Econ 219B
Psychology and Economics: Applications
(Lecture 3)

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February 1, 2012

Outline

1. Investment Goods: Work Effort
2. Leisure Goods: Credit Card Borrowing
3. Leisure Goods: Consumption and Savings I (Life-cycle)
4. Leisure Goods: Consumption and Savings II (Commitments)
5. Methodology: Commitment Field Experiment Designs
6. Methodology: Errors in Applying Present-Biased Preferences
7. Seven More Applications of Present Bias

1 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 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

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

- 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 paydate), optimal effort is

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

- **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

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

  - 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:

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

- Second term becomes large as β goes below 1 and is highest at $\beta = 1/2$

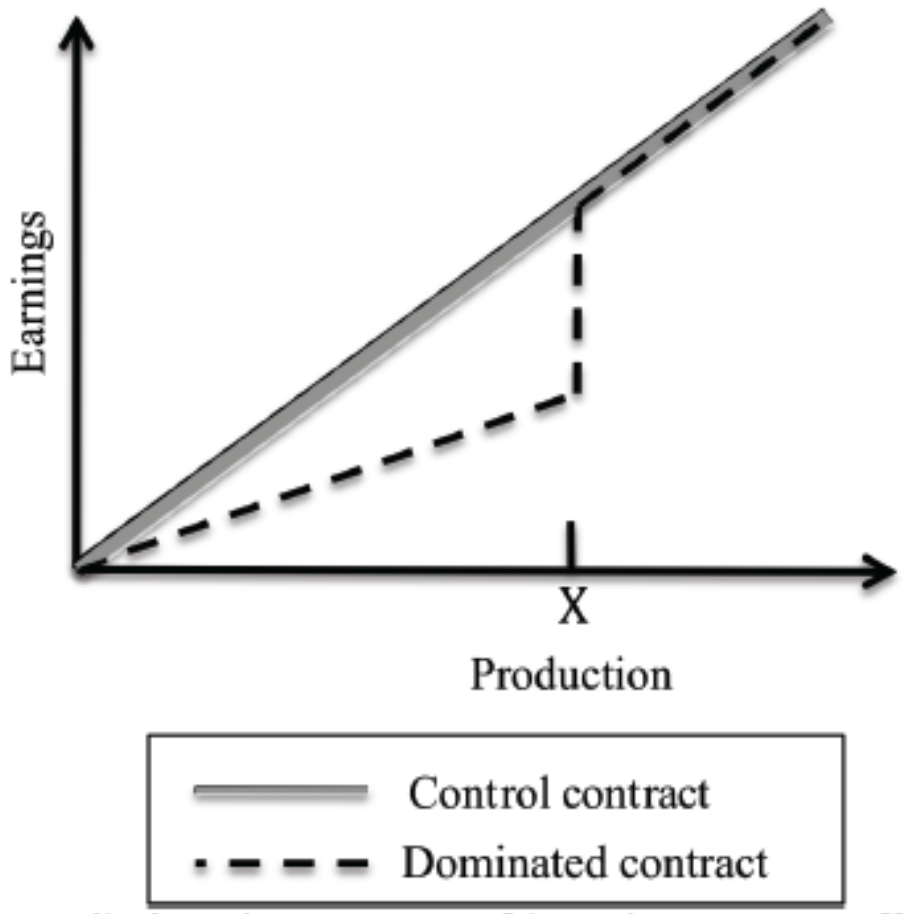
- If large enough, individual wants commitment device, prefers w_L low

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

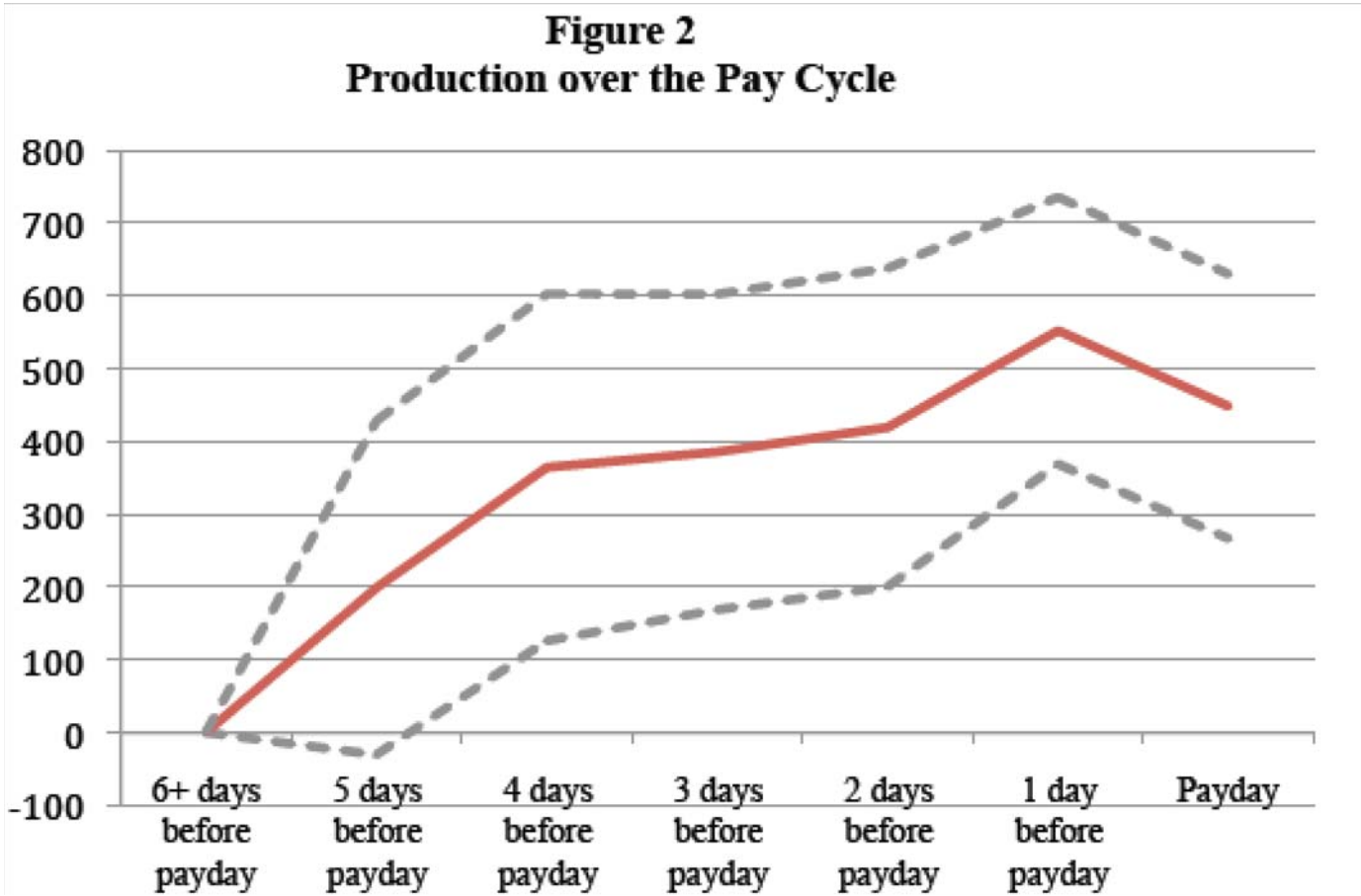
- **Proposition 3.** If there are both types with $\beta = 1$ and $\beta < 1$, demand for commitment should be associated with a payday cycle

- 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

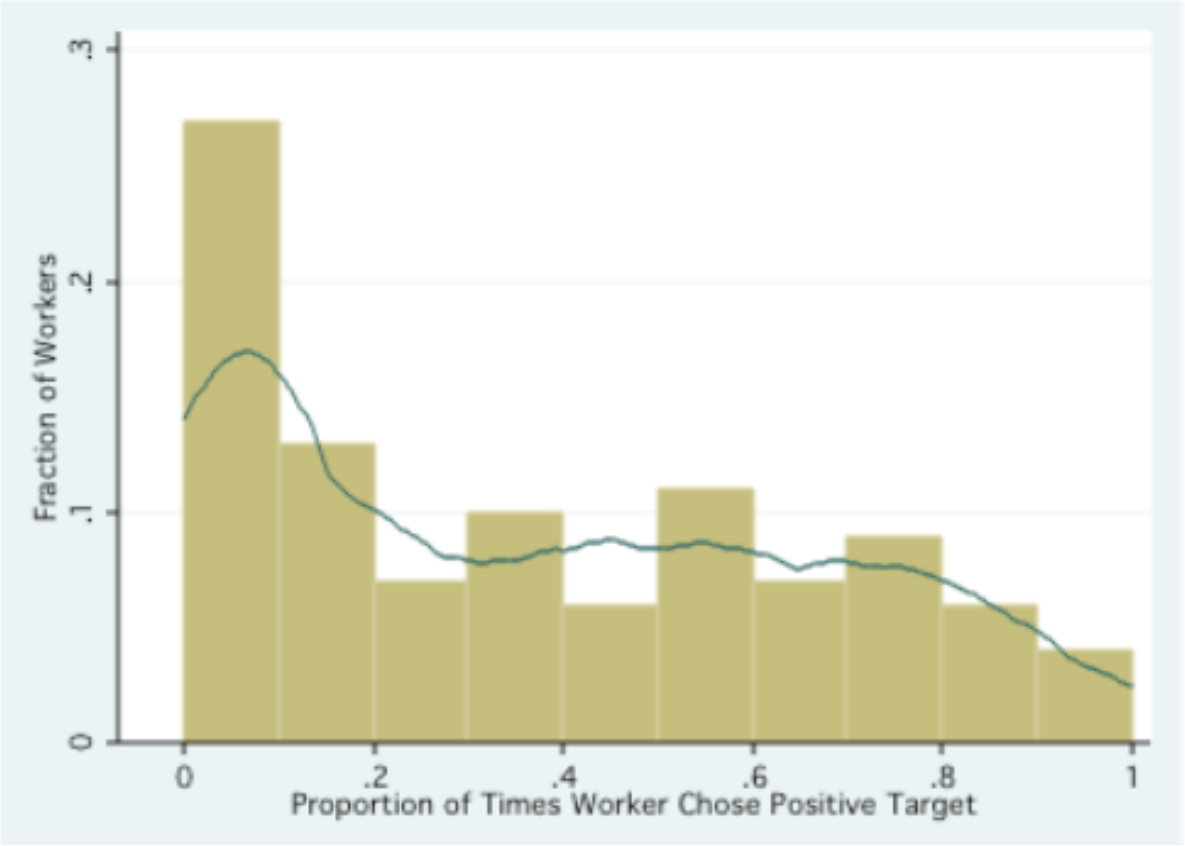


Table 4

Treatment Effects of Contract Assignment on Worker Production

Observations	*Dependent variable: Production*				*Dependent variable: Attendance*			
	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

2 Leisure Goods: Credit Card Borrowing

- Ausubel, “Adverse Selection in Credit Card Market"
- Joint-venture company-researcher
- Field Experiment: Randomized mailing of two million solicitations!
- Follow borrowing behavior for 21 months
- Variation of:
  - pre-teaser interest rate r_0: 4.9% to 7.9%
  - post-teaser interest rate r_1: Standard - 4% to Standard $+4\%$
  - Duration of teaser period T_s (measured in years)

- Part of the randomization – Incredible sample sizes. How much would this cost to run? Millions

TABLE 1: SUMMARY OF MARKET EXPERIMENTS

MARKET EXPERIMENT	MARKET CELL	NUMBER OF SOLICITATIONS MAILED	EFFECTIVE RESPONSE RATE	PERCENT GOLD CARDS	AVERAGE CREDIT LIMIT
MKT EXP I	A: 4.9% Intro Rate 6 months	100,000	1.073%	83.97%	$6,446
MKT EXP I	B: 5.9% Intro Rate 6 months	100,000	0.903%	80.18%	$6,207
MKT EXP I	C: 6.9% Intro Rate 6 months	100,000	0.687%	80.06%	$5,973
MKT EXP I	D: 7.9% Intro Rate 6 months	100,000	0.645%	76.74%	$5,827
MKT EXP I	E: 6.9% Intro Rate 9 months	100,000	0.992%	81.15%	$6,279
MKT EXP I	F: 7.9% Intro Rate 12 months	100,000	0.944%	82.31%	$6,296

- Another set of experiments:

MKT EXP III	A: Post-Intro Rate Standard - 4%	100,000	1.015%	82.96%	$5,666
MKT EXP III	B: Post-Intro Rate Standard - 2%	100,000	0.928%	77.69%	$5,346
MKT EXP III	C: Post-Intro Rate Standard + 0%	100,000	0.774%	76.87%	$5,167
MKT EXP III	D: Post-Intro Rate Standard + 2%	100,000	0.756%	76.98%	$5,265
MKT EXP III	E: Post-Intro Rate Standard + 4%	100,000	0.633%	73.62%	$5,095

- Setting:
  - Individual has initial credit card (r_0^0, r_1^0, T_s^0). Balances: b_0 pre-teaser, b_1 post-teaser
  - Credit card offers: (r_0', r_1', T_s')
- Decision to take-up new credit card:
  - switching cost $k > 0$
  - approx. saving in pre-teaser rates (T_s years): $T_s \left(r_0' - r_0^0\right) b_0$
  - approx. saving in post-teaser rates ($21/12 - T_s$ years): $(21/12 - T_s)\,(r_1^{'} - r_1) b_1$
- Net benefit of switching:

$$NB' = -k + T_s \left(r_0^{'} - r_0^0\right) b_1 + (21/12 - T_s) \left(r_1^{'} - r_1^0\right) b_1$$

- Switch if $NB + \varepsilon > 0$

- Take-up rate R is function of attractiveness NB:

$$R = R(NB), \; R' > 0$$

- Compare take-up rate of card i, R^i, to take-up rate of Standard Card St, R^{St}
  - Standard Card (6.9% followed by 16%) (Card C above)

- Assume R (approximately) linear in a neighborhood of NB^{St}, that is,

$$R\left(NB^i\right) = R\left(NB^{St}\right) + R'_{NB}\left(NB^i - NB^{St}\right)$$

- Compare cards Pre and St that differ only in interest rate r_0 (pre-teaser)
- Assume $b_0^{Pre} = b_0^{St} = b_0$ (Pre-teaser balance) $\approx \$2,000$
- Difference in attractiveness:

$$R\left(NB^{Pre}\right) - R\left(NB^{St}\right) = R'_{NB} T_s \left(r_0^{Pre} - r_0^{St}\right) b_0$$

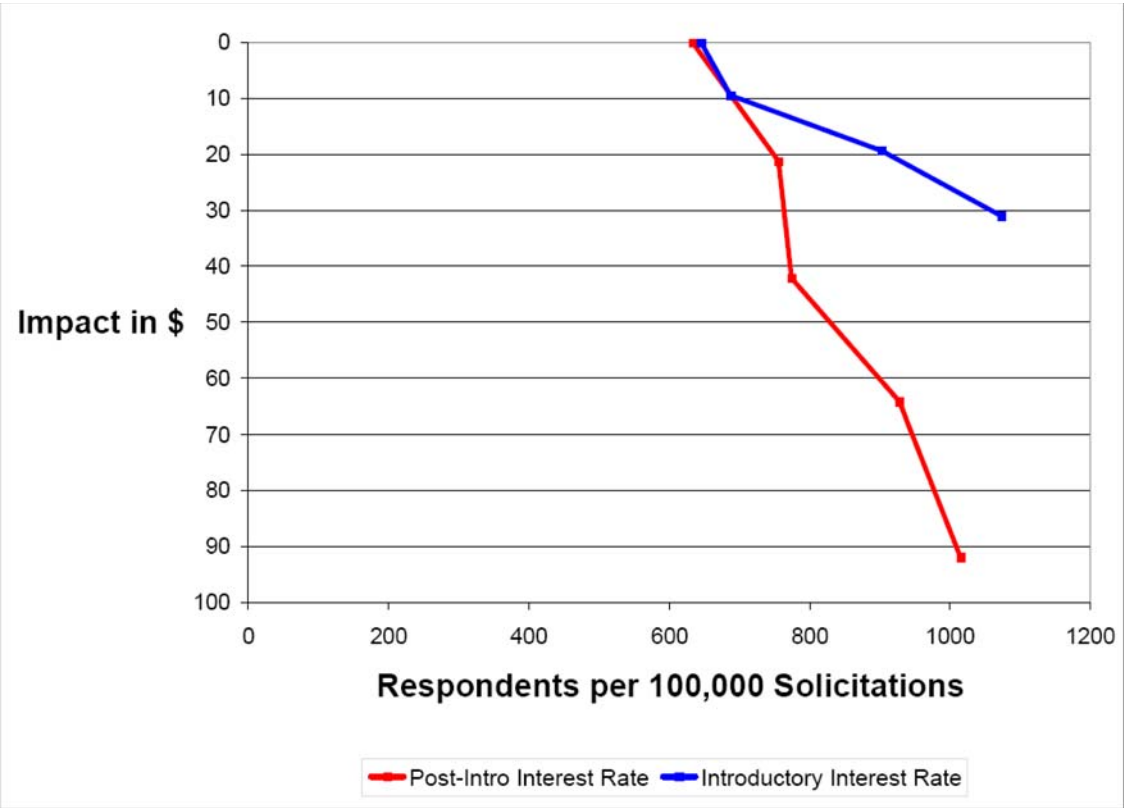
  - Pre-Teaser Offer (Card A): (4.9% followed by 16%)
    - $NB^{Pre} - NB^{St} \approx 6/12 * 2\% * \$2,000 = \$20$
    - $R\left(NB^{Pre}\right) - R\left(NB^{St}\right) =$ 386 out of 100,000

- Compare cards $Post$ and St that differ only in interest rate r_1 (post-teaser)
- Assume $b_1^{Post} = b_1^{St} = b_1$ (Post-teaser balance) $\approx \$1,000$
- Difference in attractiveness:

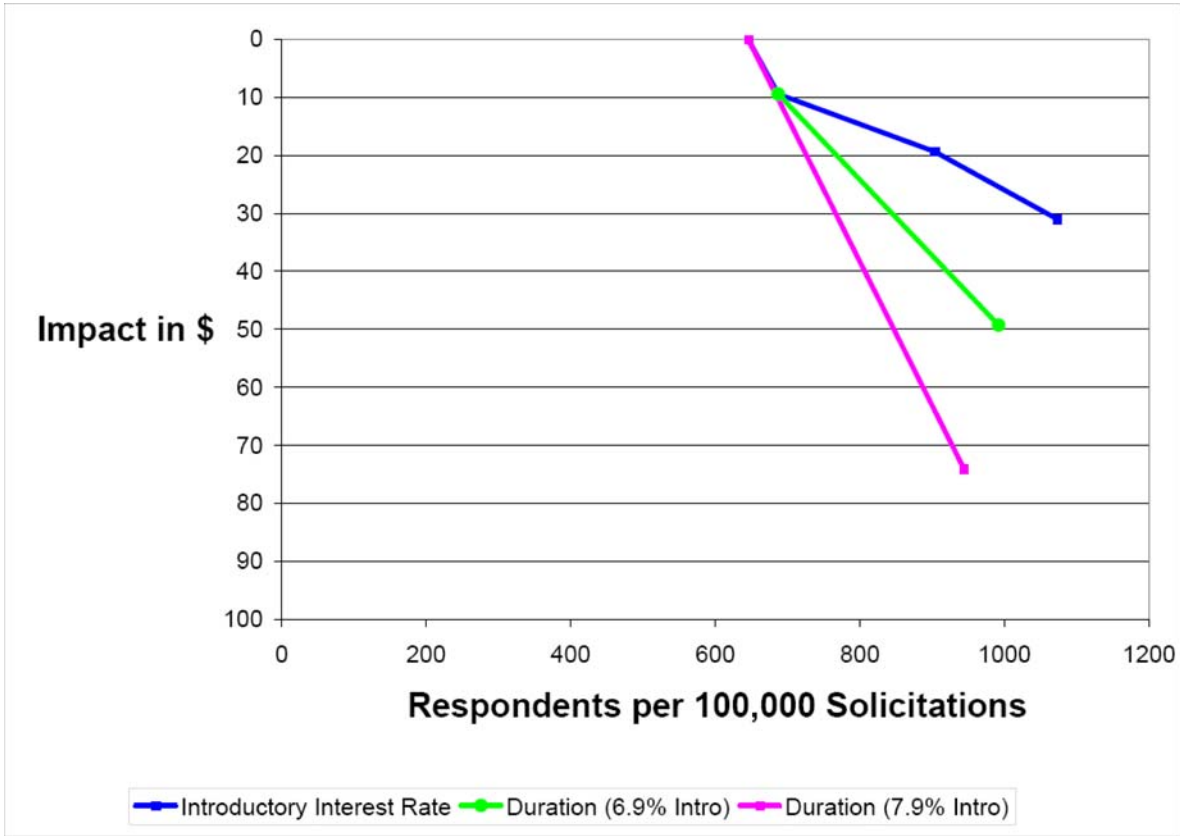
$$R(NB^{Post}) - R(NB^{St}) = R'_{NB}\,(21/12 - T_s)\left(r_1^{Post} - r_1^{St}\right) b_1$$

  - Post-Teaser Offer (Card B in Exp. III): (6.9% followed by 14%)
    - $NB^{Post} - NB^{St} \approx 15/12 * 2\% * \$1000 = \$25$
    - $R(NB^{Post}) - R(NB^{St}) =$ 154 out of 100,000
- Puzzle:
  - $NB^{Post} - NB^{St} > NB^{Pre} - NB^{St}$
  - But $R(NB^{Pre}) - R(NB^{St}) >> R(NB^{Post}) - R(NB^{St})$

- Plot NB and $R(NB)$ for different offers
- Figure 1. Compare offers varying in r_0 (flat line) and in r_1 (steep line)



- Very different slope!
- Figure 2. Vary length of teaser period. Similar findings.



- **Figure 1**. People underrespond to post-teaser interest rate.
- Why?
  - truncation at 21 months?
  - (very) high impatience?
  - sophistication?
  - most plausible: naiveté

- Naive time-inconsistent preferences
- Naives overestimate switching to another card (procrastination)
- Naives underestimate post-teaser borrowing: $\hat{b}_1 < b_1$ and $\hat{b}_0 = b_0$
- Compare cards:

$$NB^{Pre} - NB^{St} = T_s \left(r_0^{Pre} - r_0^{St} \right) b_0$$

and

$$\widehat{NB}^{Post} - \widehat{NB}^{St} = (21/12 - T_s) \left(r_1^{Post} - r_1^{St} \right) \hat{b}_1$$

- Underestimate impact of post-teaser interest rates
- Calibration: $\hat{b}_1 \approx (1/3)\, b_1$

- **Figure 2. Variation in T_s.** People underrespond to length of teaser period
- Why?
- Naive agent overestimates probability of switching to another teaser offer

3 Leisure Goods: Consumption and Savings I

- Laibson (1997) to Laibson, Repetto, and Tobacman (2007)
- Leisure Good: Temptation to overconsume at present
- Stylized facts:
  - Low liquid wealth accumulation
  - Extensive credit card borrowing (SCF, Fed, Gross and Souleles 2000)
  - Consumption-income excess comovement (Hall and Mishkin, 1982)
  - Substantial illiquid wealth (housing+401(k)s)

TABLE 1

SECOND-STAGE MOMENTS

Description and Name	$\overline{m}_{J_m}$	$\text{se}(\overline{m}_{J_m})$
% Borrowing on Visa: *"% Visa"*	0.678	0.015
Mean (Borrowing_t / mean(Income_t)): *"mean Visa"*	0.117	0.009
Consumption-Income Comovement: *"CY"*	0.231	0.112
Average weighted $\frac{wealth}{income}$: *"wealth"*	2.60	0.13

Source: Authors' calculations based on data from the Survey of Consumer Finances, the Federal Reserve, and the Panel Study on Income Dynamics. Calculations pertain to households with heads who have high school diplomas but not college degrees. The variables are defined as follows: *% Visa* is the fraction of U.S. households borrowing and paying interest on credit cards (SCF 1995 and 1998); *mean Visa* is the average amount of credit card debt as a fraction of the mean income for the age group (SCF 1995 and 1998, weighted by Fed aggregates); *CY* is the marginal propensity to consume out of anticipated changes in income (PSID 1978-92); and *wealth* is the weighted average wealth-to-income ratio for households with heads aged 50-59 (SCF 1983-1998).

- Reduced-form evidence here not sufficient
- Life-cycle consumption model (Gourinchas and Parker, 2004)
- Assume realistic features:
  - borrowing constraints
  - illiquid assets
  - bequests...

- Two steps of estimation: of MSM (Method of Simulated Moments)
  1. Estimate ('calibrate') auxiliary parameters
     - Interest rate
     - Mortality
     - Income shocks
  2. Estimate main parameters (β, δ) using Method of Simulated Moments
     - $*$ Simulate model (cannot solve analytically)
     - $*$ Choose parameters $(\hat{\beta}, \hat{\delta})$ that minimize distance of simulated moments to estimated moments
     - $*$ Take into account uncertainty in estimates of 1st stage
- (David Laibson's Slides follow)

3 Model

- We use simulation framework
- Institutionally rich environment, e.g., with income uncertainty and liquidity constraints
- Literature pioneered by Carroll (1992, 1997), Deaton (1991), and Zeldes (1989)
- Gourinchas and Parker (2001) use method of simulated moments (MSM) to estimate a structural model of life-cycle consumption

3.1 Demographics

- Mortality, Retirement (PSID), Dependents (PSID), HS educational group

3.2 Income from transfers and wages

- $Y_t =$ after-tax labor and bequest income plus govt transfers (assumed exog., calibrated from PSID)

- $y_t \equiv \ln(Y_t)$. During working life:

$$y_t = f^W(t) + u_t + \nu_t^W \tag{3}$$

- During retirement:

$$y_t = f^R(t) + \nu_t^R \tag{4}$$

3.3 Liquid assets and non-collateralized debt

- $X_t + Y_t$ represents liquid asset holdings at the beginning of period t.

- Credit limit: $X_t \geq -\lambda \cdot \bar{Y}_t$

- $\lambda = .30$, so average credit limit is approximately \$8,000 (SCF).

3.4 Illiquid assets

- Z_t represents illiquid asset holdings at age t.
- Z bounded below by zero.
- Z generates consumption flows each period of γZ.
- Conceive of Z as having some of the properties of home equity.
- Disallow withdrawals from Z; Z is perfectly illiquid.
- Z stylized to preserve computational tractability.

3.5 Dynamics

- Let I_t^X and I_t^Z represent net investment into assets X and Z during period t

- Dynamic budget constraints:

$$\begin{aligned} X_{t+1} &= R^X \cdot (X_t + I_t^X) \\ Z_{t+1} &= R^Z \cdot (Z_t + I_t^Z) \\ C_t &= Y_t - I_t^X - I_t^Z \end{aligned}$$

- Interest rates:

$$R^X = \begin{cases} R^{CC} & \text{if} \quad X_t + I_t^X < 0 \\ R & \text{if} \quad X_t + I_t^X > 0 \end{cases} ; \qquad R^Z = 1$$

- Three assumptions for $\left[R^X, \gamma, R^{CC}\right]$:

Benchmark:	[1.0375, 0.05, 1.1175]
Aggressive:	[1.03, 0.06, 1.10]
Very Aggressive:	[1.02, 0.07, 1.09]

In full detail, self t has instantaneous payoff function

$$u(C_t, Z_t, n_t) = n_t \cdot \frac{\left(\frac{C_t + \gamma Z_t}{n_t}\right)^{1-\rho} - 1}{1-\rho}$$

and continuation payoffs given by:

$$\beta \sum_{i=1}^{T+N-t} \delta^i \left(\Pi_{j=1}^{i-1} s_{t+j}\right)(s_{t+i}) \cdot u(C_{t+i}, Z_{t+i}, n_{t+i}) ...$$
$$+\beta \sum_{i=1}^{T+N-t} \delta^i \left(\Pi_{j=1}^{i-1} s_{t+j}\right)(1 - s_{t+i}) \cdot B(X_{t+i}, Z_{t+i})$$

- n_t is effective household size: adults+(.4)(kids)
- γZ_t represents real after-tax net consumption flow
- s_{t+1} is survival probability
- $B(\cdot)$ represents the payoff in the death state

3.7 Computation

- Dynamic problem:

$$\max_{I_t^X, I_t^Z} \quad u(C_t, Z_t, n_t) + \beta\delta E_t V_{t,t+1}(\Lambda_{t+1})$$
$$s.t. \text{ Budget constraints}$$

- $\Lambda_t = (X_t + Y_t, Z_t, u_t)$ (state variables)

- Functional Equation:

$$V_{t-1,t}(\Lambda_t) =$$
$$\{s_t[u(C_t, Z_t, n_t) + \delta E_t V_{t,t+1}(\Lambda_{t+1})] + (1 - s_t) E_t B(\Lambda_t)\}$$

- Solve for eq strategies using backwards induction

- Simulate behavior

- Calculate descriptive moments of consumer behavior

4 Estimation

Estimate parameter vector θ and evaluate models wrt data.

- $m_e =$ N empirical moments, VCV matrix $= \Omega$
- $m_s(\theta) =$ analogous simulated moments
- $q(\theta) \equiv (m_s(\theta) - m_e)\,\Omega^{-1}\,(m_s(\theta) - m_e)'$, a scalar-valued loss function
- Minimize loss function: $\hat{\theta} = \arg\min_{\theta} q(\theta)$
- $\hat{\theta}$ is the MSM estimator.
- Pakes and Pollard (1989) prove asymptotic consistency and normality.
- Specification tests: $q(\hat{\theta}) \sim \chi^2(N - \#parameters)$

TABLE 3

BENCHMARK STRUCTURAL ESTIMATION RESULTS

	(1) Hyperbolic	(2) Exponential	(3) Hyperbolic Optimal Wts	(4) Exponential Optimal Wts	(5) Data
Parameter estimates $\hat{\theta}$					
$\hat{\beta}$	0.7031	1.0000	0.7150	1.0000	-
s.e. (i)	(0.1093)	-	(0.0948)	-	-
s.e. (ii)	(0.1090)	-	-	-	-
s.e. (iii)	(0.0170)	-	-	-	-
s.e. (iv)	(0.0150)	-	-	-	-
$\hat{\delta}$	0.9580	0.8459	0.9603	0.9419	-
s.e. (i)	(0.0068)	(0.0249)	(0.0081)	(0.0132)	-
s.e. (ii)	(0.0068)	(0.0247)	-	-	-
s.e. (iii)	(0.0010)	(0.0062)	-	-	-
s.e. (iv)	(0.0009)	(0.0056)	-	-	-
Second-stage moments					
% Visa	0.634	0.669	0.613	0.284	0.678
mean Visa	0.167	0.150	0.159	0.049	0.117
CY	0.314	0.293	0.269	0.074	0.231
wealth	2.69	-0.05	3.22	2.81	2.60
Goodness-of-fit					
$q(\hat{\theta}, \hat{\chi})$	67.2	436	2.48	34.4	-
$\xi(\hat{\theta}, \hat{\chi})$	3.01	217	8.91	258.7	-
p-value	0.222	<1e-10	0.0116	<2e-7	-

Source: Authors' calculations.

Note on standard errors: (i) includes both the first stage correction and the simulation correction, (ii) includes just the first stage correction, (iii) includes just the simulation correction, and (iv) includes neither correction.

TABLE 4

ROBUSTNESS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Benchmark	$\gamma = 3.38\%$	$\gamma = 6.59\%$	$r^{CC} = 10\%$	$r^{CC} = 13\%$	$\rho = 1$	$\rho = 3$
Hyperbolic							
Parameter Estimates $\hat{\theta}$							
$\hat{\beta}$	0.7031	0.5071	0.8024	0.7235	0.6732	0.8186	0.5776
s.e. (i)	(0.1093)	(0.0441)	(0.0614)	(0.1053)	(0.1167)	(0.0959)	(0.1339)
$\hat{\delta}$	0.9580	0.9731	0.9425	0.9567	0.9595	0.9610	0.9545
s.e. (i)	(0.0068)	(0.0188)	(0.0093)	(0.0071)	(0.0045)	(0.0037)	(0.0096)
Goodness-of-fit							
$q(\hat{\theta}, \hat{\chi})$	67.2	108.4	49.7	64.1	70.7	63.0	67.7
$\xi(\hat{\theta}, \hat{\chi})$	3.01	16.79	5.27	12.09	10.97	7.97	1.85
p-value	0.222	0.0002	0.0717	0.0024	0.0041	0.0186	0.3965
Exponential							
Parameter Estimates $\hat{\theta}$							
$\hat{\beta}$	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
s.e. (i)	-	-	-	-	-	-	-
$\hat{\delta}$	0.8459	0.8459	0.8459	0.8520	0.8354	0.8924	0.7841
s.e. (i)	(0.0249)	(0.0249)	(0.0250)	(0.0267)	(0.0262)	(0.0204)	(0.0357)
Goodness-of-fit							
$q(\hat{\theta}, \hat{\chi})$	435.6	435.6	435.6	434.7	436.6	438.1	435.5
$\xi(\hat{\theta}, \hat{\chi})$	217	217	263	177	339	349	310
p-value	<1e-10	<1e-10	<1e-10	<1e-10	<1e-10	<1e-10	<1e-10

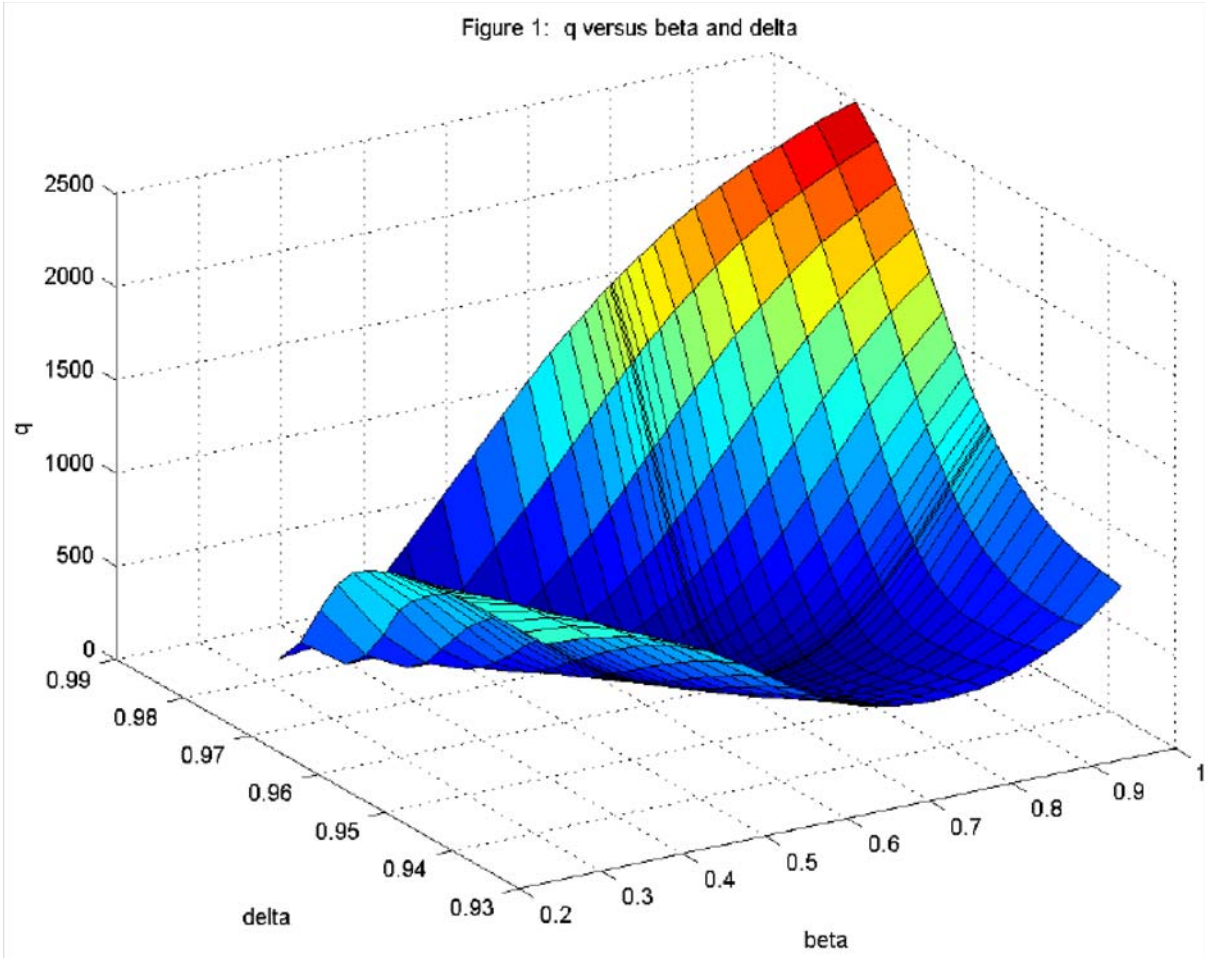


Figure 1: This figure plots the MSM objective function with respect to beta and delta under the paper's benchmark assumptions. The objective, q, equals a weighted sum of squared deviations of the empirical moments from the moments predicted by the model. Lower values of q represent a better fit of the model, and the (beta,delta) pair that minimizes q is the MSM estimator.

4 Leisure Goods: Commitments and Savings II

- Ashraf, Karlan, and Yin (2005), *QJE*
  - Different Methodology: Field Experiment
  - Different Setting: Philippines
- Three treatments:
  - SEED Treatment (N=842): Encourage to save, Offer commitment device (account with savings goal)
  - Marketing Treatment (N=466): Encourage to save, Offer no commitment
  - Control Treatment (N=469)

- Evaluation:
  - Compare SEED to Marketing Treatment: Effect of Commitment Device in addition to encouragement
  - Measure the effect on total savings (also on non-committed account)
    – This was not true in 401(k) studies
- SEED Treatment:
  - Out of 842 treated people, 202 take up SEED –> Take up of 24%
  - 167 also got lock-up box (did not observe savings there)

- Effect of SEED Treatment on Total Savings, Compared to Marketing
  - (Remember: Include all 842 people, Intent-to-Treat)
  - *Share of people with increased Balances*: 5.6 percentage (33.3 percent in SEED and 27.7 in Marketing)
  - *Share of people with increased Balances by at least 20 percent*: 6.4 percentage points
  - *Total Balances*: 287 Pesos after 6 months (not significant)
- To compute Treatment-on-The-Treated, divide by 202/842
  - Take into account no effect on non-takers (by assumption)

TABLE VI
Impact on Change in Savings Held at Bank
OLS, Probit

INTENT TO TREAT EFFECT

	OLS				Probit			
Length	6 months		12 months		12 months			
Dependent Variable:	Change in Total Balance	Change in Total Balance	Change in Total Balance	Change in Total Balance	Binary Outcome = 1 if Change in Balance > 0%	Binary Outcome = 1 if Change in Balance > 0%	Binary Outcome = 1 if Change in Balance > 20%	Binary Outcome = 1 if Change in Balance > 20%
Sample	All	Commitment & Marketing Only	All	Commitment & Marketing Only	All	Commitment & Marketing Only	All	Commitment & Marketing Only
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Commitment Treatment	234.678*	49.828	411.466*	287.575	0.102***	0.056**	0.101***	0.064***
	(101.748)	(156.027)	(244.021)	(228.523)	(3.82)	(0.026)	(0.022)	(0.021)
Marketing Treatment	184.851		123.891		0.048		0.041	
	(146.982)		(153.440)		(1.56)		(0.027)	
Constant	40.626	225.476*	65.183	189.074**				
	(61.676)	(133.405)	(124.215)	(90.072)				
Observations	1777	1308	1777	1308	1777	1308	1777	1308
R-squared	0.00	0.00	0.00	0.00				

Robust standard errors in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%. The dependent variable in the first two column is the change in total savings held at the Green Bank after six months. Column (1) regresses chnage in total savings balances on indicators for assignment in the commitment- and marketing-treatment groups. The omitted group indicator in this regression corresponds to the control group. Column (2) shows the regression restricting the sample to commitment- and marketing-treatment groups. Columns (3) and (4) repeat this regression, using change in savings balances after 12 months as a dependent variable. The dependent variable in columns (5)-(8) is a binary variable equal to 1 if balances increased by x%. 154 clients had pre-intervention a savings balance equal to zero. 24 of them had positive savings after 12 months. These individuals were coded as "one," and those that remain at zero were coded as zero for the outcome variables for columns (5) through (8). Exchange rate is 50 pesos for US $1.00.

- In addition, examine correlation with a survey response to hyperbolic-discounting-type question:
  - Preference between 200 Pesos now and in 1 month
  - Preference between 200 Pesos in 6 months and in 7 months

TABLE III
Tabulations of Responses to Hypothetical Time Preference Questions

			Indifferent between 200 pesos in 6 months and X in 7 months			
			Patient X<250	Somewhat Impatient 250<X<300	Most Impatient 300<X	Total
Indifferent between 200 pesos now and X in one month	Patient	X<250	606 34.4%	126 7.2%	73 4.1%	805 45.7%
	Somewhat Impatient	250<X<300	206 11.7%	146 8.3%	59 3.3%	411 23.3%
	Most Impatient	300<X	154 8.7%	93 5.3%	299 17%	546 31%
	Total		966 54.8%	365 20.7%	431 24.5%	1,762 100%

"Hyperbolic": More patient over future tradeoffs than current tradeoffs

"Patient Now, Impatient Later": Less patient over future tradeoffs than current tradeoffs.

Time inconsistent (direction of inconsistency depends on answer to open-ended question).

- On average, evidence on hyperbolic-discounting-type preferences
- Interesting idea: Correlate survey response with response to treatment (also in Fehr-Goette paper next lecture)
- Evidence of correlation for women, not for men

TABLE V
Determinants of SEED Takeup
Probit

	(1) All	(2) All	(3) Female	(4) Male
Time inconsistent	0.125*	0.005	0.158*	0.046
	(0.067)	(0.080)	(0.085)	(0.098)
Impatient, Now versus 1 Month	-0.030	-0.039	-0.036	-0.041
	(0.050)	(0.050)	(0.062)	(0.075)
Patient, Now versus 1 Month	0.076	0.070	0.035	0.119
	(0.072)	(0.072)	(0.089)	(0.110)
Impatient, 6 months versus 7 Months	0.097	0.108*	0.124	0.078
	(0.065)	(0.065)	(0.087)	(0.091)
Patient, 6 months versus 7 Months	0.015	0.022	0.057	-0.021
	(0.064)	(0.064)	(0.081)	(0.093)

5 Methodology: Commitment Field Experiment Designs

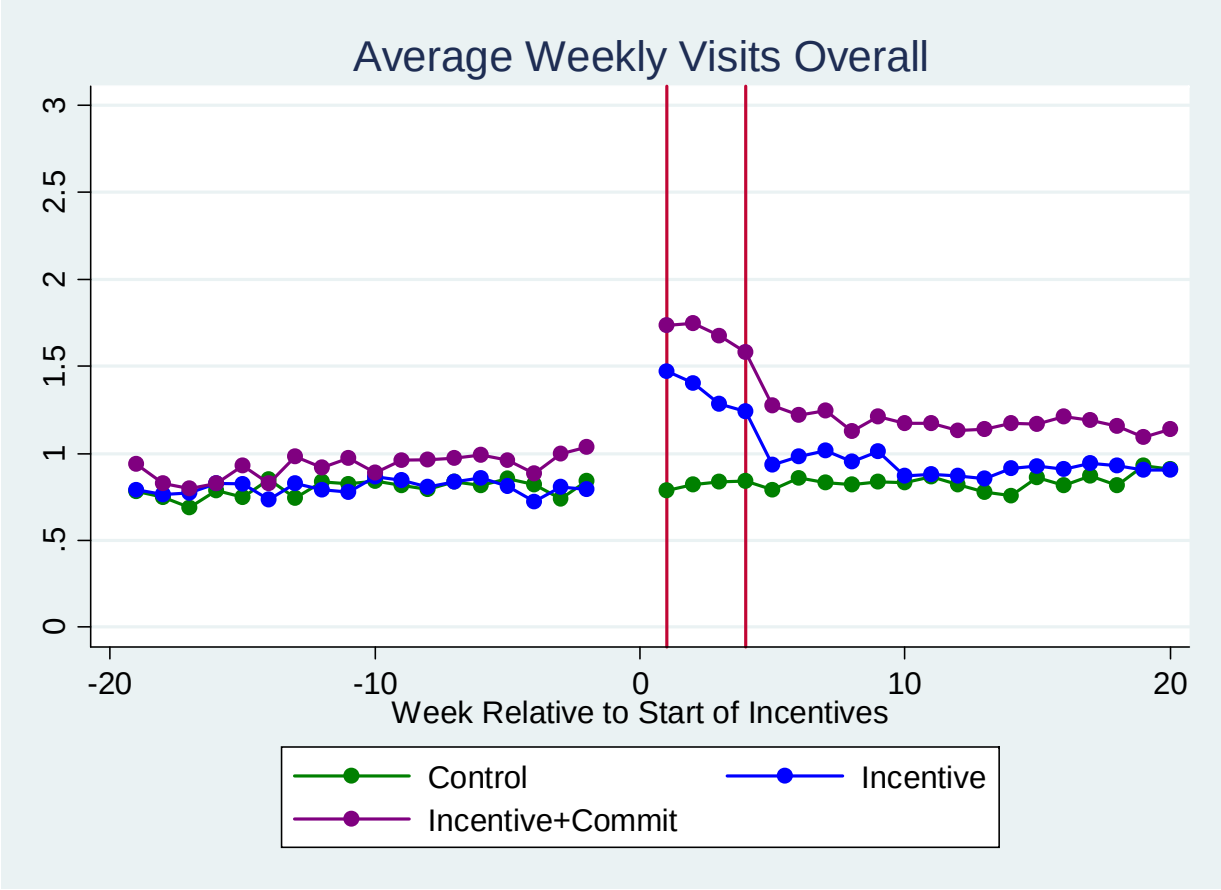
- Growing literature on field experiments offering commitment devices
- Recipe:
  - Random assignment into treatment and control group
  - Treatment group (T) offered commitment device (action that imposes constraints)
  - Control group (C) is not
  - Take-up of commitment is observed in the treatment group
  - Outcome (e.g., saving, smoking, eating) observed for both groups

- Three sets of results:
  1. *Take-up.* What share in T use commitment device?
     - Smoking gun for time inconsistency, since standard agent would never impose additional constraints
     - Time inconsistency can be from present bias, or say from hot/cold states (Bernheim and Rangel 2007)
  2. (*Who Takes Up?* Document who in T takes up commitment)
     - Correlation with measured time preferences, previous behavior, etc.
     - This is not causal evidence, but still interesting
  3. *Effect on outcome.* Compare outcomes in T and C
     - Notice: Here one has to control *everybody* in T to *everybody* in C
     - Cannot focus on those that took up the commitment in T, since do not know who they compare to in C
     - Can rescale effect (Treatment on Treated) by dividing by take-up (under assumption of no effect on no-takers)

- **Representative studies: Investment Goods**

- *Homework Completion* (Ariely-Wertenbroch)
  - Deadlines are penalties for delivering homework late
  - Result 1. Very large take-up rate (65 percent)
  - Result 3. Large effect on quality of homework and delay (in exp. 2)

- *Health-club attendance* (Royer, Stehr, and Sydnor, 2010)
  - First pay a treatment group to go to the gym
  - Then offer half of this treated group commitment device to keep going
  - Commitment device is deposit money into an account. money forfeited if do not attend at least once every 14 days for 4 months
  - Result 1: Low demand for commitment: 13% take-up, with average sum of $63
  - Result 3: Some effect on attendance


Average Weekly Visits Overall
0
.5
1
1.5
2
2.5
3
-20
-10
0
10
20
Week Relative to Start of Incentives
Control
Incentive
Incentive+Commit

- **Representative studies: Leisure Goods**
- *Consumption/Savings I* (Ashraf-Karlan-Yin)
  - Result 1. Commitment device take-up lower (24 percent)
  - Result 3. Significant effect on overall savings
- *Consumption Savings II* (SMRT plan, Thaler and Benartzi, 2007)
  - Result 1. Take-up rate 80% when offered
  - Result 3. Huge effects on 401(k) contribution rates
- *Smoking* (Gine, Karlan, and Zinman, 2010)
  - Offer urine test for smoking in 6 months
  - Can deposit money into account, money forfeited if fail test

  - Result 1. Low take-up: 11%
  - Result 3: Increase of 3 percentage point in chance of making urine test
  - Result 3: Increase still at surprise test at 12 months

- *Online gaming* (Chow, 2010 and Acland and Chow, 2010)
  - Offer online interface that one can use to limit play of online games
  - Result 1. Take-up rate relatively high initially, but declines to 5-10%
  - Result 3. Suggestive effects on time spent playing

- Why often low-take up? At least 3 possibilities:
  - Self-control not prevalent
  - Self-control prevalent, but naivete' is strong
  - Demand for commitment outweighed by costs of commitment in terms of loss of flexibility

- Alternative design of the commiment device field experiments: *2*2 Design* (Chow, 2010)
  - Offer *everyone* the commitment device
  - Then randomly assign whether commitment device is actually offered
  - Therefore groups are 2 (wanted comm./did not) * (got comm./did not)
- Advantage of this design
  - More power on demand for commitment since everybody (not just 1/2 of subjects) is asked
  - Can estimate effect of commitment both on the subjects that demand it, and the ones who do not (but who may end up using it)
- See also Chassang, Padro-i-Miguel, Snowberg, (AER 2012)

6 Methodology: Errors in Applying Present-Biased Preferences

- Present-Bias model very successful
- Quick adoption at cost of incorrect applications
- Four common errors

- **Error 1. Procrastination with Sophistication**
  - 'Self-Control leads to Procrastination'
  - This is not accurate in two ways
  - *Issue 1.*
    - (β, δ) Sophisticates do not delay for long (see our calibration)
    - Need Self-control + Naiveté (overconfidence) to get long delay
  - *Issue 2.* (Definitional issue) We distinguished between:
    - Delay. Task is not undertaken immediately
    - Procrastination. Delay systematically beyond initial expectations
    - Sophisticates and exponentials do not procrastinate, they *delay*

- **Error 2. Naives with Yearly Decisions**
  - 'We obtain similar results for naives and sophisticates in our calibrations'
  - Example 1. Fang, Silverman (*IER*, 2009)
  - Single mothers applying for welfare. Three states:
    1. Work
    2. Welfare
    3. Home (without welfare)
  - Welfare dominates Home – So why so many mothers stay Home?

	Choice at t		
Choice at $t-1$	Welfare	Work	Home
Welfare			
Row %	84.3	3.5	12.3
Column %	76.7	6.3	17.9
Work			
Row %	5.3	79.3	15.3
Column %	2.6	76.4	12.1
Home			
Row %	28.3	12.0	59.7
Column %	20.7	17.3	70.0

- – Model:
  - ∗ Immediate cost ϕ (stigma, transaction cost) to go into welfare
  - ∗ For ϕ high enough, can explain transition
  - ∗ Simulate Exponentials, Sophisticates, Naives

- However: Simulate decision at **yearly** horizon.
- BUT: At yearly horizon naives do not procrastinate:
  - Compare:
    - Switch now
    - Forego *one year* of benefits and switch next year
- Result:
  - Very low estimates of β
  - Very high estimates of switching cost ϕ
  - Naives are same as sophisticates

Parameters		(1) Time Consistent		(2) Present-Biased (sophisticated)		(3) Present-Biased (Naive)	
		Estimate	S.E.	Estimate	S.E.	Estimate	S.E.
Preference Parameters							
Discount Factors	β	1	n.a.	0.33802	0.06943	0.355	0.0983
	δ	0.41488	0.07693	0.87507	0.01603	0.868	0.02471
Net Stigma	$\phi^{(1)}$	7537.04	774.81	8126.19	834.011	8277.46	950.77
(by type)	$\phi^{(2)}$	10100.9	1064.83	10242.01	955.878	10350.20	1185.27
	$\phi^{(3)}$	13333.2	1640.18	12697.25	1426.40	12533.69	1685.92

- – Conjecture: If allowed daily or weekly decision, would get:
  - ∗ Naives fit much better than sophisticates
  - ∗ β much closer to 1
  - ∗ ϕ much smaller

– Example 2. Shui and Ausubel (2005) –> Estimate Ausubel (1999)
  * Cost k of switching from credit card to credit card
  * Again: Assumption that can switch only every quarter
  * Results of estimates (again):
    · Quite low β
    · Naives do not do better than sophisticates
    · Very high switching costs

Table 4: Estimated Parameters [a]

	Sophisticated Hyperbolic	Naive Hyperbolic	Exponential
β	0.7863	0.8172	
	(0.00192)	(0.003)	
δ	0.9999	0.9999	0.9999
	(0.00201)	(0.0017)	(0.00272)
k	0.02927	0.0326	0.1722
	\$293	\$326	\$1,722
	(0.00127)	(0.00139)	(0.0155)

- **Error 3. Present-Bias over Money**
  - 'We offer the choice between \$10 today and \$15 in a week'
  - Experiments supporting (β, δ) usually of the above type (Ainslie, 1956; Benhabib, Bisin, and Schotter, 2006; Andreoni and Sprenger, 2009)
  - BUT: Discounting applies to consumption, not income (Mulligan, 1999):

$$U_0 = u(c_0) + \beta\delta Eu(c_1) + \beta\delta^2 Eu(c_2)$$

  - Assume that individual consume the \$10 in the future –> Then the choice is between
    - $u(10)$
    - $\beta\delta Eu(15)$
  - Credit constraints –> Consume immediately, remove this problem to good extent (but confound with another problem)
  - In addition: Uncertainty over future shocks, not in present

- Ideally: Do experiments with goods to be consumed right away:
  - Low- and High-brow movies (Read and Loewenstein, 1995)
  - Squirts of juice for thirsty subjects (McClure et al., 2005)
- Same problem applies to models
  - Notice: Transaction costs of switching k in above models are real effort, apply immediately
  - Effort cost c of attending gym also 'real' (not monetary)
  - Consumption-Savings models: Utility function of consumption c, not income I

- **Error 4. Getting the Intertemporal Payoff Wrong**
  - 'Costs are in the present, benefits are in the future'
  - (β, δ) models very sensitive to timing of payoffs
  - Sometimes, can easily turn investment good into leisure good
  - Need to have strong intuition on timing
  - Example: Carrillo (1999) on nuclear plants as leisure goods
    - Immediate benefits of energy
    - Delayed cost to environment
  - BUT: 'Immediate' benefits come after 10 years of construction costs!

7 Seven More Applications of Present Bias

7.1 Fertilizer Adoption

- Duflo, Kremer, and Robinson (forthcoming): Invest in fertilizer
- Development: Why so little adoption of fertilizer and high-yield seeds?
- Literature examining role of learning, social learning
  - Effect of fertilizer in Western Kenya
  - Field Experiments: In appropriate proportions high returns
  - However, low adoption

Table 1: Returns to Fertilizer

	Top Dressing 1/4 Teaspoon			Top Dressing 1/2 Teaspoon			Top Dressing 1 teaspoon 1 Teaspoon		
	mean	median	obs	mean	median	obs	mean	median	obs
Panel A: Not Annualized									
25 Ksh per goro-goro	0.080	-0.327	116	0.189	0.156	202	-0.476	-0.494	85
40 Ksh per goro-goro	0.728	0.077	116	0.903	0.850	202	-0.161	-0.191	85
Panel B: Annualized									
25 Ksh per goro-goro	0.362	-0.794	116	1.002	0.786	202	-0.788	-0.805	85
40 Ksh per goro-goro	1.272	0.118	116	1.625	1.515	202	-0.190	-0.225	85

- Possible explanation of puzzle: Farmers would like to purchase fertilizer, but they run out of money by the time the new season comes
- Experiment (SAFI Program):
  - Manipulate timing of adoption
  - Farmers can pre-buy fertilizer at end of previous season (when 'rich')
  - Significant effect on adoption

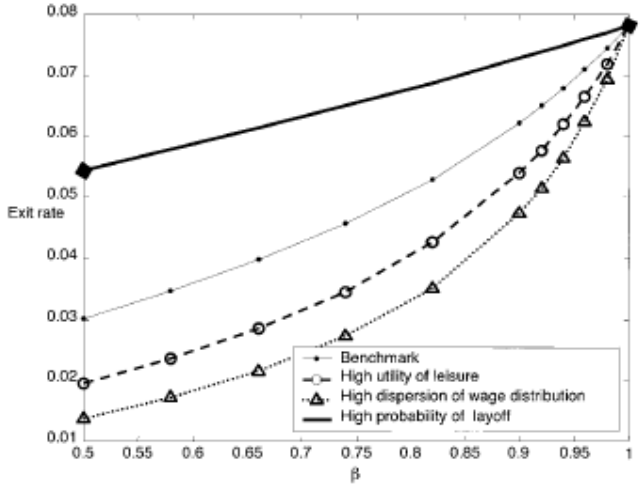
Table 8: Adoption for Parents Sampled for School-Based SAFI and Subsidy

Season	*Long Rains 2004*	*Short Rains 2004*
Number of Seasons after School-Based Demonstration Plot	*1*	*2*
Number of Seasons after Starter Kit Program	-	*1*
Programs for which an effect would be expected in the given season (coefficients in **bold**)	*SAFI LR 2004 Demo Plot*	*SAFI SR 04 Subsidy Full Price Visit Starter Kit*
Panel A. Control for School	(1)	(2)
Starter Kit Farmer	0.085	**0.047**
	(0.045)*	**(0.049)**
Sampled to Participate in School Demonstration Plot	**-0.046**	0.018
	(0.064)	(0.071)
SAFI Long Rains 2004	**0.103**	-0.020
	(0.038)***	(0.043)
SAFI Short Rains 2004	-0.037	**0.169**
	-0.047	**(0.053)*****
Subsidy Short Rains 2004	-0.046	**0.142**
	(0.056)	**(0.063)****
Full Price Visit Short Rains 2004	-0.089	**0.070**
	(0.056)	**(0.063)**
Observations	874	752

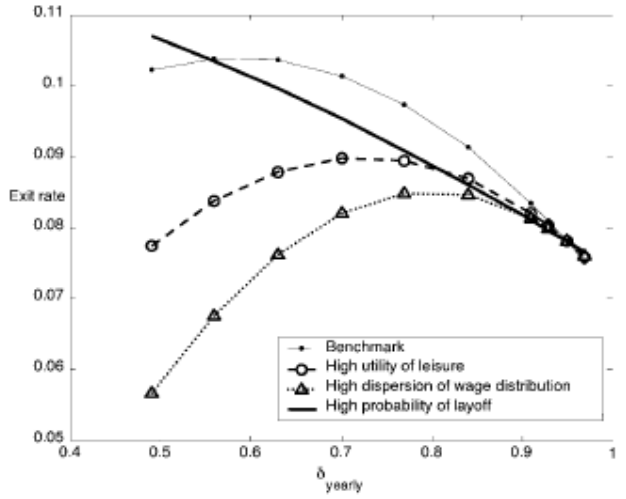
7.2 Job Search

- DellaVigna and Paserman (*JOLE* 2005)
- Stylized facts:
  - time devoted to job search by unemployed workers: 9 hours/week
  - search effort predicts exit rates from unemployment better than reservation wage choice
- Model with costly search effort and reservation wage decision:
  - search effort — immediate cost, benefits in near future — driven by β
  - reservation wage — long-term payoffs — driven by δ

a


0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
Exit rate
0.5
0.55
0.6
0.65
0.7
0.75
0.8
0.85
0.9
0.95
1
β
Benchmark
High utility of leisure
High dispersion of wage distribution
High probability of layoff

b


0.11
0.1
0.09
0.08
0.07
0.06
0.05
Exit rate
0.4
0.5
0.6
0.7
0.8
0.9
1
δ yearly
Benchmark
High utility of leisure
High dispersion of wage distribution
High probability of layoff

- Correlation between measures of impatience (smoking, impatience in interview, vocational clubs) and job search outcomes:
  - Impatience $\uparrow \Longrightarrow$ search effort $\downarrow$
  - Impatience $\uparrow \Longrightarrow$ reservation wage $\longleftrightarrow$
  - Impatience $\uparrow \Longrightarrow$ exit rate from unemployment $\downarrow$
- Impatience captures variation in β
- Sophisticated or naive – does not matter

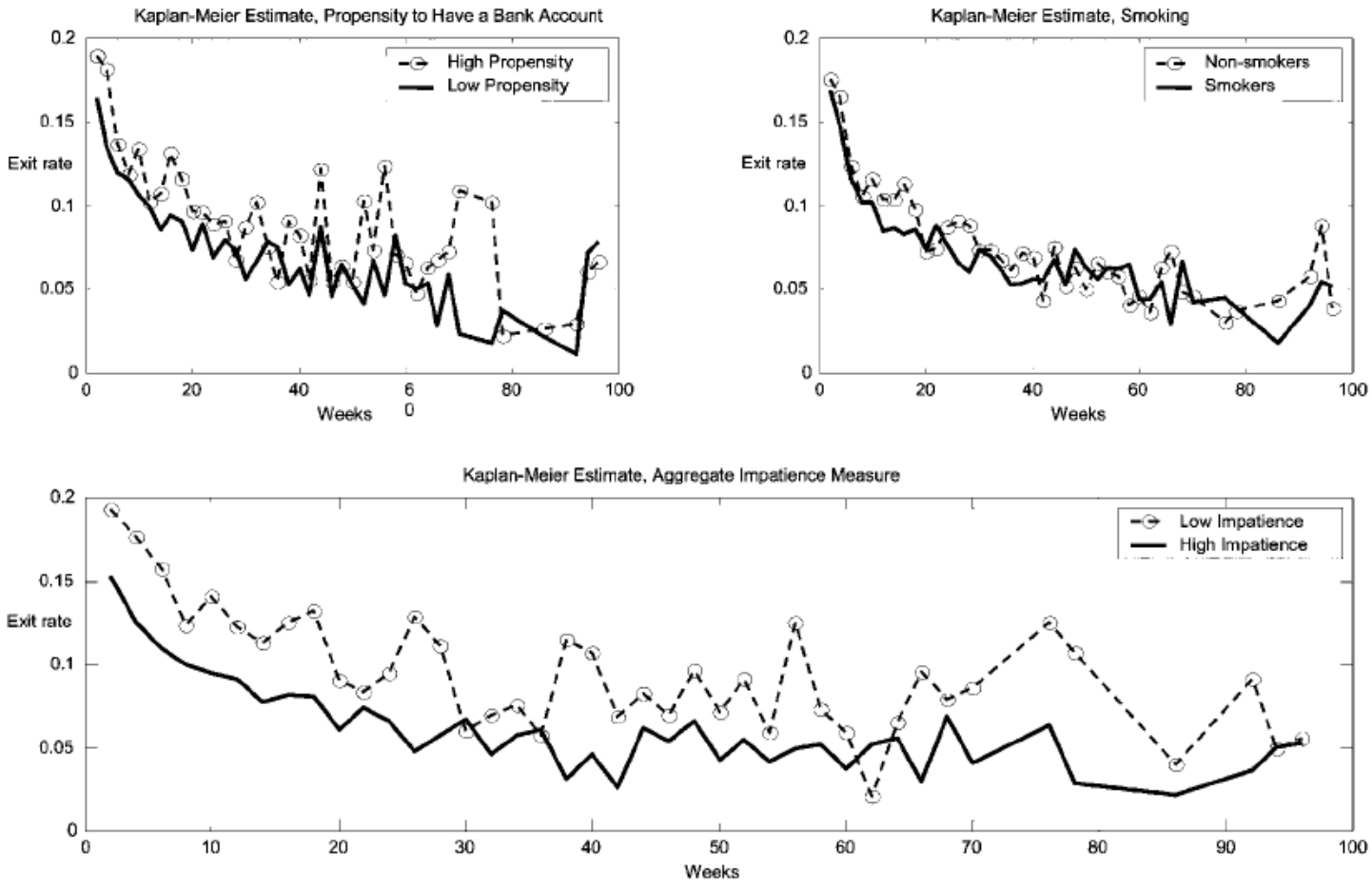


FIG. 3.—Exit rates in the NLSY

- Paserman (EJ forthcoming):
  - Structural model estimated by max. likelyhood
  - Estimation exploits non-stationarity of exit rate from unemployment

Table 2: Estimated Model Parameters †

		Low Wage Sample	Medium Wage Sample		High Wage Sample
		Lognormal	Lognormal	Normal	Lognormal
Discounting Parameters					
	β	**0.4021**	**0.4833**	**0.8140**	**0.8937**
		(0.1075)	**(0.1971)**	**(0.1672)**	**(0.1441)**
	δ	0.9962	1.0000*	1.0000*	0.9989
		(0.1848)	(0.0001)	(0.0019)	(0.1798)
Value of time when unemployed					
	b_0	-141.61	-164.31	-7.38	-308.78
		(61.16)	(61.43)	(16.54)	(193.53)

7.3 Welfare programs

- Fang, Silverman (2002, 2007)
- Stylized Facts:
  - limited transition from welfare to work
  - (more importantly) large share of mothers staying home and not claiming benefits
- Examines decisions of single mothers with kids. Three states: Welfare (leisure + benefits), Work (wages), Home (leisure)
- Mothers stay home because of one-time social disapproval of claiming benefits
- Naiveté crucial here

7.4 Addiction

- Standard model: Rational addiction (Becker and Murphy, 1988)
  - Past consumption lowers current total utility...
  - ...but raises current marginal utility
- Stylized facts:
  - Diffusion of addictions (drugs, alcohol, tobacco, obesity)
  - Repeated efforts of quitters
  - Antabuse
  - Rational addiction?
- Facts suggestive of present-bias (O'Donoghue and Rabin, 2003; Gruber and Koszegi, 2003)

- Standard test of addiction: Does cigarette consumption at t respond to future prices at $t+1$?
  - Becker, Grossman, and Murphy, *AER* 1994: Future prices lower current consumption
  - BUT: Data problems (yearly data; sales data, not consumption data)

- Gruber and Koszegi, *QJE* 2001:
  - Response of consumption to present and future taxes at monthly level
    - Consumption data: Smoking for mothers in National Vital Statistics
    - Price data: Legislated tax increase at monthly horizon
  - Compare response to tax increases at $t+1$ and $t+2$ to estimate β and δ
  - BUT: limited power –> Cannot separate present bias vs. rational addition

- Levy (2009):
  - Revisit Gruber and Koszegi, *QJE* 2001 with novel test for present bias (and projection bias)
    1. Compare response to price increase at t and at $t+1$
    2. Supplement with response to temporary (price of tobacco) vs. permanent (taxes) price increases
  - Some evidence of present bias, stronger evidence of projection bias

- Gruber and Mullainathan (2006): Use happiness data
  - (Predicted) smokers happier in states one year after smoking taxes are raised
  - Could also be rational response given yearly data

7.5 Obesity

- Overweght and obesity rates doubled over last two decades in US:
  - 1985: No US state has an obesity rate above 15%
  - 2007: only one state (Colorado) has obesity rate below 20%, most states are above 25%
- Problem increasingly common also internationally: UK, Mexico,...
- What explains the increase?
  - Cutler, Glaeser, and Shapiro (*JEP* 2003): Decrease in fixed cost of preparing food + self-control
  - Currie, DellaVigna, Moretti, and Pathania (*AEJ: Policy*, 2010): Fast-foods may have a role, but only partial

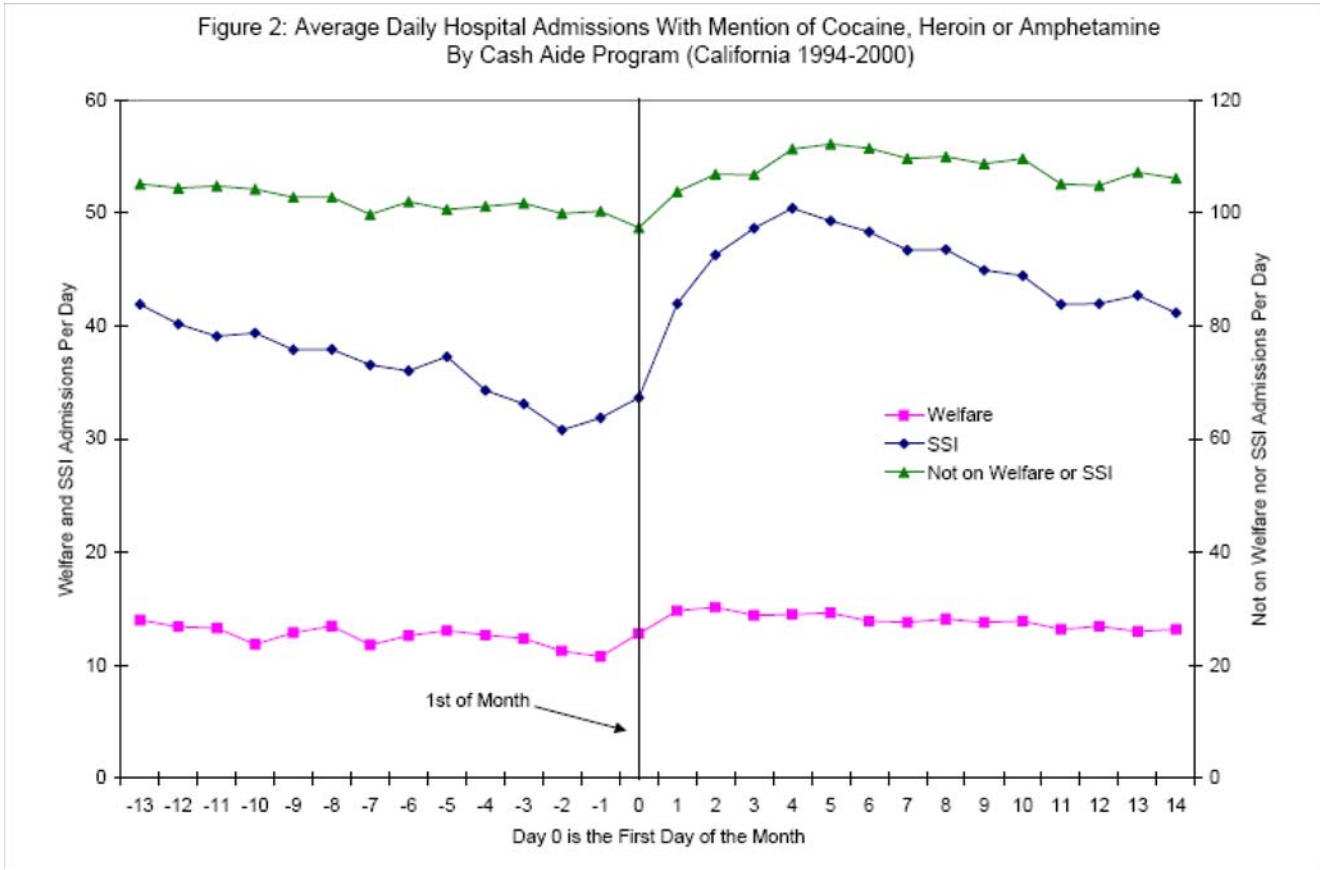
    - Fitness Test for CA 9th graders: Obesity rate increase by 5 percent if f.f. $<.1$ miles of school
    - Fitness Test for CA 9th graders: No effect at larger distances
    - Weight gain of pregnant mothers: Small (but significant) effect of f.f. $<.5$ miles of residence
    - Possible explanation: Self-control problems –> Temptation of near-by school
    - Could also be transport costs

- Need for field experiments to separate hypotheses

7.6 Payday effects

- Shapiro (2003), Melvin (2003), Huffman and Barenstein (2003)
- Stylized facts:
  - Purchases increase discretely on payday
  - Effect more pronounced for more tempting goods
  - Food intake increases as well on payday
  - Drug arrests and hospitalization spike on payday (Dobkin and Puller, 2007)

- SSI payments made on 1st of the month



7.7 Firm pricing

- **T.** Two-part tariffs chosen by firms to sell investment and leisure goods (DellaVigna and Malmendier, 2004)

- **F.** Pricing of magazines (Oster and Scott-Morton, 2005)

- See later Section on Firm Response

7.8 Present Bias: Summary

- Present bias/Hyperbolic Discounting
- Reasons for success:
  1. Simple model (one-, then two- parameter deviation). YES
  2. Powerful intuition (immediate gratification) YES
  3. Support in the laboratory OK
  4. Support from field data YES
- Lead to new subfield (behavioral contract theory/behavioral IO)

- Next: Reference Dependence
- Status:
  1. Simple model (four new features). YES
  2. Powerful intuition (reference points) YES
  3. Support in the laboratory YES
  4. Support from field data OK, more needed

8 Next Lecture

- Reference-Dependence Preferences
  - Introduction
  - Endowment Effect
  - Methodology: Effect of Experience
  - Insurance Choices