Outline

1. Laboratory Experiments on Present Bias
2. Methodology: Errors in Applying Present-Biased Preferences
3. Reference Dependence: Introduction
4. Reference Dependence: Housing I
5. Methodology: Bunching-Based Evidence of Reference Dependence
6. Reference Dependence: Housing II
7. Reference Dependence: Tax Elusion
8. Reference Dependence: Goals
9. Reference Dependence: Mergers
Section 1

Laboratory Experiments on Present Bias
Time Preferences

- Experiments on time preferences (Ainslie, 1956; Thaler, 1981; Benhabib, Bisin, and Schotter, 2009; Andreoni and Sprenger, 2012)

- Typical design (Thaler *EL* 1981):
  - What is $X$ today that makes indifferent to $10$ in one week?
  - What is $Y$ in one week that makes indifferent to $10$ in two weeks?

- Assuming (locally) linear utility:
  - $X = \beta \delta 10$ and $Y = \delta 10$
  - Hence, $Y/10$ is estimate of weekly $\delta$
  - $X/Y$ is estimate of (weekly) $\beta$
Alternative Design

- Alternative design: Benhabib, Bisin, and Schotter (BBS, *GEB* 2009):
  - What is $X$ today that makes indifferent to $10$ in one week? $\rightarrow$
  - Implied weekly discount factor $\beta \delta$
  - What is $Y$ today that makes indifferent to $10$ in $T$ weeks? $\rightarrow$
  - Implied weekly discount factor $(\beta \delta^T)^{1/T} = \beta^{1/T} \delta$
  - For $\beta < 1$, implied weekly discount factor should be increasing in $T$

- BBS (2009):
  - 27 undergraduate students making multiple choices
  - Support for a hyperbolic discount function
  - Next figure: data from a representative subject: weekly discount rate implied by choice, as function of delay
Problem 1: Credibility

• BSS: ‘If money today were to be paid subjects were handed a check. If future money were to be paid subjects were asked to supply their mailing address and were told that on the day promised a check would arrive at their campus mailboxes with the promised amount.’

• Suppose subjects believe future payments occur only with probability $q$, while immediate payments are sure.

• Implied discount factor is $q\delta^T$.

• $\beta$ captures subjective probability $q$ that future payments will be paid (compared to present payments).
Problem 2: Money vs. Consumption

- Discounting applies to consumption, not income (Mulligan, 1999):
  \[ U_0 = u(c_0) + \beta \delta E u(c_1) + \beta \delta^2 E u(c_2) \]

- Assume that individual plans to consume the \$X paid today or the \$10 paid in one week one week later → Then the choice is between
  - \( \beta \delta u(X) \)
  - \( \beta \delta u(10) \)

- Hence, present bias \( \beta \) does not play a role

- It does play a role with credit constraints → Consume immediately
Problems 3 & 4

Problem 3: Concave Utility

- Choice equates
  \[ u(10) = \beta \delta u(X) \]
- \( \beta \delta = u(10) / u(X) \) → Need to estimate the concavity of the utility function to extract discount function
- Problem likely less serious for small payments

Problem 4: Uncertain future marginal utility of money

- Marginal utility of money certain for present, uncertain in future:
  \[ u(10) = \beta \delta E u(X) \]
- → Marginal utility of money can differ in the future, depending on future shocks
Recent Lit.: Andreoni & Sprenger

- Improved experimental design: Andreoni and Sprenger (AS, AER 2012)
- To deal with *Problem 1 (Credibility)*, emphasize credibility
  - All sooner and later payments, including those for \( t = 0 \), were placed in subjects’ campus mailboxes.
  - Subjects were asked to address the envelopes to themselves at their campus mailbox, thus minimizing clerical errors.
  - Subjects were given the business card of Professor James Andreoni and told to call or e-mail him if a payment did not arrive.
- Potential drawback: Payment today take places at end of day
  - Other experiments: post-dated checks
Estimate Concavity

To deal with *Problem 3 (Concave Utility)*, design to estimate concavity:

- Subject allocate share of money to earlier versus later choice
- → That is, interior solutions, not just corner solutions
- Vary interest rate between earlier and later choice to back out concavity

Example of choice screenshot
Results

- Main result: No evidence of present bias
Recent Lit.: Augenblick, Niederle, and Sprenger (2015)

- What about *Problem 2 (Money vs. Consumption)*?
  - One solution: Do experiments with goods to be consumed right away:
    - Low- and High-brow movies (Read and Loewenstein, 1995)
    - Squirts of juice for thirsty subjects (McClure et al., 2005)
  - Problem: Harder to invoke linearity of utility when using goods as opposed to money
- Augenblick, Niederle, and Sprenger (*QJE* 2015): Address problem by having subjects intertemporally allocate effort
  - 102 subjects have to complete boring task
**Design**

- Experiment over multiple weeks, complete online
  - Pay largely at the end to reduce attrition
  - Week 1: Choice allocation of job between weeks 2 and 3
  - Week 2: Choose again allocation of job between weeks 2 and 3
  - → Do subjects revise the choice?
  - As in AS, choice of interior solution, and varied ‘interest rate’ between periods
Also do monetary discounting, with immediate cash payment (unlike AS)
Result 1: On monetary discounting no evidence of present-bias
Result 2: Clear evidence on effort allocation

![Graph showing effort allocation over different interest rates for Greek Transcription and Tetris tasks. The graph includes data points for initial and subsequent allocation means, with error bars indicating standard errors.](image-url)
Result 3: Estimate of present-bias given that can back out shape of cost of effort function $c(e)$
Recent Lit.: Dean and Sautmann (2016)

- **Dean and Sautmann (2016):** Provide direct evidence on *Problem 2 (Money vs. Consumption)*
- Elicit time preferences with standard money now versus money in the future questions

<table>
<thead>
<tr>
<th>Table 1: A Price List Experiment</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Set A</strong></td>
</tr>
<tr>
<td>today</td>
</tr>
<tr>
<td>$a_0$</td>
</tr>
<tr>
<td>CFA 50</td>
</tr>
<tr>
<td>CFA 100</td>
</tr>
<tr>
<td>CFA 150</td>
</tr>
<tr>
<td>CFA 200</td>
</tr>
<tr>
<td>CFA 250</td>
</tr>
<tr>
<td>CFA 300</td>
</tr>
<tr>
<td>CFA 350</td>
</tr>
<tr>
<td>CFA 400</td>
</tr>
</tbody>
</table>
Design

- Observe shocks to ability to borrow and marginal utility of income
  - Do those affect the choices in price list?
  - If so, clearly we are not capturing $\delta$, but rather $r$ or $u'$
  - Estimate MRS from questions above, relate to adverse income shock

<table>
<thead>
<tr>
<th>Table 5: Consumption shocks and $MRS_L$.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Adv. event (0/1)</td>
</tr>
<tr>
<td>Adv. event expense</td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>Ind FE</td>
</tr>
<tr>
<td>Time FE</td>
</tr>
<tr>
<td>Observations</td>
</tr>
</tbody>
</table>

*Standard errors clustered at the individual level (OLS) or bootstrapped (IV, ML) (in $p$).
*Significance levels: $p<0.10$, *$p<0.05$, **$p<0.01$
## Table 7: Income, spending, and $MRS_t$.

<table>
<thead>
<tr>
<th></th>
<th>MRS (A)</th>
<th>MRS (A)</th>
<th>MRS (A)</th>
<th>MRS (A)</th>
<th>MRS (A)</th>
<th>MRS (A)</th>
<th>MRS (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OLS</td>
<td>OLS</td>
<td>OLS</td>
<td>IV</td>
<td>IV</td>
<td>ML</td>
<td></td>
</tr>
<tr>
<td>Labor income</td>
<td>-0.185</td>
<td>-0.189</td>
<td>-0.153</td>
<td>-0.159</td>
<td>-0.324</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.142)</td>
<td>(0.143)</td>
<td>(0.163)</td>
<td>(0.142)</td>
<td>(0.135)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonlabor income</td>
<td>-0.330</td>
<td>-0.321</td>
<td>-0.268</td>
<td>-0.265</td>
<td>-0.281</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;endogenous&quot;</td>
<td>(0.251)</td>
<td>(0.258)</td>
<td>(0.261)</td>
<td>(0.270)</td>
<td>(0.351)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonlabor income</td>
<td>-0.409</td>
<td>-0.409</td>
<td>-0.382</td>
<td>-0.384</td>
<td>-0.378</td>
<td>-0.380</td>
<td>-0.407</td>
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<tr>
<td>&quot;exogenous&quot;</td>
<td>(0.142)</td>
<td>(0.149)</td>
<td>(0.125)</td>
<td>(0.133)</td>
<td>(0.171)</td>
<td>(0.149)</td>
<td>(0.199)</td>
</tr>
<tr>
<td>Other spending</td>
<td>0.268</td>
<td>0.245</td>
<td>0.192</td>
<td>0.177</td>
<td>0.236</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.128)</td>
<td>(0.131)</td>
<td>(0.141)</td>
<td>(0.132)</td>
<td>(0.135)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adv. event expense</td>
<td>0.252</td>
<td>0.233</td>
<td>0.251</td>
<td>0.222</td>
<td>1.683</td>
<td>1.562</td>
<td>0.357</td>
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<tr>
<td></td>
<td>(0.145)</td>
<td>(0.139)</td>
<td>(0.182)</td>
<td>(0.183)</td>
<td>(0.761)</td>
<td>(0.769)</td>
<td>(0.250)</td>
</tr>
<tr>
<td>Constant</td>
<td>4.69 **</td>
<td>4.782 **</td>
<td>4.56 **</td>
<td>4.67 **</td>
<td>4.527 **</td>
<td>4.622 **</td>
<td>2.737 **</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.059)</td>
<td>(0.093)</td>
<td>(0.125)</td>
<td>(0.144)</td>
<td>(0.145)</td>
<td>(0.145)</td>
</tr>
<tr>
<td>Ind FE</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Time FE</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td></td>
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<tr>
<td>Observations</td>
<td>2540</td>
<td>2540</td>
<td>2390</td>
<td>2390</td>
<td>2390</td>
<td>2390</td>
<td>1437</td>
</tr>
</tbody>
</table>

*Standard errors clustered at the individual level (OLS) or bootstrapped (IV, ML) (in parentheses). Significance levels + $p<0.10$, * $p<0.05$, ** $p<0.01$*
Recent Lit.: Carvalho, Meier, Wang (2016)

- **Carvalho, Meier, Wang (AER 2016):** Replicates both of the previous findings
  - Measures time preferences with money and real effort
  - 1,191 participants randomized into
    - Surveyed before payday (financially constrained)
    - Surveyed after payday (not constrained)
  - Real effort task (clever):
    - Complete shorter survey within 5 days
    - Complete longer survey within 35 days
    - Multiple choices with varying length of sooner survey
Results: Financial Choices

- Replicates Dean and Sautmann result on financial choices

<table>
<thead>
<tr>
<th>Table 3: Intertemporal Choices about Monetary Rewards</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\text{Amount of Sooner Reward}$</td>
</tr>
<tr>
<td>Coefficient</td>
</tr>
<tr>
<td>---------------------------------</td>
</tr>
<tr>
<td>{Before Payday} * {Immediate Rewards}</td>
</tr>
<tr>
<td>{Before Payday} * Interest Rate</td>
</tr>
<tr>
<td>{Before Payday} * Delay Time</td>
</tr>
<tr>
<td>{Before Payday}</td>
</tr>
<tr>
<td>{Immediate Rewards}</td>
</tr>
<tr>
<td>Experimental Interest Rate</td>
</tr>
<tr>
<td>Delay Time</td>
</tr>
<tr>
<td>Constant</td>
</tr>
</tbody>
</table>

Notes: This table reports results from an OLS regression where the dependent variable is the dollar amount of the sooner payment. "Immediate Rewards" is an indicator variable that is 1 if the mailing date of the sooner payment is today. "Delay Time" is the time interval between the sooner and later payments. The sample is restricted to the 1,060 subjects who made all 12 choices in the task with monetary rewards. $N = 12,720.$
Results: Real Effort

- Replicates Augenblick et al. on real effort

Table 4: Intertemporal Choices about Real Effort

<table>
<thead>
<tr>
<th>Monthly Discount Rate</th>
<th>{Before Payday} * {Immediate Task}</th>
<th>{Before Payday}</th>
<th>{Immediate Task}</th>
<th>(5-day deadline for short-sooner survey)</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.03</td>
<td>0.02</td>
<td>0.09</td>
<td>[0.018]***</td>
<td>0.31</td>
</tr>
<tr>
<td></td>
<td>[0.025]</td>
<td>[0.027]</td>
<td></td>
<td>[0.019]***</td>
<td></td>
</tr>
</tbody>
</table>

Notes: This table reports estimates from an interval regression where the dependent variable is the interval measure of the individual discount rate (IDR). Two IDRs are estimated for each subject, one for each time frame. “Immediate Task” is an indicator variable for the “5 days (sooner) x 35 days (later)” time frame. Standard errors clustered at the individual level. The sample is restricted to the 1,025 subjects who made all 10 choices in the non-monetary intertemporal task. N = 2,050.
Balakrishnan, Haushofer, and Jakiela (2016)

- Return to puzzle of no present bias over money in AS
- Estimate in Kenya with immediate transfers of cash over money
- Individuals likely to be more hand to mouth

Figure 3: Fraction of Budget Allocated to Earlier Account, by Interest Rate

Panel A: Immediate Payouts

Panel B: End of Day Payouts
Recent additional work using real effort

- **Augenblick and Rabin (forthcoming):**
  - Use real effort to elicit not only $\beta$, but also $\hat{\beta}$
  - Elicit forecasts for future choice, in addition to choice

![Transcription task interface](image1)

![Decision interface for present work](image2)

![Prediction interface for future work](image3)
Recent additional work using real effort

- Replicate evidence of present bias $\beta$, but $\hat{\beta} = 1$
Recent additional work using real effort

- **Augenblick (2017):** Estimate timing of $\beta$
  - Elicit preference for task going from immediate to a few hours, to $>1$ day
Recent additional work using real effort

- **Augenblick (2017):** Estimate timing of $\beta$
- Can estimate intra-day decay in $\beta$
Recent additional work using real effort

- **Fedyk (2017)**: What beliefs do people have about others’ self-control?
Recent additional work using real effort

- Fedyk (2017):
  - Naive about one self
  - Sophisticated about others

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Without attrited participants</th>
<th>With attrited participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present bias $\beta$</td>
<td>0.8589</td>
<td>0.8151</td>
</tr>
<tr>
<td></td>
<td>(0.0330)</td>
<td>(0.0335)</td>
</tr>
<tr>
<td>Self-prediction $\beta(s)$</td>
<td>1.0502</td>
<td>1.0306</td>
</tr>
<tr>
<td></td>
<td>(0.0629)</td>
<td>(0.0523)</td>
</tr>
<tr>
<td>Other-prediction $\beta(o)$</td>
<td>0.8711</td>
<td>0.8715</td>
</tr>
<tr>
<td></td>
<td>(0.0349)</td>
<td>(0.0314)</td>
</tr>
</tbody>
</table>
Section 2

Methodology: Errors in Applying Present-Biased Preferences
Introduction

- Present-Bias model very successful
- Quick adoption at cost of incorrect applications
- Four common errors
Error 1. Procrastination with Sophistication

- ‘Self-Control problems lead to Procrastination’
- This is not accurate in two ways
  - **Issue 1.**
    - \((\beta, \delta)\) Sophisticates do not delay for long (see our calibration)
    - Need Self-control + Naiveté (overconfidence) to get long delay
  - **Issue 2.** (Definitional issue) We distinguished between:
    - Delay. Task is not undertaken immediately
    - Procrastination. Delay systematically beyond initial expectations
    - Sophisticates and exponentials do not procrastinate, they delay
Error 2. Naives with Yearly Decisions

- ‘We obtain similar results for naives and sophisticates in our calibrations’
- Example 1. Fang, Silverman (*IER*, 2009)
  - Single mothers applying for welfare. Three states:
    1. Work
    2. Welfare
    3. Home (without welfare)
  - Welfare dominates Home – So why so many mothers stay Home?
Error 2. Naives with Yearly Decisions

Model:
- Immediate cost \( \phi \) (stigma, transaction cost) to go into welfare
- For \( \phi \) high enough, can explain transition
- Simulate Exponentials, Sophisticates, Naives

<table>
<thead>
<tr>
<th>Choice at ( t - 1 )</th>
<th>Welfare</th>
<th>Work</th>
<th>Home</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Welfare</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Row %</td>
<td>84.3</td>
<td>3.5</td>
<td>12.3</td>
</tr>
<tr>
<td>Column %</td>
<td>76.7</td>
<td>6.3</td>
<td>17.9</td>
</tr>
<tr>
<td><strong>Work</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Row %</td>
<td>5.3</td>
<td>79.3</td>
<td>15.3</td>
</tr>
<tr>
<td>Column %</td>
<td>2.6</td>
<td>76.4</td>
<td>12.1</td>
</tr>
<tr>
<td><strong>Home</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Row %</td>
<td>28.3</td>
<td>12.0</td>
<td>59.7</td>
</tr>
<tr>
<td>Column %</td>
<td>20.7</td>
<td>17.3</td>
<td>70.0</td>
</tr>
</tbody>
</table>
Error 2. Naives with Yearly Decisions

However: Simulate decision at \textit{yearly} horizon.

- BUT: At yearly horizon naives do not procrastinate:
  - Compare:
    - Switch now
    - Forego \textit{one year} of benefits and switch next year
  - Result:
    - Very low estimates of $\beta$
    - Very high estimates of switching cost $\phi$
    - Naives are same as sophisticates
Error 2. Naives with Yearly Decisions

<table>
<thead>
<tr>
<th>Parameters</th>
<th>(1) Time Consistent</th>
<th>(2) Present-Biased (sophisticated)</th>
<th>(3) Present-Biased (Naive)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Estimate S.E.</td>
<td>Estimate S.E.</td>
<td>Estimate S.E.</td>
</tr>
<tr>
<td>Discount Factors ( \beta )</td>
<td>1 n.a.</td>
<td>0.33802 0.06943</td>
<td>0.355 0.0983</td>
</tr>
<tr>
<td>( \delta )</td>
<td>0.41488 0.07693</td>
<td>0.87507 0.01603</td>
<td>0.888 0.02471</td>
</tr>
<tr>
<td>Net Stigma ( \phi^{(1)} ) (by type)</td>
<td>7537.04 774.81</td>
<td>8126.19 834.011</td>
<td>8277.46 950.77</td>
</tr>
<tr>
<td>( \phi^{(2)} )</td>
<td>10100.9 1064.83</td>
<td>10242.01 955.878</td>
<td>10350.20 1185.27</td>
</tr>
<tr>
<td>( \phi^{(3)} )</td>
<td>13333.2 1640.18</td>
<td>12697.25 1426.40</td>
<td>12533.69 1685.92</td>
</tr>
</tbody>
</table>

- **Conjecture:** If allowed daily or weekly decision, would get:
  - Naives fit much better than sophisticates
  - \( \beta \) much closer to 1
  - \( \phi \) much smaller
Error 2. Naives with Yearly Decisions

  - Cost $k$ of switching from credit card to credit card
  - Again: Assumption that can switch only every quarter
  - Results of estimates (again):
    - Quite low $\beta$
    - Naives do not do better than sophisticates
    - Very high switching costs

Table 4: Estimated Parameters $^a$

<table>
<thead>
<tr>
<th></th>
<th>Sophisticated Hyperbolic</th>
<th>Naive Hyperbolic</th>
<th>Exponential</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>0.7863 (0.00192)</td>
<td>0.8172 (0.003)</td>
<td></td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.9999 (0.00201)</td>
<td>0.9999 (0.0017)</td>
<td>0.9999 (0.00272)</td>
</tr>
<tr>
<td>$k$</td>
<td>0.02927 $\times 10^3$</td>
<td>0.0326 $\times 10^3$</td>
<td>0.1722 $\times 10^3$</td>
</tr>
<tr>
<td></td>
<td>$$293$</td>
<td>$$326$</td>
<td>$$1,722$</td>
</tr>
</tbody>
</table>
Error 3. Present-Bias over Money

- We discussed problem applied to experiments
- Same problem applies to models
  - Notice: Transaction costs of switching $k$ in above models are real effort, apply immediately
  - Effort cost $c$ of attending gym also ‘real’ (not monetary)
  - Consumption-Savings models: Utility function of consumption $c$, not income $I$
Error 4. Getting the Intertemporal Payoff Wrong

- ‘Costs are in the present, benefits are in the future’
- \((\beta, \delta)\) models very sensitive to timing of payoffs
- Sometimes, can easily turn investment good into leisure good
- Need to have strong intuition on timing
- Example: Paper on nuclear plants as leisure goods
  - Immediate benefits of energy
  - Delayed cost to environment
- BUT: ‘Immediate’ benefits come after 10 years of construction costs!
Section 3

Reference Dependence: Introduction
Introduction to Reference Dependence

- Kahneman and Tversky (EMA 1979) — Anomalous behavior in experiments:
  1. **Concavity over gains.** Given $1000, A=(500,1) \succ B=(1000,0.5;0,0.5)$
  2. **Convexity over losses.** Given $2000, C=(-1000,0.5;0,0.5) \succ D=(-500,1)$
  3. **Framing Over Gains and Losses.** Notice that $A=D$ and $B=C$
  4. **Loss Aversion.** $(0,1) \succ (-8,.5;10,.5)$
  5. **Probability Weighting.** $(5000,.001) \succ (5,1)$ and $(-5,1) \succ (-5000,.001)$

- Can one descriptive model theory fit these observations?
Prospect Theory Features

- Subjects evaluate a lottery \((y, p; z, 1 - p)\) as follows:
  \[
  \pi(p)v(y - r) + \pi(1 - p)v(z - r)
  \]

**Five key components:**

1. **Reference Dependence**
   - Basic psychological intuition that changes, not levels, matter (applies also elsewhere)
     - Utility is defined over differences from reference point \(r\) →
     - Explains Experiment 3 Result
Prospect Theory Features

2. Diminishing sensitivity.
   - Concavity over gains of $v$ → Explains $(500,1) \succ (1000,0.5;0,0.5)$
   - Convexity over losses of $v$ → Explains $(-1000,0.5;0,0.5) \succ (-500,1)$

3. Loss Aversion → Explains $(0,1) \succ (-8,.5;10,.5)$
Prospect Theory Features

4. Probability weighting function $\pi$ non-linear $\rightarrow$ Explains $(5000, .001) \succ (5, 1)$ and $(-5, 1) \succ (-5000, .001)$

- Overweight small probabilities $+$ Premium for certainty
Prospect Theory Features

5 Narrow framing (Barberis, Huang, and Thaler, 2006; Rabin and Weizsäcker, 2011)
   - Consider only risk in isolation (labor supply, stock picking, house sale)
   - Neglect other relevant decisions

   Tversky and Kahneman (1992) propose calibrated version

\[
v(x) = \begin{cases} 
(x - r)^{0.88} & \text{if } x \geq r; \\
-2.25 ((x - r))^{0.88} & \text{if } x < r,
\end{cases}
\]

and

\[
w(p) = \frac{p^{0.65}}{(p^{0.65} + (1 - p)^{0.65})^{1/0.65}}
\]
Reference point $r$?

- Open question – depends on context
- Koszegi-Rabin (2006 on): personal equilibrium with rational expectation outcome as reference point
- Most field applications use only $(1)+(3)$, or $(1)+(2)+(3)$

$$v(x) = \begin{cases} 
  x - r & \text{if } x \geq r; \\
  \lambda(x - r) & \text{if } x < r,
\end{cases}$$

- Assume backward looking reference point depending on context
Section 4

Reference Dependence: Housing I
Housing

- Start from old-school reference-dependence papers
- Two typical ingredients:
  1. Backward-looking reference points (status quo, focal point, or past outcome)
  2. ‘Informal’ test – No model
- Genesove-Mayer (QJE, 2001)
  1. For house sales, natural reference point is previous purchase price
     - Validation: 75% of home owners remember exactly the purchase price of their home (survey evidence from our door-to-door surveys)
  2. Loss Aversion → Unwilling to sell house at a loss
     - Will ask for higher price if at a loss relative to purchase price
Data

- Evidence: Data on Boston Condominiums, 1990-1997
- Substantial market fluctuations of price

Figure I
Boston Condominium Price Index

Note: Sample period is 1990:I to 1997:IV
Setup

- Observe
  - Listing price $L_{i,t}$ and last purchase price $P_0$
  - Observed Characteristics of property $X_i$
  - Time Trend of prices $\delta_t$

- Define:
  - $\hat{P}_{i,t}$ is market value of property $i$ at time $t$

- Ideal Specification:

$$L_{i,t} = \hat{P}_{i,t} + m1_{\hat{P}_{i,t}<P_0} \left( P_0 - \hat{P}_{i,t} \right) + \varepsilon_{i,t}$$

$$= \beta X_i + \delta_t + v_i + mLoss^* + \varepsilon_{i,t}$$
Model

However:
- Do not observe \( \hat{P}_{i,t} \), given \( v_i \) (unobserved quality)
- Hence do not observe \( Loss^* \)

Two estimation strategies to bound estimates. **Model 1:**

\[
L_{i,t} = \beta X_i + \delta_t + m \mathbf{1}_{\hat{P}_{i,t} < P_0} (P_0 - \beta X_i - \delta_t) + \varepsilon_{i,t}
\]

- This model overstate the loss for high unobservable homes (high \( v_i \))
- Bias upwards in \( \hat{m} \), since high unobservable homes should have high \( L_{i,i} \)

**Model 2:**

\[
L_{i,t} = \beta X_i + \delta_t + \alpha (P_0 - \beta X_i - \delta_t) + m \mathbf{1}_{\hat{P}_{i,t} < P_0} (P_0 - \beta X_i - \delta_t) + \varepsilon_{i,t}
\]

Estimates of impact on sale price
**TABLE II**

**Loss Aversion and List Prices**

Dependent Variable: Log (Original Asking Price), OLS equations, standard errors are in parentheses.

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1) All listings</th>
<th>(2) All listings</th>
<th>(3) All listings</th>
<th>(4) All listings</th>
<th>(5) All listings</th>
<th>(6) All listings</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS</td>
<td>0.35 (0.06)</td>
<td>0.25 (0.06)</td>
<td>0.63 (0.04)</td>
<td>0.53 (0.04)</td>
<td>0.35 (0.06)</td>
<td>0.24 (0.06)</td>
</tr>
<tr>
<td>LOSS-squared</td>
<td>-0.26 (0.04)</td>
<td>-0.26 (0.04)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTV</td>
<td>0.06 (0.01)</td>
<td>0.05 (0.01)</td>
<td>0.03 (0.01)</td>
<td>0.03 (0.01)</td>
<td>0.06 (0.01)</td>
<td>0.05 (0.01)</td>
</tr>
<tr>
<td>Estimated value in 1990</td>
<td>1.09 (0.01)</td>
<td>1.09 (0.01)</td>
<td>1.09 (0.01)</td>
<td>1.09 (0.01)</td>
<td>1.09 (0.01)</td>
<td>1.09 (0.01)</td>
</tr>
<tr>
<td>Estimated price index at quarter of entry</td>
<td>0.86 (0.04)</td>
<td>0.80 (0.04)</td>
<td>0.91 (0.03)</td>
<td>0.85 (0.03)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Residual from last sale price</td>
<td>0.11 (0.02)</td>
<td>0.11 (0.02)</td>
<td>0.11 (0.02)</td>
<td>0.11 (0.02)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Months since last sale</td>
<td>-0.0002 (0.0001)</td>
<td>-0.0003 (0.0001)</td>
<td>-0.0002 (0.0001)</td>
<td>-0.0003 (0.0001)</td>
<td>-0.0002 (0.0001)</td>
<td>-0.0003 (0.0001)</td>
</tr>
<tr>
<td>Dummy variables for quarter of entry</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.77 (0.14)</td>
<td>-0.70 (0.14)</td>
<td>-0.84 (0.13)</td>
<td>-0.77 (0.14)</td>
<td>-0.88 (0.10)</td>
<td>-0.86 (0.10)</td>
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<tr>
<td>$R^2$</td>
<td>0.85</td>
<td>0.86</td>
<td>0.86</td>
<td>0.86</td>
<td>0.86</td>
<td>0.86</td>
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<tr>
<td>Number of observations</td>
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<td>5792</td>
<td>5792</td>
<td>5792</td>
<td>5792</td>
<td>5792</td>
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</tbody>
</table>
Effect of Experience

- Effect of experience: Larger effect for owner-occupied

<table>
<thead>
<tr>
<th>TABLE IV</th>
<th>LOSS AVERSION AND LIST PRICES; OWNER-OCCUPANTS VERSUS INVESTORS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DEPENDENT VARIABLE: LOG (ORIGINAL ASKING PRICE)</td>
</tr>
<tr>
<td></td>
<td>OLS equations, standard errors are in parentheses.</td>
</tr>
<tr>
<td>Variable</td>
<td>(1) listings</td>
</tr>
<tr>
<td>----------</td>
<td>--------------</td>
</tr>
<tr>
<td>LOSS × owner-occupant</td>
<td>0.50 (0.09)</td>
</tr>
<tr>
<td>LOSS × investor</td>
<td>0.24 (0.12)</td>
</tr>
<tr>
<td>LOSS-squared × owner-occupant</td>
<td>-0.16 (0.14)</td>
</tr>
<tr>
<td>LOSS-squared × investor</td>
<td>-0.30 (0.02)</td>
</tr>
<tr>
<td>LTV × owner-occupant</td>
<td>0.03 (0.02)</td>
</tr>
<tr>
<td>LTV × investor</td>
<td>0.053 (0.027)</td>
</tr>
<tr>
<td>Dummy for investor</td>
<td>-0.02 (0.014)</td>
</tr>
<tr>
<td>Estimated value in 1990</td>
<td>1.09 (0.01)</td>
</tr>
<tr>
<td>Estimated price index at quarter of entry</td>
<td>0.84 (0.05)</td>
</tr>
<tr>
<td>Residual from last sale price</td>
<td>0.08 (0.02)</td>
</tr>
</tbody>
</table>
Effect of Last Price

- Some effect also on final transaction price

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1) All listings</th>
<th>(2) All listings</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS</td>
<td>0.18</td>
<td>0.03</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.08)</td>
</tr>
<tr>
<td>LTV</td>
<td>0.07</td>
<td>0.06</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Residual from last sale price</td>
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<td>0.16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.02)</td>
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<tr>
<td>Months since last sale</td>
<td>−0.0001</td>
<td>−0.0004</td>
</tr>
<tr>
<td></td>
<td>(0.0001)</td>
<td>(0.0001)</td>
</tr>
<tr>
<td>Dummy variables for quarter of entry</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Number of observations</td>
<td>3413</td>
<td>3413</td>
</tr>
</tbody>
</table>

LOST AVERSION AND TRANSACTION PRICES
DEPENDENT VARIABLE: LOG (TRANSACTION PRICE)
NLLS equations, standard errors are in parentheses.
Implications

- Lowers the exit rate (lengthens time on the market)

<table>
<thead>
<tr>
<th>TABLE VII</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAZARD RATE OF SALE</td>
</tr>
<tr>
<td>Duration variable is the number of weeks the property is listed on the market. Cox proportional hazard equations, standard errors are in parentheses.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>(1) All listings</th>
<th>(2) All listings</th>
<th>(3) All listings</th>
<th>(4) All listings</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOSS</td>
<td>-0.33 (0.13)</td>
<td>-0.63 (0.15)</td>
<td>-0.59 (0.16)</td>
<td>-0.90 (0.18)</td>
</tr>
<tr>
<td>LOSS-squared</td>
<td></td>
<td></td>
<td>0.27 (0.07)</td>
<td>0.28 (0.07)</td>
</tr>
<tr>
<td>LTV</td>
<td>-0.08 (0.04)</td>
<td>-0.09 (0.04)</td>
<td>-0.06 (0.04)</td>
<td>-0.06 (0.04)</td>
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<tr>
<td>Estimated value in 1990</td>
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<td>0.27 (0.04)</td>
<td>0.27 (0.04)</td>
<td>0.27 (0.04)</td>
</tr>
<tr>
<td>Residual from last sale</td>
<td>0.29 (0.07)</td>
<td>0.29 (0.07)</td>
<td>0.29 (0.07)</td>
<td>0.29 (0.07)</td>
</tr>
</tbody>
</table>

- Overall, plausible set of results that show impact of reference point
Section 5

Methodology: Bunching-Based Evidence of Reference Dependence
Identifying Reference-Dependence

- Some Cases: Key role for *diminishing sensitivity* and *probability weighting*
  - Disposition effect: Diminishing sensitivity $\rightarrow$ more prone to sell winners (part of effect)
  - Insurance: Prob. weighting $\rightarrow$ propensity to get low deductible
- Most Cases: Key role for *loss aversion*
- Common element for several papers:
  - Well-defined, backward-looking reference point $r$
  - Optimal effort choice $e^*$
  - Cost of effort $c(e)$
  - Return of effort $e$, reference point $r$
Individual maximizes

\[
\max_{e} \left[ e + \eta (e - r) - c(e) \right] \quad \text{for } e \geq r
\]

\[
\max_{e} \left[ e + \eta \lambda (e - r) - c(e) \right] \quad \text{for } e < r
\]

Derivative of utility function:

\[
1 + \eta - c'(e^*) \quad \text{for } e \geq r
\]

\[
1 + \lambda \eta - c'(e^*) \quad \text{for } e < r
\]

- Discontinuity in marginal utility of effort
- Implication 1 → Bunching at \( e^* = r \)
- Implication 2 → Missing mass of distribution for \( e < r \) compared to \( e > r \)
Older literature does not pursue this, new literature does
- Bunching is much harder to explain with alternative models
- Shift in mass can generally be well identified too under assumptions of continuity of distribution

Examine four related applications:
1. Housing (where test is not formalized)
   - Effort: How hard to ‘push’ the house
   - Reference point: Purchase price
2. Tax filing
   - Effort: Tax elusion
   - Reference point: Withholding amount
Bunching

3 Marathon running
   - Effort: Running
   - Reference point: Round goal

4 Merger
   - Effort: Pushing for higher price
   - Reference point: 52-week high

Two more related cases next lecture:

5 Labor supply
   - Effort: Work more hours
   - Reference point: Expected daily earnings?

6 Job search
   - Effort: Search for a job
   - Reference point: Recent average earnings
Section 6

Reference Dependence: Housing II
Formalize Intuition

- Return to Housing case, formalize intuition.
  - Seller chooses price \( P \) at sale
  - Higher Price \( P \)
    - lowers probability of sale \( p(P) \) (hence \( p'(P) < 0 \))
    - increases utility of sale \( U(P) \)
  - If no sale, utility is \( \bar{U} < U(P) \) (for all relevant \( P \))
Model

- Maximization problem:
  \[
  \max_P p(P)U(P) + (1 - p(P))\bar{U}
  \]

- F.o.c. implies
  \[
  MG = p(P^*)U'(P^*) = -p'(P^*)(U(P^*) - \bar{U}) = MC
  \]

- Interpretation: Marginal Gain of increasing price equals Marginal Cost

- S.o.c are
  \[
  2p'(P^*)U'(P^*) + p(P^*)U''(P^*) + p''(P^*)(U(P^*) - \bar{U}) < 0
  \]

- Need \(p''(P^*)(U(P^*) - \bar{U}) < 0\) or not too positive
Reference-dependent preferences with reference price $P_0$:

$$v(P|P_0) = \begin{cases} 
    P + \eta(P - P_0) & \text{if } P \geq P_0; \\
    P + \eta\lambda(P - P_0) & \text{if } P < P_0,
\end{cases}$$

Can write as

$$p(P)(1 + \eta) = -p'(P)(P + \eta(P - P_0) - \bar{U}) \text{ if } P \geq P_0$$

$$p(P)(1 + \eta\lambda) = -p'(P)(P + \eta\lambda(P - P_0) - \bar{U}) \text{ if } P < P_0$$

Plot Effect on MG and MC of loss aversion

Compare $P_{\lambda=1}^*$ (equilibrium with no loss aversion) and $P_{\lambda>1}^*$ (equilibrium with loss aversion)
Cases

- Case 1. Loss Aversion $\lambda$ increase price ($P_{\lambda=1}^* < P_0$)

- Case 2. Loss Aversion $\lambda$ induces bunching at $P = P_0$ ($P_{\lambda=1}^* < P_0$)
Cases

Case 3. Loss Aversion has no effect ($P^*_{\lambda=1} > P_0$)

- General predictions. When aggregate prices are low:
  - High prices $P$ relative to fundamentals
  - Bunching at purchase price $P_0$
  - Lower probability of sale $p(P)$, longer waiting on market
- Important to tie housing evidence to model
- Would be great to redo with data from recent recession
Section 7

Reference Dependence: Tax Elusion
Alex Rees-Jones (2014)

- Preparation of tax returns
  - Can lower taxes due expending effort (finding receipts/elusion)
  - Important setting with clear reference point: 0 taxes due
  - Pre-manipulation balance due $b^{PM}$
  - Denote by $s$ the tax dollars sheltered

- Slides courtesy of Alex

- Other relevant paper: Engstrom, P., Nordblom, K., Ohlsson, H., & Persson, A. (AEJ: Policy, 2016)
  - Similar evidence, but focus on claiming deductions
Simple example with smooth utility

Consider a model abstracting from income effects:

$$\max_{s \in \mathbb{R}^+} (w - b^{PM} + s) - c(s)$$

linear utility over money    cost of sheltering

Optimal sheltering is determined by the first-order condition:

$$1 - c'(s^*) = 0$$

Optimal sheltering solution: $$s^* = c'^{-1}(1)$$.

→ Distribution of balance due, $$b \equiv b^{PM} - s^*$$, is a horizontal shift of the distribution of $$b^{PM}$$.
PDF of pre-manipulation balance due
PDF of final balance due after sheltering

Balance due is shifted by sheltering activities

$s^* = c^{-1}(1)$
Loss-averse case

\[
\max_{s \in \mathbb{R}^+} m(-b^{PM} + s) - c(s)
\]

utility over money  
cost of sheltering

Loss-averse utility specification:

\[
(w - b^{PM} + s) + n(-b^{PM} + s - r)
\]

consumption utility  
gain-loss utility

\[
n(x) = \begin{cases} 
\eta x & \text{if } x \geq 0 \\
\eta \lambda x & \text{if } x < 0 
\end{cases}
\]
Optimal loss-averse sheltering

This model generates an optimal sheltering solution with different behavior across three regions:

\[
\begin{align*}
    s^*(b^{PM}) &= \begin{cases} 
    s^H & \text{if } b^{PM} > s^H - r \\
    b^{PM} + r & \text{if } b^{PM} \in [s^L - r, s^H - r] \\
    s^L & \text{if } b^{PM} < s^L - r
    \end{cases}
\end{align*}
\]

where \( s^H \equiv c'^{-1}(1 + \eta \lambda) \) and \( s^L \equiv c'^{-1}(1 + \eta) \).

- Sufficiently large \( b^{PM} \rightarrow \) high amount of sheltering.
- Sufficiently small \( b^{PM} \rightarrow \) low amount of sheltering.
- For an intermediate range, sheltering chosen to offset \( b^{PM} \).
PDF of final balance due after loss-averse sheltering

Revenue effect of loss framing: $s^H - s^L$. 
**Data description**

**Dataset:** 1979-1990 SOI Panel of Individual Returns.
- Contains most information from Form 1040 and some related schedules.
- Randomized by SSNs.

Exclude observations filed from outside of the 50 states + DC, drawn from outside the sampling frame, observations before 1979.

Exclude individuals with zero pre-credit tax due, individuals with zero tax prepayments.

Primary sample: $\approx 229k$ tax returns, $\approx 53k$ tax filers.
First look: distribution of nominal balance due
First look: distribution of nominal balance due
Fit of predicted distributions

Full sample

Shift: 389

Balance Due

Frequency

Kernel Regression (Bandwidth = 10)  Fitted Model
Fit of predicted distributions

- **AGI quartile 1**: Shift: 36
- **AGI quartile 2**: Shift: 70
- **AGI quartile 3**: Shift: 184
- **AGI quartile 4**: Shift: 586

Graphs show the fit of predicted distributions with Kernel Regression (Bandwidth = 10) and the Fitted Model.
Rationalizing differences in magnitudes

What drives the differences in the bunching and shifting estimates?

Primary explanation: assumption that sheltering can be manipulated to-the-dollar.

- Possible for some types of sheltering: e.g. direct evasion, choosing amount to give to charity, targeted capital losses.
- Not possible for many types of sheltering.
- Excess mass at zero will “leave out” individuals without finely manipulable sheltering technologies.
- Potential solution: permit diffuse bunching “near” zero.
Fit of predicted distributions

- Bunch width: 200, Shift: 53
- Bunch width: 400, Shift: 141
- Bunch width: 600, Shift: 272
- Bunch width: 800, Shift: 383
Distribution with fixed cost in loss domain
Section 8

Reference Dependence: Goal Setting
Reference point can be a goal
Marathon running: Round numbers as goals
Similar identification considering discontinuities in finishing times around round numbers
Distribution of Finishing Times

Figure 2: Distribution of marathon finishing times ($n = 9,378,546$)

NOTE: The dark bars highlight the density in the minute bin just prior to each 30 minute threshold.
**Intuition**

- Channel of effects: Speeding up if behind and can still make goal
Summary

- Evidence strongly consistent with model
  - Missing distribution to the right
  - Some bunching
- Hard to back out loss aversion given unobservable cost of effort
Section 9

Reference Dependence: Mergers
Baker, Pan, Wurgler (JF 2012)

On the appearance, very different set-up:
- Firm A (Acquirer)
- Firm T (Target)

After negotiation, Firm A announces a price $P$ for merger with Firm T
- Price $P$ typically at a 20-50 percent premium over current price
- About 70 percent of mergers go through at price proposed
- Comparison price for $P$ often used is highest price in previous 52 weeks, $P_{52}$
Example: How Cablevision (Target) trumpets deal

Figure 1. Slide from Cablevision Presentation to Shareholders, October 24, 2007. The management of Cablevision recommended acceptance of a $36.26 per share cash bid from the Dolan family. The slide compares this bid price to various recent prices including 52-week highs.

Valuation Achieved

Market Premia

- 17.9% higher than the lowest price during the 52-week period ended October 6, 2006
- 49.6% higher than the 52-week high during the period ended October 6, 2006
- 30.0% higher than the average closing price for the 180 days prior to the $36.26 May 2007 offer
- 10.4% higher than the 5-year and 52-week high prior to May 2
- April 23, 2007

Proposal

$36.26

* Adjusted to reflect payment of $10/share special dividend.
Model

- Assume that Firm T chooses price $P$, and A decides accept/reject.
- As a function of price $P$, probability $p(P)$ that deal is accepted (depends on perception of values of synergy of A).
- If deal rejected, go back to outside value $\bar{U}$.
- Then maximization problem is same as for housing sale:

$$\max_P p(P)U(P) + (1 - p(P))\bar{U}$$

- Can assume T reference-dependent with respect to

$$\nu(P|P_0) = \begin{cases} 
P + \eta(P - P_{52}) & \text{if } P \geq P_{52}; \\
P + \eta\lambda(P - P_{52}) & \text{if } P < P_{52}
\end{cases}$$
Predictions and Tests

- Obtain same predictions as in housing market
- (This neglects possible reference dependence of A)
- Baker, Pan, and Wurgler (2009): Test reference dependence in mergers
  - Test 1: Is there bunching around $P_{52}$? (GM did not do this)
  - Test 2: Is there effect of $P_{52}$ on price offered?
  - Test 3: Is there effect on probability of acceptance?
  - Test 4: What do investors think? Use returns at announcement
Test 1: Offer price $P$ around $P_{52}$

- Some bunching, shifting left tail of distribution
Test 1: Offer price $P$ around $P_{52}$

- Notice that this does not tell us how the missing left tail occurs:
  - Firms in left tail raise price to $P_{52}$?
  - Firms in left tail wait for merger until 12 months after past peak, so $P_{52}$ is higher?
  - Preliminary negotiations break down for firms in left tail

- Would be useful to compare characteristics of firms to right and left of $P_{52}$
Test 2: Kernel regression of $P$

Kernel regression of price offered $P$ (Renormalized by price 30 days before, $P_{-30}$, to avoid heterosked.) on $P_{52}$:

$$100 \times \frac{P - P_{-30}}{P_{-30}} = \alpha + \beta \left[ 100 \times \frac{P_{52} - P_{-30}}{P_{-30}} \right] + \varepsilon$$
Test 4: What do investors think?

- Test 3: Probability of final acquisition is higher when offer price is above $P_{52}$ (Skip)

- Test 4: What do investors think of the effect of $P_{52}$?
  - Holding constant current price, investors should think that the higher $P_{52}$, the more expensive the Target is to acquire
  - Standard methodology to examine this:
    - 3-day stock returns around merger announcement: $CAR_{t-1,t+1}$
    - This assumes investor rationality
    - Notice that merger announcements are typically kept top secret until last minute → On announcement day, often big impact
Test 4: What do investors think?

- Regression (Columns 3 and 5):

\[ CAR_{t-1,t+1} = \alpha + \beta \frac{P}{P_{-30}} + \varepsilon \]

where \( P/P_{-30} \) is instrumented with \( P_{52}/P_{-30} \)

Results very supportive of reference dependence hypothesis – Also alternative anchoring story
Section 10

Next Lecture
Next Lecture

- Reference-Dependent Preferences
  - Labor Supply
  - Job Search
  - Finance

- Problem Set 2 due next week