# Econ 219B
# Psychology and Economics: Applications (Lecture 4)

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# Outline

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

# Section 1

# Laboratory Experiments on Present Bias

# Time Preferences

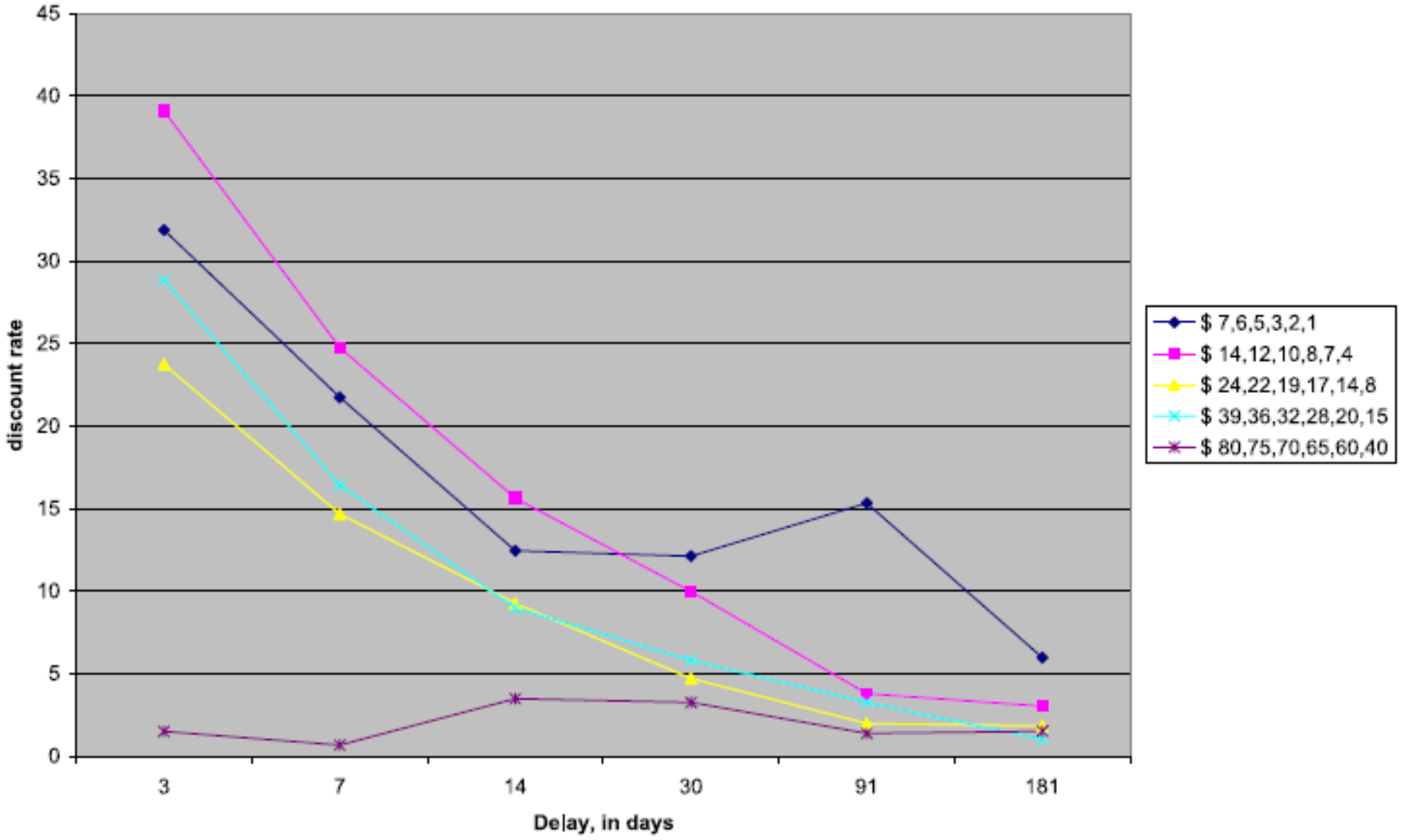
- Experiments on time preferences (Ainslie, 1956; Thaler, 1981; Benhabib, Bisin, and Schotter, 2009; Andreoni and Sprenger, 2012)

- 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 $\left(\beta\delta^T\right)^{1/T} = \beta^{1/T}\delta$
- 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


45
40
35
30
25
20
15
10
5
0
discount rate
3
7
14
30
91
181
Delay, in days
$ 7,6,5,3,2,1
$ 14,12,10,8,7,4
$ 24,22,19,17,14,8
$ 39,36,32,28,20,15
$ 80,75,70,65,60,40

# 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 $q\delta^T$
- $\rightarrow \beta$ 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):

$$U_0 = u(c_0) + \beta\delta Eu(c_1) + \beta\delta^2 Eu(c_2)$$

- Assume that individual plans to consume the \$$X$ paid today or the \$10 paid in one week one week later$\rightarrow$ 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* $\rightarrow$ Consume immediately

# Problems 3 & 4

**Problem 3: Concave Utility**

- Choice equates

$$u(10) = \beta\delta u(X)$$

- $\beta\delta = u(10)/u(X) \rightarrow$ 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:

$$u(10) = \beta\delta Eu(X)$$

- $\rightarrow$ Marginal utility of money can differ in the future, depending on future shocks

# Andreoni & Sprenger (2012)

- 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

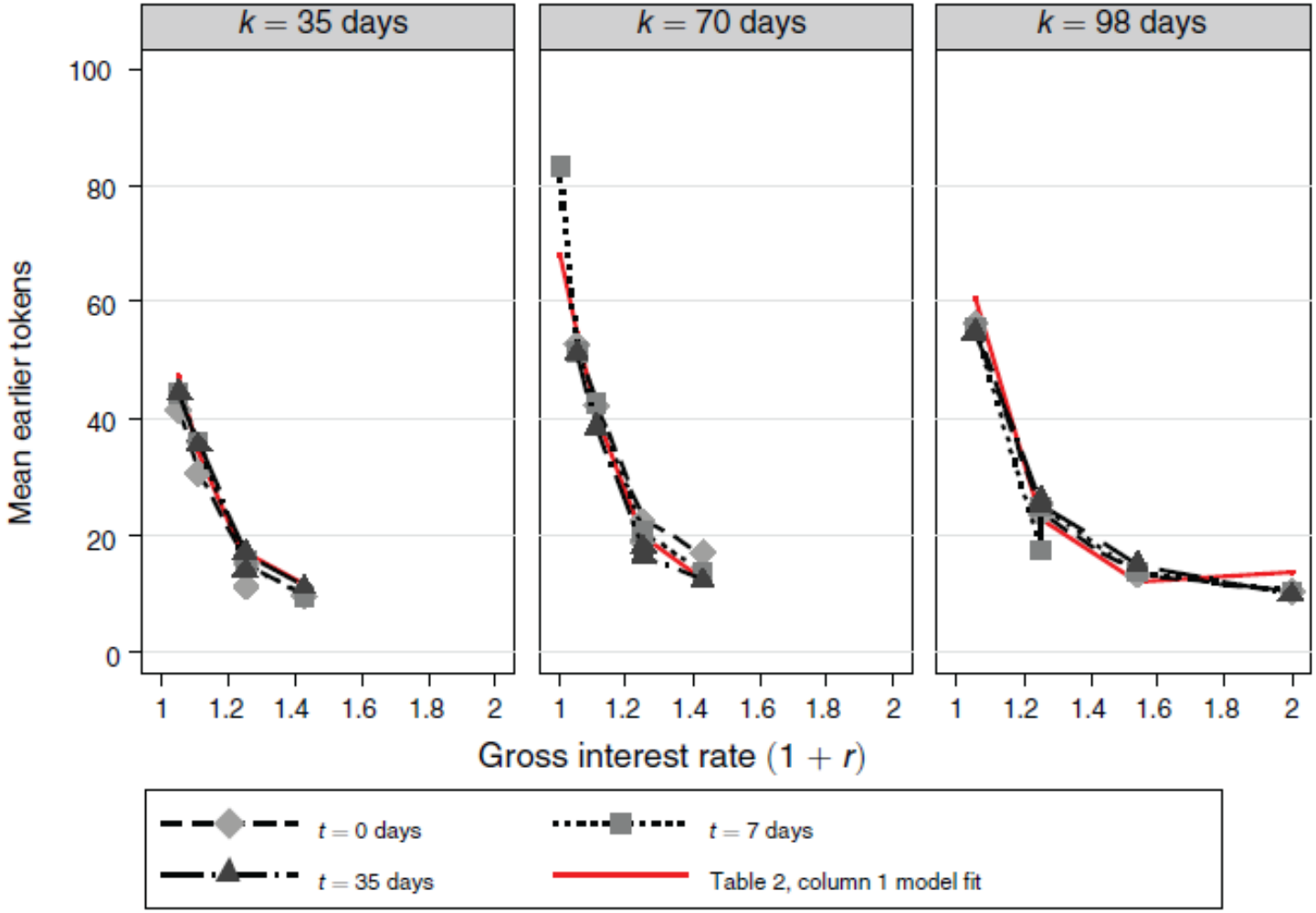
- To deal with *Problem 3 (Concave Utility)*, design to estimate concavity:
  - Subject allocate share of money to earlier versus later choice
  - $\rightarrow$ That is, interior solutions, not just corner solutions
  - Vary interest rate between earlier and later choice to back out concavity
- Example of choice screenshot

January 21, February 25 | January 21, April 1 | January 21, April 29 | January 28, March 4 | January 28, April 8

| | Divide Tokens between January 28 (1 week(s) from today), and April 8 (10 week(s) later) | | | | | January 28 | April 8 |
|---|---|---|---|---|---|---|---|
| 1 | Allocate 100 tokens: | 83 | tokens at $0.20 on January 28, and | 17 | tokens at $0.20 on April 8 | $16.60 | $3.40 |
| 2 | Allocate 100 tokens: | 51 | tokens at $0.19 on January 28, and | 49 | tokens at $0.20 on April 8 | $9.69 | $9.80 |
| 3 | Allocate 100 tokens: | 43 | tokens at $0.18 on January 28, and | 57 | tokens at $0.20 on April 8 | $7.74 | $11.40 |
| 4 | Allocate 100 tokens: | 21 | tokens at $0.16 on January 28, and | 79 | tokens at $0.20 on April 8 | $3.36 | $15.80 |
| 5 | Allocate 100 tokens: | 14 | tokens at $0.14 on January 28, and | 86 | tokens at $0.20 on April 8 | $1.96 | $17.20 |

# Results

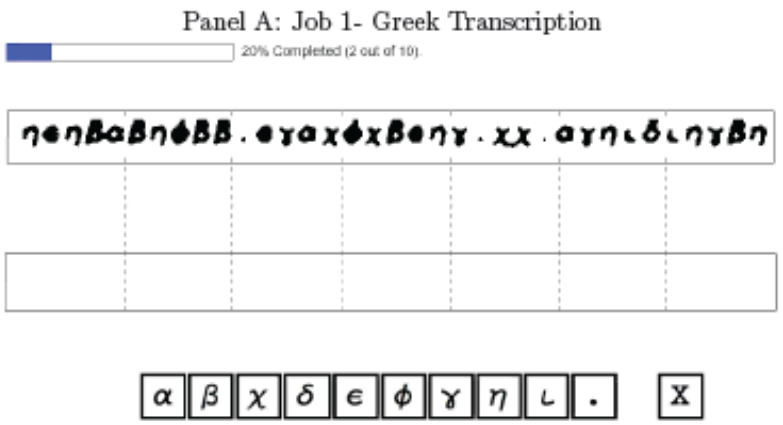
- Main result: No evidence of present bias



# 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
  - $\rightarrow$ Do subjects revise the choice?
  - As in AS, choice of interior solution, and varied 'interest rate' between periods

# Design

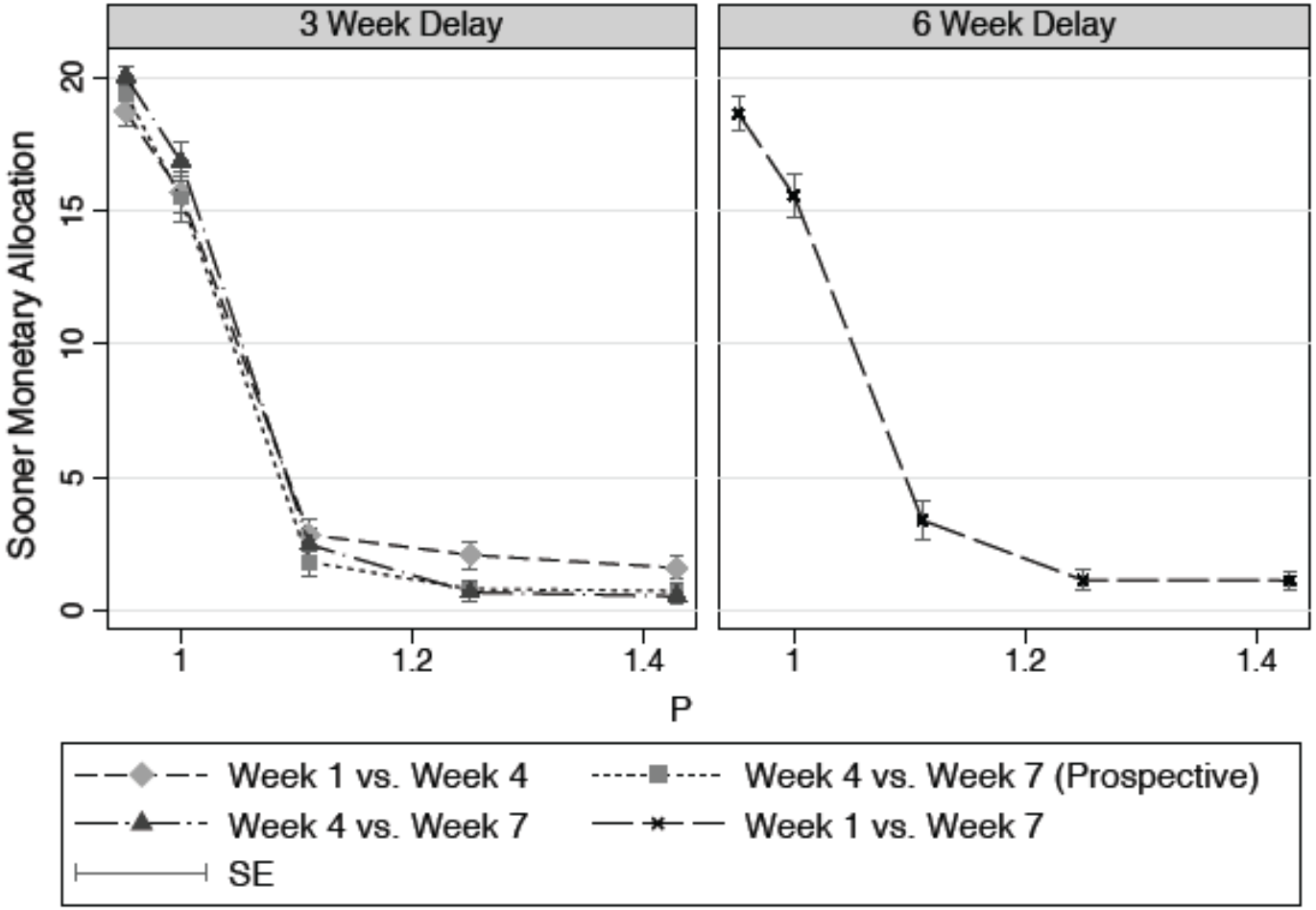
- Also do monetary discounting, with immediate *cash* payment (unlike AS)

Table 1: Summary of Longitudinal Experiment

| | 10 Effort Allocations | Minimum Work | Allocation-That-Counts Chosen | Complete Work | Commitment Choice | Receive Payment |
|---|---|---|---|---|---|---|
| Week 1 (In Lab): | x | x | | | | |
| Week 2 (Online): | x | x | x | x | | |
| Week 3 (Online): | | x | | x | | |
| Week 4 (In Lab): | x | x | | | x | |
| Week 5 (Online): | x | x | x | x | | |
| Week 6 (Online): | | x | | x | | |
| Week 7 (In Lab): | | | | | | x |

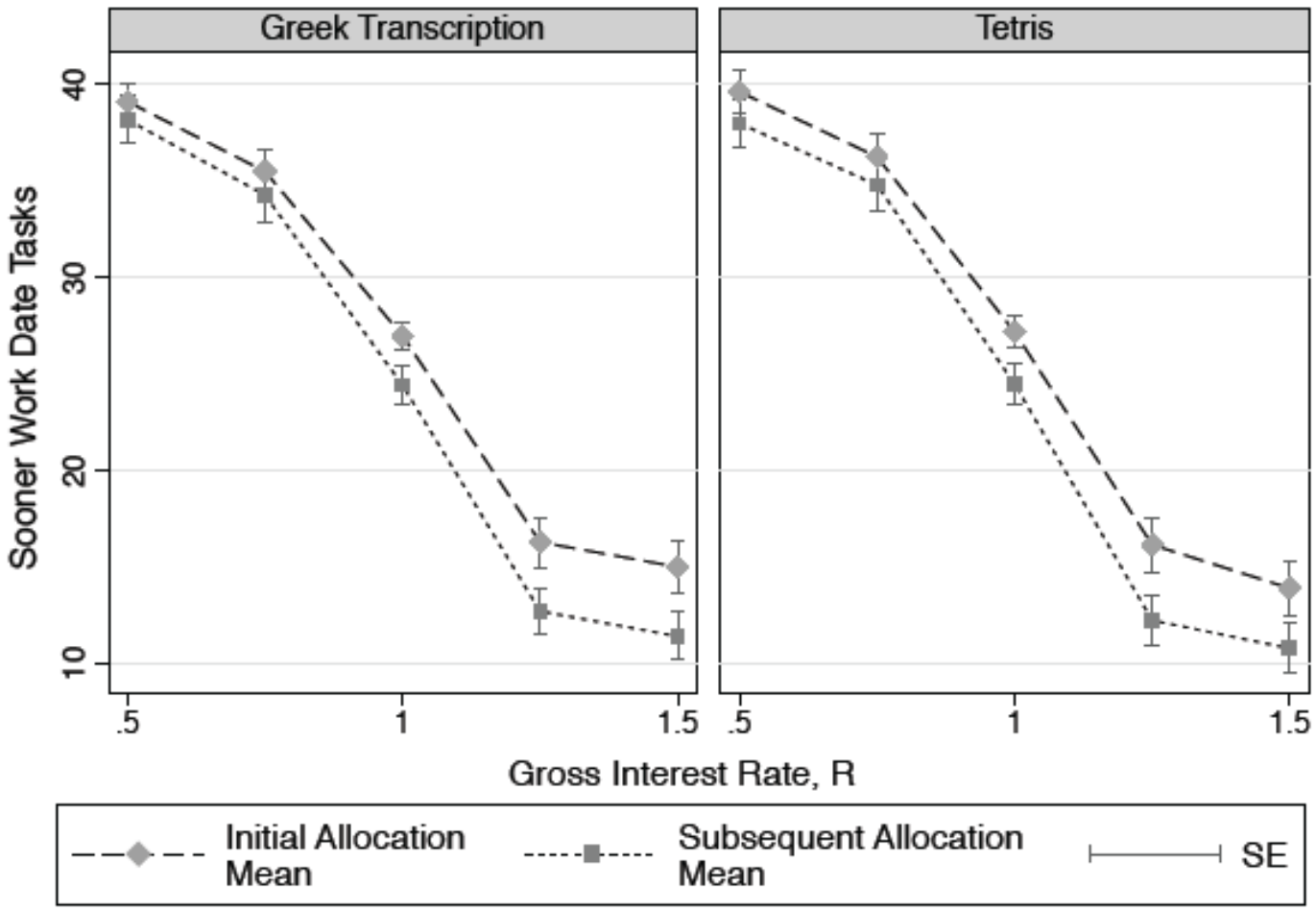
# Results

- Result 1: On monetary discounting no evidence of present-bias



# Results

- Result 2: Clear evidence on effort allocation



# Results

- Result 3: Estimate of present-bias given that can back out shape of cost of effort function $c(e)$

| | Monetary Discounting | | Effort Discounting | | |
|---|---|---|---|---|---|
| | (1) All Delay Lengths | (2) Three Week Delay Lengths | (3) Job 1 Greek | (4) Job 2 Tetris | (5) Combined |
| Present Bias Parameter: $\beta$ | 0.974 | 0.988 | 0.900 | 0.877 | 0.888 |
| | (0.009) | (0.009) | (0.037) | (0.036) | (0.033) |
| Daily Discount Factor: $\delta$ | 0.998 | 0.997 | 0.999 | 1.001 | 1.000 |
| | (0.000) | (0.000) | (0.004) | (0.004) | (0.004) |
| Monetary Curvature Parameter: $\alpha$ | 0.975 | 0.976 | | | |
| | (0.006) | (0.005) | | | |
| Cost of Effort Parameter: $\gamma$ | | | 1.624 | 1.557 | 1.589 |
| | | | (0.114) | (0.099) | (0.104) |
| # Observations | 1500 | 1125 | 800 | 800 | 1600 |
| # Clusters | 75 | 75 | 80 | 80 | 80 |
| Job Effects | | | | | Yes |

# 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 1: A Price List Experiment

| Set A | | Set B | |
|---|---|---|---|
| today | in 1 week | in 1 week | in 2 weeks |
| $a_0$ | $a_1$ | $b_1$ | $b_2$ |
| CFA 50 | CFA 300 | CFA 50 | CFA 300 |
| CFA 100 | CFA 300 | CFA 100 | CFA 300 |
| CFA 150 | CFA 300 | CFA 150 | CFA 300 |
| CFA 200 | CFA 300 | CFA 200 | CFA 300 |
| CFA 250 | CFA 300 | CFA 250 | CFA 300 |
| CFA 300 | CFA 300 | CFA 300 | CFA 300 |
| CFA 350 | CFA 300 | CFA 350 | CFA 300 |
| CFA 400 | CFA 300 | CFA 400 | CFA 300 |

# 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 5: Consumption shocks and $MRS_t$.

| | MRS (A) OLS | MRS (A) OLS | MRS (A) OLS | MRS (A) OLS | MRS (A) IV | MRS (A) IV |
|---|---|---|---|---|---|---|
| Adv. event (0/1) | 0.284 * | 0.263 * | | | | |
| | (0.124) | (0.124) | | | | |
| Adv. event expense | | | 0.256 + | 0.237 + | 1.707 * | 1.579 * |
| | | | (0.147) | (0.141) | (0.695) | (0.797) |
| Constant | 4.588 ** | 4.678 ** | 4.665 ** | 4.755 ** | 4.579 ** | 4.663 ** |
| | (0.041) | (0.074) | (0.009) | (0.059) | (0.101) | (0.130) |
| Ind FE | yes | yes | yes | yes | yes | yes |
| Time FE | | yes | | yes | | yes |
| Observations | 2547 | 2547 | 2543 | 2543 | 2543 | 2543 |

*Standard errors clustered at the individual level (OLS) or bootstrapped (IV, ML) (in pa*
*Significance levels + p<0.10, * p<0.05, ** p<0.01*

# Related to savings shock

Table 7: Income, spending, and $MRS_t$.

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

*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*

# 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 rendomized 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 3: Intertemporal Choices about Monetary Rewards

| | *$ Amount of Sooner Reward* | |
|---|---|---|
| | Coefficient | Standard Error |
| {Before Payday} * {Immediate Rewards} | 10.6 | 3.83*** |
| {Before Payday} * Interest Rate | 2.7 | 3.24 |
| {Before Payday} * Delay Time | -1.4 | 1.06 |
| {Before Payday} | -6.3 | 9.80 |
| {Immediate Rewards} | -5.3 | 2.75* |
| Experimental Interest Rate | -47.3 | 2.33*** |
| Delay Time | -0.7 | 0.72 |
| Constant | 304.3 | 6.83*** |

*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. "Delat 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

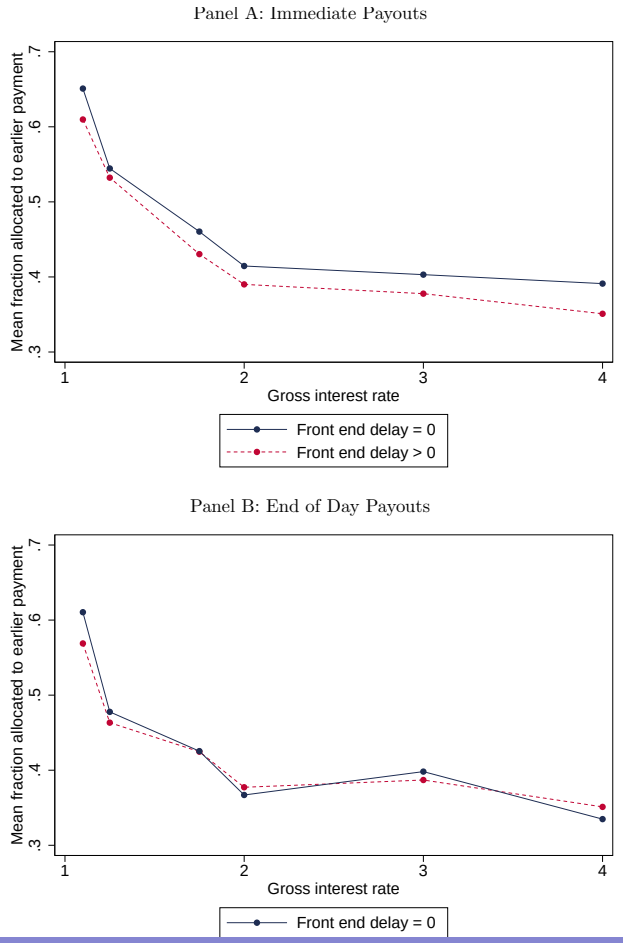
Table 4: Intertemporal Choices about Real Effort

| | *Monthly Discount Rate* |
|---|---|
| {Before Payday} * {Immediate Task} | -0.03 |
| | [0.025] |
| {Before Payday} | 0.02 |
| | [0.027] |
| {Immediate Task} | 0.09 |
| (5-day deadline for short-sooner survey) | [0.018]*** |
| Constant | 0.31 |
| | [0.019]*** |

*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. $N = 2{,}050$.

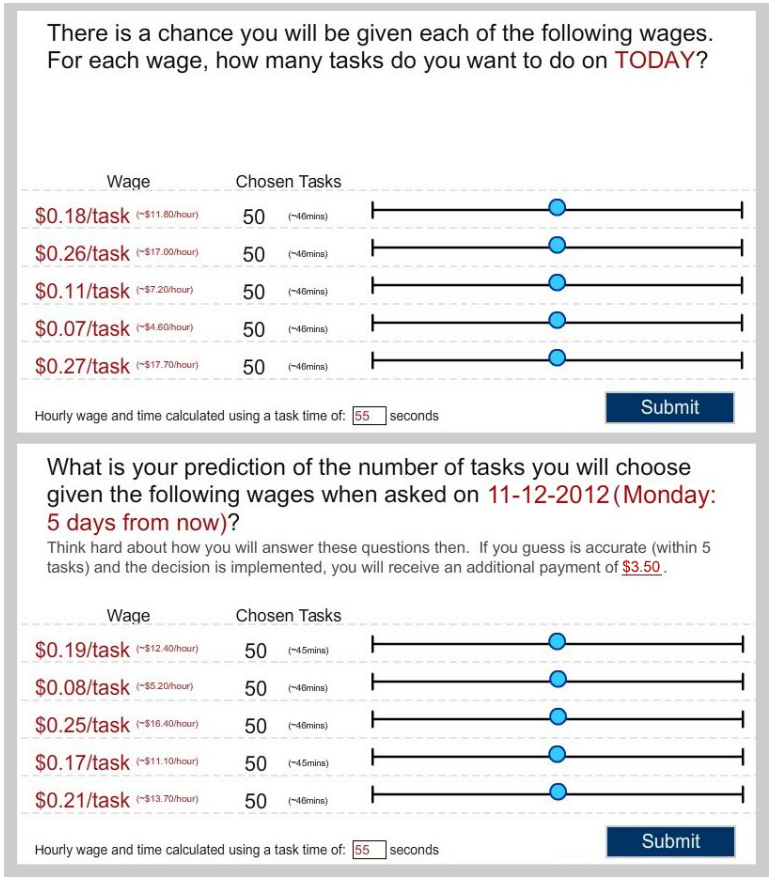
# Balakrishnan, Haushofer, Jakiela (2017)

- 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



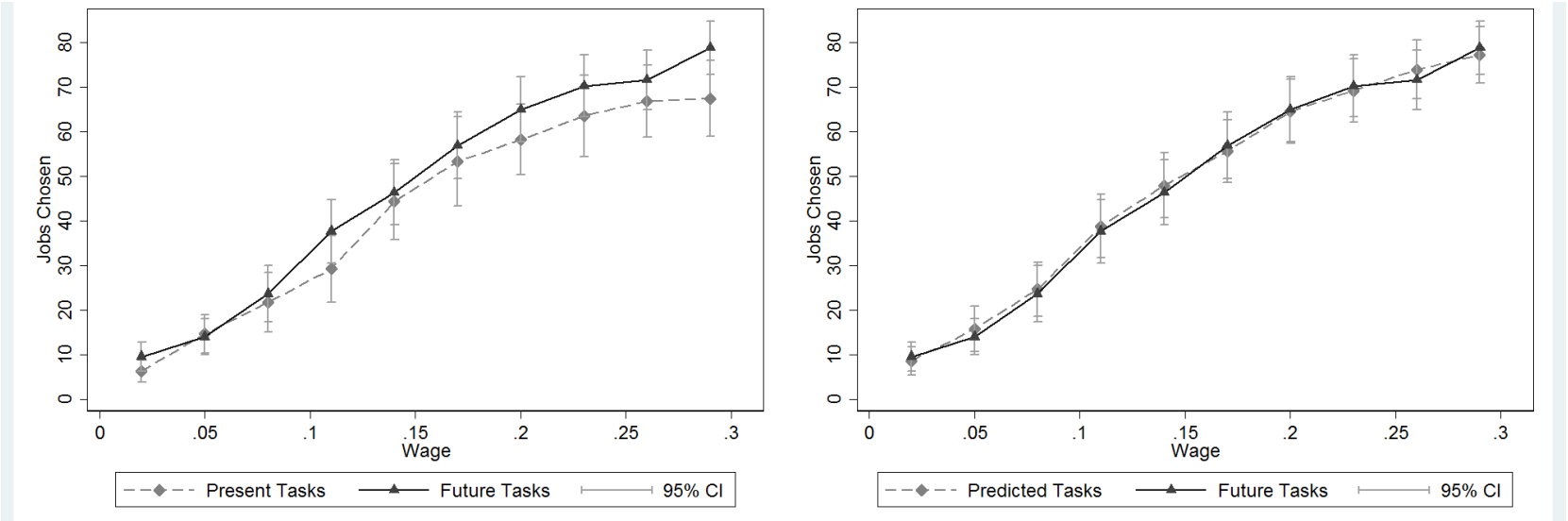
# Recent additional work using real effort

- **Augenblick and Rabin (2018)**:
  - Use real effort to elicit not only $\beta$, but also $\hat{\beta}$
  - Elicit forecasts for future choice, in addition to choice



# Recent additional work using real effort

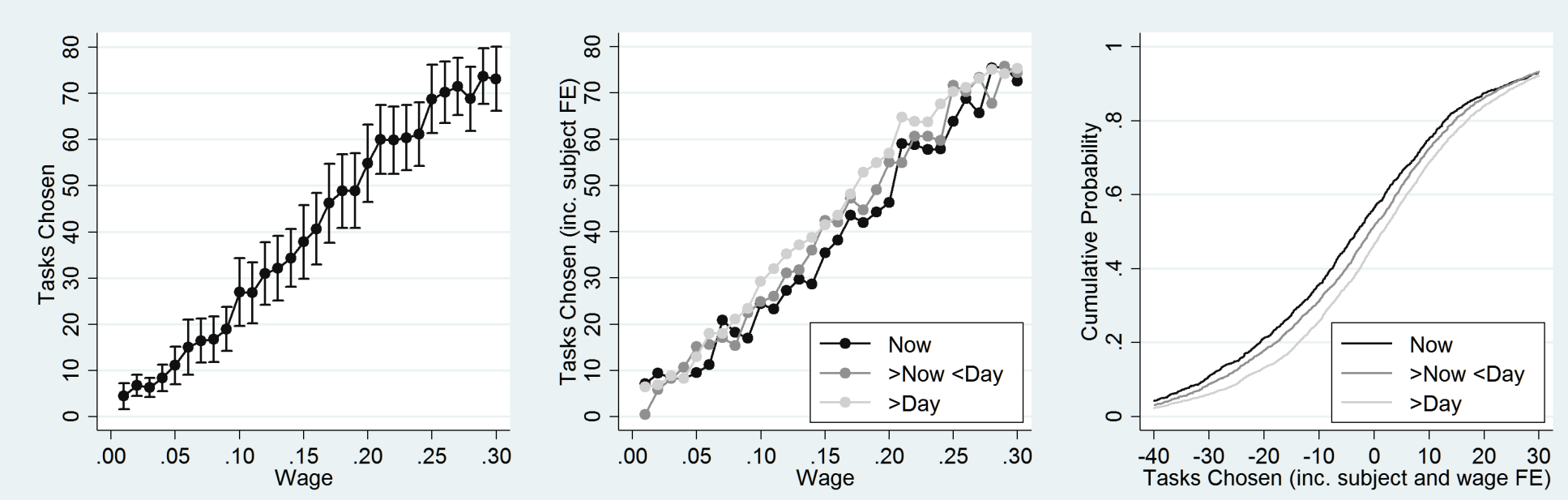
- Replicate evidence of present bias $\beta$, but $\hat{\beta} = 1$




| | Initial Estimation | Participant FE | Decision Day FE | Later Decisions | Pred. Soph. |
|---|---|---|---|---|---|
| Present Bias $\beta$ | 0.835 | 0.812 | 0.833 | 0.833 | 0.825 |
| | (0.038) | (0.042) | (0.040) | (0.041) | (0.041) |
| Naive Pres. Bias $\beta_h$ | 0.999 | 1.014 | 1.006 | 1.003 | 1.004 |
| | (0.011) | (0.011) | (0.010) | (0.009) | (0.003) |

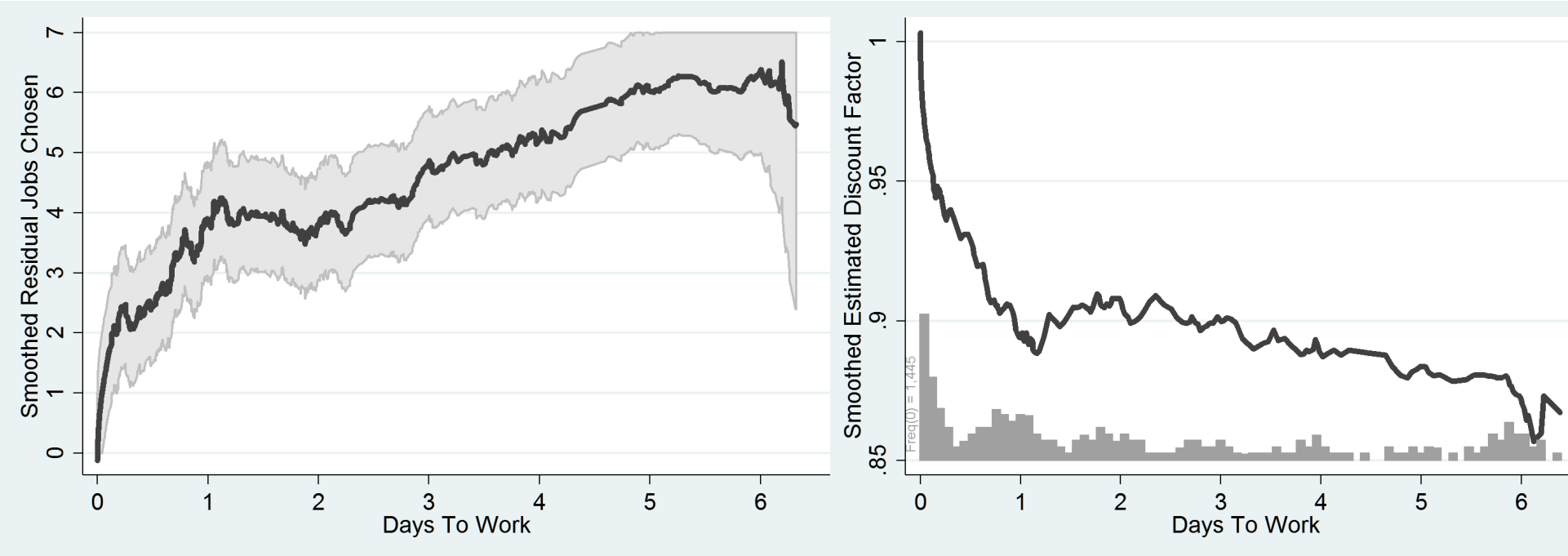
# Recent additional work using real effort

- **Augenblick (2019):** 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 (2019):** 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?

**OTHER SUBJECTS' DECISIONS: for 01/26/16**

On 01/26/16, **after the warm-up**, each subject will do some number of extra rounds of the Task. Every subject will have to complete his or her extra work **immediately** after the "Decision that Counts" is selected, with no more than 15 minutes of breaks.

**Decisions made now for work to be done on 01/26/16**

How many extra one-minute rounds do you think, on average, other subjects are **choosing today** to complete on 01/26/16 at the following wages?

| Wage | Rounds |
|---|---|

**Decisions made on 01/26/16 when the time to do the work comes**

**When the time comes to actually do the work on 01/26/16**, how many extra one-minute rounds do you think, on average, other subjects will want to do at the following wages?

| Wage | Rounds |
|---|---|

# Recent additional work using real effort

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

| Parameter | Without attrited participants | With attrited participants |
|---|---|---|
| **Present bias** $\beta$ | **0.8589** | **0.8151** |
| | *(0.0330)* | *(0.0335)* |
| **Self-prediction** $\beta_{(s)}$ | **1.0502** | **1.0306** |
| | *(0.0629)* | *(0.0523)* |
| **Other-prediction** $\beta_{(o)}$ | **0.8711** | **0.8715** |
| | *(0.0349)* | *(0.0314)* |

# 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

| | Choice at $t$ | | |
|---|---|---|---|
| Choice at $t-1$ | Welfare | Work | Home |
| Welfare | | | |
| Row % | 84.3 | 3.5 | 12.3 |
| Column % | 76.7 | 6.3 | 17.9 |
| Work | | | |
| Row % | 5.3 | 79.3 | 15.3 |
| Column % | 2.6 | 76.4 | 12.1 |
| Home | | | |
| Row % | 28.3 | 12.0 | 59.7 |
| Column % | 20.7 | 17.3 | 70.0 |

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

# Error 2. Naives with Yearly Decisions

However: Simulate decision at **yearly** horizon.

- BUT: At yearly horizon naives do not procrastinate:
  - Compare:
    - Switch now
    - Forego *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

| Parameters | | (1) Time Consistent Estimate | (1) Time Consistent S.E. | (2) Present-Biased (sophisticated) Estimate | (2) Present-Biased (sophisticated) S.E. | (3) Present-Biased (Naive) Estimate | (3) Present-Biased (Naive) S.E. |
|---|---|---|---|---|---|---|---|
| Preference Parameters | | | | | | | |
| Discount Factors | $\beta$ | 1 | n.a. | 0.33802 | 0.06943 | 0.355 | 0.0983 |
| | $\delta$ | 0.41488 | 0.07693 | 0.87507 | 0.01603 | 0.868 | 0.02471 |
| Net Stigma (by type) | $\phi^{(1)}$ | 7537.04 | 774.81 | 8126.19 | 834.011 | 8277.46 | 950.77 |
| | $\phi^{(2)}$ | 10100.9 | 1064.83 | 10242.01 | 955.878 | 10350.20 | 1185.27 |
| | $\phi^{(3)}$ | 13333.2 | 1640.18 | 12697.25 | 1426.40 | 12533.69 | 1685.92 |

- 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

- Example 2. Shui and Ausubel (2005) $\rightarrow$ Estimate Ausubel (1999)
  - 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]

| | Sophisticated Hyperbolic | Naive Hyperbolic | Exponential |
|---|---|---|---|
| $\beta$ | 0.7863 | 0.8172 | |
| | (0.00192) | (0.003) | |
| $\delta$ | 0.9999 | 0.9999 | 0.9999 |
| | (0.00201) | (0.0017) | (0.00272) |
| $k$ | 0.02927 | 0.0326 | 0.1722 |
| | \$293 | \$326 | \$1,722 |
| | (0.00127) | (0.00139) | (0.0155) |

# 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

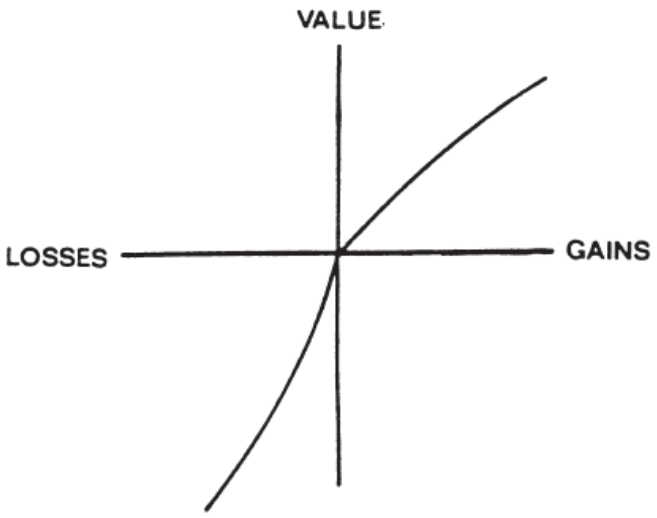
- Subjects evaluate a lottery $(y, p; z, 1-p)$ as follows: $\pi(p)\, v(y-r) + \pi(1-p)\, v(z-r)$

**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 $r \rightarrow$ Explains Experiment 3 Result

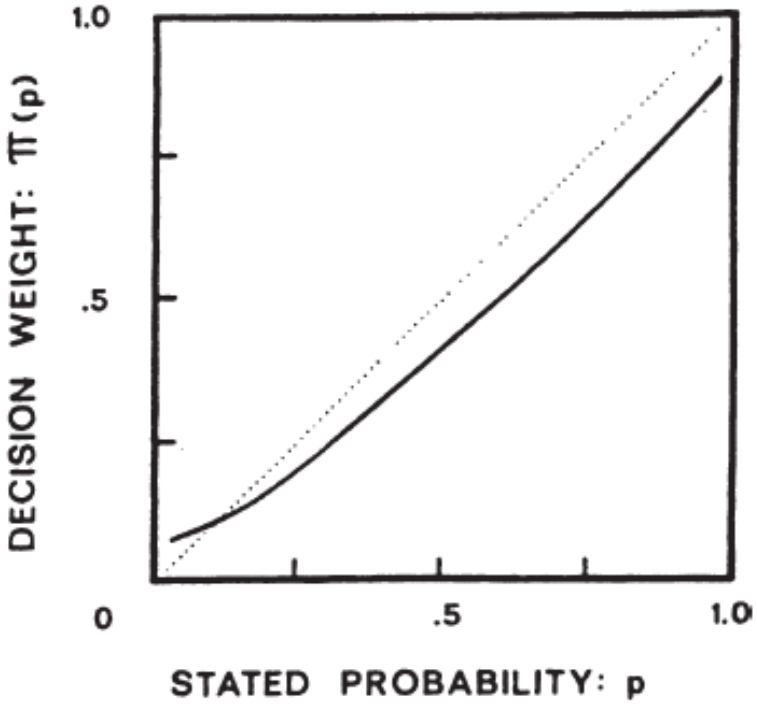
# Prospect Theory Features

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

$$v(x) = \begin{cases} (x-r)^{.88} & \text{if } x \geq r; \\ -2.25\left(-(x-r)\right)^{.88} & \text{if } x < r, \end{cases}$$

and

$$w(p) = \frac{p^{.65}}{\left(p^{.65} + (1-p)^{.65}\right)^{1/.65}}$$

# 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

# 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

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

- 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 $\rightarrow$ Bunching at $e^* = r$
  - Implication 2 $\rightarrow$ Missing mass of distribution for $e < r$ compared to $e > r$

# Bunching

- 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 contiuity of distribution

Examine four related applications:

1. Tax filing
   - Effort: Tax elusion
   - Reference point: Withholding amount
2. Property Tax Protests
   - Effort: How hard to protest the tax assessment
   - Reference point: Last year's assessment

# Bunching

3. Marathon running
   - Effort: Running
   - Reference point: Round goal
4. Merger
   - Effort: Pushing for higher price
   - Reference point: 52-week high
5. Golf
   - Effort: Effort in play
   - Reference Point: At par

# Bunching

Three more related cases next lecture:

6. Labor supply
   - Effort: Work more hours
   - Reference point: Expected daily earnings?
7. Housing
   - Effort: Pushing for higher listing price
   - Reference point: Purhase price
8. Job search
   - Effort: Search for a job
   - Reference point: Recent average earnings

# Section 5

# Reference Dependence: Tax Elusion

# Alex Rees-Jones (2018)

- **Rees-Jones (RES, 2018).** 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:

$$\max_{s \in \mathbb{R}^+} \quad \underbrace{(w - b^{PM} + s)}_{\text{linear utility over money}} \quad - \quad \underbrace{c(s)}_{\text{cost of sheltering}}$$

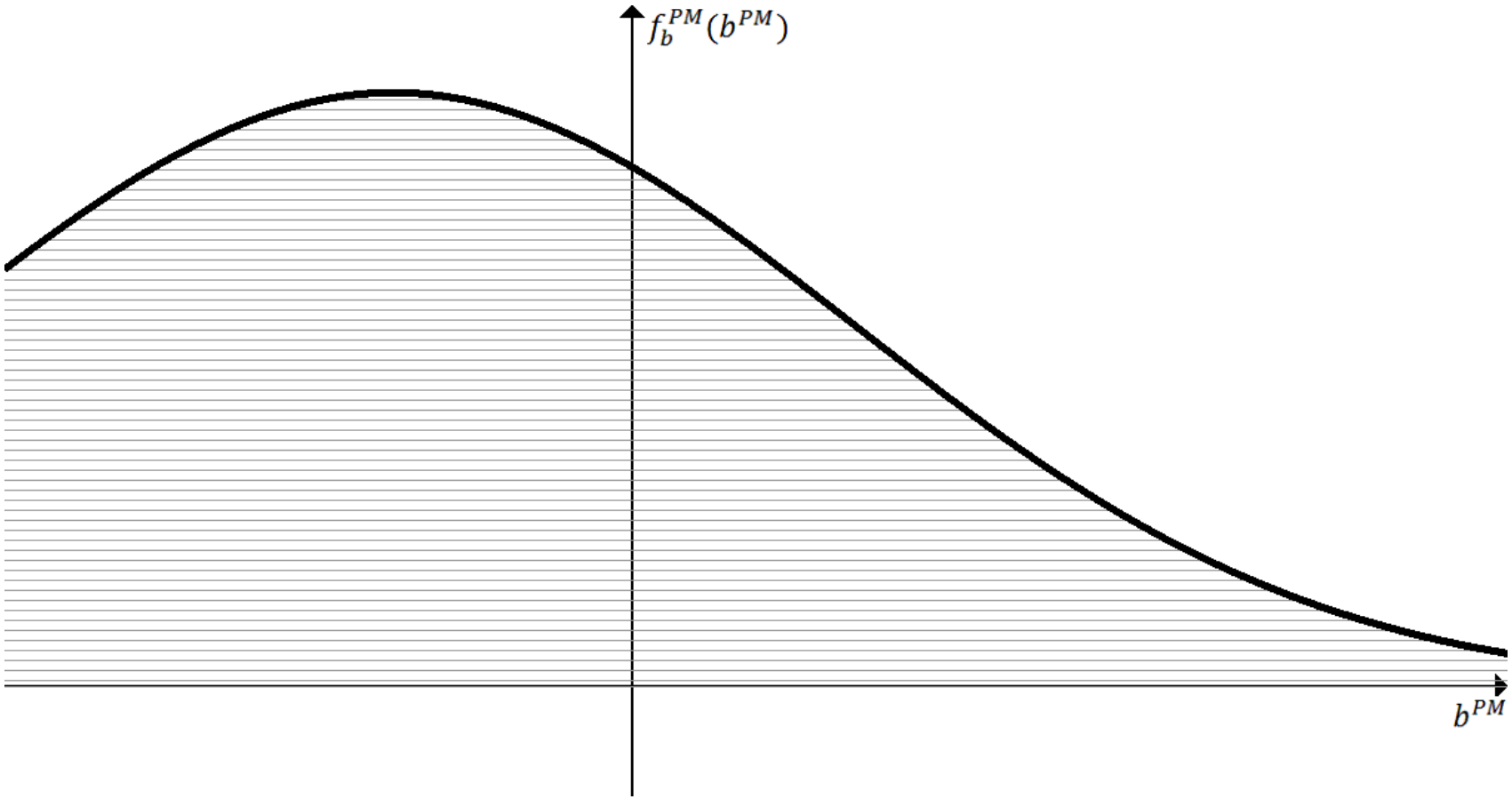
Optimal sheltering is determined by the first-order condition:

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

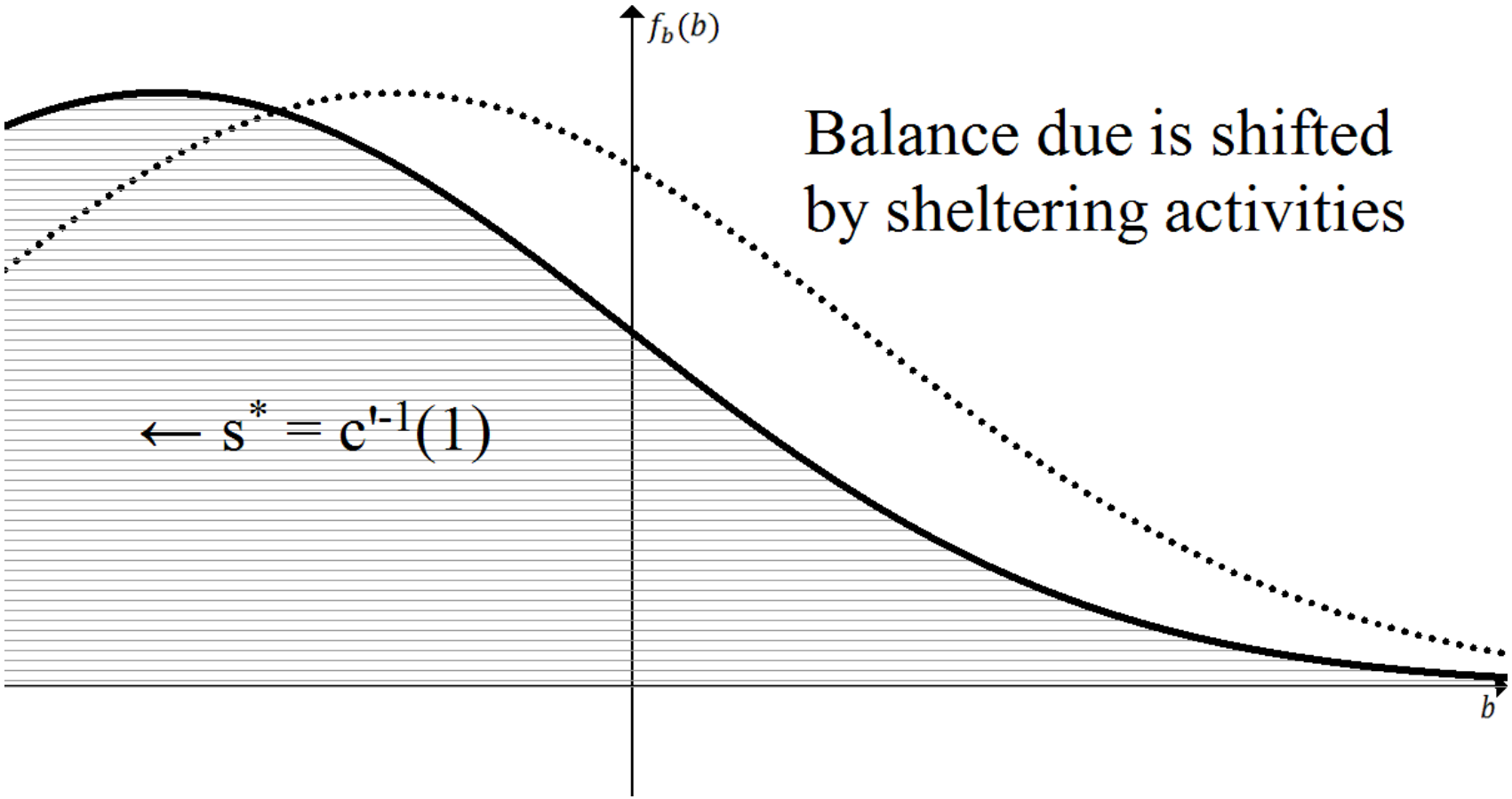
Optimal sheltering solution: $s^* = c'^{-1}(1)$.

→ 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



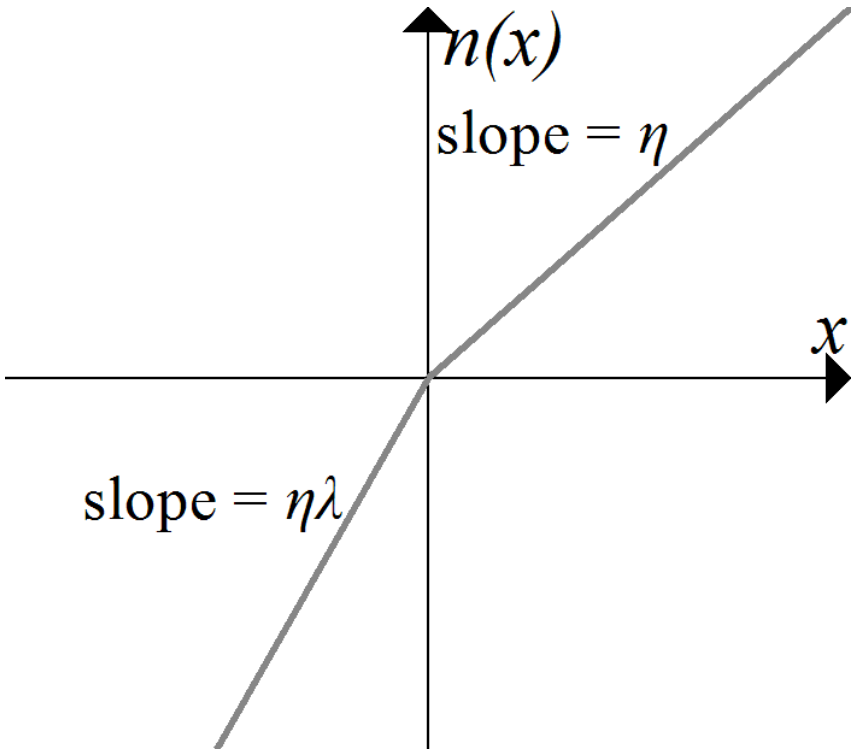
# Loss-averse case

$$\max_{s \in \mathbb{R}^+} \quad \underbrace{m(-b^{PM} + s)}_{\text{utility over money}} \quad - \quad \underbrace{c(s)}_{\text{cost of sheltering}}$$

Loss-averse utility specification:

$$\underbrace{(w - b^{PM} + s)}_{\text{consumption utility}} + \underbrace{n(-b^{PM} + s - r)}_{\text{gain-loss utility}}$$

$$n(x) = \begin{cases} \eta x & \text{if } x \geq 0 \\ \eta \lambda x & \text{if } x < 0 \end{cases}$$



# Optimal loss-averse sheltering

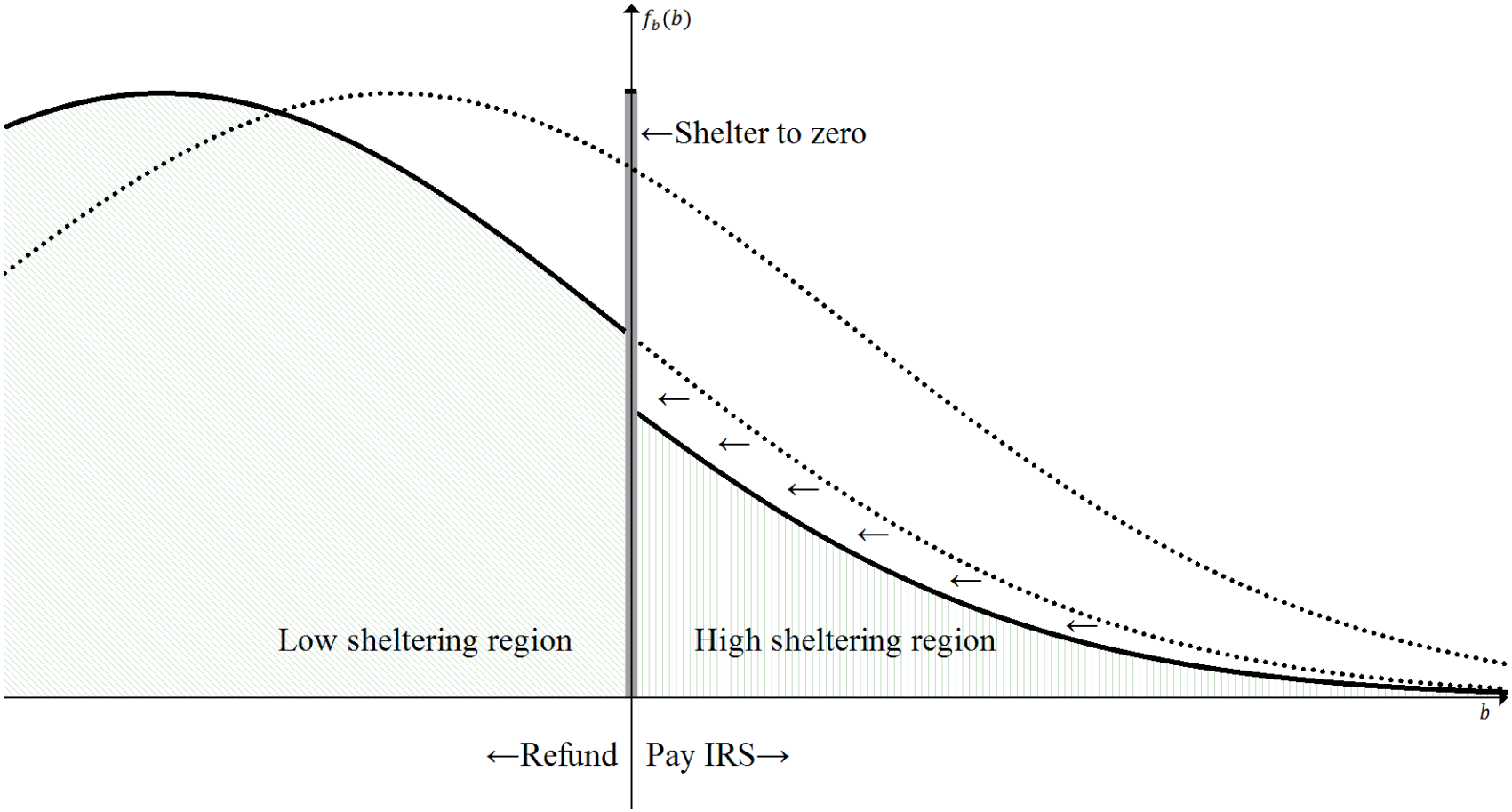
This model generates an optimal sheltering solution with different behavior across three regions:

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

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.

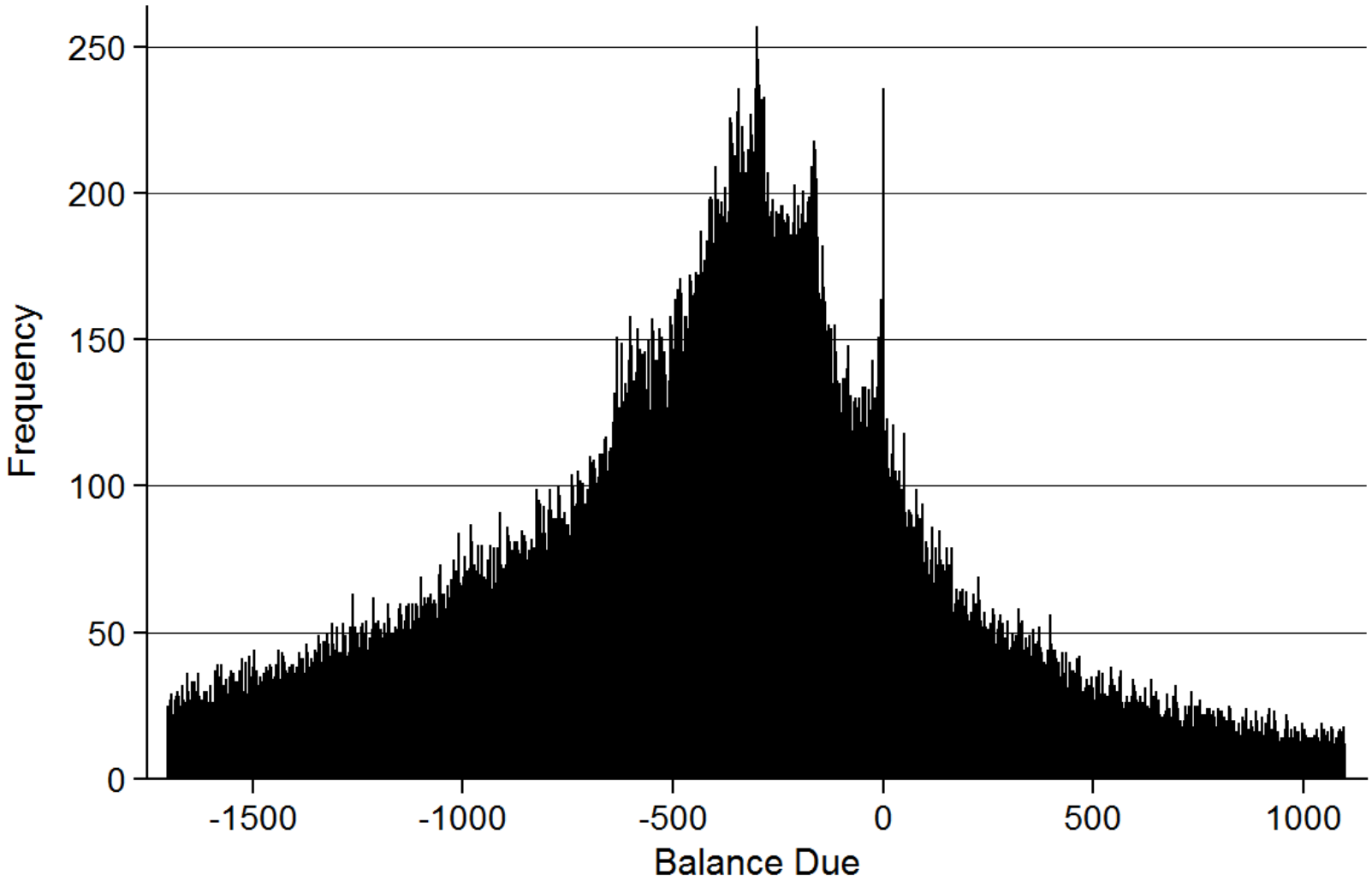
- Contains most information from Form 1040 and some related schedules.
- Randomized by SSNs.

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

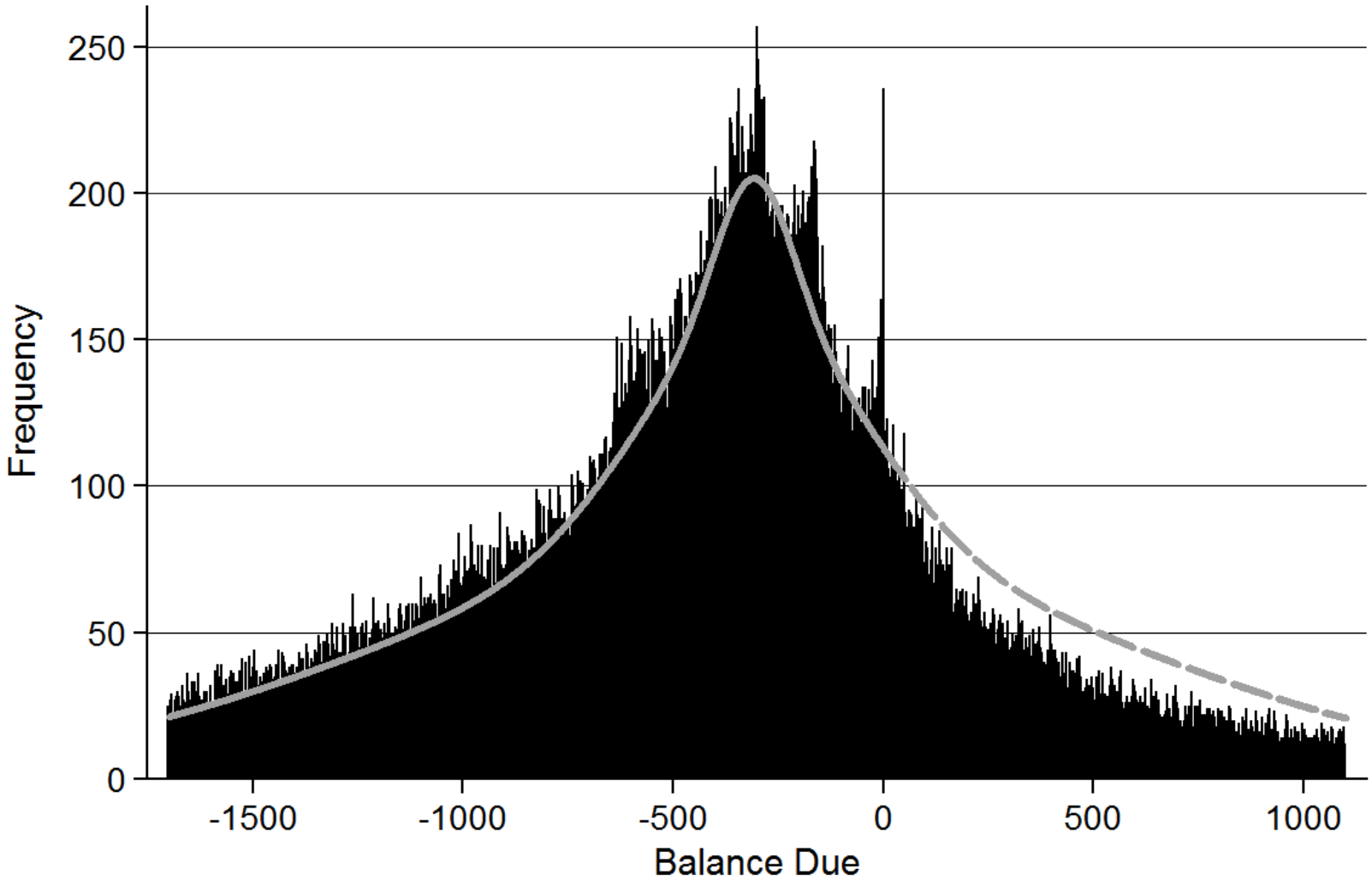
Exclude individuals with zero pre-credit tax due, individuals with zero tax prepayments.

Primary sample: $\approx 229k$ tax returns, $\approx 53k$ tax filers.

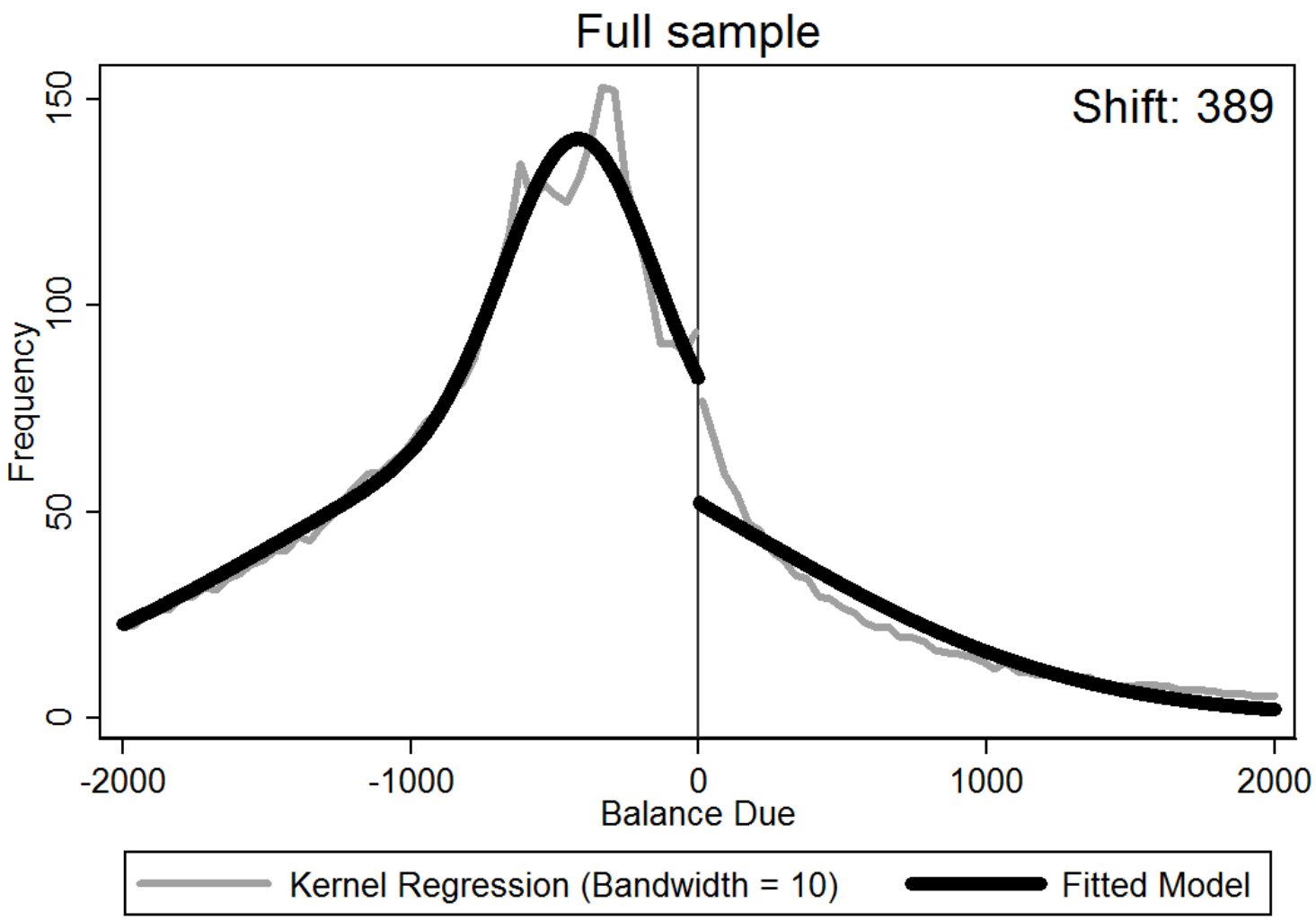
# First look: distribution of nominal balance due



# First look: distribution of nominal balance due

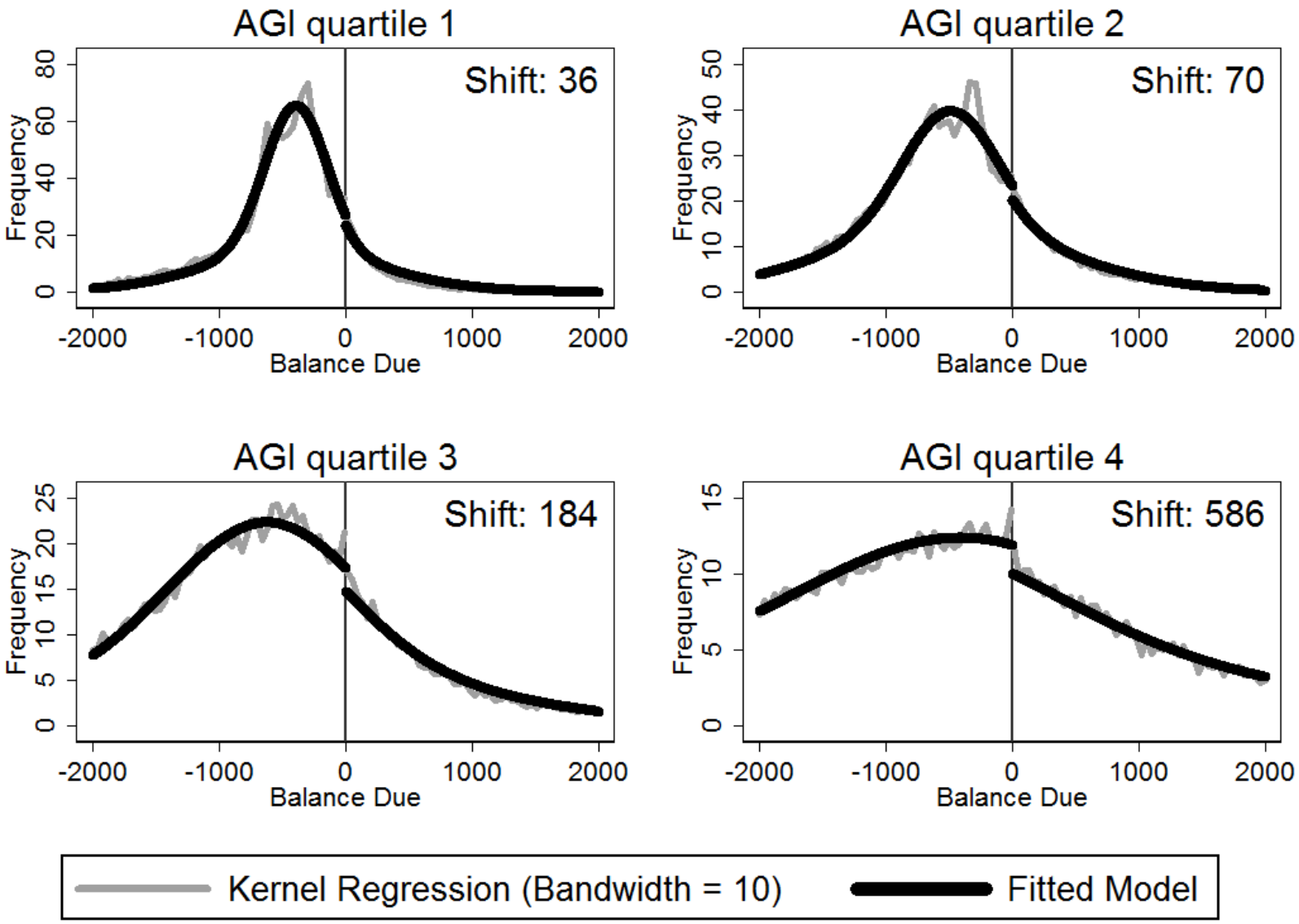


# Fit of predicted distributions




Estimate table

# Fit of predicted distributions



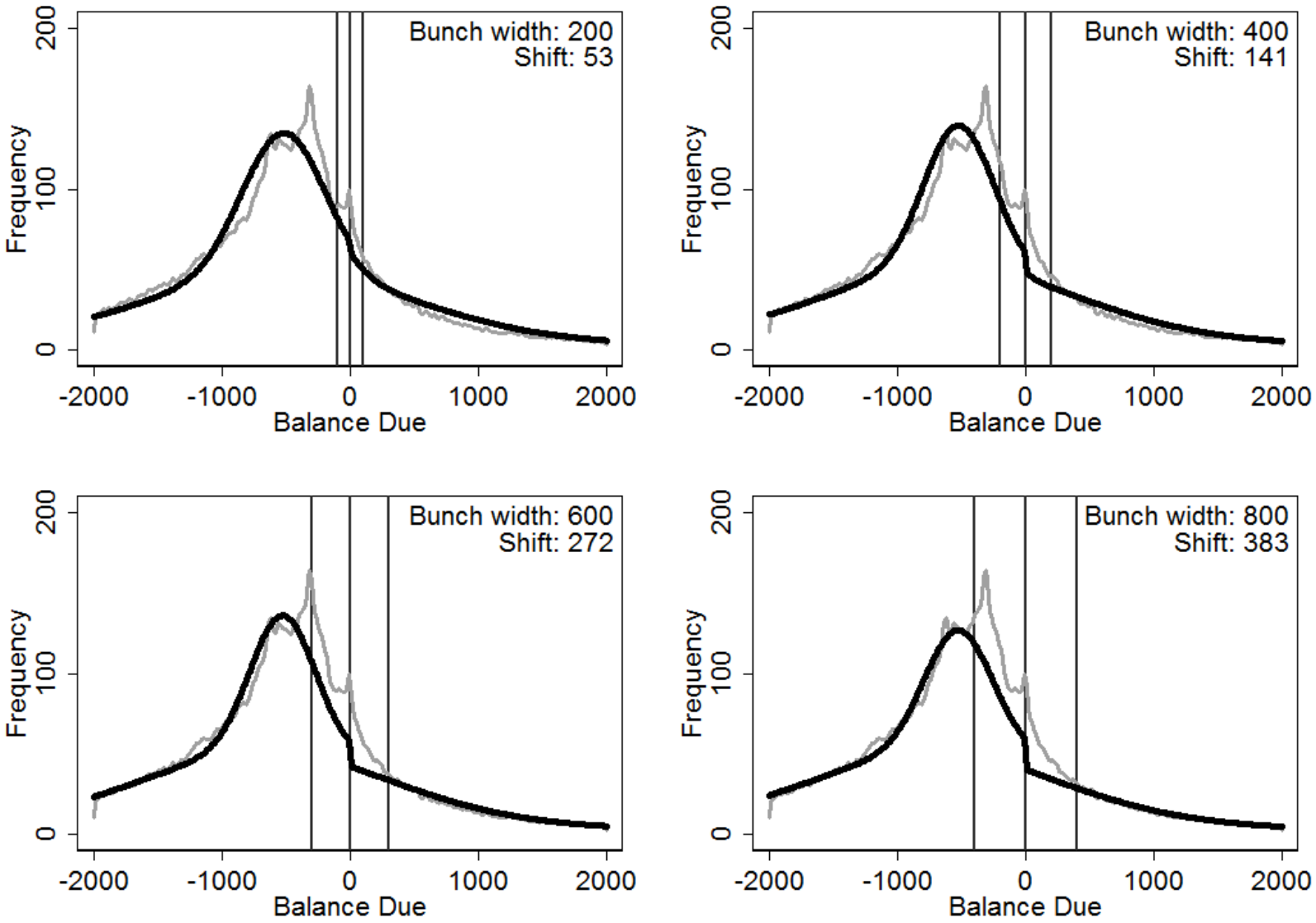
# Rationalizing differences in magnitudes

**What drives the differences in the bunching and shifting estimates?**

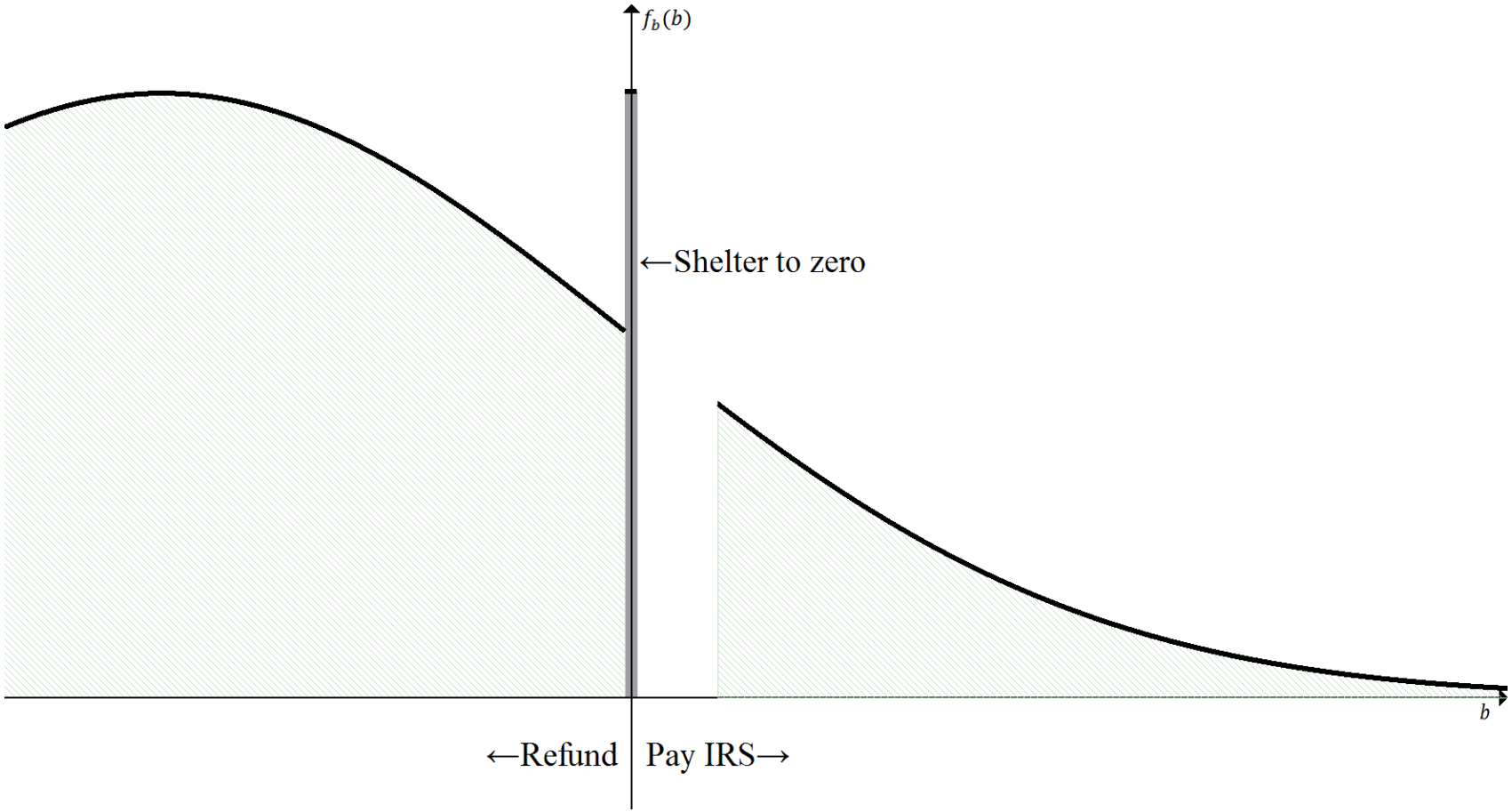
Primary explanation: assumption that sheltering can be manipulated to-the-dollar.

- 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



# Distribution with fixed cost in loss domain




Back

# Section 6

# Reference Dependence: Property Tax Protests

# Jones (2020)

- **Jones (2020).** Protest of property tax assessments
  - Can lower taxes due expending effort with a protests
  - Important setting with clear reference point: last year's assessment
- Slides courtesy of Peter

# The Premise

*1. Propose Previous Year's Assessed Value serves as a salient reference point to homeowners.*

*2. Are homeowners loss averse with respect to increases in their property's assessed value?*

**Homeowner Louisa**
**Over-Assessed by $X**

**Assessment Increased**
**Framed as Loss**

**Homeowner Ginny**
**Over-Assessed by $X**

**Assessment Decreased**
**Framed as Gain**

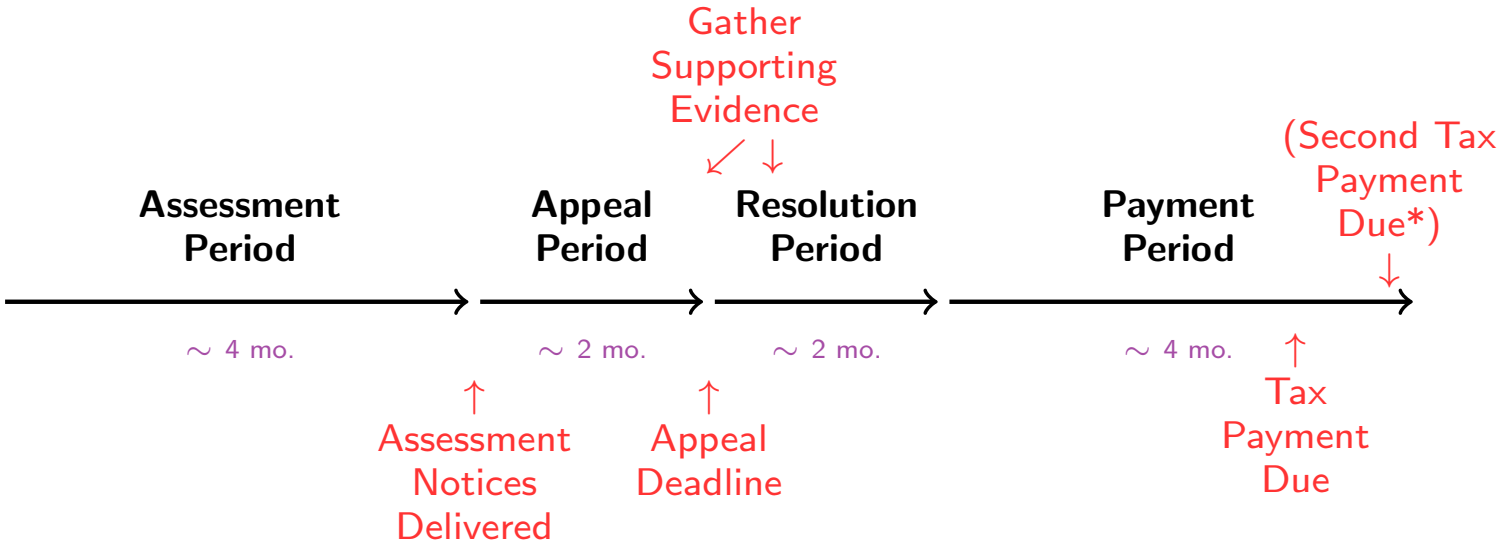
# Property Taxes in the U.S.

- Commonly cited as the most disliked and "unfair" tax (Cabral & Hoxby, 2018)
- Homeownership rate 65% in 2018Q4[1]
- Homeowners' Property Tax Liabilities in 2017:[2]
  - Total: ∼$235 Billion
  - Median: ∼$2,150
  - Mean: ∼$3,100
  - As Percent of HH Income: 3%
  - As Percent of GDP: $> 1.2\%$
- *Ad valorem* tax based on property value
- Usually funds local public goods: schools, police, firemen, recreational parks and facilities, roads, public transportation, utilities

[1] U.S. Bureau of the Census, Homeownership Rate for the United States [Series RHORUSQ156N]

[2] All estimated from the ACS.

# Typical Assessment Cycle



# Why Previous Year's Assessed Value as Reference Point?

| APPRAISED VALUE | |
|---|---|
| Last Year's Appraised Value | **This Year's Appraised Value** |
| **105,230** | **119,067** |

| JURISDICTIONS AND EXEMPTION INFORMATION | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Taxing Jurisdiction | | Last Year's Exemptions Amount | Last Year's Value After Exemptions | Exemptions Granted This Year (see explanation of codes below) | This Year's Exemptions Amount | This Year's Value After Exemptions | Last Year's Tax Rate | This Year's Estimated Taxes |
| 001 | HOUSTON ISD | 72,000 | 69,184 | RES | 38,813 | 80,254 | 1.156700 | 928.30 |
| 040 | HARRIS COUNTY | 47,000 | 84,184 | RES | 23,813 | 95,254 | 0.391170 | 372.61 |
| 041 | HARRIS CO FLOOD CNTRL | 47,000 | 84,184 | RES | 23,813 | 95,254 | 0.028090 | 26.76 |
| 042 | PORT OF HOUSTON AUTHY | 47,000 | 84,184 | RES | 23,813 | 95,254 | 0.018560 | 17.68 |
| 043 | HARRIS CO HOSP DIST | 47,000 | 84,184 | RES | 23,813 | 95,254 | 0.192160 | 183.04 |
| 044 | HARRIS CO EDUC DEPT | 47,000 | 84,184 | RES | 23,813 | 95,254 | 0.006581 | 6.27 |
| 048 | HOU COMMUNITY COLLEGE | 23,500 | 94,707 | RES | 11,907 | 107,160 | 0.097222 | 104.18 |
| 061 | CITY OF HOUSTON | 47,000 | 84,184 | RES | 23,813 | 95,254 | 0.638750 | 608.43 |

The percentage difference between the 2007 appraised value of your property and the proposed 2018 appraised value is 66%.

# Model: Infrastructure

Homeowner tax liabilities in year $t$ are described by,

$$T_t = \overbrace{\tau_t}^{\text{Tax Rate}} \cdot \overbrace{(V_t + \underbrace{\varepsilon_t}_{\text{Noise}})}^{\text{Assessed Value, } \mathbf{A_t}}.$$

Homeowner has *reference-dependent utility*,

$$u(T_t, e_t | r_t) = \overbrace{v(T_t | r_t)}^{\text{Gain/Loss Utility from Taxes}} - \overbrace{\kappa(e_t)}^{\text{Protest Choice \& Effort Cost}}$$

with backward-looking *reference point*,

$$r_t \equiv \tau_{t-1} \cdot A_{t-1} = T_{t-1}.$$

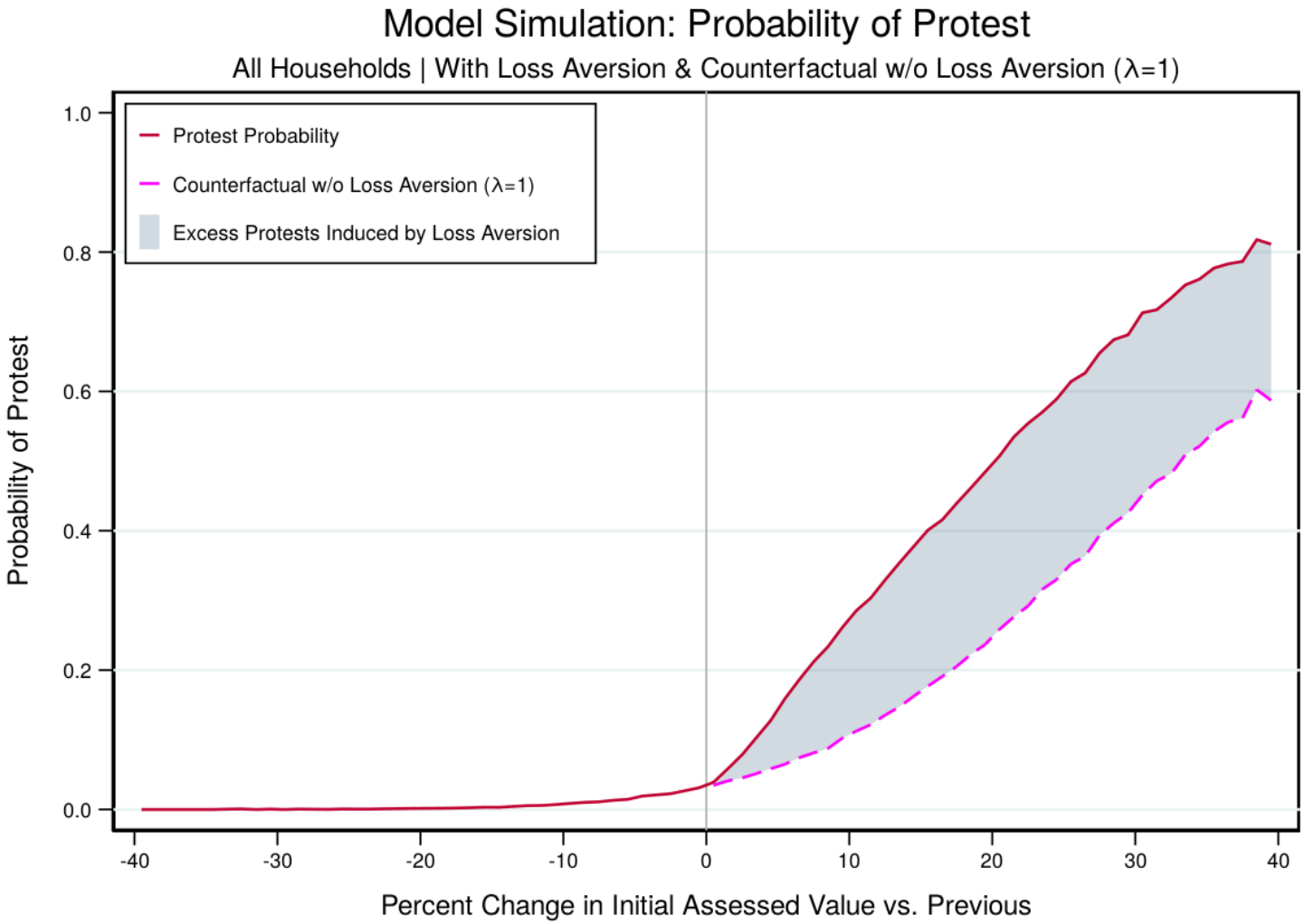
# Prediction 1: Kink in Probability of Protest at Ref. Point

**Kink Prediction**

*With $\lambda > 1$, the slope of the conditional expectation of protesting given a homeowner's percent change in Initial Assessed Value will increase at exactly the reference point, resulting in a CEF that is kinked at zero percent change in assessment.*

*Equivalently, the elasticity of protesting with respect to percent change in Initial Assessed Value is larger above of the reference point as compared with below.*

# Prediction 1: Kink in Probability of Protest at Ref. Point

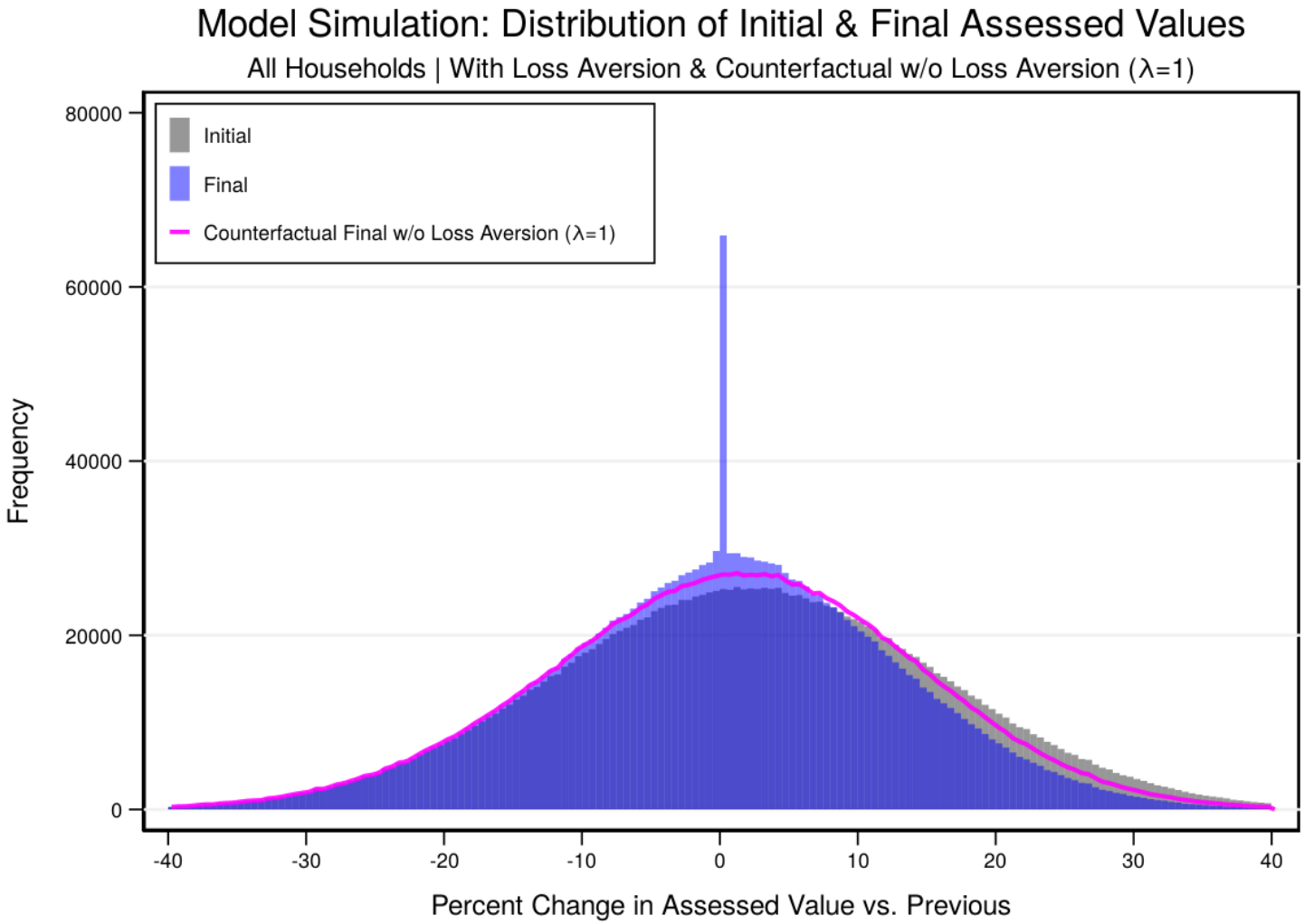


# Prediction 2: Bunching at Reference Point

**Bunching Prediction**

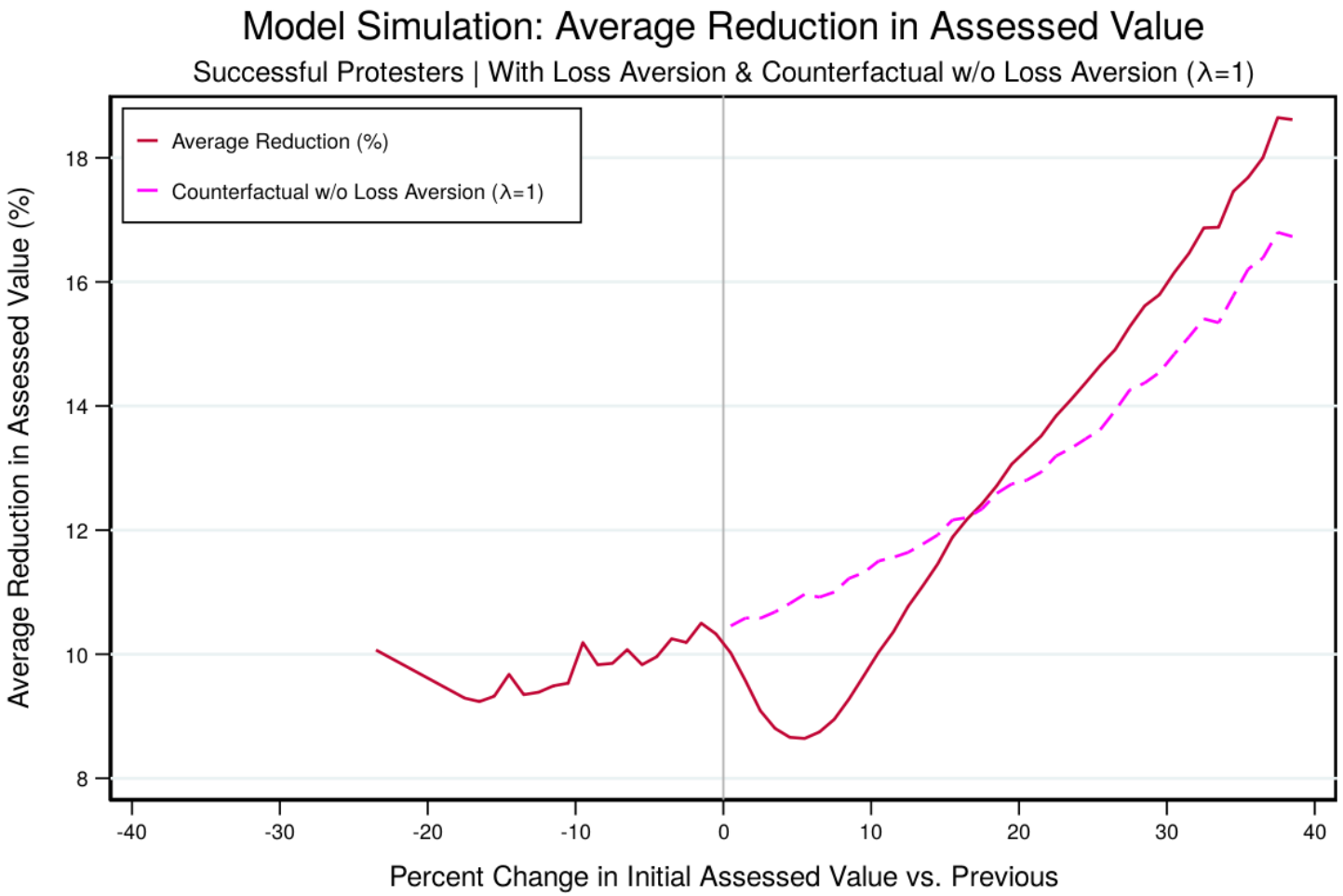
*If $\lambda > 1$, homeowners will seek value reductions that result in Final Assessed Value exactly at the Previous Assessed value, resulting in a final distribution that exhibits bunching at no change in assessed value (the reference point).*

# Prediction 2: Bunching at Reference Point



# Drop in Value Reduction at Reference Point

## Reduction Prediction




Note: Meausured as a percent of previous assessed value.
Simulated estimates with SE of simulated mean greater than 1 not included in figure.
Smoothed using a triangle kernel smoother.

# Model Prediction Recap

1. Kink in the Probability of Protest (extensive margin, initial assessments)
   - Eventually extensive margin effect wears off $\rightarrow$ probability flattens
2. Bunching in the Distribution Final Assessments (intensive margin)
3. Bunching in the Distribution of Opinion of Value (intensive margin)
4. Drop in Average Reduction Received by Protesters just barely in loss domain (extensive margin)

# Data & Summary Statistics

## Annual Assessment, Protest Admin Records from Texas

| | | Harris County (2005-2016, Ex. Crisis) | | Travis County (2011-2018) | |
|---|---|---|---|---|---|
| | | Mean | Median | Mean | Median |
| *Property-Year Level** | Initial Assessed Value | $171,000 | $121,000 | $328,000 | $255,000 |
| | $Log(A_t/A_{t-1})$ \| *Reassessed* | 0.082 | 0.077 | 0.078 | 0.078 |
| | Reassessed | 58.4% | | 93% | |
| | Protested | 18.4% | | 22.1% | |
| | Cap-Eligible | 84.4% | | 82.8% | |
| *Property-Owner Pair Level* | Property-Owner Pair Years | 5.0 | 5 | 4.8 | 5 |
| | Ever-Protested | 33% | | 37% | |
| *Protest Level* | Successful | 68% | | 81% | |
| | Owner-Protested | 44% | | 33% | |
| | Reduction \| Successful | -$21,000 | -$11,000 | -$35,000 | -$22,000 |
| | *Opinion of Value* Observed | 92% | | 12% | |

*Harris County: N = 7.1 Million
*Travis County: N = 1.7 Million

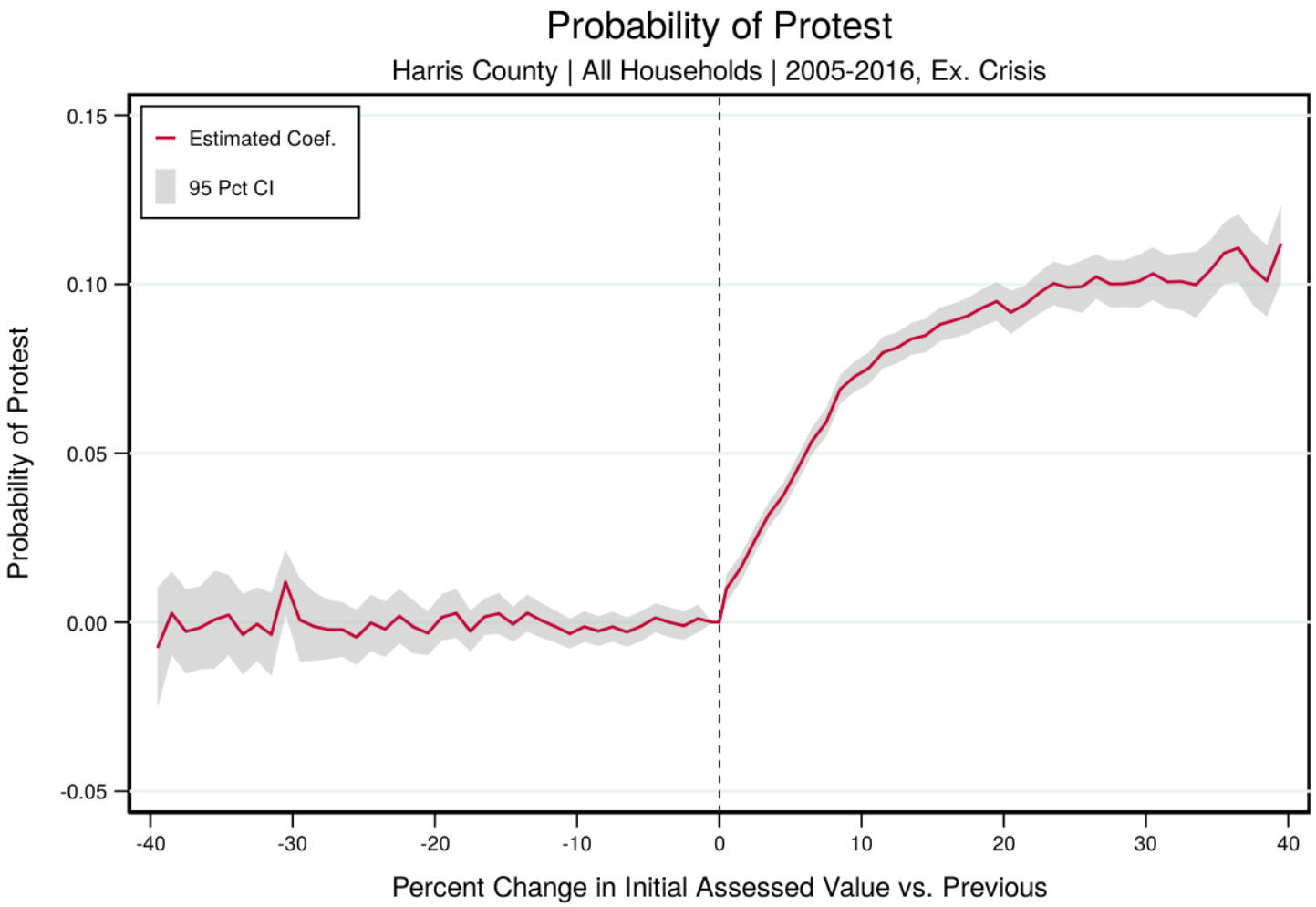
# Samples

## Harris County & Travis County

- Harris County
  - Larger Sample
  - Much better *Opinion of Value* Coverage
  - Properties (neighborhoods) reassessed about every other year, but some exceptions
  - Observable differences in covariates around the threshold of interest could be cause for identification concern
    - Will focus on within-property-owner effects
- Travis County
  - Newly Available Data
  - Properties (neighborhoods) essentially all reassessed annually (especially after 2012)
  - Cleaner sample for identification
    - Will focus on within-property-owner effects
    - Will present identification checks that lend confidence to within-property-owner results from both counties

# Kink in Probability of Protest at Reference Point

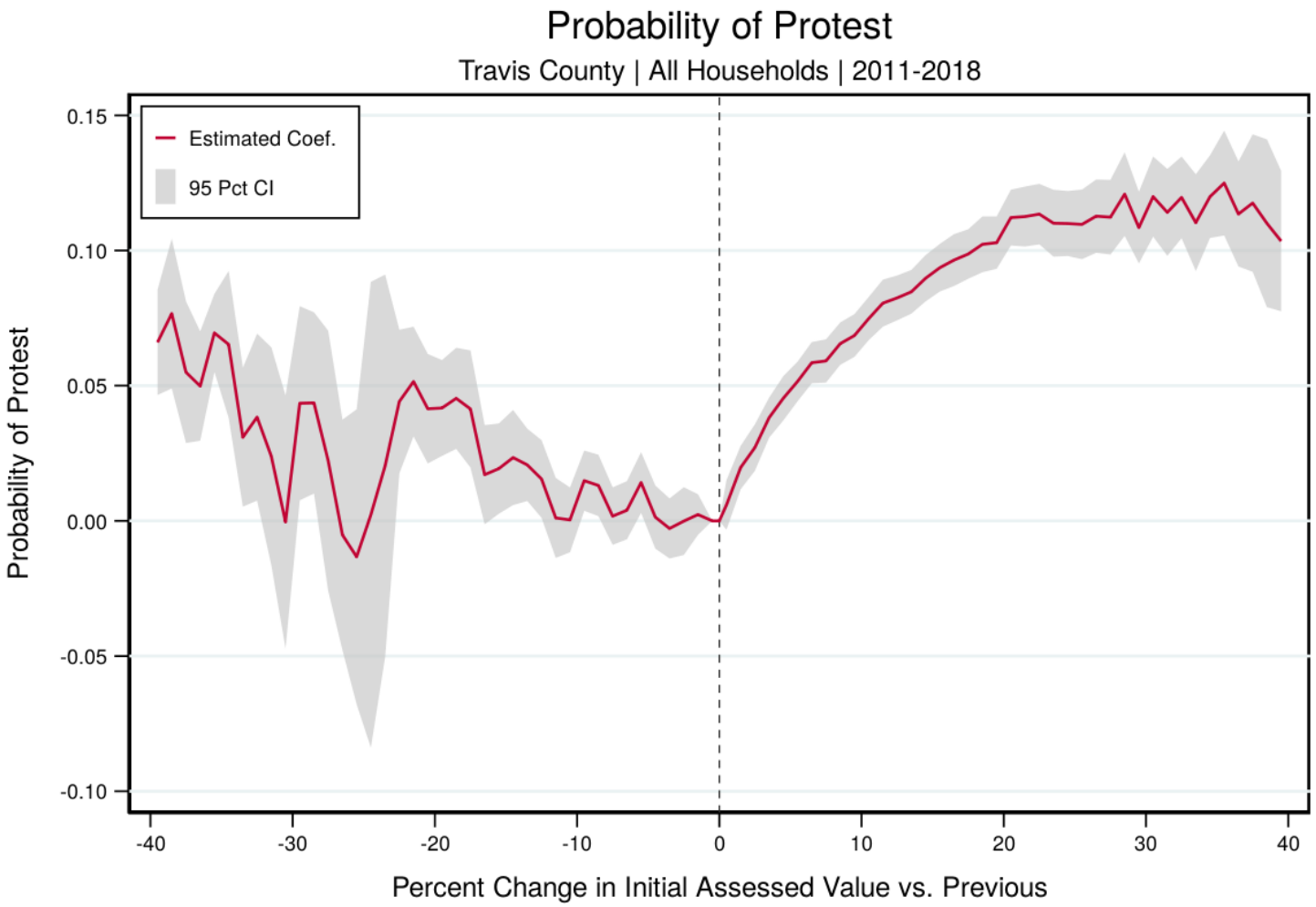
## Harris County




Includes property-owner pair and year FEs. Relative to probability given initial $\%\Delta A_t \in (-1,0)$. SEs clustered at neighborhood level. Running variable defined as log change multiplied by 100.

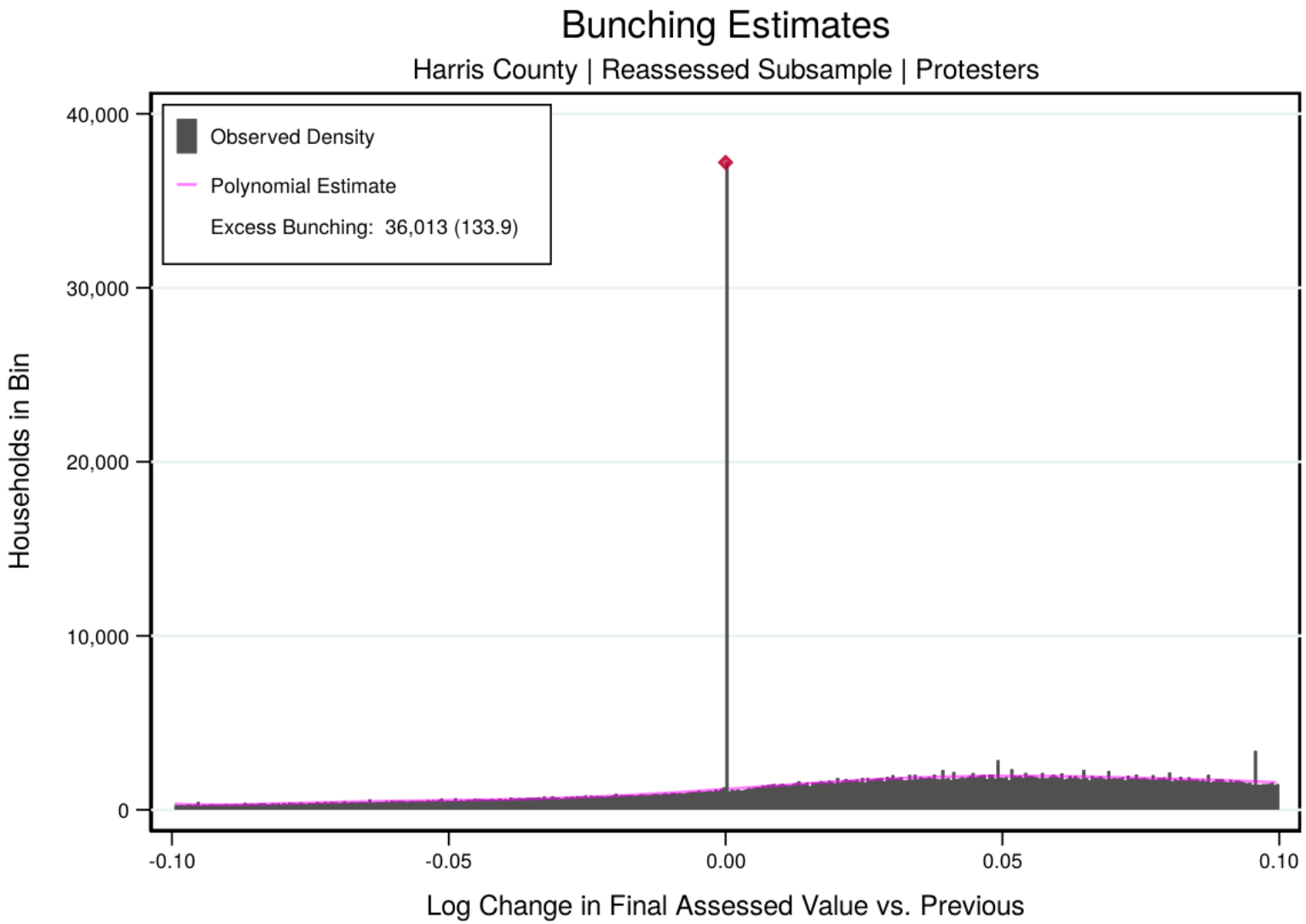
# Kink in Probability of Protest at Reference Point

## Travis County

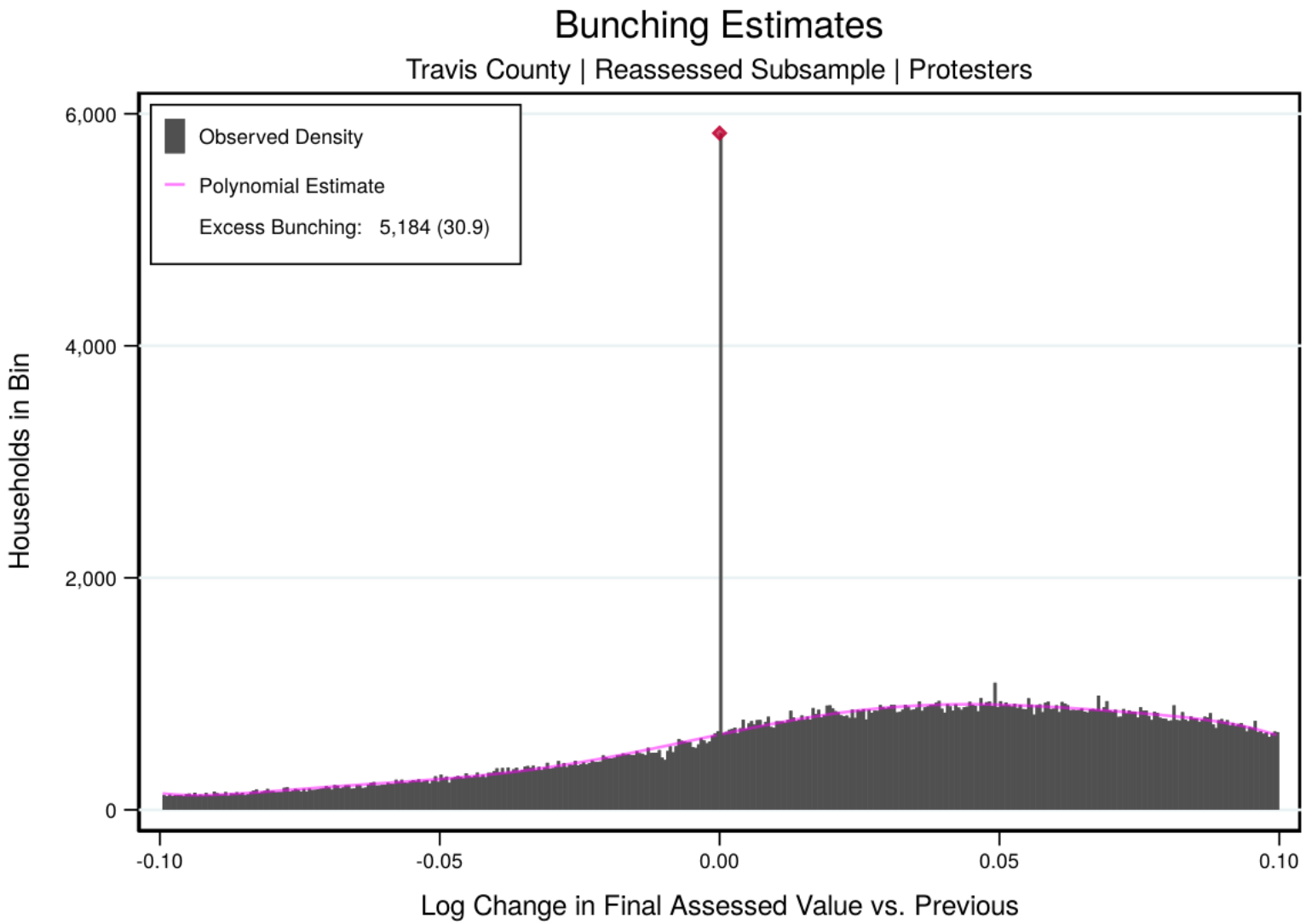



Includes property-owner pair and year FEs. Relative to probability given initial $\%\Delta A_t \in (-1,0)$. SEs clustered at neighborhood level. Running variable defined as log change multiplied by 100.

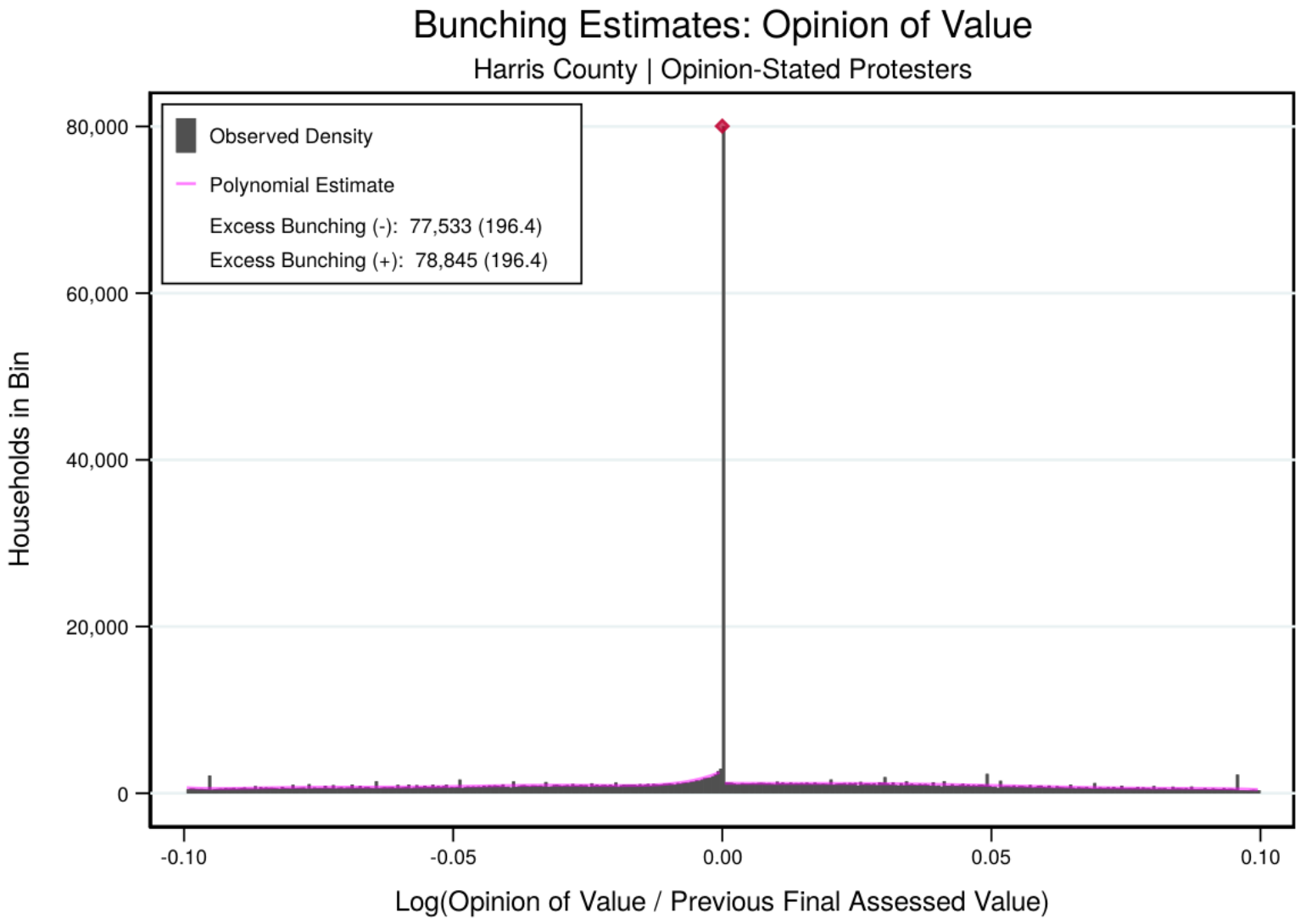
# Estimating Excess Bunching at Reference Point



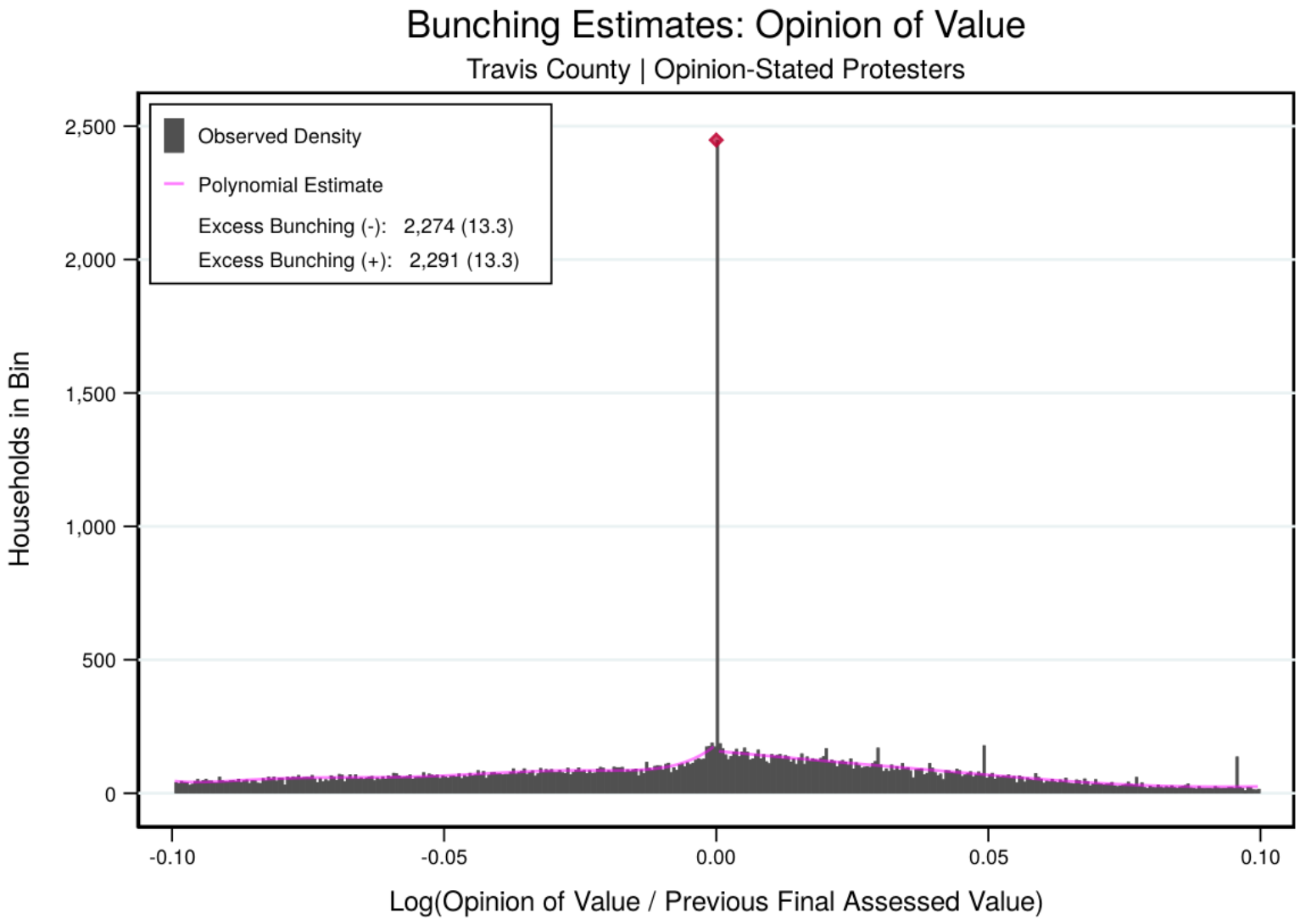
# Estimating Excess Bunching at Reference Point



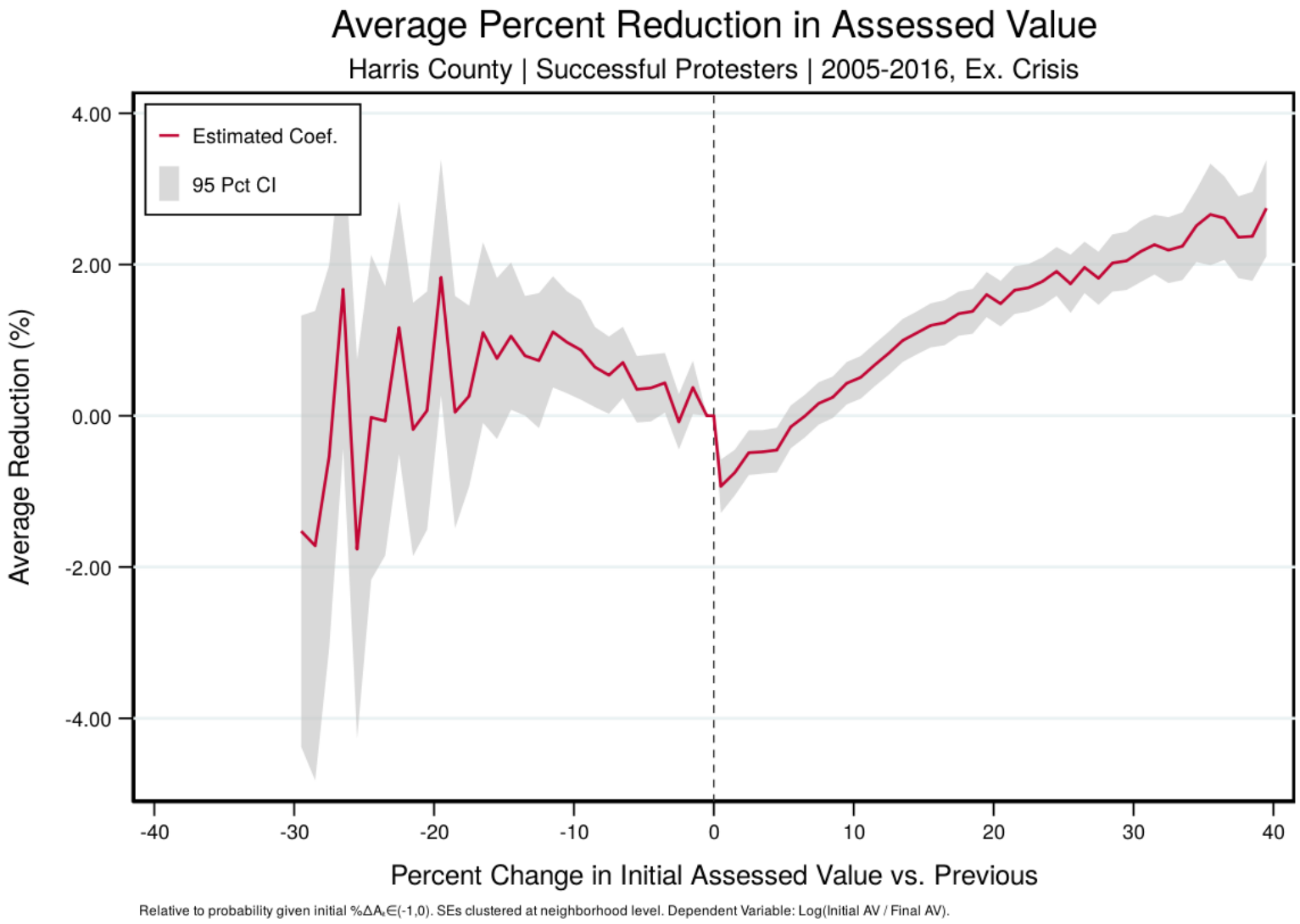
# Excess Bunching at Reference Point: Opinion of Value



# Excess Bunching at Reference Point: Opinion of Value

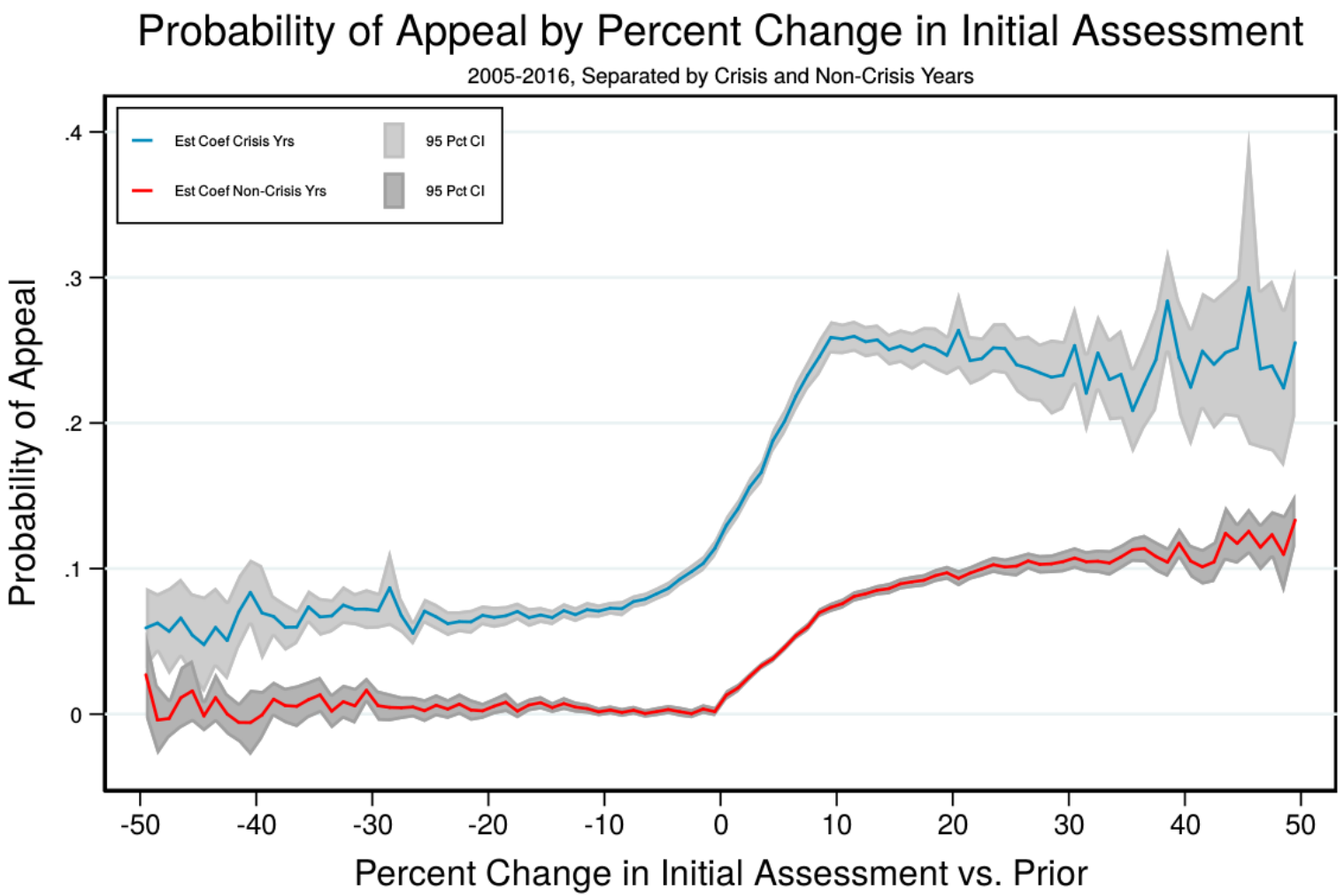


# Examining Reductions in Value near Reference Point



# Adaptive Reference Point? Harris County Crisis Years

## Interpreting as *Suggestive* Evidence Of Partial Adjustment




Note: Results from one-percent window indicator regression with individual and year FEs. Normalized to no change in non-crisis years.
SEs clustered at neighborhood level.

# Section 7

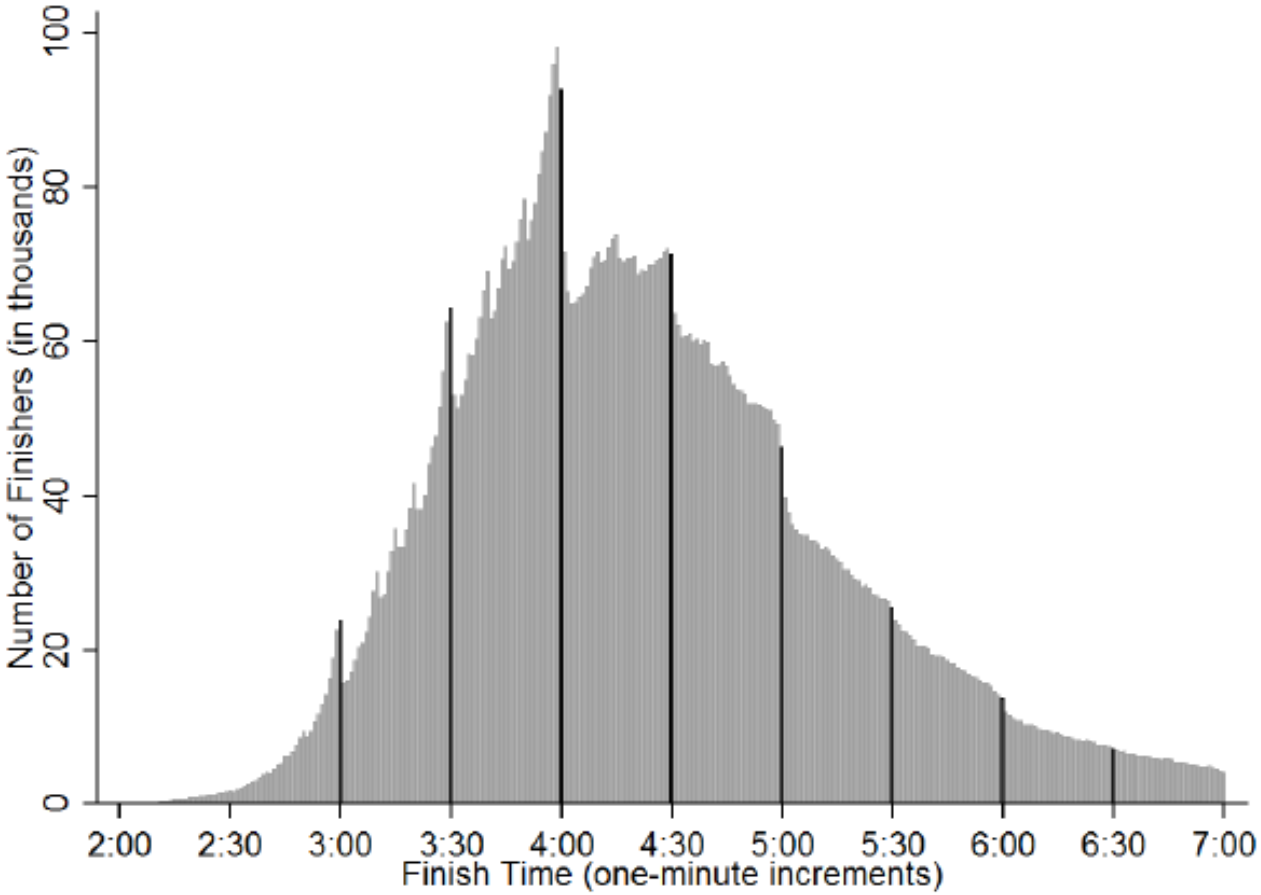
# Reference Dependence: Goal Setting

# Allen, Dechow, Pope, Wu (*MS* 2016)

- 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 ($n = 9,378,546$)



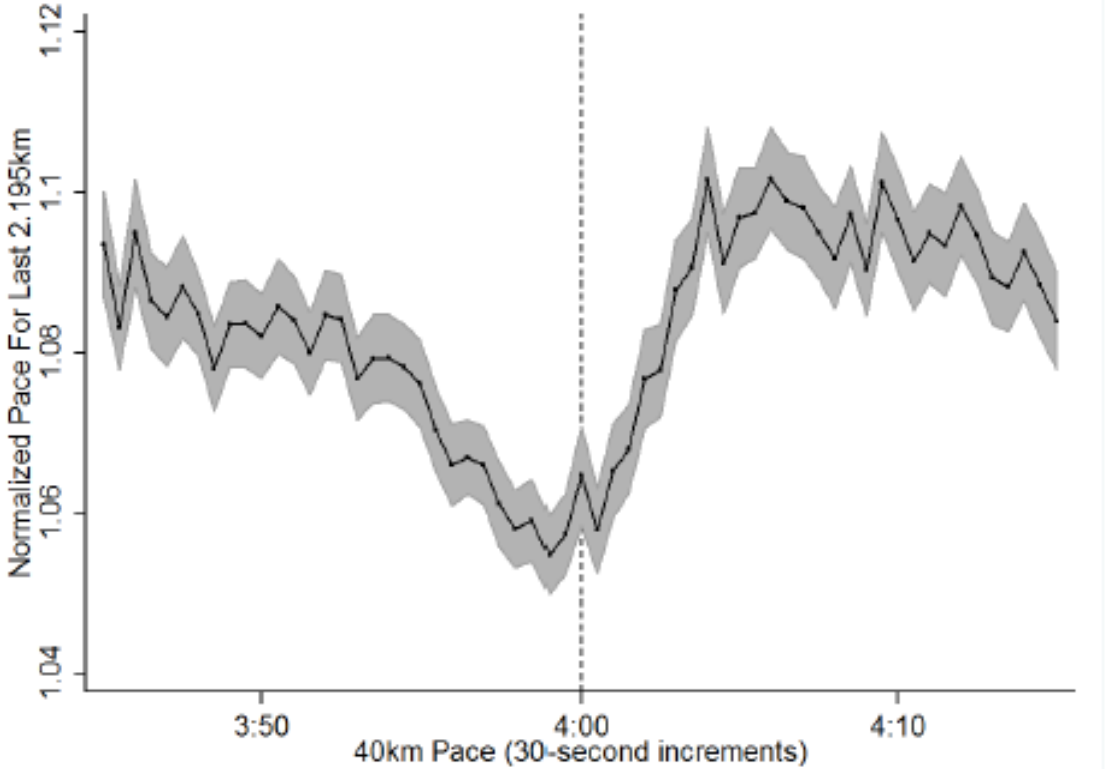

NOTE: The dark bars highlight the density in the minute bin just prior to each 30 minute threshold.

# Intuition

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

Figure 8: Normalized pace for last 2.195 kilometers as a function of 40 kilometer pace

(a) Runners on 3:45 to 4:15 pace through 40 kilometers



# 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 8

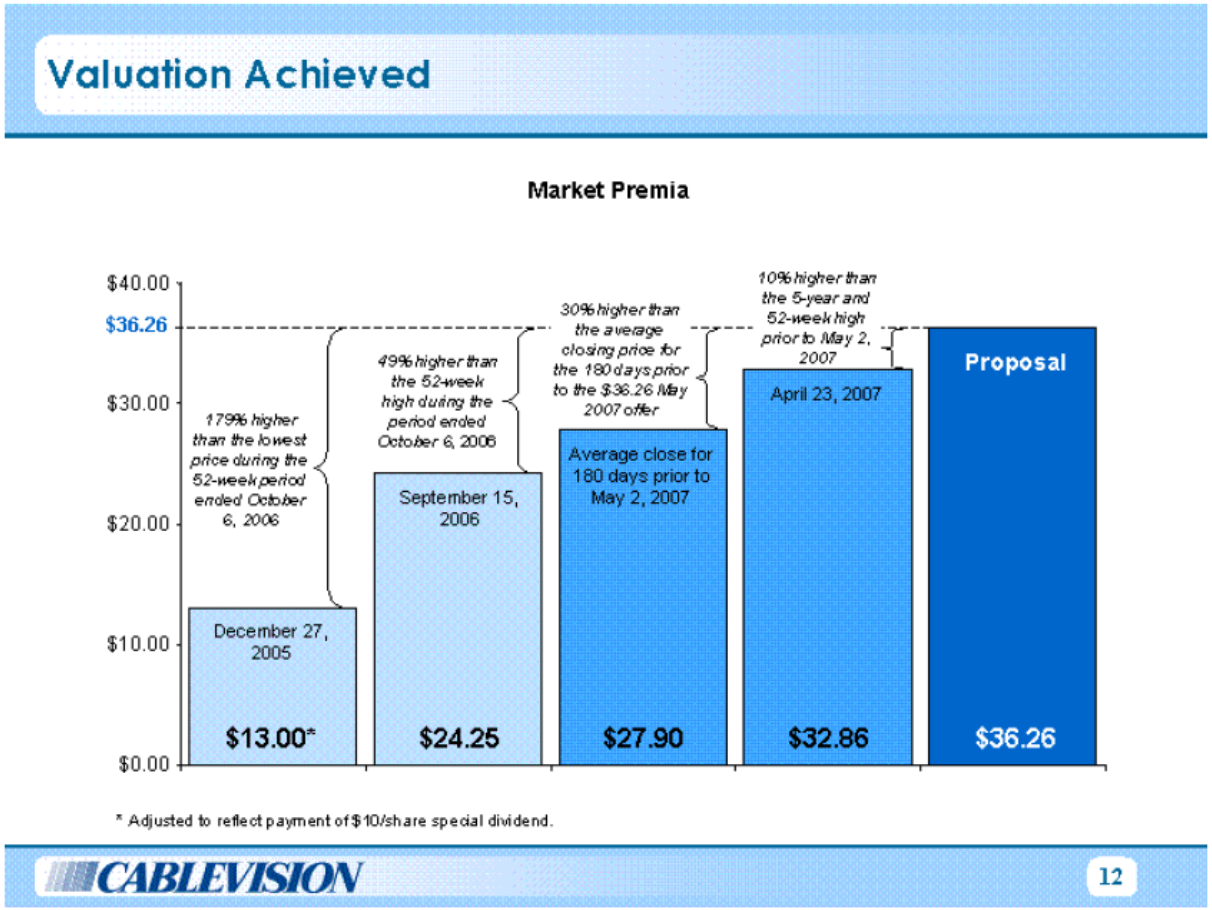
# Reference Dependence: Mergers

# 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.



# 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

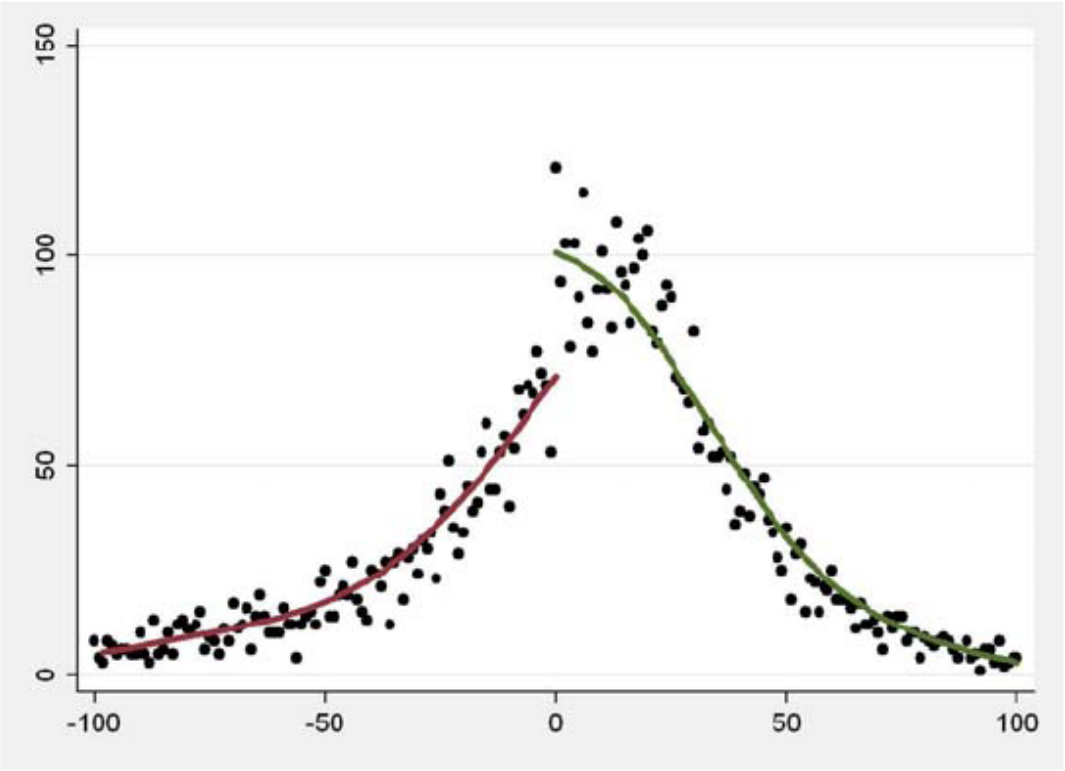
$$v(P|P_0) = \begin{cases} P + \eta(P - P_{52}) & \text{if } P \geq P_{52}; \\ P + \eta\lambda(P - P_{52}) & \text{if } P < P_{52} \end{cases}$$

# 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



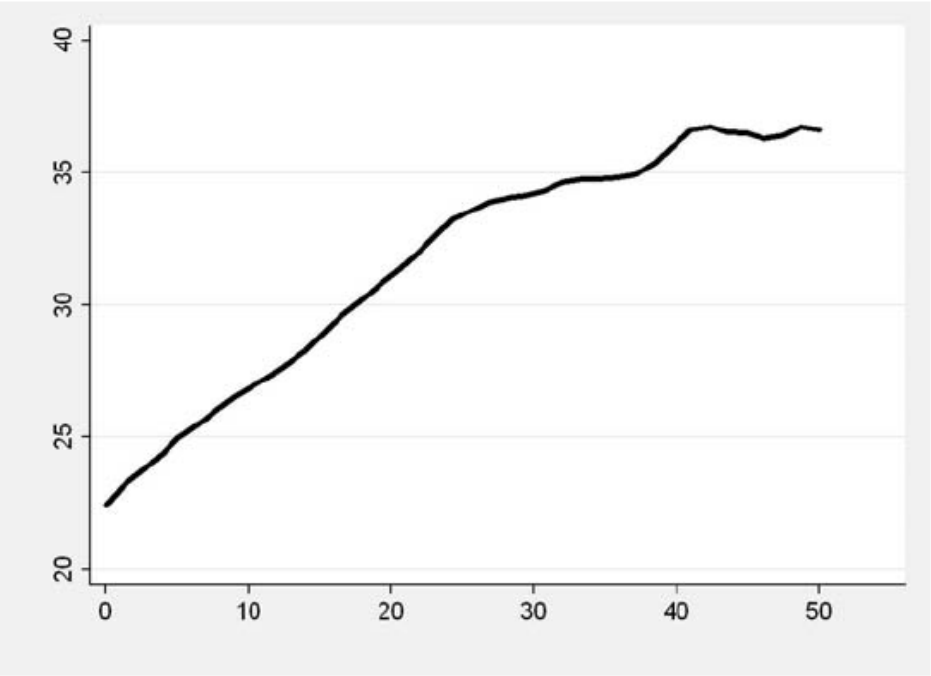
# Test 1: Offer price $P$ around $P_{52}$

- 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 $P_{52}$ :

$$100 * \frac{P - P_{-30}}{P_{-30}} = \alpha + \beta \left[ 100 * \frac{P_{52} - P_{-30}}{P_{-30}} \right] + \varepsilon$$



# 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 $\rightarrow$ 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 $P_{52}/P_{-30}$

**Table 8. Mergers and Acquisitions: Market Reaction.** Ordinary and two-stage least squares regressions of the 3-day CAR of the bidder on the offer premium.

$$r_{t-1\to t+1} = a + b\frac{Offer_{it}}{P_{i,t-30}} + e_{it}$$

$$\left(\frac{Offer_{it}}{P_{i,t-30}} - 1\right)\cdot 100 = a + b_1 \min\left(\left(\frac{52WeekHigh_{i,t-30}}{P_{i,t-30}} - 1\right)\cdot 100, 25\right) + b_2 \max\left(0, \min\left(\left(\frac{52WeekHigh_{i,t-30}}{P_{i,t-30}} - 1.25\right)\cdot 100, 50\right)\right) + b_3 \max\left(\left(\frac{52WeekHigh_{i,t-30}}{P_{i,t-30}} - 1.75\right)\cdot 100, 0\right) + e_{it}$$

where $r$ is the market-adjusted return of the bidder for the three-day period centered on the announcement date, *Offer* is the offer price from Thomson, $P$ is the target stock price from CRSP, and *52WeekHigh* is the high stock price over the 365 calendar days ending 30 days prior to the announcement date. The first, second, and fourth columns use ordinary least squares. The third and the fifth columns instrument for the offer premium using *52WeekHigh*. Robust t-statistics with standard errors clustered by month are in parentheses.

| | *OLS* | *OLS* | *IV* | *OLS* | *IV* |
|---|---|---|---|---|---|
| | **1** | **2** | **3** | **4** | **5** |
| Offer Premium: | | | | | |
| *b* | -0.0186*** | -0.0204*** | -0.215*** | -0.0443*** | -0.253*** |
| | (-2.64) | (-2.74) | (-3.48) | (-4.21) | (-4.39) |

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

# Section 9

# Reference Dependence: Golf

# Pope and Schweitzer (AER 2011)

- Last example applying the effort framework: golf
- To win golf tournament, only thing that matters is total sum of strokes
- Yet, each hole has a "suggested" number of strokes ("par value")
- That works as a reference point
- **Pope and Schweitzer (AER 2011)**

# Is Tiger Woods Loss Averse (Pope & Schweitzer, AER, 2011)

**Golf**

Start at the tee, end by putting on the green

Total # of strokes determines the winner

Par values of 3, 4, or 5

Eagle, birdie, par, bogey, and double bogey

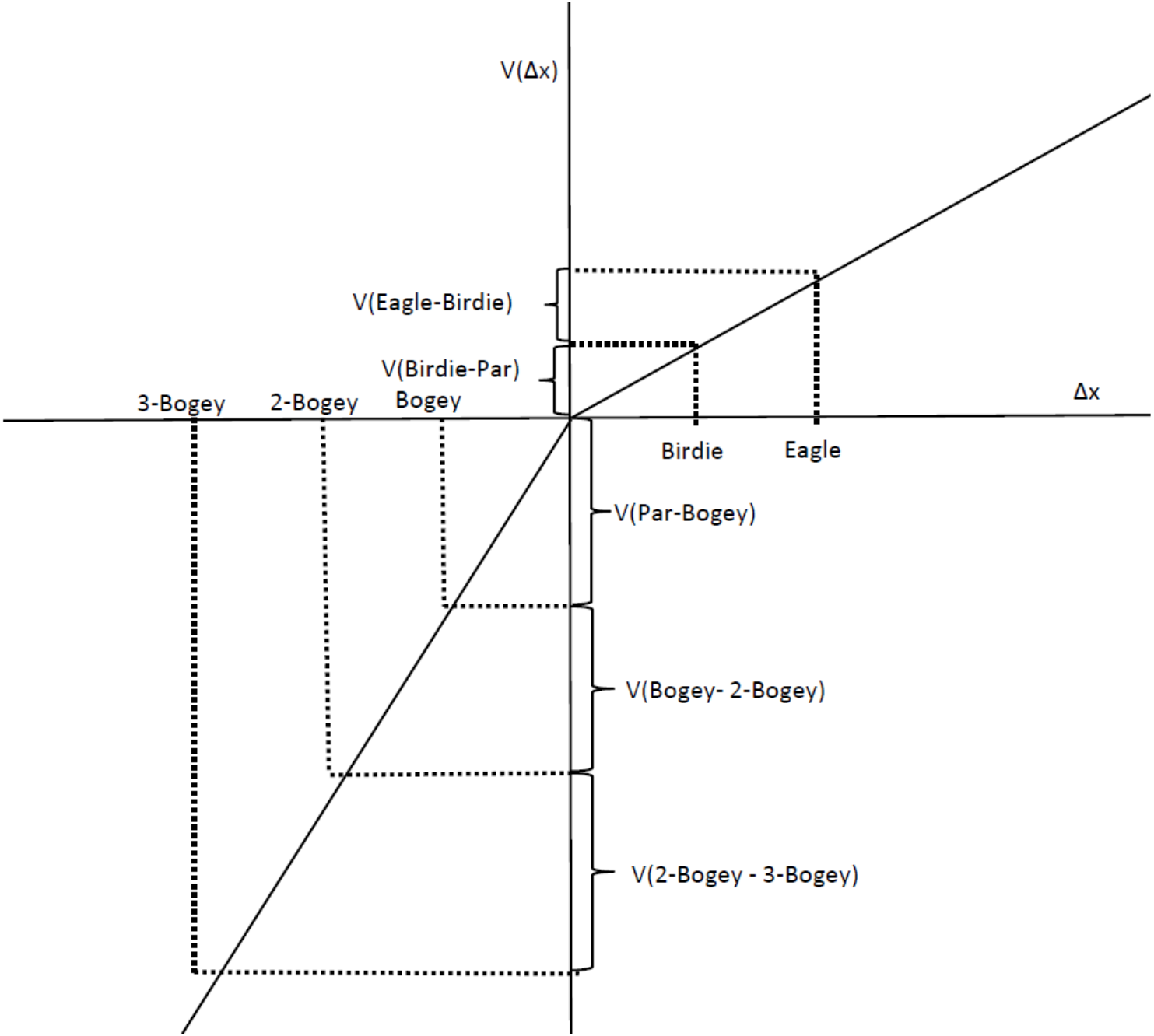
**PGA TOUR**

40-50 tournaments per/year

~150 golfers per tournament

4 rounds of 18 holes

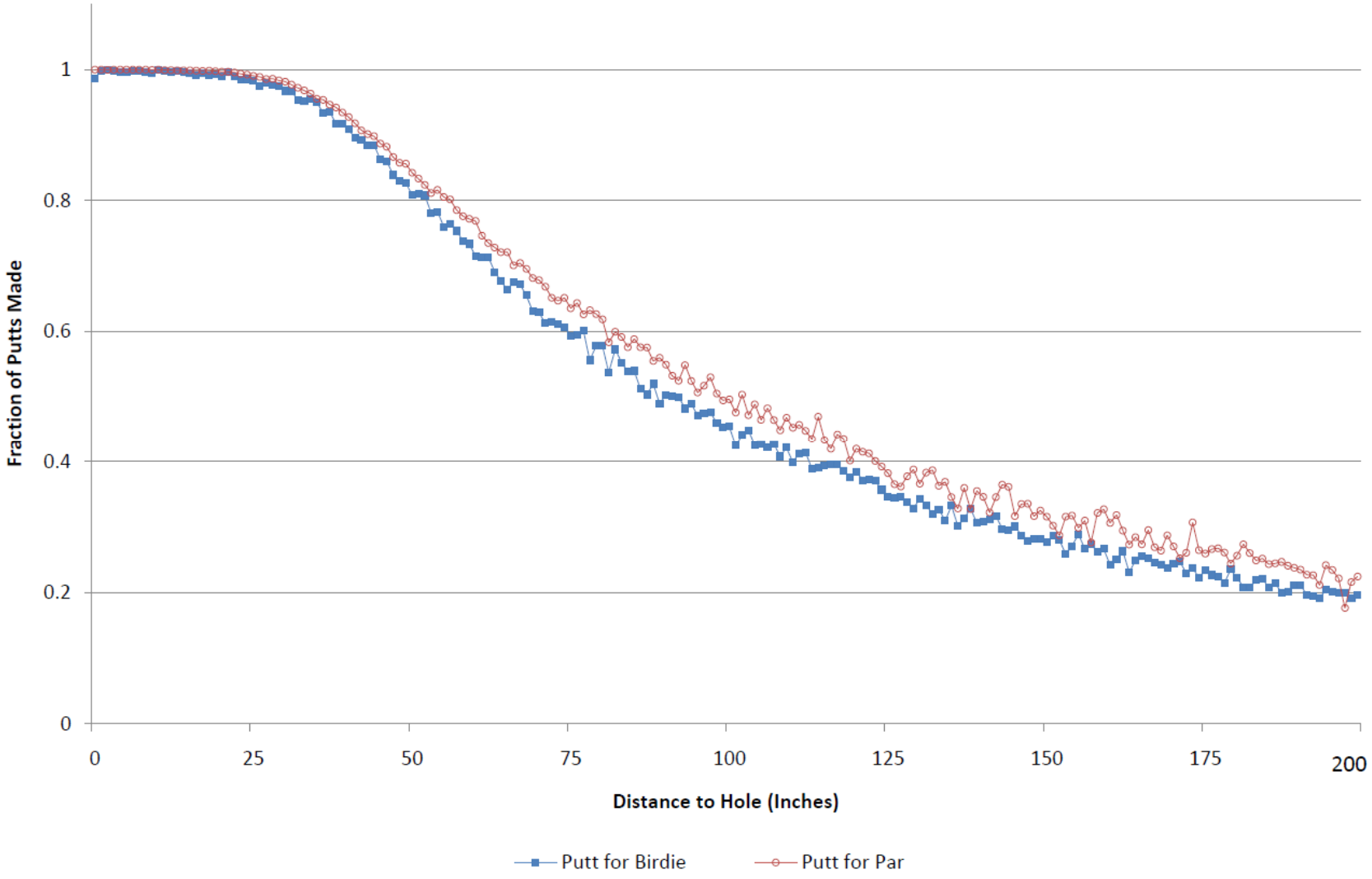
~$5M total purse – very convex


V(Δx)
V(Eagle-Birdie)
V(Birdie-Par)
3-Bogey
2-Bogey
Bogey
Δx
Birdie
Eagle
V(Par-Bogey)
V(Bogey- 2-Bogey)
V(2-Bogey - 3-Bogey)

## Data

- PGA Tour ShotLinks data from 2004 to 2009
- 239 Tournaments, 421 golfers (with more than 1,000 putts each), ~2.5 million putts
- X, y, and z coordinates for every ball placement within a centimeter on the green
- Focus on putts attempted for eagle, birdie, par, bogey, or double bogey

"A 10-footer for par feels more important than one for birdie. The reality is, that's ridiculous. I can't explain it in any way other than that it's subconscious. And pars are O.K. – Bogeys aren't." **- Paul Goydos**


Fraction of Putts Made
1
0.8
0.6
0.4
0.2
0
0
25
50
75
100
125
150
175
200
Distance to Hole (Inches)
Putt for Birdie
Putt for Par

| | Dependent Variable Equals 1 if Putt was Made<br>Logit Estimation | |
|---|---|---|
| | (1) | (2) |
| Putt for Birdie or Eagle | -.020** | |
| | (.001) | |
| Putt for Eagle | | -.024** |
| | | (.002) |
| **Putt for Birdie** | | **-.019**** |
| | | (.001) |
| Putt for Bogey | | .009** |
| | | (.001) |
| Putt for Double Bogey | | -.006** |
| | | (.002) |
| Putt Distance: 7th-Order Polynomial | X | X |
| Psuedo R-Squared | 0.550 | 0.550 |
| Observations | 2,525,161 | 2,525,161 |

# Section 10

## Next Lecture

# Next Lecture

- Reference-Dependent Preferences
  - Housing
  - Labor Supply
  - Job Search
  - Finance
- Problem Set 2 due next week