Econ 219A
Psychology and Economics: Foundations
(Lecture 2)

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Outline

1. Reference Dependence: Housing
2. Reference Dependence: Mergers
3. Reference Dependence: Insurance
4. Reference Dependence: Employment and Effort
5. Reference Dependence: Disposition Effect I

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

- S.o.c are

$$2p'(P^*)U'(P^*) + p(P^*)U''(P^*) + p''(P^*)(U(P^*) - \bar{U}) < 0$$

- Need $p''(P^*)(U(P^*) - \bar{U}) < 0$ or not too positive

- Reference-dependent preferences with reference price P_0:

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

  - 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

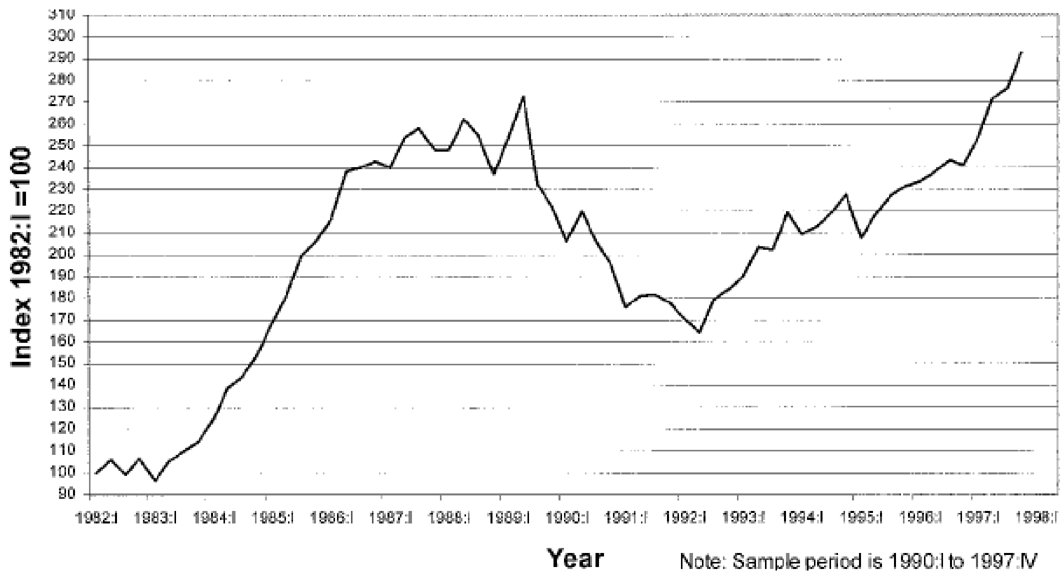


FIGURE I
Boston Condominium Price Index

- 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 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)

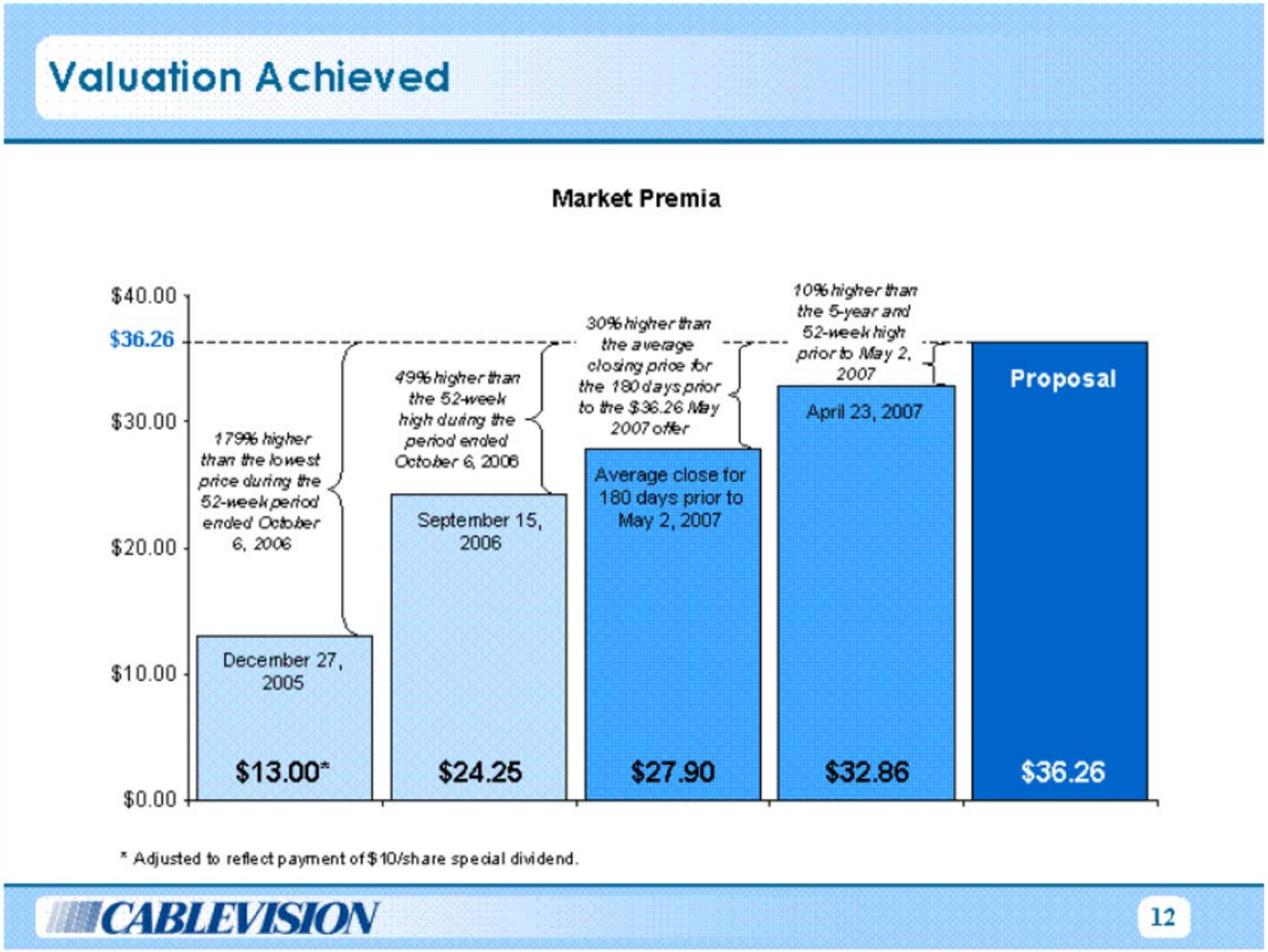
- – Overall, plausible set of results that show impact of reference point
  – Would have been nice to tie better to model

2 Reference Dependence: 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

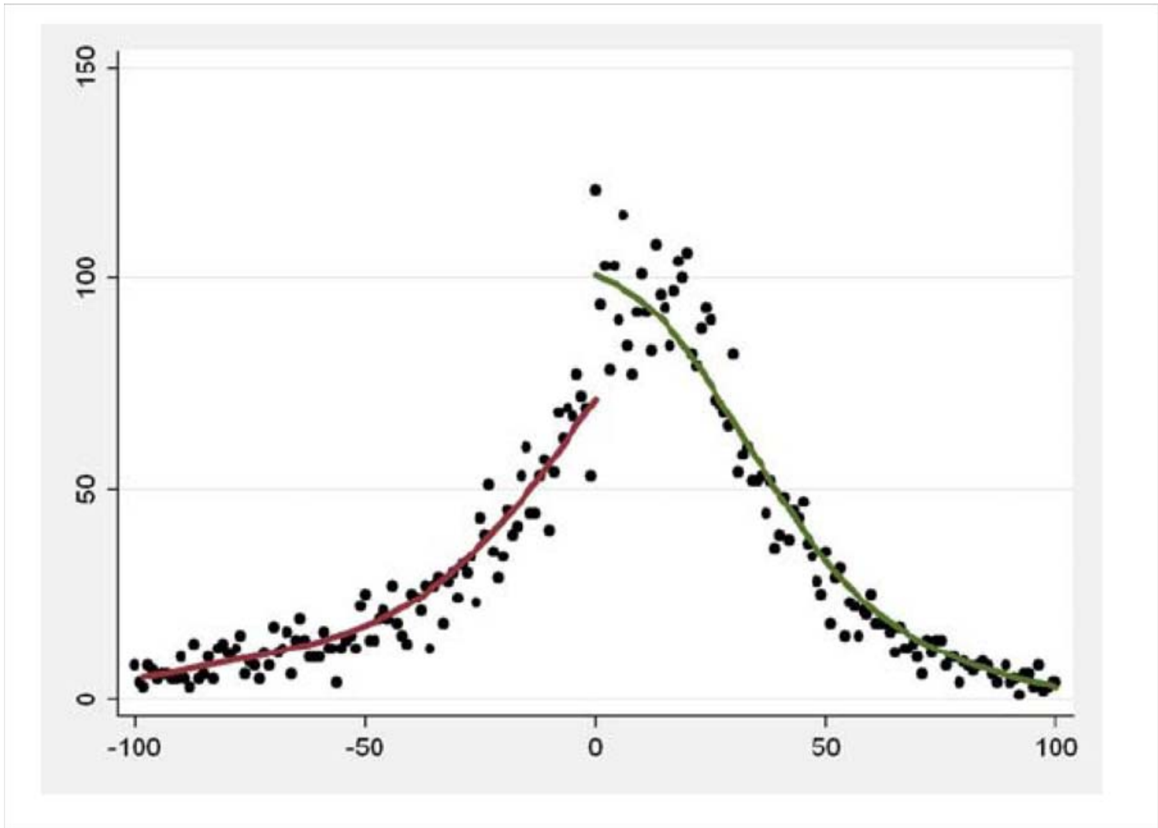
  - Test 1: Is there bunching around P_{52}? (GM did not do this)

  - 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}?

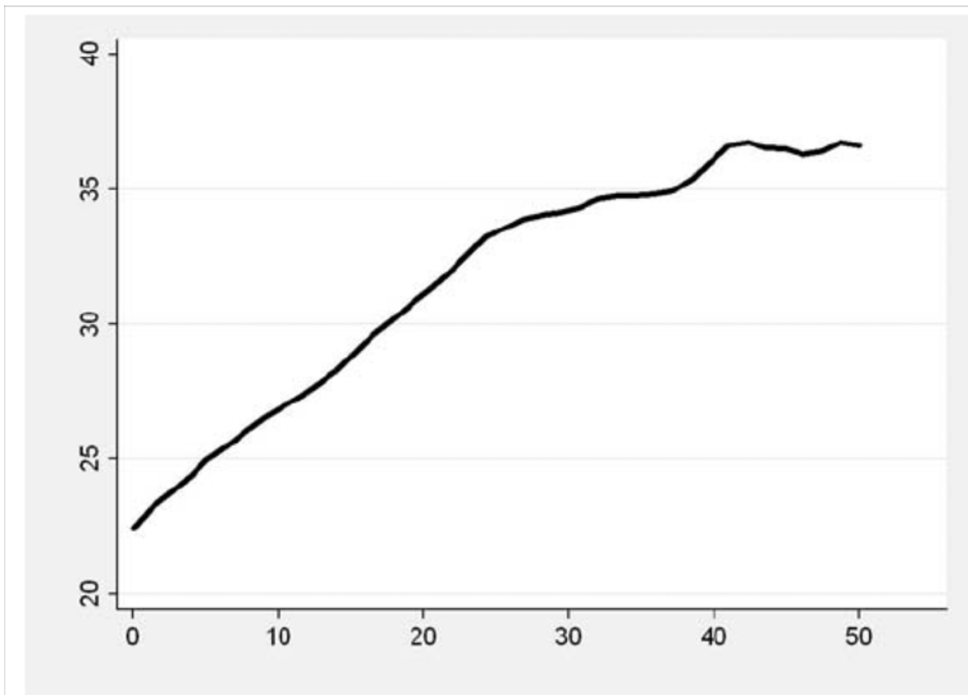
  - Firms in left tail wait for merger until 12 months after past peak, so P_{52} is higher?

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

$$\frac{P}{P_{-30}} = \alpha + \beta \frac{P_{52}}{P_{-30}} + \varepsilon$$



- 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

3 Reference Dependence: Insurance

- Much of the laboratory evidence on prospect theory is on risk taking

- Field evidence considered so far (mostly) does not involve risk:
  - Trading behavior – Endowment Effect
  - Daily Labor Supply

- Field evidence on risk taking?

- Sydnor (2006) on deductible choice in the life insurance industry

- Uses Menu Choice as identification strategy as in DellaVigna and Malmendier (2006)

- Slides courtesy of Justin Sydnor

Dataset

- 50,000 Homeowners-Insurance Policies
  - 12% were new customers
- Single western state
- One recent year (post 2000)
- Observe
  - Policy characteristics including deductible
    - 1000, 500, 250, 100
  - Full available deductible-premium menu
  - Claims filed and payouts by company

Features of Contracts

- Standard homeowners-insurance policies (no renters, condominiums)
- Contracts differ only by deductible
- Deductible is *per claim*
- No experience rating
  - Though underwriting practices not clear
- Sold through agents
  - Paid commission
  - No “default” deductible
- Regulated state

Summary Statistics

Variable	Full Sample	Chosen Deductible 1000	500	250	100
Insured home value	206,917	266,461	205,026	180,895	164,485
	(91,178)	(127,773)	(81,834)	(65,089)	(53,808)
Number of years insured by the company	8.4	5.1	5.8	13.5	12.8
	(7.1)	(5.6)	(5.2)	(7.0)	(6.7)
Average age of H.H. members	53.7	50.1	50.5	59.8	66.6
	(15.8)	(14.5)	(14.9)	(15.9)	(15.5)
Number of paid claims in sample year (claim rate)	0.042	0.025	0.043	0.049	0.047
	(0.22)	(0.17)	(0.22)	(0.23)	(0.21)
Yearly premium paid	719.80	798.60	715.60	687.19	709.78
	(312.76)	(405.78)	(300.39)	(267.82)	(269.34)
N	49,992	8,525	23,782	17,536	149
Percent of sample	100%	17.05%	47.57%	35.08%	0.30%

* Means with standard errors in parentheses.

Deductible Pricing

- X_i = matrix of policy characteristics
- $f(X_i)$ = "base premium"
  - Approx. linear in home value
- Premium for deductible D
  - $P_i^D = \delta_D f(X_i)$
- Premium differences
  - $\Delta P_i = \Delta\delta\, f(X_i)$
- $\Rightarrow$Premium differences depend on base premiums (insured home value).

Premium-Deductible Menu

Available Deductible	Full Sample
1000	$615.82 (292.59)
500	+99.91 (45.82)
250	+86.59 (39.71)
100	+133.22 (61.09)

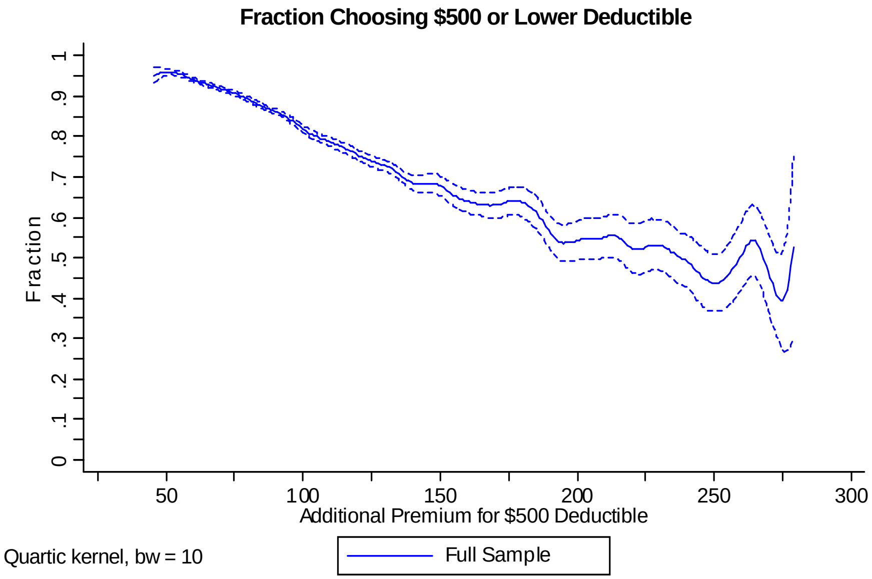
* Means with standard deviations in parentheses

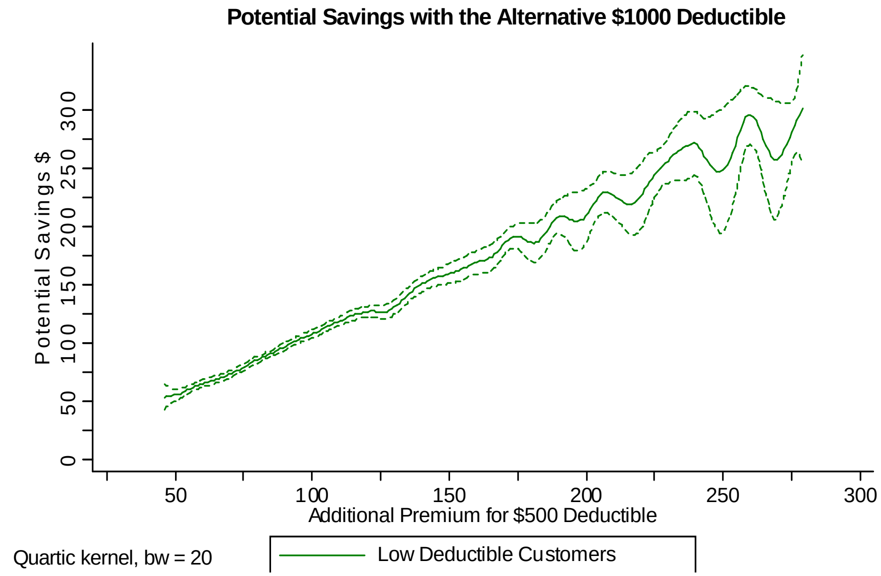
Risk Neutral Claim Rates?

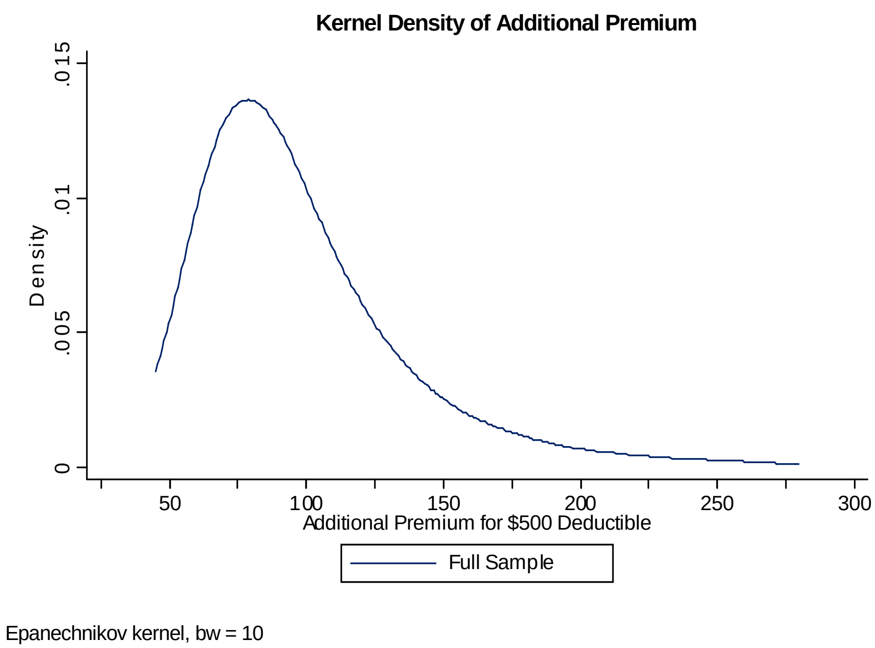
100/500 = 20%

87/250 = 35%

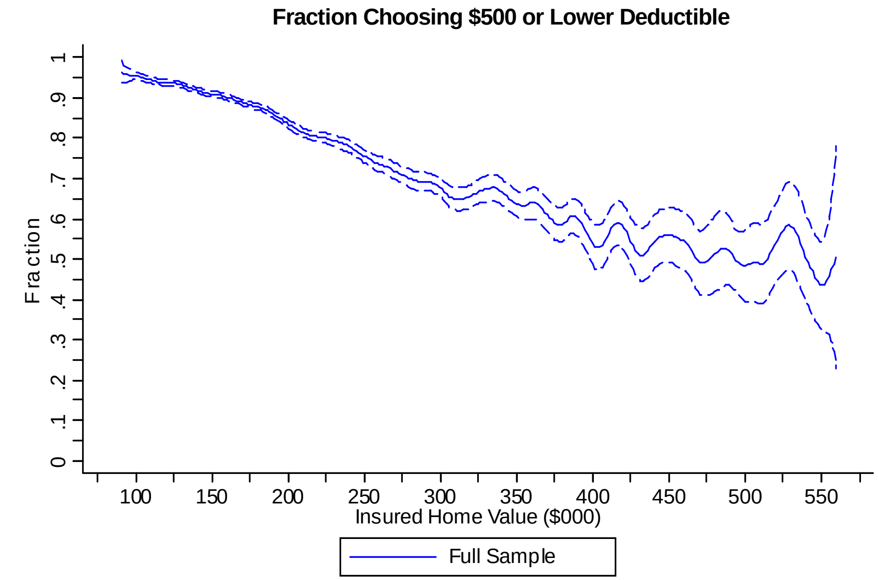
133/150 = 89%



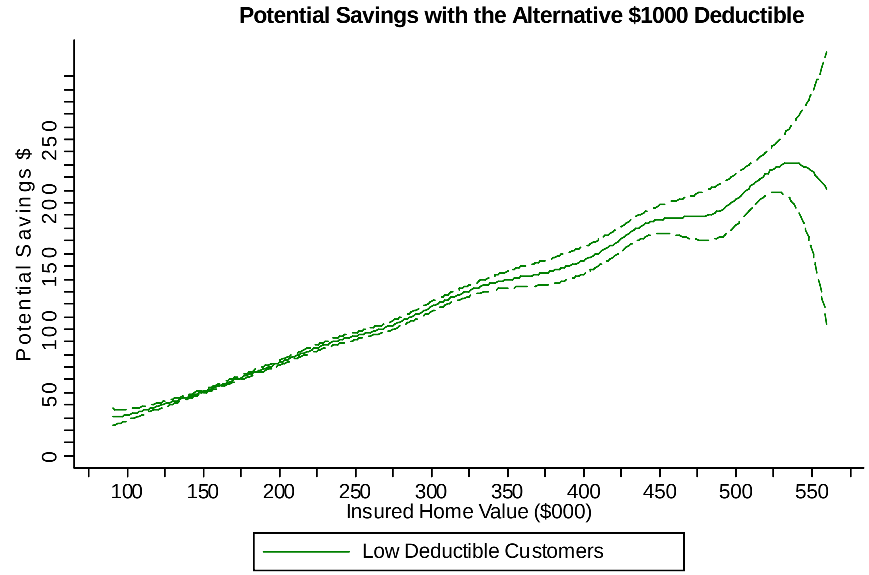




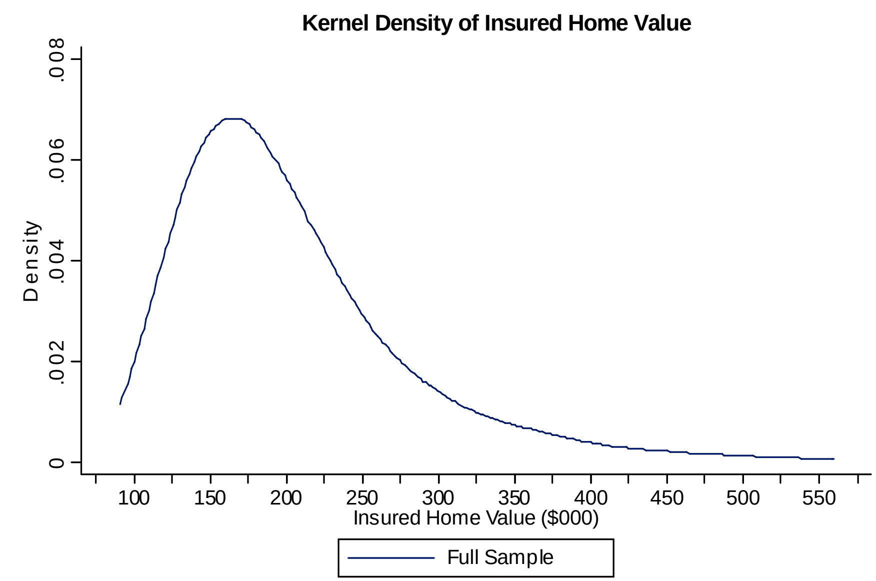
What if the x-axis were insured home value?



Quartic kernel, bw = 25



Quartic kernel, bw = 50



Epanechnikov kernel, bw = 25

Potential Savings with 1000 Ded

Claim rate?

Value of lower deductible?

Additional premium?

Potential savings?

Chosen Deductible	Number of claims per policy	Increase in out-of-pocket payments *per claim* with a $1000 deductible	Increase in out-of-pocket payments *per policy* with a $1000 deductible	Reduction in yearly premium per policy with $1000 deductible	Savings per policy with $1000 deductible
$500	0.043	469.86	19.93	99.85	79.93
N=23,782 (47.6%)	(.0014)	(2.91)	(0.67)	(0.26)	(0.71)
$250	0.049	651.61	31.98	158.93	126.95
N=17,536 (35.1%)	(.0018)	(6.59)	(1.20)	(0.45)	(1.28)

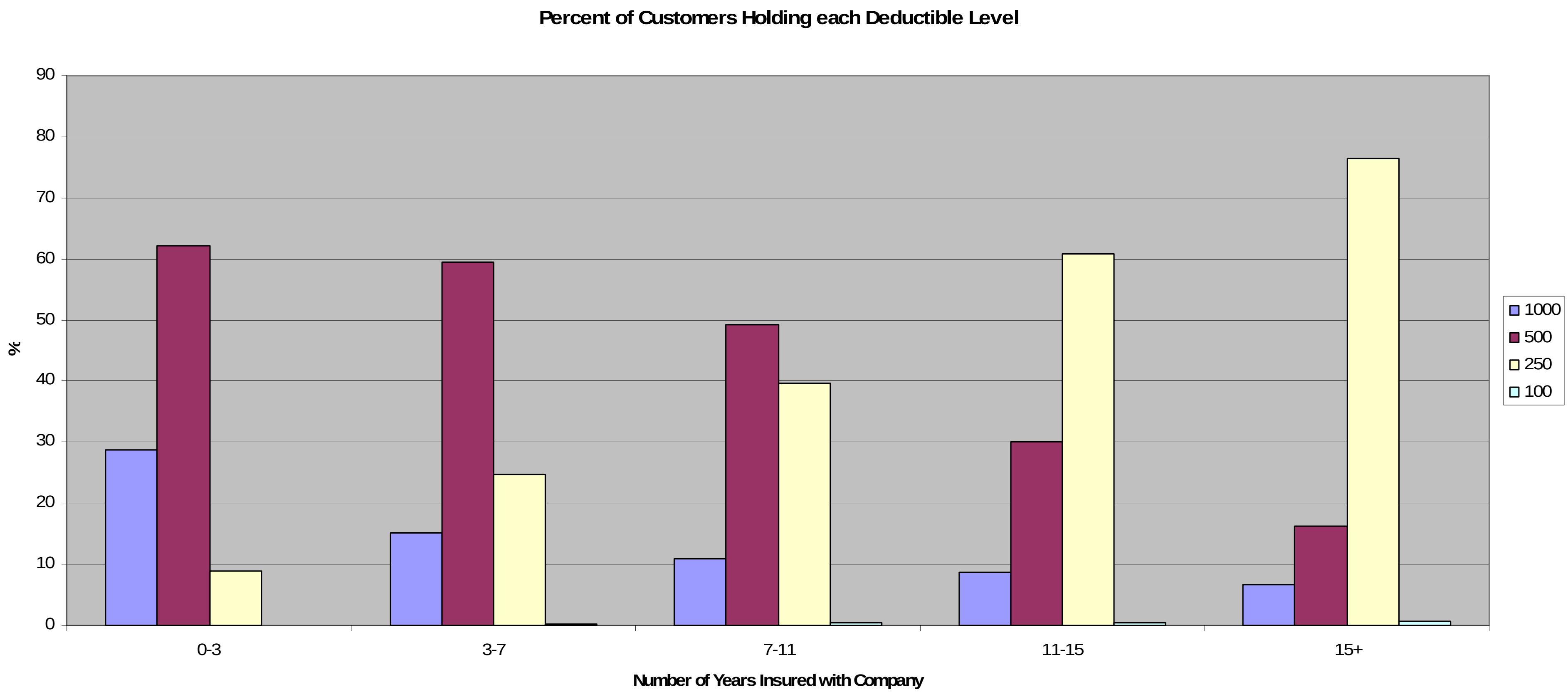
Average forgone expected savings for all low-deductible customers: $99.88

* Means with standard errors in parentheses

Back of the Envelope

- BOE 1: Buy house at 30, retire at 65, 3% interest rate ⇒ $6,300 expected
  - With 5% Poisson claim rate, only 0.06% chance of losing money
- BOE 2: (Very partial equilibrium) 80% of 60 million homeowners could expect to save $100 a year with “high” deductibles ⇒ $4.8 billion per year

Consumer Inertia?



Look Only at New Customers

Chosen Deductible	Number of claims per policy	Increase in out-of-pocket payments *per claim* with a $1000 deductible	Increase in out-of-pocket payments *per policy* with a $1000 deductible	Reduction in yearly premium per policy with $1000 deductible	Savings per policy with $1000 deductible
$500	0.037	475.05	17.16	94.53	77.37
N = 3,424 (54.6%)	(.0035)	(7.96)	(1.66)	(0.55)	(1.74)
$250	0.057	641.20	35.68	154.90	119.21
N = 367 (5.9%)	(.0127)	(43.78)	(8.05)	(2.73)	(8.43)

Average forgone expected savings for all low-deductible customers: $81.42

Risk Aversion?

- Simple Standard Model
  - Expected utility of wealth maximization
  - Free borrowing and savings
  - Rational expectations
  - Static, single-period insurance decision
  - No other variation in lifetime wealth

What level of wealth? Chetty (2005)

- Consumption maximization:

$$\max_{c_t} U(c_1, c_2, \ldots, c_T),$$
$$s.t.\ c_1 + c_2 + \ldots + c_T = y_1 + y_2 + \ldots y_T.$$

- (Indirect) utility of wealth maximization

$$\max_{w} u(w),$$

where $u(w) = \max_{c_t} U(c_1, c_2, \ldots, c_T),$
$$s.t.\ c_1 + c_2 + \ldots + c_T = y_1 + y_2 + \ldots + y_T = w$$

$\Rightarrow$ *w* is lifetime wealth

Model of Deductible Choice

- Choice between (P_L,D_L) and (P_H,D_H)
- π = probability of loss
  - Simple case: only one loss
- EU of contract:
  - $U(P,D,\pi) = \pi u(w-P-D) + (1- \pi)u(w-P)$

Bounding Risk Aversion

Assume CRRA form for u:

$$u(x) = \frac{x^{(1-\rho)}}{(1-\rho)} \quad for\ \rho \neq 1, \quad and \quad u(x) = \ln(x)\ \ for\ \rho = 1$$

Indifferent between contracts iff:

$$\pi \frac{(w - P_L - D_L)^{(1-\rho)}}{(1-\rho)} + (1-\pi)\frac{(w - P_L)^{(1-\rho)}}{(1-\rho)} = \pi \frac{(w - P_H - D_H)^{(1-\rho)}}{(1-\rho)} + (1-\pi)\frac{(w - P_H)^{(1-\rho)}}{(1-\rho)}$$

Getting the bounds

- Search algorithm at individual level
  - New customers
- Claim rates: Poisson regressions
  - Cap at 5 possible claims for the year
- Lifetime wealth:
  - Conservative: $1 million (40 years at $25k)
  - More conservative: Insured Home Value

CRRA Bounds

Chosen Deductible	Measure of Lifetime Wealth (W): (Insured Home Value)		
	W	min ρ	max ρ
$1,000	256,900	- infinity	794
N = 2,474 (39.5%)	{113,565}		(9.242)
$500	190,317	397	1,055
N = 3,424 (54.6%)	{64,634}	(3.679)	(8.794)
$250	166,007	780	2,467
N = 367 (5.9%)	{57,613}	(20.380)	(59.130)

Interpreting Magnitude

- 50-50 gamble:
  Lose $1,000/ Gain $10 million
  - 99.8% of low-ded customers would reject
  - Rabin (2000), Rabin & Thaler (2001)
- Labor-supply calibrations, consumption-savings behavior $\Rightarrow \rho < 10$
  - Gourinchas and Parker (2002) -- 0.5 to 1.4
  - Chetty (2005) -- < 2

Wrong level of wealth?

- Lifetime wealth inappropriate if borrowing constraints.
- \$94 for \$500 insurance, 4% claim rate
  - W = \$1 million $\Rightarrow \rho$ = 2,013
  - W = \$100k $\Rightarrow \rho$ = 199
  - W = \$25k $\Rightarrow \rho$ = 48

Prospect Theory

- Kahneman & Tversky (1979, <u>1992</u>)
- Reference dependence
  - Not final wealth states
- Value function
  - Loss Aversion
  - Concave over gains, convex over losses
- Non-linear probability weighting

Model of Deductible Choice

- Choice between (P_L,D_L) and (P_H,D_H)
- π = probability of loss
- EU of contract:
  - $U(P,D,\pi) = \pi u(w-P-D) + (1-\pi)u(w-P)$
- PT value:
  - $V(P,D,\pi) = v(-P) + w(\pi)v(-D)$
- Prefer (P_L,D_L) to (P_H,D_H)
  - $v(-P_L) - v(-P_H) < w(\pi)[v(-D_H) - v(-D_L)]$

Loss Aversion and Insurance

- Slovic et al (1982)
  - Choice A
    - 25% chance of $200 loss **[80%]**
    - Sure loss of $50 **[20%]**
  - Choice B
    - 25% chance of $200 loss **[35%]**
    - Insurance costing $50 **[65%]**

No loss aversion in buying

- Novemsky and Kahneman (2005) (Also Kahneman, Knetsch & Thaler (1991))
  - Endowment effect experiments
  - Coefficient of loss aversion = 1 for “transaction money”
- Köszegi and Rabin (forthcoming QJE, 2005)
  - Expected payments
- Marginal value of deductible payment > premium payment (2 times)

So we have:

- Prefer (P_L,D_L) to (P_H,D_H):

$$v(-P_L) - v(-P_H) < w(\pi)[v(-D_H) - v(-D_L)]$$

- Which leads to:

$$P_L^{\beta} - P_H^{\beta} < w(\pi)\lambda[D_H^{\beta} - D_L^{\beta}]$$

- Linear value function:

$$WTP = \Delta P = \boxed{w(\pi)\lambda}\Delta D$$

= 4 to 6 times EV

Parameter values

- Kahneman and Tversky (1992)
  - λ = 2.25
  - β = 0.88
- Weighting function

$$w(\pi) = \frac{\pi^{\gamma}}{(\pi^{\gamma} + (1-\pi)^{\gamma})^{1/\gamma}}$$

  - γ = 0.69

WTP from Model

- Typical new customer with $500 ded
  - Premium with $1000 ded = $572
  - Premium with $500 ded = +$94.53
  - 4% claim rate
- Model predicts WTP = $107
- Would model predict $250 instead?
  - WTP = $166. Cost = $177, so no.

Choices: Observed vs. Model

Chosen Deductible	Predicted Deductible Choice from Prospect Theory NLIB Specification: λ = 2.25, γ = 0.69, β = 0.88				Predicted Deductible Choice from EU(W) CRRA Utility: ρ = 10, W = Insured Home Value			
	1000	500	250	100	1000	500	250	100
$1,000 N = 2,474 (39.5%)	**87.39%**	11.88%	0.73%	0.00%	**100.00%**	0.00%	0.00%	0.00%
$500 N = 3,424 (54.6%)	18.78%	**59.43%**	21.79%	0.00%	100.00%	**0.00%**	0.00%	0.00%
$250 N = 367 (5.9%)	3.00%	44.41%	**52.59%**	0.00%	100.00%	0.00%	**0.00%**	0.00%
$100 N = 3 (0.1%)	33.33%	66.67%	0.00%	**0.00%**	100.00%	0.00%	0.00%	**0.00%**

Conclusions

- (Extreme) aversion to moderate risks is an empirical reality in an important market
- Seemingly anomalous in Standard Model where risk aversion = DMU
- Fits with existing parameter estimates of leading psychology-based alternative model of decision making
- Mehra & Prescott (1985), Benartzi & Thaler (1995)

Alternative Explanations

- Misestimated probabilities
  - ≈ 20% for single-digit CRRA
  - Older (age) new customers just as likely
- Liquidity constraints
- Sales agent effects
  - Hard sell?
  - Not giving menu? ($500?, data patterns)
  - Misleading about claim rates?
- Menu effects

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

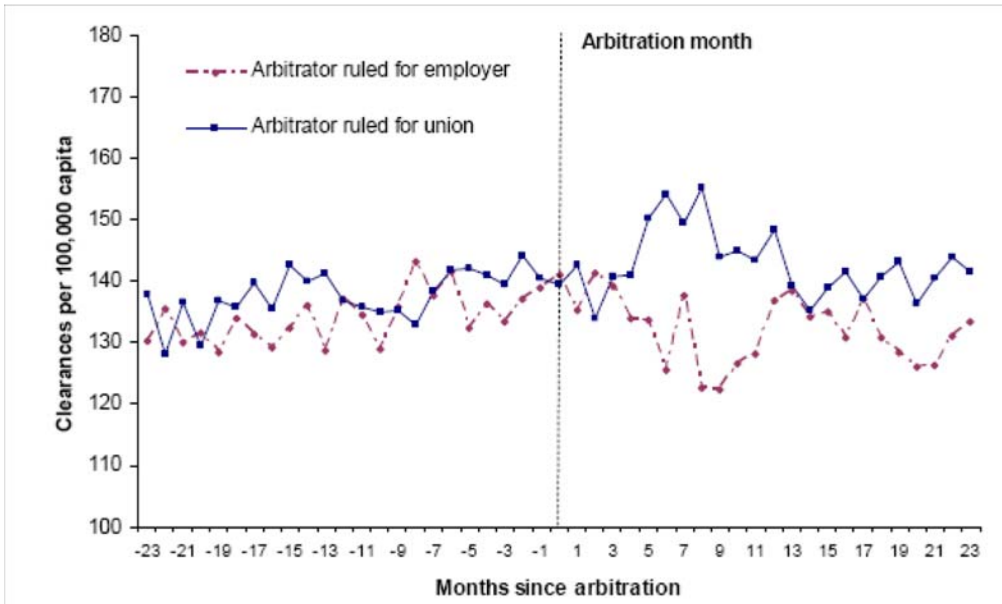
- Data:
  - 383 arbitration cases in New Jersey, 1978-1995
  - Observe offers submitted r_e, r_u, and ruling $\bar{r}_a$
  - Match to UCR crime clearance data (=number of crimes solved by arrest)

- 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

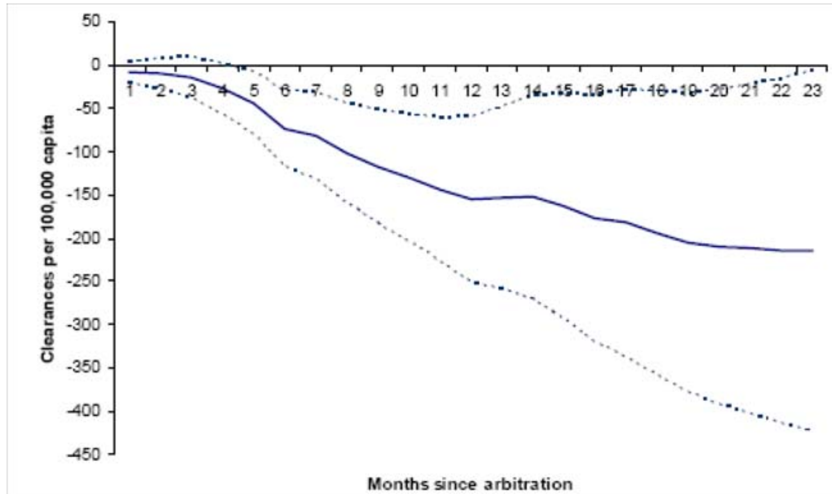
	(1) Full-sample	(2) Pre-arbitration: Employer wins	(3) Pre-arbitration: Employer loses	(4) Pre-arbitration: Employer win-Employer loss
Arbitrator rules for employer	0.344			
Final Offer: Employer	6.11	6.44	5.94	0.50
	[1.65]	[1.54]	[1.68]	(0.18)
Final Offer: Union	7.65	7.87	7.54	0.32
	[1.71]	[2.03]	[1.51]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

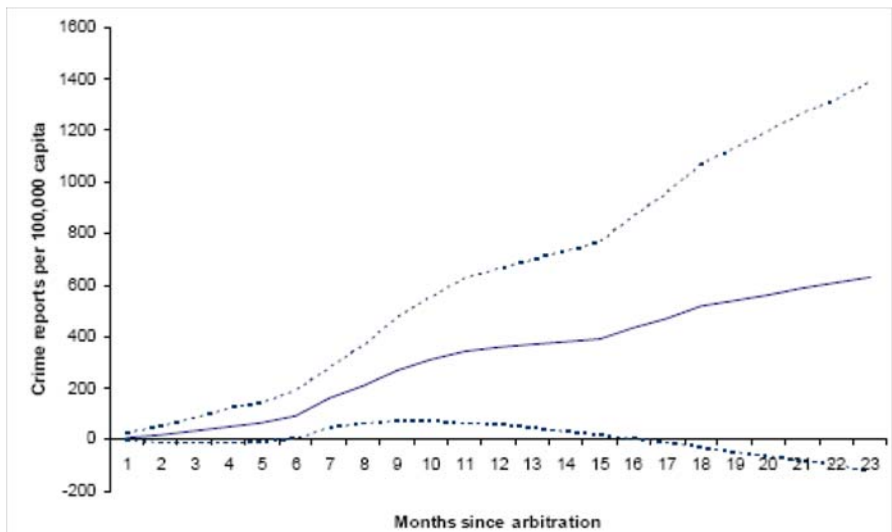
- Graphical evidence of effect of ruling on crime clearance rate



- 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


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 (63.98)		150.26 (23.23)		461.81 (42.00)	
Post-arbitration × Employer win	26.86 (25.29)	24.68 (14.68)	7.75 (7.85)	4.87 (4.70)	19.19 (18.17)	19.86 (11.19)
Post-arbitration × Union win	7.64 (16.24)	6.68 (11.42)	7.07 (5.46)	2.49 (4.46)	0.170 (11.68)	4.40 (7.87)
Row 3 – Row 2	-19.21 (30.06)	-18.01 (19.12)	-0.68 (9.56)	-2.38 (6.63)	-19.02 (21.60)	-15.46 (13.96)
Employer Win (Yes = 1)	-31.81 (84.42)		-20.43 (27.57)		-11.35 (59.50)	
Fixed-effects?		Yes		Yes		Yes
Mean of the dependent variable	444.03 [364.23]	519.42 [2037.4]	95.49 [103.16]	98.26 [363.76]	348.45 [292.10]	421.28 [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 $\bar{r}_a - (r_e + r_u)/2$

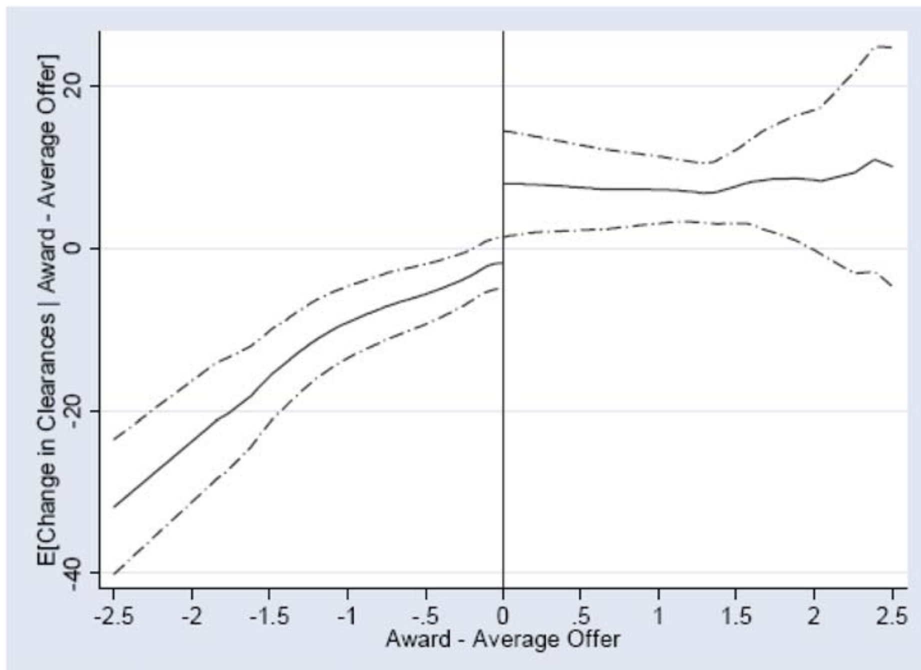


Figure V
Estimated expected change in clearances conditional on the deviation of the award from the average of the offers

- 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

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

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

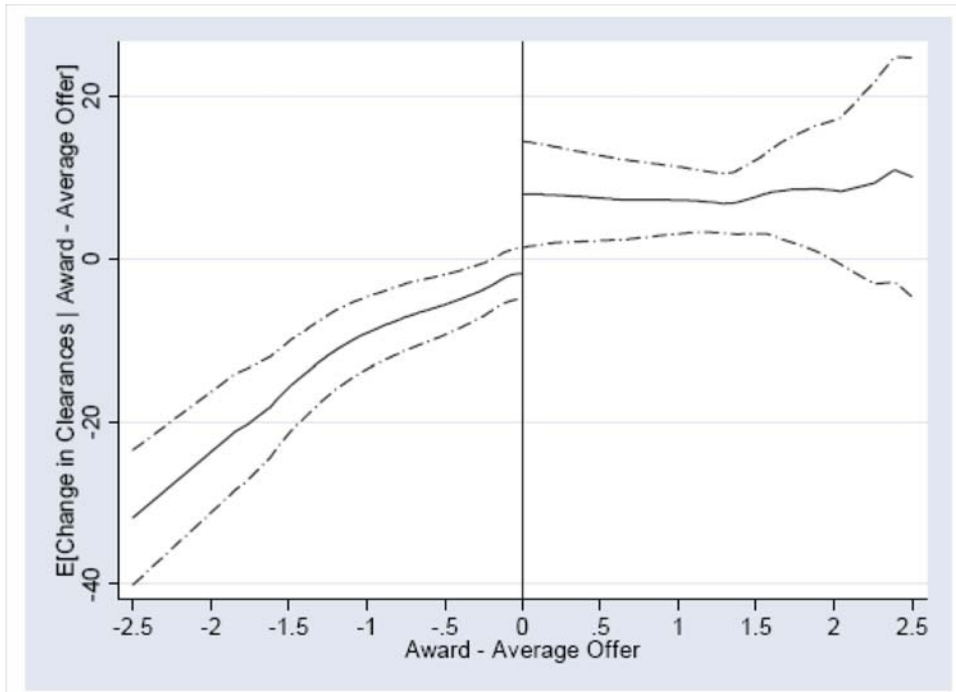
$$e^*(w) = \frac{\bar{U}}{\theta} + \frac{1}{\theta} U(w)$$

- 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 Reference Dependence: Disposition Effect

- **Odean (JF, 1998)**

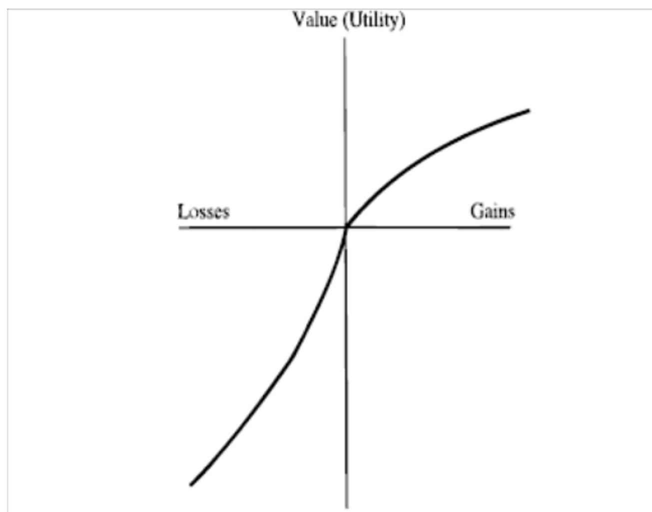
- Do investors sell winning stocks more than losing stocks?

- 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

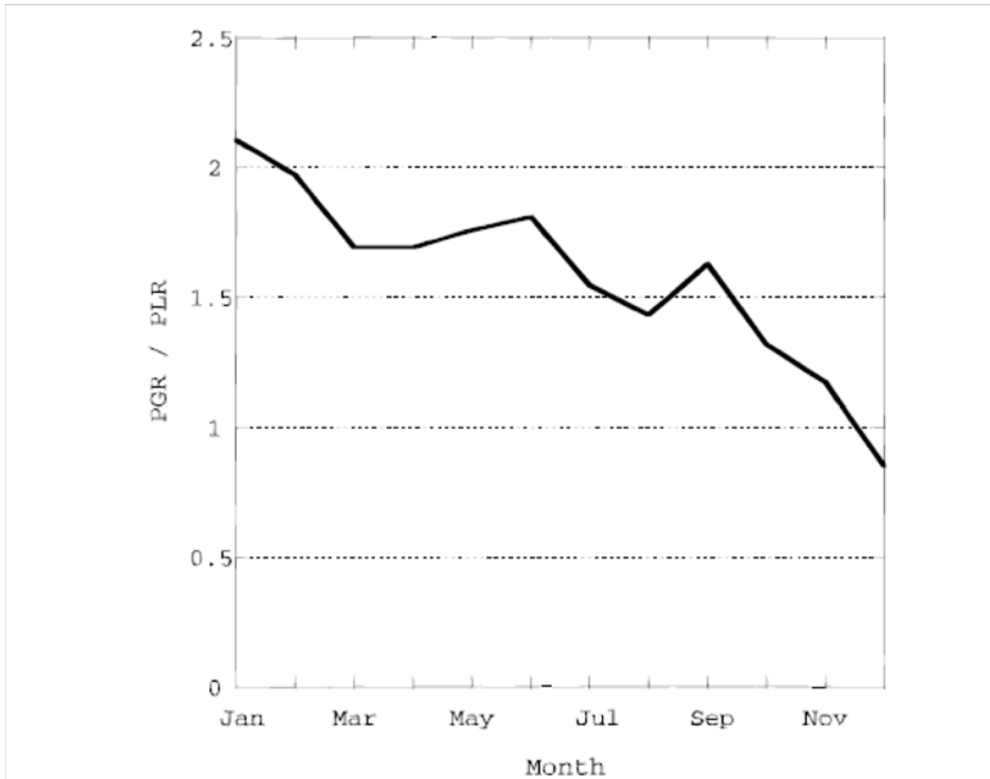
PGR and PLR for the Entire Data Set

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 linear probability model:

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

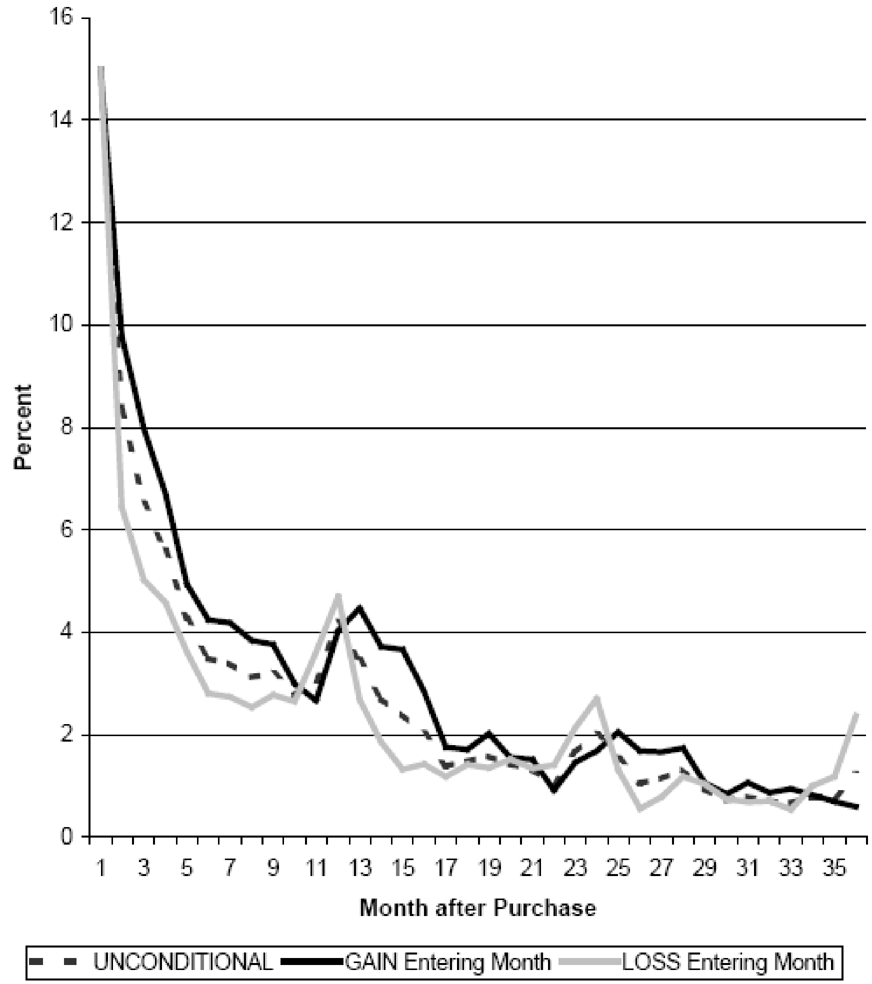
- Regression only applies to shares not already sold

- α_t is baseline hazard at month t

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

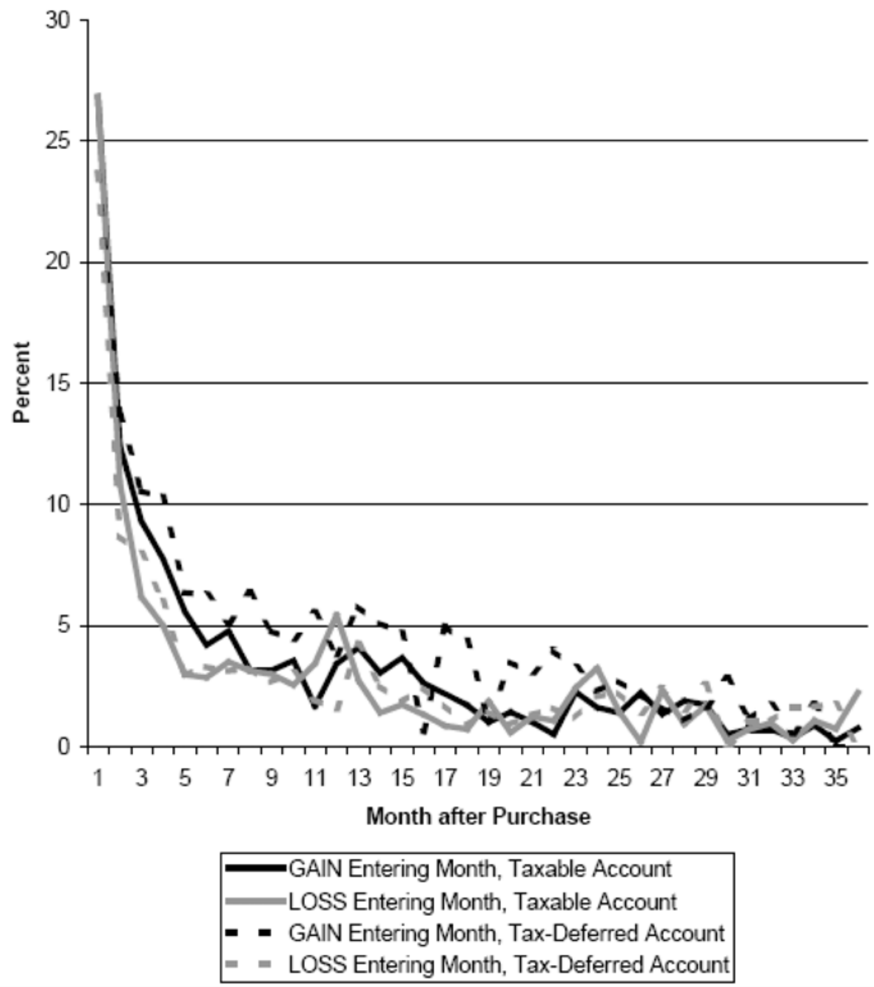
- Difference is small for tax-deferred accounts

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.

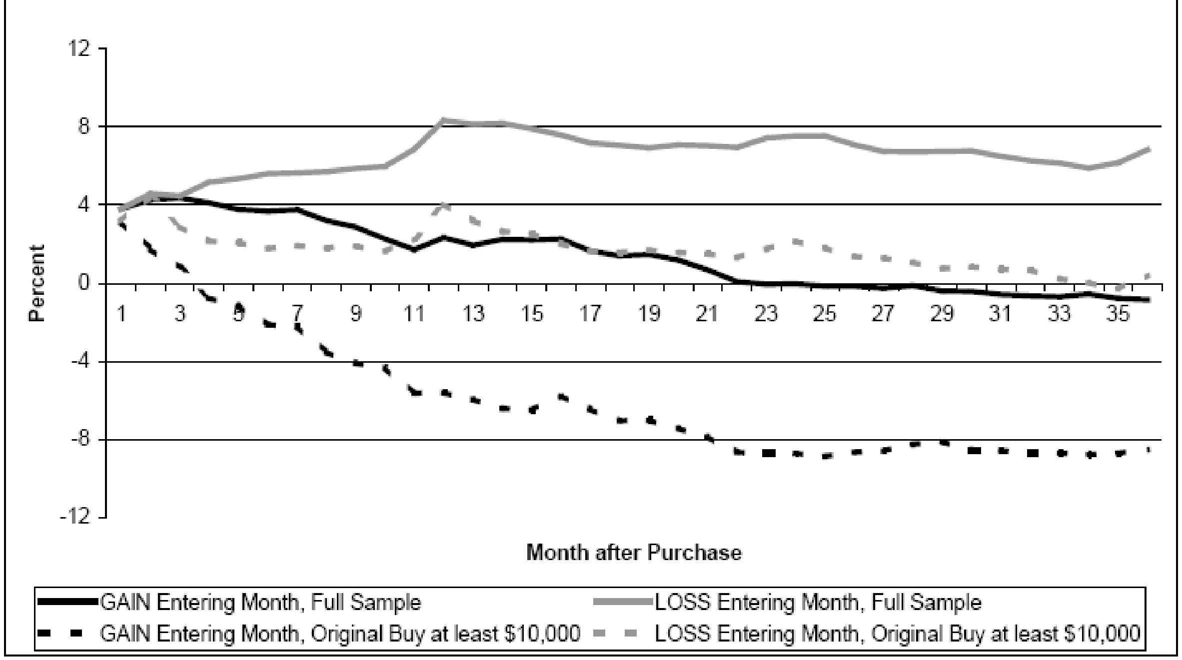


Figure 4: Cumulative Probability of Having Sold Stock in Taxable Account *Relative* to Tax-Deferred Account

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 $[\, 1 - (\Pi_{s=1,t} (1\text{-}h(s)))\,]$. Figure 4 displays cumulative probability of sale in a taxable account less that in a tax-deferred account for each month.

- – Different hazards between taxable and tax-deferred accounts –>Taxes
  – Disposition Effect very solid finding – Next time interpretation

6 Next Lecture

- Reference Dependence
  - More Disposition Effect
  - Labor Supply
- Social Preferences
  - Gift Exchange
  - Workplace
  - From Lab to Field