

# 219B – Problem Set 1 – Due in class on Jan. 31, 2007

## Present Bias and Retirement Savings

### Question #1

In this Question we consider the impact of self-control problems on investment in retirement savings. Consider a present-biased individual that is considering when (and whether) to undertake an investment activity with immediate costs and delayed benefits. The main example will be calling the Human Resources Department to change the 401(k) allocation. Compared to the alternative activity, which has payoff 0, the investment activity has payoff  $-k < 0$  at time  $t$  (the present) and payoff  $b > 0$  for all periods from  $t+1$  on. ( $t+1$  included). The individual has to choose when to undertake the investment activity, that is, at  $t$ , at  $t+1$ , at  $t+2$ , etc. (The individual can also decide not to do it, which we define as doing at  $t = \infty$ ) Assume that both  $k$  and  $b$  are deterministic.

a) Consider first a time-consistent individual ( $\beta = \hat{\beta} = 1$ ) and solve for the optimal timing of the investment decision. **Show** that the optimal solution takes the form of a threshold rule as a function of  $k$ ,  $\delta$ , and  $b$ .

b) Consider then a sophisticated present-biased individual ( $\beta = \hat{\beta} < 1$ ). Compute the utility for the current self from investing today, at time  $t$ . Compute the utility for the current self from investing  $T$  periods into the future, that is, at  $t + T$ .

c) Show that this implies that a sophisticated agent will wait for at most  $T$  days to invest if the cost of investing  $k$  satisfies

$$k \leq \frac{\beta\delta b}{1 - \beta\delta^T} T \quad (1)$$

[You will need a Taylor expansion of  $1 - \delta^T$  for  $\delta$  going to 1:  $1 - \delta^T \simeq (1 - \delta) T$ ]

d) Consider now a fully naive present-biased individual ( $\beta < \hat{\beta} = 1$ ). As of time  $t$ , under what conditions does the individual expect to invest tomorrow (at  $t + 1$ )? Argue that the naive agent compares the utility from investing today and tomorrow.

e) Show that the fully naive present-biased individual invests at time  $t$  (and otherwise never invests) if and only if

$$k \leq \frac{\beta\delta b}{1 - \beta\delta}.$$

f) In particular, discuss what the following sentence means: *The naive agent procrastinates if*

$$\frac{\beta\delta b}{1 - \beta\delta} < k \leq \frac{\delta b}{1 - \delta}.$$

What is the difference between procrastinating ( $\frac{\beta\delta b}{1 - \beta\delta} < k \leq \frac{\delta b}{1 - \delta}$ ) and not investing ( $k > \frac{\delta b}{1 - \delta}$ )? Explain intuitively.

g) Compare the behavior of the naive to the behavior of the sophisticated and exponential individual using the solutions above. Provide intuition.

## Question #2

In this Question we apply the results of Question 1 to default effects in 401(k) choice (Madrian and Shea, 2001; Choi et al., 2004; Choi et al., 2005).

a) Consider the attached Table 1 (consider only companies B, C, D, and H) and Figures 1a-1d from the survey paper “For Better or For Worse” (Choi et al., 2004). [This paper was not distributed in class, but is available on the author’s websites] Choi et al. report the result of changes in default for 401(k) investments in 4 companies. The change is of a similar type as in Madrian and Shea (2001) Comment the findings in the Figures. Describe the effect of the change in default.

b) To what extent this evidence goes beyond the evidence in Madrian and Shea (2001)? Cite at least one issue with the Madrian and Shea (2001) paper that the evidence in Choi et al. (2004) addresses.

c) Now we go back to the answers in Question 1 and calibrate them to address the evidence in Madrian and Shea (1999) and Choi et al. (2005). As in Question 1, consider a new employee in a company without automatic enrollment (that is, the default is no investment). On any day, the employee can pay an effort cost  $k > 0$  and invest in the 401(k), thereafter reaping benefit  $b$  in every subsequent day. Can you provide reasonable values for  $k$ ,  $\delta$  and  $\beta$  for an individual with average earnings? Justify all the assumptions you make. (Remember:  $b$  and  $\delta$  are on a *daily* scale).

d) In particular, which factors would enter into the determination of  $b$ ? Can it be negative for some employees? Be as precise as you can. From now on, assume that it is positive.

e) Go back to the time-consistent employee in point (a) of Question 1. For what value of  $k$  should the individual be indifferent between investing and not (given the calibrated values of  $b$ ,  $\delta$  and  $\beta$ )? What do you expect the individual to do?

f) Move on now to the sophisticated present-biased employee in points (b) and (c) of Question 1. Using equation (1) calibrate the value of  $k$  for which the individual may wait 360 days (that is, one year) to invest, which is about the observed pattern. Are these plausible levels of the parameters, or do you expect that a sophisticated agent will invest earlier?

g) Consider now the naive present-biased employee in points (d)-(f). For realistic values of the parameters, is it likely that the employee will rationally delay ( $k > \frac{\delta b}{1-\delta}$ )? Is it likely that the employee will procrastinate ( $\frac{\beta \delta b}{1-\beta \delta} < k \leq \frac{\delta b}{1-\delta}$ )?

h) How do the predictions for the different models (for the calibrated values) vary once the default is shifted to automatic investment? (Assume that this means  $k < 0$  and ‘small’)

i) In light of points (a)-(h), which calibrated model fits the data better? Why?

j) Consider now the evidence in the ‘Active Decision’ paper (Choi et al., 2005) [This was distributed in class] Summarize the evidence in this paper on the impact of the introduction of ‘Active Decision’.

k) Go back to the calibrated models for the case in which the default is Active Decision. (Assume that this means  $k = 0$ ) Describe the predictions of the different models on the effect of the change in default in Choi et al. (2005). Which model fits best?

l) (Trickier) Under the assumptions maintained above, can you make welfare evaluations? That is, is there one treatment that would allow you to infer the welfare-maximizing saving allocation? What welfare criterion are you using to make this evaluation? Provide a detailed answer to this question.

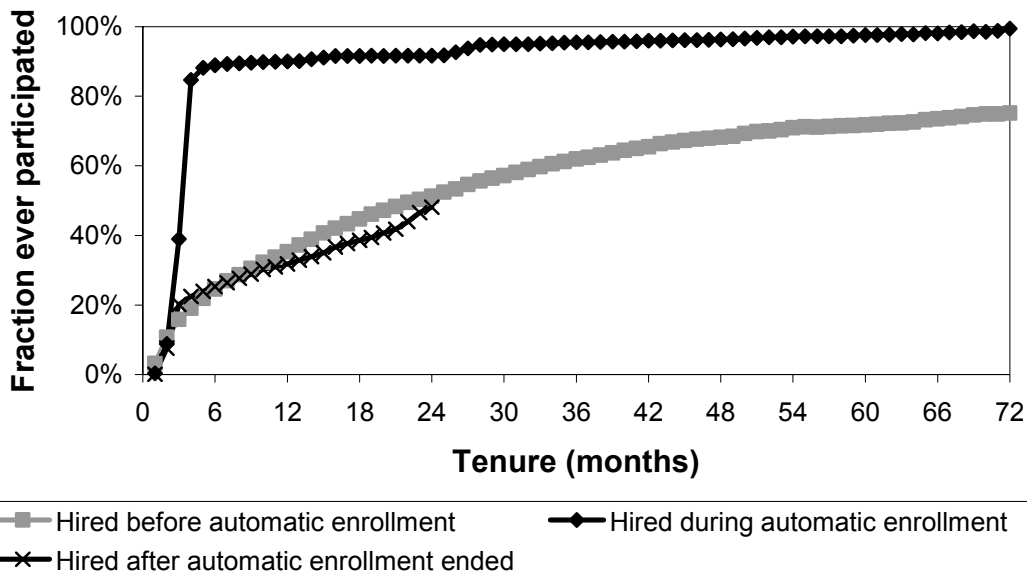
m) Now that you picked your favorite model, let's try to criticize that too. Which problems does your favorite model have? Can you imagine a way to fix them?

**TABLE 1. Companies and Their 401(k) Plan Changes or Other Interventions**

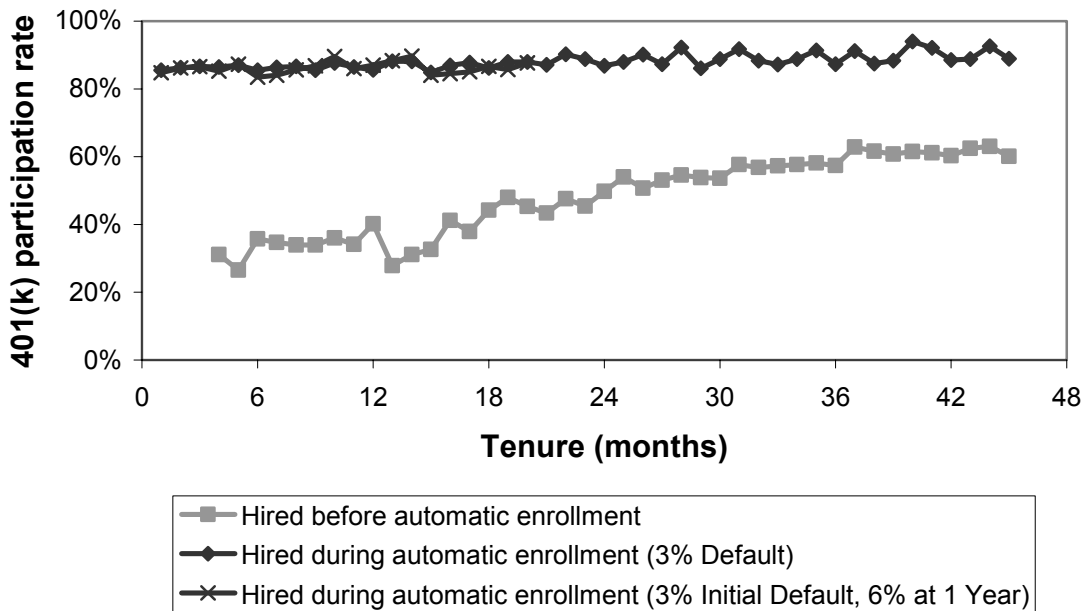
Company	Industry	Size <sup>a</sup>	Plan Change / Intervention	Date of Change/ Intervention
A	Food	10,000	Savings survey	January 2001
B	Office equipment	30,000	Adopted automatic enrollment	January 1997
			Eliminated automatic enrollment	January 2001
C	Insurance	30,000	Adopted automatic enrollment	April 1998
			Financial education seminars	January-December 2000
			Changed automatic enrollment defaults	May 2001
D	Food	20,000	Adopted automatic enrollment	January 1998
			Increased default contribution rate	January 2001
E	Utility	10,000	Increased match threshold	January 1997
F	Consumer packaged goods	40,000	Change eligibility	July 1998
			Instituted employer match	October 2000
G	Insurance	50,000	Change eligibility	January 1997
H	Manufacturing		Adopted automatic enrollment	January 2001
I	Retail	130,000	None	NA
J	Financial Services	50,000	None	NA
K	Pharmaceutical	10,000	Change eligibility	January 1996

<sup>a</sup> Number of employees (rounded to the nearest 10,000) on December 31, 1998 (Company K), December 31, 2000 (Companies A, B, D, E, F, G, I and J), June 30, 2000 (Company C) or December 31, 2001 (Company H).

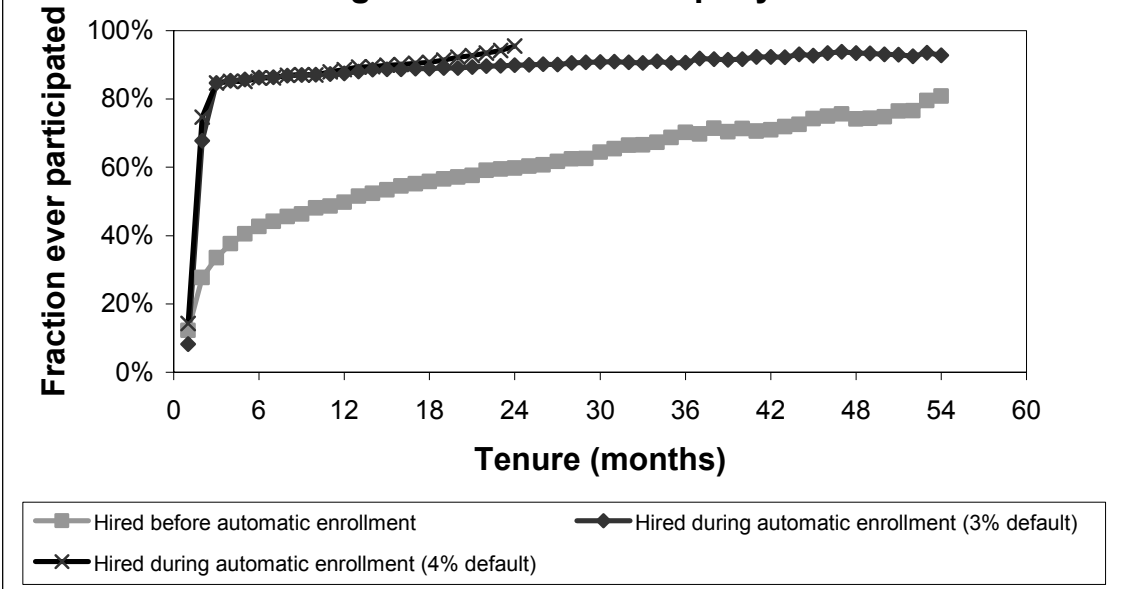
**Figure 1A. 401(k) Participation by Tenure: Company B**



**Figure 1B. 401(k) Participation by Tenure: Company C**



**Figure 1C. 401(k) Participation by Tenure for Employees Aged 40+ at Hire: Company D**



**Figure 1D. 401(k) Participation by Tenure: Company H**

