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

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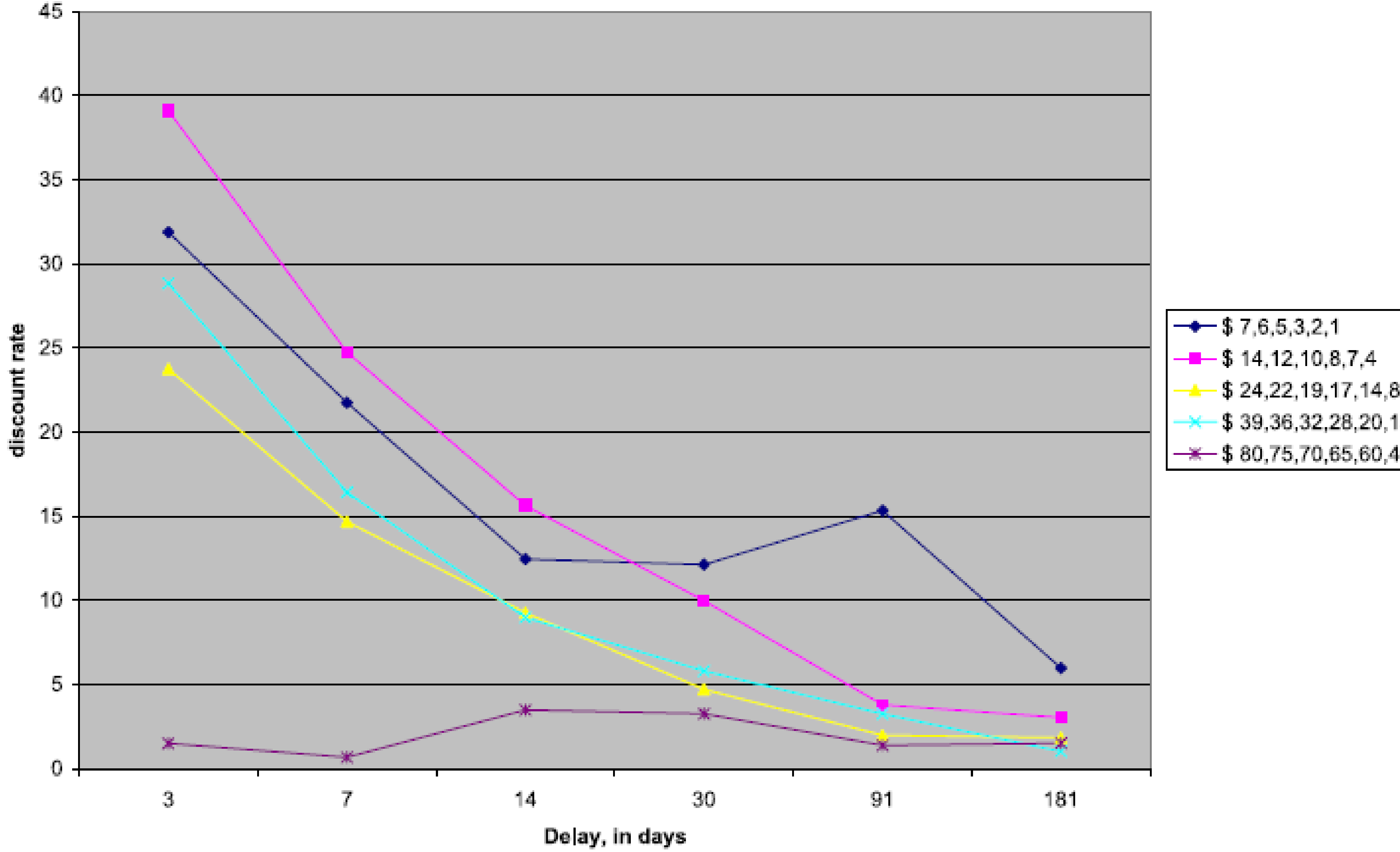
Outline

1. Laboratory Experiments on Present Bias
2. Reference Dependence: Introduction
3. Reference Dependence: Housing
4. Reference Dependence: Mergers
5. Reference Dependence: Employment and Effort

1 Laboratory Experiments on Present Bias

- Experiments on time preferences (Ainslie, 1956; Benhabib, Bisin, and Schotter, 2009; Andreoni and Sprenger, 2012)
- Typical design (Thaler 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 δ
  - X/Y is estimate of (weekly) β

- Alternative design: Benhabib, Bisin, and Schotter (BBS, 2009):
  - What is X today that makes indifferent to \$10 in one week? –> Implied weekly discount factor $\beta\delta$
  - What is Y today that makes indifferent to \$10 in T weeks? –> Implied weekly discount factor $\left(\beta\delta^T\right)^{1/T} = \beta^{1/T}\delta$
- For $\beta < 1$, implied weekly discount factor should be decreasing 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
$ 39,36,32,28,20,1
$ 80,75,70,65,60,4

- Potential problems in such designs:

- *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 $q\delta^T$

  - –> β captures subjective probability q that future payments will be paid (compared to present payments)

- *Problem 2 (Money versus 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–> Then the choice is between
    * $\beta\delta u(X)$
    * $\beta\delta u(10)$
  - Hence, present bias β does not play a role
  - It does play a role *with credit constraints* –> Consume immediately

- *Problem 3 (Concave Utility)*
  - Choice equates

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

  - 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
  - –> Marginal utility of money can differ in the future, depending on future shocks

- Recent improved experimental design: Andreoni and Sprenger (AS, 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

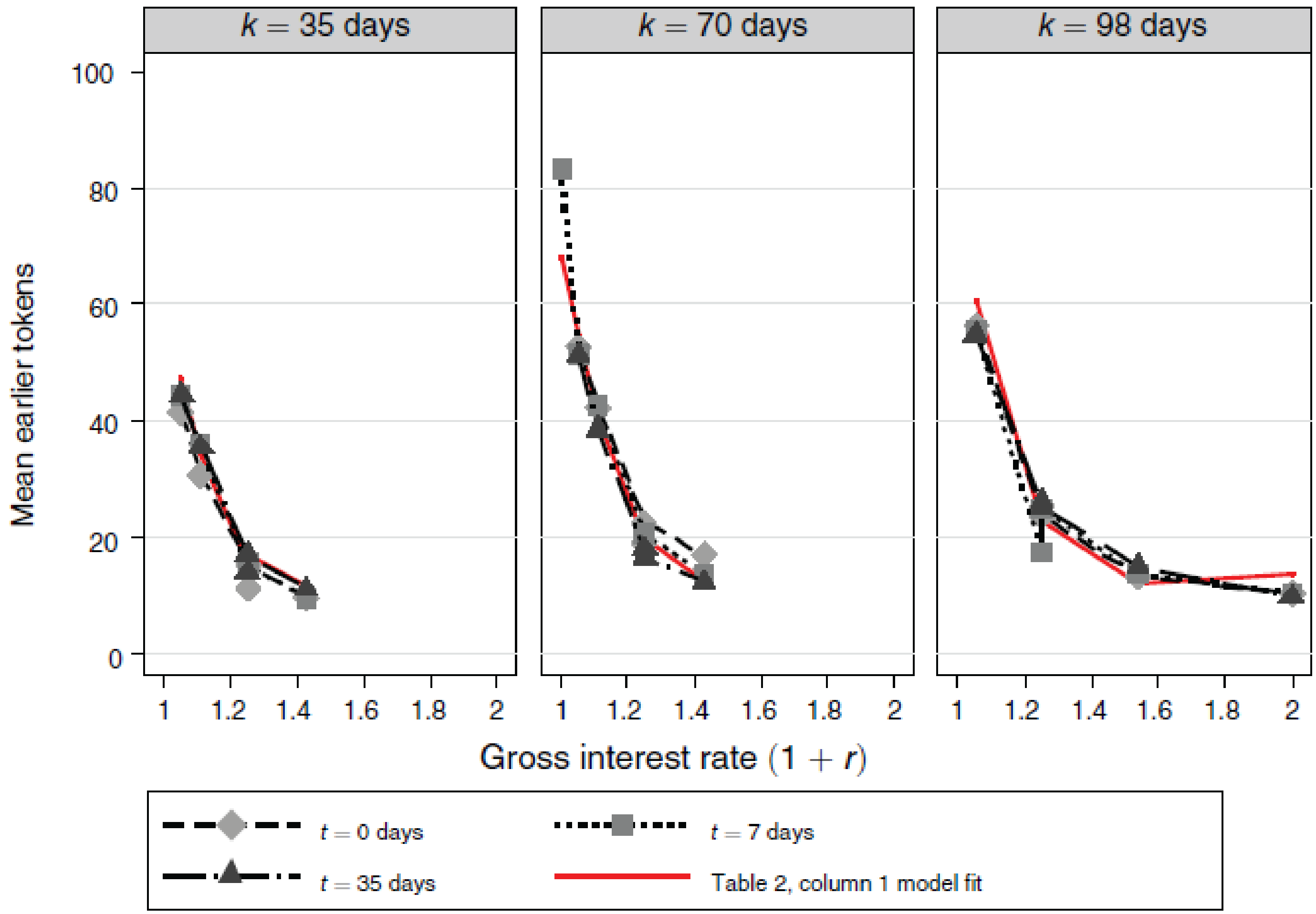
  - Other experiments: post-dated checks

- 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

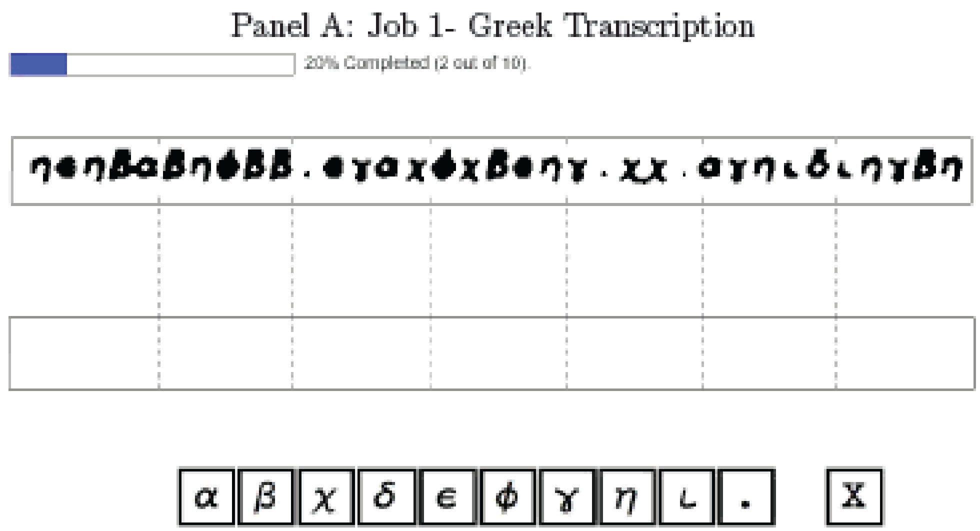
January 21, February 25 | January 21, April 1 | January 21, April 29 | January 28, March 4 | January 28, April 8

	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

- Main result: No evidence of present bias



- 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 (2013): Address problem by having subjects intertemporally allocate effort
  - 102 subjects have to complete boring task

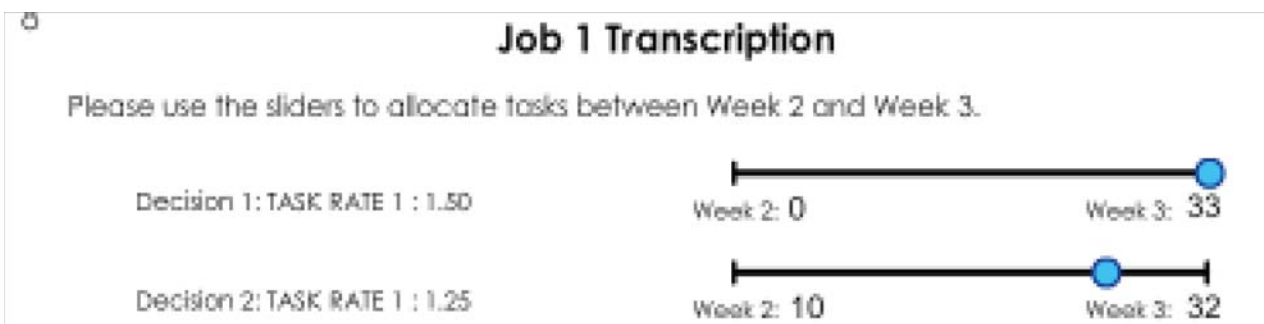


- - Experiment over multiple weeks, complete online
  - Pay largely at the end to reduce attrition
  - Week 1: Choice allocation of job between weeks 2 and 3
  - Week 2: Choose again allocation of job between weeks 2 and 3
  - –> Do subjects revise the choice?
  - As in AS, choice of interior solution, and varied ‘interest rate’ between periods

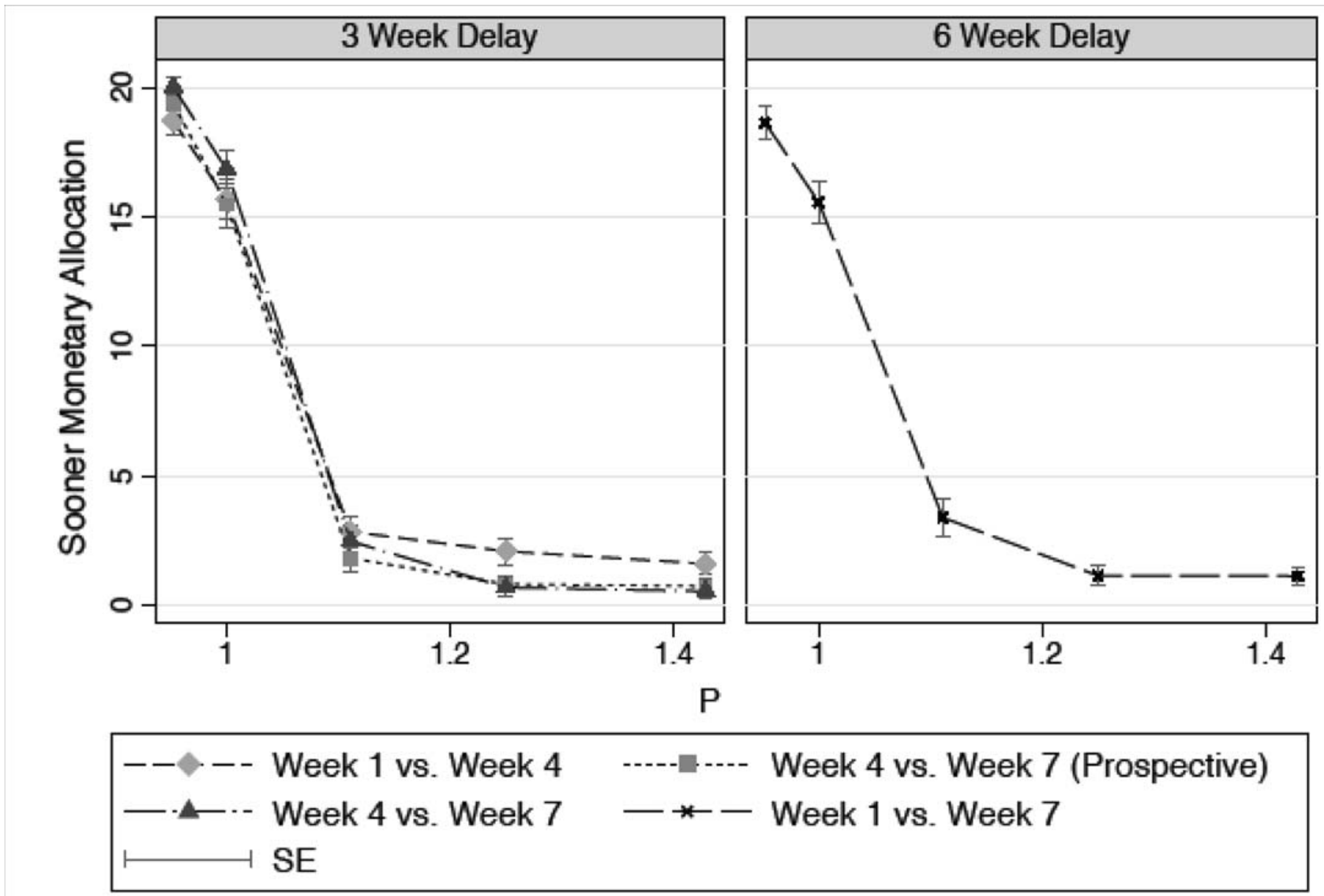
– Also do monetary discounting

Table 1: Summary of Longitudinal Experiment

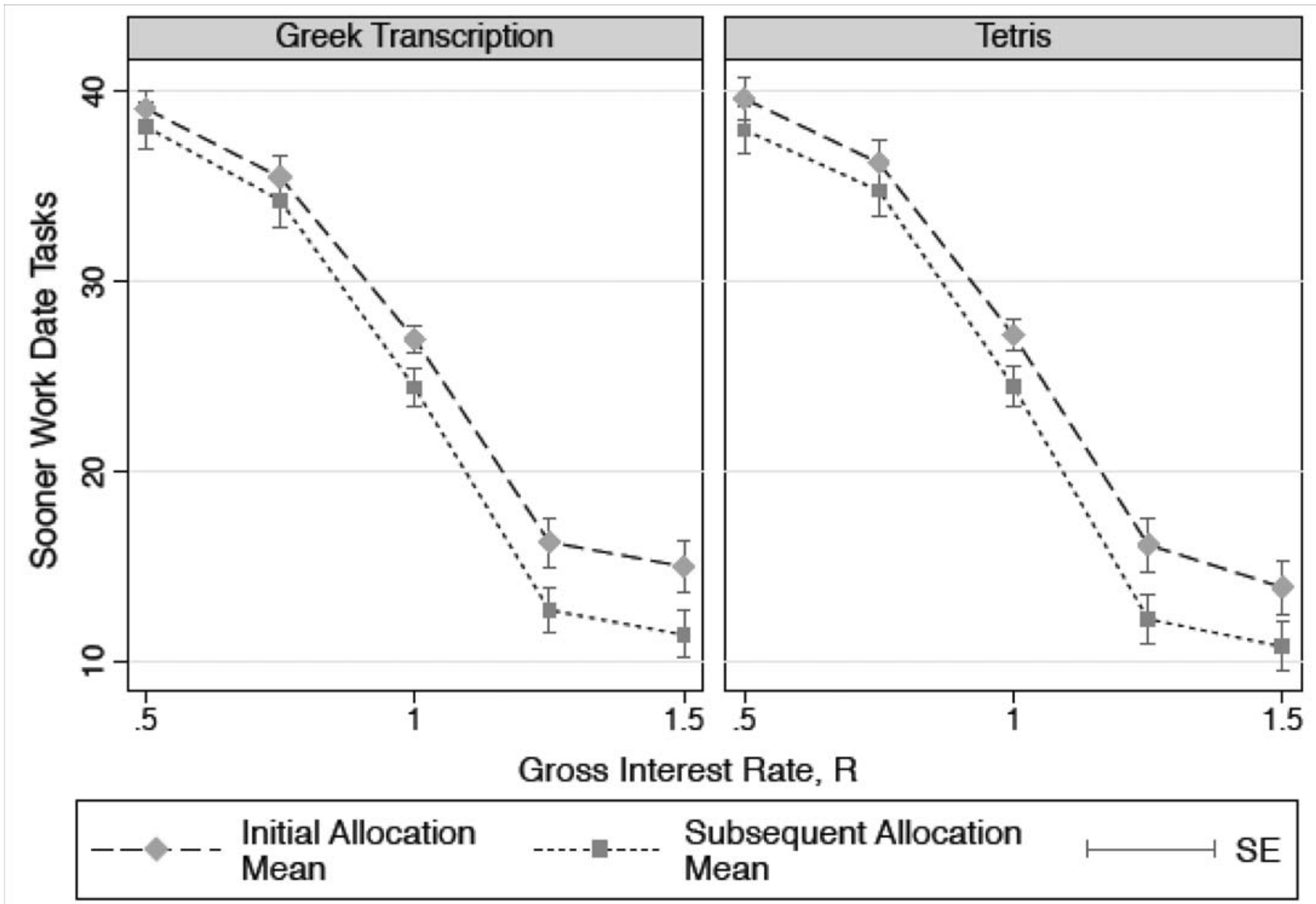
	10 Effort Allocations	Minimum Work	Allocation-That-Counts Chosen	Complete Work	Commitment Choice	Receive Payment
Week 1 (In Lab):	x	x				
Week 2 (Online):	x	x	x	x		
Week 3 (Online):		x		x		
Week 4 (In Lab):	x	x			x	
Week 5 (Online):	x	x	x	x		
Week 6 (Online):		x		x		
Week 7 (In Lab):						x



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



- Result 2: Clear evidence on effort allocation



- 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: β	0.974	0.988	0.900	0.877	0.888
	(0.009)	(0.009)	(0.037)	(0.036)	(0.033)
Daily Discount Factor: δ	0.998	0.997	0.999	1.001	1.000
	(0.000)	(0.000)	(0.004)	(0.004)	(0.004)
Monetary Curvature Parameter: α	0.975	0.976			
	(0.006)	(0.005)			
Cost of Effort Parameter: γ			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

2 Reference Dependence: Introduction

- Kahneman and Tversky (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** (Kahneman and Tversky, 1979)

- 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)

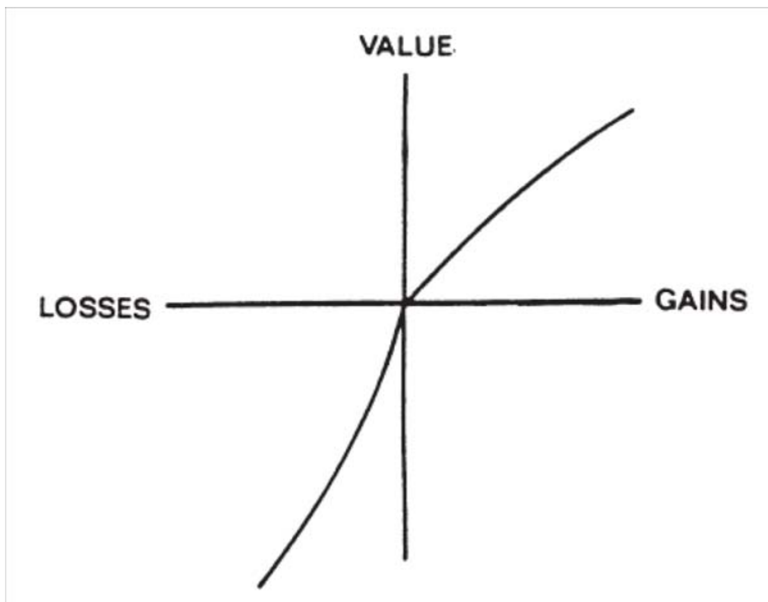
     – Utility is defined over differences from reference point r –> Explains Exp. 3

2. Diminishing sensitivity.

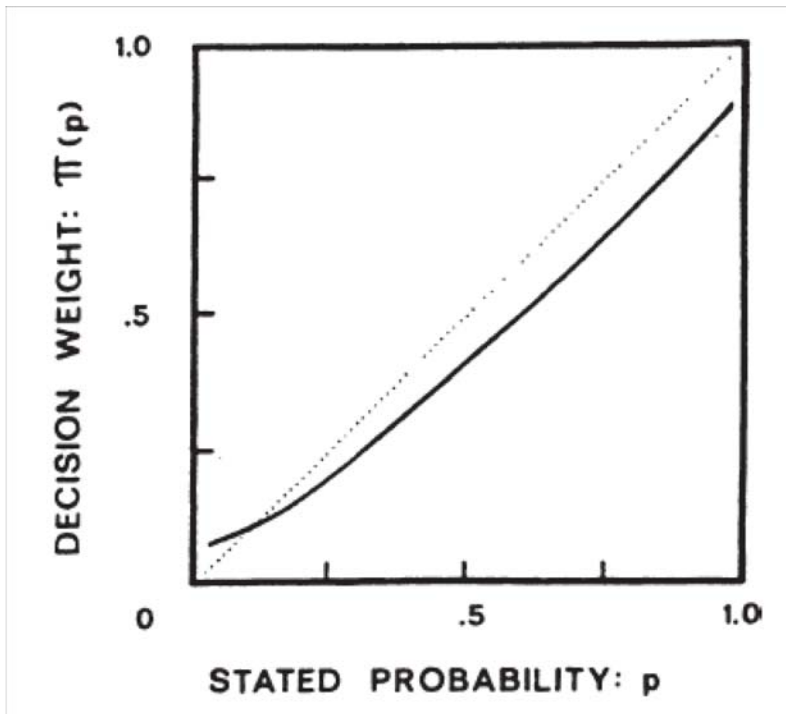
   – Concavity over gains of v –> Explains (500,1)$\succ$(1000,0.5;0,0.5)

   – 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)



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



- Overweight small probabilities + Premium for certainty

5. Narrow framing (Barberis, Huang, and Thaler, 2006; Rabin and Weizsäcker, forthcoming)

   – Consider only risk in isolation (labor supply, stock picking, house sale)

   – Neglect other relevant decisions

- Tversky and Kahneman (1992) propose calibrated version

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

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

3 Reference Dependence: Housing

- **Genesove-Mayer (QJE, 2001)**
  - For houses sales, natural reference point is previous purchase price
  - Loss Aversion –> Unwilling to sell house at a loss
- 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)

- 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 (with pure gain-loss utility):

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

  - (in this case, think of $\bar{U} < 0$)
  - Can write as

$$\begin{aligned} p(P) &= -p'(P)(P - P_0 - \bar{U}) \text{ if } P \geq P_0 \\ p(P)\lambda &= -p'(P)(\lambda (P - P_0) - \bar{U}) \text{ if } P < P_0 \end{aligned}$$

  - 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)

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

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

- 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

- Evidence: Data on Boston Condominiums, 1990-1997

- Substantial market fluctuations of price

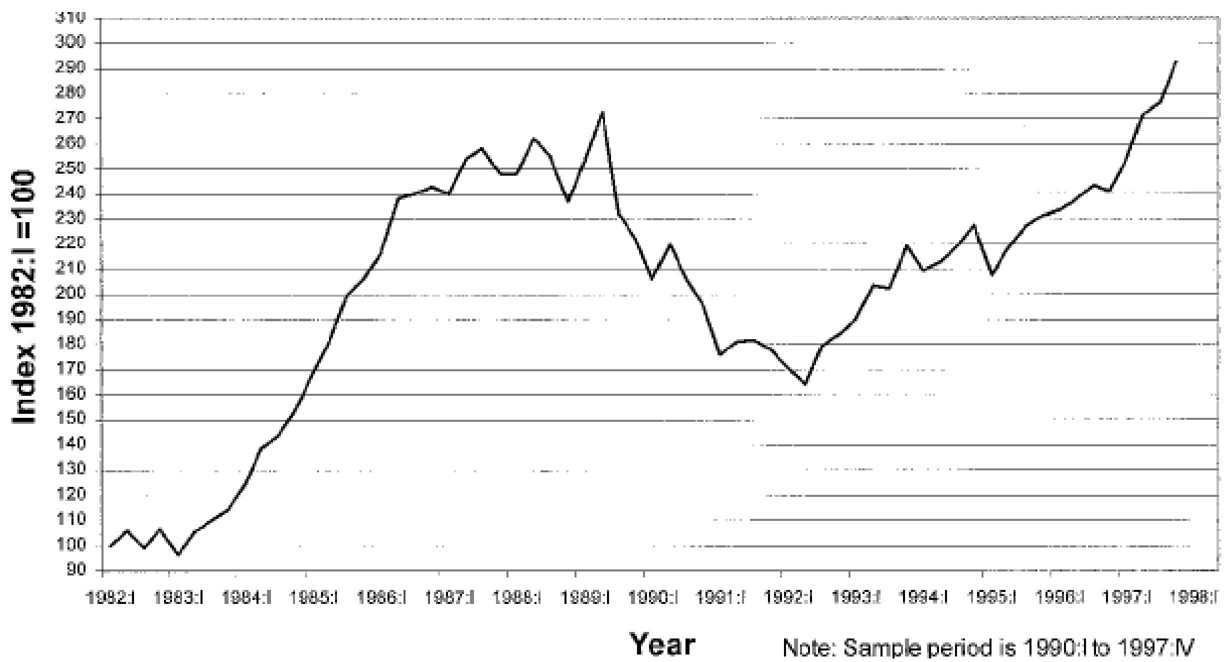


FIGURE I
Boston Condominium Price Index

- Observe:
  - Listing price $L_{i,t}$ and last purchase price P_0
  - Observed Characteristics of property X_i
  - Time Trend of prices δ_t
- Define:
  - $\hat{P}_{i,t}$ is market value of property i at time t
- Ideal Specification:

$$\begin{aligned} L_{i,t} &= \hat{P}_{i,t} + m\mathbf{1}_{\hat{P}_{i,t}<P_0}\left(P_0 - \hat{P}_{i,t}\right) + \varepsilon_{i,t} \\ &= \beta X_i + \delta_t + v_i + mLoss^* + \varepsilon_{i,t} \end{aligned}$$

- 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.

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

- Effect of experience: Larger effect for owner-occupied

TABLE IV
LOSS AVERSION AND LIST PRICES: OWNER-OCCUPANTS VERSUS INVESTORS
DEPENDENT VARIABLE: LOG (ORIGINAL ASKING PRICE)
OLS equations, standard errors are in parentheses.

Variable	(1) All listings	(2) All listings	(3) All listings	(4) All listings
LOSS × owner-occupant	0.50	0.42	0.66	0.58
	(0.09)	(0.09)	(0.08)	(0.09)
LOSS × investor	0.24	0.16	0.58	0.49
	(0.12)	(0.12)	(0.06)	(0.06)
LOSS-squared × owner-occupant			−0.16	−0.17
			(0.14)	(0.15)
LOSS-squared × investor			−0.30	−0.29
			(0.02)	(0.02)
LTV × owner-occupant	0.03	0.03	0.01	0.01
	(0.02)	(0.02)	(0.01)	(0.01)
LTV × investor	0.053	0.053	0.02	0.02
	(0.027)	(0.027)	(0.02)	(0.02)
Dummy for investor	−0.02	−0.02	−0.03	−0.03
	(0.014)	(0.01)	(0.01)	(0.01)
Estimated value in 1990	1.09	1.09	1.09	1.09
	(0.01)	(0.01)	(0.01)	(0.01)
Estimated price index at quarter of entry	0.84	0.80	0.86	0.82
	(0.05)	(0.04)	(0.04)	(0.04)
Residual from last sale price		0.08		0.08
		(0.02)		(0.02)

- Some effect also on final transaction price

TABLE VI

LOSS AVERSION AND TRANSACTION PRICES

DEPENDENT VARIABLE: LOG (TRANSACTION PRICE)

NLLS equations, standard errors are in parentheses.

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

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

TABLE VII
HAZARD RATE OF SALE
Duration variable is the number of weeks the property is listed on the market. Cox proportional hazard equations, standard errors are in parentheses.

Variable	(1) All listings	(2) All listings	(3) All listings	(4) All listings
LOSS	−0.33	−0.63	−0.59	−0.90
	(0.13)	(0.15)	(0.16)	(0.18)
LOSS-squared			0.27	0.28
			(0.07)	(0.07)
LTV	−0.08	−0.09	−0.06	−0.06
	(0.04)	(0.04)	(0.04)	(0.04)
Estimated value	0.27	0.27	0.27	0.27
in 1990	(0.04)	(0.04)	(0.04)	(0.04)
Residual from		0.29		0.29
last sale		(0.07)		(0.07)

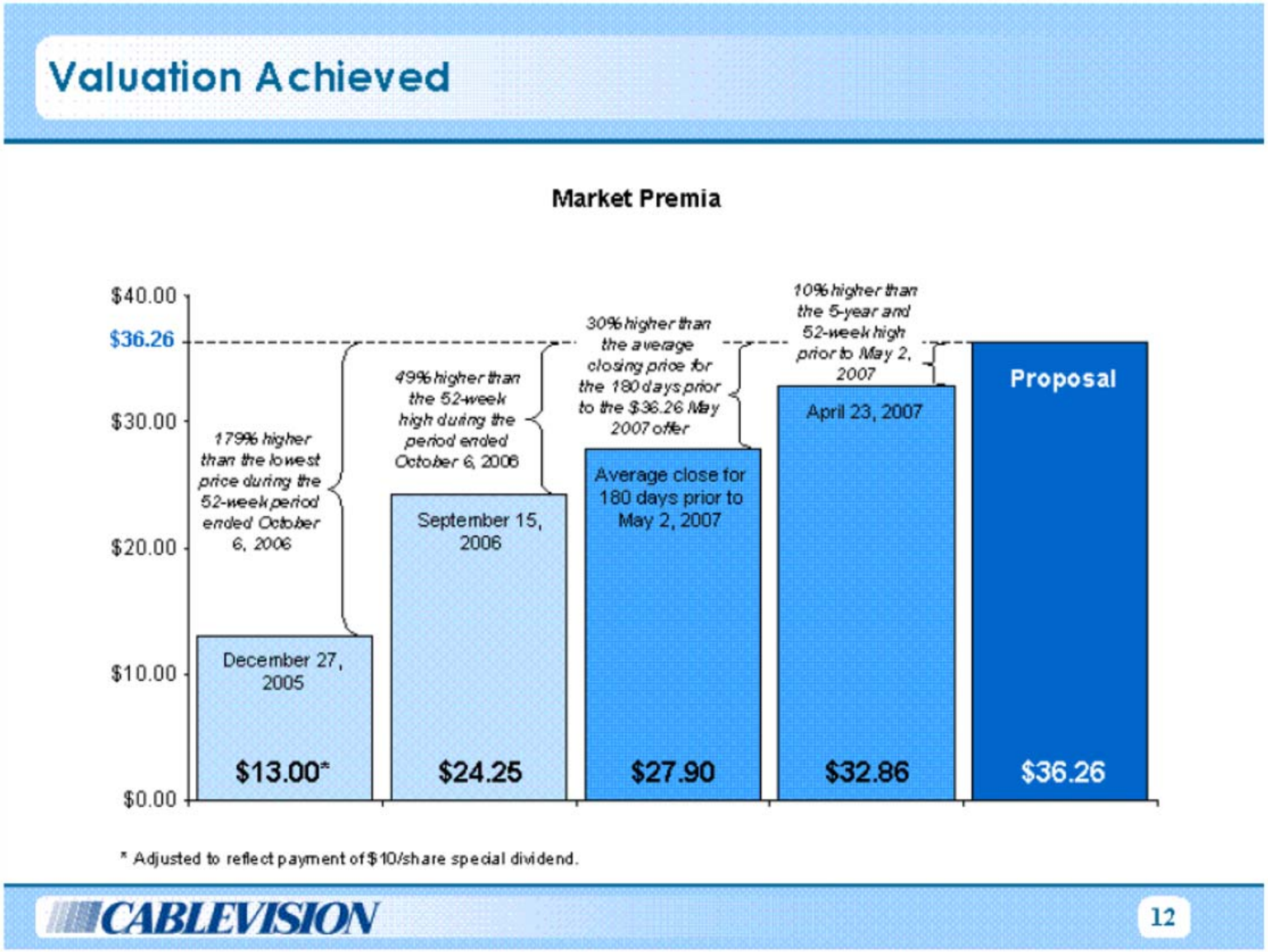
- – Overall, plausible set of results that show impact of reference point
  – Important to tie to model (Gagnon-Bartsch, Rosato, and Xia, 2010)

4 Reference Dependence: Mergers

- 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 of 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.



- 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

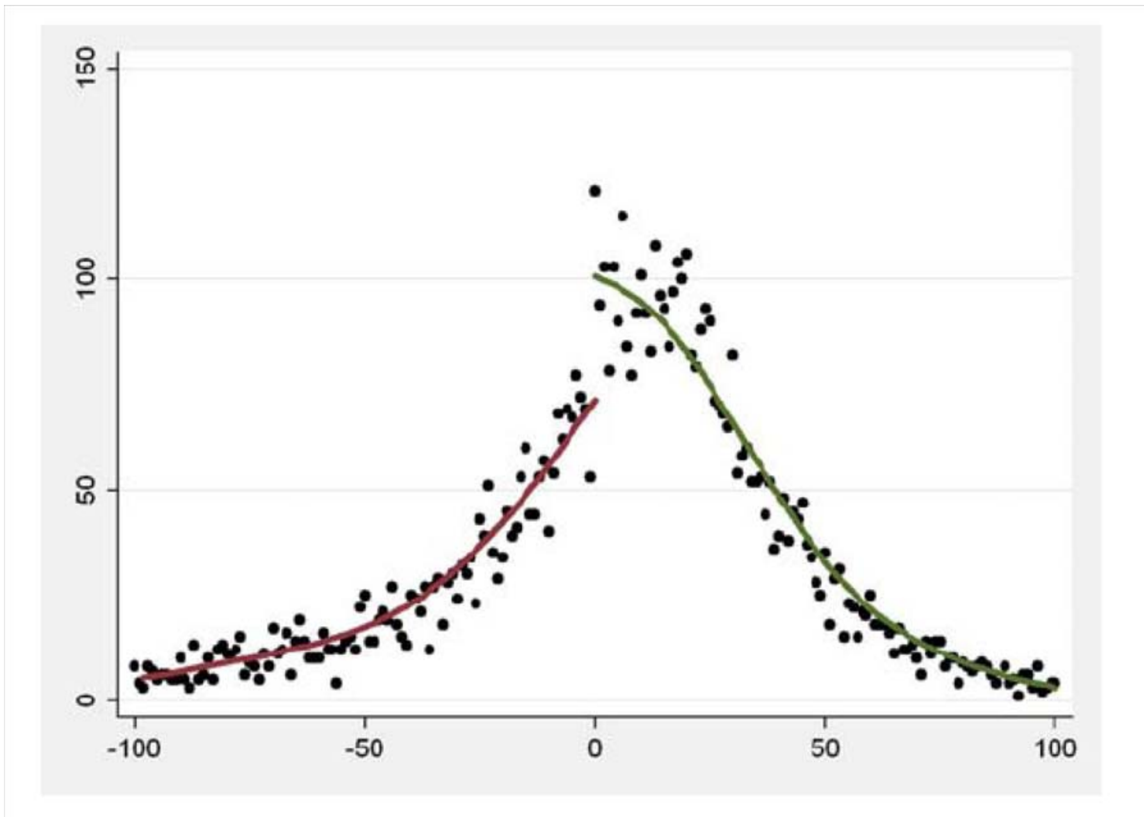
$$v(P|P_0) = \begin{cases} P - P_{52} & \text{if } P \geq P_{52}; \\ \lambda(P - P_{52}) & \text{if } P < P_{52}, \end{cases}$$

- 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

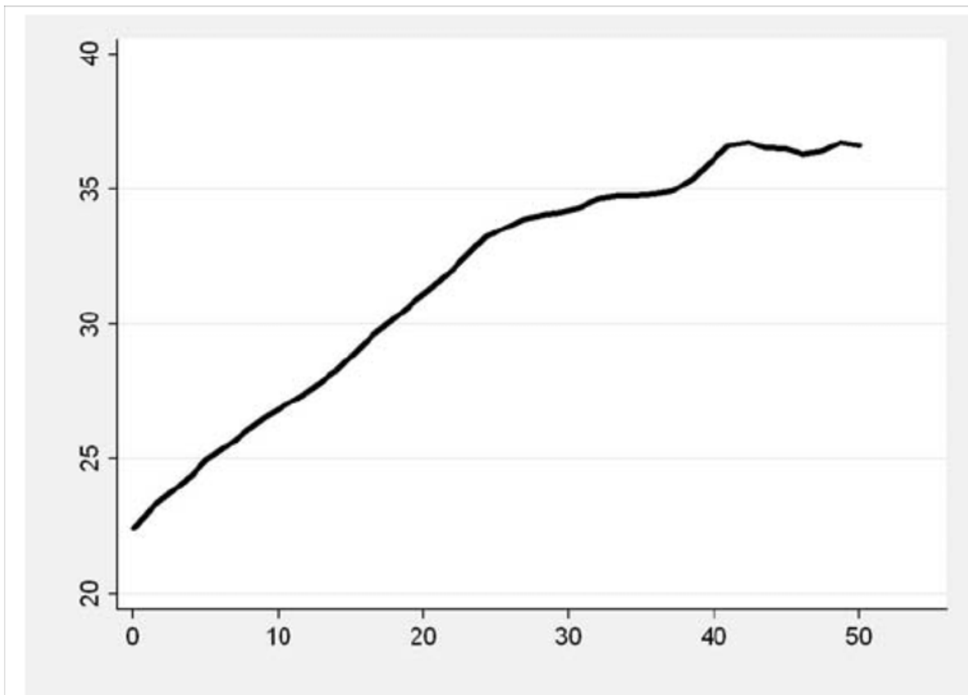
- Test 1: Offer price P around P_{52}
  - Some bunching, missing left tail of distribution



- 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 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 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

- 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

5 Reference Dependence: Employment and Effort

- Back to labor markets: Do reference points affect performance?
- **Mas (QJE 2006)** examines police performance
- Exploits quasi-random variation in pay due to arbitration
- Background
  - 60 days for negotiation of police contract –> If undecided, arbitration
  - 9 percent of police labor contracts decided with final offer arbitration

- Framework:
  - pay is $w * (1 + r)$
  - union proposes r_u, employer proposes r_e, arbitrator prefers r_a
  - arbitrator chooses r_e if $|r_e - r_a| \leq |r_u - r_a|$
  - $P(r_e, r_u)$ is probability that arbitrator chooses r_e
  - Distribution of r_a is common knowledge (cdf F)
  - Assume $r_e \leq r_a \leq r_u$ –> Then

    $$P = P(r_a - r_e \leq r_u - r_a) = P(r_a \leq (r_u + r_e)/2) = F\left(\frac{r_u + r_e}{2}\right)$$

- Nash Equilibrium:
  - If r_a is certain, Hotelling game: convergence of r_e and r_u to r_a
  - Employer's problem:

$$\max_{r_e} PU\left(w\left(1+r_e\right)\right)+\left(1-P\right)U\left(w\left(1+r_u^*\right)\right)$$

  - Notice: $U' < 0$
  - First order condition (assume $r_u \geq r_e$):

$$\frac{P'}{2}\left[U\left(w\left(1+r_e^*\right)\right)-U\left(w\left(1+r_u^*\right)\right)\right]+PU'\left(w\left(1+r_e^*\right)\right)w=0$$

  - $r_e^* = r_u^*$ cannot be solution –> Lower r_e and increase utility ($U' < 0$)

- Union's problem: maximizes

$$\max_{r_u} PV\left(w\left(1+r_e^*\right)\right)+\left(1-P\right)V\left(w\left(1+r_u\right)\right)$$

- Notice: $V' > 0$

- First order condition for union:

$$\frac{P'}{2}\left[V\left(w\left(1+r_e^*\right)\right)-V\left(w\left(1+r_u^*\right)\right)\right]+\left(1-P\right)V'\left(w\left(1+r_e^*\right)\right)w=0$$

- To simplify, assume $U\left(x\right)=-bx$ and $V\left(x\right)=bx$

- This implies $V\left(w\left(1+r_e^*\right)\right)-V\left(w\left(1+r_u^*\right)\right)=-U\left(w\left(1+r_e^*\right)\right)-U\left(w\left(1+r_u^*\right)\right)$ ->

$$-bP^*w=-\left(1-P^*\right)bw$$

- Result: $P^* = 1/2$

- Prediction (i) in Mas (2006): "*If disputing parties are equally risk-averse, the winner in arbitration is determined by a coin toss.*"

- Therefore, as-if random assignment of winner

- Use to study impact of pay on police effort

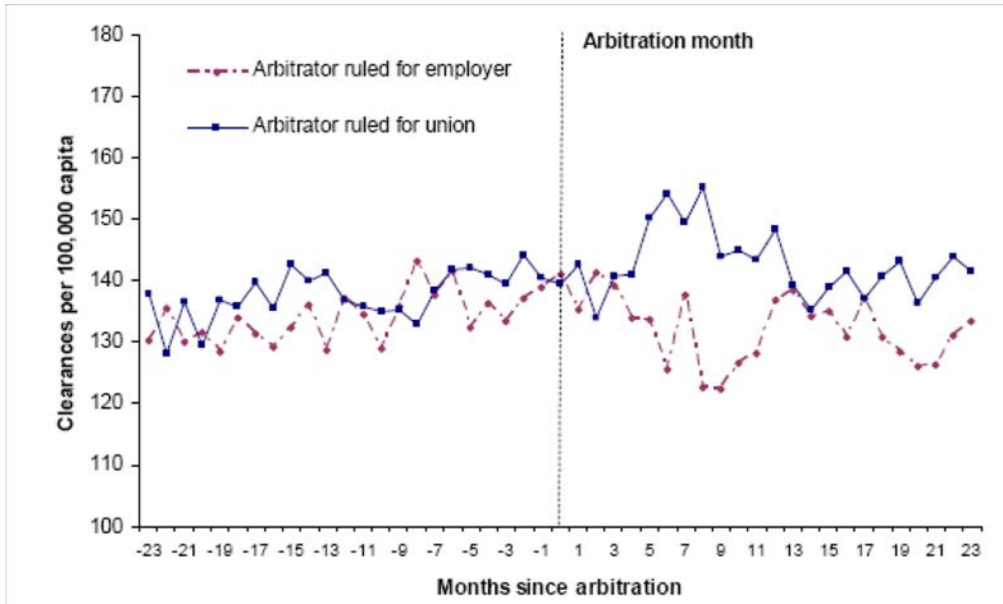
- Data:
  - 383 arbitration cases in New Jersey, 1978-1995
  - Observe offers submitted r_e, r_u, and ruling $\bar{r}_a$
  - Match to UCR crime clearance data (=number of crimes solved by arrest)

- Compare summary statistics of cases when employer and when police wins
- Estimated $\hat{P} = .344 \neq 1/2$ −>Unions more risk-averse than employers
- No systematic difference between Union and Employer cases except for r_e

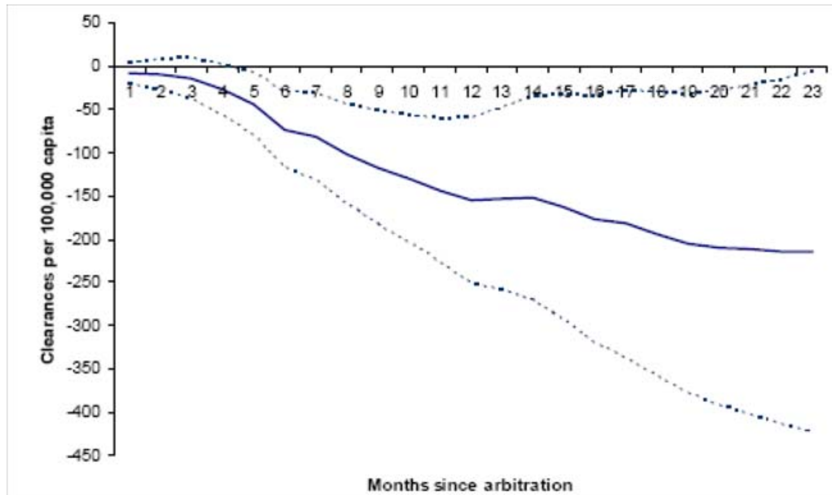
Table I
Sample characteristics in the -12 to +12 month event time window

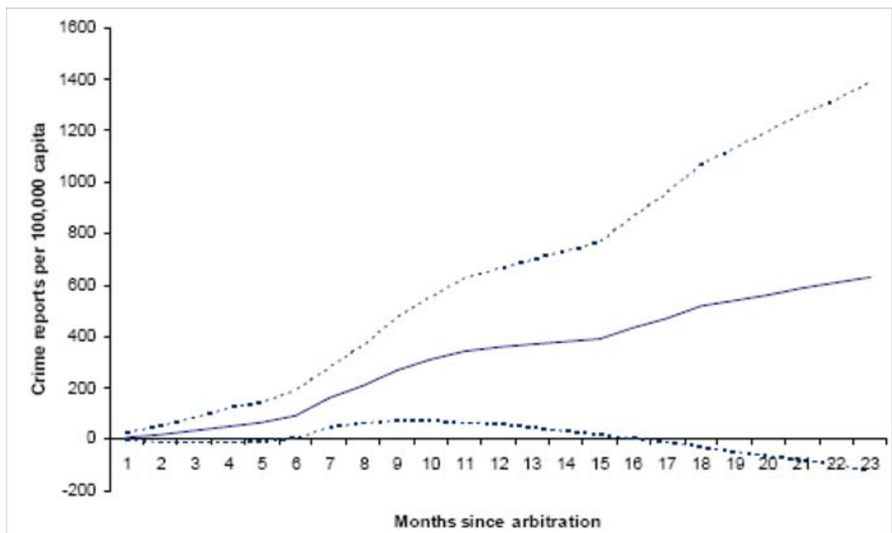
	(1) Full-sample	(2) Pre-arbitration: Employer wins	(3) Pre-arbitration: Employer loses	(4) Pre-arbitration: Employer win-Employer loss
Arbitrator rules for employer	0.344			
Final Offer: Employer	6.11	6.44	5.94	0.50
	[1.65]	[1.54]	[1.68]	(0.18)
Final Offer: Union	7.65	7.87	7.54	0.32
	[1.71]	[2.03]	[1.51]	(0.18)
Population	21,345	22,893	20,534	2,358
	[33,463]	[34,561]	[32,915]	(3,598)
Contract length	2.09	2.09	2.09	0.007
	[0.66]	[0.64]	[0.66]	(0.071)
Size of bargaining unit	42.58	41.36	43.22	-1.86
	[97.34]	[53.33]	[113.84]	(15.66)
Arbitration year	85.56	85.85	85.41	0.436
	[4.75]	[5.10]	[4.56]	(0.510)
Clearances per 100,000 capita	120.31	122.28	118.57	3.71
	[106.65]	[108.76]	[104.35]	(9.46)

- Graphical evidence of effect of ruling on crime clearance rate



- Significant effect on clearance rate for one year after ruling
- Estimate of the cumulated difference between Employer and Union cities on clearance rates and crime


50
0
-50
-100
-150
-200
-250
-300
-350
-400
-450
Clearances per 100,000 capita
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Months since arbitration


1600
1400
1200
1000
800
600
400
200
0
-200
Crime reports per 100,000 capita
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Months since arbitration

- Arbitration leads to an average increase of 15 clearances out of 100,000 each month

Table II
Event study estimates of the effect of arbitration rulings on clearances; -12 to +12 month event time window

	All clearances			Violent crime clearances			Property crime clearances		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	118.57 (5.12)	141.25 (9.94)		63.16 (3.13)	75.10 (6.86)		55.42 (2.88)	66.15 (4.55)	
Post-arbitration × Employer win	-6.79 (2.62)	-8.48 (2.20)	-9.75 (2.70)	-2.54 (1.75)	-3.10 (1.35)	-3.77 (1.78)	-4.26 (1.62)	-5.39 (2.25)	-4.45 (1.87)
Post-arbitration × Union win	4.99 (2.09)	7.92 (2.91)	5.96 (2.65)	4.17 (1.53)	5.62 (1.95)	5.31 (1.42)	0.819 (1.24)	2.31 (1.58)	2.19 (1.37)
Row 3 – Row 2	11.78 (3.35)	16.40 (3.65)	15.71 (3.75)	6.71 (2.32)	8.71 (2.37)	9.08 (2.26)	5.08 (2.04)	7.69 (2.75)	6.40 (2.30)
Employer Win (Yes = 1)	3.71 (9.46)	-2.81 (14.92)		2.14 (6.11)	-5.73 (9.53)		1.57 (4.93)	2.92 (7.51)	
Fixed-effects?			Yes			Yes			Yes
Weighted sample?		Yes	Yes		Yes	Yes		Yes	Yes
Augmented sample?			Yes			Yes			Yes
Mean of the Dependent variable	120.31 [106.65]	120.31 [106.65]	130.82 [370.58]	64.79 [71.28]	64.79 [71.28]	72.15 [294.78]	55.51 [58.72]	55.51 [58.72]	58.63 [180.55]
Sample Size	9,538	9,538	59,137	9,538	9,538	59,135	9,538	9,538	59,136
R^2	0.0008	0.005	0.63	0.0007	0.0078	0.59	0.001	0.0015	0.55

- Effects on crime rate more imprecise

Table IV
Event study estimates of the effect of arbitration rulings on crime;
-12 to +12 month event time window

	All crime		Violent crime		Property crime	
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	612.18		150.26		461.81	
	(63.98)		(23.23)		(42.00)	
Post-arbitration	26.86	24.68	7.75	4.87	19.19	19.86
× Employer win	(25.29)	(14.68)	(7.85)	(4.70)	(18.17)	(11.19)
Post-arbitration	7.64	6.68	7.07	2.49	0.170	4.40
× Union win	(16.24)	(11.42)	(5.46)	(4.46)	(11.68)	(7.87)
Row 3 – Row 2	-19.21	-18.01	-0.68	-2.38	-19.02	-15.46
	(30.06)	(19.12)	(9.56)	(6.63)	(21.60)	(13.96)
Employer Win	-31.81		-20.43		-11.35	
(Yes = 1)	(84.42)		(27.57)		(59.50)	
Fixed-effects?		Yes		Yes		Yes
Mean of the	444.03	519.42	95.49	98.26	348.45	421.28
dependent variable	[364.23]	[2037.4]	[103.16]	[363.76]	[292.10]	[1865.8]
Sample size	9,528	59,060	9,529	59,085	9,537	59,119
R^2	0.001	0.54	0.007	0.76	0.0003	0.42

- Do reference points matter?
- Plot impact on clearances rates (12,-12) as a function of $\bar{r}_a - (r_e + r_u)/2$

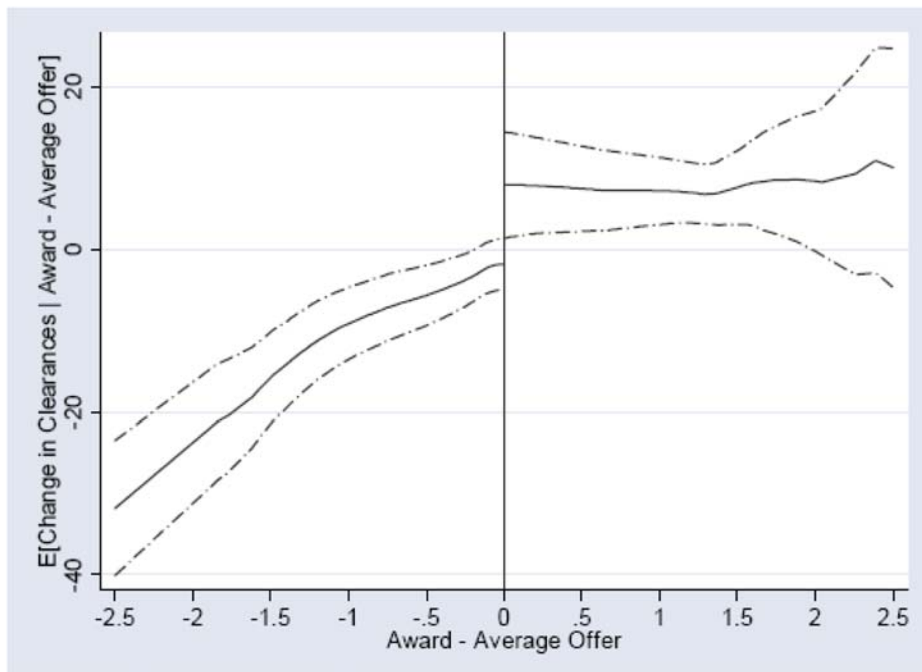


Figure V
Estimated expected change in clearances conditional on the deviation of the award from the average of the offers

- Effect of loss is larger than effect of gain

Table VII
Heterogeneous effects of arbitration decisions on clearances by loss size, award, and deviation from the expected offer; -12 to +12 month event time window

	(1)	(2)	(3)	(4)	(5) Police lose	(6) Police win
Post-Arbitration	5.72	-8.17	12.99	-7.42	4.97	7.30
	(2.31)	(9.58)	(8.45)	(4.76)	(3.14)	(4.17)
Post-Arbitration × Award		1.23	-1.00			
		(1.16)	(0.98)			
Post-Arbitration × Loss size	-10.31		-10.93		-0.20	
	(1.59)		(1.89)		(4.54)	
Post-Arbitration × Union win				13.38		
				(5.32)		
Post-Arbitration × (expected award-award)					-17.72	2.82
					(7.94)	(4.13)
Post-Arbitration × p(loss size)^				Included		
Sample Size	59,137	59,137	59,137	59,137	52,857	55,879
R^2	0.63	0.63	0.63	0.63	0.60	0.62

Standard errors, clustered on the intersection of arbitration window and city, are in parentheses. Standard deviations are in brackets. Observations are municipality × month cells. The sample is weighted by population size in 1976. The dependant variable is clearances per 100,000 capita. Loss size is defined as the union demand (percent increase on previous wage) less the arbitrator award. Amongst cities that underwent arbitration, the mean loss size is 0.489 with a standard deviation of 0.953. The expected award is the mathematical expectation of the award given the union and employer offers and the predicted probability of an employer win. The predicted probability of an employer win is estimated with a probit model using as predictors year of arbitration dummies, the average of the final offers, log population, and the length of the contract. See text for details. The samples in models (1)-(4) consist of the 12 months before to the 12 months after arbitration, for jurisdictions that underwent arbitration, as well as all jurisdictions that never underwent arbitration for all months between 1976 and 1996. The sample in model (5) consists of cities where the union lost in arbitration and the comparison group of non-arbitrating cities. The sample in model (6) consists of cities where the union won in arbitration and the comparison group of non-arbitrating cities. All models include month × year effects (252), arbitration window effects (383), and city effects (452). Author's calculation based on NJ PERC arbitration cases matched to monthly municipal clearance rates at the jurisdiction level from FBI Uniform Crime Reports.

- Column (3): Effect of a gain relative to $(r_e + r_u)/2$ is not significant; effect of a loss is
- Columns (5) and (6): Predict expected award $\hat{r}_a$ using covariates, then compute $\bar{r}_a - \hat{r}_a$
  - $\bar{r}_a - \hat{r}_a$ does not matter if union wins
  - $\bar{r}_a - \hat{r}_a$ matters a lot if union loses
- Assume policeman maximizes

$$\max_e \left[\bar{U} + U(w)\right] e - \theta \frac{e^2}{2}$$

where

$$U(w) = \begin{cases} w - \hat{w} & \text{if} \quad w \geq \hat{w} \\ \lambda(w - \hat{w}) & \text{if} \quad w < \hat{w} \end{cases}$$

- Reduced form of reciprocity model where altruism towards the city is a function of how nice the city was to the policemen $(\bar{U} + U(w))$

- F.o.c.:

$$\bar{U} + U(w) - \theta e = 0$$

Then

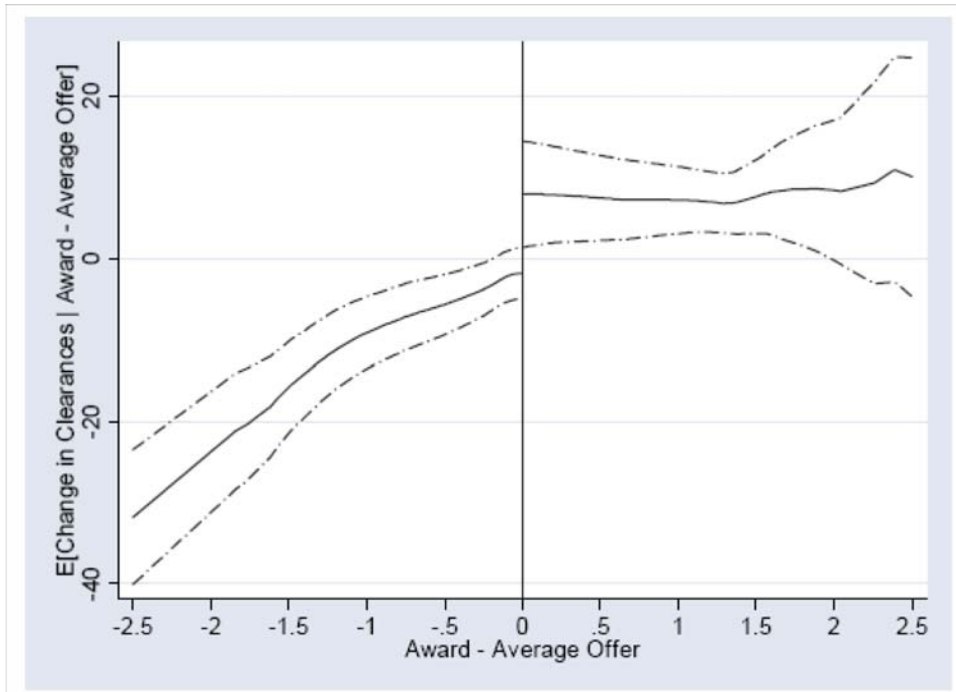
$$e^*(w) = \frac{\bar{U}}{\theta} + \frac{1}{\theta} U(w)$$

- It implies that we would estimate

$$Clearances = \alpha + \beta(\bar{r}_a - \hat{r}_a) + \gamma(\bar{r}_a - \hat{r}_a) 1 (\bar{r}_a - \hat{r}_a < 0) + \varepsilon$$

with $\beta > 0$ (also in standard model) and $\gamma > 0$ (not in standard model)

- Compare to observed pattern



- Close to predictions of model

6 Next Lecture

- Reference-Dependent Preferences
  - Workplace
  - Finance
  - Labor Supply
  - Insurance
- Problem Set due after Spring Break