Econ 219B
Psychology and Economics: Applications
(Lecture 8)

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Outline

1. Overconfidence II
2. Law of Small Numbers
3. Projection Bias
4. Non-Standard Decision-Making
5. Attention: Introduction
6. Attention: Simple Model
7. Attention: eBay Auctions
8. Attention: Taxes
9. Attention: Left Digits

1 Overconfidence

- **Example 3. Overconfidence about ability by CEOs**
- **Malmendier-Tate (JF 2005 and JFE 2008)**
- Assume that CEOs overestimate their capacity to create value
- Consider implications for:
  - Investment decisions (MT 2005)
  - Mergers (MT forthcoming)
  - Equity issuance (MT 2007)
- Slides courtesy of Ulrike

Model

Assumptions

1. CEO acts in interest of current shareholders.
   (*No agency problem.*)

2. Efficient capital market.
   (*No asymmetric information.*)

Notation

V_A = market value of the acquiring firm
V_T = market value of the target firm
V = market value of the combined firm
$\hat{V}_A$ = acquiring CEO's valuation of his firm
$\hat{V}$ = acquiring CEO's valuation of the combined firm
c = cash used to finance the merger

Rational CEO

- Target shareholders demand share s of firm such that:

$$sV = V_T - c.$$

- CEO decides to merge if $V - (V_T - c) > V_A$ (levels).

  $\Rightarrow$ Merge if $e > 0$ (differences), where e is "synergies."

  $\Rightarrow$ First-best takeover decision.

- Post-acquisition value to current shareholders:

$$\overline{V} = V - (V_T - c) = (V_A + V_T + e - c) - (V_T - c) = V_A + e$$

$$\Rightarrow \frac{\partial \overline{V}}{\partial c} = 0 \text{ (}\textit{No financing prediction.}\text{)}$$

Overconfident CEO (I)

- CEO overestimates future returns to own firm:

$$\hat{V}_A > V_A$$

  CEO overestimates returns to merger:

$$\hat{V} - V > \hat{V}_A - V_A$$

- Target shareholders demand share s of firm such that:

$$sV = V_T - c$$

  CEO believes he should have to sell s such that:

$$s\hat{V} = V_T - c$$

Overconfident CEO (II)

- CEO decides to merge if

$$\hat{V} - (V_T - c) - \left[\frac{(\hat{V} - V)(V_T - c)}{V} \right] > \hat{V}_A \text{ (levels)},$$

i.e. merges if

$$e + \hat{e} > \left[\frac{(\hat{V}_A - V_A + \hat{e})(V_T - c)}{V} \right] \text{ (differences)},$$

where $\hat{e}$ are perceived "synergies."

Propositions

Compare

$$V(c) - (V_T - c) > V_A \quad \text{and}$$

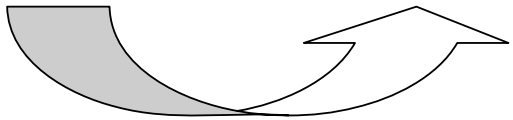
$$\widehat{V}(c) - (V_T - c) - \frac{[\widehat{V}(c) - V(c)](V_T - c)}{V(c)} > \widehat{V}_A$$

1. Overconfident managers do some value-destroying mergers. (Rational CEOs do not.)
2. An overconfident manager does more mergers than a rational manager when internal resources are readily available
3. An overconfident manager may forgo some value-creating mergers. (Rational managers do not.)

Empirical Predictions

Rational CEO

Overconfident CEO



1. On average?
2. Overconfident CEOs do more mergers that are likely to destroy value
3. Overconfident CEOs do more mergers when they have abundant internal resources
4. The announcement effect after overconfident CEOs make bids is lower than for rational CEOs

Data

Data on private accounts

1. Hall-Liebman (1998)
   Yermack (1995)

Key: Panel data on stock and option holdings of CEOs of Forbes 500 companies 1980-1994

2. Personal information about these CEOs from
   - Dun & Bradstreet
   - Who's who in finance

Data on corporate accounts

1. CRSP/COMPUSTAT

   Cash flow, Q, stock price…

2. CRSP/SDC-merger databases

   Acquisitions

Primary Measure of Overconfidence

"Longholder"

(Malmendier and Tate 2003)

CEO holds an option until the year of expiration.

CEO displays this behavior at least once during sample period.

→ minimizes impact of CEO wealth, risk aversion, diversification

Robustness Checks:

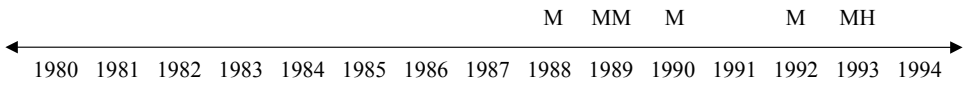
1. Require option to be at least *x*% in the money at the beginning of final year
2. Require CEO to *always* hold options to expiration
3. Compare "late exercisers" to "early exercisers"

Identification Strategy (I)

Case 1:

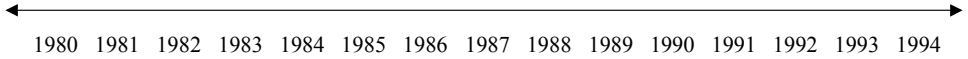
Wayne Huizenga (Cook Data Services/Blockbuster)

- CEO for all 14 years of sample
- Longholder



J Willard Marriott (Marriott International)

- CEO for all 15 years of sample
- Not a Longholder



AND

Case 2:

Colgate Palmolive

- Keith Crane CEO from 1980-1983 (Not a Longholder)
- Reuben Mark CEO from 1984-1994 (Longholder)

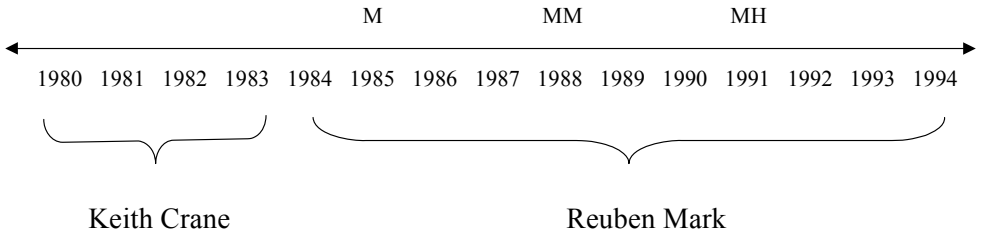


Table 4. Do Overconfident CEOs Complete More Mergers?

Longholder = holds options until last year before expiration (at least once)
Distribution: Logistic. Constant included.
Dependent Variable: Acquistion (yes or no)**; Normalization:** Capital.

	logit with controls	random effects logit	logit with fixed effects
Size	**0.8733**	**0.8600**	**0.6234**
	(1.95)*	(2.05)**	(2.60)***
Q_{t-1}	**0.7296**	**0.7316**	**0.8291**
	(2.97)***	(2.70)***	(1.11)
Cash Flow	**2.0534**	**2.1816**	**2.6724**
	(3.93)***	(3.68)***	(2.70)***
Ownership	**1.2905**	**1.3482**	**0.8208**
	(0.30)	(0.28)	(0.11)
Vested Options	**1.5059**	**0.9217**	**0.2802**
	(1.96)*	(0.19)	(2.36)**
Governance	**0.6556**	**0.7192**	**1.0428**
	(3.08)***	(2.17)**	(0.21)
Longholder	**1.5557**	**1.7006**	**2.5303**
	(2.58)***	(3.09)***	(2.67)***
Year Fixed Effects	yes	yes	yes
Observations	3690	3690	2261
Firms		327	184

Table 6. Are Overconfident CEOs Right to Hold Their Options? (I)

Returns from exercising 1 year sooner and investing in the S&P 500 index	
Percentile	Return
10th	-0.24
20th	-0.15
30th	-0.10
40th	-0.05
50th	-0.03
60th	0.03
70th	0.10
80th	0.19
90th	0.39
Mean	0.03
Standard Deviation	0.27
All exercises occur at the maximum stock price during the fiscal year	

Alternative Explanations

1. Inside Information or Signalling
   - Mergers should "cluster" in final years of option term
   - Market should react favorably on merger announcement
   - CEOs should "win" by holding

2. Stock Price Bubbles
   - Year effects already removed
   - All cross-sectional firm variation already removed
   - Lagged stock returns should explain merger activity

3. Volatile Equity

4. Finance Training

Table 8. Diversifying Mergers

Longholder = holds options until last year before expiration (at least once)
Distribution: Logistic. Constant included; **Normalization:** Capital.
Dependent Variable: Diversifying merger (yes or no).

	logit	logit with random effects	logit with fixed effects
Longholder	**1.6008**	**1.7763**	**3.1494**
	(2.40)**	(2.70)***	(2.59)***
Year Fixed Effects	yes	yes	yes
Observations	3690	3690	1577
Firms		327	128

Dependent Variable: Intra-industry merger (yes or no).

Longholder	**1.3762**	**1.4498**	**1.5067**
	(1.36)	(1.47)	(0.75)
Year Fixed Effects	yes	yes	yes
Observations	3690	3690	1227
Firms		327	100

Regressions include Cash Flow, Q_{t-1}, Size, Ownership, Vested Options, and Governance. Industries are Fama French industry groups.

Kaplan-Zingales Index

$$KZ = -1.00 \cdot \frac{CashFlow}{Capital} + 0.28 \cdot Q + 3.14 \cdot Leverage - 39.37 \cdot \frac{Dividends}{Capital} - 1.31 \cdot \frac{Cash}{Capital}$$

- Coefficients from logit regression (Pr{financially constrained})
- High values ⟶ Cash constrained
  - Leverage captures debt capacity
  - Deflated cash flow, cash, dividends capture cash on hand
  - Q captures market value of equity (Exclude?)

Table 9. Kaplan-Zingales Quintiles

Longholder = holds options until last year before expiration (at least once)
Distribution: Logistic. Constant included.
Dependent Variable: Acquistion (yes or no)**; Normalization:** Capital.
All regressions are logit with random effects.

	Least Equity Dependent		---------->		Most Equity Dependent
			All Mergers		
	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Longholder	**2.2861**	**1.6792**	**1.7756**	**1.9533**	**0.8858**
	(2.46)**	(1.48)	(1.54)	(1.50)	(0.33)
Year Fixed Effects	yes	yes	yes	yes	yes
Observations	718	719	719	719	718
Firms	125	156	168	165	152
			Diversifying Mergers		
	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Longholder	**2.5462**	**1.8852**	**1.7297**	**1.0075**	**1.0865**
	(1.89)*	(1.51)	(1.36)	(0.01)	(0.18)
Year Fixed Effects	yes	yes	yes	yes	yes
Observations	718	719	719	719	718
Firms	125	156	168	165	152

Regressions include Cash Flow, Q_{t-1}, Size, Ownership, Vested Options, and Governance.

Empirical Specification

$$CAR_i = \beta_1 + \beta_2 \bullet O_i + X'\gamma + \varepsilon_i$$

with i company

O overconfidence

X controls

$$CAR_i = \sum_{t=-1}^{1} \left(r_{it} - E[r_{it}] \right)$$

where $E[r_{it}]$ is daily S&P 500 returns (α=0; β=1)

Table 14. Market Response

Longholder = holds options until last year before expiration (at least once)
Dependent Variable: Cumulative abnormal returns [-1,+1]

	OLS (3)	OLS (4)	OLS (5)
Relatedness	**0.0048**	**0.0062**	**0.0043**
	(1.37)	(1.24)	(1.24)
Corporate Governance	**0.0079**	**0.0036**	**0.0073**
	(2.18)**	(0.64)	(1.98)**
Cash Financing	**0.014**	**0.0127**	**0.0145**
	(3.91)***	(2.60)***	(3.99)***
Age			**-0.0005**
			(1.46)
Boss			**0.0001**
			(0.04)
Longholder	**-0.0067**	**-0.0099**	**-0.0079**
	(1.81)*	(2.33)**	(2.00)**
Year Fixed Effects	yes	yes	yes
Industry Fixed Effects	no	yes	no
Industry*Year Fixed Effects	no	yes	no
Observations	687	687	687
R-squared	0.10	0.58	0.10

Regressions include Ownership and Vested Options.

Do Outsiders Recognize CEO Overconfidence?

Portrayal in Business Press:

1. Articles in
   - New York Times
   - Business Week
   - Financial Times
   - The Economist
   - Wall Street Journal
2. Articles published 1980-1994
3. Articles which characterize CEO as
   - Confident or optimistic
   - Not confident or not optimistic
   - Reliable, conservative, cautious, practical, steady or frugal

Table 13. Press Coverage and Diversifying Mergers

Distribution: Logistic. Constant included; **Normalization:** Capital. **Dependent Variable:** Diversifying merger (yes or no).	logit	logit with random effects	logit with fixed effects
TOTALconfident	**1.6971**	**1.7826**	**1.5077**
	(2.95)***	(3.21)***	(1.48)
Year Fixed Effects	yes	yes	yes
Observations	3647	3647	1559
Firms		326	128
Dependent Variable: Intra-industry merger (yes or no).			
TOTALconfident	**1.0424**	**1.0368**	**0.8856**
	(0.20)	(0.16)	(0.31)
Year Fixed Effects	yes	yes	yes
Observations	3647	3647	1226
Firms		326	100
Regressions include Total Coverage, Cash Flow, Q_{t-1}, Size, Ownership, Vested Options, and Governance. Industries are Fama French industry groups.			

Conclusions

- Overconfident managers are more acquisitive.
- Much of this acquisitiveness is in the form of diversifying mergers.
- Overconfidence has largest impact if CEO has abundant internal resources.
- The market reacts more negatively to the mergers of overconfident CEOs

- Overconfidence/Overprecision: Overestimate the precision of one's estimates
- **Alpert-Raiffa (1982).** Ask questions such as
  - 'The number of "Physicians and Surgeons" listed in the 1968 Yellow Pages of the phone directory for Boston and vicinity'
  - 'The total egg production in millions in the U.S. in 1965.'
  - 'The toll collections of the Panama Canal in fiscal 1967 in millions of dollars'
- Ask for 99 percent confidence intervals for 1,000 questions
- No. of errors: 426! (Compare to expected 20)
- (Issue: Lack of incentives)

- **Investor Overconfidence: Odean (1999)**
- Investor overconfidence/overprecision predicts excessive trading
  - investor believes signal is too accurate –> Executes trade
- Empirical test using data set from discount brokerage house
- Follow all trades of 10,000 accounts
- January 1987-December 1993
- 162,948 transactions

- Traders that overestimate value of their signal trade too much
- Substantial cost for trading too much:
  - Commission for buying 2.23 percent
  - Commission for selling 2.76 percent
  - Bid-ask spread 0.94 percent
  - Cost for 'round-trip purchase': 5.9 percent (!)

- Stock return on purchases must be at least 5.9 percent.
- Compute buy-and-hold returns
- Evidence: Sales outperform purchases by 2-3 percent!

TABLE 1—AVERAGE RETURNS FOLLOWING PURCHASES AND SALES

Panel A: All Transactions

	n	84 trading days later	252 trading days later	504 trading days later
Purchases	49,948	1.83	5.69	−24.00
Sales	47,535	3.19	9.00	27.32
Difference		−1.36	−3.31	−3.32
N1		(0.001)	(0.001)	(0.001)
N2		(0.001)	(0.001)	(0.002)

- Is the result weaker for individuals that trade the most? No

Panel C: The 10 Percent of Investors Who Trade the Most				
	n	84 trading days later	252 trading days later	504 trading days later
Purchases	29,078	2.13	7.07	25.28
Sales	26,732	3.04	9.76	28.78
Difference		−0.91	−2.69	−3.50
N1		(0.001)	(0.001)	(0.001)
N2		(0.001)	(0.001)	(0.010)

- Huge cost to trading for individuals:
  - Transaction costs
  - Pick wrong stocks

- **Barber and Odean, 2001:** Gender difference
  - Psychology: Men more overconfident than women about finances
  - Men trade 45 percent more than women –> pay a larger returns cost
- This is correlational evidence:
  - gender correlates with overconfidence + gender correlates with trading —> Overconfidence explanations
  - However: Gender may proxy for unobservables correlated with trading activity
- General issue with correlations design (Michigan and NYU schools + Heckman proponents of this)
- **D'Acunto (2013):** Prime gender on MTurk and see effect on lottery choices –> Effect of priming

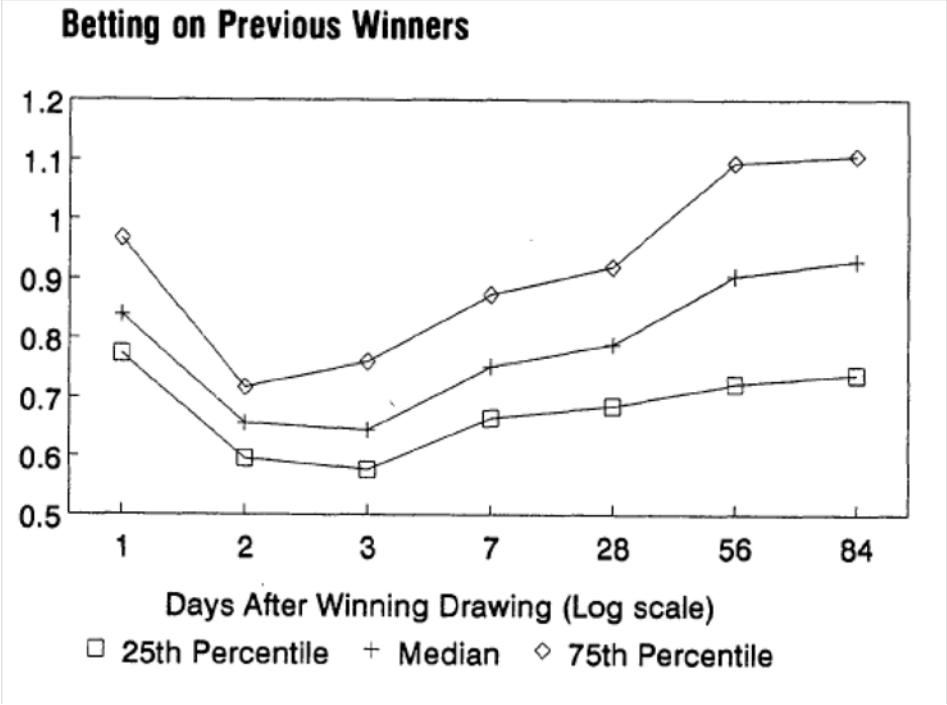
- Overconfidence/overprecision can explain other puzzles in asset pricing:
  - short-term positive correlation of returns (momentum)
  - long-term negative correlation (long-term reversal)
- **Daniel-Hirshleifer-Subrahmanyam (1998)**
- Assume overconfidence + self-attribution bias (discount information that is inconsistent with one's priors)
  - Overconfidence –> trade excessively in response to private information
  - Long-term: public information prevails, valuation returns to fundamentals –> long-term reversal
  - Short-term: additional private information interpreted with self-attribution bias –> become even more overconfident
- Two other explanations for this: Law of small numbers + Limited attention

2 Law of Small Numbers

- Overconfidence is only one form of non-Bayesian beliefs
- **Tversky-Kahneman (1974).** Individuals follow heuristics to simplify problems:
  - *Anchoring.* –> Leads to over-precision (above)
  - *Availability.* –> Connected to limited attention (next lecture)
  - *Representativeness.* –> Today's lecture
- Individuals expect random draws to be exceedingly representative of the distribution they come from
  - HTHHTT judged more representative than HHHTTT
  - But the two are equally likely! (exchangeability)

- **Rabin (QJE, 2002). Law of Small Numbers**
  - I.i.d. signals from urn drawn with replacement
  - Subjects instead believe drawn from an urn of size $N < \infty$ without replacement
  - –> *Gambler's Fallacy:* After signal, subject expect next draw to be a different signal
  - Example: Return to mutual fund is drawn from an urn with 10 balls, 5 Up and 5 Down (with replacement)
  - Observe 'Up, Up' — Compute probability of another Up
    - Bayesian: .5
    - Law of Small Numbers: $3/8 < .5$
  - Example of representativeness: 'Up, Up, Down' more representative than 'Up, Up, Up'

- Evidence on gambler's fallacy.
- **Clotfelter and Cook (MS, 1993)**
- Lotteries increasingly common in US ($17bn sales in 1989)
- Maryland daily-numbers lottery –> Bet on 3-digit number
  - Probability of correct guess .001
  - Payout: $500 per $1 bet (50 percent payout)
- Gambler's Fallacy –> Betters will stop betting on number just drawn
  - Examine 52 winning numbers in 1988
  - In 52 of 52 cases (!) betting volume decreases 3 days after win, relative to baseline



- – Substantial decrease in betting right after number is drawn
  - – Effect lasts about 3 months
  - – However: no cost for fallacy –> Does effect replicate with cost?

- **Terrell (JRU, 1994)**
- New Jersey's pick-three-numbers game (1988-1992)
- Pari-mutuel betting system
  - the fewer individuals bet on a number, the higher is the expected payout
  - Cost of betting on popular numbers
  - Payout ratio .52 –> Average win of $260 for 50c bet
- Issue: Do not observe betting on all numbers –> Use payout for numbers that repeat

Table 1. Average payouts to winning numbers

	Number	Mean	Standard deviation
Winners repeating within 1 week	8	349.06	91.66
Winners repeating between 1 and 2 weeks	8	349.44	81.56
Winners repeating between 2 and 3 weeks	14	307.76	58.33
Winners repeating between 3 and 8 weeks	59	301.03	70.55
Winners not repeating within 8 weeks	1622	260.11	57.98
All Winners	1714	262.79	57.99

- Strong gambler's fallacy:
  - Right after win, 34 percent decrease in betting
  - –> 34 percent payout increase
  - Effect dissipates over time

- Comparison with Maryland lottery:
  - Smaller effect (34 percent vs. 45 percent)
  - –> Incentives temper phenomenon, but only partially
- Other applications:
  - Probabilities are known, but subjects misconstrue the i.i.d. nature of the draws.
  - Example: Forecast of the gender of a third child following two boys (or two girls)

- Back to **Rabin (QJE, 2002)**.
  - Probabilities known –> Gambler's Fallacy
  - Probabilities not known –> Overinference: After signals of one type, expect next signal of *same* type

- Example:
  - Mutual fund with a manager of uncertain ability.
  - Return drawn with replacement from urn with 10 balls
    - Probability .5: fund is well managed (7 balls Up and 3 Down)
    - Probability .5: fund is poorly managed (3 Up and 7 Down)
  - Observe sequence 'Up, Up, Up' –> What is $P(Well|UUU)$?
    - Bayesian: $P(Well|UUU) = .5P(UUU|Well)/[.5P(UUU|Well)+ .5P(UUU|Poor)] = .7^3/\left(.7^3+.3^3\right) \approx .927.$

* Law-of-Small-Number: $P\left(Well|UUU\right) = (7/10{*}6/9{*}5/8)/[(7/10{*}6/9*5/8) + (3/10*2/9*1/8)] \approx .972$.
* Over-inference about the ability of the mutual-fund manager

– Also assume:
* Law-of-Small-Number investor believes that urn replenished after 3 periods
* Need re-start or

– What is Forecast of $P\left(U|UUU\right)$?
* Bayesian: $P\left(U|UUU\right) = .927*.7 + (1-.927)*.3 \approx .671$
* Law-of-Small-Number: $P\left(U|UUU\right) = .972{*}.7 + (1-.972){*}.3 \approx .689$

- Over-inference despite the gambler's fallacy beliefs

- Substantial evidence of over-inference (also called extrapolation)
- Notice: Case with unknown probabilities is much more common than lottery case
- **Benartzi (JF, 2001)**
  - Examine investment of employees in employer stock
  - Does it depend on the past performance of the stock?
- Sample:
  - S&P 500 companies with retirement program
  - Data from 11-k filing
  - 2.5 million participants, $102bn assets

Buy-and-Hold Raw Returns and Subsequent Allocations to Company Stock as a Percentage of Discretionary Contributions

This table displays equally weighted mean allocations to company stock (as a percentage of discretionary contributions) by quintile of past buy-and-hold raw returns. Company stock allocations are measured at the end of 1993. Portfolio 1 (5) includes retirement savings plans with the lowest (highest) past buy-and-hold raw returns. The table also provides the difference between the allocations of the extreme portfolios (i.e., portfolio 5 minus portfolio 1) and *t*-statistics. $N = 142$.

Quintiles Formed on the Basis of Buy-and-Hold Raw Returns for:	Quintile of Buy-and-Hold Returns					Observed Difference	
	(Low) 1	2	3	4	5 (High)	(5 − 1)	*T*-Statistic
Prior year	21.10%	23.16%	27.85%	25.99%	23.70%	2.60%	0.60
Prior 2 years	22.61	22.43	25.18	28.74	22.96	0.35	0.06
Prior 3 years	14.14	25.45	26.21	28.84	27.78	13.64	3.33
Prior 4 years	11.74	22.20	28.18	31.10	30.23	18.49	4.64
Prior 5 years	12.64	18.68	26.27	34.66	31.21	18.57	4.33
Prior 6 years	11.99	18.72	29.33	33.45	29.96	17.97	4.63
Prior 7 years	11.36	18.98	24.11	34.79	33.70	22.34	5.87
Prior 8 years	11.46	20.69	24.22	32.96	33.63	22.17	5.70
Prior 9 years	11.08	20.76	20.52	34.04	36.68	25.60	6.49
Prior 10 years	10.37	19.68	21.56	31.51	39.70	29.33	8.39

- Very large effect of past returns + Effect depends on long-term performance

- Is the effect due to inside information?

	Allocation to Company Stock					Observed Difference (5 − 1)	Threshold for Significant Difference at $\alpha = 10\%$
	(Low) 1	2	3	4	5 (High)		
Allocation to company stock as a percentage of discretionary contributions	4.59%	12.19%	19.34%	31.85%	53.90%	49.41%	
One-year returns	6.64	6.55	1.27	−1.03	0.13	−6.77	7.12
Two-year returns	43.69	40.78	38.24	43.33	31.92	−11.77	14.75
Three-year returns	59.29	70.28	68.64	79.66	56.25	−3.04	21.99
Four-year returns	101.08	114.55	109.89	149.92	103.14	2.06	36.15

- No evidence of insider information
- Over-inference pattern observed for investors of all types

- Over-inference pattern observed for investors of all types
- **Barber-Odean-Zhou (JFE, forthcoming):** Uses Individual trades data
  - Individual US investors purchase stocks with high past returns
  - Average stock that individual investors purchase outperformed the stock market in the previous three years by over 60 percent
- This implies effect on pricing: Stocks with high past returns get overpriced –> Later mean-revert
- **DeBondt and Thaler (1985):**
  - Compare winners in the past 3 years to losers in past 3 years.
  - 'Winners' underperform the 'losers' by 25 percentage points over the next three years
- **[Talk about Laibson JEP paper]**

- **Barberis-Shleifer-Vishny (JFE, 1998)**
  - Alternative model of law of small number in financial markets.
  - Draws of dividends are i.i.d.
  - Investors believe that
    * draws come from 'mean-reverting' regime or 'trending' regime
    * 'mean-reverting' regime more likely ex ante
  - Result: If investors observe sequence of identical signals,
    * Short-Run: Expect a mean-reverting regime (the gambler's fallacy) –> Returns under-react to information –> Short-term positive correlation (momentum)
    * Long-run: Investors over-infer and expect a 'trending' regime –> Long-term negative correlation of returns

3 Projection Bias

- Beliefs systematically biased toward current state
- **Read-van Leeuwen (1998):**
  - Office workers choose a healthy snack or an unhealthy snack
  - Snack will be delivered a week later (in the late afternoon).
  - Two groups: Workers are asked
    * when plausibly hungry (in the late afternoon) –> 78 percent chose an unhealthy snack
    * when plausibly satiated (after lunch).–> 42 percent choose unhealthy snack

- **Gilbert, Pinel, Wilson, Blumberg, and Wheatly (1999):**
  - individuals under-appreciate adaptation to future circumstances –> Projection bias about future reference point
  - Subjects forecast happiness for an event
  - Compare predictions to responses after the event has occurred
  - Thirty-three current assistant professors at the University of Texas (1998) forecast that getting tenure would significantly improve their happiness (5.9 versus 3.4 on a 1-7 scale).
  - Difference in rated happiness between 47 assistant professors that were awarded tenure by the same university and 20 that were denied tenure is smaller and not significant (5.2 versus 4.7).
  - Similar results as function of election of a Democratic of Republican president, compared to the realized ex-post differences.

- *Projection bias.* (Loewenstein, O'Donoghue, and Rabin (2003)
  - Individual is currently in state s' with utility $u(c, s')$
  - Predict future utility in state s
  - Simple projection bias:

$$\hat{u}(c, s) = (1 - \alpha) u(c, s) + \alpha u\left(c, s'\right)$$

  - Parameter α is extent of projection bias –> $\alpha = 0$ implies rational forecast

- Notice: People misforecast utility $\hat{u}$, not state s; however, same results if the latter applies

- **Conlin-O'Donoghue-Vogelsang (2006)**
- Purchasing behavior: Cold-weather items
- Main Prediction:
  - Very cold weather
  - –> Forecast high utility for cold-weather clothes
  - –> Purchase 'too much'
  - –> Higher return probability
- Additional Prediction:
  - Cold weather at return –> Fewer returns

- Focus on Probability[Return|Order]
- Denote temperature at Order time as ω_O and temperature at Return time as ω_R
- Predictions:
  1. If $\alpha = 0$ (no proj. bias), P[R|O] is independent of ω_O and ω_R
  2. If $\alpha > 0$ (proj. bias), ∂P[R|O]$/\partial\omega_O < 0$ and ∂P[R|O]$/\partial\omega_R > 0$
- Notice: Do not observe date of return decision

- Purchase data from US Company selling outdoor apparel and gear
  - January 1995-December 1999, 12m items
  - Date of order and date of shipping + Was item returned
  - Shipping address
- Weather data from National Climatic Data Center
  - By 5-digit ZIP code, use of closest weather station
- Items:
  - Parkas/Coats/Jackets Rated Below 0F
  - Winter Boots
  - Drop mail orders, if billing and shipping address differ, $>$9 items ordered, multiple units same item, low price
  - No. obs. 2,200,073

- Summary Stats:
  - Probability of return fairly high
  - Prices of items substantial
  - Delay between order and receipt 4-5 days

TABLE 1
Summary Statistics by Item Categories

	Gloves/ Mittens	Winter Boots	Hats	Sports Equipment	Parkas/ Coats	Vests	Jackets	All Seven Categories
Observations	484,084	262,610	484,086	146,594	524,831	151,958	145,910	2,200,073
Number of Different Items	106	93	88	233	133	20	37	710
Percent Returned	10.9	15.6	10.8	6.6	22.2	12.8	18.0	14.4
Price of Item (dollars)	29.26	68.33	23.74	74.10	148.58	40.90	106.70	70.10
Percent of Buyer's Prior Purchases Returned	7.2	6.6	6.9	7.2	7.3	6.8	8.2	7.14
Number of Buyer's Prior Purchases	27.3	22.2	23.9	27.7	20.5	21.71	25.3	23.83
Buyer has a Prior Purchase	0.85	0.82	0.83	0.86	0.77	0.83	0.82	0.82
Days Between Order and Shipment	0.42	0.97	0.72	0.94	2.17	1.24	1.13	1.11
Days Between Order and Receipt	4.13	4.66	4.46	4.58	5.92	5.04	4.89	4.84
Ordered Through Internet	0.04	0.03	0.03	0.02	0.04	0.02	0.05	0.03
Purchased by a Female	0.71	0.66	0.71	0.70	0.66	0.72	0.66	0.69
Item Purchased with Credit Card	0.97	0.98	0.98	0.97	0.98	0.98	0.97	0.98
Items in Order	3.5	2.5	3.4	2.9	2.2	2.8	2.3	2.9
Temperature Rating					-10.11		-5.64	
WEATHER CONDITIONS								
Order-Date Temperature (°F)	40.60	39.74	41.48	37.81	43.29	44.76	46.88	41.85
Receiving-Date Temperature (°F)	39.90	38.97	40.72	36.70	42.29	43.20	45.70	40.94
Snowfall on Day Item Ordered (0.1")*	1.79	2.69	1.69	2.65	1.30	1.26	0.63	1.70
Snowfall on Day Item Received (0.1")*	1.58	2.32	1.51	2.35	1.33	1.43	0.66	1.57

- Main estimation: Probit

$$P(R|O) = \Phi\left(\alpha + \gamma_O \omega_O + \gamma_R \omega_R + BX\right)$$

Probit Regression Measuring the Effect of Temperature on the Probability Cold Weather Clothing is Returned

Dependent Variable is Whether Item is Returned (=1 if item returned and 0 otherwise)

	Gloves & Mittens	Winter Boots	Hats	Sports Equipment	Parkas & Coats	Vests	Jackets	All Seven Categories
Order-Date Temperature	-0.00013**	-0.00026**	-0.00020**	-0.00011*	-0.00009	-0.00048**	-0.00014	-0.00019**
	(0.00005)	(0.00009)	(0.00005)	(0.00006)	(0.00007)	(0.00011)	(0.00013)	(0.00003)
Receiving-Date Temperature	0.00005	0.00018*	-0.00005	-0.00008	0.00007	-0.00010	0.00010	0.00003
	(0.00006)	(0.00009)	(0.00006)	(0.00007)	(0.00008)	(0.00011)	(0.00014)	(0.00003)
Price of Item	0.00075**	0.00005	0.00145**	0.00033**	0.00019**	0.00166**	0.00016	0.00023**
	(0.00024)	(0.00013)	(0.00025)	(0.00008)	(0.00004)	(0.00024)	(0.00018)	(0.00003)
Item Purchased with Credit Card	0.02042**	0.04337**	0.02876**	0.02395**	0.05893**	0.02294**	0.05312**	0.03531**
	(0.00250)	(0.00418)	(0.00244)	(0.00191)	(0.00405)	(0.00535)	(0.00568)	(0.00137)
Items in Order	-0.00157**	0.00012	-0.00035	-0.00078**	0.00196**	-0.00177**	0.00141**	-0.00028**
	(0.00022)	(0.00039)	(0.00022)	(0.00028)	(0.00033)	(0.00045)	(0.00058)	(0.00012)
Clothing Type Fixed Effects	YES	YES	YES	NO[a]	YES	YES	YES	YES
Item Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Month-Region Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Year-Region Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Observations	484,067	262,610	484,085	146,403	524,831	151,958	145,910	2,199,950
R-Squared	0.04	0.05	0.07	0.13	0.03	0.03	0.04	0.07

Table presents marginal effects on the probability that an item is returned. Standard errors are in parentheses.

* Statistically significant at the .10 level; ** Statistically significant at the .05 level.

[a] Clothing Type information was not provided for sports equipment items.

- Main finding: $\gamma_O < 0$.
  - Warmer weather on order date lowers probability of return
  - *Magnitude:*
  - This goes against standard story: If weather is warmer, less likely you will use it –> Return it more
  - Projection Bias: Very cold weather –> Mispredict future utility –> Return the item
- Second finding: $\gamma_R \approx 0$
  - Warmer weather on (predicted) return does not affect return
  - This may be due to the fact that do not observe when return decision is made

- Similar estimates for linear probability model with household fixed effects
- (Restrict sample to multiple orders by households)

TABLE 3
Linear Regression Measuring the Effect of Temperature on the Probability Cold Weather Clothing is Returned: With and Without Household Fixed Effects

	Household Fixed Effects	No Household Fixed Effects
Order-Date Temperature	-0.00082**	-0.00039**
	(0.00027)	(0.00013)
Receiving-Date Temperature	0.00017	0.00002
	(0.00029)	(0.00015)
Clothing Type Fixed Effects	YES	YES
Item Fixed Effects	YES	YES
Month-Region Fixed Effects	YES	YES
Year-Region Fixed Effects	YES	YES
Household Fixed Effects	YES	NO
Observations	162,580	162,580
R-Squared	0.19	0.10

- Simple structural model of projection bias: Estimates of projection bias α around .3-.4

TABLE 6
Structural Estimation

	Winter Boots	Hats	Parkas & Coats	Vests	Jackets
α	0.3084** (0.0570)	0.4698** (0.00001)	0.3814** (0.0352)	0.0002 (0.0056)	0.4992** (0.0002)

- Other applications?

- Also, **Levy (2009):** addiction model with present bias and projection bias
  - Test for projection bias: Effect of higher variance of future prices
    - Standard model: Higher variance lowers current consumption because getting addicted becomes more costly
    - Projection bias: Do not realize link between current smoking and future addiction —> Higher variance can increase smoking
  - Data: Positive correlation of variance of prices with current smoking —> Supports projection bias
- Parametric estimate: projection bias $\alpha \approx .4$

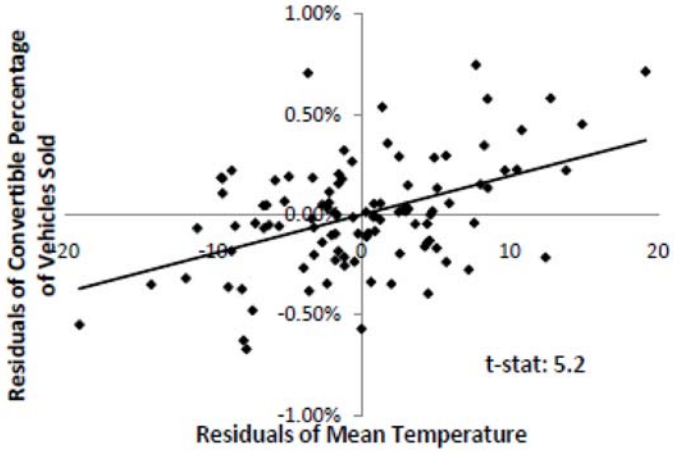
- **Busse, Pope, Pope, Silva-Risso (2013):** Evidence from car purchases and house purchases

- Projection bias:
  - Convertible looks particularly attractive on a hot day
  - 4-wheel drive attractive on snowy day
  - House with pool higher selling price on hot day

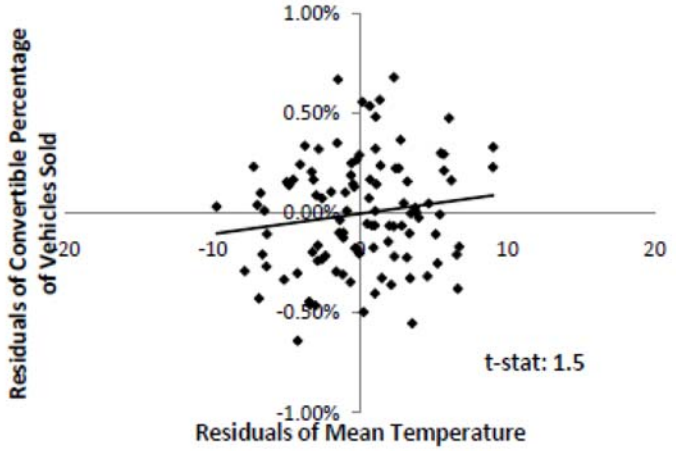
- Strong evidence in the data

Figure 5. Temperature-Convertible Residuals - Chicago. This Figure provides scatter plots for the residuals of convertible percentage of vehicles sold (Panel B of Figure 3) and residuals of mean high temperature (Panel B of Figure 4) separately for each quarter of the year.

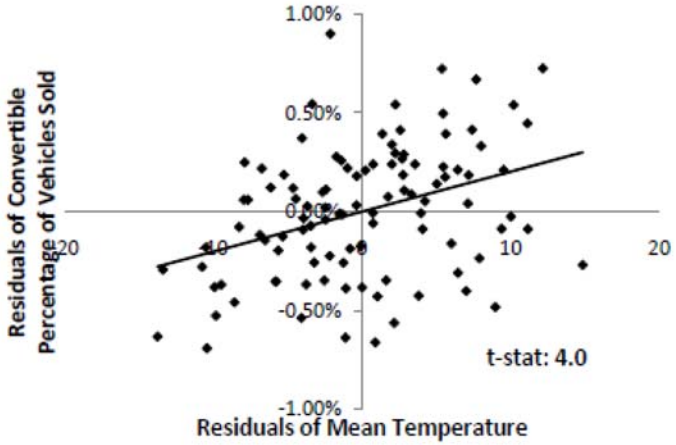
Panel A. Quarter 1



Panel C. Quarter 3



Panel B. Quarter 2



Panel D. Quarter 4

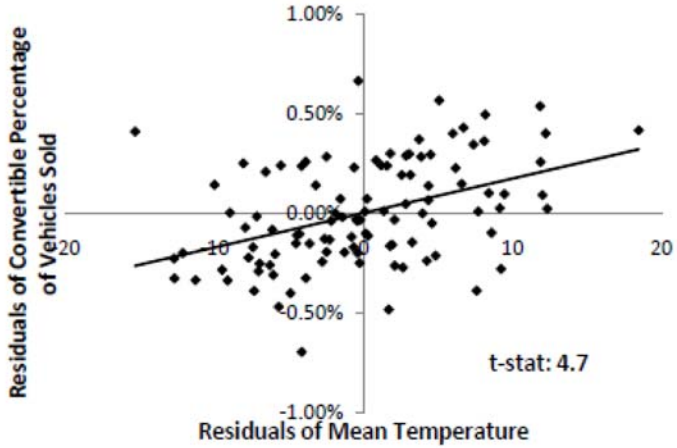


Figure 10. Snowfall and 4-Wheel Drive Sales - Event-Study Design. This Figure plots the weighted average and 95% confidence intervals for the residuals of the 4-wheel drive percentage of total vehicles sold for the twelve weeks leading up to and the twelve weeks after a snow storm event (week 0). The events were chosen to be the highest snow fall week of the year for DMAs that have above-median in weather variation.

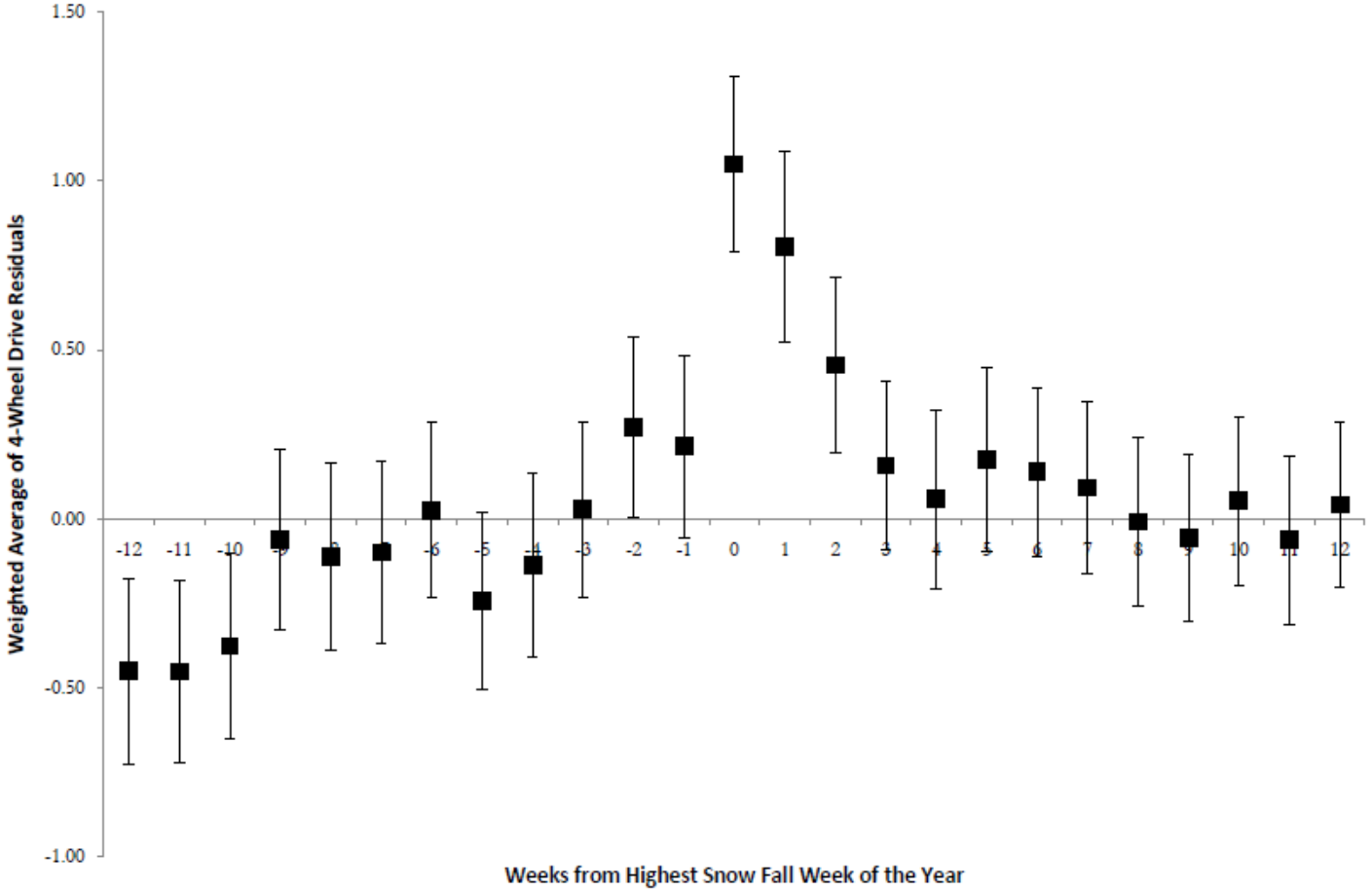
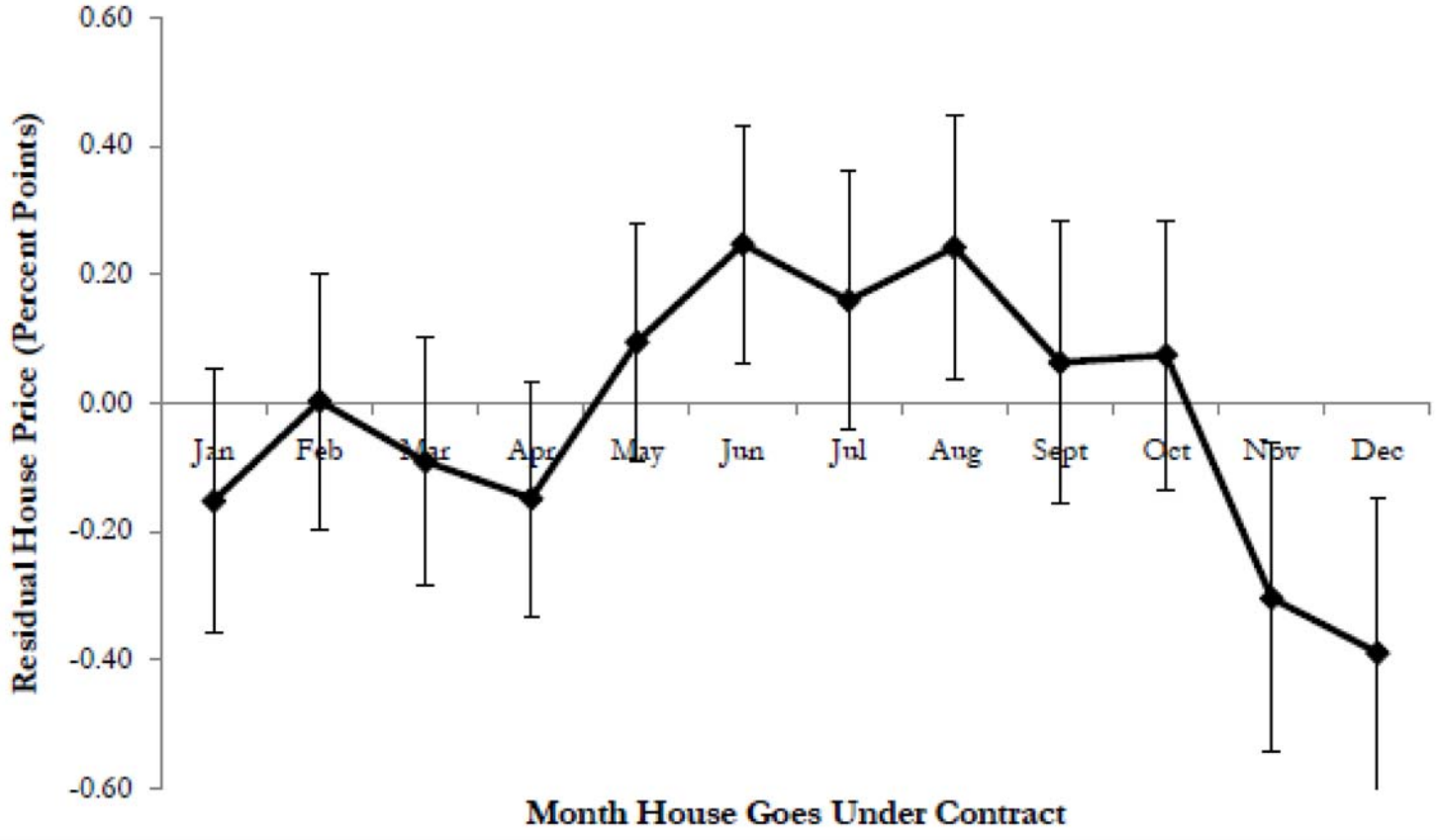


Figure 11 - Seasonal Value of a Swimming Pool. Panel A shows the average residual values for homes with swimming pools that go under contract during each month of the year. Panel B shows the estimated effect of a swimming pool on a house's residual sales price, conditional on other house characteristics, as estimated by Equation (7). 95% confidence intervals are also presented.

Panel A. Residuals by Month



4 Non-Standard Decision-Making

- First part of class: Non-standard preferences $U(x|s)$:
  - Over time (present-bias)
  - Over risk (reference-dependence)
  - Over social interactions (social preferences)
- And Non-Standard Beliefs $p(s)$
  - About skill (overconfidence)
  - Updating (law of small numbers)
  - About preferences (projection bias)

- Now, third category: non-standard decision-making
- Standard $U(x|s)$ and $p(s)$ –> Still, non-standard decisions
- Five sub-categories
  - Limited attention
  - Framing
  - Menu effects
  - Persuasion and social pressure
  - Emotions
- This in turn often leads to non-standard beliefs $\widetilde{p}(s)$

5 Attention: Introduction

- Attention as limited resource
- Psychology Experiments: Dichotic listening (**Broadbent, 1958**)
  - Hear two messages:
    - in left ear
    - in right ear
  - Instructed to attend to message in one ear
  - Asked about message in other ear –> Cannot remember it
  - More important: Asked to rehearse a number (or note) in their head –> Remember much less the message
- Attention clearly finite

- How to optimize given limited resources?
  - Satisficing choice (**Simon, 1955 –> Conlisk, JEL 1996**)
  - Heuristics for solving complex problems (**Gabaix-Laibson, 2002**; **Gabaix et al., 2003**)

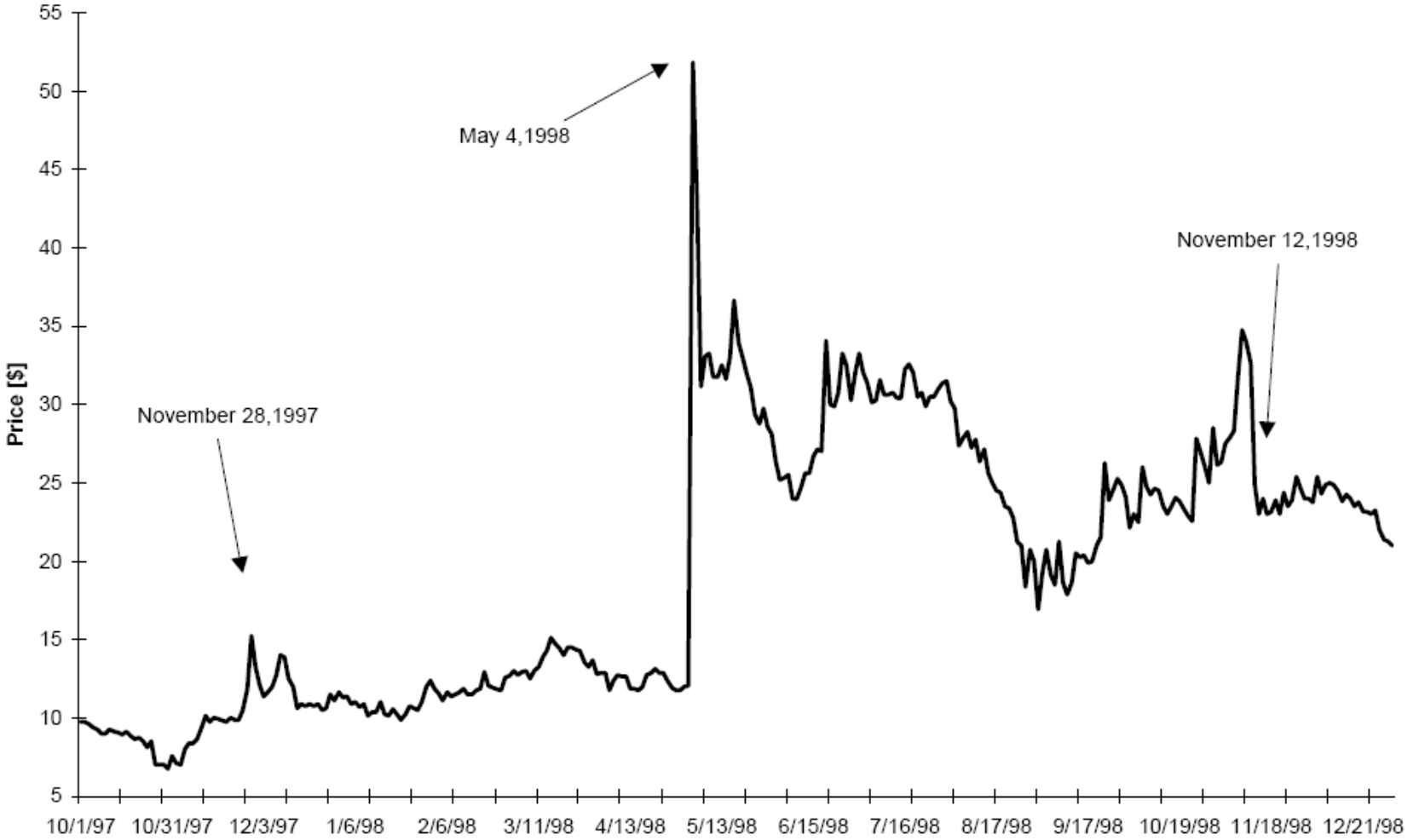
- In a world with a plethora of stimuli, which ones do agents attend to?
- Psychology: Salient stimuli (**Fiske-Taylor, 1991**) –> Not very helpful
- Probably, no general rule – Inattention along many dimensions

- Does this apply to high-stakes items?
- Event of economic importance: **Huberman-Regev (JF, 2001)**
- Timeline:
  - October-November 1997: Company EntreMed has very positive early results on a cure for cancer
  - November 28, 1997: *Nature* "prominently features;" *New York Times* reports on page A28
  - May 3, 1998: *New York Times* features essentially same article as on November 28, 1997 on front page
  - November 12, 1998: *Wall Street Journal* front page about failed replication

- In a world with unlimited arbitrage...

- In reality...

Figure 5: ENMD Closing Prices and Trading Volume 10/1/97-12/30/98



- At least two interpretations:
  1. Limited attention initially + Catch up later
  2. Full incorporation initially + Overreaction later
- Persistence for 6 months suggests (1) more plausible
- Other interpretations:
  - Focal point
  - non-Bayesian inference

6 Attention: Simple Model

- Simple model
- Consider good with value V (inclusive of price), sum of two components: $V = v + o$
  1. Visible component v
  2. Opaque component o
- Inattention
  - Consumer perceives the value $\hat{V} = v + (1 - \theta)\, o$
  - Degree of inattention θ, with $\theta = 0$ standard case
  - Interpretation: each individual sees o, but processes it only partially, to the degree θ

- Alternative model:
  - share θ on individuals are inattentive, $1-\theta$ attentive –>
  - Models differ where not just mean, but also max/min matter (Ex.: auctions)
- Inattention θ is function of:
  - Salience $s \in [0,1]$ of o, with $\theta'_s < 0$ and $\theta(1,N) = 0$
  - Mumber of competing stimuli N: $\theta = \theta(s,N)$, with $\theta'_N > 0$ (Broadbent)
- Consumer demand $D[\hat{V}]$, with $D'[x] > 0$ for all x

- Model suggests three strategies to identify the inattention parameter θ:

  1. Compute response of $\hat{V}$ to change in o –> compare $\partial\hat{V}/\partial o = (1-\theta)$ to $\partial\hat{V}/\partial v = 1$ (Hossain-Morgan (2006) and Chetty-Looney-Kroft (2007))

  2. Examine the response of $\hat{V}$ to an increase in the salience s, $\partial\hat{V}/\partial s = -\theta'_s o$: differs from zero? (Chetty et al. (2007))

  3. Vary competing stimuli N, $\partial\hat{V}/\partial N = -\theta'_N o$: differs from zero? (DellaVigna-Pollet (forthcoming) and Hirshleifer-Lim-Teoh (2007))

- Common trick: identify a piece of opaque information o –> Hardest part

- Two caveats:
  - Measuring salience of information is subjective — psychology experiments do not provide a general criterion
  - Inattention can be rational or not.
    * Can rephrase as rational model with information costs
    * However, opaque information is publicly available at a zero or small cost (for example, earnings announcements news)
    * Rational interpretation less plausible

7 Attention: eBay Auctions

- **Hossain-Morgan (2006).** *Inattention to shipping cost*
- Setting:
  - v is value of the object
  - o negative of the shipping cost: $o = -c$
  - Inattentive bidders bid value net of the (perceived) shipping cost: $b^* = v - (1 - \theta)\, c$ (2nd price auction)
  - Revenue R raised by the seller: $R = b^* + c = v + \theta c$.
  - Hence, \$1 increase in the shipping cost c increases revenue by θ dollars
  - Full attention ($\theta = 0$): increases in shipping cost have no effect on revenue

- Field experiment selling CD and XBoxs on eBay
  - Treatment 'LowSC' [A]: reserve price $r =$ \$4 and shipping cost $c =$ \$0
  - Treatment 'HighSC' [B]: reserve price $r =$ \$.01 and shipping cost $c =$ \$3.99
  - Same total reserve price $r_{TOT} = r + c =$ \$4
  - Measure effect on total revenue R, probability of sale p
- Predictions:
  - Standard model: $\partial R/\partial c = 0 = \partial p/\partial c$ ->$R_A = R_B$
  - Inattention: $\partial R/\partial c = \theta$ ->$R_A < R_B$

- Similar strategy to Ausubel (1999)

- Strong effect: $R_B - R_A =$ \$2.61 –>Inattention $\theta = 2.61/4 = .65$

Table 3. Revenues from Low Reserve Treatments

CD Title	Revenues under Treatment A	Revenues under Treatment B	B - A	Percent Difference
Music	5.50	7.24	1.74	32%
Ooops! I Did it Again	6.50	7.74	1.24	19%
Serendipity	8.50	10.49	1.99	23%
O Brother Where Art Thou?	12.50	11.99	-0.51	-4%
Greatest Hits - Tim McGraw	11.00	15.99	4.99	45%
A Day Without Rain	13.50	14.99	1.49	11%
Automatic for the People	0.00	9.99	9.99	
Everyday	7.28	9.49	2.21	30%
Joshua Tree	6.07	8.25	2.18	36%
Unplugged in New York	4.50	5.24	0.74	16%
Average	*7.54*	*10.14*	*2.61*	*35%*
Average excluding unsold	*8.37*	*10.16*	*1.79*	*21%*

- Smaller effect for XBox: $R_B - R_A = \$0.71$ –> Inattention $\theta = 0.71/4 = .18$

- Pooling data across treatments: $R_B > R_A$ in 16 out of 20 cases –> Significant difference

Xbox Game Title	Revenues under Treatment A	Revenues under Treatment B	B - A	Percent Difference
Halo	34.05	41.24	7.19	21%
Wreckless	44.01	33.99	-10.02	-23%
Circus Maximus	40.99	39.99	-1.00	-2%
Max Payne	36.01	36.99	0.98	3%
Genma Onimusha	41.00	32.99	-8.01	-20%
Project Gotham Racing	37.00	38.12	1.12	3%
NBA 2K2	42.12	42.99	0.87	2%
NFL 2K2	26.00	33.99	7.99	31%
NHL 2002	36.00	37.00	1.00	3%
WWF Raw	33.99	40.99	7.00	21%
Average	*37.12*	*37.83*	*0.71*	*2%*

- Similar treatment with high reserve price:
  - Treatment 'LowSC' [C]: reserve price $r = \$6$ and shipping cost $c = \$2$
  - Treatment 'HighSC' [D]: reserve price $r = \$2$ and shipping cost $c = \$6$
- No significant effect for CDs (perhaps reserve price too high?): $R_D - R_C = -.29$ –> Inattention $\theta = -.29/4 = -.07$
- Large, significant effect for XBoxs: $R_D - R_C = 4.11$ –> Inattention $\theta = 4.11/4 = 1.05$
- Overall, strong evidence of partial disregard of shipping cost: $\hat{\theta} \approx .5$
- Inattention or rational search costs

Table 4. Revenues from High Reserve Treatments

CD Title	Revenues under Treatment C	Revenues under Treatment D	D - C	Percent Difference
Music	9.00	8.00	-1.00	-11%
Ooops! I Did it Again	0.00	0.00	0.00	
Serendipity	12.50	13.50	1.00	8%
O Brother Where Art Thou?	11.52	11.00	-0.52	-5%
Greatest Hits - Tim McGraw	18.00	17.00	-1.00	-6%
A Day Without Rain	15.50	16.00	0.50	3%
Automatic for the People	0.00	0.00	0.00	
Everyday	10.50	13.50	3.00	29%
Joshua Tree	8.00	11.10	3.10	39%
Unplugged in New York	8.00	0.00	-8.00	-100%
Average	*9.30*	*9.01*	*-0.29*	*-3%*
Average excluding unsold	*12.15*	*12.87*	*0.73*	*6%*

Game Title	Revenues under Treatment C	Revenues under Treatment D	D - C	Percent Difference
Halo	40.01	43.00	2.99	7%
Wreckless	35.00	36.00	1.00	3%
Circus Maximus	39.00	42.53	3.53	9%
Max Payne	37.50	42.00	4.50	12%
Genma Onimusha	36.00	37.00	1.00	3%
Project Gotham Racing	35.02	40.01	4.99	14%
NBA 2K2	41.00	45.00	4.00	10%
NFL 2K2	33.00	40.10	7.10	22%
NHL 2002	36.00	41.00	5.00	14%
WWF Raw	37.00	44.00	7.00	19%
Average	*36.95*	*41.06*	*4.11*	*11%*

8 Attention: Taxes

- **Chetty et al. (AER, 2009):** Taxes not featured in price likely to be ignored
- Use data on the demand for items in a grocery store.
- Demand D is a function of:
  - visible part of the value v, including the price p
  - less visible part o (state tax $-tp$)
  - $D = D\left[v - (1-\theta)\, tp\right]$
- Variation: Make tax fully salient ($s = 1$)

- Linearization: change in log-demand

$$\begin{aligned}\Delta \log D &= \log D\left[v - tp\right] - \log D\left[v - (1-\theta)\, tp\right] = \\ &= -\theta tp * D'\left[v - (1-\theta)\, tp\right] / D\left[v - (1-\theta)\, tp\right] \\ &= -\theta t * \eta_{D,p}\end{aligned}$$

  - $\eta_{D,p}$ is the price elasticity of demand
  - $\Delta \log D = 0$ for fully attentive consumers ($\theta = 0$)
  - This implies $\theta = -\Delta \log D/(t * \eta_{D,p})$

- **Part I: field experiment**
  - Three-week period: price tags of certain items make salient after-tax price (in addition to pre-tax price).

- Compare sales D to:
  - previous-week sales for the same item
  - sales for items for which tax was not made salient
  - sales in control stores
  - Hence, D-D-D design (pre-post, by-item, by-store)
- Result: average quantity sold decreases (significantly) by 2.20 units relative to a baseline level of 25, an 8.8 percent decline

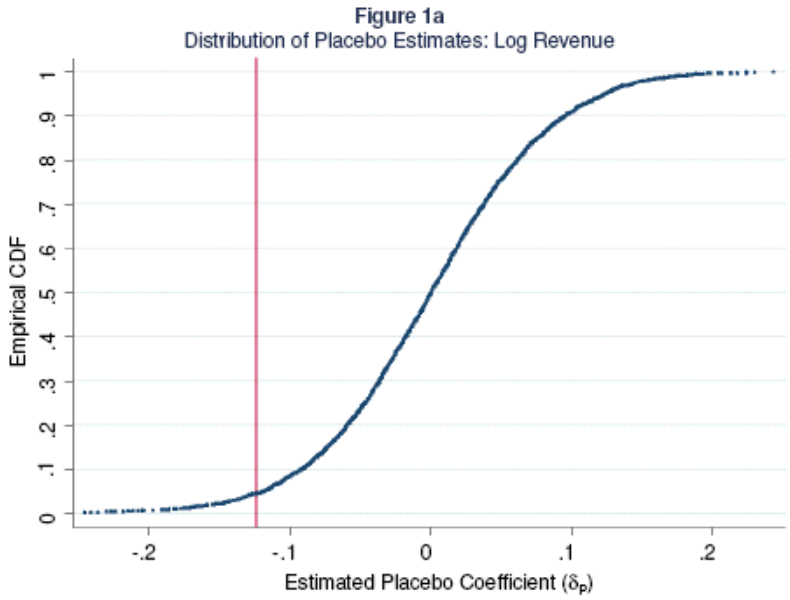
TABLE 3

DDD Analysis of Means: Weekly Quantity by Category

TREATMENT STORE			
Period	Control Categories	Treated Categories	Difference
Baseline (2005:1-2006:6)	26.48 (0.22) [5510]	25.17 (0.37) [754]	-1.31 (0.43) [6264]
Experiment (2006: 8-2006:10)	27.32 (0.87) [285]	23.87 (1.02) [39]	-3.45 (0.64) [324]
Difference over time	0.84 (0.75) [5795]	-1.30 (0.92) [793]	**DD_{TS} = -2.14** (0.64) [6588]
CONTROL STORES			
Period	Control Categories	Treated Categories	Difference
Baseline (2005:1-2006:6)	30.57 (0.24) [11020]	27.94 (0.30) [1508]	-2.63 (0.32) [12528]
Experiment (2006: 8-2006:10)	30.76 (0.72) [570]	28.19 (1.06) [78]	-2.57 (1.09) [648]
Difference over time	0.19 (0.64) [11590]	0.25 (0.92) [1586]	**DD_{CS} = 0.06** (0.90) [13176]
		DDD Estimate	***-2.20*** (0.58) [19764]

Notes: Each cell shows mean number of units sold per category per week, for various subsets of the sample. Standard errors (clustered by week) in parentheses, number of observations in square

- Compute inattention:
  - Estimates of price elasticity $\eta_{D,p}$: -1.59
  - Tax is .07375
  - $\hat{\theta} = -(-.088)/(-1.59 * .07375) \approx .75$
- Additional check of randomization: Generate placebo changes over time in sales
- Compare to observed differences
- Use Log Revenue and Log Quantity



- Non-parametric p-value of about 5 percent

- **Part II: Panel Variation**
  - Compare more and less salient tax on beer consumption
  - Excise tax included in the price
  - Sales tax is added at the register
  - Panel identification: across States and over time
  - Indeed, elasticity to excise taxes substantially larger –> estimate of the inattention parameter of $\hat{\theta} = .94$
- Substantial consumer inattention to non-transparent taxes

TABLE 7

Effect of Excise and Sales Taxes on Beer Consumption

Dependent Variable: Change in Log(per capita beer consumption)				
	Baseline	Bus Cycle	Bus Cycle Lags	Alc Regulations
	(1)	(2)	(3)	(4)
ΔLog(1+Excise Tax Rate)	**-0.87**	**-0.91**	**-0.86**	**-0.89**
	(0.17)***	(0.17)***	(0.17)***	(0.17)***
ΔLog(1+Sales Tax Rate)	**-0.20**	**-0.00**	**0.03**	**-0.02**
	(0.30)	(0.30)	(0.30)	(0.30)
ΔLog(Population)	0.03	-0.07	0.05	-0.07
	(0.06)	(0.07)	(0.19)	(0.07)
ΔLog(Income per Capita)		0.22	0.18	0.22
		(0.05)***	(0.05)***	(0.05)***
ΔLog(Unemployment Rate)		-0.01	-0.01	-0.01
		(0.01)**	(0.01)	(0.01)**
Lag Bus. Cycle Controls			x	
Alcohol Regulation Controls				x
Year Fixed Effects	x	x	x	x
F-Test for Equality of Tax Variables (Prob>F)	0.05	0.01	0.01	0.01
Sample Size	1607	1487	1440	1487

Notes: Standard errors, clustered by state, in parentheses: * significant at 10%; ** significant at 5%; *** significant at 1%. All specifications include year fixed effects and log state population. Column 2 controls for log state personal income per capita and log state unemployment rate (unavailable in some states in the early 1970s). Column 3 adds one year lags of personal income per capita and unemployment rate variables. Column 4 controls for changes in alcohol policy by including three separate indicators for whether the state implemented per se drunk driving standards, administrative license revocation laws, or zero tolerance youth drunk driving laws, and the change in the minimum drinking age (measured in years).

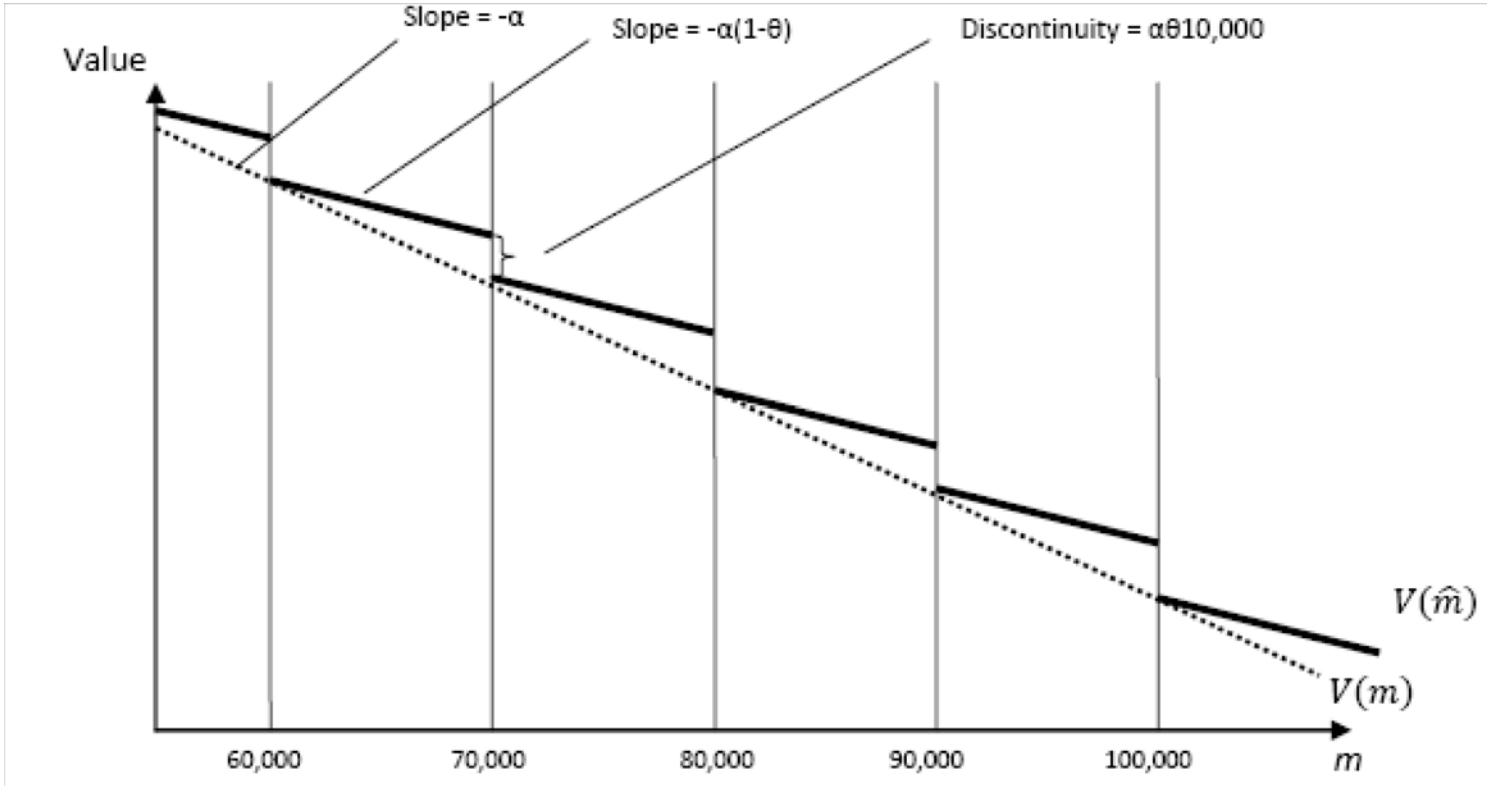
9 Attention: Left Digits

- Are consumers paying attention to full numbers, or only to more salient digits?
- Classical example: X =\$5.99 vs. Y =\$6.00
- Consumer inattentive to digits other than first, perceive

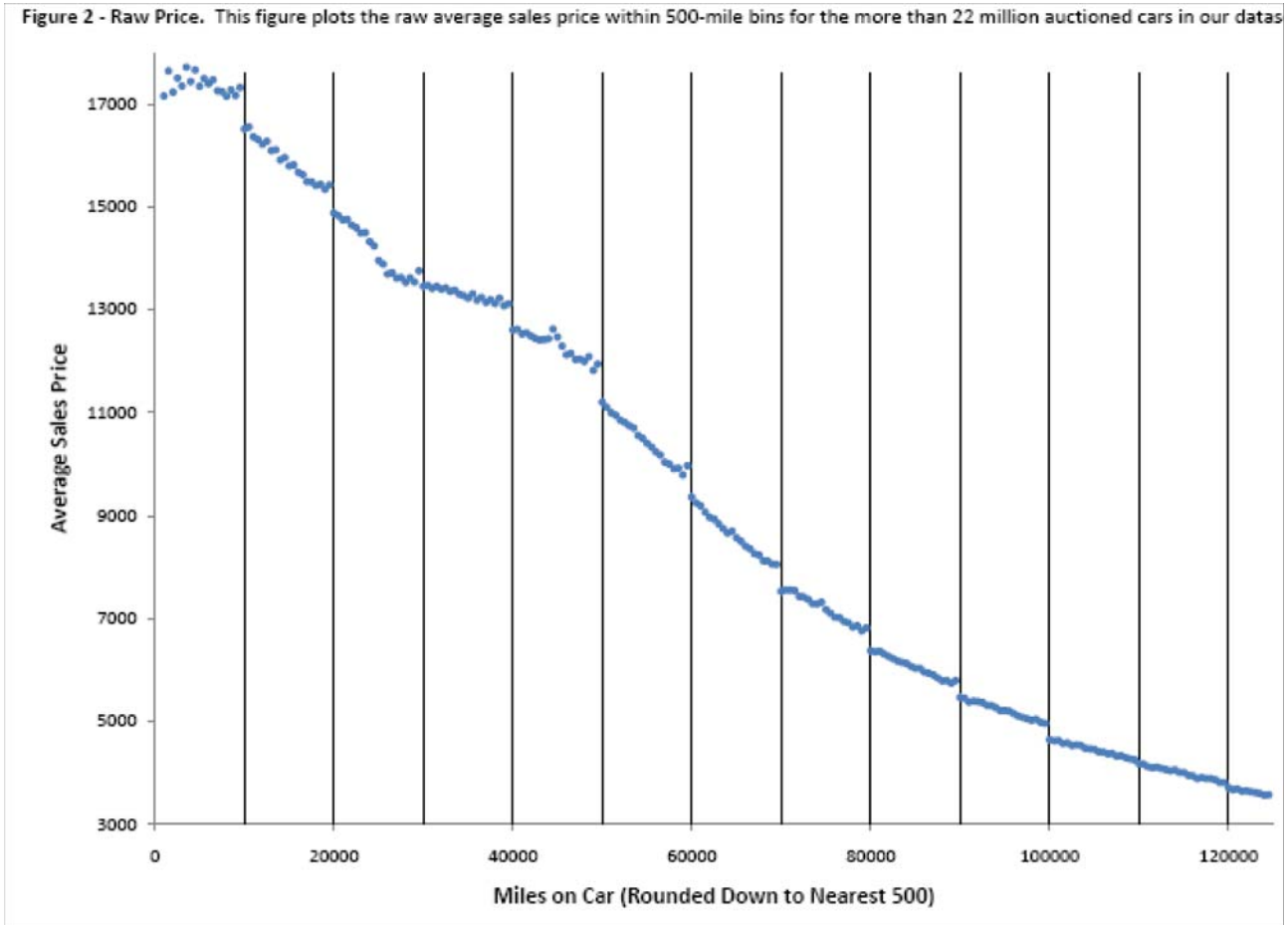
$$\begin{aligned} X &= 5 + (1-\theta)\,.99 \\ Y &= 6 \\ Y - X &= .01 + .\theta 99 \end{aligned}$$

- Indeed, evidence of 99 cents effect in pricing at stores
- However, can argue – stakes small for consumers

- **Lacetera, Pope, and Sydnor (2009). Inattention in Car Sales**
- Sales of used cars –Odometer is important measure of value of car



- Data set with 22 million wholesale used car transactions



- Remarkable precision in the estimates of the discontinuity
- Can estimate $\theta = 0.33$
- Consistent estimate broadly with other evidence
- However: Who des this inattention refer to?
- Data is from sales to car dealers, who are presumably incorporating preferences of buyers

10 Next Lecture

- Framing
- Menu Effects