Econ 219B
Psychology and Economics: Applications
(Lecture 6)

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Outline

1. Reference Dependence: Housing
2. Reference Dependence: Disposition Effect
3. Reference Dependence: Equity Premium
4. Reference Dependence: Employment and Effort

1 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

- Reference-dependent preferences

  - Assume reference price P_0

  - Can write as

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

  - Plot Effect on MG and MC of loss aversion

- Case 1. Loss Aversion λ increase price

- Case 2. Loss Aversion λ induces bunching at $P = P_0$

- Case 3. Loss Aversion has no effect ($P > P_0$)

- General predictions. When aggregate prices are low:
  - High prices P relative to fundamentals
  - Lower probability of sale $p(P)$
  - Longer waiting on market

- Evidence: Data on Boston Condominiums, 1990-1997

- Substantial market fluctuations of price

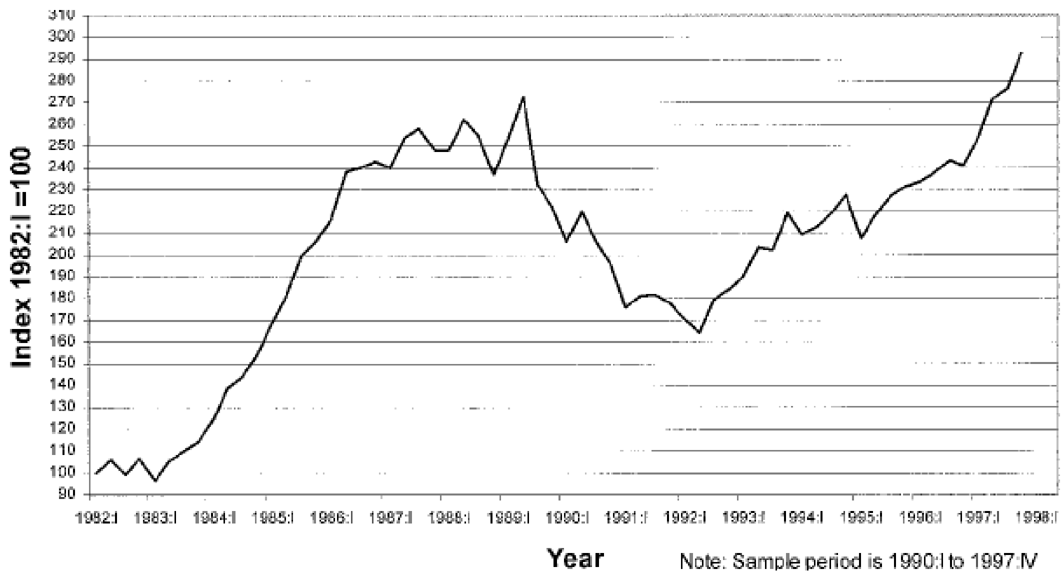


FIGURE I
Boston Condominium Price Index

- 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 i
- 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 in 1990	0.27	0.27	0.27	0.27
	(0.04)	(0.04)	(0.04)	(0.04)
Residual from last sale		0.29		0.29
		(0.07)		(0.07)

- – Overall, plausible set of results that show impact of reference point
  – Would have been nice to tie better to model

2 Reference Dependence: Disposition Effect

- **Odean (JF, 1998)**

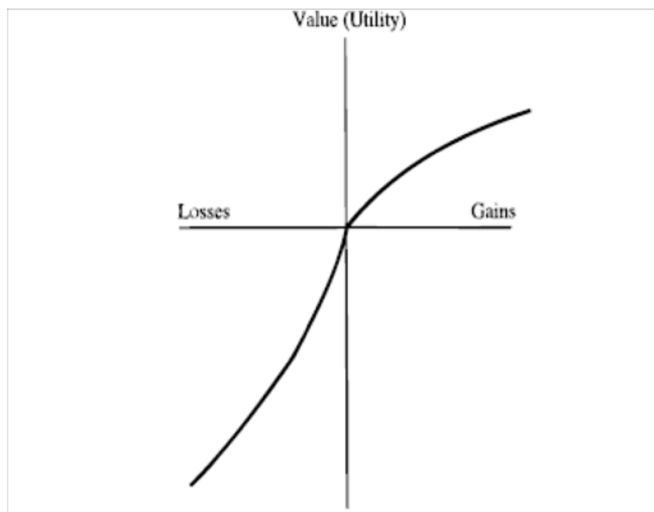
- Do investors sell winning stocks more than losing stocks?

- Tax advantage to sell losers

  - Can post a deduction to capital gains taxation

  - Stronger incentives to do so in December, so can post for current tax year

- Prospect theory intuition:
  - Evaluate stocks regularly
  - Reference point: price of purchase
  - Convexity over losses —> gamble, hold on stock
  - Concavity over gains —> risk aversion, sell stock



- Individual trade data from Discount brokerage house (1987-1993)

- Rare data set –> Most financial data sets carry only aggregate information

- Share of realized gains:

$$PGR = \frac{\text{Realized Gains}}{\text{Realized Gains+Paper Gains}}$$

- Share of realized losses:

$$PLR = \frac{\text{Realized Losses}}{\text{Realized Losses+Paper Losses}}$$

- These measures control for the availability of shares at a gain or at a loss

- Notes on construction of measure:
  - Use only stocks purchased after 1987
  - Observations are counted on all *days* in which a sale or purchase occurs
  - On those days the paper gains and losses are counted
  - Reference point is *average* purchase price
  - PGR and PLR ratios are computed using data over all observations.
  - Example:

$$PGR = \frac{13,883}{13,883 + 79,658}$$

- Result: $PGR > PLR$ for all months, except December

Table I

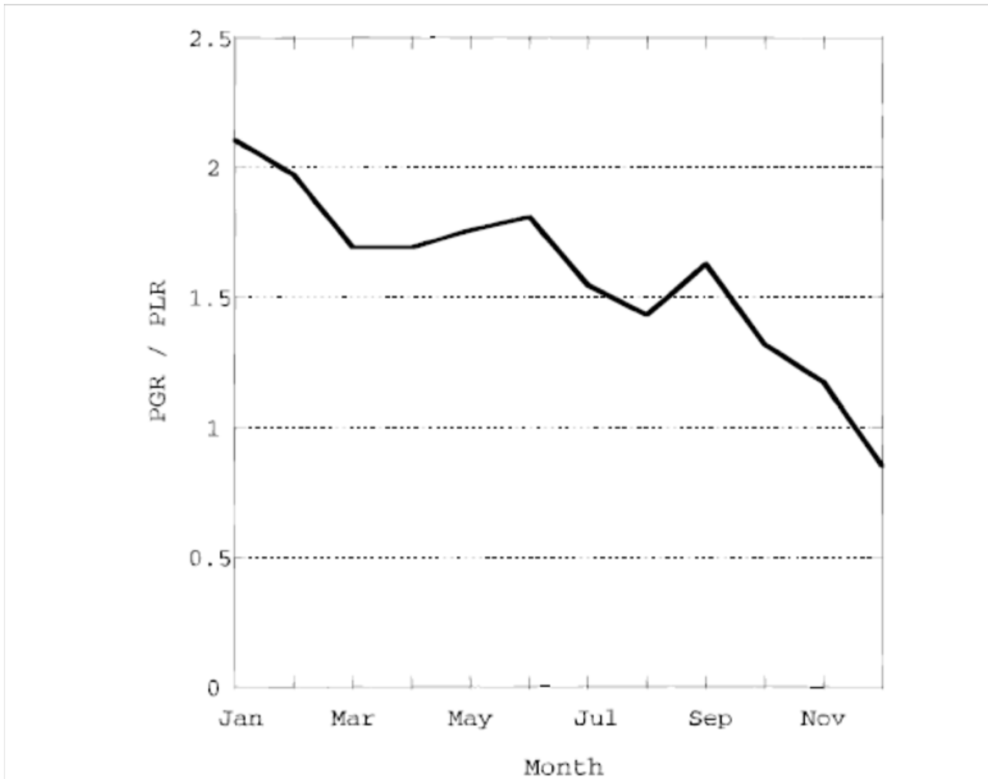
PGR and PLR for the Entire Data Set

This table compares the aggregate Proportion of Gains Realized (PGR) to the aggregate Proportion of Losses Realized (PLR), where PGR is the number of realized gains divided by the number of realized gains plus the number of paper (unrealized) gains, and PLR is the number of realized losses divided by the number of realized losses plus the number of paper (unrealized) losses. Realized gains, paper gains, losses, and paper losses are aggregated over time (1987–1993) and across all accounts in the data set. PGR and PLR are reported for the entire year, for December only, and for January through November. For the entire year there are 13,883 realized gains, 79,658 paper gains, 11,930 realized losses, and 110,348 paper losses. For December there are 866 realized gains, 7,131 paper gains, 1,555 realized losses, and 10,604 paper losses. The t-statistics test the null hypotheses that the differences in proportions are equal to zero assuming that all realized gains, paper gains, realized losses, and paper losses result from independent decisions.

	Entire Year	December	Jan.–Nov.
PLR	0.098	0.128	0.094
PGR	0.148	0.108	0.152
Difference in proportions	−0.050	0.020	−0.058
t-statistic	−35	4.3	−38

- Strong support for disposition effect

- Effect monotonically decreasing across the year



- Tax reasons are also at play

- Robustness: Across years and across types of investors

	1987–1990	1991–1993	Frequent Traders	Infrequent Traders
Entire year PLR	0.126	0.072	0.079	0.296
Entire year PGR	0.201	0.115	0.119	0.452
Difference in proportions	−0.075	−0.043	−0.040	−0.156
t-statistic	−30	−25	−29	−22

- Alternative Explanation 1: **Rebalancing** –> Sell winners that appreciated

  – Remove partial sales

	Entire Year	December
PLR	0.155	0.197
PGR	0.233	0.162
Difference in proportions	−0.078	0.035
t-statistic	−32	4.6

- Alternative Explanation 2: **Ex-Post Return** –> Losers outperform winners ex post

  - Table VI: Winners sold outperform losers that could have been sold

	Performance over Next 84 Trading Days	Performance over Next 252 Trading Days	Performance over Next 504 Trading Days
Average excess return on winning stocks sold	0.0047	0.0235	0.0645
Average excess return on paper losses	−0.0056	−0.0106	0.0287
Difference in excess returns	0.0103	0.0341	0.0358
(p-values)	(0.002)	(0.001)	(0.014)

- Alternative Explanation 3: **Transaction costs** –> Losers more costly to trade (lower prices)
  - Compute equivalent of PGR and PLR for additional purchases of stock
  - This story implies $PGP > PLP$
  - Prospect Theory implies $PGP < PLP$ (invest in losses)

- Evidence:

$$
\begin{aligned}
PGP &= \frac{Gains\ Purchased}{Gains\ Purchased + Paper\ Gains} = .094 \\
&< PLP = \frac{Losses\ Purchased}{Losses\ Purchased + Paper\ Losses} = .135.
\end{aligned}
$$

- Alternative Explanation 4: **Belief in Mean Reversion** –> Believe that losers outperform winners
  - Behavioral explanation: Losers do not outperform winners
  - Predicts that people will buy new losers -> Not true

- How big of a cost? Assume $1000 winner and $1000 loser
  - Winner compared to loser has about $850 in capital gain –> $130 in taxes at 15% marginal tax rate
  - Cost 1: Delaying by one year the $130 tax ded. –> $10
  - Cost 2: Winners overperform by about 3% per year –> $34

- Are results robust to time period and methodology?

- **Ivkovich, Poterba, and Weissbenner (2006)**

- Data

  - 78,000 individual investors in Large discount brokerage, 1991-1996

  - Compare taxable accounts and tax-deferred plans (IRAs)

  - Disposition effect should be stronger for tax-deferred plans

- Methodology: Do hazard regressions of probability of buying an selling monthly, instead of PGR and PLR

- For each month t, estimate

$$SELL_{i,t} = \alpha_t + \beta_{1,t} I(Gain)_{i,t-1} + \beta_{2,t} I(Loss)_{i,t-1} + \varepsilon_{i,t}$$

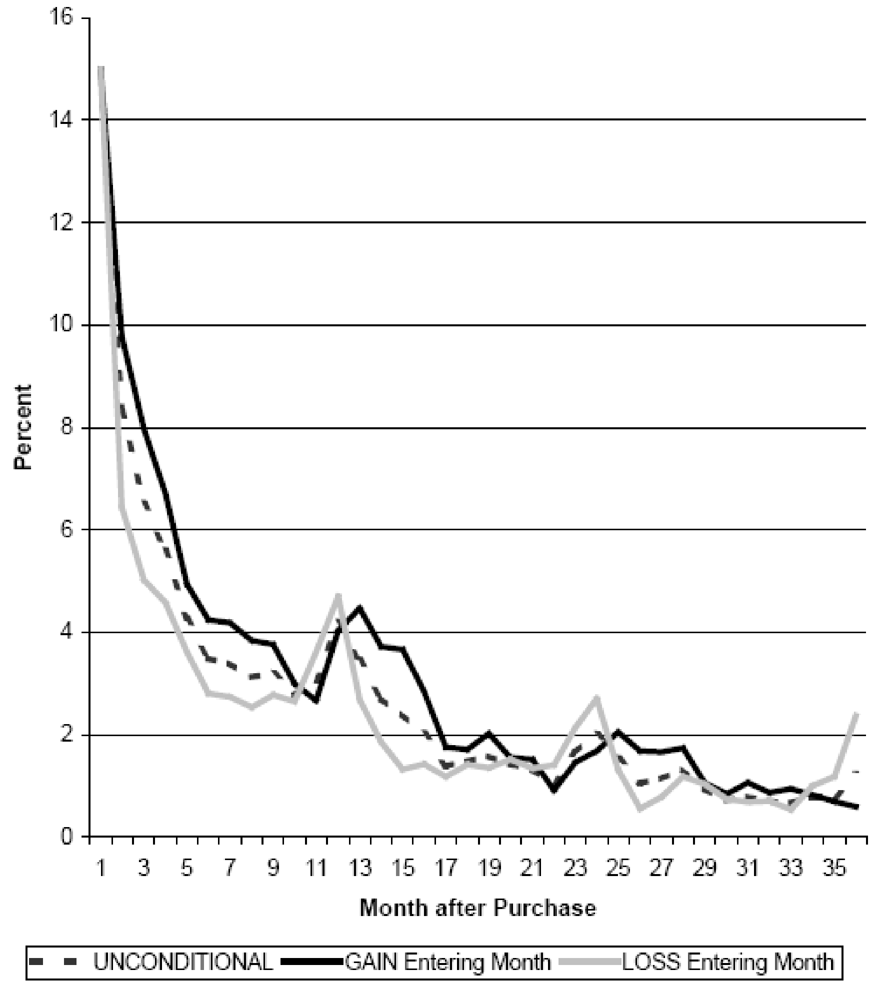
- Regression only applies to shares not already sold

- α_t is baseline hazard at month t

- Pattern of βs always consistent with disposition effect, except in December

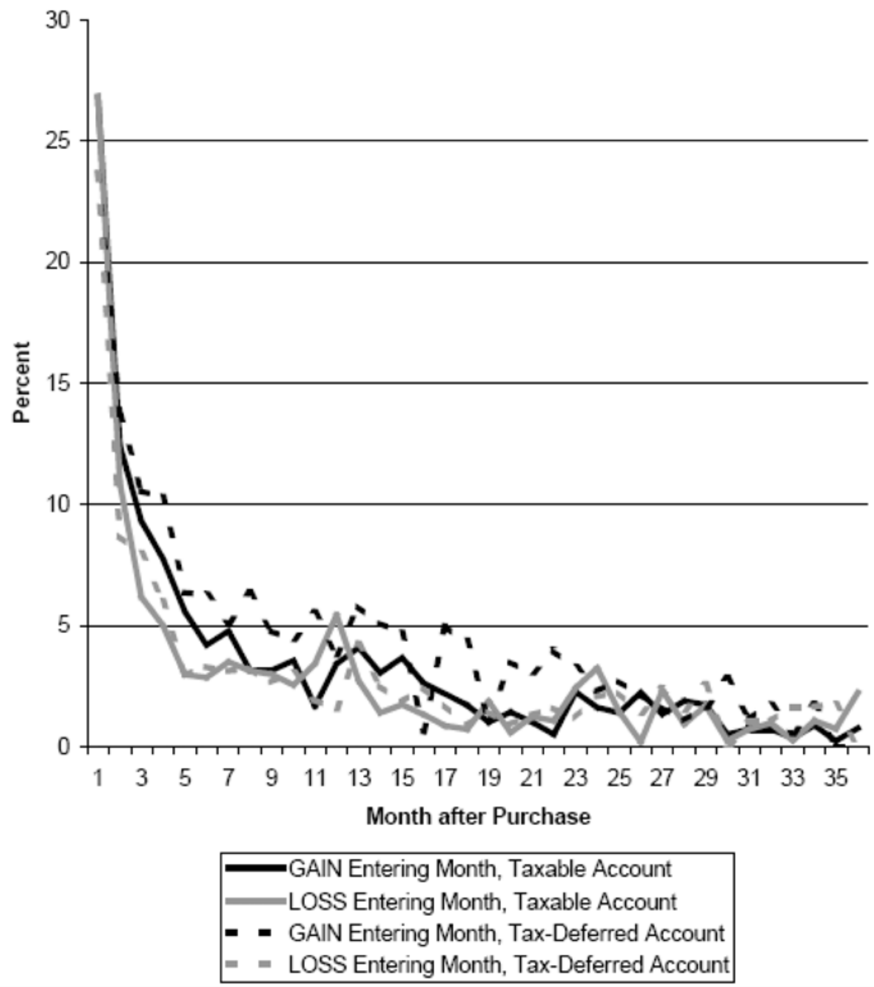
- Difference is small for tax-deferred accounts

Figure 1: Hazard Rate of Having Sold Stock in Taxable Accounts, Full Sample

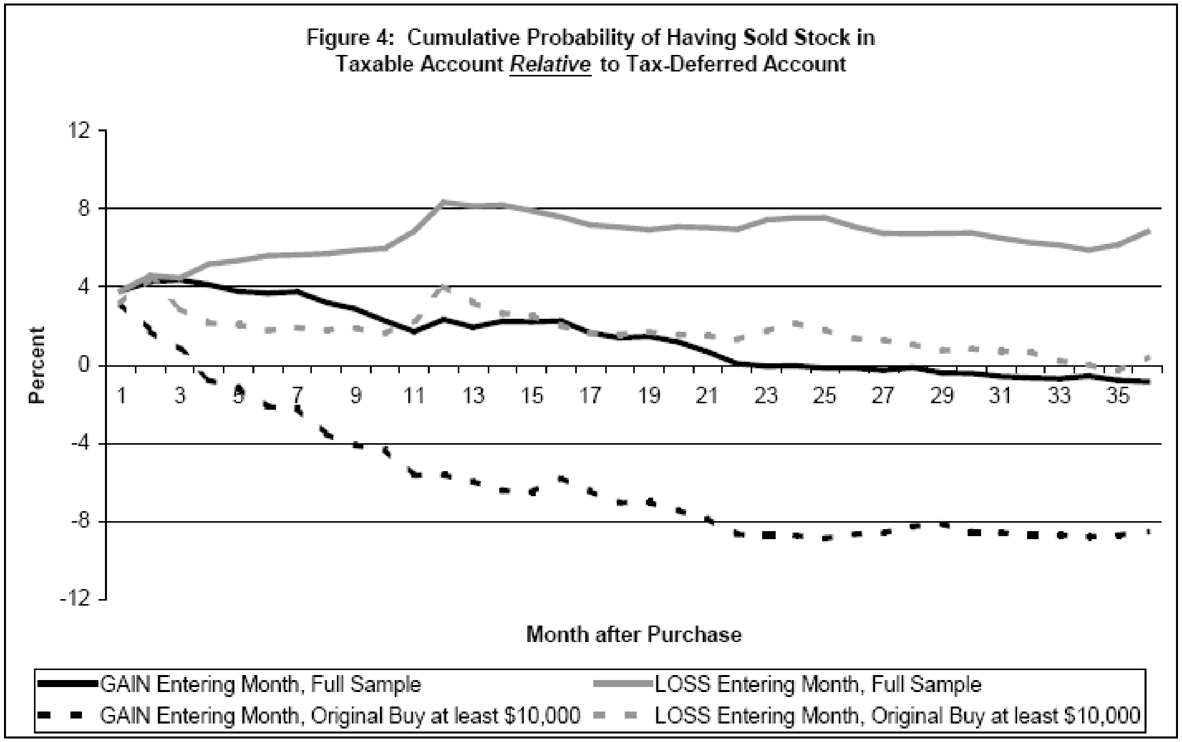


Notes: Sample is January purchases of stock 1991-96 in taxable accounts. The hazard rate for stock purchases unconditional on the stock's price performance, as well as conditional on whether the stock has an accrued capital gain or loss entering the month, is displayed.

Figure 2: Hazard Rate of Having Sold Stock in Taxable and Tax-Deferred Accounts, Original Buy at least $10,000



Notes: Sample is January purchases of stock of at least $10,000 from 1991-96. The hazard rate for stock purchases conditional on whether the stock has an accrued capital gain or loss entering the month is displayed for taxable and tax-deferred accounts.



Notes: Sample is January purchases of stock 1991-96. If h(t) denotes the hazard rate in month t, the probability that the stock is sold by the end of month t is $[1 - (\Pi_{s=1,t}(1-h(s)))]$. Figure 4 displays cumulative probability of sale in a taxable account less that in a tax-deferred account for each month.

- Plot difference in hazards between taxable and tax-deferred account
- Taxes also matter

- Disposition Effect is very solid finding

- **Barberis and Xiang (2006).** Model asset prices with full prospect theory (loss aversion+concavity+convexity), except for prob. weighting

- Under what conditions prospect theory generates disposition effect?

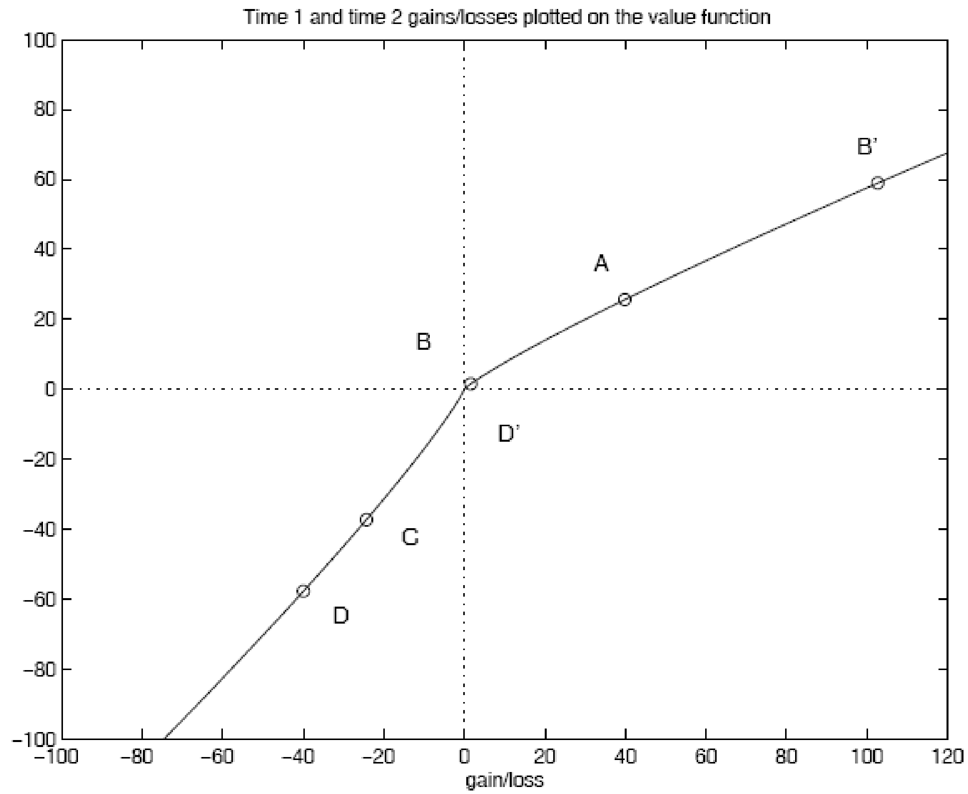
- Setup:
  - Individuals can invest in risky asset or riskless asset with return R_f
  - Can trade in $t = 0, 1, ..., T$ periods
  - Utility is evaluated only at end point, after T periods
  - Reference point is initial wealth W_0
  - utility is $v\left(W_T - W_0 R_f\right)$

- Calibrated model: Prospect theory may not generate disposition effect!

Table 2: For a given (μ, T) pair, we construct an artificial dataset of how 10,000 investors with prospect theory preferences, each of whom owns N_S stocks, each of which has an annual gross expected return μ, would trade those stocks over T periods. For each (μ, T) pair, we use the artifical dataset to compute PGR and PLR, where PGR is the proportion of gains realized by all investors over the entire trading period, and PLR is the proportion of losses realized. The table reports "PGR/PLR" for each (μ, T) pair. Boldface type identifies cases where the disposition effect fails (PGR $<$ PLR). A hyphen indicates that the expected return is so low that the investor does not buy any stock at all.

μ	$T = 2$	$T = 4$	$T = 6$	$T = 12$
1.03	-	-	-	.55/.50
1.04	-	-	.54/.52	.54/.52
1.05	-	-	.54/.52	.59/.45
1.06	-	.70/.25	.54/.52	.58/.47
1.07	-	.70/.25	.54/.52	.57/.49
1.08	-	.70/.25	**.48/.58**	**.47/.60**
1.09	-	**.43/.70**	**.48/.58**	**.46/.61**
1.10	**0.0/1.0**	**.43/.70**	**.48/.58**	**.36/.69**
1.11	**0.0/1.0**	**.43/.70**	**.49/.58**	**.37/.68**
1.12	**0.0/1.0**	**.28/.77**	**.23/.81**	**.40/.66**
1.13	**0.0/1.0**	**.28/.77**	**.24/.83**	**.25/.78**

- Intuition:
  - Previous analysis of reference-dependence and disposition effect focused on concavity and convexity of utility function
  - Neglect of kink at reference point (loss aversion)
  - Loss aversion induces high risk-aversion around the kink –> Two effects
    1. Agents purchase risky stock only if it has high expected return
    2. Agents sell if price of stock is around reference point
  - Now, assume that returns are high enough and one invests:
    * on gain side, likely to be far from reference point –> do not sell, despite (moderate) concavity
    * on loss side, likely to be close to reference point –> may lead to more sales (due to local risk aversion), despite (moderate) convexity



- Some novel predictions of this model:
  - Stocks near buying price are more likely to be sold
  - Disposition effect should hold when away from ref. point

- Barberis-Xiong assumes that utility is evaluated every T period for all stocks

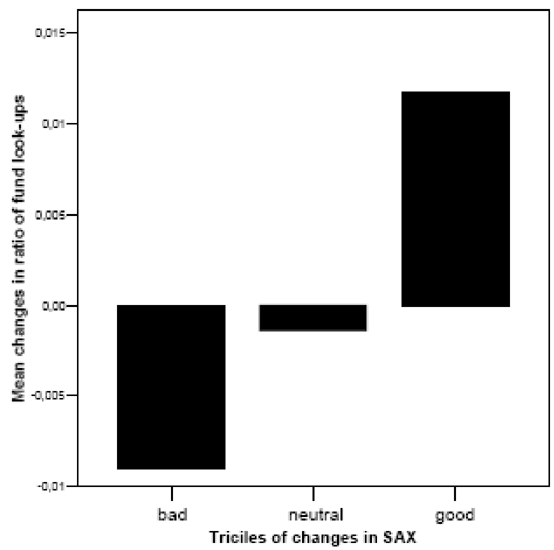
- Alternative assumption: Investors evaluate utility **only** when selling
  - Loss from selling a loser $>$ Gain of selling winner
  - Sell winners, hoping in option value
  - Would induce bunching at exactly purchase price

- Key question: When is utility evaluated?

- **Karlsson, Loewenstein, and Seppi: Ostrich Effect**
  - Investors do not want to evaluate their investments at a loss
  - Stock market down –> Fewer logins into investment account

Figure 4b: Changes in the SAX and ratio of fund look-ups to logins to personal banking page by investors at a large Swedish bank

The sample period is June 30, 2003 through October 7, 2003.



3 Reference Dependence: Equity Premium

- Disposition Effect is about cross-sectional returns and trading behavior –> Compare winners to losers

- Now consider reference dependence and market-wide returns

- **Benartzi and Thaler (1995)**

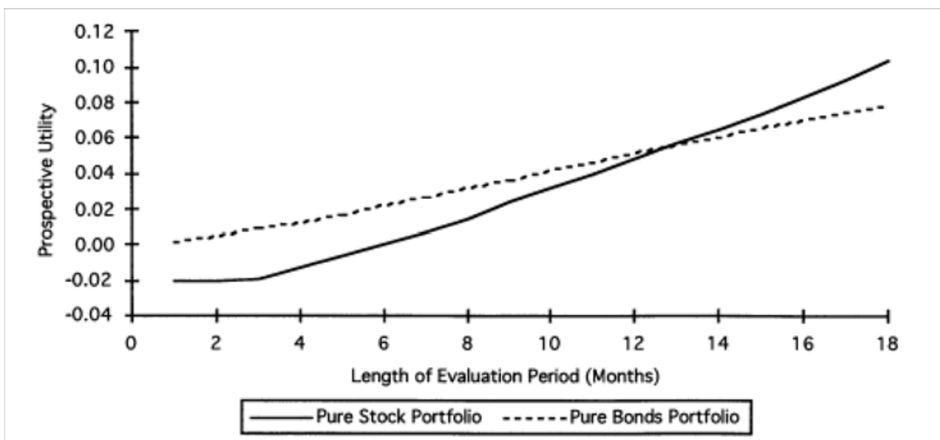
- Equity premium (Mehra and Prescott, 1985)
  - Stocks not so risky
  - Do not covary much with GDP growth
  - BUT equity premium 3.9% over bond returns (US, 1871-1993)

- Need very high risk aversion: $RRA \geq 20$

- Benartzi and Thaler: Loss aversion + narrow framing solve puzzle
  - Loss aversion from (nominal) losses—> Deter from stocks
  - Narrow framing: Evaluate returns from stocks every n months

- More frequent evaluation—>Losses more likely –> Fewer stock holdings

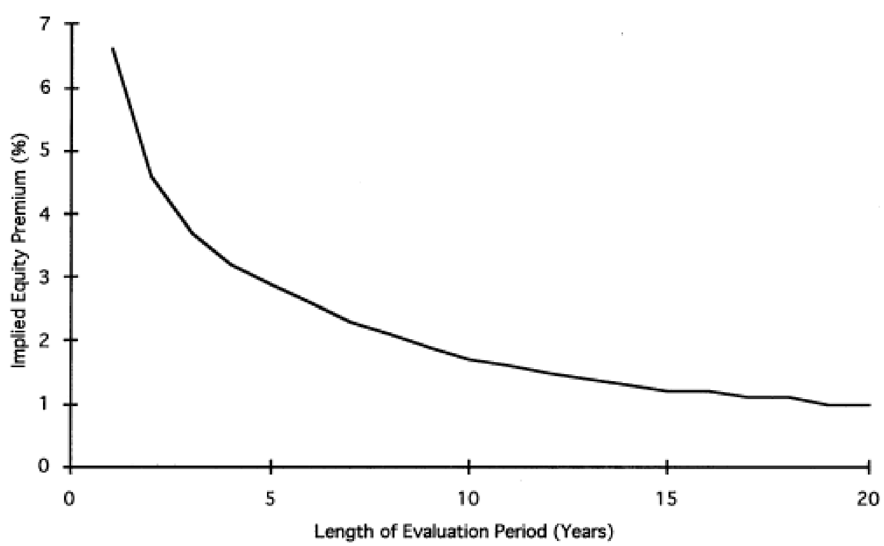
- Calibrate model with λ (loss aversion) 2.25 and full prospect theory specification –>Horizon n at which investors are indifferent between stocks and bonds



- If evaluate every year, indifferent between stocks and bonds

- (Similar results with piecewise linear utility)

- Alternative way to see results: Equity premium implied as function on n



- **Barberis, Huang, and Santos (2001)**

- Piecewise linear utility, $\lambda = 2.25$

- Narrow framing at aggregate stock level

- Range of implications for asset pricing

- Barberis and Huang (2001)

- Narrowly frame at individual stock level (or mutual fund)

4 Reference Dependence: Employment and Effort

- Back to labor markets: Do reference points affect performance?

- **Mas (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 $U(x) = -bx$ and $V(x) = bx$

– 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

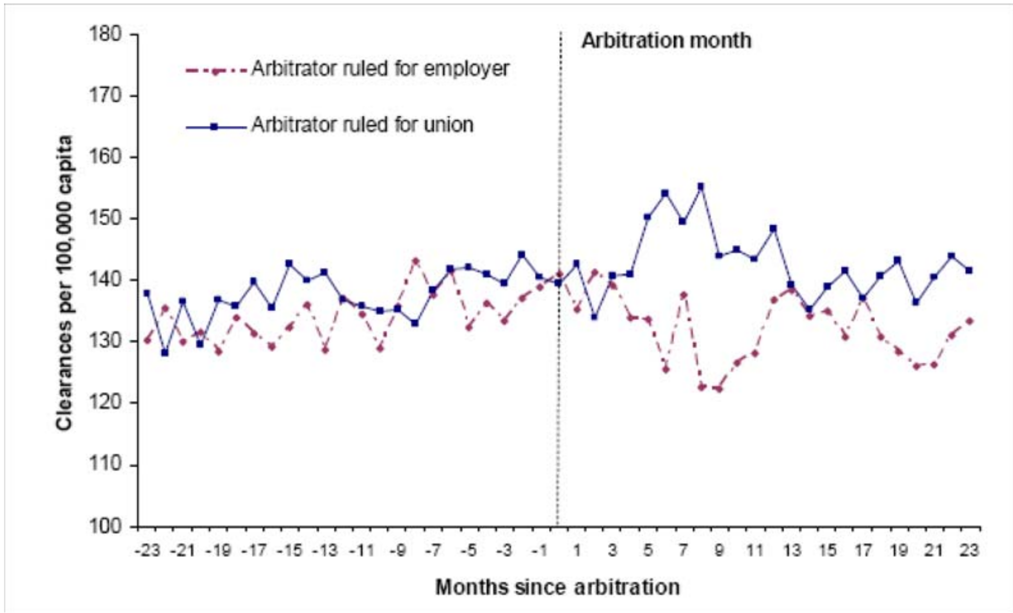
- Data:
  - 383 arbitration cases in New Jersey, 1978-1995
  - Observe offers submitted r_e, r_u, and ruling $\bar{r}_a$
  - Match to UCR crime clearance data (=number of crimes solved by arrest)

- 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

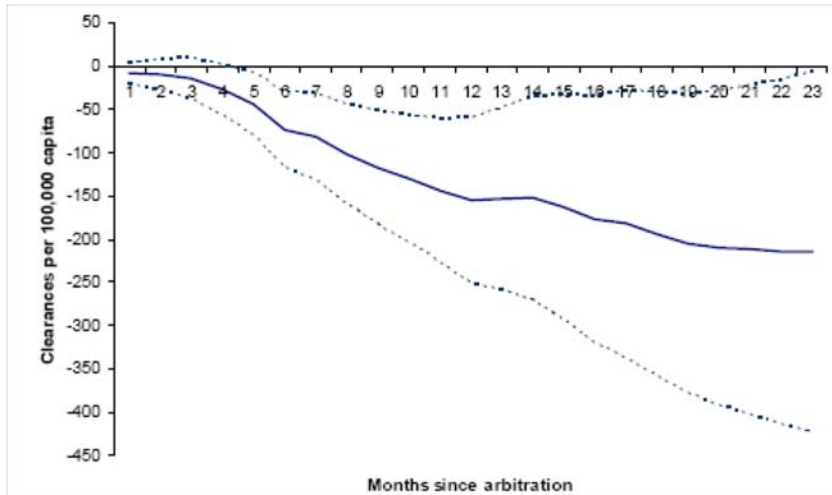
	(1) Full-sample	(2) Pre-arbitration: Employer wins	(3) Pre-arbitration: Employer loses	(4) Pre-arbitration: Employer win-Employer loss
Arbitrator rules for employer	0.344			
Final Offer: Employer	6.11	6.44	5.94	0.50
	[1.65]	[1.54]	[1.68]	(0.18)
Final Offer: Union	7.65	7.87	7.54	0.32
	[1.71]	[2.03]	[1.51]	(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	120.31	122.28	118.57	3.71
per 100,000 capita	[106.65]	[108.76]	[104.35]	(9.46)

- Graphical evidence of effect of ruling on crime clearance rate

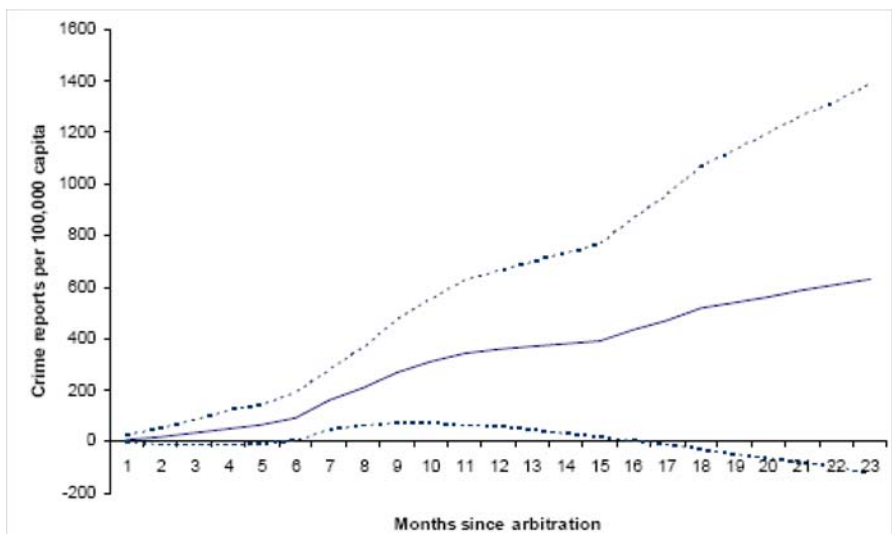


- Significant effect on clearance rate for one year after ruling

- Estimate of the cumulated difference between Employer and Union cities on clearance rates and crime



Clearances per 100,000 capita
Months since arbitration



Crime reports per 100,000 capita
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 $\bar{r}_a - (r_e + r_u)/2$

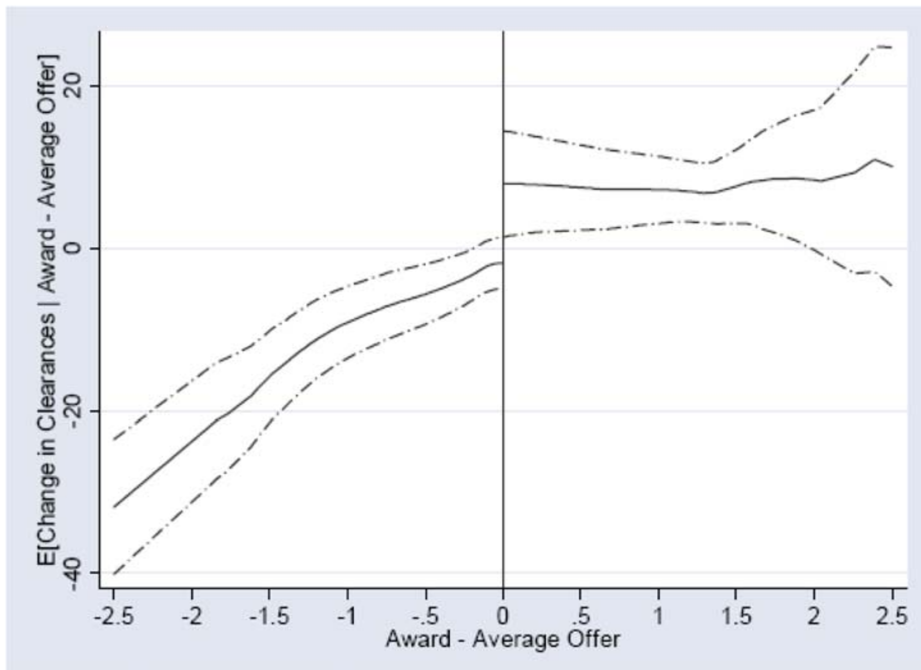


Figure V
Estimated expected change in clearances conditional on the deviation of the award from the average of the offers

- 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

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

- F.o.c.:

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

Then

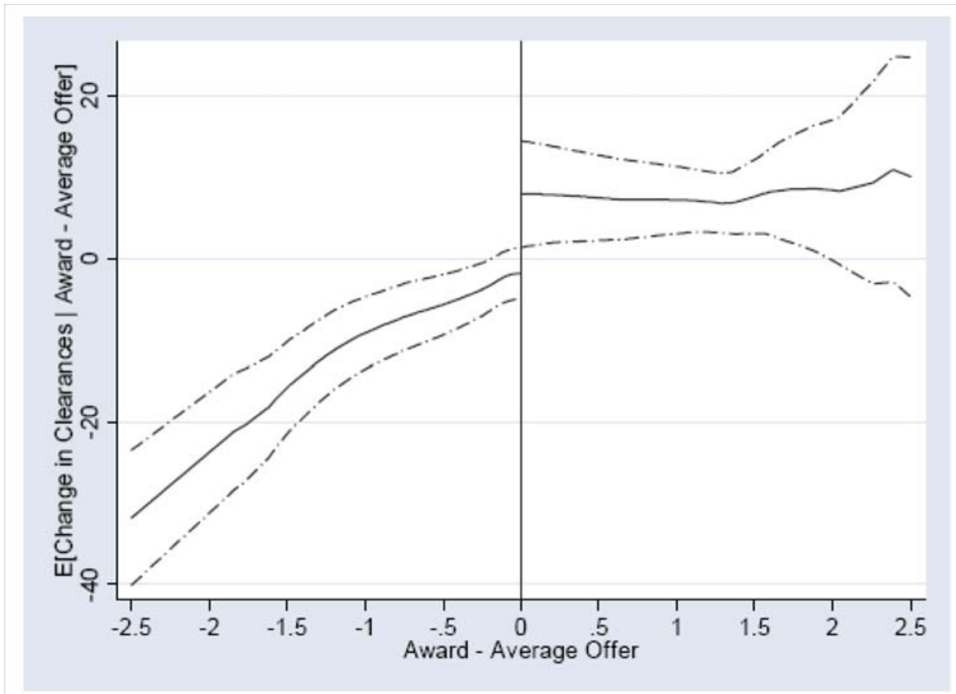
$$e^*(w) = \frac{\bar{U}}{\theta} + \frac{1}{\theta} U(w)$$

- 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

5 Next Lecture

- Social Preferences
  - Charitable Giving
  - Gift Exchange
  - From Lab to Field
- Limited Attention