Outline

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

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

• Formalize intuition.
  – Seller chooses price $P$ at sale
  – Higher Price $P$
    * lowers probability of sale $p(P)$ (hence $p'(P) < 0$)
    * increases utility of sale $U(P)$
  – If no sale, utility is $\bar{U} < U(P)$ (for all relevant $P$)
• Maximization problem:

\[ \max_P p(P)U(P) + (1 - p(P))\bar{U} \]

• F.o.c. implies

\[ MG = p(P^*)U'(P^*) = -p'(P^*)(U(P^*) - \bar{U}) = MC \]

• Interpretation: Marginal Gain of increasing price equals Marginal Cost

• S.o.c are

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

• Need \( p''(P^*)(U(P^*) - \bar{U}) < 0 \) or not too positive
• Reference-dependent preferences with reference price $P_0$:

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

– Can write as

$$p(P) = -p'(P)(P - P_0 - \bar{U}) \text{ if } P \geq P_0$$

$$p(P)\lambda = -p'(P)(\lambda(P - P_0) - \bar{U}) \text{ if } P < P_0$$

– Plot Effect on MG and MC of loss aversion

• Compare $P_{\lambda=1}^*$ (equilibrium with no loss aversion) and $P_{\lambda>1}^*$ (equilibrium with loss aversion)
• Case 1. Loss Aversion $\lambda$ increase price ($P_{\lambda=1}^* < P_0$)

• Case 2. Loss Aversion $\lambda$ induces bunching at $P = P_0$ ($P_{\lambda=1}^* < P_0$)
• Case 3. Loss Aversion has no effect \((P_{\lambda=1}^* > P_0)\)

• General predictions. When aggregate prices are low:
  – High prices \(P\) relative to fundamentals
  – Bunching at purchase price \(P_0\)
  – Lower probability of sale \(p(P)\)
  – Longer waiting on market
- Evidence: Data on Boston Condominiums, 1990-1997

- Substantial market fluctuations of price
• Observe:
  
  – Listing price \( L_{i,t} \) and last purchase price \( P_0 \)
  
  – Observed Characteristics of property \( X_i \)
  
  – Time Trend of prices \( \delta_t \)

• Define:
  
  – \( \hat{P}_{i,t} \) is market value of property \( i \) at time \( t \)

• Ideal Specification:

\[
L_{i,t} = \hat{P}_{i,t} + m \mathbf{1}_{\hat{P}_{i,t} < P_0} \left( P_0 - \hat{P}_{i,t} \right) + \varepsilon_{i,t} = \beta X_i + \delta_t + v_i + m Loss^* + \varepsilon_{i,t}
\]
• However:
  – Do not observe \( \hat{P}_{i,t} \), given \( v_i \) (unobserved quality)
  – Hence do not observe \( \text{Loss}^* \)

• Two estimation strategies to bound estimates. *Model 1*:

\[
L_{i,t} = \beta X_i + \delta_t + m \mathbf{1}_{\hat{P}_{i,t} < P_0} (P_0 - \beta X_i - \delta_t) + \varepsilon_{i,t}
\]

  – This model overstate the loss for high unobservable homes (high \( v_i \))
  – Bias upwards in \( \hat{m} \), since high unobservable homes should have high \( L_{i,i} \)

• *Model 2*:

\[
L_{i,t} = \beta X_i + \delta_t + \alpha (P_0 - \beta X_i - \delta_t) + m \mathbf{1}_{\hat{P}_{i,t} < P_0} (P_0 - \beta X_i - \delta_t) + \varepsilon_{i,t}
\]

• Estimates of impact on sale price
TABLE II
LOSS AVERSION AND LIST PRICES
DEPENDENT VARIABLE: LOG (ORIGINAL ASKING PRICE),
OLS equations, standard errors are in parentheses.

<table>
<thead>
<tr>
<th>Variable</th>
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</table>
- Effect of experience: Larger effect for owner-occupied

| TABLE IV |
|-------------------------------|--------|--------|--------|--------|
| LOSS AVERSION AND LIST PRICES: OWNER-OCCUPIANTS VERSUS INVESTORS |        |        |        |        |
| Dependent variable: LOG (ORIGINAL ASKING PRICE) |        |        |        |        |
| OLS equations, standard errors are in parentheses. |        |        |        |        |

<table>
<thead>
<tr>
<th>Variable</th>
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<td>listings</td>
<td>listings</td>
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<td>LOSS × owner-occupant</td>
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<td>0.42</td>
<td>0.66</td>
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<td>LOSS × investor</td>
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<td>LOSS-squared × owner-occupant</td>
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<td>−0.17</td>
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<tr>
<td>LTV × owner-occupant</td>
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<td>0.01</td>
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<td>LTV × investor</td>
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<td>(0.014)</td>
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<td>1.09</td>
<td>1.09</td>
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<tr>
<td></td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
<td>(0.01)</td>
</tr>
<tr>
<td>Estimated price index at quarter of entry</td>
<td>0.84</td>
<td>0.80</td>
<td>0.86</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.04)</td>
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<td>(0.04)</td>
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<tr>
<td>Residual from last sale price</td>
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<tr>
<td></td>
<td>(0.02)</td>
<td>(0.02)</td>
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</table>
• Some effect also on final transaction price

| TABLE VI |
|-----------------|-----------------|-----------------|
| LOSS AVersion AND TRANSACTION PRICES | DEPENDENT VARIABLE: Log (TRANSACTION PRICE) |
| NLLS equations, standard errors are in parentheses. | |
| Variable | (1) All listings | (2) All listings |
| LOSS | 0.18 | 0.03 |
| | (0.03) | (0.08) |
| LTV | 0.07 | 0.06 |
| | (0.02) | (0.01) |
| Residual from last sale | | 0.16 |
| | | (0.02) |
| Months since last sale | −0.0001 | −0.0004 |
| | (0.0001) | (0.0001) |
| Dummy variables for quarter of entry | Yes | Yes |
| Number of observations | 3413 | 3413 |
- Lowers the exit rate (lengthens time on the market)

<table>
<thead>
<tr>
<th>TABLE VII</th>
</tr>
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<td>HAZARD RATE OF SALE</td>
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<tr>
<td>Duration variable is the number of weeks the property is listed on the market. Cox proportional hazard equations, standard errors are in parentheses.</td>
</tr>
<tr>
<td>Variable</td>
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<tr>
<td>---</td>
</tr>
<tr>
<td>All listings</td>
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<tr>
<td>LOSS</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>LOSS-squared</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>LTV</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Estimated value in 1990</td>
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<tr>
<td></td>
</tr>
<tr>
<td>Residual from last sale</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

- Overall, plausible set of results that show impact of reference point
  - Would have been nice to tie better to model
2 Reference Dependence: Mergers

- On the appearance, very different set-up:
  - Firm A (Acquirer)
  - Firm T (Target)

- After negotiation, Firm A announces a price $P$ for merger with Firm T
  - Price $P$ typically at a 20-50 percent premium over current price
  - About 70 percent of mergers go through at price proposed
  - Comparison price for $P$ often used is highest price in previous 52 weeks, $P_{52}$
  - Example of how Cablevision (Target) trumpets deal
Figure 1. Slide from Cablevision Presentation to Shareholders, October 24, 2007. The management of Cablevision recommended acceptance of a $36.26 per share cash bid from the Dolan family. The slide compares this bid price to various recent prices including 52-week highs.

Valuation Achieved

Market Premia

- 179% higher than the lowest price during the 52-week period ended October 6, 2006
- 49% higher than the 52-week high during the period ended October 6, 2006
- 30% higher than the average closing price for 150 days prior to the $36.26 May 2007 offer
- 10% higher than the 5-year and 52-week high prior to May 2, 2007

Proposal

- Average close for 150 days prior to May 2, 2007
- April 23, 2007

$36.26

$32.86

$27.90

$24.26

$13.00

December 27, 2005

September 15, 2006

- Adjusted to reflect payment of $10/share special dividend.
• Assume that Firm T chooses price $P$, and A decides accept reject

• As a function of price $P$, probability $p(P)$ that deal is accepted (depends on perception of values of synergy of A)

• If deal rejected, go back to outside value $\bar{U}$

• Then maximization problem is same as for housing sale:

$$\max_P p(P)U(P) + (1 - p(P))\bar{U}$$

• Can assume T reference-dependent with respect to

$$v(P|P_0) = \begin{cases} 
  P - P_{52} & \text{if } P \geq P_{52}; \\
  \lambda (P - P_{52}) & \text{if } P < P_{52},
\end{cases}$$
• Obtain same predictions as in housing market

• (This neglects possible reference dependence of A)

• Baker, Pan, and Wurgler (2009): Test reference dependence in mergers
  
  – Test 1: Is there bunching around $P_{52}$? (GM did not do this)
  
  – Test 2: Is there effect of $P_{52}$ on price offered?
  
  – Test 3: Is there effect on probability of acceptance?
  
  – Test 4: What do investors think? Use returns at announcement
• Test 1: Offer price \( P \) around \( P_{52} \)
  
  – Some bunching, missing left tail of distribution
• Notice that this does not tell us how the missing left tail occurs:

  – Firms in left tail raise price to $P_{52}$?

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

  – Preliminary negotiations break down for firms in left tail

• Would be useful to compare characteristics of firms to right and left of
  $P_{52}$
• Test 2: Kernel regression of $P_{52}$ on price offered $P$ (Renormalized by price 30 days before, $P_{-30}$, to avoid heterosked.): 

$$\frac{P}{P_{-30}} = \alpha + \beta \frac{P_{52}}{P_{-30}} + \epsilon$$
• Test 3: Probability of final acquisition is higher when offer price is above $P_{52}$ (Skip)

• Test 4: What do investors think of the effect of $P_{52}$?
  
  – Holding constant current price, investors should think that the higher $P_{52}$, the more expensive the Target is to acquire
  
  – Standard methodology to examine this:
    * 3-day stock returns around merger announcement: $CAR_{t-1,t+1}$
    * This assumes investor rationality
    * Notice that merger announcements are typically kept top secret until last minute $\rightarrow$ On announcement day, often big impact
• Regression (Columns 3 and 5):

\[ CAR_{t-1,t+1} = \alpha + \beta \frac{P}{P_{-30}} + \varepsilon \]

where \( P/P_{-30} \) is instrumented with \( P_{52}/P_{-30} \)

<table>
<thead>
<tr>
<th>Offer Premium:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<tbody>
<tr>
<td>( b )</td>
<td>-0.0186***</td>
<td>-0.0204***</td>
<td>-0.215***</td>
<td>-0.0443***</td>
<td>-0.253***</td>
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<tr>
<td></td>
<td>(-2.64)</td>
<td>(-2.74)</td>
<td>(-3.48)</td>
<td>(-4.21)</td>
<td>(-4.39)</td>
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</table>

• Results very supportive of reference dependence hypothesis – Also alternative anchoring story
3 Reference Dependence: Insurance

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

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

- Field evidence on risk taking?

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

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

- Slides courtesy of Justin Sydnor
Dataset

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

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

<table>
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<th>Variable</th>
<th>Full Sample</th>
<th>Chosen Deductible</th>
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<tr>
<td>Insured home value</td>
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<td>266,461 (127,773)</td>
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<td>Number of years insured by the company</td>
<td>8.4 (7.1)</td>
<td>5.1 (5.6)</td>
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<td>Average age of H.H. members</td>
<td>53.7 (15.8)</td>
<td>50.1 (14.5)</td>
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<td>49,992</td>
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<td>Percent of sample</td>
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<td>17.05%</td>
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</table>

* Means with standard errors in parentheses.
Deductible Pricing

- $X_i =$ matrix of policy characteristics
- $f(X_i) =$ “base premium”
  - Approx. linear in home value
- Premium for deductible $D$
  - $P^D_i = \delta_D f(X_i)$
- Premium differences
  - $\Delta P_i = \Delta \delta f(X_i)$
- $\Rightarrow$ Premium differences depend on base premiums (insured home value).
## Premium-Deductible Menu

### Available Deductible

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<td>(61.09)</td>
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### Risk Neutral Claim Rates?

- \( \frac{100}{500} = 20\% \)
- \( \frac{87}{250} = 35\% \)
- \( \frac{133}{150} = 89\% \)

* Means with standard deviations in parentheses
The curves in the upper graphs are fan locally-weighted kernel regressions using a quartic kernel. The dashed lines give 95% confidence intervals calculated using a bootstrap procedure with 200 repetitions.

The range for additional premium covers 98% of the available data.

The graph in the upper left gives the fraction that chose either the $250 or $500 deductibles versus the additional premium an individual faced to move from a $1000 to the $500 deductible. The graph in the upper right represents the average expected savings from switching to the $1000 deductible for customers facing a given premium difference. The potential savings is calculated at the individual level and then the kernel regressions are run. Because they filed no claims, for most customers this measure is simply the premium reductions they would have seen with the $1000 deductible. For the roughly 4% of customers who filed claims the potential savings is typically negative.

What if the x-axis were insured home value?
The graph in the upper left gives the fraction that chose either the $250 or $500 deductibles as a function of the insured home value. The graph in the upper right represents the average expected savings from switching to the $1000 deductible for customers who chose one of the lower deductibles. The potential savings is calculated at the individual level and then the kernel regressions are run. Because they filed no claims, for most customers this measure is simply the premium reductions they would have seen with the $1000 deductible. For the roughly 4% of customers who filed claims the potential savings is typically negative.

The curves in the upper graphs are fitted locally-weighted kernel regressions using a quartic kernel. The dashed lines give 95% confidence intervals calculated using a bootstrap procedure with 200 repetitions.

The range for insured home value covers 99% of the available data.
**Potential Savings with 1000 Ded**

<table>
<thead>
<tr>
<th>Chosen Deductible</th>
<th>Number of claims per policy</th>
<th>Increase in out-of-pocket payments per claim with a $1000 deductible</th>
<th>Increase in out-of-pocket payments per policy with a $1000 deductible</th>
<th>Reduction in yearly premium per policy with $1000 deductible</th>
<th>Savings per policy with $1000 deductible</th>
</tr>
</thead>
<tbody>
<tr>
<td>$500</td>
<td>0.043 (0.0014)</td>
<td>469.86 (2.91)</td>
<td>19.93 (0.67)</td>
<td>99.85 (0.26)</td>
<td>79.93 (0.71)</td>
</tr>
<tr>
<td>N=23,782 (47.6%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$250</td>
<td>0.049 (0.0018)</td>
<td>651.61 (6.59)</td>
<td>31.98 (1.20)</td>
<td>158.93 (0.45)</td>
<td>126.95 (1.28)</td>
</tr>
<tr>
<td>N=17,536 (35.1%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Means with standard errors in parentheses*

**Average forgone expected savings for all low-deductible customers**: $99.88
Back of the Envelope

- BOE 1: Buy house at 30, retire at 65, 3% interest rate ⇒ $6,300 expected
  - With 5% Poisson claim rate, only 0.06% chance of losing money

- BOE 2: (Very partial equilibrium) 80% of 60 million homeowners could expect to save $100 a year with “high” deductibles ⇒ $4.8 billion per year
Consumer Inertia?

Percent of Customers Holding each Deductible Level

Number of Years Insured with Company

Legend:
- □ 1000
- ■ 500
- □ 250
- ◼ 100

0-3 3-7 7-11 11-15 15+
Chosen Deductible | Number of claims per policy | Increase in out-of-pocket payments per claim with a $1000 deductible | Increase in out-of-pocket payments per policy with a $1000 deductible | Reduction in yearly premium per policy with $1000 deductible | Savings per policy with $1000 deductible
--- | --- | --- | --- | --- | ---
$500 | 0.037 | 475.05 | 17.16 | 94.53 | 77.37
N = 3,424 (54.6%) | (.0035) | (7.96) | (1.66) | (0.55) | (1.74)
$250 | 0.057 | 641.20 | 35.68 | 154.90 | 119.21
N = 367 (5.9%) | (.0127) | (43.78) | (8.05) | (2.73) | (8.43)

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

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

Chetty (2005)

- Consumption maximization:

$$\max_{c_t} U(c_1, c_2, \ldots, c_T),$$

s.t. $$c_1 + c_2 + \ldots + c_T = y_1 + y_2 + \ldots y_T.$$

- (Indirect) utility of wealth maximization

$$\max_w u(w),$$

where $$u(w) = \max_{c_t} U(c_1, c_2, \ldots, c_T),$$

s.t. $$c_1 + c_2 + \ldots + c_T = y_1 + y_2 + \ldots + y_T = w$$

$$\Rightarrow w$$ is lifetime wealth
Model of Deductible Choice

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

Assume CRRA form for $u$:

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

Indifferent between contracts iff:

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

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

<table>
<thead>
<tr>
<th>Chosen Deductible</th>
<th>Measure of Lifetime Wealth (W): (Insured Home Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>W</td>
</tr>
<tr>
<td>$1,000$</td>
<td>256,900</td>
</tr>
<tr>
<td></td>
<td>N = 2,474 (39.5%)</td>
</tr>
<tr>
<td>$500$</td>
<td>190,317</td>
</tr>
<tr>
<td></td>
<td>N = 3,424 (54.6%)</td>
</tr>
<tr>
<td>$250$</td>
<td>166,007</td>
</tr>
<tr>
<td></td>
<td>N = 367 (5.9%)</td>
</tr>
</tbody>
</table>
Interpreting Magnitude

- 50-50 gamble:
  Lose $1,000/ Gain $10 million
  - 99.8% of low-ded customers would reject

- Labor-supply calibrations, consumption-savings behavior $\Rightarrow \rho < 10$
  - Gourinchas and Parker (2002) -- 0.5 to 1.4
  - Chetty (2005) -- $< 2$
Wrong level of wealth?

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

- Kahneman & Tversky (1979, 1992)
- Reference dependence
  - Not final wealth states
- Value function
  - Loss Aversion
  - Concave over gains, convex over losses
- Non-linear probability weighting
Model of Deductible Choice

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

  - Choice A
    - 25% chance of $200 loss [80%]
    - Sure loss of $50 [20%]
  - Choice B
    - 25% chance of $200 loss [35%]
    - Insurance costing $50 [65%]
No loss aversion in buying

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

- Prefer \((P_L, D_L)\) to \((P_H, D_H)\):
  
  \[
  \nu(-P_L) - \nu(-P_H) < w(\pi)[\nu(-D_H) - \nu(-D_L)]
  \]

- Which leads to:
  
  \[
  P_L^\beta - P_H^\beta < w(\pi) \lambda [D_H^\beta - D_L^\beta]
  \]

- Linear value function:
  
  \[
  WTP = \Delta P = w(\pi) \lambda \Delta D
  \]

  \[
  = 4 \text{ to } 6 \text{ times EV}
  \]
Parameter values

- Kahneman and Tversky (1992)
  - $\lambda = 2.25$
  - $\beta = 0.88$
- Weighting function
  \[ w(\pi) = \frac{\pi^\gamma}{(\pi^\gamma + (1 - \pi)^\gamma)^{\frac{1}{\gamma}}} \]
  - $\gamma = 0.69$
WTP from Model

- Typical new customer with $500 ded
  - Premium with $1000 ded = $572
  - Premium with $500 ded = +$94.53
  - 4% claim rate

- Model predicts WTP = $107

- Would model predict $250 instead?
  - WTP = $166. Cost = $177, so no.
## Choices: Observed vs. Model

<table>
<thead>
<tr>
<th>Chosen Deductible</th>
<th>Predicted Deductible Choice from Prospect Theory NLIB Specification: ( \lambda = 2.25, \gamma = 0.69, \beta = 0.88 )</th>
<th>Predicted Deductible Choice from EU(W) CRRA Utility: ( \rho = 10, W = \text{Insured Home Value} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1,000</td>
<td>87.39% 11.88% 0.73% 0.00%</td>
<td>100.00% 0.00% 0.00% 0.00%</td>
</tr>
<tr>
<td>N = 2,474 (39.5%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$500</td>
<td>18.78% 59.43% 21.79% 0.00%</td>
<td>100.00% 0.00% 0.00% 0.00%</td>
</tr>
<tr>
<td>N = 3,424 (54.6%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$250</td>
<td>3.00% 44.41% 52.59% 0.00%</td>
<td>100.00% 0.00% 0.00% 0.00%</td>
</tr>
<tr>
<td>N = 367 (5.9%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$100</td>
<td>33.33% 66.67% 0.00% 0.00%</td>
<td>100.00% 0.00% 0.00% 0.00%</td>
</tr>
<tr>
<td>N = 3 (0.1%)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conclusions

- (Extreme) aversion to moderate risks is an empirical reality in an important market
- Seemingly anomalous in Standard Model where risk aversion = DMU
- Fits with existing parameter estimates of leading psychology-based alternative model of decision making
Alternative Explanations

- Misestimated probabilities
  - $\approx 20\%$ for single-digit CRRA
  - Older (age) new customers just as likely
- Liquidity constraints
- Sales agent effects
  - Hard sell?
  - Not giving menu? ($500?, data patterns)
  - Misleading about claim rates?
- Menu effects
4 Reference Dependence: Employment and Effort

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

- **Mas (2006)** examines police performance

- Exploits quasi-random variation in pay due to arbitration

- Background
  - 60 days for negotiation of police contract → If undecided, arbitration
  - 9 percent of police labor contracts decided with final offer arbitration
• Framework:

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

\[
P = P(r_a - r_e \leq r_u - r_a) = P(r_a \leq (r_u + r_e) / 2) = F\left(\frac{r_u + r_e}{2}\right)
\]
• Nash Equilibrium:

  – If $r_a$ is certain, Hotelling game: convergence of $r_e$ and $r_u$ to $r_a$

  – Employer’s problem:

    \[
    \max_{r_e} PU (w (1 + r_e)) + (1 - P) U (w (1 + r_u^*))
    \]

  – Notice: $U' < 0$

  – First order condition (assume $r_u \geq r_e$):

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

    – $r_e^* = r_u^*$ cannot be solution $\Rightarrow$ Lower $r_e$ and increase utility ($U' < 0$)
- Union’s problem: maximizes

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

- Notice: $V' > 0$

- First order condition for union:

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

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

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

$$-bP^*w = -(1 - P^*) bw$$
Result: \( P^* = 1/2 \)

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

- Therefore, as-if random assignment of winner

- Use to study impact of pay on police effort

- Data:
  - 383 arbitration cases in New Jersey, 1978-1995
  - Observe offers submitted \( r_e, r_u, \) and ruling \( \bar{r}_a \)
  - Match to UCR crime clearance data (=number of crimes solved by arrest)
• Compare summary statistics of cases when employer and when police wins
• Estimated $\hat{P} = .344 \neq 1/2 \rightarrow$ Unions more risk-averse than employers
• No systematic difference between Union and Employer cases except for $r_e$

Table I

<table>
<thead>
<tr>
<th>Sample characteristics in the -12 to +12 month event time window</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>(1)                                           (2)            (3)            (4)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Arbrator rules for employer                          0.344</td>
</tr>
<tr>
<td>Final Offer: Employer                               6.11 [1.65]     6.44 [1.54]     5.94 [1.68]     0.50 (0.18)</td>
</tr>
<tr>
<td>Final Offer: Union                                  7.65 [1.71]     7.87 [2.03]     7.54 [1.51]     0.32 (0.18)</td>
</tr>
<tr>
<td>Contract length                                    2.09 [0.66]     2.09 [0.64]     2.09 [0.66]     0.007 (0.071)</td>
</tr>
<tr>
<td>Size of bargaining unit                            42.58 [97.34]   41.36 [33.33]   43.22 [113.84] -1.86 (15.66)</td>
</tr>
<tr>
<td>Arbitration year                                   85.56 [4.75]    85.85 [5.10]    85.41 [4.56]    0.436 (0.510)</td>
</tr>
<tr>
<td>Clearances per 100,000 capita                        120.31 [106.65] 122.28 [108.76] 118.57 [104.35] 3.71 (9.46)</td>
</tr>
</tbody>
</table>
• Graphical evidence of effect of ruling on crime clearance rate

• Significant effect on clearance rate for one year after ruling

• Estimate of the cumulated difference between Employer and Union cities on clearance rates and crime
- Arbitration leads to an average increase of 15 clearances out of 100,000 each month

<table>
<thead>
<tr>
<th>Table II</th>
<th>Event study estimates of the effect of arbitration rulings on clearances; -12 to +12 month event time window</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All clearances</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Constant</td>
<td>118.57</td>
</tr>
<tr>
<td></td>
<td>(5.12)</td>
</tr>
<tr>
<td>Post-arbitration</td>
<td>-6.79</td>
</tr>
<tr>
<td>× Employer win</td>
<td>(2.62)</td>
</tr>
<tr>
<td>Post-arbitration</td>
<td>4.99</td>
</tr>
<tr>
<td>× Union win</td>
<td>(2.69)</td>
</tr>
<tr>
<td>Row 3 – Row 2</td>
<td>11.78</td>
</tr>
<tr>
<td></td>
<td>(3.35)</td>
</tr>
<tr>
<td>Employer Win</td>
<td>3.71</td>
</tr>
<tr>
<td>(Yes = 1)</td>
<td>(9.46)</td>
</tr>
<tr>
<td>Fixed-effects?</td>
<td>Yes</td>
</tr>
<tr>
<td>Weighted sample?</td>
<td>Yes</td>
</tr>
<tr>
<td>Augmented sample?</td>
<td>Yes</td>
</tr>
<tr>
<td>Mean of the Dependent variable</td>
<td>120.31</td>
</tr>
<tr>
<td></td>
<td>[106.65]</td>
</tr>
<tr>
<td>Sample Size</td>
<td>9,538</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.0008</td>
</tr>
</tbody>
</table>
- Effects on crime rate more imprecise

<table>
<thead>
<tr>
<th></th>
<th>All crime</th>
<th>Violent crime</th>
<th>Property crime</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Constant</td>
<td>612.18</td>
<td>150.28</td>
<td>461.81</td>
</tr>
<tr>
<td></td>
<td>(63.98)</td>
<td>(23.22)</td>
<td>(42.00)</td>
</tr>
<tr>
<td>Post-arbitration</td>
<td>7.64</td>
<td>6.68</td>
<td>0.07</td>
</tr>
<tr>
<td>× Employer win</td>
<td>(16.24)</td>
<td>(11.42)</td>
<td>(11.68)</td>
</tr>
<tr>
<td>Post-arbitration</td>
<td>7.64</td>
<td>6.68</td>
<td>0.07</td>
</tr>
<tr>
<td>× Union win</td>
<td>(16.24)</td>
<td>(11.42)</td>
<td>(11.68)</td>
</tr>
<tr>
<td>Row 3 - Row 2</td>
<td>-19.21</td>
<td>-18.01</td>
<td>-19.02</td>
</tr>
<tr>
<td></td>
<td>(50.06)</td>
<td>(19.12)</td>
<td>(21.60)</td>
</tr>
<tr>
<td>Employer Win</td>
<td>-31.11</td>
<td>-20.43</td>
<td>-11.35</td>
</tr>
<tr>
<td>(Yes = 1)</td>
<td>(84.42)</td>
<td>(27.57)</td>
<td>(39.30)</td>
</tr>
<tr>
<td>Fixed-effects?</td>
<td></td>
<td>Yes</td>
<td>Yes</td>
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<td>Mean of the dependent variable</td>
<td>444.03</td>
<td>319.42</td>
<td>95.49</td>
</tr>
<tr>
<td></td>
<td>[564.23]</td>
<td>[2037.4]</td>
<td>[163.18]</td>
</tr>
<tr>
<td>( R^2 )</td>
<td>0.001</td>
<td>0.54</td>
<td>0.007</td>
</tr>
</tbody>
</table>
- Do reference points matter?
- Plot impact on clearances rates (12,-12) as a function of $\bar{r}_a - (r_e + r_u)/2$
- Effect of loss is larger than effect of gain

Table VII

| Heterogeneous effects of arbitration decisions on clearances by loss size, award, and deviation from the expected offer; -12 to +12 month event time window |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) Police lose | (6) Police win |
| | (2.31) | (9.58) | (8.45) | (4.76) | (3.14) | (4.17) |
| Post-Arbitration × Award | 1.23 | -1.00 | | | | |
| | (1.16) | (0.98) | | | |
| Post-Arbitration × Loss size | -10.31 | -10.93 | -0.20 | | |
| | (1.59) | (1.89) | (4.54) | | |
| Post-Arbitration × Union win | | | | | | 13.38 |
| | | | | | (5.32) |
| Post-Arbitration × (expected award-award) | -17.72 | | 2.82 | | | |
| | | | (7.94) | | (4.13) |
| Post-Arbitration × p(loss size)^5 | | | | | Included | |
| Sample Size | 59,137 | 59,137 | 59,137 | 59,137 | 52,857 | 55,879 |
| R^2 | 0.63 | 0.63 | 0.63 | 0.63 | 0.60 | 0.62 |

Standard errors, clustered on the intersection of arbitration window and city, are in parentheses. Standard deviations are in brackets. Observations are municipality × month cells. The sample is weighted by population size in 1976. The dependent variable is clearances per 100,000 capita. Loss size is defined as the union demand (percent increase on previous wage) less the arbitrator award. Amongst cities that underwent arbitration, the mean loss size is 0.489 with a standard deviation of 0.953. The expected award is the mathematical expectation of the award given the union and employer offers and the predicted probability of an employer win. The predicted probability of an employer win is estimated with a probit model using as predictors year of arbitration dummies, the average of the final offers, log population, and the length of the contract. See text for details. The sample in models (1)-(4) consist of the 12 months before to the 12 months after arbitration, for jurisdictions that underwent arbitration, as well as all jurisdictions that never underwent arbitration for all months between 1978 and 1996. The sample in model (5) consists of cities where the union lost in arbitration and the comparison group of non-arbitrating cities. The sample in model (6) consists of cities where the union won in arbitration and the comparison group of non-arbitrating cities. All models include month × year effects (232), arbitration window effects (383), and city effects (432). Author's calculation based on NJ PECR arbitration cases matched to monthly municipal clearance rates at the jurisdiction level from FBI Uniform Crime Reports.
• Column (3): Effect of a gain relative to \((r_e + r_u)/2\) is not significant; effect of a loss is

• Columns (5) and (6): Predict expected award \(\hat{r}_a\) using covariates, then compute \(\bar{r}_a - \hat{r}_a\)

  - \(\bar{r}_a - \hat{r}_a\) does not matter if union wins

  - \(\bar{r}_a - \hat{r}_a\) matters a lot if union loses

• Assume policeman maximizes

\[
\max_e \left[ \bar{U} + U(w) \right] e - \theta \frac{e^2}{2}
\]
where
\[ U(w) = \begin{cases} 
  w - \hat{w} & \text{if } w \geq \hat{w} \\
  \lambda (w - \hat{w}) & \text{if } w < \hat{w}
\end{cases} \]

- F.o.c.:
\[ \bar{U} + U(w) - \theta e = 0 \]

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

- It implies that we would estimate
\[
Clearances = \alpha + \beta (\bar{r}_a - \hat{r}_a) + \gamma (\bar{r}_a - \hat{r}_a) 1(\bar{r}_a - \hat{r}_a < 0) + \varepsilon
\]
with \( \beta > 0 \) (also *in* standard model) and \( \gamma > 0 \) (not in standard model)
- Compare to observed pattern

- Close to predictions of model
5 Reference Dependence: Disposition Effect

- Odean (JF, 1998)

- Do investors sell winning stocks more than losing stocks?

- Tax advantage to sell losers
  - Can post a deduction to capital gains taxation
  - Stronger incentives to do so in December, so can post for current tax year
• Prospect theory intuition:
  – Evaluate stocks regularly
  – Reference point: price of purchase
  – Convexity over losses $\rightarrow$ gamble, hold on stock
  – Concavity over gains $\rightarrow$ risk aversion, sell stock
• Individual trade data from Discount brokerage house (1987-1993)

• Rare data set — Most financial data sets carry only aggregate information

• Share of realized gains:

\[ PGR = \frac{\text{Realized Gains}}{\text{Realized Gains} + \text{Paper Gains}} \]

• Share of realized losses:

\[ PLR = \frac{\text{Realized Losses}}{\text{Realized Losses} + \text{Paper Losses}} \]

• These measures control for the availability of shares at a gain or at a loss
• Notes on construction of measure:

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

  – Example:

\[
PGR = \frac{13,883}{13,883 + 79,658}
\]
• Result: $PGR > PLR$ for all months, except December

Table I

PGR and PLR for the Entire Data Set

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

<table>
<thead>
<tr>
<th></th>
<th>Entire Year</th>
<th>December</th>
<th>Jan.–Nov.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLR</td>
<td>0.098</td>
<td>0.128</td>
<td>0.094</td>
</tr>
<tr>
<td>PGR</td>
<td>0.148</td>
<td>0.108</td>
<td>0.152</td>
</tr>
<tr>
<td>Difference in proportions</td>
<td>−0.050</td>
<td>0.020</td>
<td>−0.058</td>
</tr>
<tr>
<td>$t$-statistic</td>
<td>−35</td>
<td>4.3</td>
<td>−38</td>
</tr>
</tbody>
</table>

• Strong support for disposition effect
- Effect monotonically decreasing across the year

- Tax reasons are also at play
• Robustness: Across years and across types of investors

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Entire year PLR</td>
<td>0.126</td>
<td>0.072</td>
<td>0.079</td>
<td>0.296</td>
</tr>
<tr>
<td>Entire year PGR</td>
<td>0.201</td>
<td>0.115</td>
<td>0.119</td>
<td>0.452</td>
</tr>
<tr>
<td>Difference in proportions</td>
<td>-0.075</td>
<td>-0.043</td>
<td>-0.040</td>
<td>-0.156</td>
</tr>
<tr>
<td>t-statistic</td>
<td>-30</td>
<td>-25</td>
<td>-29</td>
<td>-22</td>
</tr>
</tbody>
</table>

• Alternative Explanation 1: **Rebalancing** → Sell winners that appreciated

– Remove partial sales

<table>
<thead>
<tr>
<th></th>
<th>Entire Year</th>
<th>December</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLR</td>
<td>0.155</td>
<td>0.197</td>
</tr>
<tr>
<td>PGR</td>
<td>0.233</td>
<td>0.162</td>
</tr>
<tr>
<td>Difference in proportions</td>
<td>-0.078</td>
<td>0.035</td>
</tr>
<tr>
<td>t-statistic</td>
<td>-32</td>
<td>4.6</td>
</tr>
</tbody>
</table>
- Alternative Explanation 2: **Ex-Post Return** → Losers outperform winners ex post

- Table VI: Winners sold outperform losers that could have been sold
• Alternative Explanation 3: **Transaction costs** $\rightarrow$ Losers more costly to trade (lower prices)
  
  – Compute equivalent of $PGR$ and $PLR$ for additional purchases of stock
  
  – This story implies $PGP > PLP$
  
  – Prospect Theory implies $PGP < PLP$ (invest in losses)

• Evidence:

\[
P_{GP} = \frac{\text{Gains Purchased}}{\text{Gains Purchased} + \text{Paper Gains}} = .094
\]

\[
< PLP = \frac{\text{Losses Purchased}}{\text{Losses Purchased} + \text{Paper Losses}} = .135.
\]
• Alternative Explanation 4: **Belief in Mean Reversion** → Believe that losers outperform winners
  
  – Behavioral explanation: Losers do not outperform winners
  
  – Predicts that people will buy new losers → Not true

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

• Ivkovich, Poterba, and Weissbenner (2006)

• Data
  – 78,000 individual investors in Large discount brokerage, 1991-1996
  – Compare taxable accounts and tax-deferred plans (IRAs)
  – Disposition effect should be stronger for tax-deferred plans
Methodology: Do hazard regressions of probability of buying and selling monthly, instead of \( PGR \) and \( PLR \)

For each month \( t \), estimate linear probability model:

\[
SELL_{i,t} = \alpha_t + \beta_1,tI(Gain)_{i,t-1} + \beta_2,tI(Loss)_{i,t-1} + \varepsilon_{i,t}
\]

Regression only applies to shares not already sold

\( \alpha_t \) is baseline hazard at month \( t \)

Pattern of \( \beta s \) always consistent with disposition effect, except in December

Difference is small for tax-deferred accounts
Figure 1: Hazard Rate of Having Sold Stock in Taxable Accounts, Full Sample

Notes: Sample is January purchases of stock 1991-96 in taxable accounts. The hazard rate for stock purchases unconditional on the stock’s price performance, as well as conditional on whether the stock has an accrued capital gain or loss entering the month, is displayed.
Figure 2: Hazard Rate of Having Sold Stock in Taxable and Tax-Deferred Accounts, Original Buy at least $10,000

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

Disposition Effect very solid finding – Next time interpretation

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

- Reference Dependence
  - More Disposition Effect
  - Labor Supply

- Social Preferences
  - Gift Exchange
  - Workplace
  - From Lab to Field