Econ 219B
Psychology and Economics: Applications
(Lecture 2)

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Outline

1. Default Effects and Present Bias
2. Default Effects: Alternative Explanations
3. Present Bias and Consumption
4. Investment Goods: Homework
5. Investment Goods: Exercise
6. Investment Goods: Work Effort

1 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 $t+1 \Longrightarrow$ short-run impatience;
  - δ between $t+1$ and $t+2 \Longrightarrow$ 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 τ 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,...) $->$ Invest at $t = 0$

  - (N, N, I, N, N, I, N, N, I,...) $->$ Invest at $t = 2$

  - (N, I, N, N, I, N, N, I, N,...) $->$ 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

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

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

  - 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

$$\frac{\beta b T}{1-\beta} \lessapprox k_N \leq \frac{\delta b}{1-\delta}$$

- **Calibration**

- Cost k_N?
  - Time cost: 3 hours
  - $k_N \approx 3 * \$12 = \$36$

- Benefit b?
  - Consume today $(t = T_0)$ with tax rate τ_0, or at retirement $(t = T_R)$ with tax rate τ_R
  - Compare utility at T_0 and at T_R:
    * Spend S additional dollars at T_0: $U'(C_0) * (1 - \tau_0)$
    * Save, get firm match α, and spend S dollars at T_R: $\delta^{T_R - T_0} U'(C_R) * (1 + r)^{T_R - T_0} (1 - \tau_R)(1 + \alpha) S$
  - Assumptions: $U'(C_0) = U'(C_R)$ and $\delta = 1/(1 + r)$

– b is net utility gain from delayed consumption of S:

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

– 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))

– $b \approx [.3 + .5 - .2 * (1.5)] S = .5S =$ \$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 $\delta^{365} = .97, \delta b/(1-\delta) = 10,000 * b$

  - For $\delta^{365} = .9, \delta b/(1-\delta) = 3,464 * b$

  - 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 $\beta = .9$, $\bar{T} = 36/(9 * 2.5) \approx 2$ days
  - For $\beta = .8$, $\bar{T} = 36/(4 * 2.5) \approx 4$ days
  - For $\beta = .5$, $\bar{T} = 36/2.5 \approx 14$ 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

$$k_N \lessapprox \frac{\beta T b}{(1-\beta)}$$

  - For $T = 1$ (I'll do it tomorrow), investment if $36 < 2.5 * \beta / (1-\beta)$
    - $\beta = .8$ (or .5) –>Procrastination since $36 > 2.5 * 4$ (or $36 > 2.5$)
  - For $T = 7$ (I'll do it next week), investment if $36 < 5.6 * \beta / (1-\beta)$
    - $\beta = .8$ –>Investment since $36 < 7 * 2.5 * 4$
    - $\beta = .5$ –>Procrastination since $36 > 7 * 2.5$
  - 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 $k_C = 0$
  - [$T = 360$ under ACTIVE]

- Predictions:
  - Exponentials and Sophisticates:
    - Predicted enrollment: $\text{OLD2} \simeq \text{OLD} \simeq \text{ACTIVE} \simeq \text{NEW}$
  - Naives:
    - $0 < k_C < k_A$ −> Predicted enrollment: $\text{OLD2} = \text{OLD} << \text{ACTIVE} \leq \text{NEW}$
    - [Move from $T = 360$ (ACTIVE) to $T = 1$ (OLD2) −> Predicted enrollment: $\text{OLD} = \text{OLD2} < \text{ACTIVE}$

- **Fact 3. Active Choice resembles Default Investment (**$\text{OLD} << \text{ACTIVE} \simeq \text{NEW}$

- 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 $k \sim K$ –> 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 $k^n = \beta k^e$
  - –> Investment probability of exponential agent: $\Pr(k \leq k^e)$
  - –> Investment probability of naive agent: $\Pr(k \leq \beta k^e)$

- This implies that distribution of k has important effect on delay –> Left tail is thin implies larger delays for naives

2 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 + naiveté

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?

3 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

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

- *Naiveté* (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:

     – Homework and Task Completion (Ariely and Wertenbroch, *PS* 2002)

     – Exercise (DellaVigna and Malmendier, *QJE* 2006)

     – Work Effort (Kaur, Kremer, and Mullainathan 2013)

  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)

     – Smoking (Gine Karlan, and Zinman, 2010, *AEJ Applied*)

4 Investment Goods: Homework

- Wertenbroch-Ariely, "Procrastination, Deadlines, and Performance", *Psychological Science,* 2002.

- 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)

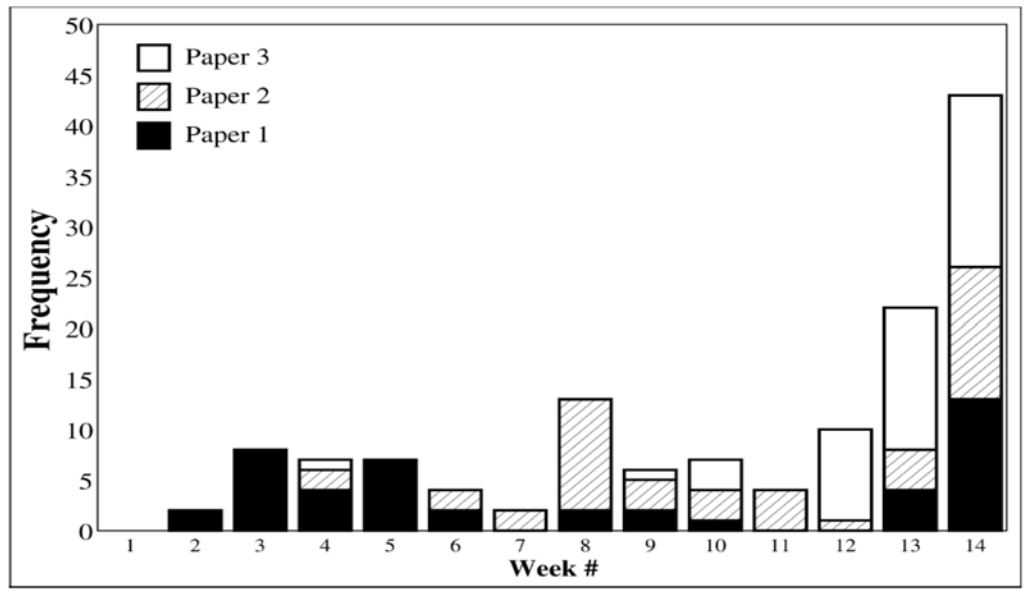


Fig. 1. Frequency distribution of the declared deadlines in Study 1 as a function of the week of class (Week 1 is the first week, and Week 14 the last week), plotted separately for the three papers.

- 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: $A > C > B$

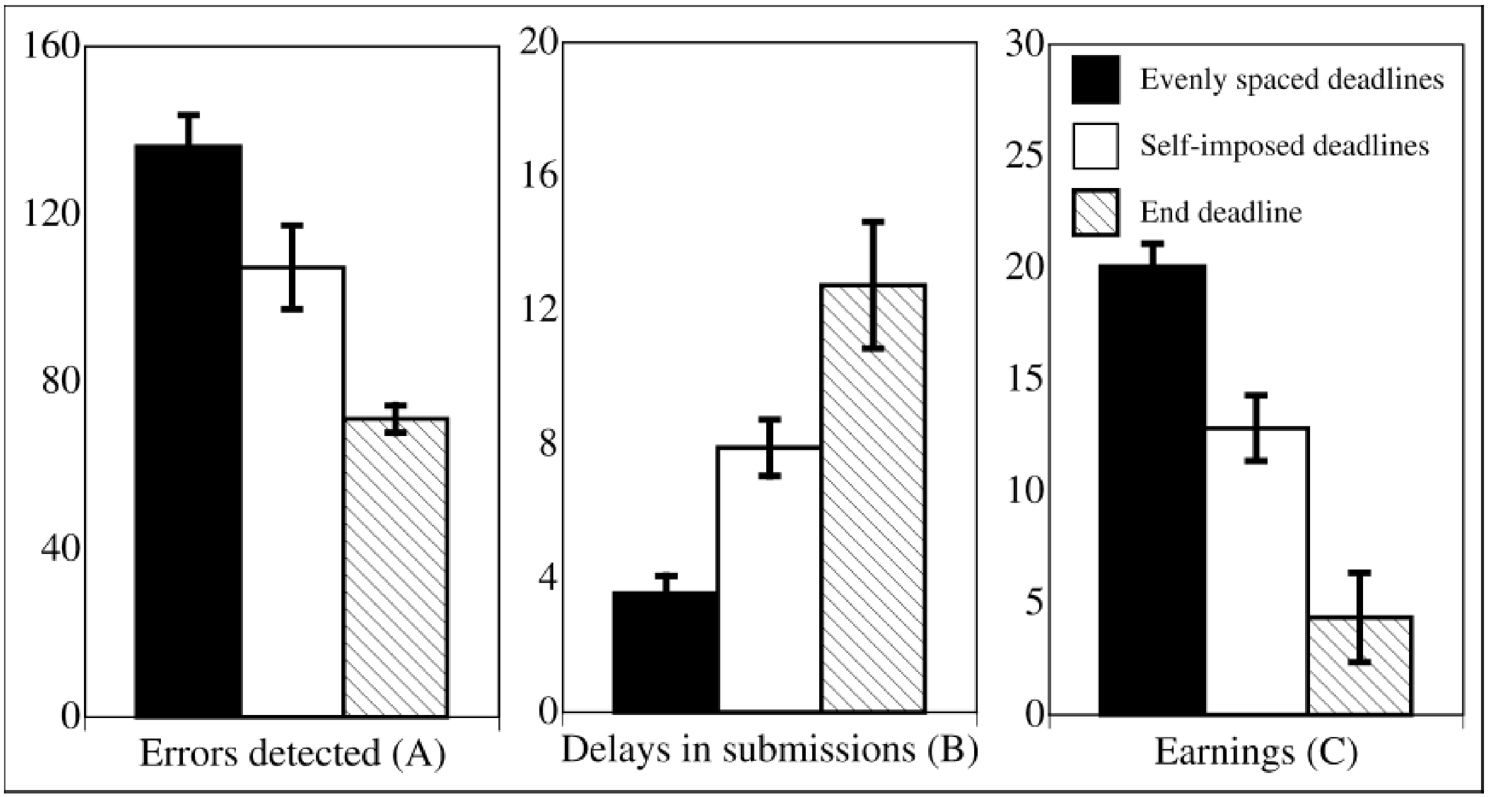


Fig. 2. Mean errors detected (a), delays in submissions (b), and earnings (c) in Study 2, compared across the three conditions (error bars are based on standard errors). Delays are measured in days, earnings in dollars.

- 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

5 Investment Goods: Exercise

- DellaVigna, Malmendier, "Paying Not To Go To The Gym" *American Economic Review*, 2006

- 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

$$\begin{aligned} a(T)L \leq & \quad pTG(\beta\delta h) \\ & + (1-\hat{\beta})\delta hT\left(G(\hat{\beta}\delta h) - G(\hat{\beta}\delta h - p)\right) \\ & + pT\left(G(\hat{\beta}\delta h) - G(\beta\delta h)\right) \end{aligned}$$

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 3—PRICE PER AVERAGE ATTENDANCE AT ENROLLMENT

	Sample: No subsidy, all clubs		
	Average price per month (1)	Average attendance per month (2)	Average price per average attendance (3)
	Users initially enrolled with a monthly contract		
Month 1	55.23	3.45	16.01
	(0.80)	(0.13)	(0.66)
	N = 829	N = 829	N = 829
Month 2	80.65	5.46	14.76
	(0.45)	(0.19)	(0.52)
	N = 758	N = 758	N = 758
Month 3	70.18	4.89	14.34
	(1.05)	(0.18)	(0.58)
	N = 753	N = 753	N = 753
Month 4	81.79	4.57	17.89
	(0.26)	(0.19)	(0.75)
	N = 728	N = 728	N = 728
Month 5	81.93	4.42	18.53
	(0.25)	(0.19)	(0.80)
	N = 701	N = 701	N = 701
Month 6	81.94	4.32	18.95
	(0.29)	(0.19)	(0.84)
	N = 607	N = 607	N = 607
Months 1 to 6	75.26	4.36	17.27
	(0.27)	(0.14)	(0.54)
	N = 866	N = 866	N = 866
	Users initially enrolled with an annual contract, who joined at least 14 months before the end of sample period		
Year 1	66.32	4.36	15.22
	(0.37)	(0.36)	(1.25)
	N = 145	N = 145	N = 145

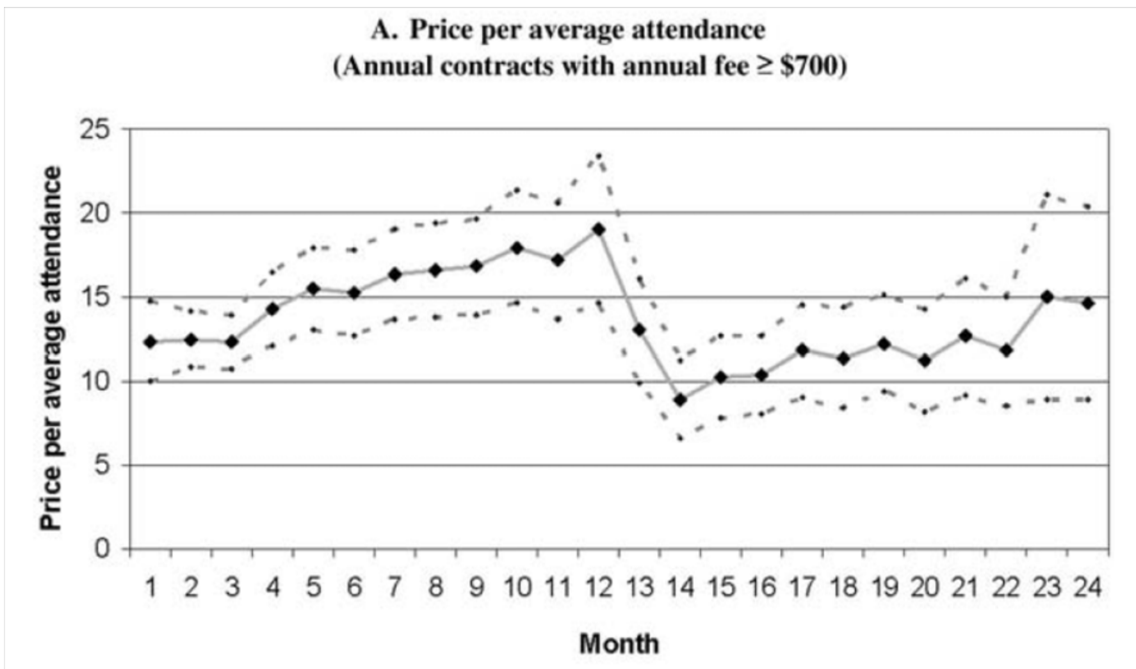
- Result is not due to small number of outliers
- 80 percent of people would be better off in pay-per-visit

TABLE 4—DISTRIBUTION OF ATTENDANCE AND PRICE PER ATTENDANCE AT ENROLLMENT

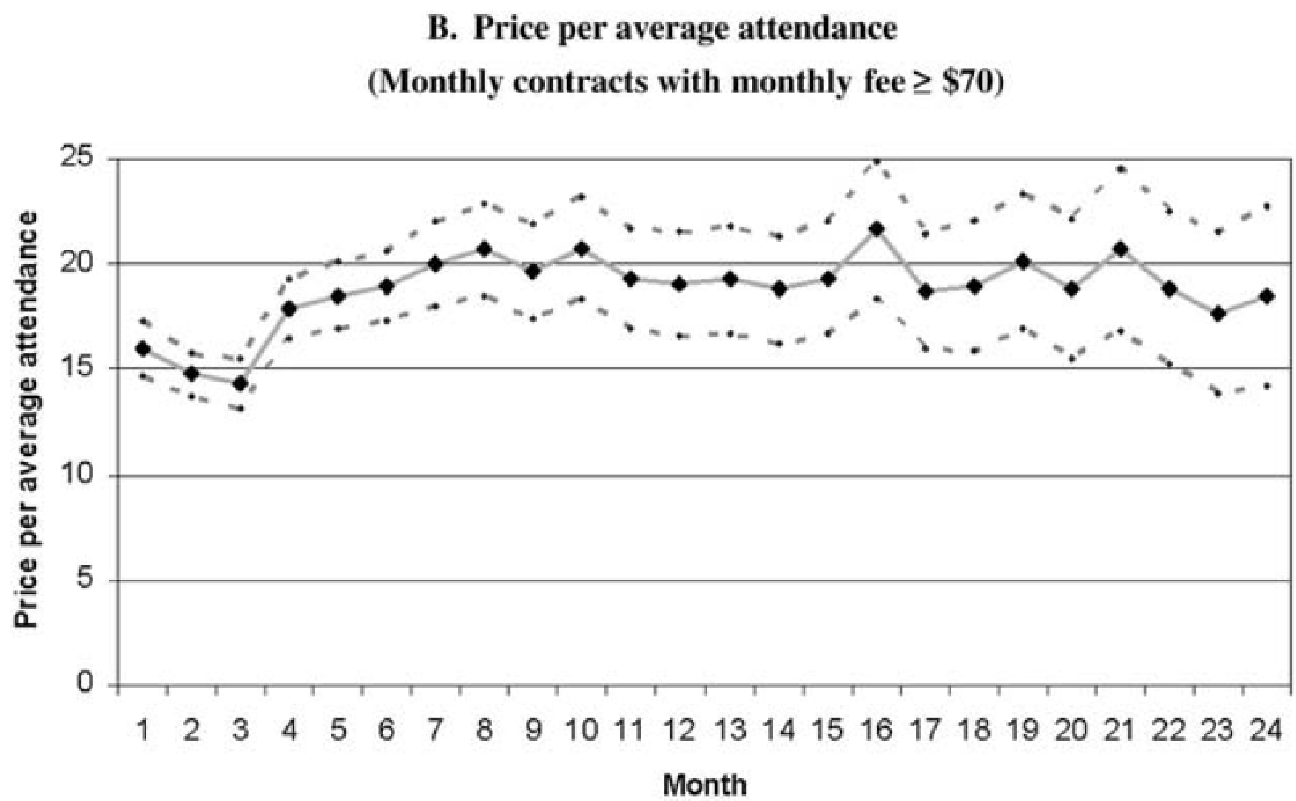
	Sample: No subsidy, all clubs			
	First contract monthly, months 1–6 (monthly fee ≥ $70)		First contract annual, year 1 (annual fee ≥ $700)	
	Average attendance per month (1)	Price per attendance (2)	Average attendance per month (3)	Price per attendance (4)
Distribution of measures				
10th percentile	0.24	7.73	0.20	5.98
20th percentile	0.80	10.18	0.80	8.81
25th percentile	1.19	11.48	1.08	11.27
Median	3.50	21.89	3.46	19.63
75th percentile	6.50	63.75	6.08	63.06
90th percentile	9.72	121.73	10.86	113.85
95th percentile	11.78	201.10	13.16	294.51
	N = 866	N = 866	N = 145	N = 145

Choice of contracts over time

- Choice at enrollment explained by sophistication or naiveté
- And over time? We expect some switching to payment per visit
- **Annual contract.** Switching after 12 months



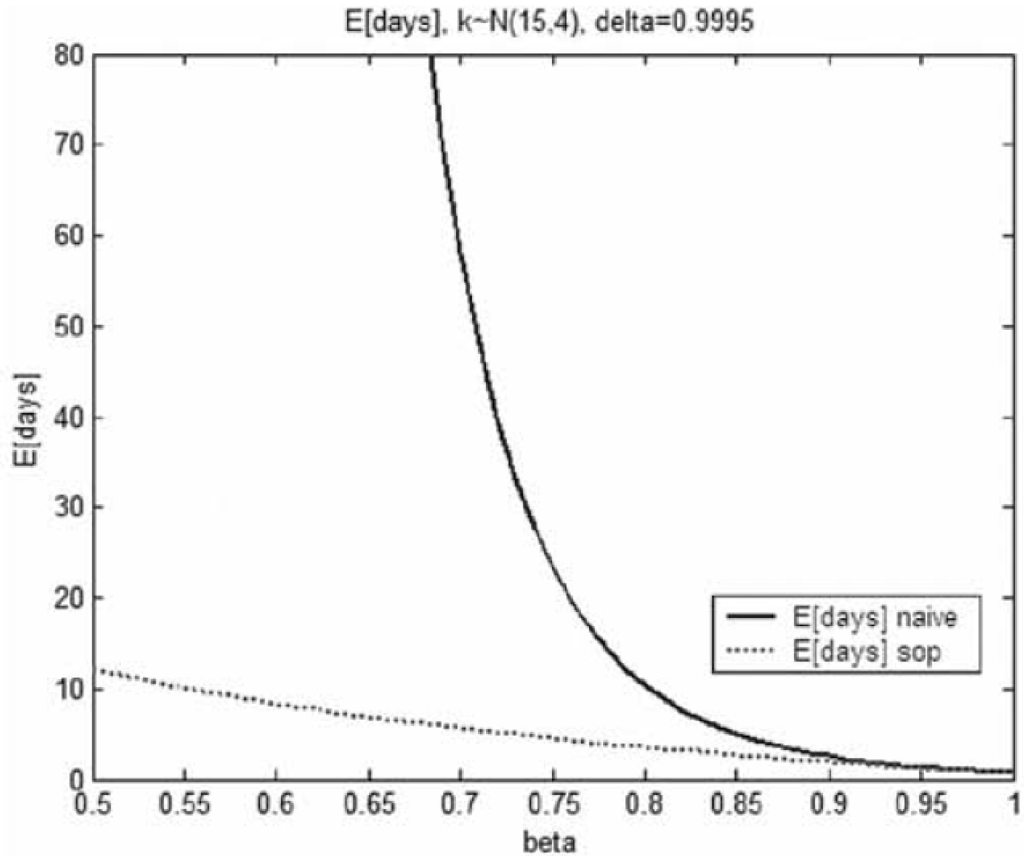
- **Monthly contract.** No evidence of selective switching



- 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 β and different types



A. Simulated expected number of days before a monthly member switches to payment per visit
Assumptions: cost *k~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**

6 Investment Goods: Work Effort

- Kaur, Kremer, and Mullainathan, "Self-Control at Work"
- Setting: workers in India who are paid a piece rate w in a weekly paycheck
- Since effort at work is immediate and benefits delayed, effort at work is an investment good
- Assume β, but set $\delta = 1$
- Consider effort at work e, which costs $-c(e)$, with $c' > 0$, $c'' > 0$
- Assume for special case $c(e) = \gamma e^2/2$
- Two states:
  - high output y_H with probability e –> pay w_H
  - low output y_L with probability $1 - e$ –> pay w_L

- Notice: this is only local approximation, for $e \in [0,1]$

- Pay at $t = 2$

- If working at $t = 1$, maximize

$$\max_e \beta \left[e w_H + (1-e) w_L \right] - c(e)$$

  - f.o.c.

$$\beta \left[w_H - w_L \right] - c'(e^*) = 0$$

  - Effort e^* increases in $w_H - w_L$ and in β
  - Special case:

$$e^* = \frac{\beta \left[w_H - w_L \right]}{\gamma}$$

- If working at $t = 2$ (same period as payday), optimal effort is

$$\left[w_H - w_L \right] - c'(e^*) = 0$$

- **Prediction 1.** Effort is higher near payday for $\beta < 1$
- From $t = 0$ perspective, utility from working at $t = 1$ is

$$V_0 = e^* w_H + (1 - e^*) w_L - c(e^*)$$

  - Effect of altering w_L on $t = 0$ welfare is

$$\begin{aligned} \frac{dV_0}{dw_L} &= (1 - e^*) + \frac{de^*}{dw_L} \Big[[w_H - w_L] - c'(e^*) \Big] = \\ &= (1 - e^*) + \frac{de^*}{dw_L} [(1 - \beta) [w_H - w_L]] \end{aligned}$$

  - First term is direct effect on pay: lowering w_L lowers pay and thus welfare
  - The second term is the effect on incentive, which is zero for $\beta = 1$, by the envelope theorem – but envelope theorem **does not apply** for $\beta < 1$. Indeed, second term is negative

- Special case:

$$\frac{dV_0}{dw_L} = 1 - \frac{\beta\,[w_H - w_L]}{\gamma} - \frac{\beta\,(1-\beta)\,[w_H - w_L]}{\gamma}$$

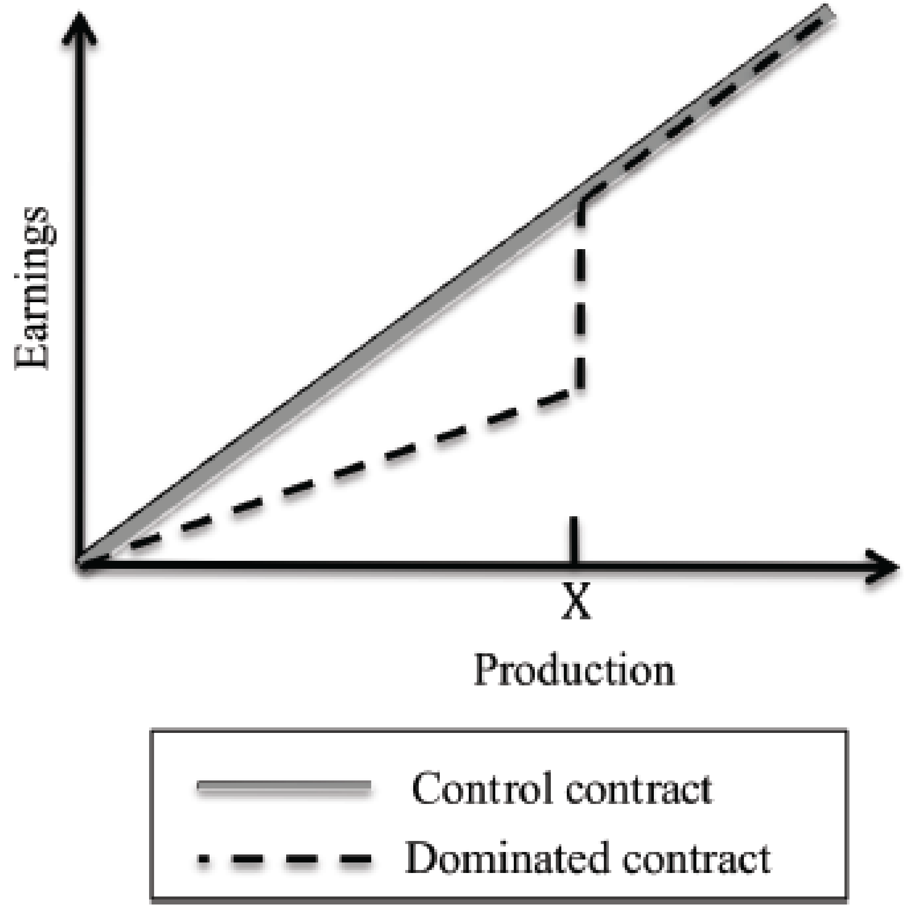
- Second term becomes large as β goes below 1 and is highest at $\beta = 1/2$
- If large enough, individual wants commitment device, prefers w_L low

- **Proposition 2.** Individual with $\beta < 1$ may prefer commitment device (low w_L)

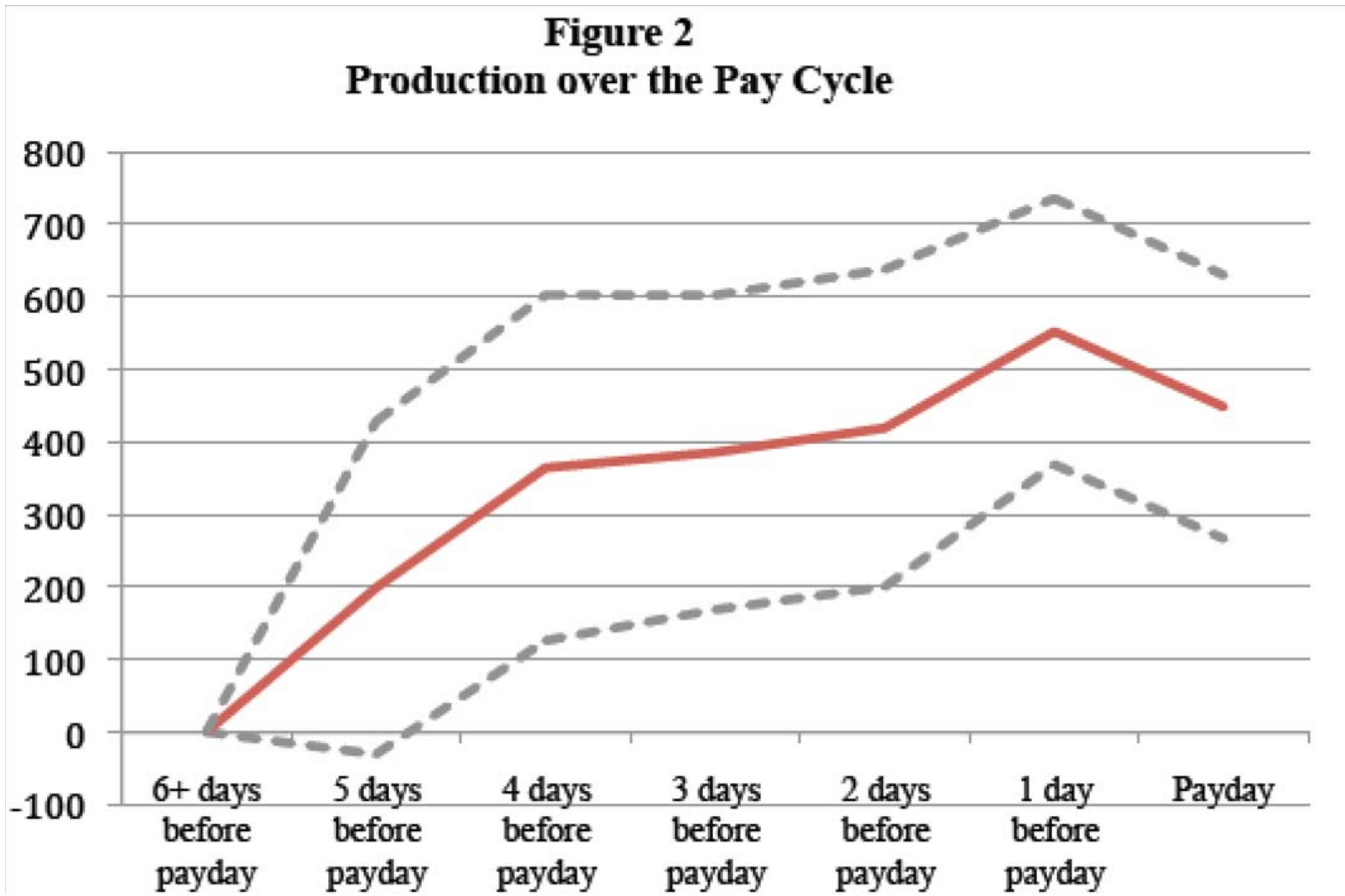
- **Proposition 3.** If there are both types with $\beta = 1$ and $\beta < 1$, demand for commitment should be associated with a payday cycle

- Field experiment in India
  - Randomization of pay date (Tu, Th, Sa) to test proposition 1 unconfounded with day-of-week effects
  - Randomization of availability of commitment device: get paid $w/2$ instead of w if miss production target
  - Randomization of whether choice is made evening before, or morning of

Figure 1
Incentive Contracts



- **Prediction 1.** Evidence of pay cycle in effort



- **Prediction 2.** Quite significant take-up of commitment contract

Figure 3
Take-up of Dominated Contracts: Distribution of Worker Means

Table 4
Treatment Effects of Contract Assignment on Worker Production

	Dependent variable: Production				*Dependent variable: Attendance*			
Observations	All obs	All obs	Control & Choice	Control & Choice	All obs	All obs	Control & Choice	Control & Choice
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Assignment to choice	111		120		0.007		0.007	
	(59)*		(59)**		(0.009)		(0.009)	
Assignment to evening choice		150		156		0.01		0.014
		(69)**		(69)**		(0.01)		(0.010)
Assignment to morning choice		73		84		-0.00		0.001
		(69)		(69)		(0.01)		(0.010)
Assignment to low target	3	3			-0.002	-0.00		
	(90)	(90)			(0.013)	(0.01)		
Assignment to medium target	213	213			-0.006	-0.01		
	(91)**	(91)**			(0.013)	(0.01)		
Assignment to high target	335	334			-0.005	-0.01		
	(150)**	(150)**			(0.019)	(0.02)		
Worker fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Seat fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Date fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lag production controls	Yes	Yes	Yes	Yes	No	No	No	No
Observations	8423	8423	6310	6310	8423	8423	6310	6310
R2	0.59	0.59	0.60	0.60	0.15	0.15	0.11	0.11
Dependent variable mean	5337	5337	5311	5311	0.88	0.88	0.88	0.88
Proportion choosing a positive target (conditional on attendance)	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Proportion choosing a positive target (target=0 when absent)	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28

- **Prediction 3.** Correlation between payday effect and take-up of commitment, as well as with productivity effect

Table 5
Heterogeneity in Take-up of Dominated Contracts: Correlation with Payday Impact

Dependent variable	*Target level chosen*	*Positive target indicator*
	(1)	(2)
High payday production impact	353	0.138
	(129)***	(0.044)***
Seat fixed effects	Yes	Yes
Date fixed effects	Yes	Yes
Lag production controls	Yes	Yes
Observations	4098	4098
R2	0.22	0.20
Dependent variable mean	759	0.28

Table 6

Heterogeneity in Contract Treatment Effects: Correlation with Payday Impact

Dependent variable	*Production*	*Production*	*Production*	*Attendance*	*Attendance*	*Attendance*
	(1)	(2)	(3)	(4)	(5)	(6)
Assignment to choice	118	-69	-146	0.007	-0.016	-0.028
	(60)*	(74)	(84)*	(0.009)	(0.010)	(0.011)**
Assignment to choice *		482	735		0.058	0.091
High payday production impact		(126)***	(144)***		(0.019)***	(0.022)***
Assignment to choice *			401			0.064
Payday			(179)**			(0.024)***
Assignment to choice * Payday *			-1314			-0.178
High payday production impact			(288)***			(0.041)***
Assignment to a target	153	-35	-48	-0.003	-0.019	-0.024
	(71)**	(86)	(96)	(0.010)	(0.012)*	(0.013)*
Assignment to a target *		483	673		0.042	0.066
High payday production impact		(148)***	(168)***		(0.022)*	(0.025)***
Assignment to a target *			68			0.026
Payday			(219)			(0.029)
Assignment to target * Payday *			-972			-0.120
High payday production impact			(348)***			(0.049)***
Payday			-183			-0.009
			(153)			(0.021)
High payday impact *			1178			0.164
Payday			(234)***			(0.032)***
Worker fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Seat fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Date fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Lag production controls	Yes	Yes	Yes	No	No	No
Observations	8240	8240	8240	8240	8240	8240
R2	0.60	0.59	0.59	0.11	0.11	0.11
Dependent variable mean	5355	5355	5355	0.875	0.875	0.875

- Evidence very consistent with model of self-control problems and (at least partial) sophistication
- Discount factor is not $\beta - \delta$, but smoother decay (true hyperbolic)
- Significant demand of commitment device – different than some of other settings, see later
- Correlation with underlying measure of self-control
- Great evidence in important setting

7 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 (β, δ) model