes:* for more details, see the notes in the back of this page.
## Median Price

| 2-bedroom home in ZIP Code 33308 |
|-------------------------------|-------------------------------|
| **May 2019:** $343,000        | **May 2020:** $352,000        |
| (forecast)                    | (forecast)                    |

+2.6%

**Notes:** for more details, see the notes in the back of this page. The forecasts originate from our own statistical models and as such are subject to error.
## Median Price

2-bedroom home in ZIP Code 33308

<table>
<thead>
<tr>
<th>Year</th>
<th>Median Price</th>
<th>Change</th>
<th>Forecast</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 2019</td>
<td>$343,000</td>
<td>+4.1%</td>
<td></td>
</tr>
<tr>
<td>May 2020</td>
<td>$357,000</td>
<td></td>
<td>(forecast)</td>
</tr>
</tbody>
</table>

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## Median Price

<table>
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<th>May 2019:</th>
<th>May 2020:</th>
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<td>2-bedroom home in ZIP Code 33308</td>
<td>$343,000</td>
<td>$355,000</td>
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**Notes:** for more details, see the notes in the back of this page. The forecasts originate from our own statistical models and as such are subject to error.
Heterogeneity in Signals

Weighted data
OLS
45 deg. line

\[ \beta = 0.852 (0.017) \]

\[ R^2 = 0.659 \]
Supplementary Online Survey

- We wanted survey data to:
  - Validate the identification strategy.
  - Quantify the “strength” of the first stage.
  - Included a survey link in the letter but expected few responses.

Complementary survey experiment on Amazon Mechanical Turk (mTurk).
Collected 1,404 responses simultaneously with field experiment.
Included in RCT pre-registry.
Identical information-provision experiment.
Supplementary Online Survey

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- Included in RCT pre-registry.
- Identical information-provision experiment. +
Implementation Details
Timing

- Mailed letters to 57,910 unique homeowners.
  - From 36 different counties.
  - Properties valued at $34 billion.
- Mailed letters on June 10 2019.
Timing

- Start of Letter Delivery

- Share of Properties Sold

- Weeks Since Start of Letter Delivery

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Betting on the House
March 2021
Results
First Stage (Online Survey)

<table>
<thead>
<tr>
<th>Information Shock</th>
<th>Survey Data</th>
</tr>
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<tbody>
<tr>
<td>Mean Outcome</td>
<td></td>
</tr>
<tr>
<td>Std. Dev. Outcome</td>
<td></td>
</tr>
<tr>
<td>Observations</td>
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<p>| | |</p>
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- **Information Shock**: Information Shock 0.205∗∗∗, 0.167∗∗, -0.014, 0.017
- **Mean Outcome**: Mean Outcome 3.86, 2.31, 3.88, 3.58
- **Std. Dev. Outcome**: Std. Dev. Outcome 4.42, 4.36, 5.39, 9.05
- **Observations**: Observations 1,404, 1,404, 1,404, 1,404
## First Stage (Online Survey)

<table>
<thead>
<tr>
<th>Survey Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) $H_{1y}^{post}$</td>
</tr>
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</table>
| Information Shock | 0.205***  
| (0.064) |
| Mean Outcome | 3.86 |
| Std. Dev. Outcome | 4.42 |
| Observations | 1,404 |
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<td>(0.070)</td>
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<tr>
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<td>0.167** (0.070)</td>
<td>-0.014 (0.066)</td>
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<td>3.88</td>
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<td>Std. Dev. Outcome</td>
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<td>(0.134)</td>
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<td>3.88</td>
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<td>Std. Dev. Outcome</td>
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Effects on Posterior Belief

Housing Expectations, Posterior Belief

Information Shock
Effects on Posterior Belief

Slope = 0.205 (0.055)
N=1,404

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Betting on the House

March 2021
### Behavioral Data

<table>
<thead>
<tr>
<th>Information Shock</th>
<th>Mean Outcome</th>
<th>Std. Dev. Outcome</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>57,910</td>
</tr>
<tr>
<td>S+12w</td>
<td>-0.330</td>
<td>-0.325</td>
<td></td>
</tr>
<tr>
<td>S+28w</td>
<td>0.014</td>
<td></td>
<td></td>
</tr>
<tr>
<td>S−1w</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dpre</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Effects on Behavioral Outcomes

<table>
<thead>
<tr>
<th>Information Shock</th>
<th>-0.330*** (0.103)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Mean Outcome</th>
<th>36.99</th>
</tr>
</thead>
<tbody>
<tr>
<td>Std. Dev. Outcome</td>
<td>48.28</td>
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<tr>
<td>Observations</td>
<td>57,910</td>
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</table>
## Effects on Behavioral Outcomes

<table>
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<th>( S_{+28w} )</th>
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</thead>
<tbody>
<tr>
<td>(1) Information Shock</td>
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<td>-0.325*** (0.107)</td>
</tr>
<tr>
<td>Mean Outcome</td>
<td>36.99</td>
<td>56.90</td>
</tr>
<tr>
<td>Std. Dev. Outcome</td>
<td>48.28</td>
<td>49.52</td>
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<tr>
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## Effects on Behavioral Outcomes

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<th>Information Shock</th>
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<th>(3) $S_{-1w}$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean Outcome</strong></td>
<td>36.99</td>
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<td>0.58</td>
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<tr>
<td><strong>Std. Dev. Outcome</strong></td>
<td>48.28</td>
<td>49.52</td>
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<td><strong>Observations</strong></td>
<td>57,910</td>
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<tr>
<th>Information Shock</th>
<th>$-0.330^{***}$</th>
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<th>0.014</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(0.103)</td>
<td>(0.107)</td>
<td>(0.019)</td>
</tr>
</tbody>
</table>

Note: 
- **$S_{+12w}$** refers to a 12-week increase in information shock.
- **$S_{+28w}$** refers to a 28-week increase in information shock.
- **$S_{-1w}$** refers to a 1-week decrease in information shock.
### Effects on Behavioral Outcomes

#### Behavioral Data

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
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<td>Mean Outcome</td>
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<td>56.90</td>
<td>0.58</td>
<td>3.81</td>
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Effects on Behavioral Outcomes

Information Shock

P(Sold at 12 weeks post-treatment)

34% 35% 36% 37% 38% 39% 40%

Information Shock

Bottan & Perez-Truglia

Betting on the House

March 2021
Effects on Behavioral Outcomes

Slope $= -0.330$ (0.104)  
N=57,910

Information Shock

Slope $= -0.330$ (0.104)

Bottan & Perez-Truglia
Betting on the House
March 2021
Event-Study Analysis

- Effect of Information Shock on \( P(\text{Sold}) \)

- Share of Letters Read

- Start of Letter Delivery

Note: 90% Confidence Intervals in brackets

Bottan & Perez-Truglia
Betting on the House
March 2021
Event-Study Analysis

Effect of Information Shock on \( P(\text{Sold}) \)

Start of Letter Delivery
Share of Letters Read

\begin{align*}
\text{Note: } 90\% \text{ Confidence Intervals in brackets}
\end{align*}
Event-Study Analysis

Start of Letter Delivery
Share of Letters Read

Effect of Information Shock on P(Sold)

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Falsification Tests

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Bottan & Perez-Truglia

Betting on the House

March 2021
A 1 pp higher information shock increases sales probability (within 6 months) by 0.325 pp.
How Elastic are Sellers?

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- This is an intention-to-treat effect.
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- This is an intention-to-treat effect.
  - Imperfect pass-through from information shocks to expectations.
  - Some subjects may not read the letter on time.
How Elastic are Sellers?

- Effects of 1% higher information shock:
  - Expectations $\uparrow 0.205 \text{ pp}.$
  - Sales probability $\downarrow 0.325 \text{ pp}.$
How Elastic are Sellers?

- Effects of 1% higher information shock:
  - Expectations ↑ 0.205 pp.
  - Sales probability ↓ 0.325 pp.

- Implied elasticity of -1.59 \( \left( = \frac{-0.325}{0.205} \right) \).
  - ↑ 1 pp expectation causes ↓ 1.59 pp in sales probability.
How Elastic are Sellers?

- We estimate that 64.9% of subjects read the letter on time.
  - 95% of letters are delivered.
  - 74% of letters are not discarded.
  - 92.5% of letters are opened before property is sold.

Final elasticity of $-2.44 \left(= -0.325 \times 0.205 \times 0.649 \right)$.

↑ 1 pp expectation causes ↓ of 2.44 pp in sales probability.
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- We estimate that 64.9% of subjects read the letter on time.
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Heterogeneity Analysis

- We study (pre-registered) heterogeneity on:
  - Owner-occupied (66.99% of subjects).
  - Non-owner-occupied (33.01% of subjects).
Heterogeneity Analysis

- We study (pre-registered) heterogeneity on:
  - Owner-occupied (66.99% of subjects).
  - Non-owner-occupied (33.01% of subjects).

- Relative to non-owner-occupied, owner-occupied face optimization frictions.
  - They need to move out of the home after selling it.
  - May face deadlines to move out (e.g., school, work).
Effect of Information Shock on P(Sold)

Weeks Since Start of Letter Delivery

Note: 90% Confidence Intervals in brackets
Owner vs. Non-Owner Occupied

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Effect of Information Shock on $P(Sold)$

Note: 90% Confidence Intervals in brackets
Owner vs. Non-Owner Occupied

Weeks Since Start of Letter Delivery

Effect of Information Shock on P(Sold)

Note: 90% Confidence Intervals in brackets
Heterogeneity Analysis

LISTING CHARACTERISTICS

Overall
Owner-occupied (67% of sample)
Non-owner-occupied (33% of sample)
< $359.9K (50%)
≥ $359.9K (50%)
Within 25% (52%)
Over 25% (48%)

By owner occupancy

By listing price

< $359.9K (50%)
≥ $359.9K (50%)

By listing price to 2019 ZHVI ratio

Within 25% (52%)
Over 25% (48%)

By price difference from Redfin estimate

< 0 (23%)
≥ 0 (77%)

Note: 90% Confidence Intervals in brackets
Heterogeneity Analysis

OWNER DEMOGRAPHICS

Overall
Female (25%)
Male (53%)
< 59 (33%)
≥ 59 (34%)
White (58%)
Non-white (34%)

By gender
By age
By race

Note: 90% Confidence Intervals in brackets
Heterogeneity Analysis

MARKET CHARACTERISTICS

- Overall
  - Florida (68%)
  - Other state (32%)
- By $311K
  - < $311K (50%)
  - ≥ $311K (50%)
- By 4.06
  - < 4.06 (50%)
  - ≥ 4.06 (50%)
- By Zillow’s seller power index
  - < 4.06 (50%)
  - ≥ 4.06 (50%)
- By Zillow’s ZIP5 size rank
  - < 2416 (51%)
  - ≥ 2416 (49%)

Note: 90% Confidence Intervals in brackets
Non-Owner Occupied by ZIP code

Start of Letter Delivery

−1.2
−1.0
−0.8
−0.6
−0.4
−0.2
0.0
0.2
0.4
0.6

Effect of Information Shock on \( P(\text{Sold}) \)

Weeks Since Start of Letter Delivery

Same ZIP
Different ZIP

Note: 90% Confidence Intervals in brackets
Our evidence supports conjecture that non-owner occupied contribute disproportionately to housing speculation.

Favorite interpretation: differences due to information frictions.

We provide evidence against some alternative explanations.

Non-owner-occupied provide a more accurate picture of the relevant elasticity.

Implied elasticity of -4.23.
Additional Results

- Symmetric reaction to pessimistic/optimistic signals.  

- Estimates nearly identical using disclosure-randomization and source-randomization separately.

- Suggestive evidence of backward-looking expectations.

- Suggestive evidence that changes to listing prices was one of the mechanisms.
Conclusions
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- We quantify the relationship: elasticity between expectations and sales probability of -2.44.
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- We quantify the relationship: elasticity between expectations and sales probability of -2.44.
- In addition to information frictions, we provide evidence of optimization frictions.
  - Heterogeneity by owner- and non-owner-occupied.
Conclusions

▶ This methodology can be applied to explore other hypotheses from behavioral economics, urban economics, finance and others.
  ▶ Hard outcome measured with administrative data.
  ▶ Naturally-occurring, high-stakes, context.
  ▶ Based on 100% publicly available data.
  ▶ Super cheap ($0.25 per subject).
  ▶ Scalable to millions of subjects.
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  - Scalable to millions of subjects.

- We are documenting the implementation carefully.
  - Email us if you need help with implementation.
  - Happy to share data/code/tips.