Income Smoothing and Self Control:

The Case of Schoolteachers

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Abstract

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Close to half the California school districts let teachers choose whether to receive their salaries ten monthly payments or in twelve. Fisherine intertemporal maximization implies that they should choose ten payments and earn interest on their savings for their summer. But about half choose twelve installments , even though when summed over a reasonable period the foregone interest is considerable. This can be explained by the cost of exercising self control and by Laibson's model of hyperbolic discounting. A survey of teachers supports this interpretation.

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Experimental economics is frequently criticized on the grounds that the incentives offered to subjects in the laboratory are too low to give the results any validity. In particular, when the results reject the standard economic maximizing model, the presumption is frequently made that anomalies will go away if incentives are raised to levels faced in the "real world." Indeed as Camerer and Hogarth have recently noted, (1999) it is "an open question what results from the laboratory tell us about incentives in naturally occurring environments."

In this paper we report the choices made by subjects in one such naturally occurring environment, the choice of payment pattern by California public schoolteachers. We calibrate the size of their incentives and show that not insignificant amounts of income are given up by large numbers of individuals (all of whom are college graduates) to implement what may be considered a sensible consumption plan , but one that is not optimal according to the standard income smoothing utility-maximizing model.

1 The Choice Problem.

Teachers usually work ten months in a twelve month academic year, so that if they are paid only during their working period they receive no salary in July and August. In the standard economic model of intertemporal financial planning, however, the absence of summer checks would present no problem since teachers could simply save at interest some fraction of their salary, arranging whatever summer consumption pattern was desired within the overall budget constraint.

Several authors (e.g. Thaler (1980), Schelling (1984), Thaler and Sheffrin(1981), Loewenstein(1992), Laibson(1997), Prelec (1992) and Rabin (1997)) have questioned the validity of the standard model and proposed an alternative approach[1]. In this new approach the teacher may well agree that the optimal plan is to smooth consumption by saving at interest during the earning months, but executing this optimal plan is not without cost. Thaler and Sheffrin, who explicitly note the schoolteachers' planning problem, argue that these implementation costs, or costs of self control, could change the behavior of teachers and make them willing to enter an implicit savings program at zero interest even though that would lower the present value of their income. An obvious question for field investigation is "how many do this and at what cost?" In addition for those teachers who enter such schemes, it is of interest to know if they see themselves as being challenged by issues of self control.

[1] Frederick et al [2002] provide a recent overview of this literature

2 Data and Results:

Our data come from two questionnaires (shown in Appendices A and B). The first questionnaire was sent to 259 school districts in California[2]. Replies with usable data were received from 130 districts (50 percent). A follow-up telephone survey checked on the possibility that a school district might pay interest to teachers who take the salaries that they earn over ten months in twelve monthly installments, and also that teachers might choose to be paid over an eleven months period[3]. A second questionnaire was sent to all teachers in one of the school districts identified in the first survey as offering a twelve months payment option. This survey examined the motives of those teachers who chose to be paid over 12 months.

In our sample, 71 school districts (55%) did not offer their employees any choice of salary arrangement. Of these, 37 (with 15,205 teachers) paid salaries on a 10 months basis, 15 (with 11,284 teachers) paid on a 12 months basis and 10 districts paid teachers who work 10 months on a 10 month basis and those who work 12 months 12 times.[4]

Thus there were 59 school districts (45%) , employing 29,103 teachers which offered a choice of payment pattern, so that our sample is large.[5] In some districts teachers who prefer twelve

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[2] The other California districts were included in a pilot survey that was not used here.

[3] We were alerted to this possibility by one district - which we excluded - that does pay such interest. None of the others that we questioned in the follow-up survey do this. We could not reach a few districts because they had not supplied an address or phone number. But since we found only two districts (which we have eliminated) that did pay interest, and very few that allow teachers to chose an eleven months pay period, we assumed that none of the districts that our follow-up survey failed to reach does either of these.

[4] In addition, 3 districts volunteered the information that they pay on an 11 month basis. One district (with 14 teachers) pays 3 checks in June, and the information from 5 districts is ambiguous.

[5] It is not clear how the respondents accounted for part-time teachers and some appear to have included non-teaching personnel when answering the question about the number of teachers in their district. This introduces some error because the percentages for all teachers were calculated by multiplying the percentages choosing a particular salary by the number of teachers in each district.

payments receive three checks in June. Presumably districts do this to avoid having to administer a payroll during the summer months, and participating teachers prefer this arrangement to being paid in ten installments because it requires less self control not to cash their July and August checks prematurely than to avoid spending funds that accumulate in their deposits during the academic year. We therefore treated these teachers as though they chose twelve payments. Table 1 shows the pay preferences.

Insert Table 1 here.

As can be seen, of the approximately 30,000 teachers in our sample who were given the choice of a savings plan at zero interest some 15,000 took it. How much did this choice cost in terms of foregone income?

3 The Costs of Deferring Income:

To answer this question we need to know the teacher's salary, the salary path, and the interest rate. These data are not available. Instead we offer some calculations of foregone salary under a number of possible scenarios.

We begin by noting the range of teacher's salaries. For the twelve largest cities in California The median of the minimum salaries in the twelve largest California cities in 2001 was $35,981 for teachers with a B.A. degree and the median of the maximum salaries for teachers with an M.A. was $54,491, (American Federation of Teachers, 2001, Table IV-1) Given this range of salaries, we next calculated the present value of earnings lost by adopting the 12 month rather than the 10 month option for a number of possible salaries and interest rates, see Table 2. Note that when a teacher has the option of a 10 month or a 12 month contract at zero interest, it is irrelevant that the school district

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[6] All sums were discounted at the interest rate shown.

may have access to higher yielding assets than its teachers. Such access could, of course, increase average salaries for a teacher who deferred income, but given this higher salary, any teacher who chose the 12 month option over the 10 month option at zero interest is still leaving on the table the dollar sums given in Table 2.

Insert Table 2 here

Since teachers will choose different asset portfolios, there is no obvious single interest rate which can be used to measure income forgone. The 1 per cent and 2 per cent rates measure roughly the foregone interest income using as an alternative someone who places one sixth of each month's salary into a checking account. The 7% measures the forgone return on equities at the historical rate of return, and the 18% measures the income saved if a credit card debt is paid down. For teachers who are capital rationed, the relevant rate may even exceed 18%, and for some, probably many, teachers, one should add to the explicit yields the liquidity services they obtain from holding liquid assets in place of a claim for accrued pay. All measures are shown on a present value basis. For interest rates between those given, income loss can easily be approximated by extrapolation

As can be seen, a starting teacher who chooses the 10 months option and uses the accelerated payment schedule to pay down credit card debt could have the same consumption stream as the teacher who chooses the 12 months option and have approximately $400 left over [6]. Of course the loss at the rate on checking accounts is much smaller and for one year may be considered inconsequential.

Presumably most teachers who enter a zero-interest saving plan intend to do so for more than one year, and then the present value of the foregone income over a teacher's life becomes even more

substantial.[7] Relating this sum to the cost of self control, however, requires careful interpretation. Consider, for example, the 10 year loss for a teacher earning $42,000 per annum for whom the relevant rate is 18%. Table 2 shows that this sum amounts to $2503.

Since a teacher who receives 10 payments per year has to exercise self control 120 times during a 10 year period, she is paid, in effect, $20.86 for each instance of exercising control given the 18 percent rate, or $13.66 given the 7 percent rate, or $5.27 using the 2 percent rate. However, the burden of exercising self control need not be constant for these ten years. It seems highly plausible that here, too, there is "learning by doing", so that the burden falls over time. Teachers who are aware of this may therefore choose the ten months option, even though the first few times the interest earned is insufficient to compensate them for exercising self control.

As Table 2 shows, when summed over a period long enough to correspond to a reasonable estimate of a teaching career, the income foregone by choosing twelve payments is substantial, and much greater than the levels of compensation used in laboratory experiments. Hence, even though teachers can change their pay arrangements next year at the cost of overcoming inertia and spending some time, they do have an incentive to think about their choice more carefully than do the subjects of laboratory experiments. Moreover, in this case we do not have to worry that motives arising from the experimental situation, such as trying to please the experimenter, play any role.

4 Implications

The standard model of the teacher's choice of payment mechanism views the allocation problem as a simple version of the classic intertemporal maximization model of Fisher (1930).

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[7] There is the possibility that payment over twelve months might maximize teachers' income by shifting the period over which they are paid for the summer months to a time when their salaries are higher, either because of a general

Assuming we can write intertemporal preferences in an additively separable form, and assuming geometric discounting at a constant rate, the problem becomes

$$\text{Max.} \sum_{i=0,\,11} U(C_i)\,/(1+\delta)^i \qquad (1)$$

$$\text{s.t.} \sum_{i=0,\,11} C_i\,/(1+r)^i = \sum_{i=0,\,9} Y\,/(1+r)^i = Y \sum_{i=0,\,9} 1/(1+r)^i \qquad (2)$$

where r is the constant monthly interest rate, Y is income and C is consumption. The solution to this problem is well known to be

$$C(i) = C(0)\,[(1+r)^i / (1+\delta)^i] \quad i = 1,11 \qquad (3)$$

where initial consumption C(0) is chosen to satisfy the budget constraint (2). Because of (3), total utility is a monotonically increasing function of initial consumption C(0) which in turn is a monotonically increasing function of the present value of income. In terms of this model, choosing the 12 months payment option lowers the present value of income, so it is neither income nor utility maximizing and is not predicted by the model.

Issues of self control, however, offer an explanation for this anomalous behavior.

Self control issues do not arise in the standard intertemporal model because as time moves forward, the consumption plan in (3) chosen in September remains optimal for each remaining month. As Strotz (1955) first showed, this "time consistency" is a mathematical consequence of the geometric discounting assumed in (1)

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salary increase, or because they have moved up on the payment ladder. Neither of these possibilities materialized in

Suppose, however, that discounting was not geometric. As a simple alternative, suppose that teacher's preferences are represented by the function

$$U(C_{0,\ldots}C_n) = U(C_0) + \beta \sum U(C_i)/(1+\delta)^i \qquad (4)$$

where C_0 is current consumption and the summation is over the remainder of the planning year, Phelps and Pollak (1968). Objective functions with this structure are said to display hyperbolic discounting, see Laibson (1997) and for a critical viewpoint, see Rubinstein (2002)

Assume also that the teacher's pay cycle starts in September. Now it is clear that as seen from September where both June and July consumption are affected by the factor β, the trade off between consumption in June (the last paid month) and consumption in July (the first non- paid month) would look quite different from the way it looks in June. In the later month, only July is discounted by the factor β. This fact that the trade off between two future months depends on which month it is viewed from leads to time inconsistency in planning, and poses the obvious question of which month's preferences the teacher will respect. Since the teacher must now be thought of as having multiple preference systems (multiple selves), any attempt to limit decisions made according to the preferences of the current month's decision maker leads to issues of self control.

With this non-geometric discounting a very different picture of the teacher's 12 months choice emerges. If a teacher realizes in September that a decision which favors September over July consumption is an artifact of the beta discounting of July's consumption and that this discounting will disappear in July, she may decide to precommit to a program which executes

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the districts surveyed.

later preferences rather than earlier preferences. Rabin (1997) calls this precommitment strategy "sophisticated" and with this nomenclature the teacher who chooses the 12 months zero interest option is displaying sophisticated behavior.

This strategy of precommitment is not free. Table 2 is a measure of the income a sophisticated teacher would have to spend to avoid the consequences of allowing decision making to pass from month to month. However, we should note that in this context the income loss does not correspond to a utility loss, since a higher initial consumption in September can no longer be monotonically associated with a uniformly higher consumption stream, but may instead be a mistake (as viewed by later preferences). The 12 payment strategy at zero interest is the predicted behavior for sophisticated agents in this type of model if the interest costs of self control are sufficiently high. Finally we note that if, as is frequently done, a test for utility maximization substitutes income for utility, this data reject the utility maximizing model.

To be sure our data show that only half of the teachers actually follow the 12 months rule. Without further inquiry we cannot describe the behavior of the other half who choose the 10 months option. They may be what Rabin calls "naive" in that they fail to give any weight to future preferences and simply use the preferences of the current month to allocate income or they may be fully aware of the potential advantages of pre-commitment, but, because they face high costs of self control, are still unable to do it. Finally they may be following the Fisher model by setting up a private saving scheme at interest as that model predicts. Without more detailed investigation we cannot tell. What we can say is that the Fisher model is rejected for one half of all teachers who were given the choice of a 12 months schedule and that over a lifetime this choice costs the teacher a significant amount of income.

5 Surveying Individual Teachers

To elicit more information we sent a questionnaire (shown in Appendix B) to teachers in one of the school districts that offers a choice of pay systems[8]. Table 3 shows the responses to some of the questions[9].

Insert Table 3 here.

Other questions asked whether the teacher is on a ten or twelve months pay schedule - 45 percent responded that they were on a ten month schedule -, and about whether anyone with whom the teacher pools income receives a salary in July and August. The responses to the questions about income pooling are not shown in Table 3, or used to analyze separately those respondents who do no pool income, because of the limited number of such responses, but are shown in Appendix Table 1

We obtained 122 responses with at least some useful information, a response rate of 32 percent percent. Given the personal nature of some of the questions, this response rate is reasonable, though it does, of course, raise a question about the representativeness of our sample - and its small size suggests that only tentative conclusions can be drawn from it.

Although only one of the alternative responses in this survey provides information that bears directly on the prevalence of hyperbolic discounting, other responses provide indirect support for it because they are inconsistent with its main rival, the standard Fisher model. Thus, as previously discussed, that approximately half the respondents prefer to be paid in twelve installments suggests that their behavior cannot be explained by a model, such as the Fisher model, that ignores the cost of self control.

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[8] We are indebted to Richard Thaler for suggesting this survey

[9] In questions 2 and 3 respondents also had a choice of "other" with a space to write in an explanation. Several of these responses could readily be allocated to one of the other responses shown in Table 3. A number of respondents were asked to rank three alternatives, any alternative that was not checked received a ranking of 4.

This discrepancy between the standard Fisher model and the survey responses should, however, be viewed in its proper context. Suppose that the question had involved a large sum of money, say $100,000, with the interest lost by choosing ten installments being, say $2,000. Then, most respondents might well have cited the ability to earn interest as their reason for choosing ten installments. But many individual household decisions about spending or saving do involve relatively small sums that in the aggregate may be too important to be ignored by a model intended to explain savings decisions.

Turning to respondents who chose twelve payments, one of the alternatives offered does provide direct support for a hyperbolic discount function. This is that, as Table 3 and Appendix Table 1 show, to these respondents concern about having sufficient self control is an important a reason for choosing twelve payments. Half of them give this as their most important reason, thus identifying themselves as Rabin's "sophisticated" agents[10].

Another one of the three listed responses, "I have never considered any other way [than twelve payments] of saving for the summer", is also inconsistent with the Fisher model, and is more compatible with a satisficing model. (But here, too, had the potential gain from taking ten payments been much larger, presumably fewer teachers would have given this response.) Only the third response, that the potential interest earnings do not make it worth switching to ten payments, fits well into the Fisher model.

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[10] Another alternative provided in this question is having sufficient other income not to have to worry about the absence of paychecks from the school district during the summer. We included this choice because it may be relevant for many respondents, and about one third chose it. It does not, however, provide much information, because, to keep the questionnaire simple, it had to be worded loosely, that is in terms of "worry" about saving for the summer, rather than in terms that can be more readily translated into the concepts of utility theory. Since a receipt of "other" income during the summer might confound our results, we also looked separately at those questionnaires that reported no summer income from pooling. The results were similar to those for the whole sample.

6. Conclusion:

The opportunity for many teachers to choose between being paid in 10 or in 12 month installments provides a natural experiment for testing the Fisher intertemporal utility maximizing model. And for about half the teachers it fails this test. The behavior of these teachers can, however, be explained by a hyperbolic discount function, or simply by including a term in the utility function for the cost of exercising self control.

Table 1

Teachers Choices of Payments Arrangement.

	Number of Teachers	Percent
10 months	11,832	44
11 months	1,169	4
12 months	15,102	52
Total	28,103	100

Table 2

Income Lost By Choosing 12 Monthly Payments

		Income						
		30000	36000	42000	48000	54000	60000	66000
Present value summed over	Interest rate							
	1%	25	30	35	40	45	50	55
	2%	50	60	70	80	91	101	111
one year	4%	96	116	135	154	173	193	212
	7%	167	200	233	267	300	333	367
	18%	398	477	557	636	716	796	875
	1%	235	282	329	376	423	470	517
	2%	452	542	632	723	813	903	994
10 Years	4%	781	938	1094	1250	1406	1562	1719
	7%	1171	1405	1640	1874	2108	2342	2576
	18%	1788	2145	2503	2860	3218	3575	3933
	1%	448	538	627	717	806	896	986
	2%	822	987	1151	1315	1480	1645	1845
20 Years	4%	1309	1571	1833	2095	2356	2618	2880
	7%	1766	2120	2473	2826	3180	3533	3886
	18%	2129	2555	2981	3407	3833	4258	4684
	1%	641	769	897.	1025	1153.32	1281	1410
	2%	1126	1351	1577	1802	2027.1	2252.	2477
30 Years	4%	1666	1999	2332	2666	2998.09	3331	3664
	7%	2069	2483	2897	3311	3724.33	4138	4552
	18%	2195	2633	3072	3511	3950	4389	4828

Table 3
Responses of Teachers

Percent of

Questions	Respondents Checking Item [a]	Mean Score[b]	Number of Cases
A, Asked of those receiving 10 payments:			
What is the reason you have chosen 10 payments?			
a. I realize that I need to have income over the summer months, but I can save enough from each paycheck to have money in the summer	83.5	2.43	67
b. I have sufficient income form other sources, so that I do not need to worry about saving money for the summer out of each of the 10 paychecks.	73.6	2 .91	68.
c. That way I can earn interest on the money I save for the summer.	82.6	2.46	68
B. Asked of those receiving 12 payments?			
What are the reasons you have chosen 12 payments?			
a. I need money in the summer, so I arranged to be paid in 12 monthly installments, I have never considered any other way of saving for the summer.	71.9	2.63	55
b. I have considered the possibility of being paid over 10 months, and saving some of my pay each month, but am afraid that if I tried that I would just spend the money during the 10 months.	76.9	2.34	55
c. I have considered being paid over 10 months, and saving some the money in a bank or elsewhere, but the interest rate is too low to make this worth doing,	57.0	3.53	55

Appendix Table 1

Frequency Distribution of Responses

[a] Percent of respondents who answered this question. Respondents were asked to check all of the reasons that are relevant for them, if possible in order of importance.

[b] Scores range from 1 - the most important reason - to 4 for a reason that the respondent did not check. Hence the lower the score, the more important is the reason..

	Alternatives							
	0 [a]	1	1.5 [b]	2	3	4	NA	Mean Rank [c]
	Number of Respondents							
Question								
2a	na	13	12	7	2	20	68	2.43
2b	na	15	2	3	3	31	68	2.91
2c	na	12	12	8	1	21	68	2.46
3a	na	27	0	5	1	34	55	2.63
3b	na	34	1	3	1	28	55	2.34
3c	na	5	1	5	4	52	55	3.53
4a	44	73	na	na	na	na	5	.62
4b	38	78	na	na	na	na	6	.67
4c1	9	53	na	na	na	na	60	.85
4c2	9	13	na	na	na	na	100	.59
4d	0	2	0	43 [d]	33	19	25	2.72

Note: For the questions corresponding to each number see the questionnaire reproduced in the Appendix

a. Where applicable a zero denotes a "no" answer, and a 1 a "yes",.

b. Fractional responses denote cases where a respondent checked two alternatives without ranking them.

c. Low rank indicates that respondents gave high priority to this response

d. Includes a respondent who gave a response exactly in-between alternatives 2 and 3

Appendix A

School District Survey

1. Do you offer teachers the choice of 10 or 12 payments?

   a. YES
      i. If yes, how many (or what proportion) take the

      ii. 10 month option? _____

      iii. 12 month option? _____

   b. NO
      i. If no, do you pay all teachers in 10 or 12 installments?

         (1) 10

         (2) 12

2. Do teachers who start in September on a 12 month contract receive payment for the <u>previous</u> July or August?

   a. NO

   b. YES
      i. If yes, when salaries are raised after July do teachers paid in 12 installments receive a retroactive increase to put them in the same position as teachers paid in 10 installments?

         (1) YES

         (2) NO

         (3) This issue does not arise in this District.

3. Approximately how many teachers did your district employ in the 1998-99 academic year?

   _____

If you don't mind providing any of the following, please do so:
Your Name:
School District Name:
Office Phone Number:

Appendix B

SURVEY OF PAYMENT METHODS

Q.1. Is your salary paid over: 10 months [ ] 12 months [ ] other [ ] please specify _____

Q.2. Did you receive a significant amount of salary from sources <u>other</u> than this District during: July or August 2000? yes [ ] no [ ]
Do you expect such salary in July or August 2001? yes [ ] no [ ]
If yes for either question, approximately what percent of your regular salary from your school does this represent? July/August 2000 _____%, July/August 2001 _____%

Q.3. Many people base their budget decisions on more than one person's salary. For example, if you are married, you may pool your salary with your spouse.
Does such pooling describe your situation in the summer of 2000? yes [ ] no [ ]
Do you expect it to describe your situation in the summer of 2001? yes [ ] no [ ]

Q.4. Does the person with whom you pool your salary receive a salary check in July and August? yes [ ] no [ ]

Q.5. Roughly speaking, what fraction of the combined salary is contributed by your salary? _____

Q.6. Please answer this question only if you have chosen the 10-months option. Otherwise, please go on to the next question.
What is the reason you have chosen the 10-month option? If several reasons are relevant, please mark the 1, 2, 3 in descending order of importance.
[ ] I realize that I need to have income for the summer months, but I can save enough from each paycheck to have money in the summer, and earn interest on my savings.
[ ] I have sufficient income from other sources so that I do not need to worry about saving money out of each of the 10 paychecks.
[ ] Other: Please specify: _____

Q.7. Please answer this question only if you have chosen the 12-months option.
What is the reason you have chosen the 12-months option? If several reasons are relevant, please mark the 1, 2, 3 in descending order of importance.
[ ] I need the money in summer, so I arranged to have something withheld from my paycheck each month. I have never considered any other way of saving for the summer.
[ ] I have considered the possibility of being paid over 10 months and saving some of my pay each month, but I am afraid that if I tried I would spend the money during the 10 months.
[ ] I have considered being paid over 10 months, and saving some of the money in a bank or elsewhere, but the interest rate is too low to make this worth doing.
[ ] Other: Please specify: _____

It is hard to specify in a questionnaire all the circumstances that may be relevant for every respondent. So, if you would care to amplify any of your answers, or raise some related issue, please do so: Thank you.

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