Econ 219B
Psychology and Economics: Applications
(Lecture 10)

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Outline

Section 1

Attention: Simple Model

Simple model (DellaVigna JEL 2009)

- 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
  - Model captures in reduced form underlying attention model, eg. sparsity (Gabaix, 2018) or rational inattention (Matejka and McKay, 2016)
  - Interpretation: each individual sees o, but processes it only partially, to the degree θ

Alternative Model

- Alternative model:
  - share θ on individuals are inattentive, $1-\theta$ attentive $\rightarrow$
  - 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 $\theta(1,N) = 0$
  - Number 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

Identification

- Model suggests three strategies to identify the inattention parameter θ:
  1. Compute response of $\hat{V}$ to change in $o \rightarrow$ compare $\partial \hat{V}/\partial o = (1-\theta)$ to $\partial \hat{V}/\partial v = 1$ (Hossain-Morgan (2006), Chetty-Looney-Kroft (2009), Lacetera-Pope-Sydnor (2012), Cohen-Frazzini (2011), Taubinsky and Rees-Jones (2018))
  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. (2009); Allcott and Taubinsky, 2015)
  3. Vary competing stimuli N, $\partial \hat{V}/\partial N = -\theta_N' o$: differs from zero? (DellaVigna-Pollet (2009) and Hirshleifer-Lim-Teoh (2009))
- Key (unmodeled) element: identify opaque information o

Two caveats:

1. Measuring salience of information is subjective — psychology experiments do not provide a general criterion

2. Inattention can be rational, or not.
   - Can rephrase as rational model with information costs
   - Opaque information is sometimes available at a zero or small cost (for example, earnings announcements news) –> Rational interpretation less plausible
   - Leading edge in the literature is to pin down underlying attention model, eg, salience a la Gabaix or rational inattention a la Sims (2003)

Section 2

Attention: eBay Auctions

Hossain and 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

Methodology

- Field experiment selling CD and XBox Games 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

Methodology

- Field experiment selling CD and XBox Games 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: $\partial R/\partial c = 0 = \partial p/\partial c \rightarrow R_A = R_B$
  - Inattention: $\partial R/\partial c = \theta \rightarrow R_A < R_B$

Results: CDs

- Strong effect: $R_B - R_A = \$2.61 \rightarrow$ 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%*

Results: XBox Games

- Smaller effect for XBox: $R_B - R_A = \$0.71 \rightarrow$ Inattention
  $\theta = 0.71/4 = .18$
- Pooling data across treatments: $R_B > R_A$ in 16 out of 20 cases
  $\rightarrow$ 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%*

Robustness Check

- 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 $c = \$6$

Robustness Check

- 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?): $R_D - R_C = -.29 \rightarrow$ Inattention $\theta = -.29/4 = -.07$
- Large, significant effect for XBoxs: $R_D - R_C = 4.11 \rightarrow$ Inattention $\theta = 4.11/4 = 1.05$

Robustness Check

- 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?): $R_D - R_C = -.29 \rightarrow$ Inattention $\theta = -.29/4 = -.07$
- Large, significant effect for XBoxs: $R_D - R_C = 4.11 \rightarrow$ 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

Results: High Reserve Treatment

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%*

Section 3

Attention: Taxes

Salience and Taxation: Theory and Evidence

- **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

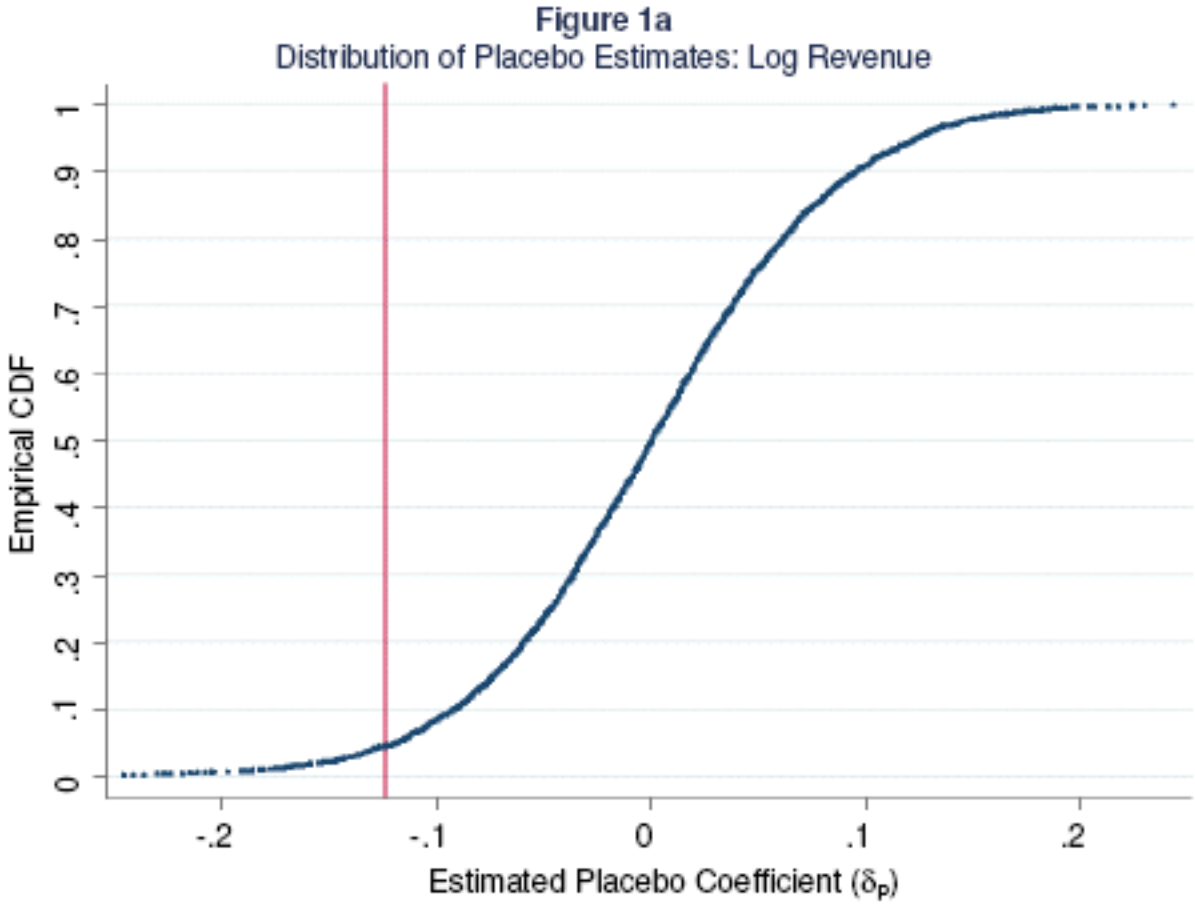
TABLE 3
DDD Analysis of Means: Weekly Quantity by Category

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

- Chetty et al. also consider welfare implications of the results
- Limited attention can be good for welfare!
- Intuition:
  - Limited attention limits consumption response to tax
  - It lowers the deadweight loss of taxation

Follow-up Work

- Next step in the literature: **Taubinsky and Rees-Jones (RES 2018)**
- Significant advance
  1. Estimate limited attention with much higher precision
  2. Estimate how limited attention varies with the stakes (higher price items, higher tax)
  3. Estimate heterogeneity in limited attention
- For result, see 219a, but key take-aways
  1. Limited attention is very significant economically
  2. Attention is higher for higher stakes
  3. Attention is very heterogeneous
- Result 3 reverses welfare implication: Heterogeneous inattention hurts consumers

Section 4

Attention: Left Digits

Introduction

- 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

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

- Optimal Pricing at 99 cents

- Indeed, evidence of 99 cents effect in pricing at stores

Ashton (2014)

- Re-analysis of Chetty et al. data
  - Show that effect on sales is concentrated to cases in which first digit changes
    - Not much effect if adding tax raises price from 3.50 to 3.80
    - Effect is adding tax raises price from 3.99 to 4.30
  - Compute DDD for Shifting digit and Rigid digit
  - Effect is entirely due to Shifting Digit

Table 4: Comparison of Means.

		Sensitive dollar-value prices					*Rigid dollar-value prices*				
		Control Stores		Treated Store		*Diff (stores)*	Control Stores		Treated Store		*Diff (stores)*
Treated Categories	Baseline Period		12.297 (0.187) [1612]		10.769 (0.187) [806]	D_{CT}= *-1.528* *(0.206)* *[2418]*		15.514 (0.237) [1612]		14.356 (0.283) [806]	D_{CT}= *-1.158* *(0.224)* *[2418]*
	Experimental Period		13.744 (0.499) [78]		10.949 (0.431) [39]	D_{TT}= *-2.795* *(0.811)* *[117]*		14.449 (1.068) [78]		12.923 (0.823) [39]	D_{TT}= *-1.526* *(0.962)* *[117]*
	Diff (time)	D_{CS}=	*1.447* *(0.452)* *[1690]*	D_{TS}=	*0.180* *(0.401)* *[845]*	**DD_{TC}=** *-1.267* *(0.696)* *[2535]*	D_{CS}=	-1.066 (0.910) [1690]	D_{TS}=	-1.433 (0.734) [845]	**DD_{TC}=** *-0.367* *(0.820)* *[2535]*
Control Categories	Baseline Period		18.540 (0.170) [11842]		16.541 (0.151) [5890]	D_{CT}= *-2.000* *(0.137)* *[17732]*		13.458 (0.151) [10491]		11.513 (0.137) [5134]	D_{CT}= *-1.945* *(0.130)* *[15625]*
	Experimental Period		17.733 (0.494) [573]		16.488 (0.707) [285]	D_{TT}= *-1.245* *(0.467)* *[858]*		14.427 (0.510) [511]		12.258 (0.573) [252]	D_{TT}= *-2.169* *(0.269)* *[763]*
	Diff (time)	D_{CS}=	*-0.807* *(0.441)* *[12415]*	D_{TS}=	*-0.053* *(0.601)* *[6175]*	**DD_{CC}=** *0.754* *(0.408)* *[18590]*	D_{CS}=	0.969 (0.446) [11002]	D_{TS}=	0.745 (0.491) [5386]	**DD_{CC}=** *-0.224* *(0.257)* *[16388]*
						DDD= **-2.021** **(0.979)** **[21125]**					**DDD=** **-0.143** **(0.984)** **[18923]**

Notes: Standard deviations are reported in parentheses bellow the means. Number of observations are reported in square brackets bellow the standard errors. See Appendix 3 for description of treated and control categories. Statistics are computed using the full sample.

Shlain (2018)

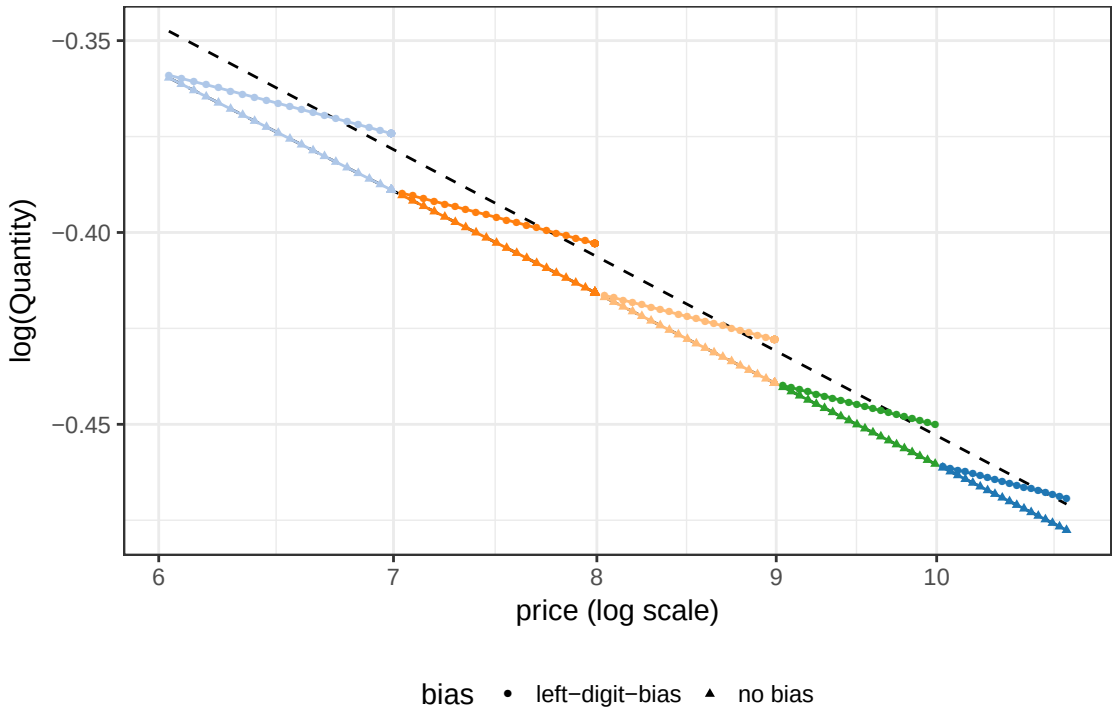
- Examine left-digit inattention with 3-way tack:
  1. Do demand curves indeed exhibit discontinuity in price response as predicted with limited attention?
  2. Are observed price endings consistent with inattention model?
  3. Can we use a natural experiment in price endings to get evidence on (1) and (2), and test for firm profit maximization?
- Difficulty:
  - (2) is a major confound for (1), as prices are highly endogenous
  - In most data sets, price is recorded noisily in the presence of sales
  - Briefly present evidence on (1)

Shlain (2018)

- Assume demand is given by

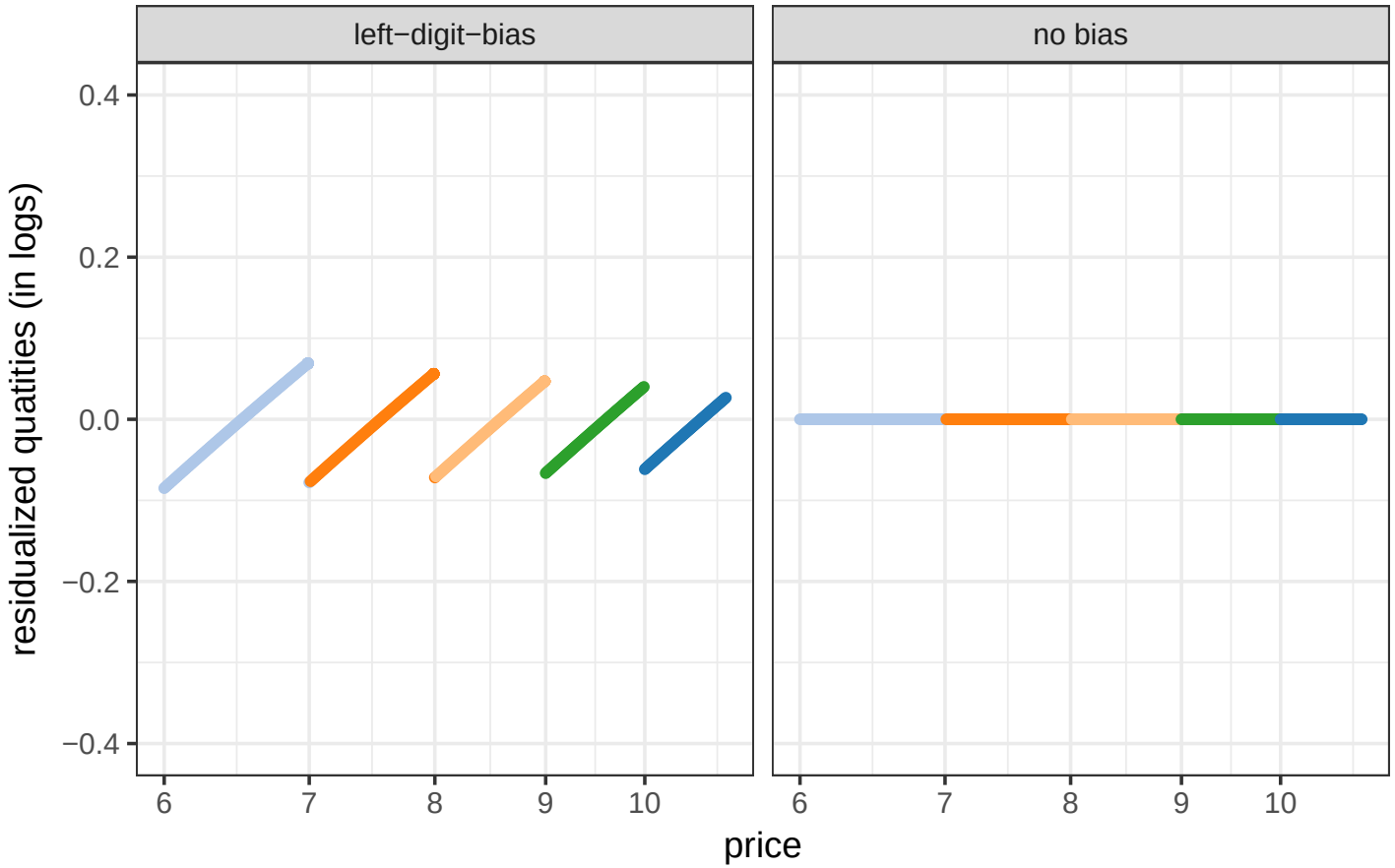
$$logQ = A + \eta log(P)$$

  with η being elasticity
- Then this is what is predicted with, and without, left-digit bias



Shlain (2018)

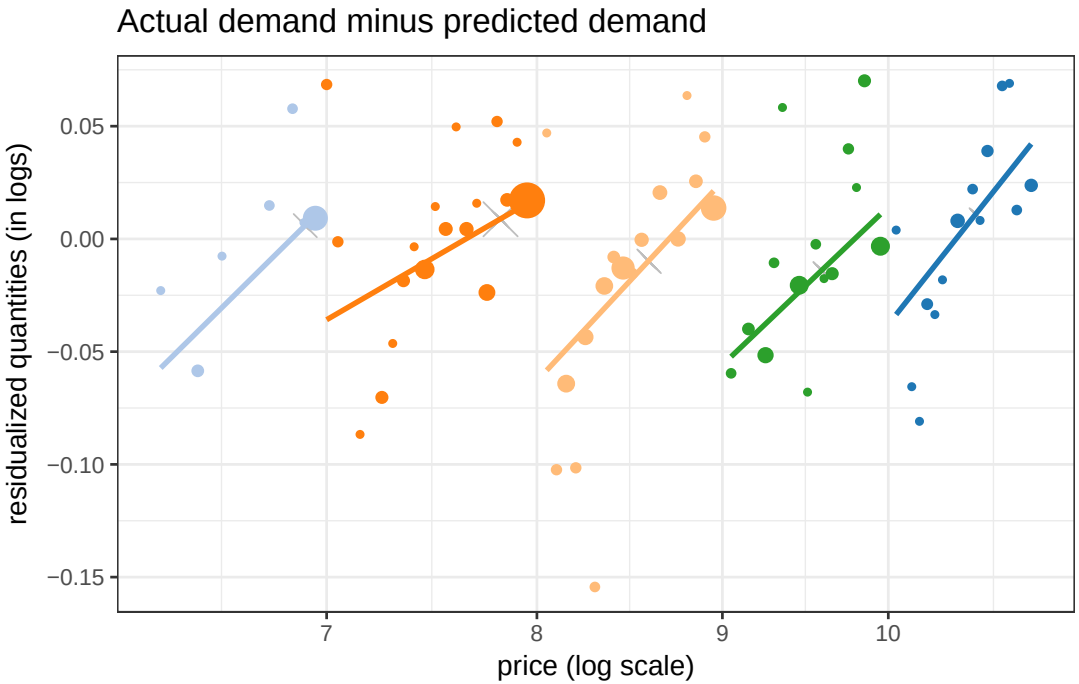
- Using residual



Simulation: Shape of residualized quantities from logQ~logP regression with random pricing.

Shlain (2018)

- Findings



binned residuals from chain−level regressions of logQ_st ~ eta_c(s)*logP_st + store + year + month fixed effects,
where s is store, c is chain, and `t` is date.
56 retail chains, with 10,139 stores, 8 years of weekly prices.
Subset of `regular prices` including only price spells of length 6 weeks at least.
Residuals are binned to 5 cents bins, and weighted by price frequency. Product: coffee1

- Clear evidence of limited attention, identifies also elasticity!
- –> Can then use to predict optimal pricing

Inattention in Car Sales

- **Lacetera, Pope, and Sydnor (AER 2012). Inattention in Car Sales**
- Sales of used cars – Odometer is important measure of value of car
- Suppose perceived value $\hat{V}$ of car is

$$\hat{V} = K - \alpha \hat{m}$$

- Perceived mileage is

$$\hat{m} = floor(m, 10k) + (1 - \theta)\, mod(m, 10k)$$

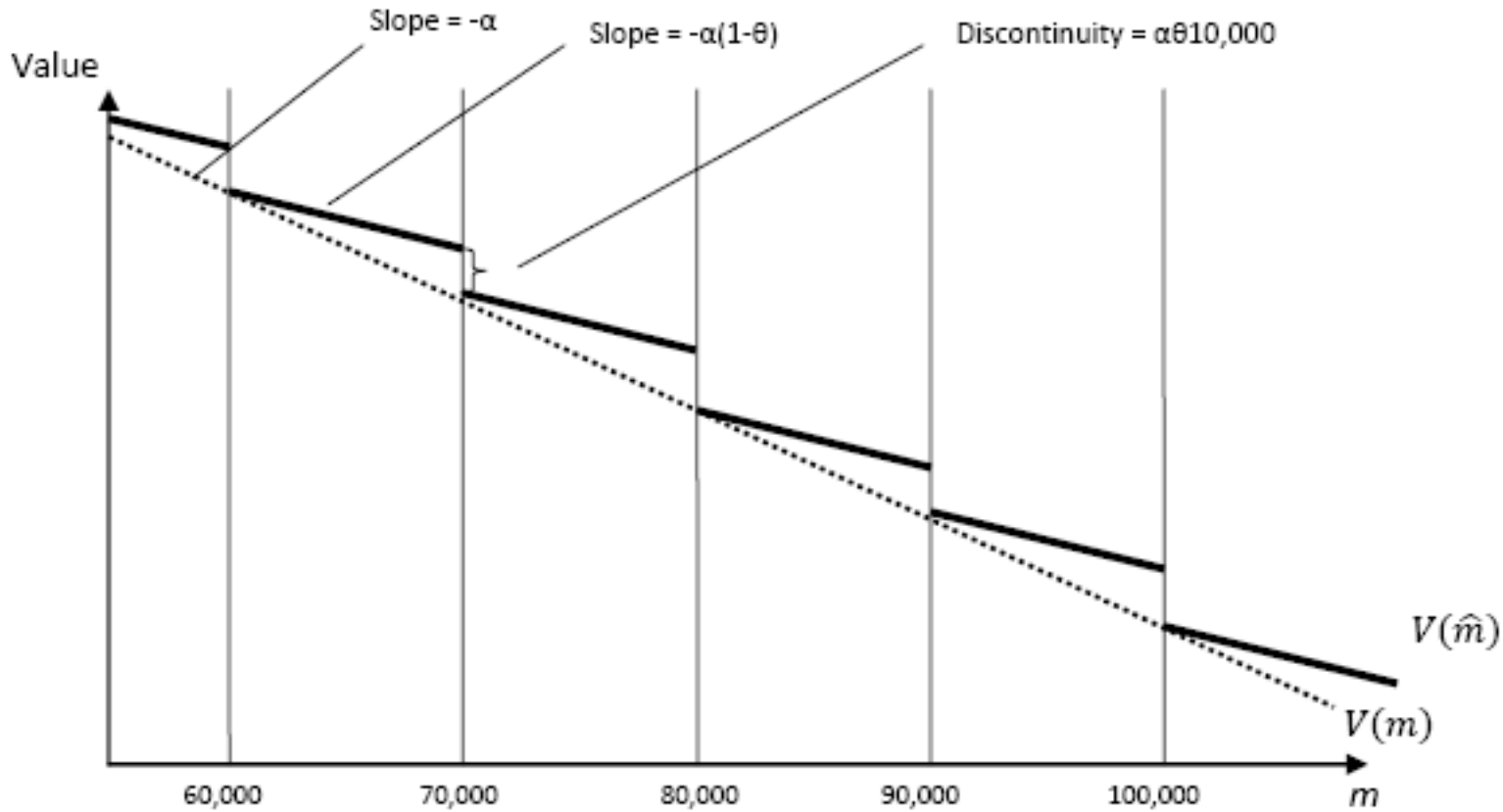
- Model predicts jump in value $\hat{V}$ at 10k discontinuity of

$$-\alpha\theta 10k$$

while slope is

$$-\alpha\,(1 - \theta)$$

- Can estimate inattention parameter θ: Jump/Slope gives $\theta/(1-\theta)$

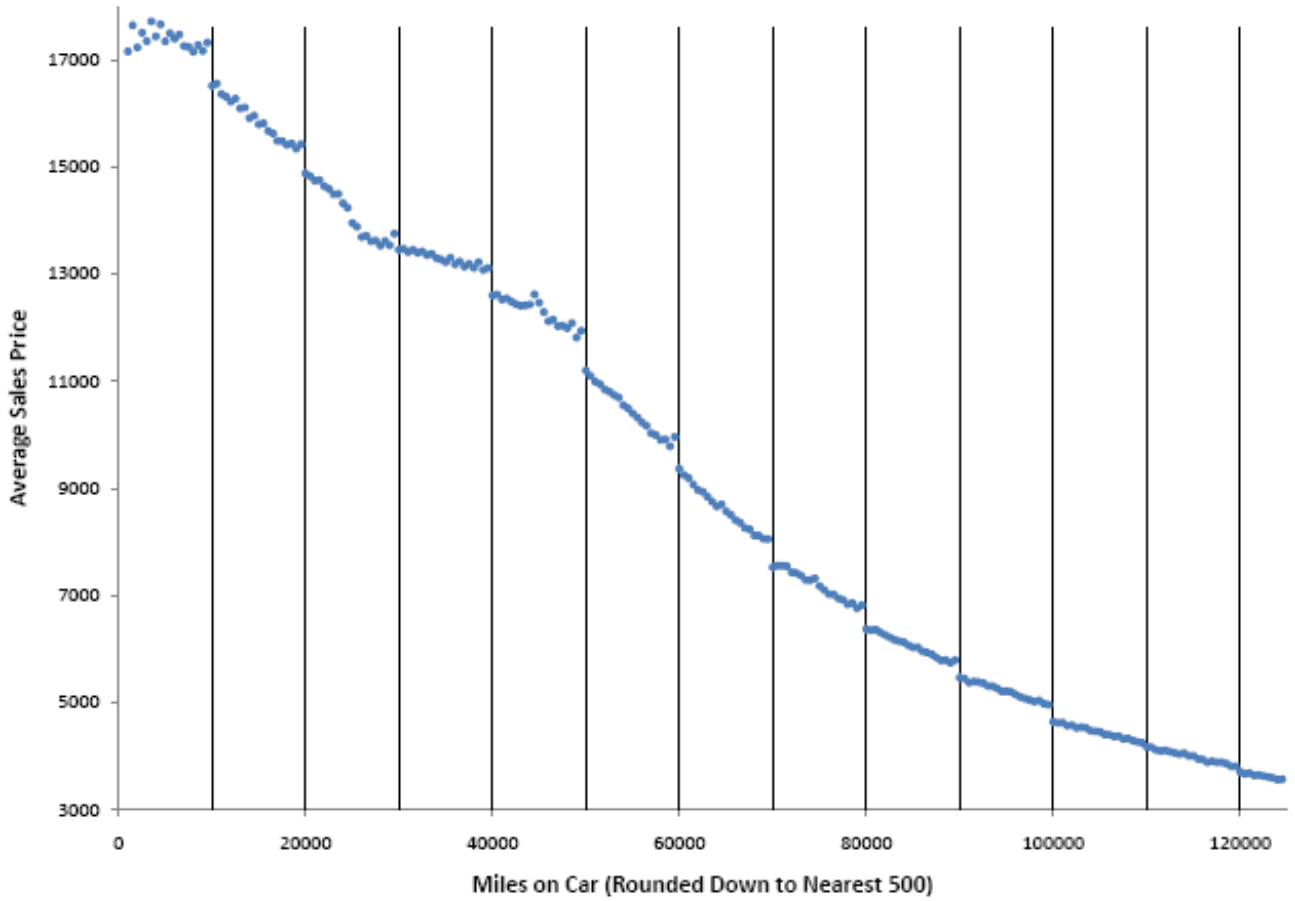


Data and Results

- Data set
  - 27 million wholesale used car auctions
  - January 2002 to September 2008
  - Buyer: Used car dealer
  - Seller: car dealer or fleet/lease
  - Continuous mileage displayed prominently on auction floor
- Result: Amazing resemblance of data to theory-predicted patterns: jump at 10k mark
  - Sizeable magnitudes: $200

Results I: 10,000s

Figure 2 - Raw Price. This figure plots the raw average sales price within 500-mile bins for the more than 22 million auctioned cars in our datas



- If discontinuity, expect smaller jumps also at 1k mileage points

Results II: 1,000s

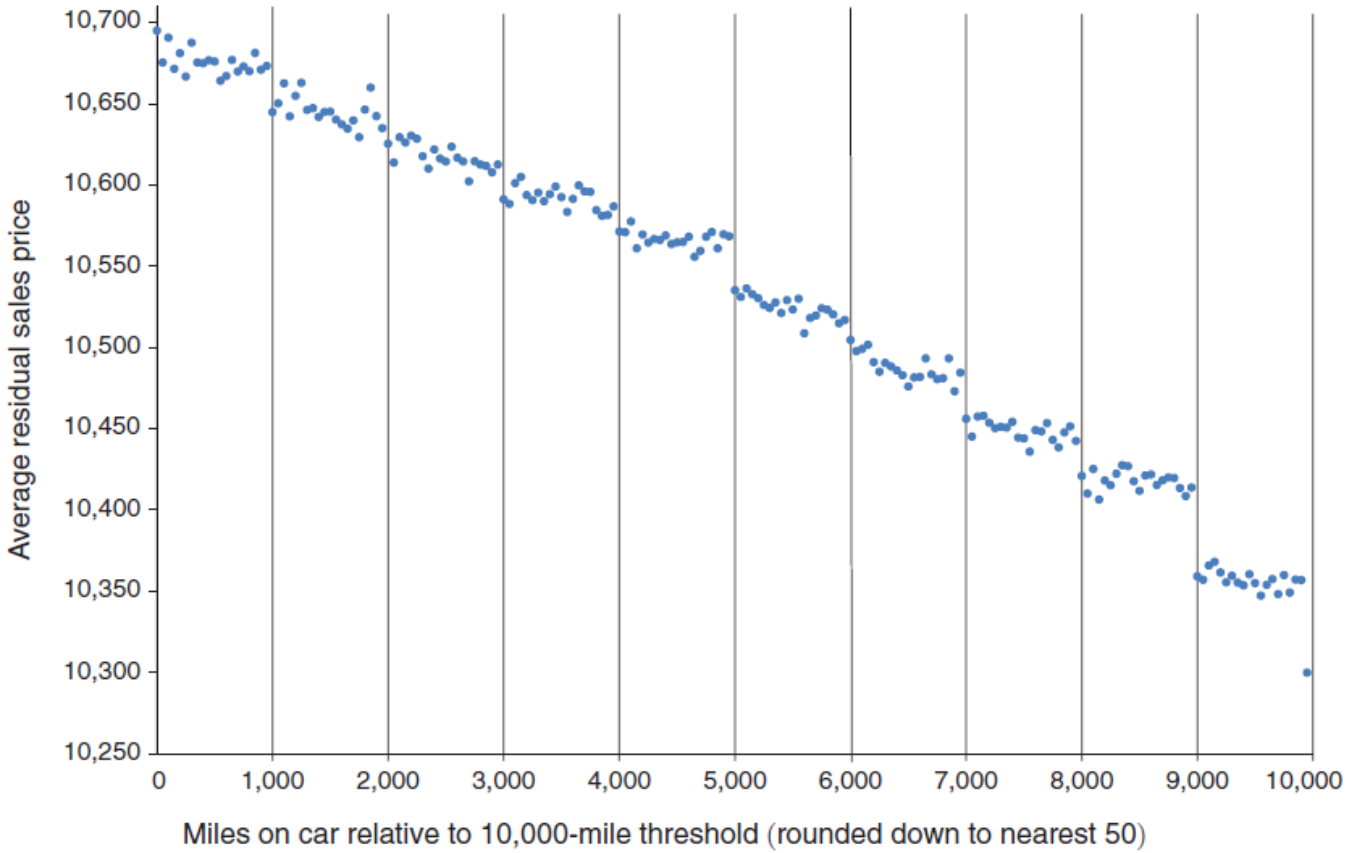


FIGURE 9. 1,000-MILE DISCONTINUITIES

Notes: This figure plots the average residual sales price within 50-mile bins for all cars in our dataset. To decrease noise, the data were stacked so that each dot is the average residual for cars in the same bin relative to a 10,000-mile threshold. For example, the very first dot represents the average residual value of all cars whose mileage falls between 10,000–10,050, 20,000–20,050, 30,000–30,050, …, or 110,000–110,050.

- Structural estimation of limited attention parameter can be done with Delta method or with NLS
  - Structural estimation can be from OLS
  - Estimate $\hat{\theta} = 0.33$ (0.01) for dealers, $\hat{\theta} = 0.22$ (0.01) for lease
  - Remarkable precision in the estimate of inattention
  - Consistent with other evidence, but much more precise

- Who does this inattention refer to?
  1. Auction buyers are biased $\rightarrow$ But these are used car re-sellers
  2. Ultimate car buyers are biased $\rightarrow$ Auction buyers incorporate it in bids
- Provide some evidence on experience of used car buyers:
  1. Hyp. 1 implies more experienced buyers will not buy at 19,990
  2. Hyp. 2 implies more experienced buyers will indeed buy at 19,990

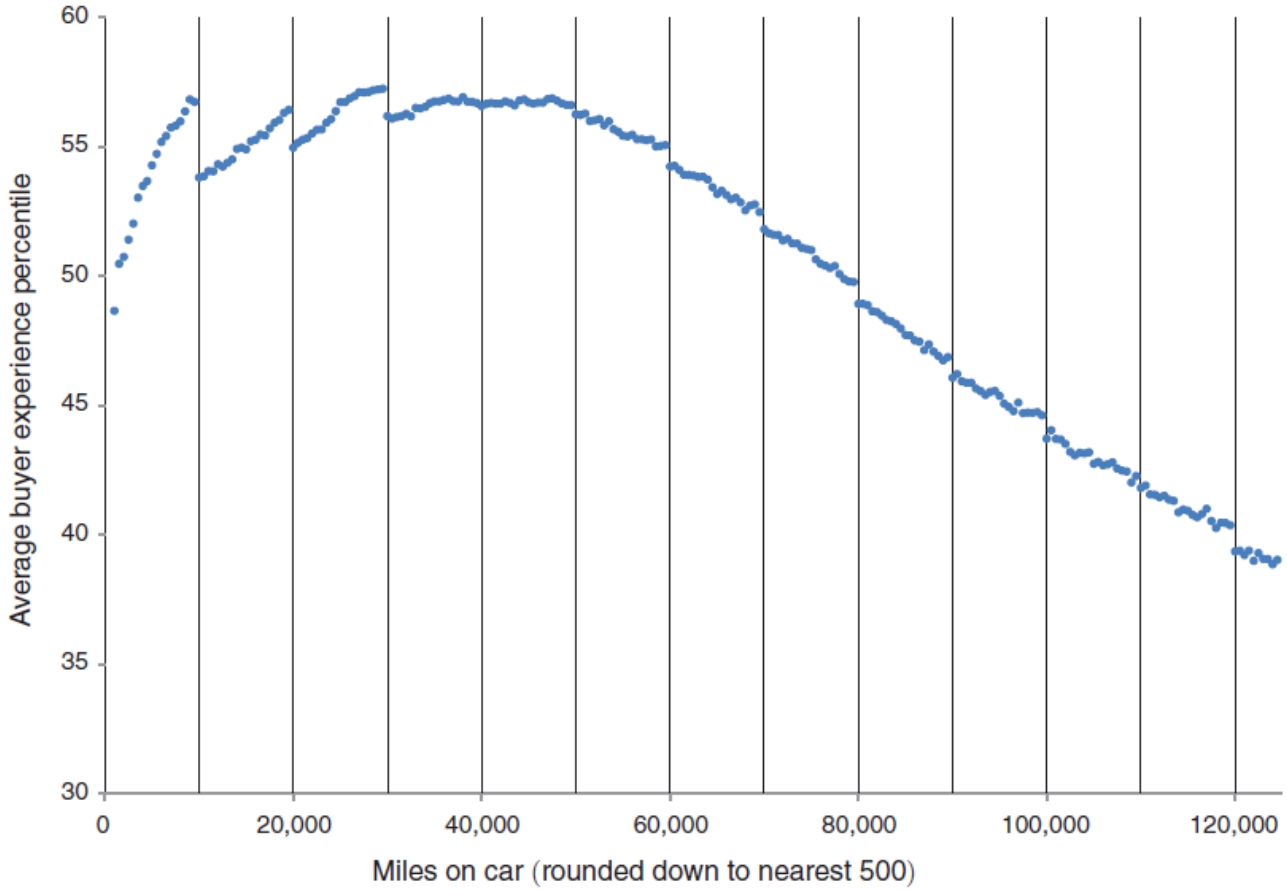


FIGURE 11. EXPERIENCE PERCENTILE

Notes: Each buyer in the dataset is given an experience percentile rating based on total volume of purchases (the 1 percent of buyers with the highest volume receive a percentile score of 99 percent). This figure plots the average buyer experience percentile for each 500-mile bin.

Behavioral IO

- Behavioral IO:
  - Biases of consumers
  - Rational firms respond to it, altering transaction price
- Would like more direct evidence: Do ultimate car buyers display bias?

- **Busse, Lacetera, Pope, Silva-Risso, Sydnor (AER P&P 2013)**
  - Data from 16m transaction of used cars
  - Information on sale price
  - Same time period
  - Is there similar pattern? Yes

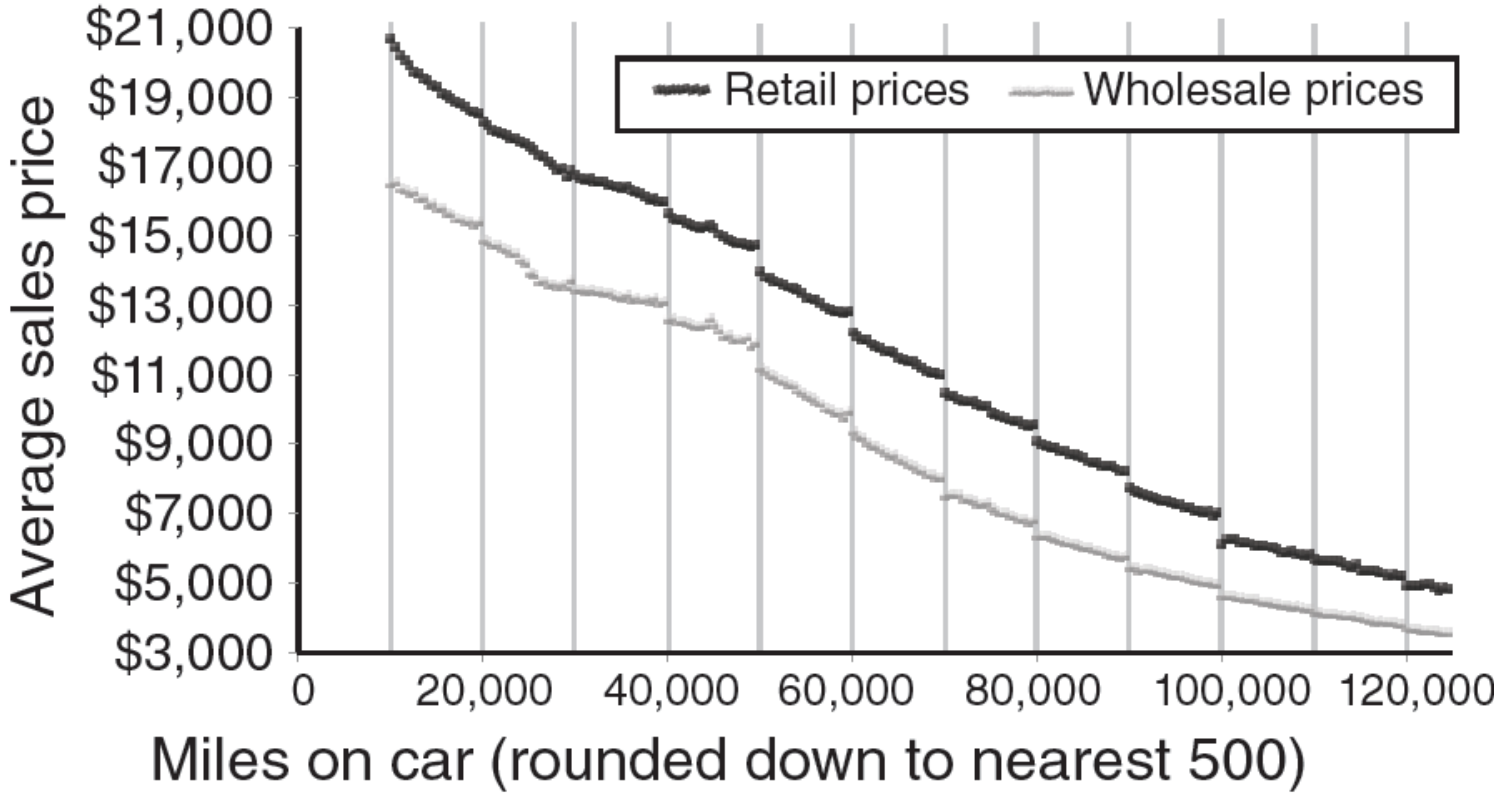


FIGURE 1. AVERAGE PRICE BY MILEAGE

- Similar estimate of inattention for auction buyers and ultimate buyers

TABLE 1—STRUCTURAL MODEL ESTIMATES

Sample	30K	40K	50K	60K	70K	80K	90K	100K
Retail—all								
Discontinuity ($)	240	167	310	317	365	324	366	402
Mileage depreciation rate (α)	0.135	0.125	0.131	0.123	0.118	0.098	0.102	0.086
Inattention parameter (θ)	0.178	0.134	0.237	0.258	0.308	0.329	0.360	0.467
	(0.006)	(0.007)	(0.008)	(0.009)	(0.011)	(0.015)	(0.017)	(0.024)
Wholesale								
Discontinuity ($)	172	196	283	236	227	214	177	180
Mileage depreciation rate (α)	0.060	0.074	0.081	0.066	0.059	0.047	0.042	0.039
Inattention parameter (θ)	0.285	0.266	0.348	0.360	0.387	0.451	0.425	0.461
	(0.0171)	(0.0154)	(0.016)	(0.0209)	(0.0235)	(0.0288)	(0.0317)	(0.0346)

- Heterogeneity by income (at ZIP level)? Some

Retail—low income								
Discontinuity ($)	248	162	305	311	379	295	361	381
Mileage depreciation rate (α)	0.126	0.116	0.120	0.115	0.113	0.098	0.099	0.086
Inattention parameter (θ)	0.197	0.139	0.255	0.270	0.336	0.303	0.364	0.443
	(0.008)	(0.010)	(0.012)	(0.014)	(0.016)	(0.021)	(0.024)	(0.033)
Retail—high income								
Discontinuity ($)	235	169	296	318	342	353	352	401
Mileage depreciation rate (α)	0.145	0.133	0.142	0.130	0.121	0.096	0.102	0.087
Inattention parameter (θ)	0.163	0.127	0.209	0.245	0.282	0.367	0.344	0.460
	(0.008)	(0.009)	(0.011)	(0.013)	(0.016)	(0.024)	(0.026)	(0.038)

Section 5

Attention: Financial Markets

Introduction

- Is inattention limited to consumers?
- Finance: examine response of asset prices to release of quarterly earnings news
- Setting:
  - Announcement a time t
  - v is known information about cash-flows of the company
  - o is new information in earnings announcement
  - Day $t-1$: company price is $P_{t-1} = v$
  - Day t:
    - company value is $v + o$
    - Inattentive investors: asset price P_t responds only partially to the new information: $P_t = v + (1-\theta)\, o$.
  - Day $t+60$: Over time, price incorporates full value: $P_{t+60} = v + o$

Implications

- Implication about returns:
  - Short-run stock return r_{SR} equals $r_{SR} = (1 - \theta)\, o/v$
  - Long-run stock return r_{LR}, instead, equals $r_{LR} = o/v$
  - Measure of investor attention: $(\partial r_{SR}/\partial o)/(\partial r_{LR}/\partial o) = (1 - \theta)$
    $\rightarrow$ Test: Is this smaller than 1?
  - (Similar results after allowing for uncertainty and arbitrage, as long as limits to arbitrage — see final lectures)

- Indeed: Post-earnings announcement drift (**Bernard-Thomas, 1989**): Stock price keeps moving after initial signal

- Inattention leads to delayed absorption of information.

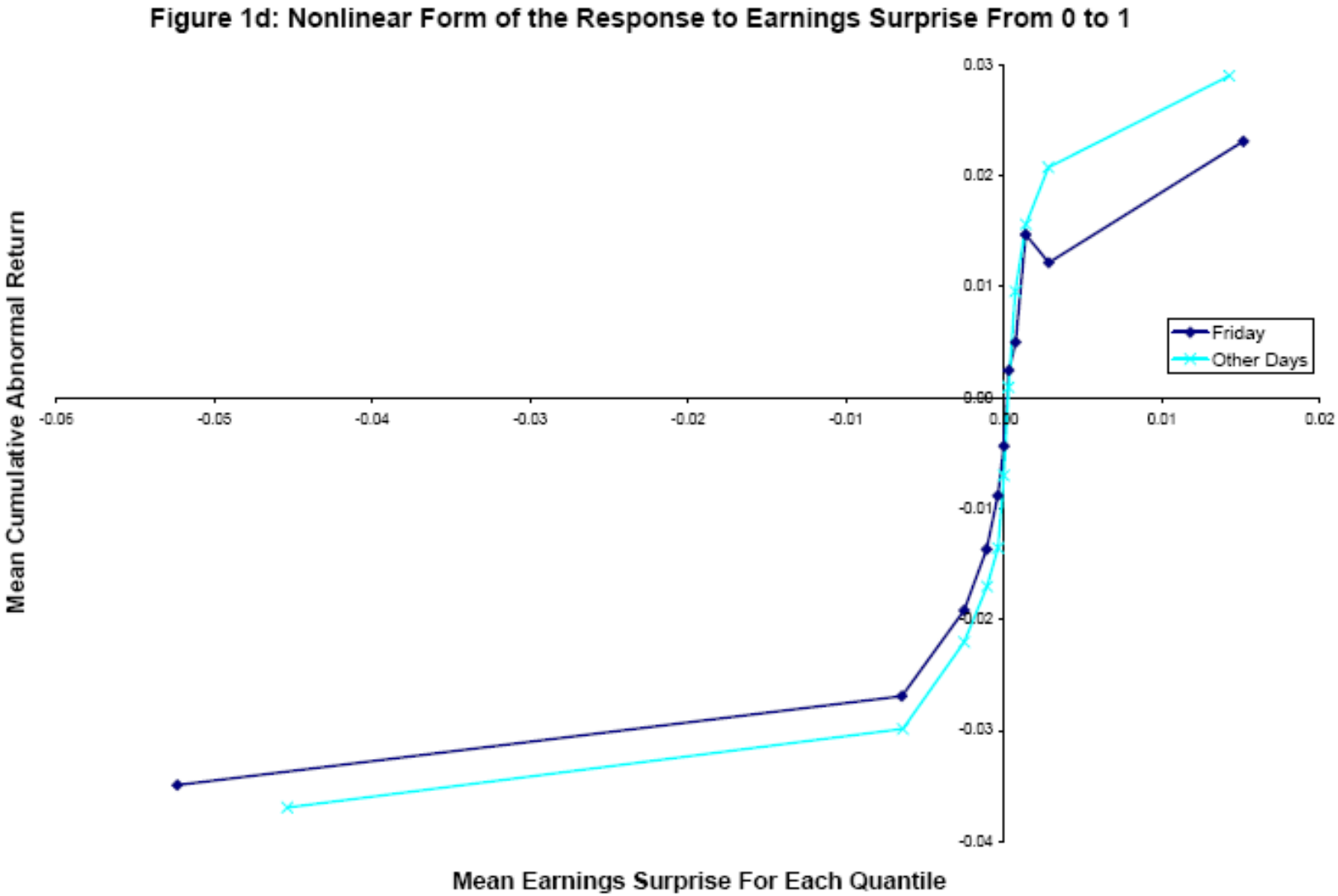
- **DellaVigna-Pollet (JF 2009)**
  - Estimate $(\partial r_{SR}/\partial o)/(\partial r_{LR}/\partial o)$ using the response of returns r to the earnings surprise o
  - r_{SR}: returns in 2 days surrounding an announcement
  - r_{LR}: returns over 75 trading days from an announcement
- Measure earnings news o_t:

$$o_t = \frac{e_t - \hat{e}_t}{p_{t-1}}$$

  - Difference between earnings announcement e_t and consensus earnings forecast by analysts in 30 previous days
  - Divide by (lagged) price p_{t-1} to renormalize

- Next step: estimate $\partial r_{SR}/\partial o$
- Problem: Response of stock returns r to information o is highly non-linear
- How to evaluate derivative?

Portfolio Methodology



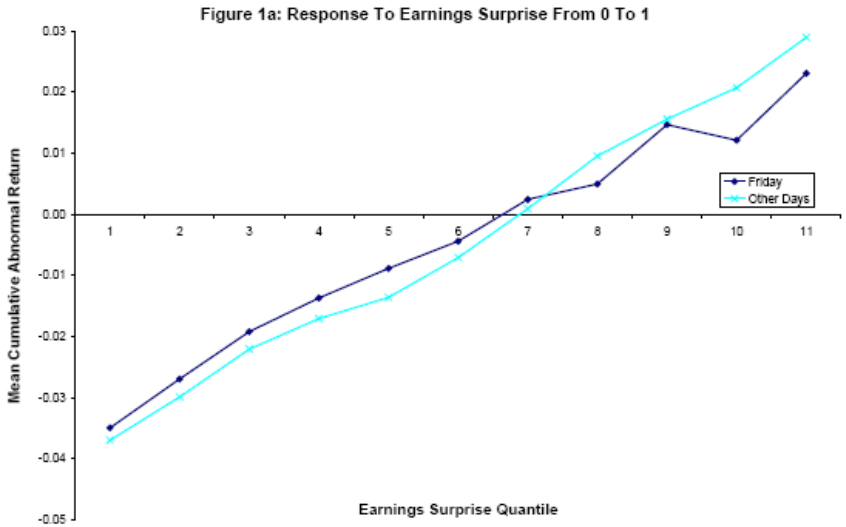
Quantiles and Portfolios

- Economists' approach:
  - Make assumptions about functional form $\rightarrow$ Arctan for example
  - Do non-parametric estimate $\rightarrow$ kernel regressions
- Finance: Use of quantiles and portfolios (explained in the context of DellaVigna-Pollet (JF 2009))

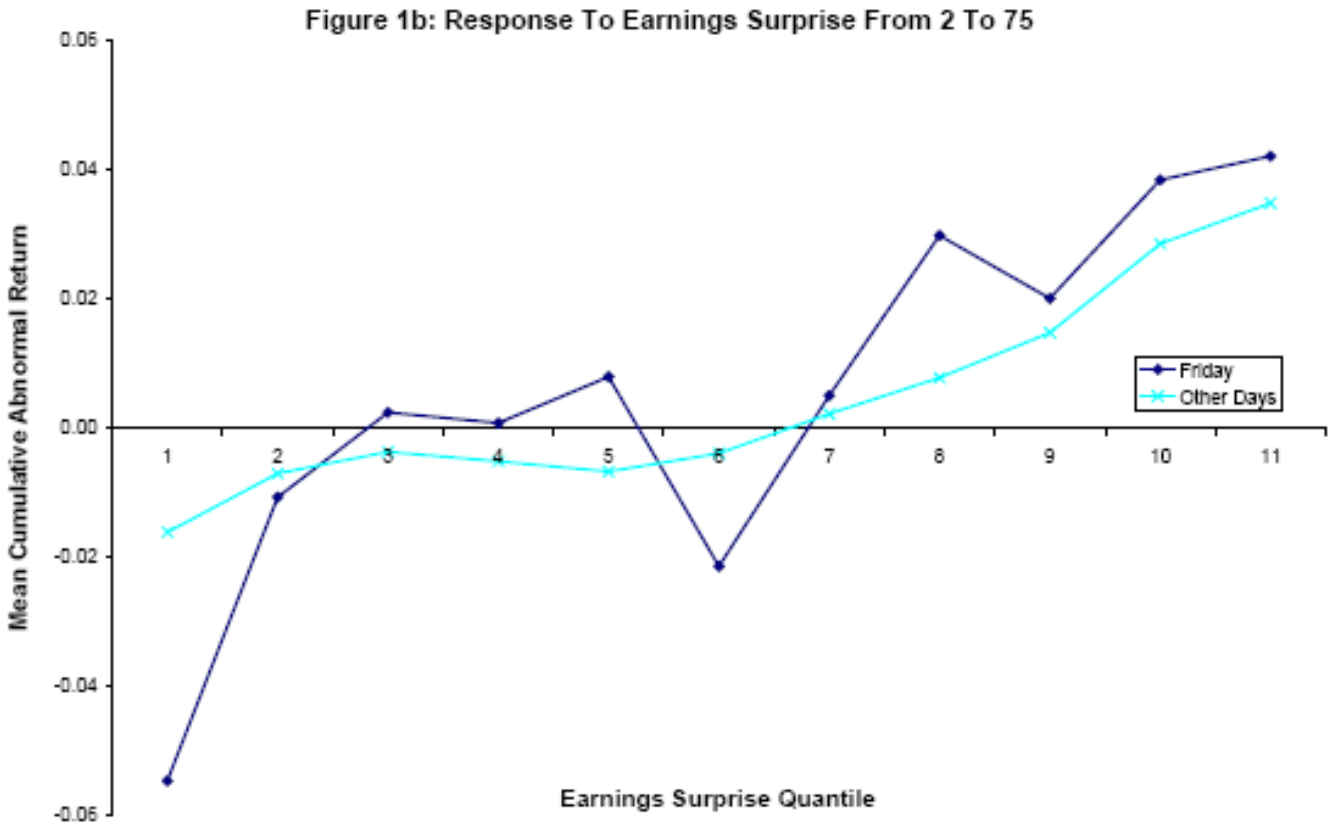
- First methodology: *Quantiles*
  - Sort data using underlying variable (in this case earnings surprise o_t)
  - Divide data into n equal-spaced quantiles: $n = 10$ (deciles), $n = 5$ (quintiles), etc
  - Evaluate difference in returns between top quantiles and bottom quantiles: $Er_n - Er_1$

This paper

- Quantiles 7-11. Divide all positive surprises
- Quantiles 6. Zero surprise (15-20 percent of sample)
- Quantiles 1-5. Divide all negative surprise



- Notice: Use of quantiles "linearizes" the function
- Delayed response $r_{LR} - r_{SR}$ (post-earnings announcement drift)



Results: Inattention

- Inattention:
  - To compute $\partial r_{SR}/\partial o$, use $Er^{11}_{SR} - Er^{1}_{SR} = 0.0659$ (on non-Fridays)
  - To compute $\partial r_{LR}/\partial o$, use $Er^{11}_{LR} - Er^{1}_{LR} = 0.1210$ (on non-Fridays)
  - Implied investor inattention:
    $(\partial r_{SR}/\partial o)/(\partial r_{LR}/\partial o) = (1-\theta) = .544 \rightarrow$ Inattention
    $\theta = .456$

- Is inattention larger when more distraction?
- Weekend as proxy of investor distraction.
  - Announcements made on Friday: $(\partial r_{SR}/\partial o)/(\partial r_{LR}/\partial o)$ is 41 percent $\rightarrow \hat{\theta} \approx .59$

Second Method: Portfolios

- Second methodology: *Portfolios*
  - Instead of using individual data, pool all data for a given time period t into a 'portfolio'
  - Compute average return r_t^P for portfolio t over time
  - Control for Fama-French 'factors':
    - Market return r_t^m
    - Size r_r^S
    - Book-to-Market r_t^{BM}
    - Momentum r_t^M
    - (Download all of these from Kenneth French's website)
  - Regression:

$$r_t^P = \alpha + BR_t^{Factors} + \varepsilon_t$$

  - Test: Is α significantly different from zero?

- Example in DellaVigna-Pollet (2009)
  - Each month t portfolio formed as follows: $(r_F^{11} - r_F^1) - (r_{Non-F}^{11} - r_{Non-F}^1)$
  - Returns r_{Drift} (3-75) -Differential drift between Fridays and non-Fridays
- Intercept $\hat{\alpha} = .0384$: monthly returns of 3.84 percent from this strategy

	Dependent Variable: Monthly Return on the Zero-Investment Portfolio					
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	0.0384 (0.0134)***	0.0462 (0.0139)***	0.0584 (0.0220)***	0.0218 (0.0079)***	0.0232 (0.0086)***	0.0277 (0.0091)***
VW Index Excess Return (VWRF)	-0.2742 (0.3090)	-0.6419 (0.2778)**	-0.0968 (0.4262)	-0.1842 (0.1865)	-0.1068 (0.2301)	-0.4580 (0.1937)**
Size Factor Return (SMB)		0.2344 (0.4195)	0.5644 (0.6227)	-0.0390 (0.2464)	0.0701 (0.2930)	-0.0137 (0.2438)
Value Factor Return (HML)		-0.4607 (0.6143)	-1.5556 (0.7277)**	0.0762 (0.3329)	-0.3264 (0.2840)	-0.2094 (0.3820)
Momentum Factor Return (UMD)		-0.3994 (0.2632)	-1.1817 (0.6559)*	-0.0696 (0.1740)	-0.0410 (0.2206)	-0.3454 (0.1940)*
One month holding period	X	X	X	X		X
Two month holding period					X	
Top minus bottom quantile	X	X	X		X	
Matched sample			X			
Top two minus bottom two quantiles				X		
Top minus bottom decile						X
R^2	0.0073	0.0385	0.1736	0.0152	0.0153	0.0398
N	N = 125	N = 125	N = 124	N = 130	N = 138	N = 127

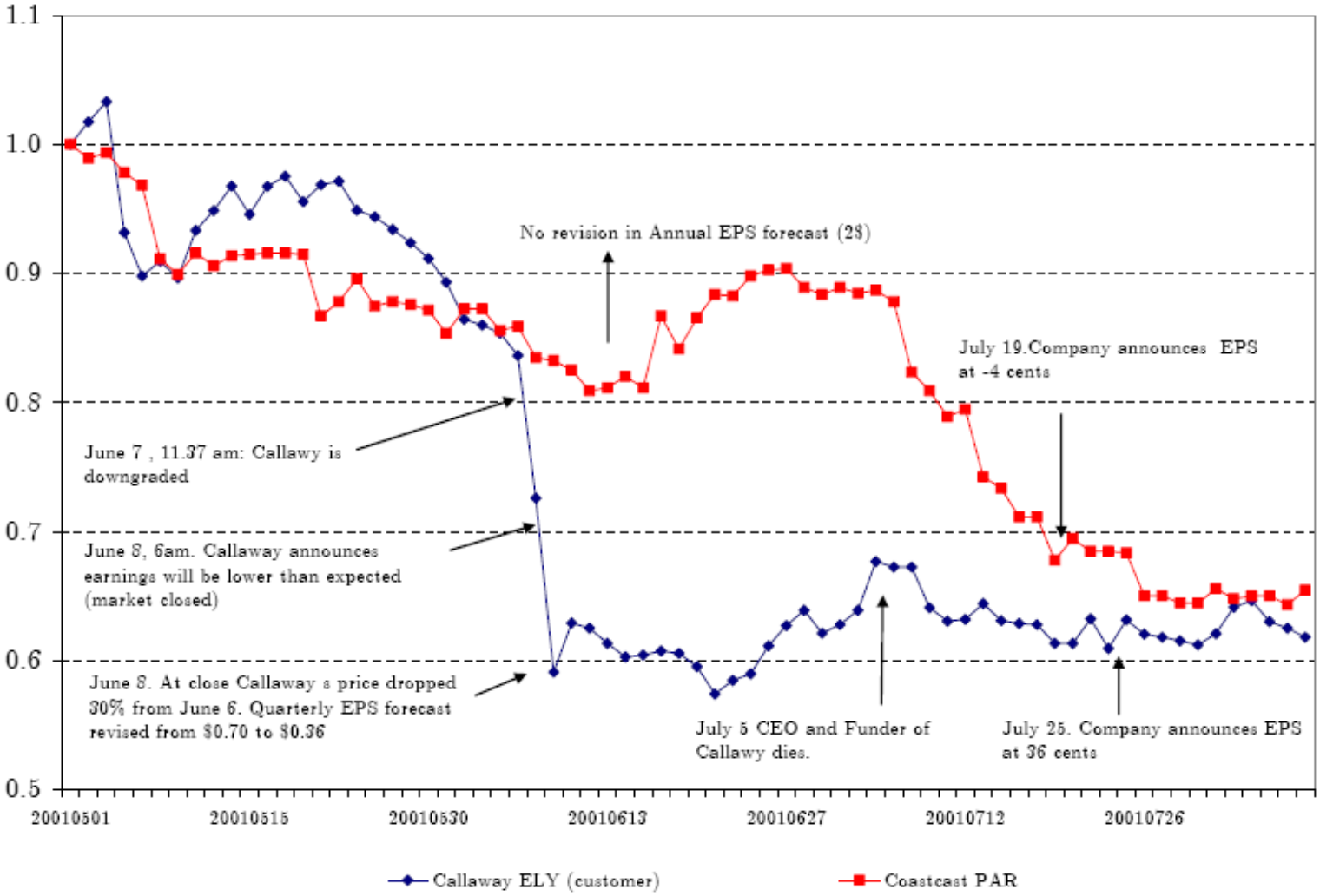
* significant at 10%; ** significant at 5%; *** significant at 1%

Subtle Links

- **Cohen-Frazzini (JF 2011) – Inattention to subtle links**
- Suppose that you are a investor following Company A
- Are you missing more subtle news about Company A?
- Example: Huberman and Regev (2001) – Missing the *Science* article
- Cohen-Frazzini (2011) – Missing the news about your main customer:
  - Coastcoast Co. is leading manufacturer of golf club heads
  - Callaway Golf Co. is leading retail company for golf equipment
  - What happens after shock to Callaway Co.?

Figure 1: Coastcast Corporation and Callaway Golf Corporation

This figure plots the stock prices of Coastcast Corporation (ticker = PAR) and Callaway Golf Corporation (ticker = ELY) between May and August 2001. Prices are normalized (05/01/2001 = 1).



- Data:
  - Customer- Supplier network – Compustat Segment files (Regulation SFAS 131)
  - 11,484 supplier-customer relationships over 1980-2004
- Preliminary test:
  - Are returns correlated between suppliers and customers?
  - Correlation 0.122 at monthly level

Computation of long-short returns

- Sort into 5 quintiles by returns in month t of principal customers, r_t^C
- By quintile, compute average return in month $t+1$ for portfolio of suppliers r_{t+1}^S: $r_{1,t+1}^S, r_{2,t+1}^S, r_{3,t+1}^S, r_{4,t+1}^S, r_{5,t+1}^S$
- By quintile q, run regression

$$r_{q,t+1}^S = \alpha_q + \beta_q X_{t+1} + \varepsilon_{q,t+1}$$

- X_{t+1} are the so-called factors: market return, size, book-to-market, and momentum (Fama-French Factors)
- Estimate $\hat{\alpha}_q$ gives the monthly average performance of a portfolio in quintile q
- Long-Short portfolio: $\hat{\alpha}_5 - \hat{\alpha}_1$

Results I

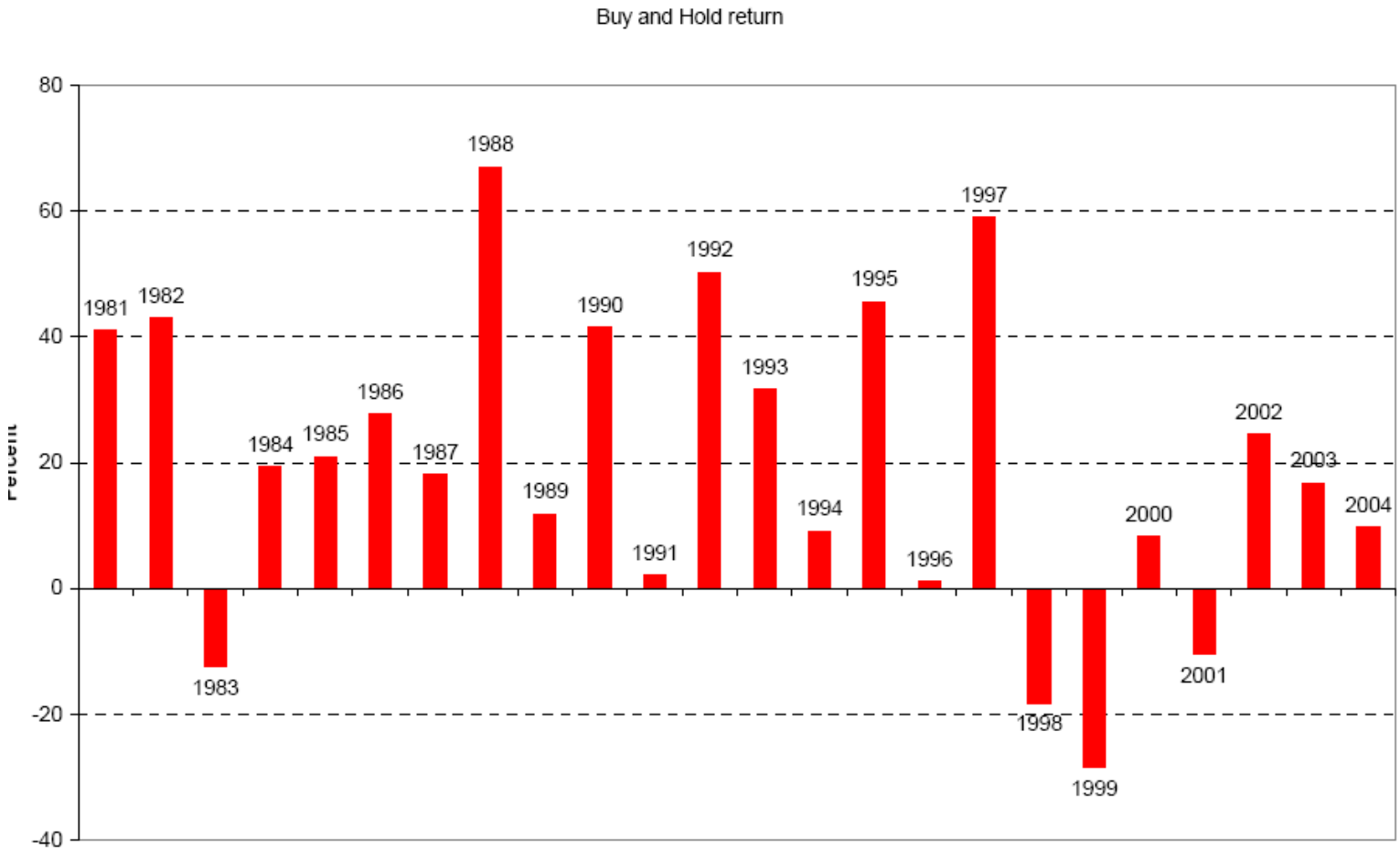
- Results in Table III: *Monthly* abnormal returns of 1.2-1.5 percent (huge)

Panel A: value weights	Q1(low)	Q2	Q3	Q4	Q5(high)	L/S
Excess returns	-0.596	-0.157	0.125	0.313	**0.982**	**1.578**
	[-1.42]	[-0.41]	[0.32]	[0.79]	[2.14]	[3.79]
3-factor alpha	**-1.062**	**-0.796**	**-0.541**	-0.227	**0.493**	**1.555**
	[-3.78]	[-3.61]	[-2.15]	[-0.87]	[1.98]	[3.60]
4-factor alpha	**-0.821**	**-0.741**	-0.488	-0.193	**0.556**	**1.376**
	[-2.93]	[-3.28]	[-1.89]	[-0.72]	[1.99]	[3.13]
5-factor alpha	**-0.797**	**-0.737**	-0.493	-0.019	0.440	**1.237**
	[-2.87]	[-3.04]	[-1.94]	[-0.07]	[1.60]	[2.99]

- Information contained in the customer returns not fully incorporated into supplier returns

Results II

- Returns of this strategy are remarkably stable over time



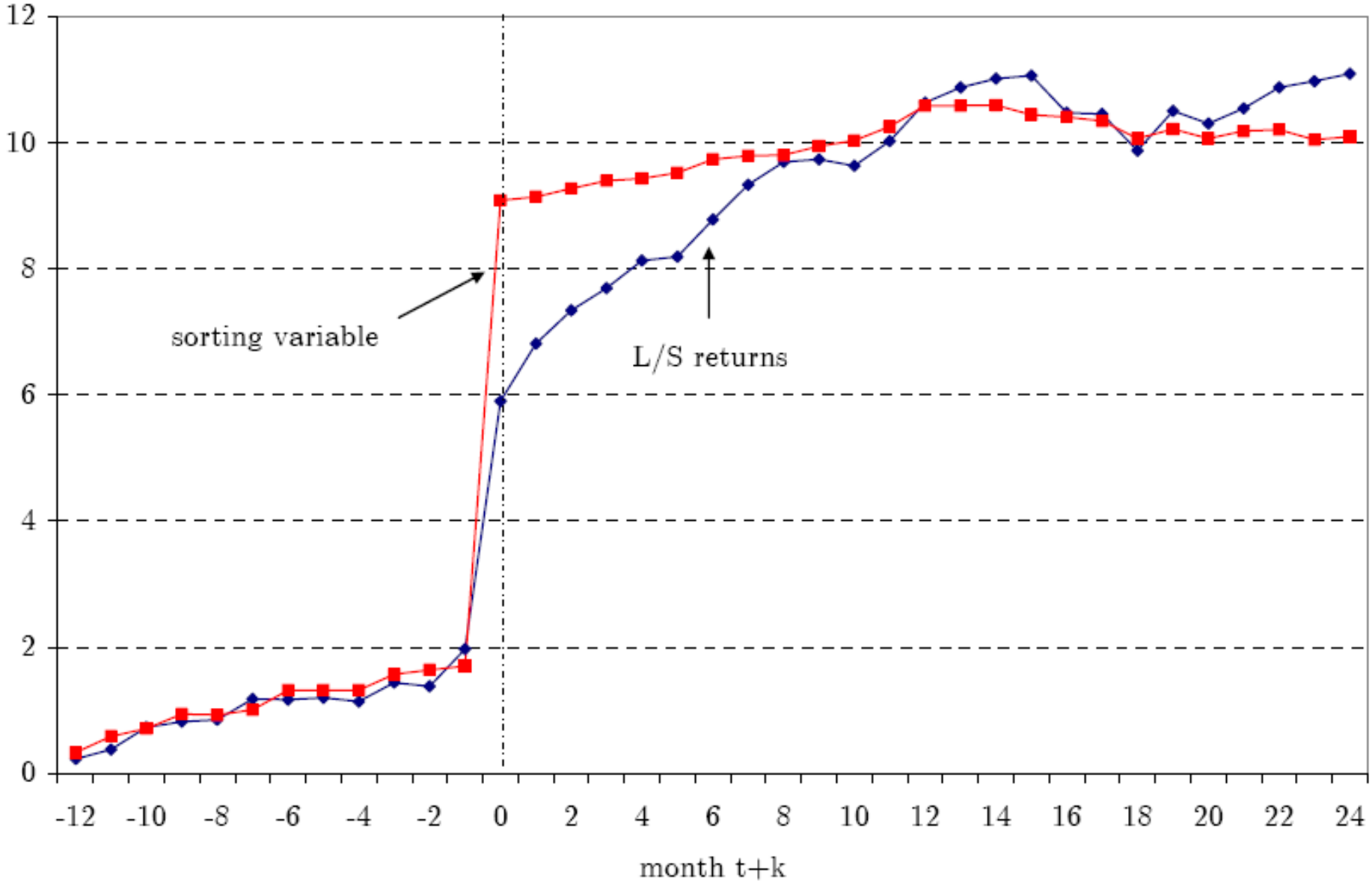
How quickly is info incorporated?

- Can run similar regression to test how quickly the information is incorporated
  - Sort into 5 quintiles by returns in month t of principal customers, r_t^C
  - Compute cumulative return up to month k ahead, that is, $r^S_{q,t->t+k}$
  - By quintile q, run regression of returns of Supplier:

$$r^S_{q,t->t+k} = \alpha_q + \beta_q X_{t+k} + \varepsilon_{q,t+1}$$

  - For comparison, run regression of returns of Customer:

$$r^C_{q,t->t+k} = \alpha_q + \beta_q X_{t+k} + \varepsilon_{q,t+1}$$


12
10
8
6
4
2
0
-12
-10
-8
-6
-4
-2
0
2
4
6
8
10
12
14
16
18
20
22
24
month t+k
sorting variable
L/S returns

Further Test

- For further test of inattention, examine cases where inattention is more likely
- Measure what share of mutual funds own both companies: COMOWN
- Median Split into High and Low COMOWN (Table IX)

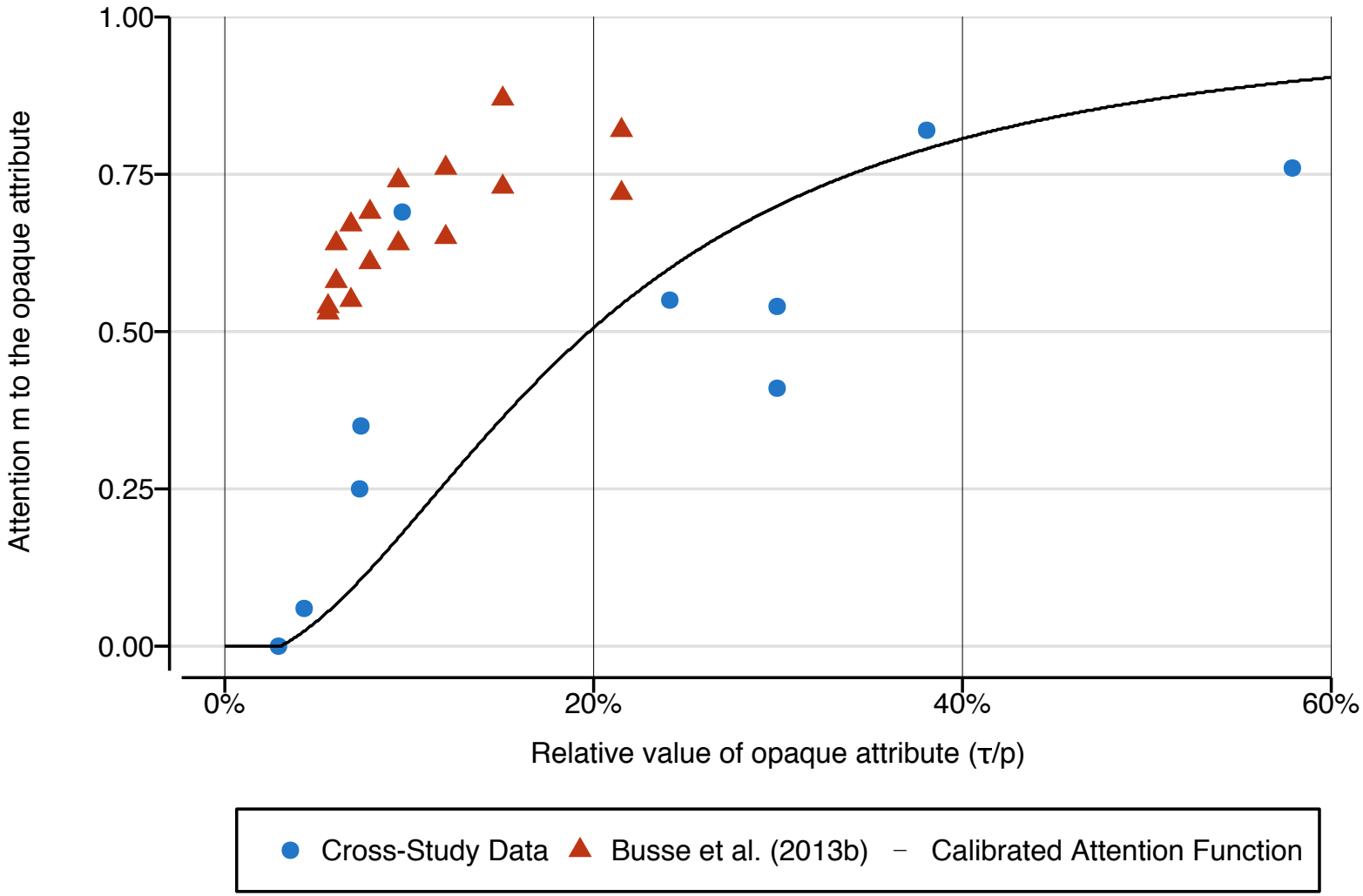
			At least 20 mutual funds holding the stock							
	All stocks		All stocks		At least 10 common funds		Larger firms (CRSP median)		Larger firms (NYSE median)	
Weight	EW	VW	EW	VW	EW	VW	EW	VW	EW	VW
Low COMOWN Lower percent of common ownership	1.653 [5.46]	2.301 [5.24]	1.659 [2.96]	2.306 [3.64]	1.469 [1.75]	1.889 [2.08]	1.572 [2.82]	2.288 [3.60]	2.703 [3.49]	2.852 [3.55]
High COMOWN Higher percent of common ownership	0.750 [1.97]	1.098 [2.17]	0.528 [0.98]	0.736 [1.23]	0.532 [0.85]	0.835 [1.21]	0.407 [0.75]	0.732 [1.22]	0.611 [1.05]	1.278 [2.11]
High-Low	-0.903 [-2.08]	-1.203 [-1.99]	-1.131 [-1.60]	-1.571 [-1.98]	-0.937 [-0.92]	-1.054 [-0.95]	-1.165 [-1.66]	-1.557 [-1.96]	-2.093 [-2.42]	-1.575 [-1.71]

Section 6

Attention: Wrap up

Taking it Together

- Enough evidence that we start to be able to move to next steps:
  - Is attention rational?
  - What models capture it best?
- Gabaix (2018) very nice meta-analysis figure


1.00
0.75
0.50
0.25
0.00
Attention m to the opaque attribute
0%
20%
40%
60%
Relative value of opaque attribute (τ/p)
Cross-Study Data
Busse et al. (2013b)
Calibrated Attention Function

Section 7

Framing

Tenet of Psychology: Context and Framing Matter

- Classical example (Tversky and Kahneman, 1981 in version of Rabin and Weizsäcker, 2009): Subjects asked to consider a pair of '*concurrent decisions. [...]*'
  - **Decision 1**. *Choose between: A. a sure gain of £2.40 and B. a 25% chance to gain £10.00 and a 75% chance to gain £0.00.*
  - **Decision 2**. *Choose between: C. a sure loss of £7.50 and D. a 75% chance to lose £10.00 and a 25% chance to lose £0.00.*'

Classical Example Results

- Of 53 participants playing for money, 49 percent chooses A over B and 68 percent chooses D over C
- 28 percent of the subjects chooses the combination of A and D
  - This lottery is a 75% chance to lose £7.60 and a 25% chance to gain £2.40
  - Dominated by combined lottery of B and C: 75% chance to lose £7.50 and a 25% chance to gain £2.50
- Separate group of 45 subjects presented same choice in broad framing (they are shown the distribution of outcomes induced by the four options)
  - None of these subjects chooses the A and D combination

Interpretation

- Interpret this with reference-dependent utility function with narrow framing.
  - Approximately risk-neutral over gains – $>$ 49 percent choosing A over B
  - Risk-seeking over losses – $>$ 68 percent choosing D over C.
  - Key point: Individuals accept the framing induced by the experimenter and do not aggregate the lotteries
- General feature of human decisions:
  - judgments are comparative
  - changes in the framing can affect a decision if they change the nature of the comparison

- Presentation format can affect preferences even aside from reference points

- **Benartzi and Thaler (JF 2002): Impact on savings plan choices:**
  - Survey 157 UCLA employees participating in a 403(b) plan
  - Ask them to rate three plans (labelled plans A, B, and C):
    - Their own portfolio
    - Average portfolio
    - Median portfolio
  - For each portfolio, employees see the 5th, 50th, and 95th percentile of the projected retirement income from the portfolio (using Financial Engines retirement calculator)
  - Revealed preferences $\rightarrow$ expect individuals on average to prefer their own plan to the other plans

- Results:
  - Own portfolio rating (3.07)
  - Average portfolio rating (3.05)
  - Median portfolio rating (3.86)
  - 62 percent of employees give higher rating to median portfolio than to own portfolio
- Key component: Re-framing the decision in terms of ultimate outcomes affects preferences substantially

- Alternative interpretation: Employees never considered the median portfolio in their retirement savings decision $\rightarrow$ would have chosen it had it been offered
- Survey 351 participants in a different retirement plan

- These employees were explicitly offered a customized portfolio and actively opted out of it
- Rate:
  - Own portfolio
  - Average portfolio
  - Customized portfolio
- Portfolios re-framed in terms of ultimate income
- 61 percent of employees prefers customized portfolio to own portfolio
- Choice of retirement savings depends on format of the choices presented

- Open question: Why this *particular* framing effect?
- Presumably because of fees:

- Consumers put too little weight on factors that determine ultimate returns, such as fees $\rightarrow$ Unless they are shown the ultimate projected returns
- Or consumers do not appreciate the riskiness of their investments $\rightarrow$ Unless they are shown returns

- Framing also can focus attention on different aspects of the options

- **Duflo, Gale, Liebman, Orszag, and Saez (QJE 2006):** Field Experiment with H&R Block
  - Examine participation in IRAs for low- and middle-income households
  - Estimate impact of a match
- Field experiment:
  - Random sub-sample of H&R Block customers are offered one of 3 options:
    - No match
    - 20 percent match
    - 50 percent match

- Match refers to first $1,000 contributed to an IRA
  - Effect on take-up rate:
    - No match (2.9 percent)
    - 20 percent match (7.7 percent)
    - 50 percent match (14.0 percent)
- Match rates have substantial impact

- Framing aspect: Compare response to explicit match to response to a comparable match induced by tax credits in the Saver's Tax Credit program
  - Effective match rate for IRA contributions decreases from 100 percent to 25 percent at the $30,000 household income threshold
  - Compare IRA participation for
    - Households slightly below the threshold ($27,500-$30,000)
    - Households slight above the threshold ($30,000-$32,500)
  - Estimate difference-in-difference relative to households in the same income groups that are ineligible for program
  - Result: Difference in match rate lowers contributions by only 1.3 percentage points $\rightarrow$ Much smaller than in H&R Block field experiment
- Why framing difference? Simplicity of H&R Block match $\rightarrow$ Attention
- Implication: Consider behavioral factors in design of public policy

Section 8

Menu Effects: Introduction

Menu Effects

- We now consider a specific context: **Choice from Menu** N (typically, **with large** N)
  - Health insurance plans
  - Savings plans
  - Politicians on a ballot
  - Stocks or mutual funds
  - Type of Contract (Ex: no. of minutes per month for cell phones)
  - Classes
  - Charities
  - ...

Heuristics

- We explore 4 +1 (non-rational) heuristics
  1. Excess Diversification (EXTRA material)
  2. Choice Avoidance
  3. Preference for Familiar
  4. Preference for Salient
  5. Confusion

- Heuristics 1-4 deal with difficulty of choice in menu
  - Related to bounded rationality: Cannot process complex choice $\rightarrow$ Find heuristic solution
- Heuristic 5 – Random confusion in choice from menu

Section 9

Menu Effects: Choice Avoidance

Field Evidence I

- Heuristic: Refusal to choose with choice overload
- **Choice Avoidance.** Classical Experiment (**Yiengar-Lepper, JPSP 2000**)
  - Up-scale grocery store in Palo Alto
  - Randomization across time of day of number of jams displayed for taste
    - Small number: 6 jams
    - Large number: 24 jams
  - Results:
    - More consumers sample with Large no. of jams (145 vs. 104 customers)
    - *Fewer* consumers buy with Large no. of jams (4 vs. 31 customers)

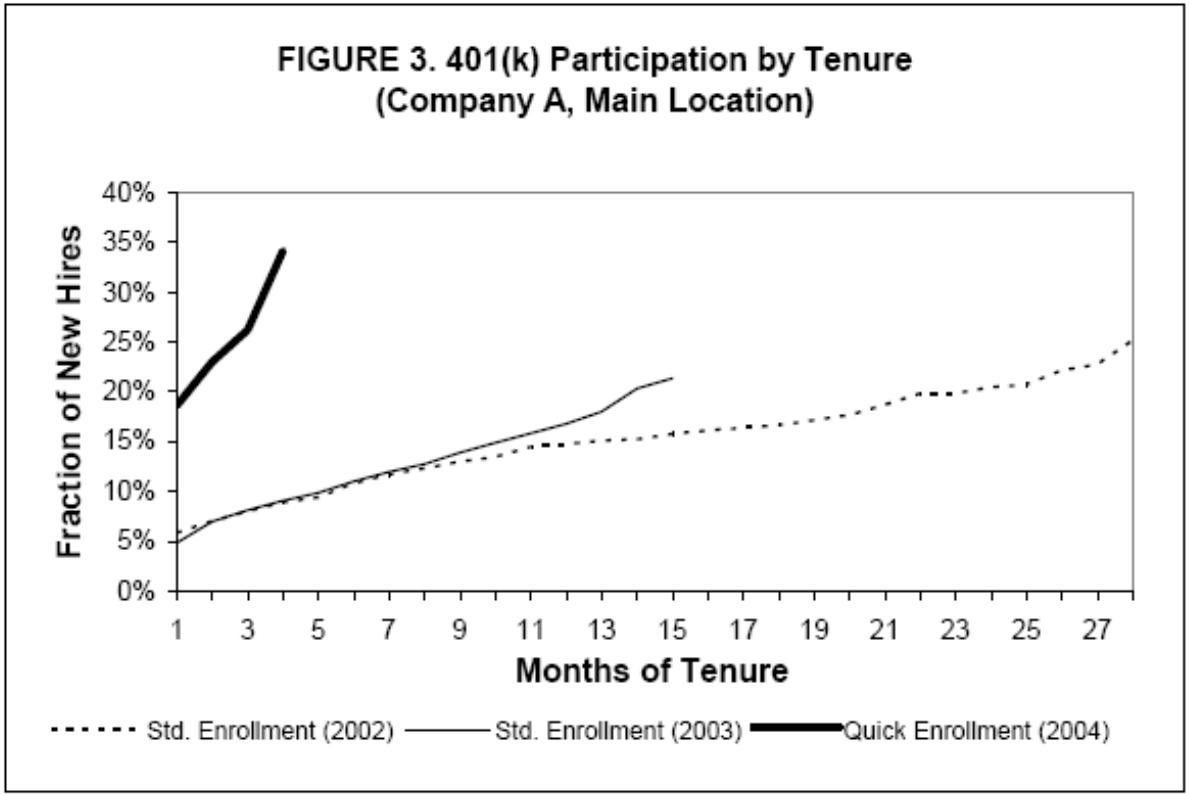
Field Evidence II

- Field evidence 2: **Choi-Laibson-Madrian (2006):** Natural experiment

- Introduce in Company A of Quick Enrollment
  - Previously: Default no savings
  - 7/2003: Quick Enrollment Card:
    - Simplified investment choice: 1 Savings Plan
    - Deadline of 2 weeks
  - In practice: Examine from 2/2004

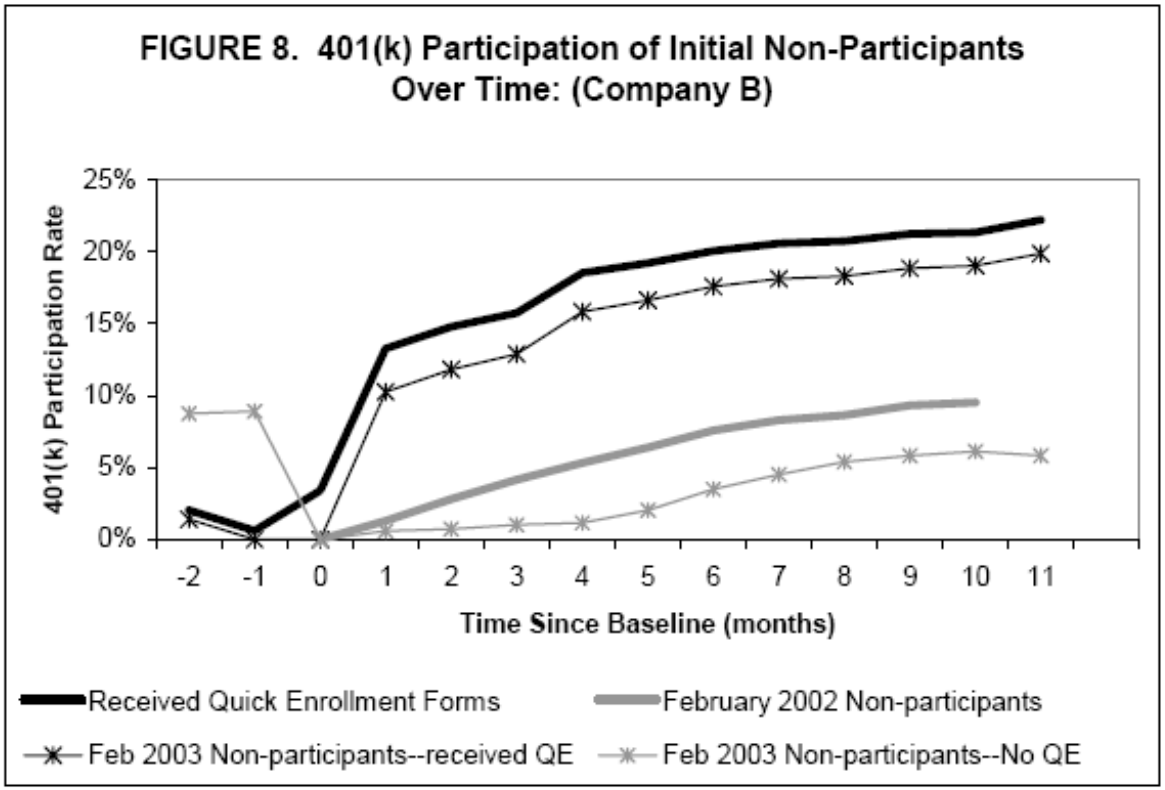
- Company B:
  - Previously: Default no savings
  - 1/2003: Quick Enrollment Card
- Notice: This affects
  - Simplicity of choice
  - But also cost of investing + deadline (self-control)

Participation: Company A



- 15 to 20 percentage point increase in participation – Large effect
- Increase in participation all on opt-in plan

Participation: Company B



- Very similar effect for Company B

Explanation

- What is the effect due to?
- Increase may be due to a reminder effect of the card
- However, in other settings, reminders are not very powerful.

- Example: Choi-Laibson-Madrian (2005):
  - Sent a survey including 5 questions on the benefits of employer match
  - Treatment group: 345 employees that were not taking advantage of the match
  - Control group: 344 employees received the same survey except for the 5 specific questions.
  - Treatment had no significant effect on the savings rate.

Field Evidence III

- Field Evidence 3: **Bertrand, Karlan, Mullainathan, Shafir, Zinman (QJE 2010)**

- Field Experiment in South Africa
  - South African lender sends 50,000 letters with offers of credit
  - Randomization of interest rate (economic variable)
  - Randomization of psychological variables
  - Crossed Randomization: Randomize independently on each of the n dimensions
    - Plus: Use most efficiently data
    - Minus: Can easily lose control of randomization

Table 2
Summary of Randomized Interventions[a]

	(1)	(2)	(3)	(4)	(5)
Sample:	**All**	**Customers who did not take up**	**Customers who took up**	**"High attention" customer**	**"Low attention" customer**
September wave	0.395	0.394	0.401	0.398	0.393
	(0.49)	(0.49)	(0.49)	(0.49)	(0.49)
October wave	0.605	0.606	0.599	0.602	0.607
	(0.49)	(0.49)	(0.49)	(0.49)	(0.49)
Offer Interest	7.929	7.985	7.233	6.970	8.384
Rate	(2.42)	(2.42)	(2.31)	(2.11)	(2.43)
Small option table	0.432	0.438	0.349	0.250	0.518
	(0.50)	(0.50)	(0.48)	(0.43)	(0.50)
No comparison to	0.200	0.200	0.200	0.202	0.199
competitor	(0.40)	(0.40)	(0.40)	(0.40)	(0.40)
comparison expressed	0.401	0.400	0.408	0.397	0.403
as a gain	(0.49)	(0.49)	(0.49)	(0.49)	(0.49)
No photo on mailing	0.202	0.202	0.206	0.198	0.204
	(0.40)	(0.40)	(0.40)	(0.40)	(0.40)
Black photo	0.477	0.477	0.476	0.488	0.472
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
Coloured photo	0.071	0.071	0.071	0.072	0.071
	(0.26)	(0.26)	(0.26)	(0.26)	(0.26)
Indian photo	0.125	0.125	0.122	0.123	0.126
	(0.33)	(0.33)	(0.33)	(0.33)	(0.33)
White photo	0.124	0.124	0.125	0.120	0.127
	(0.33)	(0.33)	(0.33)	(0.32)	(0.33)
Female photo	0.399	0.398	0.411	0.398	0.399
	(0.49)	(0.49)	(0.49)	(0.49)	(0.49)
Male photo	0.399	0.400	0.383	0.404	0.397
	(0.49)	(0.49)	(0.49)	(0.49)	(0.49)
Photo matches	0.534	0.535	0.531	0.537	0.533
customer's race?	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
Photo matches	0.401	0.402	0.388	0.403	0.400
customer's gender?	(0.49)	(0.49)	(0.49)	(0.49)	(0.49)
Promotional lottery	0.250	0.251	0.246	0.250	0.251
	(0.43)	(0.43)	(0.43)	(0.43)	(0.43)
Suggestion call	0.003	0.003	0.005	0.003	0.003
	(0.05)	(0.05)	(0.07)	(0.05)	(0.05)
Sample	53194	49250	3944	17108	36086

Manipulation of interest here

- Vary number of options of repayment presented
  - Small Table: Single Repayment option
  - Big Table 1: 4 loan sizes, 4 Repayment options, 1 interest rate
  - Big Table 2: 4 loan sizes, 4 Repayment options, 3 interest rates
  - Explicit statement that "other loan sizes and terms were available"
- Compare Small Table to other Table sizes
- Small Table increases Take-Up Rate by .603 percent
- One additional point of (monthly) interest rate decreases take-up by .258

Results

Table 3 Effect of Simplicity of Offer Description on Take-Up[a]

Dependent Variable: Take-Up Dummy **Sample:**	**All**	**High attention**	**Low attention**
	(1)	(2)	(3)
Small option table	0.603	1.146	0.407
	(0.239)	(0.674)	(0.219)
Δ interest rate equivalent	[2.337]	[3.570]	[1.887]
Interest rate	-0.258	-0.321	-0.215
	(0.049)	(0.145)	(0.044)
Risk category F.E.?	yes	yes	yes
Experimental wave F.E.?	yes	yes	yes
Sample size	53194	17108	36086

- Small-option Table increases take-up by equivalent of 2.33 pct. interest

Results

- Strong effect of behavioral factor, compared with effect of interest rate
- Effect larger for 'High-Attention' group (borrow at least twice in the past, once within 8 months)

- Authors also consider effect of a number of other psychological variables:
  - Content of photo (large effect of female photo on male take-up)
  - Promotional lottery (no effect)
  - Deadline for loan (reduces take-up)

Section 10

Menu Effects: Preference for Familiar

- Third Heuristic: Preference for items that are more familiar
- Choice of stocks by individual investors (**French-Poterba, AER 1991**)
  - Allocation in domestic equity: Investors in the USA: 94%
  - Explanation 1: US equity market is reasonably close to world equity market
    - BUT: Japan allocation: 98%
    - BUT: UK allocation: 82%
  - Explanation 2: Preference for own-country equity may be due to costs of investments in foreign assets

- Test: Examine within-country investment: **Huberman (RFS, 2001)**
  - Geographical distribution of shareholders of Regional Bell companies
  - Companies formed by separating the Bell monopoly
  - Fraction invested in the own-state Regional Bell is 82 percent higher than the fraction invested in the next Regional Bell company

- Third, extreme case: Preference for own-company stock
  - On average, employees invest 20-30 percent of their discretionary funds in employer stocks (**Benartzi JF, 2001**)

Panel C: Company Stock Allocation as a Percentage of the Employee Contributions			
Number of plans	78	58	136
Mean: equally weighted	18	29	23
Mean: weighted by employee contributions	21	33	24
Mean: weighted by the number of active participants	21	31	24

  - Notice: This occurs despite the fact that the employees' human capital is already invested in their company
  - Also: This choice does not reflect private information about future performance
  - Companies where a higher proportion of employees invest in employer stock have lower subsequent one-year returns, compared to companies with a lower proportion of employee investment

	Allocation to Company Stock					Observed Difference
	(Low) 1	2	3	4	5 (High)	(5 − 1)
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
Two-year returns	43.69	40.78	38.24	43.33	31.92	−11.77

- Possible Explanation? Ambiguity aversion
  - **Ellsberg (1961)** paradox:
  - Investors that are ambiguity-averse prefer:
    - Investment with known distribution of returns
    - To investment with unknown distribution
  - This occurs even if the average returns are the same for the two investments, and despite the benefits of diversification.

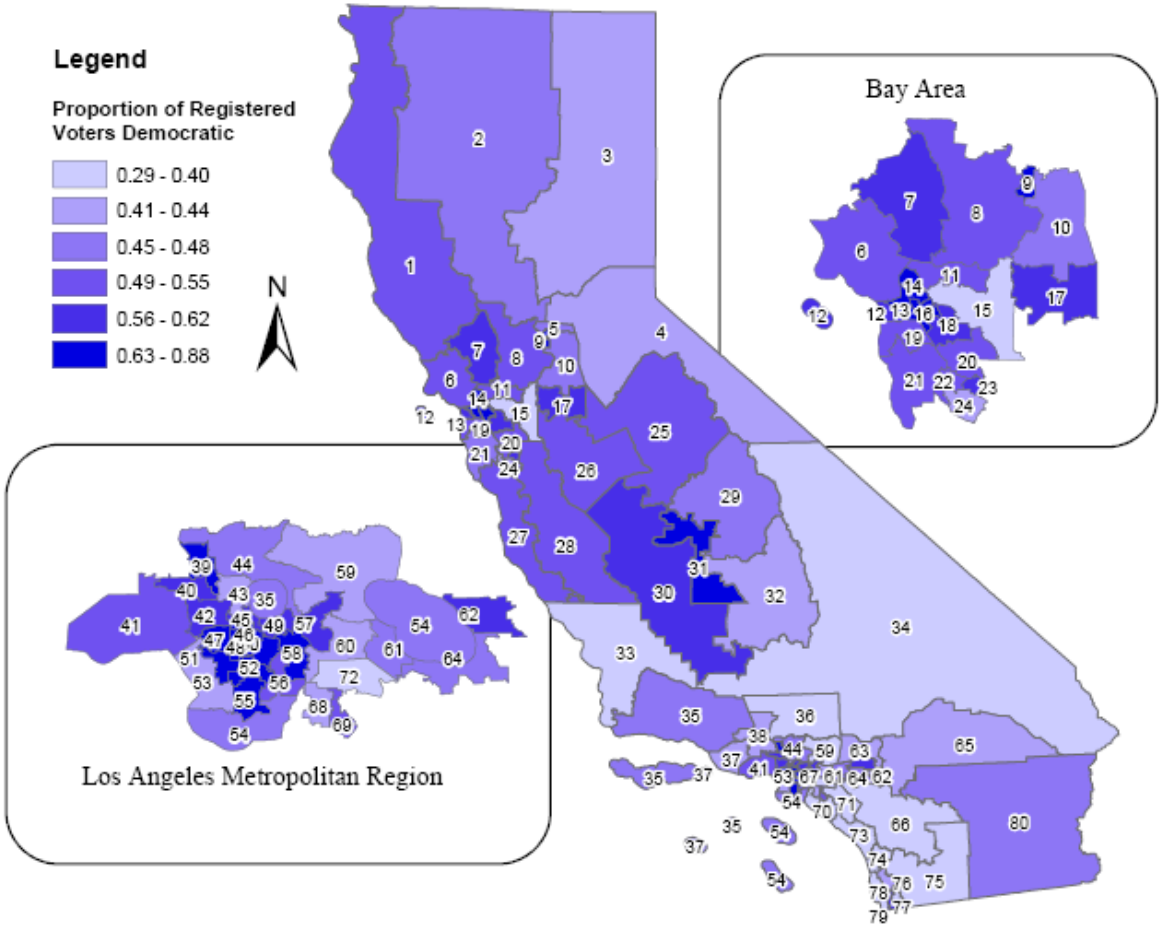
Section 11

Menu Effects: Preference for Salient

- What happens with large set of options if decision-maker uninformed?
- Possibly use of irrelevant, but salient, information to choose

- **Ho-Imai (2004).** Order of candidates on a ballot
  - Exploit randomization of ballot order in California
  - Years: 1978-2002, Data: 80 Assembly Districts
- Notice: Similar studies go back to **Bain-Hecock** (1957)

- Areas of randomization



- Use of randomized alphabet to determine first candidate on ballot

Year	Election	Randomized Alphabet																								
1982	Primary	S	C	X	D	Q	G	W	R	V	Y	U	A	N	H	L	P	B	K	J	I	E	T	O	M	F	Z
	General	L	S	N	D	X	A	M	W	V	T	O	F	I	B	K	Y	U	P	E	Q	C	J	Z	H	R	G
1983	Consolidated	L	C	P	K	I	A	U	G	Z	O	N	B	X	D	W	H	E	M	F	V	R	S	T	Y	Q	J
1984	Primary	W	M	F	B	Q	Y	T	D	J	U	O	V	I	K	R	H	S	N	P	C	A	E	L	Z	G	X
	General	V	W	I	H	R	Q	G	J	O	M	T	S	Y	C	A	F	U	X	K	B	P	E	Z	N	D	L
1986	General	Q	N	H	U	B	J	E	G	M	V	L	W	X	C	K	O	F	D	Z	R	Y	I	T	S	P	A
1988	Primary	W	O	K	N	Q	A	V	T	H	J	F	Z	L	B	U	D	Y	M	I	R	G	C	E	S	X	P
	General	S	W	F	M	K	J	U	Y	A	T	V	G	O	N	Q	B	D	E	P	L	Z	C	I	X	R	H
1990	Primary	E	J	B	Y	Q	F	K	M	O	V	X	L	N	Z	C	W	A	P	R	D	G	T	H	I	S	U
	General	W	F	C	L	D	I	N	J	H	V	K	O	S	A	R	E	Q	B	T	M	Y	U	G	Z	X	P
1992	Primary	U	R	F	A	J	C	D	N	M	K	P	Z	Y	X	G	W	O	H	E	B	I	S	V	L	Q	T
	General	F	Y	U	A	J	S	B	Z	G	O	E	Q	R	L	I	M	H	V	N	T	P	D	K	X	C	W
1994	Primary	K	J	H	G	A	M	I	Q	U	N	C	Z	S	W	V	R	P	Y	B	L	O	T	D	F	E	X
	General	V	I	A	E	M	S	O	K	L	B	G	N	W	Y	D	P	U	F	Z	Q	J	X	C	R	H	T
1996	Primary	G	E	F	C	Y	P	D	B	Z	I	V	A	U	S	M	L	H	K	N	T	O	J	Q	R	X	W
	General	J	Y	E	P	A	U	S	Q	B	H	T	R	K	N	L	X	F	D	O	G	M	W	I	Z	C	V
1998	Primary	L	W	U	J	X	K	C	N	D	O	Q	A	P	T	Z	R	Y	F	E	V	B	H	G	I	M	S
	General	W	K	D	N	V	A	G	P	Y	C	Z	I	S	T	L	J	X	Q	O	F	H	R	B	U	M	E
2000	Primary	O	P	C	Y	I	H	X	Z	V	R	S	Q	E	K	L	G	D	W	J	U	T	M	B	F	A	N
	General	I	T	F	G	J	S	W	R	N	M	K	U	Y	L	D	C	Q	A	H	X	O	E	B	V	P	Z
2002	Primary	W	I	Z	C	O	M	A	Q	U	K	X	E	B	Y	N	P	T	R	L	V	S	J	H	D	F	G
	General	H	M	V	P	E	B	Q	U	G	N	D	K	X	Z	J	A	W	Y	C	O	S	F	I	T	R	L
2003	Recall	R	W	Q	O	J	M	V	A	H	B	S	G	Z	X	N	T	C	I	E	K	U	P	D	Y	F	L

Table 1: Randomized Alphabets Used for the California Statewide Elections Since 1982.

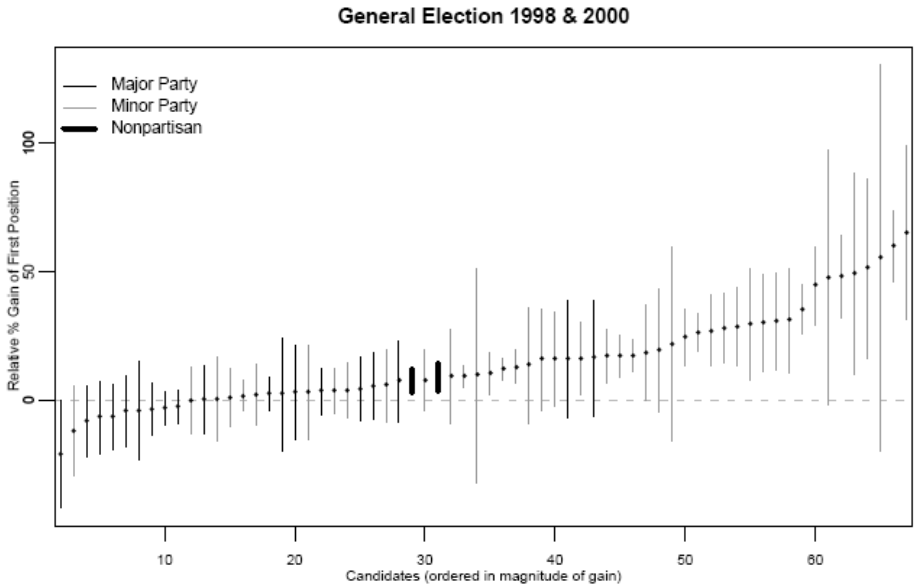
- Observe each candidate in different orders in different districts
- Compute absolute vote (Y) gain

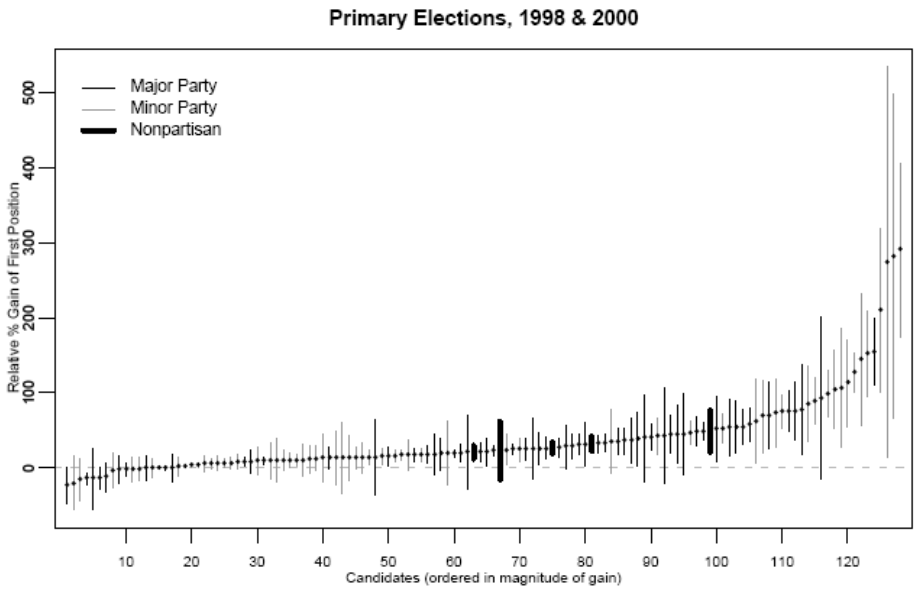
$$E\left[Y\left(i=1\right)-Y\left(i\neq 1\right)\right]$$

and percentage vote gain

$$E\left[Y\left(i=1\right)-Y\left(i\neq 1\right)\right]/E\left[Y\left(i\neq 1\right)\right]$$

- Result:
  - Small to no effect for major candidates
  - Large effects on minor candidates


General Election 1998 & 2000
Major Party
Minor Party
Nonpartisan
Relative % Gain of First Position
0
50
100
10
20
30
40
50
60
Candidates (ordered in magnitude of gain)


Primary Elections, 1998 & 2000
Major Party
Minor Party
Nonpartisan
Relative % Gain of First Position
0
100
200
300
400
500
10
20
30
40
50
60
70
80
90
100
110
120
Candidates (ordered in magnitude of gain)

	General				Primary			
	Absolute		Relative		Absolute		Relative	
	ATE	SE	ATE	SE	ATE	SE	ATE	SE
Democratic	0.05	0.46	0.25	0.90	1.89	0.32	43.58	5.53
Republican	-0.06	0.53	-0.43	1.29	2.16	0.46	33.62	5.91
American Independent	0.16	0.02	20.83	1.39	2.33	0.15	26.76	3.55
Green	0.56	0.17	21.18	5.82	3.15	1.16	6.24	3.54
Libertarian	0.23	0.02	14.56	1.03	6.59	1.42	71.92	13.55
Natural Law	0.31	0.06	26.13	2.85	0.40	0.08	44.78	5.45
Peace and Freedom	0.28	0.03	25.49	2.15	6.31	0.53	14.75	1.43
Reform	0.26	0.07	19.57	2.23	4.11	1.56	48.45	9.66
Nonpartisan	1.95	0.30	9.21	3.31	3.44	0.78	19.42	4.05

Table 3: Party-Specific Average Causal Effects of Being Listed in First Position on Ballots Using All Races from 1978 to 2002. ATE and SE represent the average causal effects and their standard errors, respectively. For general and primary elections, the left two columns present the estimates of average absolute gains in terms of the total or party vote, respectively, while the right two columns show those of average relative gains. Each candidate-specific effect is averaged over different races to obtain the overall average effect for each party. In general elections, only minor party and nonpartisan candidates are affected by the ballot order. In primaries, however, the candidates of all parties are affected. The largest effects are found for nonpartisan candidates.

Investors with Limited Attention

- **Barber-Odean (2008).** Investor with limited attention
  - Stocks in portfolio: Monitor continuously
  - Other stocks: Monitor extreme deviations (*salience*)
- Which stocks to purchase? High-attention (salient) stocks. On days of high attention, stocks have
  - Demand increase
  - No supply increase
  - Increase in net demand

Heterogeneity

- Heterogeneity:
  - Small investors with limited attention attracted to salient stocks
  - Institutional investors less prone to limited attention
- Market interaction: Small investors are:
  - Net buyers of high-attention stocks
  - Net sellers of low-attention stocks.

- Measure of net buying is Buy-Sell Imbalance:

$$BSI_t = 100 * \frac{\sum_i NetB\ uy\ _{i,t} - \sum_i NetSell_{i,t}}{\sum_i NetB\ uy\ _{i,t} + \sum_i NetSell_{i,t}}$$

Data and Methodology

- Notice: Unlike in most financial data sets, here use of individual trading data
- In fact: No obvious prediction on prices

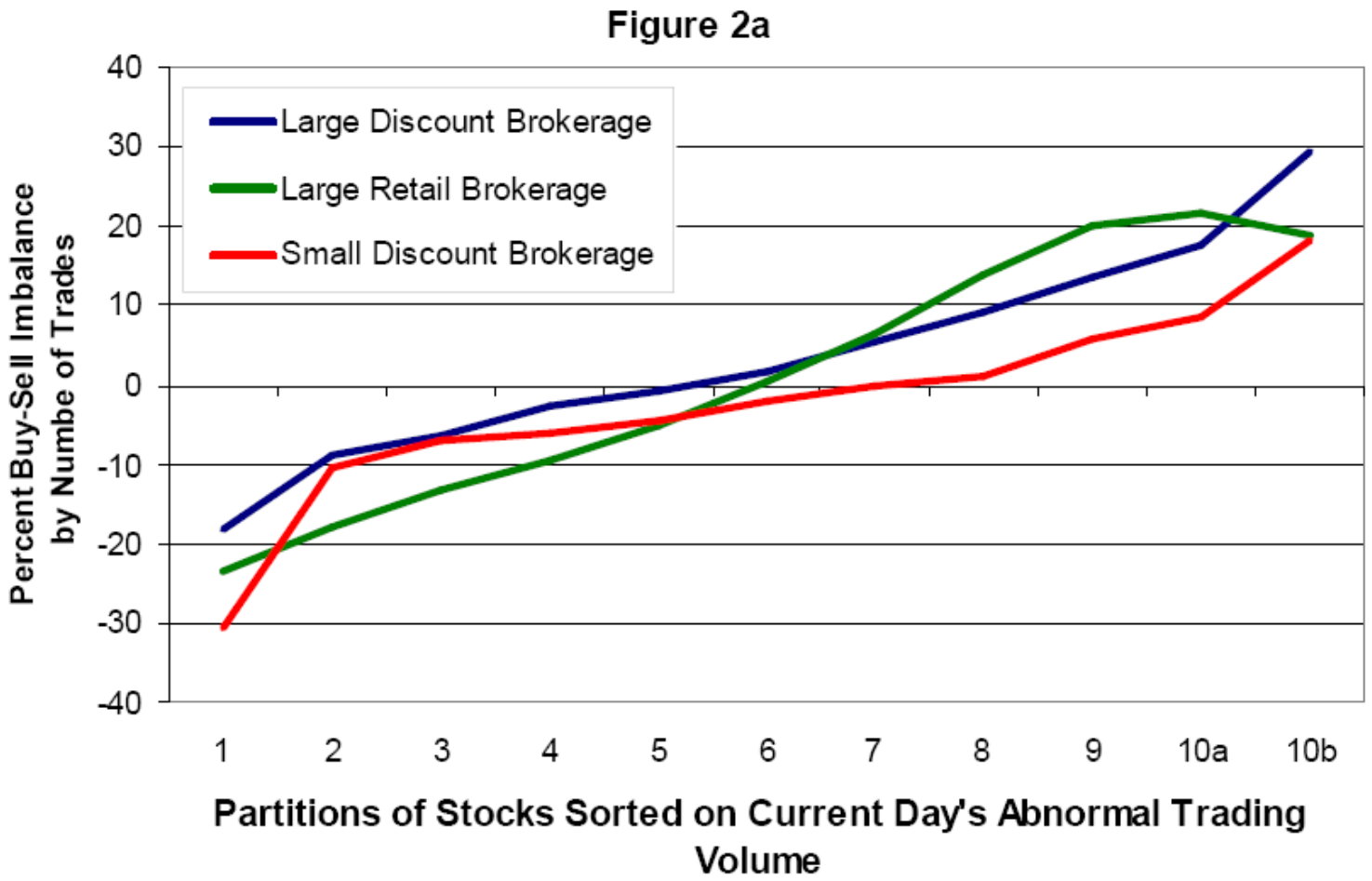
- Measures of attention:
  - same-day (abnormal) volume V_t
  - previous-day return r_{t-1}
  - stock in the news (Using Dow Jones news service)

Methodology: Bins

- Use of sorting methodology
  - Sort variable (V_t, r_{t-1}) and separate into equal-sized bins (in this case, deciles)
    - Example: $V_t^1, V_t^2, V_t^3, \ldots, V_t^{10a}, V_t^{10b}$
    - (Finer sorting at the top to capture top 5 percent)
  - Classical approach in finance
  - Benefit: Measures variables in a non-parametric way
  - Cost: Loses some information and magnitude of variable

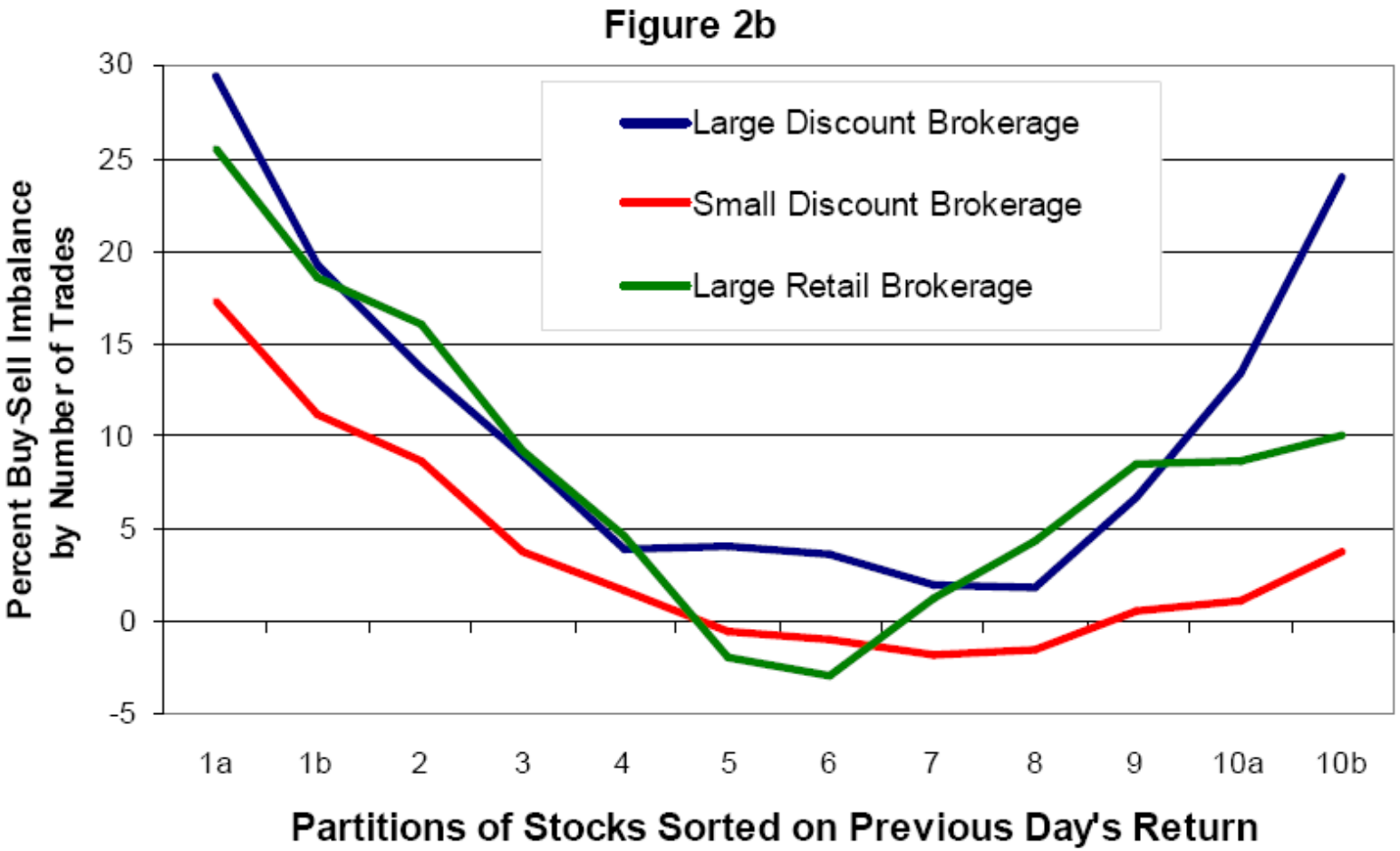
Results: Abnormal Volume

- Effect of same-day (abnormal) volume V_t monotonic (Volume captures 'attention')



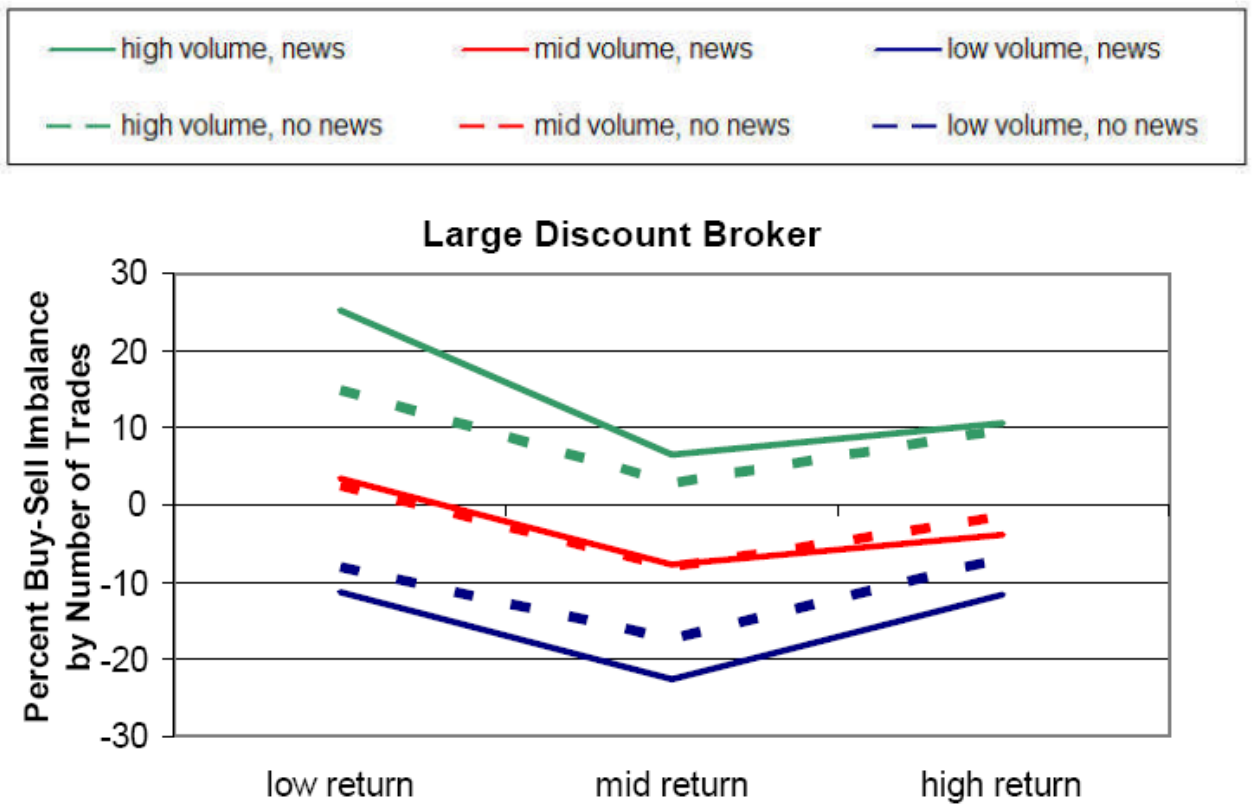
Results: Previous Returns

- Effect of previous-day return r_{t-1} U-shaped
  (Large returns—positive or negative—attract attention)



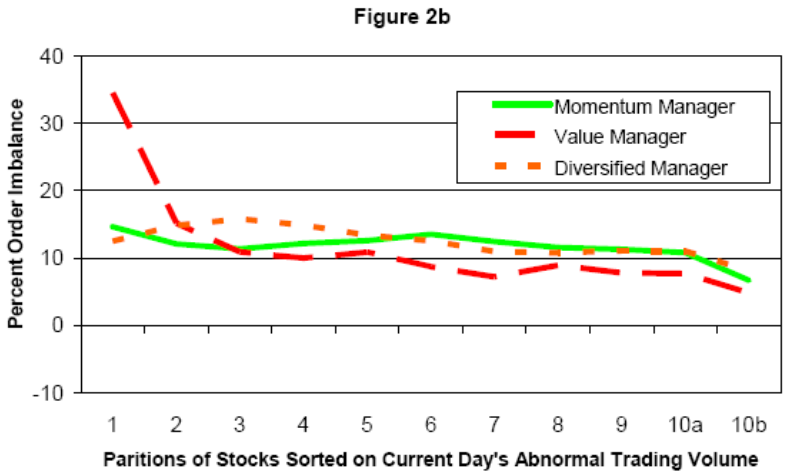
Results: Robustness

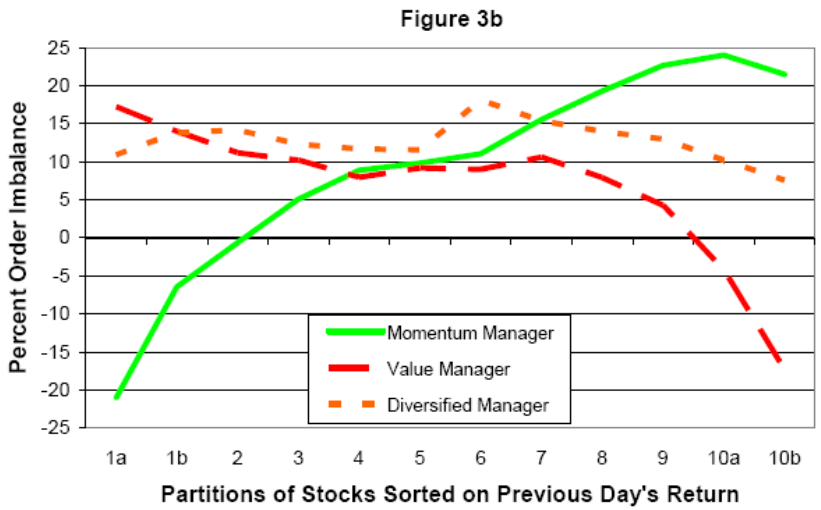
- Notice: Pattern is consistent across different data sets of investor trading
- Figures 2a and 2b a



Comparison

- Patterns are the opposite for institutional investors (Fund managers)





Alternative interpretations of results

- Small investors own few stocks, face short-selling constraints
- (To sell a stock you do not own you need to borrow it first, then you sell it, and then you need to buy it back at end of lending period)
- If new information about the stock:
  - buy if positive news
  - do nothing otherwise
- If no new information about the stock:
  - no trade
- Large investors are not constrained

Test

- Study pattern for stocks that investors already own

Panel A: Buy-sell imbalance for Stocks Already Owned Sorted on Current Day's Abnormal Trading Volume.

	Large Discount Brokerage		Large Retail Brokerage		Small Discount Brokerage	
Decile	Number Imbalance	Value Imbalance	Number Imbalance	Value Imbalance	Number Imbalance	Value Imbalance
1 (lowest volume)	-54.22	-55.64	-28.74	-33.99	-24.25	-33.22
	(1.43)	(1.89)	(1.42)	(1.84)	(6.28)	(7.58)
2	-51.13	-53.20	-29.46	-34.09	-33.80	-29.67
	(0.78)	(1.07)	(1.09)	(1.36)	(3.18)	(4.47)
3	-48.27	-49.69	-29.54	-31.25	-31.76	-30.05
	(0.64)	(0.95)	(1.04)	(1.31)	(1.71)	(2.44)
4	-47.19	-49.51	-28.69	-32.96	-35.65	-33.93
	(0.56)	(0.88)	(0.94)	(1.11)	(1.26)	(1.96)
5	-45.95	-47.59	-26.71	-31.04	-32.34	-30.01
	(0.53)	(0.81)	(0.90)	(1.07)	(1.12)	(1.63)
6	-45.01	-48.65	-24.32	-29.71	-30.00	-26.50
	(0.49)	(0.71)	(0.90)	(1.04)	(0.97)	(1.42)
7	-42.36	-45.85	-21.83	-30.29	-29.85	-26.21
	(0.50)	(0.71)	(0.84)	(0.89)	(0.95)	(1.33)
8	-39.43	-43.75	-18.72	-27.21	-28.20	-26.23
	(0.51)	(0.71)	(0.81)	(0.87)	(0.87)	(1.22)
9	-35.64	-40.68	-15.45	-21.79	-27.07	-24.99
	(0.52)	(0.70)	(0.78)	(0.91)	(0.85)	(1.21)
10a	-33.03	-39.31	-12.27	-19.97	-26.81	-27.99
	(0.63)	(0.85)	(0.97)	(1.12)	(1.06)	(1.42)
10b (highest volume)	-24.97	-32.82	-15.01	-20.04	-17.32	-19.38
	(0.69)	(0.92)	(1.04)	(1.19)	(0.98)	(1.42)

Section 12

Next Lecture

Next Lecture

- Menu Effects:
  - Confusion
- Persuasion
- Emotions: Mood