Econ 219B
Psychology and Economics: Applications
(Lecture 6)

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Outline

1. Psychology and Economics by Field
2. Defaults and 401(k)s: The Facts
3. Comparison to Effect of Financial Education
4. Default Effects and Present Bias
5. Default Effects: Alternative Explanations
6. Present Bias and Consumption
7. Investment Goods: Homework
8. Methodology: Reading the Psychology Journals

1 Defaults and 401(k)s: The Facts

- 401(k) savings most common voluntary savings vehicle in the US
  - Set aside money for retirement
  - Choice of percent contribution, and stocks/bonds composition
  - Penalty for early withdrawal
  - Sometimes: Company matching of contribution up to a threshold

- Patterns of 401(k) investment (Highly recommended survey: Choi et al., 2006 – "*Saving for Retirement on the Path of Least Resistance*")

- Today: Focus on Default Effects

- **Fact 1. Majority of investors follows Default Plan (at least initially)**

- Madrian and Shea (QJE, 2001): Single most important piece of field evidence on P&E

- Details:
  - Health Care company
  - Paper-and-pencil 401(k) choice
  - Can enroll any day

- Design (Table 1)
  - Discontinuity of 401(k) plan defaults depending on date of hire
  - After 4/1/1998 investment by default
  - 50 percent match up to 6% contribution
  - Observe effect on investment decisions

TABLE I

401(k) PLAN FEATURES BY PLAN DATE

	Before 4/1/1998	After 4/1/1998
Eligibility		
Eligible employees	All except union and temporary employees	All except union and temporary employees
First eligible	After one year of employment	Immediately upon hire
Employer match eligible	After one year of employment	After one year of employment
Contributions		
Employee contributions	1 percent to 15 percent of compensation[a]	1 percent to 15 percent of compensation[a]
Employer match	50 percent of employee contribution up to 6 percent of compensation[a]	50 percent of employee contribution up to 6 percent of compensation[a]
Vesting		
Vesting of employee contributions	Immediate	Immediate
Vesting of employer contributions	2-year cliff	2-year cliff
Participation		
Default participation decision	No	Yes
Default contribution rate	None	3 percent of compensation
Default fund allocation	None	Money market fund

- OLD Cohort hired 4/1/96-3/31/97:
  - default: no enrollment
  - 1-year wait period for eligibility

- WINDOW Cohort hired 4/1/97-3/31/98:
  - default: no enrollment
  - wait period for eligibility till 4/1/98

- NEW Cohort hired 4/1/98-3/31/99:
  - default: enrollment in 3 percent money market fund
  - immediate eligibility

TABLE II
EMPLOYEE COHORTS FOR COMPARATIVE ANALYSIS

	OLD	WINDOW	NEW
Dates of hire[a]	4/1/1996 to 3/31/1997	4/1/1997 to 3/31/1998	4/1/1998 to 3/31/1999
First eligible to participate in 401(k) plan	One year after date of hire	4/1/1998	Date of hire
First eligible for employer match	One year after date of hire	One year after date of hire	One year after date of hire
Automatically enrolled in 401(k) plan	No	No	Yes
Default contribution rate	None	None	3 percent
Default fund allocation	None	None	Money market fund

- Step 1. Check Design (endogeneity issues)
  - Compare different cohorts: No large differences

TABLE III
COMPARISON OF WORKER CHARACTERISTICS

	Study company				
	OLD cohort	WINDOW cohort	NEW cohort	All workers	U. S. workforce
Average age (years)	37.2	36.0	34.5	37.6	38.8
Gender					
Male	25.4%	23.9%	22.0%	22.1%	53.1%
Female	74.6	76.1	78.0	77.9	46.9
Ethnicity[a]					
White	77.1%	71.7%	68.8%	75.1%	74.6%
Black	12.5	16.8	18.9	14.1	11.3
Hispanic	7.1	8.2	6.7	6.6	9.5
Other	3.3	3.4	5.6	4.2	4.6
Hours					
Full-time (HPW $>$ 35)	96.7%	95.6%	95.8%	94.6%	78.8%
Part-time (HPW $<$ 35)	3.3	4.4	4.2	5.4	21.2
Compensation[b]					
Mean	$41,970	$38,424	$34,264	$40,180	$28,248
Median	$33,470	$30,530	$26,519	$31,333	$20,400

- Step 2. Compare plan choices:

1. *Participation* rates in 401(k) by June 30, 1999 (Figure I and Table IV):
   - OLD: 57%, WINDOW: 49%, NEW: 86%

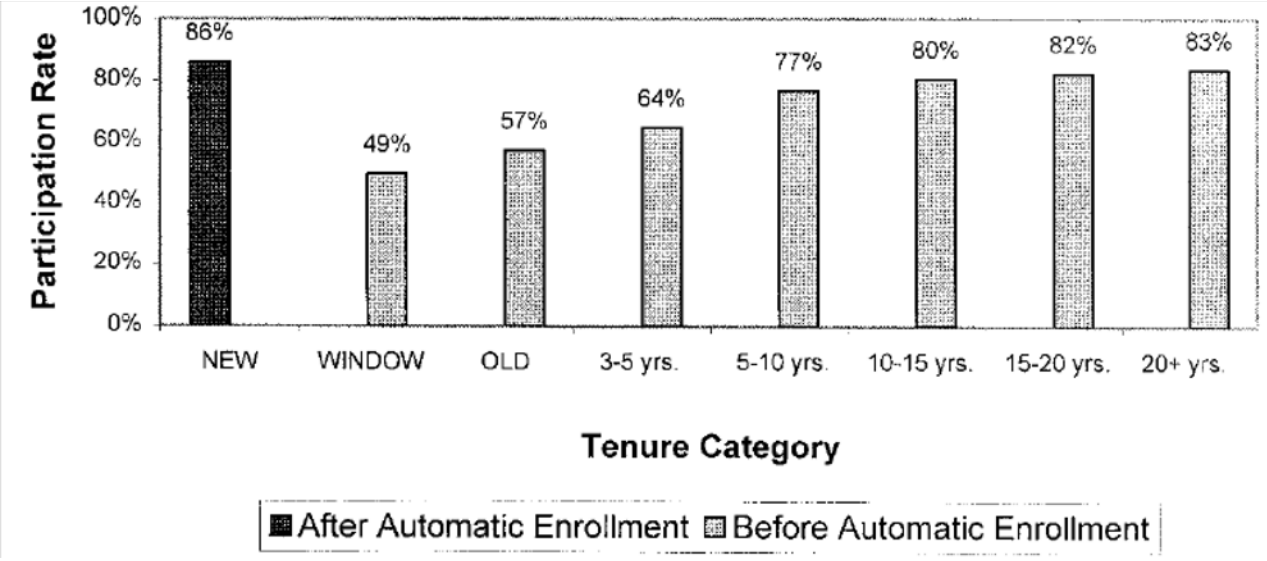


TABLE IV

THE EFFECTS OF AUTOMATIC ENROLLMENT AND IMMEDIATE ELIGIBILITY ON 401(k) PARTICIPATION

	Automatic enrollment		Immediate eligibility	
	Participation rate of Window cohort on 6/30/98	Participation rate of New cohort on 6/30/99	Participation rate of Old cohort on 6/30/98	Participation rate of Window cohort on 6/30/99
Overall	37.4%	85.9%	48.7%	49.4%
Gender				
Male	42.3	85.7	56.1	55.9
Female	35.9	86.0	46.3	47.4
Race/ethnicity				
White	42.7	88.2	53.4	54.4
Black	21.7	81.3	30.7	32.6
Hispanic	19.0	75.1	27.8	34.5
Other	46.2	85.2	55.0	62.9
Age				
Age <20	—	73.6	25.0	33.3
Age 20–29	25.3	82.7	36.7	36.9
Age 30–39	37.2	86.3	47.9	50.3
Age 40–49	47.3	90.1	54.9	58.0
Age 50–59	51.8	90.0	64.3	64.3
Age 60–64	60.0	86.0	60.6	70.0
Compensation				
<$20K	12.5	79.5	20.0	21.2
$20–$29K	24.5	82.8	31.7	35.3
$30–$39K	42.2	88.9	50.1	55.4
$40–$49K	51.0	91.8	61.6	64.5
$50–$59K	61.6	92.8	70.2	75.2
$60–$69K	59.7	94.7	79.2	75.1
$70–$79K	57.9	91.5	76.3	71.6
$80K+	68.3	94.2	76.3	82.6
Sample size	N = 4249	N = 5801	N = 3275	N = 4247

1. *Contribution* rates (Figures IIc):

   - WINDOW: 63% are at 0 percent, 4% at 3 percent
   - NEW: 65% are at 3 percent (Default)

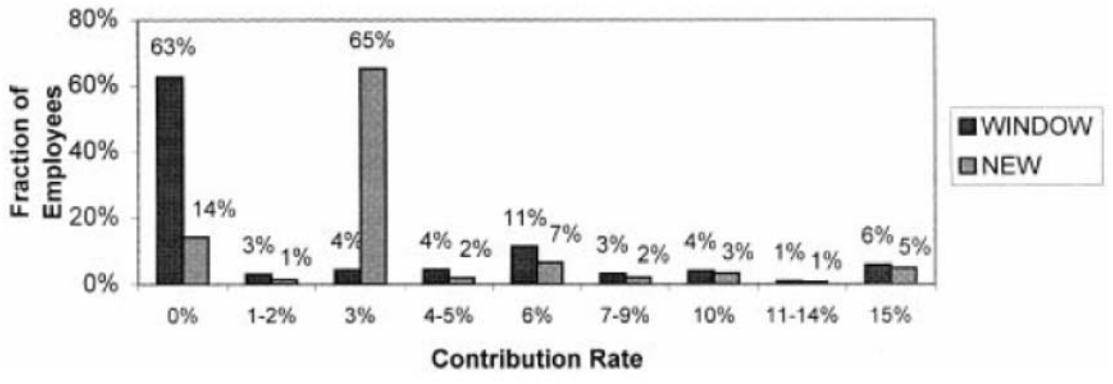


FIGURE IIc
Distribution of 401(k) Contribution Rates for the WINDOW and NEW Cohorts Including Nonparticipation

1. *Allocation* of funds in stocks (Figure III):

   - OLD: 75%, WINDOW: 73%, NEW: 16%

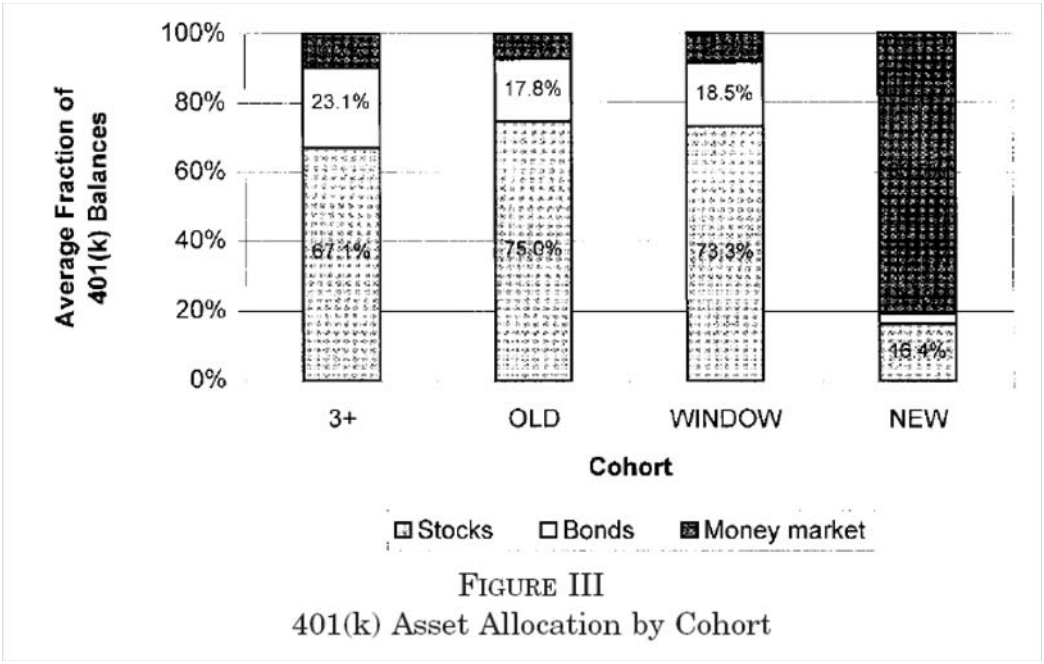


FIGURE III
401(k) Asset Allocation by Cohort

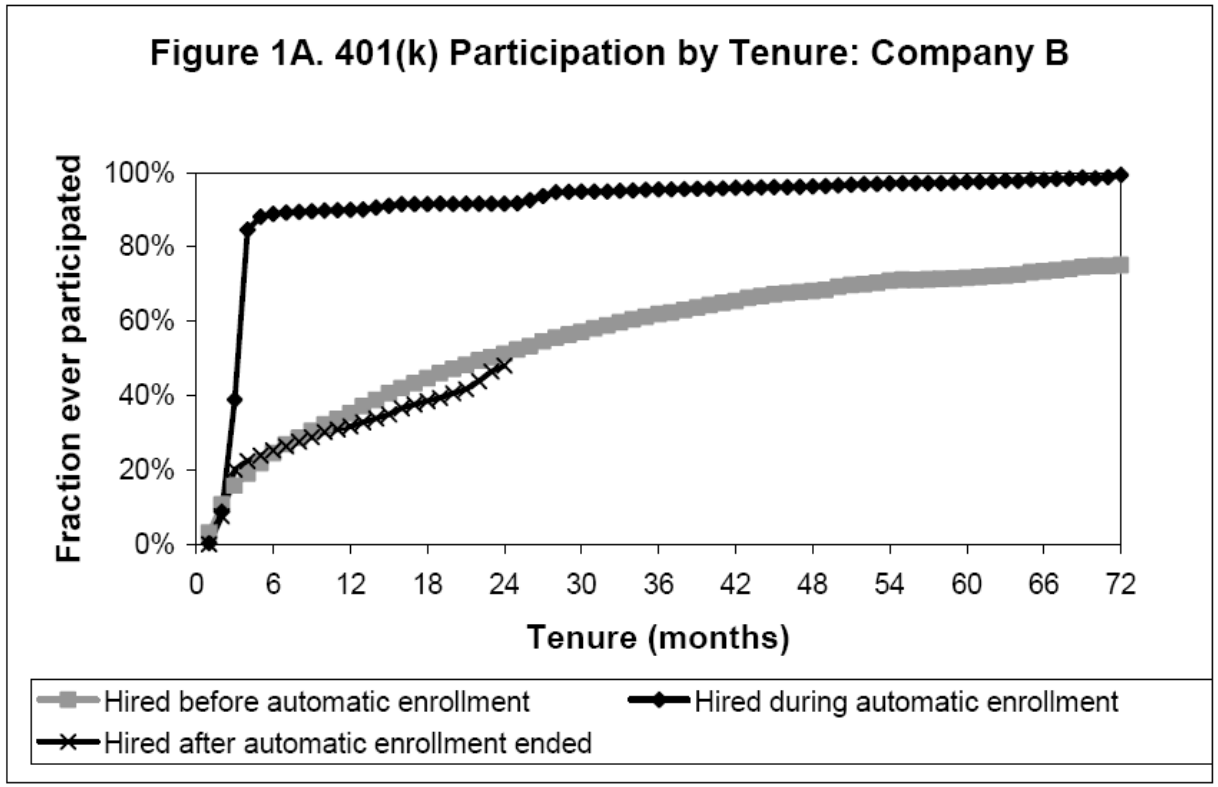
- Results equally strong with controls (Table VI)

TABLE VI
RAW AND REGRESSION-ADJUSTED EFFECTS OF AUTOMATIC ENROLLMENT AND IMMEDIATE ELIGIBILITY

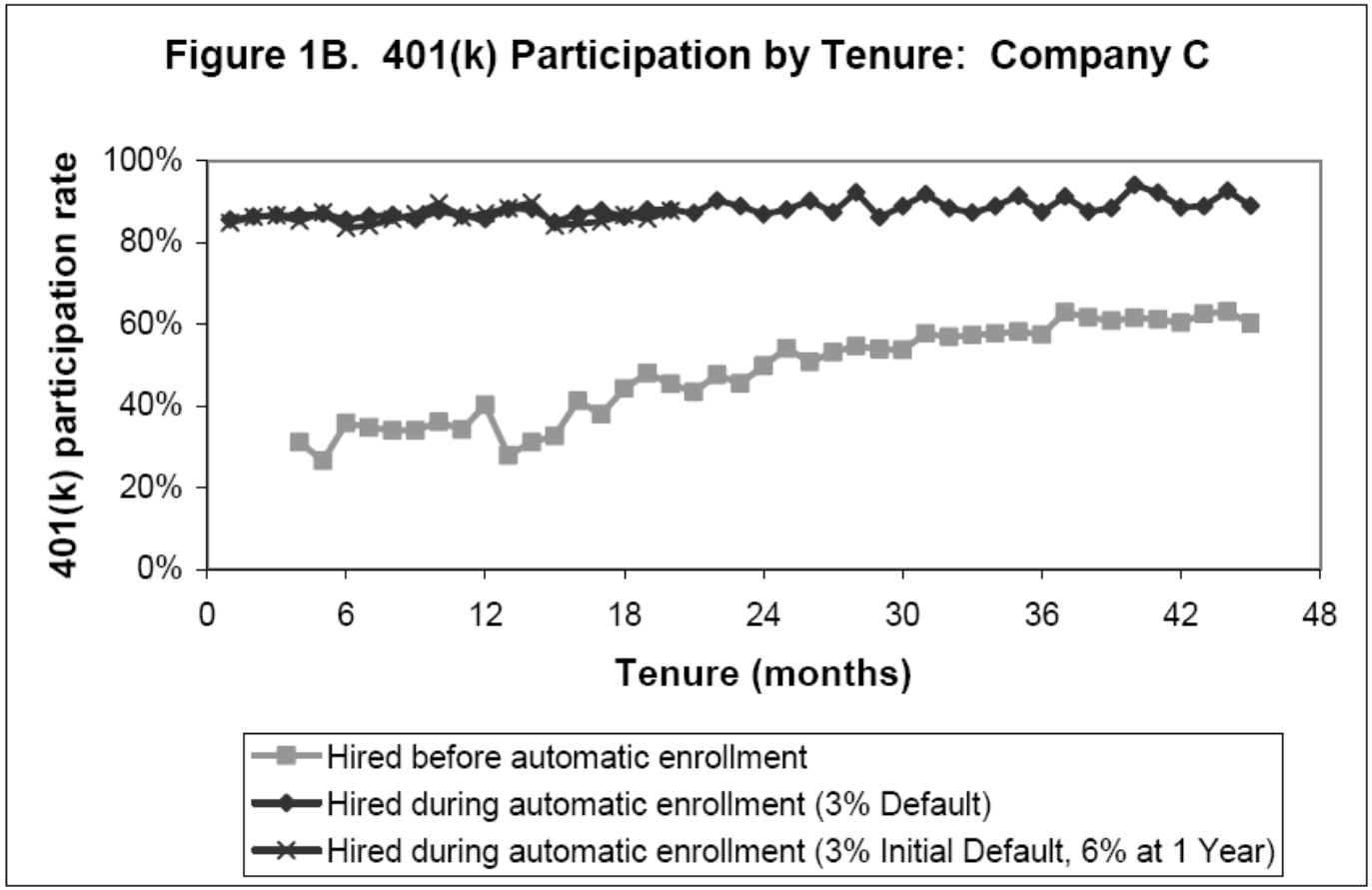
	Effect of Automatic enrollment: Window cohort on 6/30/98 vs. New cohort on 6/30/99	Effect of Immediate eligibility: Old cohort on 6/30/98 vs. Window cohort on 6/30/99
401(k) Participation rate		
Raw difference	48.5%*	0.6%
Regression-adjusted difference	50.4%*	4.1%*
401(k) Contribution rate		
Raw difference	−2.9%*	−0.1%
Regression-adjusted difference	−2.2%*	0.2%

- Results very robust. Choi et al. (2004) Survey paper:

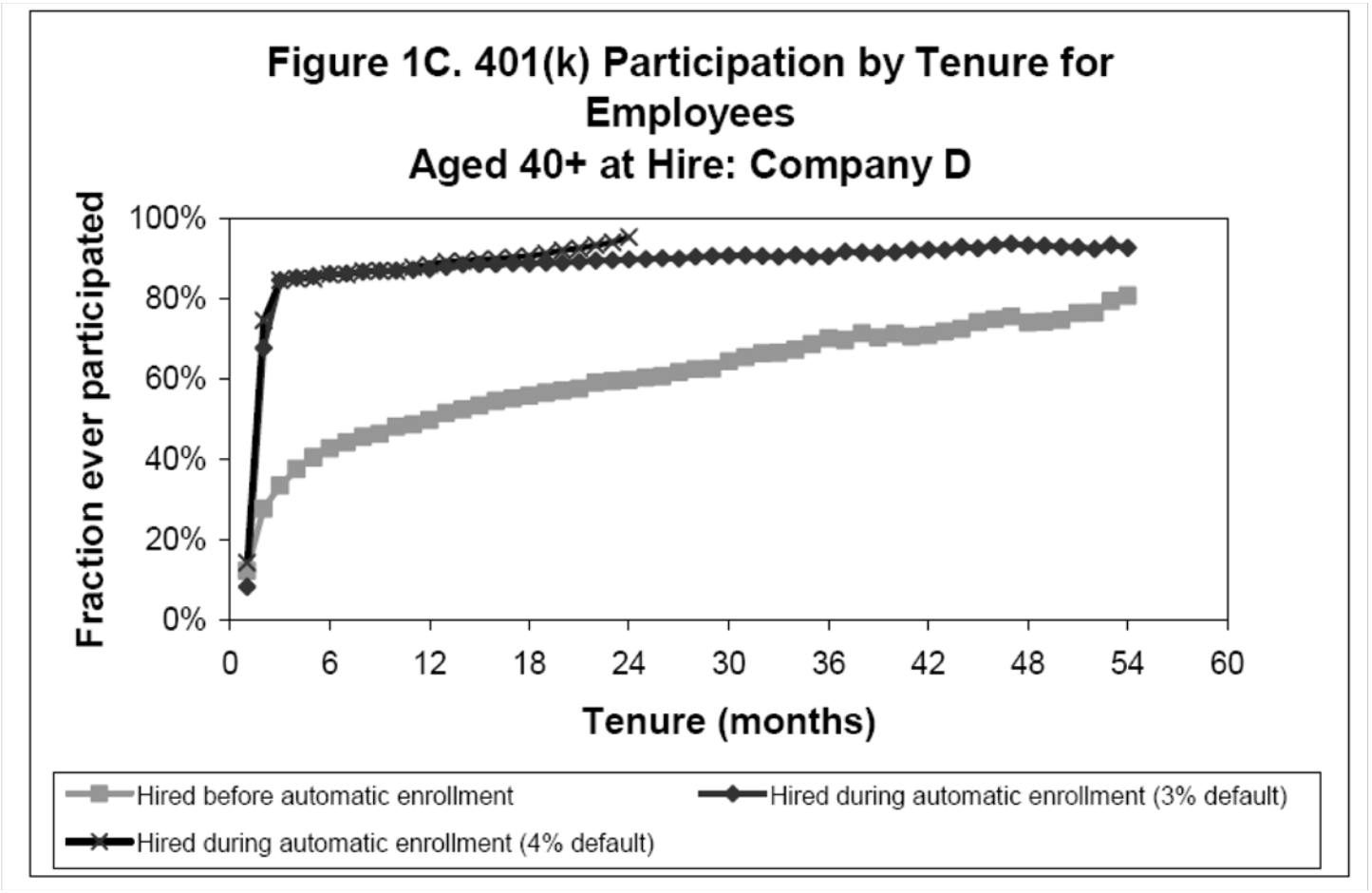
- Company B switches from OLD to NEW to OLD



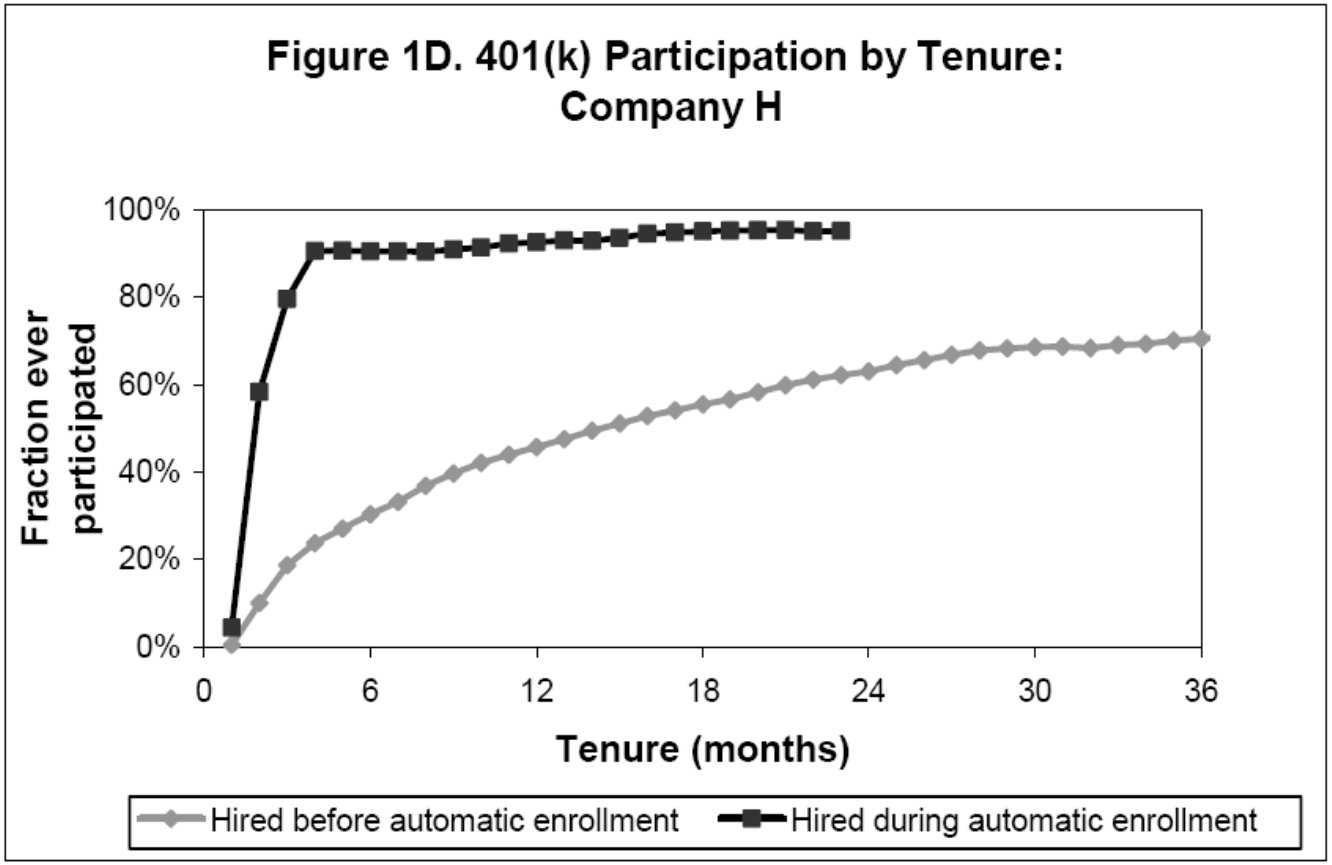
- Company C switches from OLD to NEW to NEW2



- Company D switches from OLD to NEW to NEW2



- Company H switches from OLD to NEW



- – * 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., 2007) – Large Fortune-500 Company, Financial sector

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

- **Fact 3. Active Choice resembles Default Investment**

Table 1. 401(k) plan features by effective date

	Effective January 1, 1997	Effective November 23, 1997
Eligibility		
Eligible employees	U.S. employees, age 18+	U.S. employees, age 18+
First eligible	Immediately upon hire	Immediately upon hire
Employer match eligible	Immediately upon hire	Immediately upon hire
Enrollment	First 30 days of employment or January 1 of succeeding calendar years	Daily
Contributions		
Employee contributions	Up to 17% of compensation	Up to 17% of compensation
Non-discretionary employer match	50% of employee contribution up to 5% of compensation	50% of employee contribution up to 5% of compensation
Discretionary employer match	Up to 100% of employee contribution depending on company profitability (50% for bonus-eligible employees); 100% in 1997.	Up to 100% of employee contribution depending on company profitability (50% for bonus-eligible employees); varied from 0% to 100% for 1997-2000.[a]
Vesting	Immediate	Immediate
Other		
Loans	Not available	Available; 2 maximum
Hardship withdrawals	Available	Available
Investment choices	6 options. Employer stock also available, but only for after-tax contributions.	8 options + employer stock (available for before- and after-tax contributions)

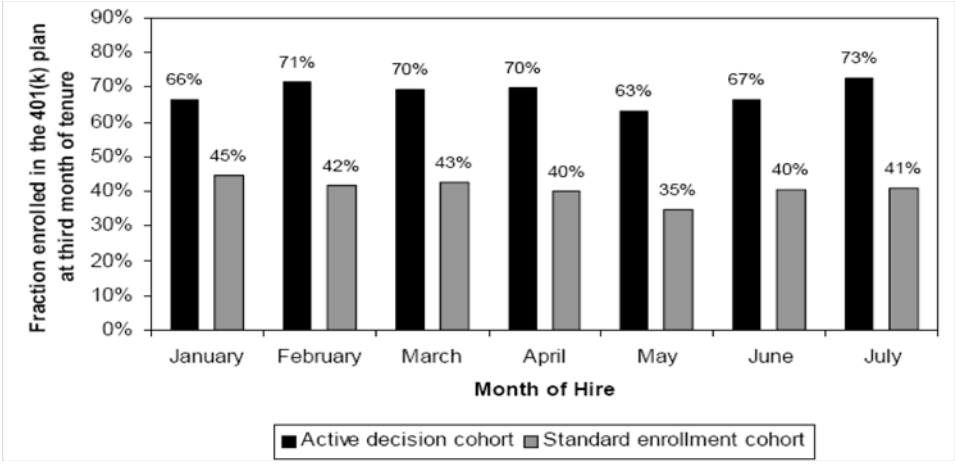
- ACTIVE Cohort, hired 1/1/97-7/31/97
  - 30 days to return 401(k) form with legal packet
  - Next enrollment period: January 1998
  - Paper-and-pencil form
- OLD2 Cohort, hired 1/1/98-7/31/98
  - Standard, no-saving-default (like OLD)
  - Can enroll any time
  - Telephone-based enrollment, 24/7

- Step 1. Check Design
  - Summary Stats (Table 2)–No substantial difference across cohorts

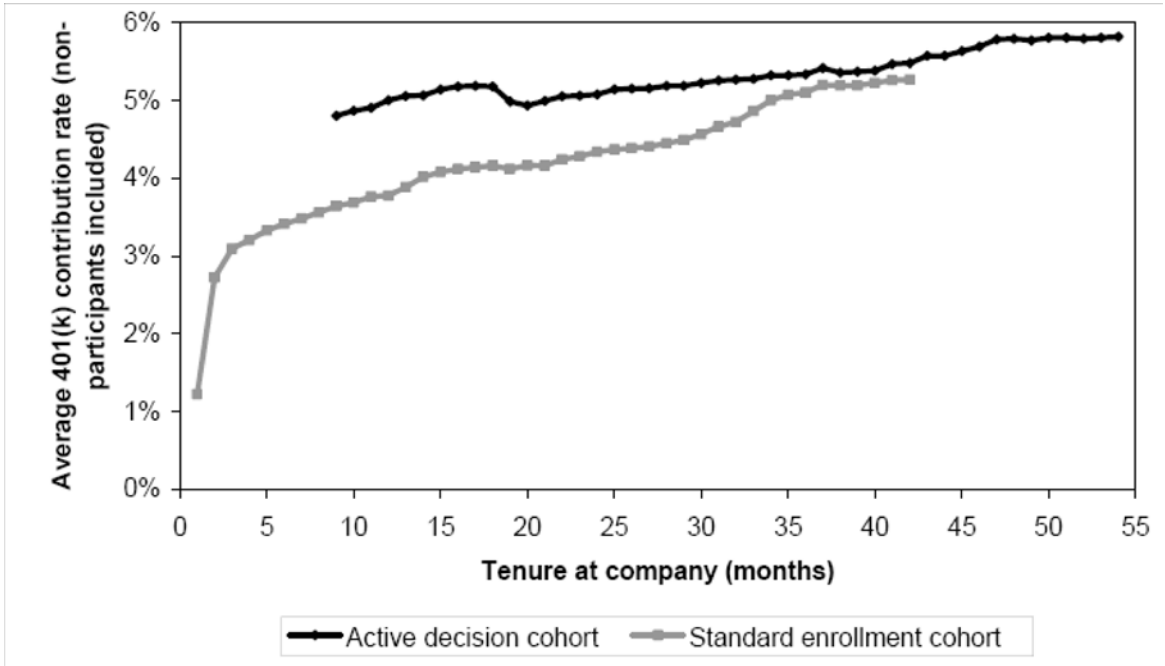
Table 2. Comparison of worker characteristics

	Study company			
	Active decision cohort on 12/31/98	Standard enroll. cohort on 12/31/99	All workers on 12/31/99	U.S. workforce (3/98 CPS)
Average age (years)	34.1	34.0	40.5	38.8
Gender				
Male	45.4%	43.4%	45.0%	53.1%
Female	54.6%	56.6%	55%	46.9
Marital Status				
Single	42.8%	47.8%	32.4%	39.0%
Married	57.2%	52.2%	67.6%	61.0%
Compensation				
Avg. monthly base pay	$2,994	$2,911	$4,550	--
Median monthly base pay	$2,648	$2,552	$3,750	--
Avg. annual income[a]	$34,656	$34,001	$52,936	$32,414
Median annual income[a]	$30,530	$29,950	$42,100	$24,108

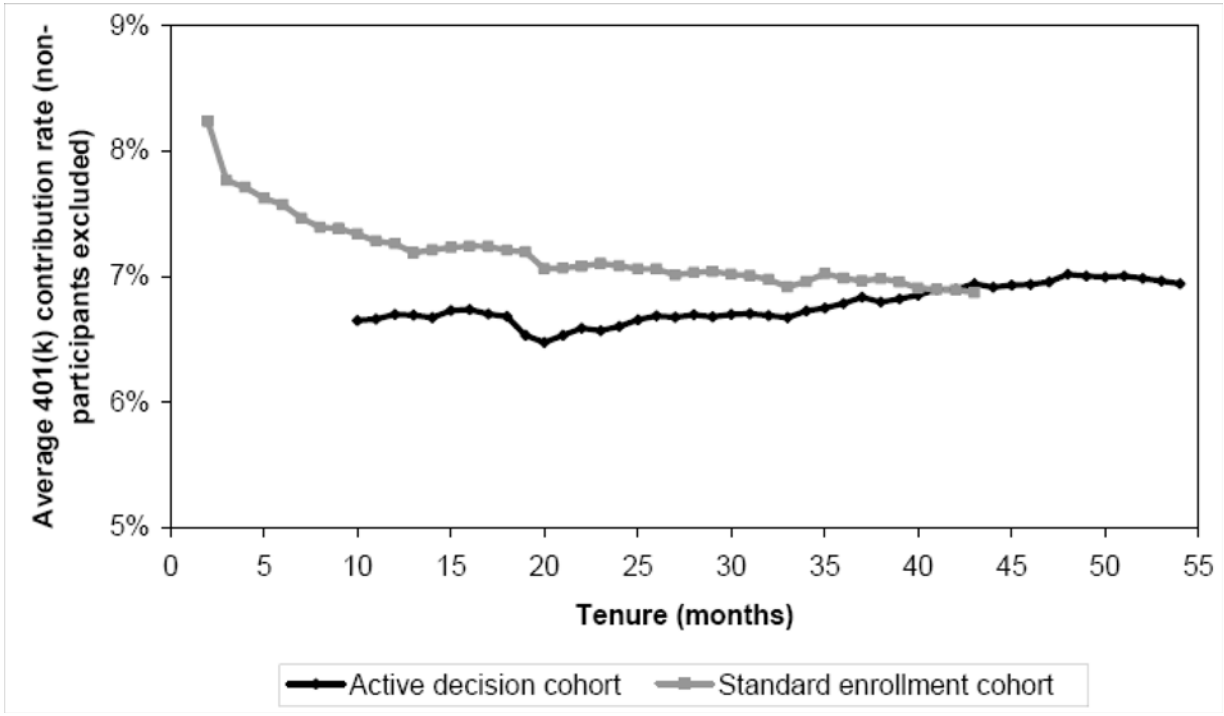
- Step 2. Compare plan choices (Figures 1 and 2)
  - *Participation* rates in 401(k) using cross-sectional data (Figure 1):
    - ACTIVE: 69% – OLD2: 41% (at month 3)
    - Compare to NEW (86%) and OLD (57%) in MS01 after >6 months
    - Does not depend on month of hire (see below)



- – *Contribution* rates (including zeros) (Figure 3)
  - ACTIVE: 4.8% – OLD2: 3.5% (at month 9, when longitudinal date becomes available)

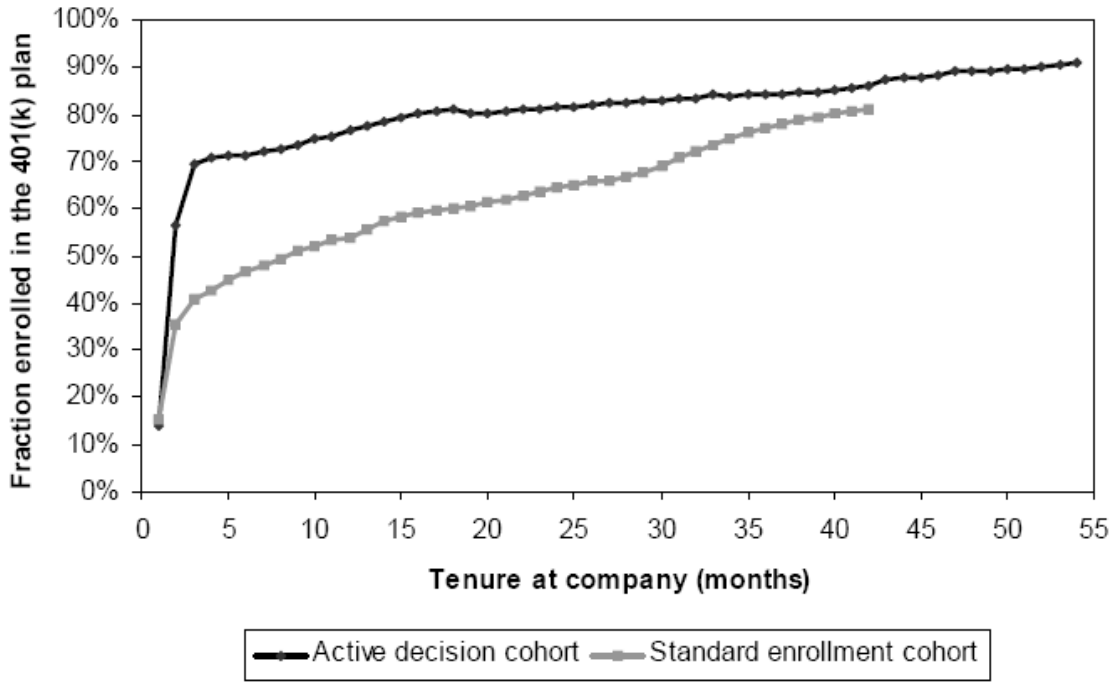


- – *Contribution* rates (excluding zeros) (Figure 4)
  - ACTIVE: 6.8% – OLD2: 7.5% (at month 9)
  - Selection effect: Marginal individuals are lower savers



- – 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)
  - Privatization of Social Security in Sweden in 2000
  - 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

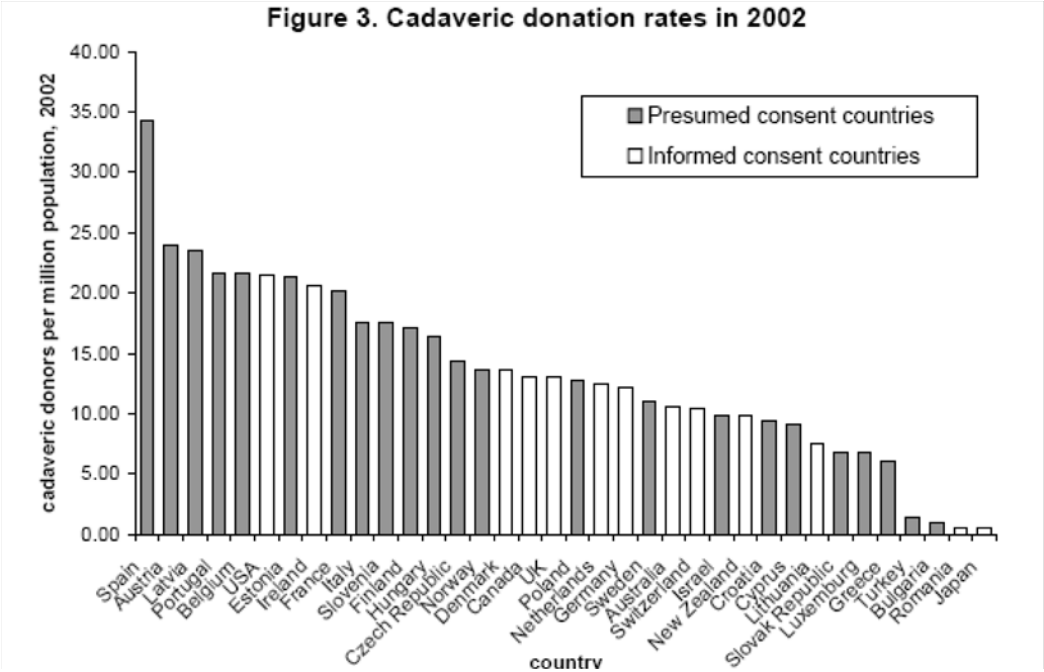
TABLE 1—COMPARISON OF THE DEFAULT FUND AND THE MEAN ACTIVELY CHOSEN PORTFOLIO

	Percentages[a]	
Portfolio characteristic	Default	Mean actively chosen portfolio
Asset allocation		
Equities	82	96.2
Sweden	17	48.2
Americas	35	23.1
Europe	20	18.2
Asia	10	6.7
Fixed-income securities	10	3.8
Hedge funds	4	0
Private equity	4	0
Indexed	60	4.1
Fee	0.17	0.77
Beta	0.98	1.01
Ex post performance	−29.9	−39.6

- Additional evidence of default effects in other contexts:

  1. SMRT plan for savings (Benartzi and Thaler, JPE 2004)
  2. Health-club contracts (DellaVigna and Malmendier, 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)

- Abadie and Gay, *Journal of Health economics*, 2006
  - Organ donation: Presumed Consent vs. Informed Consent
  - Comparison across Countries (too few within-country changes)



Dependent variable: Natural logarithm of cadaveric donors per million population

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Legislation:								
Presumed consent	.1559	.1027	.2615**	.2577**	.2839**	.2562*	.3111**	.2493**
	(.1352)	(.1316)	(.1206)	(.1233)	(.1294)	(.1386)	(.1238)	(.1164)
Wealth & health expenditures:								
Log GDP per capita			.2191*		.2561*	.3138**	.3032**	.3145**
			(.1205)		(.1374)	(.1448)	(.1309)	(.1181)
Log of health expenditures per capita				.2061*				
				(.1175)				
Religious beliefs:								
Catholic country					.1705	.0913		
					(.1717)	(.1846)		
Legislative system:								
Common law					.1636	.3109*	.3233*	.3460**
					(.1084)	(.1609)	(.1668)	(.1643)
Potential donors:								
Log of MVA & CVD deaths (per 1000 pop.)						.4090*	.4104*	.4863**
						(.2282)	(.2244)	(.1938)
Include Spain	yes	no	yes	yes	yes	yes	yes	no
Specification test (p-value)			.9504	.3876	.9074	.2230	.2340	.3863
R-squared	.0587	.0342	.2111	.2124	.2754	.3216	.3111	.3636
Number of observations	213	203	213	186	213	146	146	140

- Concern: Consent default reflects higher social capital

- "Placebo": Blood donations (social capital measure) do not predict default

	Dependent variable: Natural log of cadaveric donors pmp		*Dependent variable:* Presumed consent country	
	(1)	**(2)**	**(3)**	**(4)**
Variables from Table II, columns (6) and (7):				
Presumed consent	.2940**	.3613**		
	(.1334)	(.1158)		
Log GDP per capita	.2121	.2182	-.0551	-.0488
	(.1558)	(.1479)	(.1070)	(.0810)
Catholic country	.1328		.2947*	
	(.1589)		(.1524)	
Common law	.4175**	.4265**	-.6032**	-.6856**
	(.1805)	(.1862)	(.1738)	(.1558)
Log of MVA & CVD deaths (per 1000 pop.)	.2740	.2975	.1936	.2890
	(.2571)	(.2542)	(.2028)	(.2329)
Social preferences:				
Log of blood donations (per 1000 pop.)	.4374*	.3459	-.1726	-.4417
	(.2500)	(.2770)	(.3657)	(.3605)

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)

	Seminar Attendees		Non-Attendees
Planned Action	Planned Change	Actual Change	Actual Change
Non-participants			
Enroll in 401(k) plan	100%	14%	7%
401(k) participants			
Increase contribution rate	28%	8%	5%
Change fund selection	47%	15%	10%
Change fund allocation	36%	10%	6%

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 (2003), *Quarterly Journal of Economics*
  - 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 1

DESCRIPTIVE STATISTICS, BY GROUPS

	Treated departments			
	All (group $D = 1$)	Treated (group $D = 1$, $L = 1$)	Untreated (group $D = 1$, $L = 0$)	Untreated departments (group $D = 0$)
	(1)	(2)	(3)	(4)
PANEL A: BACKGROUND CHARACTERISTICS				
TDA participation before the fair (Sept. 2000)	0.010	0.009	0.011	0.012
	(.0015)	(.0021)	(.0022)	(.0024)
Observations	4168	2039	2129	2043
Sex (fraction male)	0.398	0.400	0.396	0.418
	(.0076)	(.0109)	(.0107)	(.011)
Years of service	5.898	5.864	5.930	6.008
	(.114)	(.161)	(.16)	(.157)
Annual salary	38,547	38,807	38,297	38,213
	(304)	(438)	(422)	(416)
Age	38.3	38.4	38.2	38.7
	(.17)	(.24)	(.24)	(.24)
Observations	4126	2020	2106	2018
PANEL B: FAIR ATTENDANCE (REGISTRATION DATA)				
Fair attendance rate among non-TDA enrollees	0.214	0.280	0.151	0.049
	(.0064)	(.01)	(.0078)	(.0048)
Observations	4126	2020	2106	2018
Fair attendance rate for all staff employees	0.192			0.063
	(.0132)			(.0103)
Observations	6687			3311
PANEL C: TDA PARTICIPATION (ADMINISTRATIVE DATA)				
TDA participation rate after 4.5 months	0.049	0.045	0.053	0.040
	(.0035)	(.0049)	(.0051)	(.0045)
Observations	3726	1832	1894	1861
TDA participation rate after 11 months	0.088	0.089	0.088	0.075
	(.005)	(.0071)	(.007)	(.0065)
Observations	3246	1608	1638	1633

- Summary of effects:
  - Large effect of subsidy on attendance (including peer effect)
  - Small effects of attendance on retirement savings

TABLE II
REDUCED-FORM ESTIMATES (OLS)

	Dependent variable		
		TDA enrollment after	
	Fair attendance (1)	4.5 months (2)	11 months (3)
PANEL A: Average effect of department treatment			
Treated	0.166	0.0093	0.0125
Department dummy D	(.013)	(.0043)	(.0065)
Observations	6144	5587	4879
PANEL B: Effect of letter and department treatment			
Letter dummy L	0.129	−0.0066	0.0005
	(.0226)	(.0061)	(.0102)
Treated	0.102	0.0125	0.0123
Department dummy D	(.0139)	(.0054)	(.0086)
Observations	6144	5587	4879

- 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 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:

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

- 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: OLD2$\simeq$OLD$\simeq$ACTIVE$\simeq$NEW
  - Naives:
    - $0 < k_C < k_A$ –> Predicted enrollment: OLD2=OLD<<ACTIVE$\leq$NEW
    - [Move from $T = 360$ (ACTIVE) to $T = 1$ (OLD2) –> Predicted enrollment: OLD=OLD2<ACTIVE
- **Fact 3. Active Choice resembles Default Investment (**OLD<<ACTIVE$\simeq$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:

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

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

4 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?

5 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:
     - Homeworks and Task Completion (Ariely and Werternbroch, 2002)
     - Exercise (DellaVigna and Malmendier, 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, 2006)

6 Investment Goods: Homeworks

- 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)

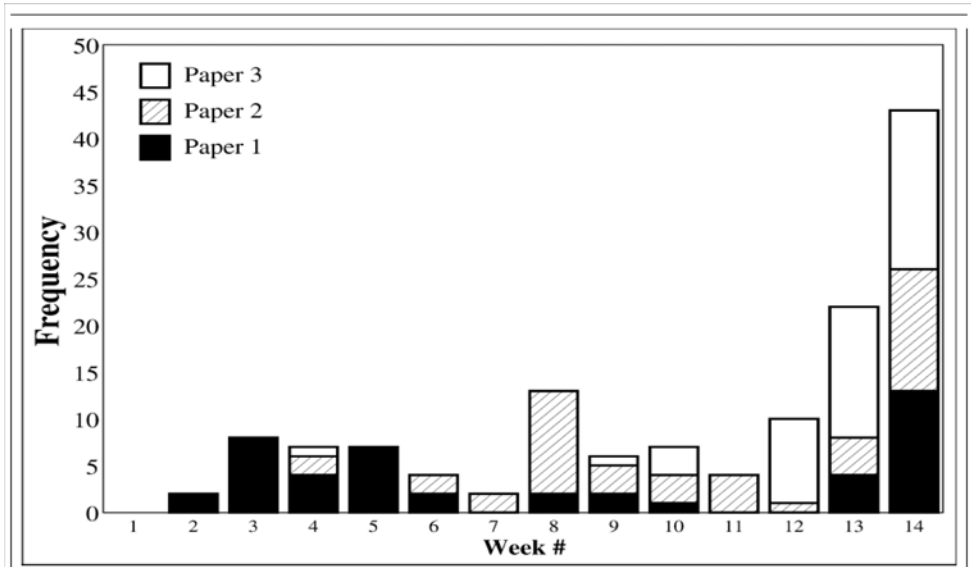


Fig. 1. Frequency distribution of the declared deadlines in Study 1 as a function of the week of class (Week 1 is the first week, and Week 14 the last week), plotted separately for the three papers.

- 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: $A > C > B$

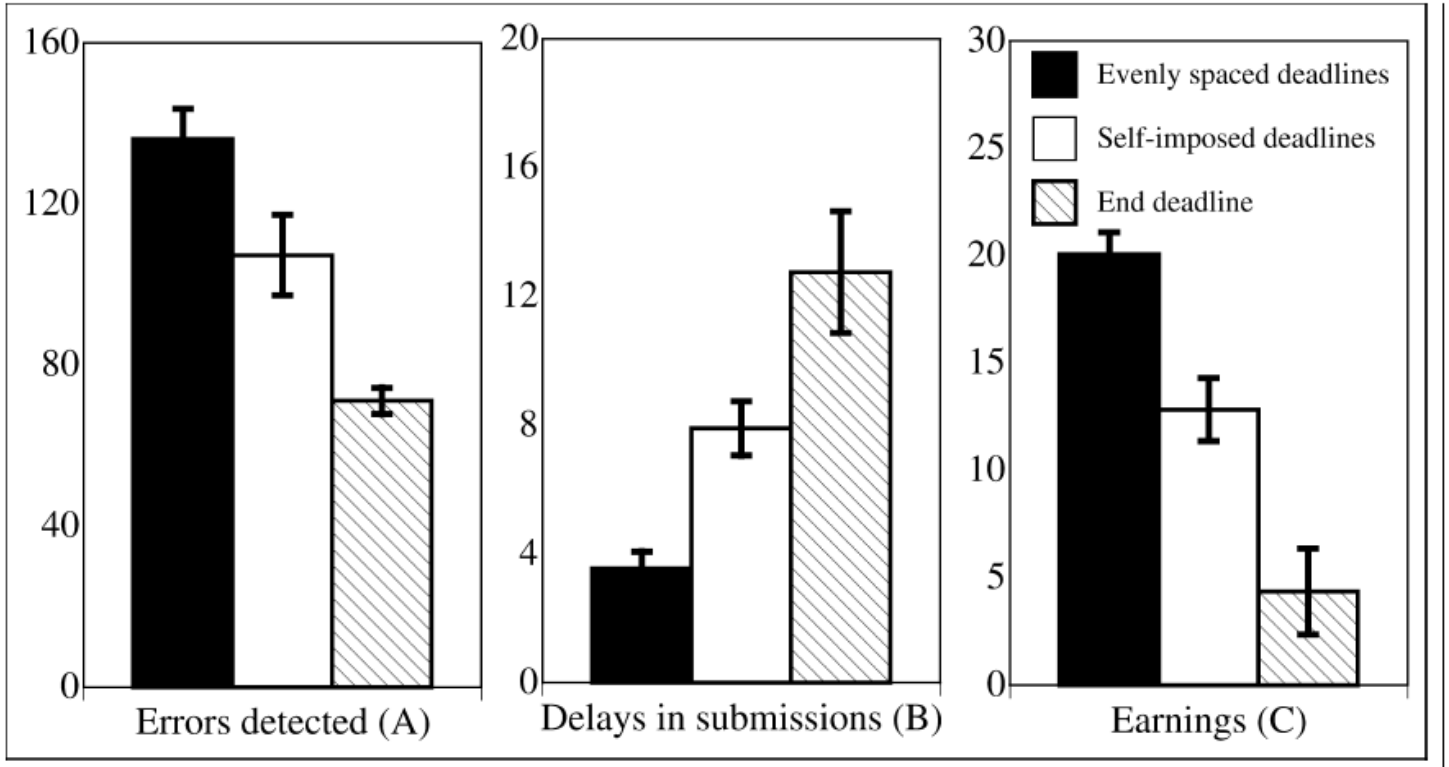


Fig. 2. Mean errors detected (a), delays in submissions (b), and earnings (c) in Study 2, compared across the three conditions (error bars are based on standard errors). Delays are measured in days, earnings in dollars.

- 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

7 Methodology: Reading Psychology Journals

- One strategy for papers in Psychology and Economics:
  - Get idea from reading psychology literature
  - Think of economic setting to apply to
    - Model new phenomenon
    - Test with economic experiments
    - Apply using field data
- How to start with psychology literature?

- **Step 1.** Choosing your Psychology. Not all kinds of psychology are equally useful!
  - *Social Psychology* (attribution errors, emotions, discrimination). YES!
  - *Cognitive Psychology* (Kahneman and Tversky agenda). YES!
  - *Personality Psychology* (Big Four personality types). Not very optimistic (Michigan and NYU group more optimistic)
  - *Developmental Psychology* (Development of skills in children). Not much so far, may become important (see Bill Harbaugh's experiments)
  - *Comparative Psychology* (Example: Asians not overconfident). Difficult to test empirically, but promising

- **Step 2.** Where to start?
  - Read a good introductory book
    - On social psychology I strongly recommend L. Ross and R.E. Nisbett, *The Person and the Situation*, McGraw-Hill, 1991. (Let me know if cannot find it)
    - On cognitive psychology a classic is Daniel Kahneman, Paul Slovic, and Amos Tversky. *Judgment Under Uncertainty: Heuristics and Biases*, Cambridge University Press, 1982
  - Attend a graduate (or undergraduate) class in social of cognitive psychology. Check listing in Psychology Department

- **Step 3.** Continuing education – Choosing the psychology journals
  - Look for the top psychology journals:
    1. *Journal of Personality and Social Psychology* (*JPSP*)
       * Mostly very high-quality experiments
       * Go directly to design—Do not stop at summary
       * Skip the Section on personality psychology
    2. *Psychological Bulletin*
       * Publishes mostly reviews
    3. *Psychological Review*
       * Publishes 'theoretical' contributions, i.e., attempts to summarize existing experimental evidence. No Greek letters!

– Top marketing journals can be useful too

1. *Journal of Consumer Research.* Generally the most psychology-based
2. Also *Journal of Marketing Research*

- **Step 4.** Reading a psychology article
  - Do not go for the newest finding.
    - Look for findings that have been replicated, preferably by different researchers
    - Use Google Scholar for that
  - Reading group: Reading the articles in a group of 2-3
  - Psych articles will contain typically 3-6 experiments. Focus on strongest one or two
  - Classical issues to look for:
    - Sample sizes small
    - Are outcome variables interesting?

    * Deception

- Psych authors tend to claim that they found a new effect – Look for unifying theme instead
- Read meta-analyses (summaries of experiments in an area) — But be wary that many bad experiments do not make a good one

- **Step 5.** Apply it to economics
  1. Criticize the findings
     - Are they relevant for economics?
     - Can existing economic models explain it? (information stories often successful)
  2. Find economic problem could apply to
     - Brainstorm areas: charitable giving, yes-men in companies, shopping behavior,...
  3. Once have an idea, look for related papers in economics (and psychology)

- It may not work, but you will learn much

8 Next Lecture (March 17)

- Consumption Choices
- *Investment Good:*
  - Health-Club Attendance
- *Leisure Goods:*
  - Credit Card Usage (Ausubel, 1999; Shui and Ausubel, 2005)
  - Consumption (Laibson, Repetto, and Tobacman, 2006)

- Methodological Topic 1: Errors in Applying (β, δ) model