Outline

1. More on Default Effects in Savings
2. Comparison to Effect of Financial Education
3. Default Effects in Other Decisions
4. Default Effects and Present Bias
5. Default Effects: Alternative Explanations
6. Present Bias and Consumption
7. Investment Goods: Homework
8. Investment Goods: Exercise
1 More on Default Effects

- Summary of Madrian and Shea (2001)
  - OLD and NEW cohorts invest very differently one year after initial hire
    * Fact 1. **Fact 1. 40% to 50% of investors follow Default Plan**
    * Fact 1a. Applies to participation (yes/no)
    * Fact 1b. Applies also to contribution level and allocation
  - (Less commonly cited) WINDOW cohort resembles OLD cohort
    * Fact 2. ‘**Suggested choice**’ not very attractive unless default
• BUT: Default effects not informative of optimal saving plans.
  – Is OLD cohort under-saving?
  – Or is NEW cohort over-saving?

• Introduction of Active Choice (Carroll et al., 2009) – Large Fortune-500 Company, Financial sector

• Comparison between Active Choice (before) and No Enrollment (after)

• Fact 3. Active Choice resembles Default Investment
<table>
<thead>
<tr>
<th><strong>Table 1. 401(k) plan features by effective date</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Eligibility</strong></td>
</tr>
<tr>
<td>Eligible employees</td>
</tr>
<tr>
<td>First eligible</td>
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<tr>
<td>Employer match eligible</td>
</tr>
<tr>
<td><strong>Enrollment</strong></td>
</tr>
<tr>
<td><strong>Contributions</strong></td>
</tr>
<tr>
<td>Employee contributions</td>
</tr>
<tr>
<td>Non-discretionary employer match</td>
</tr>
<tr>
<td>Discretionary employer match</td>
</tr>
<tr>
<td><strong>Vesting</strong></td>
</tr>
<tr>
<td><strong>Other</strong></td>
</tr>
<tr>
<td>Loans</td>
</tr>
<tr>
<td>Hardship withdrawals</td>
</tr>
<tr>
<td>Investment choices</td>
</tr>
</tbody>
</table>
• ACTIVE Cohort, hired 1/1/97-7/31/97
  – 30 days to return 401(k) form with legal packet
  – Next enrollment period: January 1998
  – Paper-and-pencil form

• OLD2 Cohort, hired 1/1/98-7/31/98
  – Standard, no-saving-default (like OLD)
  – Can enroll any time
  – Telephone-based enrollment, 24/7
• Step 1. Check Design

  – Summary Stats (Table 2)—No substantial difference across cohorts

<table>
<thead>
<tr>
<th>Table 2. Comparison of worker characteristics</th>
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<tbody>
<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>on 12/31/98</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Average age (years)</td>
</tr>
<tr>
<td>Gender</td>
</tr>
<tr>
<td>Male</td>
</tr>
<tr>
<td>Female</td>
</tr>
<tr>
<td>Marital Status</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>Married</td>
</tr>
<tr>
<td>Compensation</td>
</tr>
<tr>
<td>Avg. monthly base pay</td>
</tr>
<tr>
<td>Median monthly base pay</td>
</tr>
<tr>
<td>Avg. annual income*</td>
</tr>
<tr>
<td>Median annual income*</td>
</tr>
</tbody>
</table>

*Income includes tips.
• Step 2. Compare plan choices (Figures 1 and 2)

  – Participation rates in 401(k) using cross-sectional data (Figure 1):
    * ACTIVE: 69% – OLD2: 41% (at month 3)
    * Compare to NEW (86%) and OLD (57%) in MS01 after >6 months
    * Does not depend on month of hire (see below)
• Contribution rates (including zeros) (Figure 3)

* ACTIVE: 4.8% – OLD2: 3.5% (at month 9, when longitudinal data becomes available)
• Contribution rates (excluding zeros) (Figure 4)
  * ACTIVE: 6.8% – OLD2: 7.5% (at month 9)
  * Selection effect: Marginal individuals are lower savers
- Differences between ACTIVE and OLD2 disappear by year 3 (Figure 2)
- Still: Important because no catch-up in levels, and because of frequent changes in employers
Summary.

- ACTIVE is close to NEW and differs from OLD and OLD2
  * Fact 3. Active Choice resembles Default Investment
  * Fact 3b. Month of Hire does not matter

- Fact 4. Effect of default mostly disappears after three years

- Prevalence of OLD Default can (at least in part) explain under-saving for retirement
• Other evidence on default effects in choice of savings: Cronqvist and Thaler (2004, AER P&P)

  – 456 funds, 1 default fund (chosen by government)

  – Year 2000:
    * Choice of default is discouraged with massive marketing campaign.
    * Among new participants, 43.3 percent chooses default

  – Year 2003:
    * End of marketing campaign.
    * Among new participants, 91.6 percent chooses default
– Side point for us (but key point in paper): Portfolio actively chosen in year 2000 does much worse than default

<table>
<thead>
<tr>
<th>Portfolio characteristic</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Default</td>
</tr>
<tr>
<td>Asset allocation</td>
<td></td>
</tr>
<tr>
<td>Equities</td>
<td>82</td>
</tr>
<tr>
<td>Sweden</td>
<td>17</td>
</tr>
<tr>
<td>Americas</td>
<td>35</td>
</tr>
<tr>
<td>Europe</td>
<td>20</td>
</tr>
<tr>
<td>Asia</td>
<td>10</td>
</tr>
<tr>
<td>Fixed-income securities</td>
<td>10</td>
</tr>
<tr>
<td>Hedge funds</td>
<td>4</td>
</tr>
<tr>
<td>Private equity</td>
<td>4</td>
</tr>
<tr>
<td>Indexed</td>
<td>60</td>
</tr>
<tr>
<td>Fee</td>
<td>0.17</td>
</tr>
<tr>
<td>Beta</td>
<td>0.98</td>
</tr>
<tr>
<td>Ex post performance</td>
<td>-29.9</td>
</tr>
</tbody>
</table>
2 Comparison to Effect of Financial Education

- Studies of the effect of financial education:
  - Cross-Sectional surveys (Bernheim and Garrett, 2003; Bayer, Bernheim, and Scholz, 1996)
    * Sizeable impact
    * BUT: Strong Biases (Reverse Causation + Omitted Vars)
  - Time-series Design (McCarthy and McWhirter 2000; Jacobius 2000)
    * Sizeable impact
    * BUT: Use self-reported desired saving
  - Need for plausible design
• Choi et al. (2005):
  – Financial education class (one hour) in Company D in 2000
  – Participation rate: 17 percent
  – People are asked: “After attending today’s presentation, what, if any, action do you plan on taking toward your personal financial affairs?”
  – Administrative data on Dec. 1999 (before) and June 2000 (after)
  – Examine effect:
    * participants (self-selected) – 12% of them were not saving before
      → Demand for financial education comes from people who already save!
    * non-participants

• Effect likely biased upwards
### TABLE 5. Financial Education and Actual vs. Planned Savings Changes (Company C)

<table>
<thead>
<tr>
<th>Planned Action</th>
<th>Seminar Attendees</th>
<th>Non-Attendees</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Planned Change</td>
<td>Actual Change</td>
</tr>
<tr>
<td>Non-participants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Enroll in 401(k) plan</td>
<td>100%</td>
<td>14%</td>
</tr>
<tr>
<td>401(k) participants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increase contribution rate</td>
<td>28%</td>
<td>8%</td>
</tr>
<tr>
<td>Change fund selection</td>
<td>47%</td>
<td>15%</td>
</tr>
<tr>
<td>Change fund allocation</td>
<td>36%</td>
<td>10%</td>
</tr>
</tbody>
</table>

The sample is active 401(k)-eligible employees at company locations that offered financial education seminars from January-June 2000. Actual changes in savings behavior are measured over the period from December 31, 1999 through June 30, 2000. Planned changes are those reported by seminar attendees in an evaluation of the financial education seminars at the conclusion of the seminar. The planned changes from surveys responses of attendees have been scaled to reflect the 401(k) participation rate of seminar attendees.

- Result: Very little impact on changes in savings, compared to non-attendees or to control time period
• Duflo and Saez (QJE 2003)
  – Target staff in prestigious university (Harvard? MIT?)
  – Randomized Experiment in a university:
    * 1/3 of 330 Departments control group
    * 2/3 of 330 Departments treatment group:
      · 1/2 not-enrolled staff: letter with $20 reward for attending a fair
      · 1/2 not-enrolled staff: no reward

• Measure attendance to the fair and effect on retirement savings
<table>
<thead>
<tr>
<th>TABLE 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESCRIPTIVE STATISTICS, BY GROUPS</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Treated departments</th>
</tr>
</thead>
<tbody>
<tr>
<td>All (group D = 1)</td>
</tr>
<tr>
<td>(1)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PANEL A: BACKGROUND CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDA participation before the fair (Sept. 2000)</td>
</tr>
<tr>
<td>(0.0015)</td>
</tr>
<tr>
<td>Observations</td>
</tr>
<tr>
<td>(0.076)</td>
</tr>
<tr>
<td>Sex (fraction male)</td>
</tr>
<tr>
<td>(0.114)</td>
</tr>
<tr>
<td>Years of service</td>
</tr>
<tr>
<td>(0.14)</td>
</tr>
<tr>
<td>Annual salary</td>
</tr>
<tr>
<td>(304)</td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>(17)</td>
</tr>
<tr>
<td>Observations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PANEL B: FAIR ATTENDANCE (REGISTRATION DATA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fair attendance rate among non-TDA enrollees</td>
</tr>
<tr>
<td>(0.064)</td>
</tr>
<tr>
<td>Observations</td>
</tr>
<tr>
<td>Fair attendance rate for all staff employees</td>
</tr>
<tr>
<td>(0.0132)</td>
</tr>
<tr>
<td>Observations</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PANEL C: TDA PARTICIPATION (ADMINISTRATIVE DATA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDA participation rate after 4.5 months</td>
</tr>
<tr>
<td>(0.035)</td>
</tr>
<tr>
<td>Observations</td>
</tr>
<tr>
<td>TDA participation rate after 11 months</td>
</tr>
<tr>
<td>(0.005)</td>
</tr>
<tr>
<td>Observations</td>
</tr>
</tbody>
</table>
• Summary of effects:
  – Large effect of subsidy on attendance (including peer effect)
  – Small effects of attendance on retirement savings

<table>
<thead>
<tr>
<th>TABLE II</th>
<th>Reduced-Form Estimates (OLS)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dependent variable</td>
</tr>
<tr>
<td></td>
<td>Fair attendance (1)</td>
</tr>
<tr>
<td>PANEL A: Average effect of department treatment</td>
<td></td>
</tr>
<tr>
<td>Treated</td>
<td>0.166</td>
</tr>
<tr>
<td>Department dummy $D$</td>
<td>(.013)</td>
</tr>
<tr>
<td>Observations</td>
<td>6144</td>
</tr>
<tr>
<td>PANEL B: Effect of letter and department treatment</td>
<td></td>
</tr>
<tr>
<td>Letter dummy $L$</td>
<td>0.129</td>
</tr>
<tr>
<td></td>
<td>(.0226)</td>
</tr>
<tr>
<td>Treated</td>
<td>0.102</td>
</tr>
<tr>
<td>Department dummy $D$</td>
<td>(.0139)</td>
</tr>
<tr>
<td>Observations</td>
<td>6144</td>
</tr>
</tbody>
</table>
• Results:
  – Approximately: Of the people induced to attend the fair, 10% sign up
  – Compare to Default effects: Change allocations for 40%-50% of employees

• Summary:
  – Just explaining retirement savings not very effective at getting people to save
  – Effect of changing default much larger
  – Interesting variation: Re-Do this study but give opportunity to sign up at fair
3 Default Effects in Other Decisions

- Additional evidence of default effects in other contexts:

1. SMRT plan for savings (Thaler and Benartzi, *JPE* 2004)
2. Health-club contracts (DellaVigna and Malmendier, *AER* 2006)
3. Car insurance plan choice (Johnson et al, 1993)
4. Car option purchases (Park, Yun, and MacInnis, 2000)
5. Consent to e-mail marketing (Johnson, Bellman and Lohse, 2003)
6. TV channel choice (Esteves-Sorenson, 2008)
7. Organ donation (Johnson and Goldstein, 2003; Abadie and Gay, 2006)
• Ben Handel, “Adverse Selection and Switching Costs in Health Insurance Markets: When Nudging Hurts”, 2011

  – Administrative data on health insurance choice within a company

  – Observe data in years $t_{-1}$, $t_0$ and $t_1$

  – Year $t_0$: introduction of new plans, *active choice* required

  – Year $t_1$: choice by default, but plan benefits changed substantially

  – Restrict choice to only PPO plans, *all offered by same insurer*

  – Only difference is financial details (premia, co-pay, etc.)

  – Estimate individual risk characteristics using $t_{-1}$ data, consider $t_0$ active choice, then inertial choice at $t_1$ as option attractiveness varies
• Options offered

<table>
<thead>
<tr>
<th>Choice Behavior</th>
<th>$t_{-1}$</th>
<th>$t_0$</th>
<th>$t_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$PPO_{250}$</td>
<td>-</td>
<td>2,199 (25%)</td>
<td>1,937 (21%)</td>
</tr>
<tr>
<td>$PPO_{500}$</td>
<td>-</td>
<td>998 (11%)</td>
<td>1,544 (18%)</td>
</tr>
<tr>
<td>$PPO_{1200}$</td>
<td>-</td>
<td>876 (10%)</td>
<td>824 (9%)</td>
</tr>
<tr>
<td>$HMO_1$</td>
<td>2,094 (25%)</td>
<td>2,050 (23%)</td>
<td>2,031 (22%)</td>
</tr>
<tr>
<td>$HMO_2$</td>
<td>701 (8%)</td>
<td>1,273 (14%)</td>
<td>1,181 (13%)</td>
</tr>
<tr>
<td>$PPO_{-1}$</td>
<td>3,264 (39%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$HMO_3$</td>
<td>668 (8%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$HMO_4$</td>
<td>493 (6%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Waive</td>
<td>1,207 (14%)</td>
<td>1,447 (16%)</td>
<td>1,521 (17%)</td>
</tr>
</tbody>
</table>

• In particular, in year $t_1$ for a group $PPO_{250}$ is dominated – do employees still choose it? Yes,
- Do employees in the dominated plan still choose it? Yes, a majority still after two years

<table>
<thead>
<tr>
<th>Dominated Plan Analysis</th>
<th>$t_1$</th>
<th>$t_1$</th>
<th>$t_2$</th>
<th>$t_2$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dominated Stay</td>
<td>Dominated Switch</td>
<td>Dominated Stay</td>
<td>Dominated Switch</td>
</tr>
<tr>
<td>N</td>
<td>498</td>
<td>61</td>
<td>378</td>
<td>126</td>
</tr>
<tr>
<td>Minimum Money Lost*</td>
<td>$374</td>
<td>$453</td>
<td>$396</td>
<td>$306</td>
</tr>
<tr>
<td>$PPO_{500}$</td>
<td>-</td>
<td>44 (72%)</td>
<td>-</td>
<td>103 (81%)</td>
</tr>
<tr>
<td>$PPO_{1200}$</td>
<td>-</td>
<td>4 (7%)</td>
<td>-</td>
<td>6 (5%)</td>
</tr>
<tr>
<td>Any HMO</td>
<td>-</td>
<td>13 (21%)</td>
<td>-</td>
<td>17 (14%)</td>
</tr>
</tbody>
</table>
- Descriptive evidence of strong inertia effects when comparing new enrollees

<table>
<thead>
<tr>
<th>New Enrollee Analysis</th>
<th>New Enrollee $t_{-1}$</th>
<th>New Enrollee $t_0$</th>
<th>New Enrollee $t_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$N, t_0$</td>
<td>1056</td>
<td>1377</td>
<td>-</td>
</tr>
<tr>
<td>$N, t_1$</td>
<td>784</td>
<td>1267</td>
<td>1305</td>
</tr>
<tr>
<td>$t_0$ Choices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$PPO_{250}$</td>
<td>259 (25%)</td>
<td>287 (21%)</td>
<td>-</td>
</tr>
<tr>
<td>$PPO_{500}$</td>
<td>205 (19%)</td>
<td>306 (23%)</td>
<td>-</td>
</tr>
<tr>
<td>$PPO_{1200}$</td>
<td>155 (15%)</td>
<td>236 (17%)</td>
<td>-</td>
</tr>
<tr>
<td>$HMO_1$</td>
<td>238 (23%)</td>
<td>278 (20%)</td>
<td>-</td>
</tr>
<tr>
<td>$HMO_2$</td>
<td>199 (18%)</td>
<td>270 (19%)</td>
<td>-</td>
</tr>
<tr>
<td>$t_1$ Choices</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$PPO_{250}$</td>
<td>182 (23%)</td>
<td>253 (20%)</td>
<td>142 (11%)</td>
</tr>
<tr>
<td>$PPO_{500}$</td>
<td>201 (26%)</td>
<td>324 (26%)</td>
<td>562 (43%)</td>
</tr>
<tr>
<td>$PPO_{1200}$</td>
<td>95 (12%)</td>
<td>194 (15%)</td>
<td>188 (14%)</td>
</tr>
<tr>
<td>$HMO_1$</td>
<td>171 (22%)</td>
<td>257 (20%)</td>
<td>262 (20%)</td>
</tr>
<tr>
<td>$HMO_2$</td>
<td>135 (17%)</td>
<td>239 (19%)</td>
<td>151 (12%)</td>
</tr>
</tbody>
</table>
• Model estimation

• Assumes individuals have a value for insurance based on previous risk

• Allows for asymmetric information

• Models the switching cost in reduced form as a cost $k$ paid to switch – no cost in year $t_0$ when active choice

<table>
<thead>
<tr>
<th>Empirical Model Results</th>
<th>Primary</th>
<th>Base</th>
<th>MH Robust</th>
<th>$\gamma$ Robust</th>
<th>$\epsilon$ Robust</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching Cost - Single, $\eta_0$</td>
<td>1729 (28)</td>
<td>1779 (72)</td>
<td>1859 (107)</td>
<td>2430 (116)</td>
<td>1944 (150)</td>
</tr>
<tr>
<td>Switching Cost - Family, $\eta_0 + \eta_2$</td>
<td>2480 (26)</td>
<td>2354 (62)</td>
<td>2355 (113)</td>
<td>3006 (94)</td>
<td>2365 (34)</td>
</tr>
</tbody>
</table>
• Estimated cost of about $2,000 is very unlikely to capture administrative costs
  
  – More likely to capture procrastination, or limited attention
  
  – Notice though: If no choice by deadline, can make no change until one year later
  
  – In this setting (see below), no procrastination expected even for naives

• However, consider alternative model:
  
  – Naive agent forgetful of deadline date
  
  – Then procrastinate until deadline, with probability of missing the deadline
• Paper also considers impact of debiasing which reduces switching costs

• All else equal, this is good for consumers

• BUT: inertia had side effect of limiting the adverse selection into contracts
  → Enables more pooling and therefore ‘better’ contracts

• Removing the inertia may make things worse in general equilibrium
4 Default effects and Present Bias

• How do we explain the default effects?
  – Present-bias ((quasi-) hyperbolic discounting – (β, δ) preferences):
    \[ U_t = u_t + \beta \sum_{s=1}^{\infty} \delta^s u_{t+s} \]
    with \( \beta \leq 1 \). Discount function: 1, \( \beta \delta \), \( \beta \delta^2 \), ...

• Time inconsistency. Discount factor for self \( t \) is
  – \( \beta \delta \) between \( t \) and \( t + 1 \) \( \implies \) short-run impatience;
  – \( \delta \) between \( t + 1 \) and \( t + 2 \) \( \implies \) long-run patience.

• Naiveté about time inconsistency
  – Agent believes future discount function is 1, \( \hat{\beta} \delta \), \( \hat{\beta} \delta^2 \),..., with \( \hat{\beta} \geq \beta \).
Non-Automatic Enrollment (OLD Cohort in Madrian-Shea, 2001)

- Setup of O’Donoghue and Rabin (2001): One-time decision (investment)
  - immediate (deterministic) cost $k_N > 0$ with $k_N = k'_N + k''_N$:
    * $k'_N > 0$ – effort of filling up forms
    * $k''_N > 0$ – effort of finding out optimal plan
  - delayed (deterministic) benefit $b > 0$
  - $T = 1$ (can change investment every day)

- When does investment take place?
• **Exponential** employee ($\beta = \hat{\beta} = 1$):

• Compares investing now to never investing:

\[ -k_N + \sum_{t=1}^{\infty} \delta^t b = -k_N + \frac{\delta b}{1 - \delta} \geq 0 \]

• Invests if

\[ k_N \leq \frac{\delta b}{1 - \delta} \]
• **Sophisticated** present-biased employee ($\beta = \hat{\beta} < 1$):

  - Would like tomorrow’s self to invest if:
    
    $$\beta\delta \left[ -k_N + \frac{\delta b}{1 - \delta} \right] \geq 0$$

  - Would like to invest now if:
    
    $$-k_N + \beta\delta \frac{b}{1 - \delta} \geq 0$$

  - War of attrition between selves
• Multiple equilibria in the investing period: Invest every $\tau$ periods

• Example for $\tau = 3$. List strategies to Invest (I) and Not Invest (N) over the time periods 0, 1, 2, 3, etc.. Set of equilibria:
  
  – $(I, N, N, I, N, N, I, N, N, \ldots) \rightarrow$ Invest at $t = 0$
  
  – $(N, N, I, N, N, I, N, N, I, \ldots) \rightarrow$ Invest at $t = 2$

  – $(N, I, N, N, I, N, N, I, N, \ldots) \rightarrow$ Invest at $t = 1$

• There is no equilibria such that agent delays more than 2 periods
• **Bound on delay in investment.**

  – Agent prefers investing now to waiting for \( T \) periods if

  \[
  -k_N + \beta \delta \frac{b}{1 - \delta} \geq \beta \delta^T \left[ -k_N + \frac{\delta b}{1 - \delta} \right]
  \]

  – Simplify to

  \[
  k_N \leq \beta \delta \frac{b \left( 1 - \delta^T \right)}{(1 - \delta)(1 - \beta \delta^T)} \approx \frac{\beta \delta b}{(1 - \beta \delta^T)^T} \approx \frac{\beta b}{1 - \beta} T
  \]

  [Taylor expansion of \( 1 - \delta^T \) for \( \delta \) going to 1: \( 0 - T \left( \delta - 1 \right) = (1 - \delta) T \)]

  – Maximum delay \( \bar{T} \):

  \[
  \bar{T} = k_N \frac{1 - \beta}{\beta b}
  \]
• (Fully) **Naive** present-biased employee \( (\beta < \hat{\beta} = 1) \)

  - Compares investment today or at the next occasion (in \( T \) days).
  - Expects to invest next period if
    \[
    -k_N + \frac{\delta b}{1 - \delta} \geq 0
    \]
  - Invest today if
    \[
    -k_N + \beta \delta \frac{b}{1 - \delta} \geq \beta \delta T \left[ -k_N + \frac{\delta b}{1 - \delta} \right]
    \]
  - Procrastinate forever if
    \[
    \frac{\beta b T}{1 - \beta} \leq k_N \leq \frac{\delta b}{1 - \delta}
    \]
• Calibration

• Cost $k_N$?
  – Time cost: 3 hours
  – $k_N \approx 3 \times $12 = $36

• Benefit $b$?
  – Consume today ($t = T_0$) with tax rate $\tau_0$, or at retirement ($t = T_R$) with tax rate $\tau_R$
  – Compare utility at $T_0$ and at $T_R$:
    * Spend $S$ additional dollars at $T_0$: $U'(C_0) \times (1 - \tau_0)$
    * Save, get firm match $\alpha$, and spend $S$ dollars at $T_R$: $\delta^{T_R-T_0}U'(C_R)\times (1 + r)^{T_R-T_0} (1 - \tau_R) (1 + \alpha) S$
  – Assumptions: $U'(C_0) = U'(C_R)$ and $\delta = 1 / (1 + r)$
– $b$ is net utility gain from delayed consumption of $S$:

$$b = \left[\delta (1 + r) \right]^{T_R - T_0} (1 - \tau_R) (1 + \alpha) - (1 - \tau_0) \right] S = \left[ \tau_0 + \alpha - \tau_R (1 + \alpha) \right] S$$

– Calibration to Madrian and Shea (2001): 50 percent match ($\alpha = .5$), taxes $\tau_0 = .3$ and $\tau_R = .2$, saving $S = $5 (6% out of daily $w = $83 (median individual income $\approx $30,000))

– $b \approx [.3 + .5 - .2 \ast (1.5)] S = .5S = $2.5

– Comparative statics:

* What happens if $\alpha = 0$?

* What happens is marginal utility at retirement is 10 percent higher than at present? (because of drop of consumption at retirement)

* Effect of higher earnings $S$?
• What does model predict for different types of agents?

• **Exponential** agent invests if

\[ k_N \leq \frac{\delta b}{1 - \delta} \]

- For \( \delta^{365} = .97 \), \( \delta b / (1 - \delta) = 10,000 \times b \)
- For \( \delta^{365} = .9 \), \( \delta b / (1 - \delta) = 3,464 \times b \)

- Invest immediately!

- Effect of \( k \) is dwarfed by effect of \( b \)
• **Sophisticated** maximum delay in days:

\[ \bar{T} = k_N \frac{1 - \beta}{\beta b} \]

- For \( \beta = 1 \), \( \bar{T} = 0 \) days
- For \( \beta = 0.9 \), \( \bar{T} = 36/(9 \times 2.5) \approx 2 \) days
- For \( \beta = 0.8 \), \( \bar{T} = 36/(4 \times 2.5) \approx 4 \) days
- For \( \beta = 0.5 \), \( \bar{T} = 36/2.5 \approx 14 \) days

- Sophisticated waits at most a dozen of days
- Present Bias with sophistication induces only limited delay
• (Fully) Naive t.i. with $\beta = .8$ invests if

$$k_N \lesssim \frac{\beta Tb}{(1 - \beta)}$$

- For $T = 1$ (I’ll do it tomorrow), investment if $36 < 2.5 \times \beta / (1 - \beta)$
  * $\beta = .8$ (or .5) $\rightarrow$ Procrastination since $36 > 2.5 \times 4$ (or $36 > 2.5$)
- For $T = 7$ (I’ll do it next week), investment if $36 < 5.6 \times \beta / (1 - \beta)$
  * $\beta = .8$ $\rightarrow$ Investment since $36 < 7 \times 2.5 \times 4$
  * $\beta = .5$ $\rightarrow$ Procrastination since $36 > 7 \times 2.5$

- Relatively small cost $k$ can induce infinite delay (procrastination)
- Procrastination more likely if agent can change allocation every day
Automatic Enrollment (NEW Cohort in Madrian-Shea, 2001)

- Model:
  - $k_A' < 0$ – not-enrolling requires effort
  - $k_A'' = 0$? – do not look for optimal plan
  - $k_A = k_A' + k_A'' < 0$
  - $T = 1$ (can enroll any day)

- Exp., Soph., and Naive invest immediately (as long as $b > 0$)

- No delay since investing has no immediate costs (and has delayed benefits)
• Fact 1. 40% to 50% investors follow Default Plan

• Exponentials and Sophisticates ➞ Should invest under either default

• Naives ➞ Invest under NEW, procrastinate under OLD

• Evidence of default effects consistent with naivete’

• (Although naivete’ predicts procrastination forever – need to introduce stochastic costs)
• Can $b$ be negative?

• It can: liquidity-constrained agent not interested in saving

• (consumption-savings decision not modeled here)

• $b < 0$ for at least 14% of workers (NEW: 86% participate).

• Is there too much 401(k) investment with automatic enrollment?

• With $T = 1$ and $k_A < 0$, naive guys may invest even if $b < 0$. 
Active Choice (ACTIVE Cohort)

- Model:
  
  - $k_C' = 0$ – not-enrolling requires effort
  
  - $k_C'' > 0$? – harder to guess optimal plan than to set 0 investment
  
  - $k_C = k_C' + k_C'' > 0$ (but smaller than before) or $k_C = 0$
  
  - $[T = 360 \text{ under ACTIVE}]$
Predictions:

- Exponentials and Sophisticates:
  * Predicted enrollment: OLD2 \approx OLD \approx ACTIVE \approx NEW

- Naives:
  * \(0 < k_C < k_A\) \rightarrow\) Predicted enrollment: OLD2 = OLD << ACTIVE \leq NEW
  * [Move from \(T = 360\) (ACTIVE) to \(T = 1\) (OLD2) \rightarrow Predicted enrollment: OLD = OLD2 < ACTIVE]

Fact 3. Active Choice resembles Default Investment (OLD << ACTIVE \approx NEW)

Findings consistent with naivete’
• Fact 4. Effect of default mostly disappears after three years

• Problem for naivete’ with model above: delay forever

• Introduce Stochastic cancellation costs $k \sim K \rightarrow$ Dynamic programming

• Solution for exponential agent. Threshold $k^e$:
  
  – enroll if $k \leq k^e$;
  
  – wait otherwise.

• For $k = k^e$ indifference between investing and not:

$$-k^e + \frac{\delta b}{1 - \delta} = \delta V^e (k^e)$$
where $V^e (k^e)$ is continuation payoff for exponential agent assuming that threshold rule $k^e$ is used in the future.

• Threshold $k^n$ for naive agent satisfies:

$$-k^n + \beta \frac{\delta b}{1 - \delta} = \beta \delta V^e (k^e)$$

• This implies $k^n = \beta k^e$

  \[\rightarrow\] Investment probability of exponential agent: $\Pr (k \leq k^e)$

  \[\rightarrow\] Investment probability of naive agent: $\Pr (k \leq \beta k^e)$

• This implies that distribution of $k$ has important effect on delay \[\rightarrow\] Left tail is thin implies larger delays for naives
5 Default Effects: Alternative explanations

- A list of alternative explanations:

1. Rational stories

2. Bounded Rationality. Problem is too hard

3. Persuasion. Implicit suggestion of firm

4. Memory. Individuals forget that they should invest

5. Reference point and loss aversion relative to firm-chosen status-quo
Some responses to the explanations above:

1. Rational stories

   (a) Time effect between 1998 and 1999 / Change is endogenous (political economy)
   
   - Replicates in Choi et al. (2004) for 4 other firms

   (b) Cost of choosing plan is comparatively high (HR staff unfriendly) →
       Switch investment elsewhere

   (c) Selection effect (People choose this firm because of default)
   
   - Why choose a firm with default at 3%?
2. Bounded Rationality: Problem is too hard

- In surveys employees say they would like to save more
- Replicate where can measure losses more directly (health club data)

3. Persuasion. Implicit suggestion of firm

- Why should individuals trust firms?

- **Fact 2.** Window cohort does not resemble New cohort
4. Memory. Individuals forget that they should invest

- If individuals are aware of this, they should absolutely invest before they forget!
- Need limited memory + naïveté

5. Reference point and loss aversion relative to firm-chosen status-quo

- First couple month people get used to current consumption level
- Under NonAut., employees unwilling to cut consumption
- BUT: Why wait for couple of months to chose?
6 Present-Bias and Consumption

- Consider an agent that at time 1 can choose:
  - A consumption activity $A$ with immediate payoff $b_1$ and delayed payoff (next period) $b_2$
  - An outside option $O$ with payoff 0 in both periods

- Activity can be:
  - Investment good (exercise, do homework, sign document): $b_1 < 0, b_2 > 0$
  - Leisure good (borrow and spend, smoke cigarette): $b_1 > 0, b_2 < 0$
• How is consumption decision impacted by present-bias and naiveté?

• **Desired consumption.** A time 0, agent wishes to consume $A$ at $t = 1$ if

$$\beta \delta b_1 + \beta \delta^2 b_2 \geq 0 \text{ or } b_1 \geq -\delta b_2$$

• **Actual consumption.** A time 1, agent consumes $A$ if

$$b_1 \geq -\beta \delta b_2$$

• **Self-control problem (if } \beta < 1):$$
  
  – Agent under-consumes investment goods ($b_2 > 0$)
  
  – Agent over-consumes leisure goods ($b_2 < 0$)
• **Forecasted consumption.** As of time 0, agent expects to consumer $A$ if

$$b_1 \geq -\hat{\beta}\delta b_2.$$  

• **Naïveté (if $\beta < \hat{\beta}$):**
  
  – Agent over-estimates consumption of investment goods ($b_2 > 0$)
  
  – Agent under-estimates consumption of leisure goods ($b_2 < 0$)

• **Implications:**
  
  – Sophisticated agent will look for commitment devices to align desired and actual consumption
  
  – Naive agent will mispredict future consumption
• Present evidence on these predictions for:

1. Investment Goods:
   - Homeworks and Task Completion (Ariely and Werternbroch, *PS* 2002)
   - Exercise (DellaVigna and Malmendier, *QJE* 2006)

2. Leisure Goods:
   - Credit Card Usage (Ausubel, 1999; Shui and Ausubel, 2005)
   - Life-cycle Savings (Laibson, Repetto, and Tobacman, 2006; Ashraf, Karlan, and Yin, *QJE* 2006)
7 Investment Goods: Homeworks


- Experiment 1 in classroom:
  - sophisticated people: 51 executives at Sloan (MIT);
  - high incentives: no reimbursement of fees if fail class
  - submission of 3 papers, 1% grade penalty for late submission
• Two groups:
  – Group A: evenly-spaced deadlines
  – Group B: set-own deadlines: 68 percent set deadlines prior to last week
    -> Demand for commitment (Sophistication)
• Results on completion and grades:
  
  – No late submissions (!)
  
  – Papers: Grades in Group A (88.7) higher than grades in Group B (85.67)

  – Consistent with self-control problems

  – However, concerns:

    * Two sessions not randomly assigned

    * Sample size: $n = 2$ (correlated shocks in two sections)
• Experiment 2 deals with issues above. Proofreading exercise over 21 days, $N = 60$
  
  – Group A: evenly-spaced deadlines
  
  – Group B: no deadlines
  
  – Group C: self-imposed deadlines

• Predictions:
  
  – Standard Theory: $B = C > A$
  
  – Sophisticated Present-Biased (demand for commitment): $C > A > B$
  
  – Fully Naive Present-Biased: $A > B = C$
  
  – Partially Naive Present-Biased: $A > C > B$
• Results on Performance: \( A > C > B \)

Fig. 2. Mean errors detected (a), delays in submissions (b), and earnings (c) in Study 2, compared across the three conditions (error bars are based on standard errors). Delays are measured in days, earnings in dollars.
• Main Results:

• Result 1. *Deadline setting helps performance*
  – Self-control Problem: $\beta < 1$
  – (Partial) Sophistication: $\hat{\beta} < 1$

• Result 2. *Deadline setting sub-optimal*
  – (Partial) Naiveté: $\beta < \hat{\beta}$

• Support for $(\beta, \hat{\beta}, \delta)$ model with partial naiveté
8 Investment Goods: Exercise


- Exercise as an investment good

- Present-Bias: Temptation not to exercise
Choice of flat-rate vs. per-visit contract

• **Contractual elements:** Per visit fee $p$, Lump-sum periodic fee $L$

• **Menu of contracts**
  - Flat-rate contract: $L > 0$, $p = 0$
  - Pay-per-visit contract: $L = 0$, $p > 0$

• **Health club attendance**
  - Immediate cost $c_t$
  - Delayed health benefit $h > 0$
  - Uncertainty: $c_t \sim G$, $c_t$ i.i.d. $\forall t$. 
Attendance decision.

- Long-run plans at time $0$:
  
  Attend at $t \iff \beta \delta^t (-p - c_t + \delta h) > 0 \iff c_t < \delta h - p$.

- Actual attendance decision at $t \geq 1$:
  
  Attend at $t \iff -p - c_t + \beta \delta h > 0 \iff c_t < \beta \delta h - p$. (Time Incons.)
  
  Actual $P(\text{attend}) = G(\beta \delta h - p)$

- Forecast at $t = 0$ of attendance at $t \geq 1$:
  
  Attend at $t \iff -p - c_t + \hat{\beta} \delta h > 0 \iff c_t < \hat{\beta} \delta h - p$. (Naiveté)
  
  Forecasted $P(\text{attend}) = G(\hat{\beta} \delta h - p)$
Choice of contracts at enrollment

**Proposition 1.** If an agent chooses the flat-rate contract over the pay-per-visit contract, then

\[
a(T) L \leq pTG(\beta \delta h) + (1 - \hat{\beta}) \delta h T \left( G(\hat{\beta} \delta h) - G(\hat{\beta} \delta h - p) \right) \\
+ pT \left( G(\hat{\beta} \delta h) - G(\beta \delta h) \right)
\]

**Intuition:**
1. *Exponentials* \((\beta = \hat{\beta} = 1)\) pay at most \(p\) per expected visit.

2. *Hyperbolic* agents may pay more than \(p\) per visit.
   - (a) *Sophisticates* \((\beta = \hat{\beta} < 1)\) pay for commitment device \((p = 0)\). Align actual and desired attendance.
   - (b) *Naïves* \((\beta < \hat{\beta} = 1)\) overestimate usage.
- Estimate average attendance and price per attendance in flat-rate contracts

<table>
<thead>
<tr>
<th>Month</th>
<th>Average price per month (1)</th>
<th>Average attendance per month (2)</th>
<th>Average price per average attendance (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month 1</td>
<td>55.23</td>
<td>3.45</td>
<td>16.01</td>
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<tr>
<td></td>
<td>(0.80)</td>
<td>(0.13)</td>
<td>(0.66)</td>
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<td>N = 829</td>
<td>N = 829</td>
<td>N = 829</td>
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<tr>
<td>Month 2</td>
<td>80.65</td>
<td>5.46</td>
<td>14.76</td>
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<tr>
<td></td>
<td>(0.45)</td>
<td>(0.19)</td>
<td>(0.52)</td>
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<td>N = 758</td>
<td>N = 758</td>
<td>N = 758</td>
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<tr>
<td>Month 3</td>
<td>70.18</td>
<td>4.89</td>
<td>14.34</td>
</tr>
<tr>
<td></td>
<td>(1.05)</td>
<td>(0.18)</td>
<td>(0.58)</td>
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<tr>
<td></td>
<td>N = 753</td>
<td>N = 753</td>
<td>N = 753</td>
</tr>
<tr>
<td>Month 4</td>
<td>81.79</td>
<td>4.57</td>
<td>17.89</td>
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<tr>
<td></td>
<td>(0.26)</td>
<td>(0.19)</td>
<td>(0.75)</td>
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<td></td>
<td>N = 728</td>
<td>N = 728</td>
<td>N = 728</td>
</tr>
<tr>
<td>Month 5</td>
<td>81.93</td>
<td>4.42</td>
<td>18.53</td>
</tr>
<tr>
<td></td>
<td>(0.25)</td>
<td>(0.19)</td>
<td>(0.80)</td>
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<tr>
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<td>N = 701</td>
<td>N = 701</td>
<td>N = 701</td>
</tr>
<tr>
<td>Month 6</td>
<td>81.94</td>
<td>4.32</td>
<td>18.95</td>
</tr>
<tr>
<td></td>
<td>(0.29)</td>
<td>(0.19)</td>
<td>(0.84)</td>
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<td>N = 607</td>
<td>N = 607</td>
<td>N = 607</td>
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<tr>
<td>Months 1 to 6</td>
<td>75.26</td>
<td>4.36</td>
<td>17.27</td>
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<tr>
<td></td>
<td>(0.27)</td>
<td>(0.14)</td>
<td>(0.54)</td>
</tr>
<tr>
<td></td>
<td>N = 866</td>
<td>N = 866</td>
<td>N = 866</td>
</tr>
</tbody>
</table>

Users initially enrolled with a monthly contract.

Users initially enrolled with an annual contract, who joined at least 14 months before the end of sample period.

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Average price per month (1)</th>
<th>Average attendance per month (2)</th>
<th>Average price per average attendance (3)</th>
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<tbody>
<tr>
<td></td>
<td>66.32</td>
<td>4.36</td>
<td>15.22</td>
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<td>(0.37)</td>
<td>(0.36)</td>
<td>(1.25)</td>
</tr>
<tr>
<td></td>
<td>N = 145</td>
<td>N = 145</td>
<td>N = 145</td>
</tr>
</tbody>
</table>
• Result is not due to small number of outliers
• 80 percent of people would be better off in pay-per-visit
Choice of contracts over time

- Choice at enrollment explained by sophistication or naïveté
- And over time? We expect some switching to payment per visit
- **Annual contract.** Switching after 12 months
• **Monthly contract.** No evidence of selective switching

B. Price per average attendance  
(Monthly contracts with monthly fee ≥ $70)

• **Puzzle.** Why the different behavior?
• Simple Explanation – Again the power of defaults
  
  – Switching out in monthly contract takes active effort
  
  – Switching out in annual contract is default

• Model this as for 401(k)s with cost $k$ of effort and benefit $b$ (lower fees)

• In DellaVigna and Malmendier (2006), model with stochastic cost $k \sim N(15, 4)$

• Assume $\delta = .9995$ and $b = $1 (low attendance – save $1 per day)

• How may days on average would it take between last attendance and contract termination? Observed: 2.31 months
- Calibration for different $\beta$ and different types

A. Simulated expected number of days before a monthly member switches to payment per visit. Assumptions: cost $k \sim N(15, 4)$, daily savings $s = 1$, and daily discount factor $\delta = 0.9995$. The observed average delay is 2.31 months (70 days) (Finding 4)
• Overall:
  – Present-Biased preferences *with* naiveté organize all the facts
  – Can explain magnitudes, not just qualitative patterns
  – Acland and Levy (2009) elicit incentivized expectations of future gym attendance with ‘p-coupons’: significant over-estimation

• Alternative interpretations
  – *Overestimation of future efficiency.*
  – *Selection effect.* People that sign in gyms are already not the worst procrastinators
  – *Bounded rationality*
  – *Persuasion*
  – *Memory*
9 Next Week

- Present-Bias, Part 3:
  - Leisure Goods: Credit Card Borrowing (Ausubel, 1999)
  - Leisure Goods: Consumption (Laibson, Repetto, and Tobacman, 2006 and Ashraf, Karlan, and Yin)
  - Leisure Goods: Smoking (Gine Karlan, and Zinman, 2010)
  - Summary of the Present-Bias Applications

- Methodological Topic 2: Errors in Applying \((\beta, \delta)\) model