AN EXPERIMENTAL TEST ON RETIREMENT DECISIONS

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As part of the current debate on the reform of pension systems, this paper presents an original experimental test where subjects face three different payoff sequences with identical expected value. Two central questions are analyzed. First, whether the distribution of retirement benefits across time influences the retirement decision. And second, whether actuarially fair pension systems distort the retirement decision. The results indicate both that a lump-sum payment rather than annuity benefits is far more effective in delaying the retirement decision and that recent reforms that encourage the link between lifetime contributions and pension benefits to delay the retirement decision should take into account timing considerations. (*JEL* C91, H55, J26)

I. INTRODUCTION

The reform of social security systems is now one of the main issues on the economic policy agenda of most industrialized countries. It is widely considered that, unless serious changes take place, the aging of the population implying a rise in the number of retirees relative to that of workers will threaten the viability of pay-as-you-go public pension systems in the long run. This threat is being reinforced by the progressive reduction in the retirement age of the working population.

The central reforms that are being proposed to neutralize these future financing problems are the raising of the contribution rate, the decreasing of pension benefits, or/and the delay of the retirement age.

With reference to this latter reform, as Blondal and Scarpetta (1998) state, a direct way to encourage people to work longer would be to raise the pensionable age. But delaying the retirement age may not be very popular. According to recent surveys, most workers claim that they are happy with the current retirement age (see Cremer and Pestieau 2003). This may help to explain why reforms on the legal retirement age have currently become a very delicate matter for governments.[1]

On the other hand, pension systems in virtually all Organization for Economic Cooperation and Development (OECD) countries in the mid-1990s made it financially unattractive to work after the age of 55, see Gruber and Wise (1997) or Blondal and Scarpetta (1998). Indeed, the general consensus in the theoretical

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1. A survey of January 2005 for the insurance company AXA based on a sample of 9,300 people in 15 of the world's major industrialized countries finds widespread opposition among workers to an increase in the retirement age limit, notably so when they are close to retirement: http://www.retirement-scope.axa.com.

ABBREVIATIONS

OECD: Organization for Economic Cooperation and Development
OLS: Ordinary Least Squares
TR1: Treatment 1
TR1: Treatment 2
TR1: Treatment 3
GDP: Gross Domestic Product
LINEEX: Laboratory for Research in Experimental Economics

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literature related to social security and retirement decisions is that pension systems create enormous incentives to leave the labor force early.[2]

Therefore, increasing the retirement age as a tool to improve the financial problems of public pensions systems faces two sensitive problems: the opposition of workers to a delay in the standard retirement age and the disincentives to continuous work being embedded in the pension system.

The large decline in labor force participation is attributed to the specific fact that to keep on working implies a reduction in the present value of total pension benefits. The terms "old-age pension wealth" and "implicit tax on postponing retirement" have been frequently used to illustrate these disincentives in the pension system.

The old-age pension wealth is the discounted value of expected pension benefits minus the discounted cost of obtaining such benefits. After the earliest age at which pensions can be accessed, working for an extra year may imply changes in this pension wealth by foregoing 1 yr of pensions, paying contributions for an additional year, and maybe increasing the pension benefits per year. Therefore, if the costs of postponing retirement are higher than the gains, then it is considered that the pension system is implicitly taxing to prolong the working period. That is, the drop in pension wealth acts as *an implicit tax on income* from continued work and as such is a clear incentive to retire early.

Actually, reforms aiming to increase the effective retirement age to improve the financial problems of public pensions systems have mainly focused on the reduction of this implicit tax on prolonging the working period.

It is also considered that when the increase in pension benefits is exactly offset by the higher cost in terms of contributions and forgone pensions, the pension system is not distorting the retirement decision. That is, the pension systems that are marginally *actuarially fair* will not distort individual decisions concerning retirement age, and, consequently, they are defined as neutral systems.

For this reason, the main economic policy measures move in the direction of strengthening the link between lifetime contributions and pension benefits.[3] Indeed, this reform is one of the policy conclusions of *Maintaining Prosperity in an Ageing Society*, OECD (2000): "... the most appropriate reform would be to allow people to retire at the age of their own choice and to adjust pension level so that the pension system is neutral on average. Under such a system the increase in pensions due to an additional year of work would make up for an additional year of pension contributions and for delaying the receipt of pensions by one year removing the incentives to retire early."

It is considered that the increase in older workers' participation rates as a consequence of reforms toward actuarial adjustments in retirement incentives could have substantial positive effects on the financial viability of social security systems. The raising of the effective retirement age might reduce the dependency ratio both by increasing the working population and by decreasing the number of retirees, and, as a result, a longer working period might also contribute to the economic growth of countries. Herbertsson and Orszag (2001) show that early retirement costs about 7% of GDP in OECD countries. Fehr, Sterkeby, and Thorgersen (2003), who investigate the economic effects of five social security reforms in a simulation model, show that if the reform leads households to work longer, the economy might grow and the additional labor income tax revenues might be used to finance the rise in pension benefits.[4]

However, the aim of this paper is not to analyze the potential positive effects of delaying the retirement age due to actuarial reforms.

2. Many studies have analyzed the relationship between retirement and social security. Earlier literature mainly focused on the effect of the introduction of a pension system on the individual retirement decision; see among others, Feldstein (1977), Sheshinski (1978), Kotlikoff (1979a, 1979b), Crawford and Lilien (1981), or Cremer and Pestieau (2000). There is, however, more recent literature dealing with the retirement decision in a political economy environment; see Crettez and Le Maitre (2002), Conde-Ruiz, Galasso, and Profeta (2003, 2005), Conde-Ruiz and Galasso (2003, 2004), Casamatta, Cremer, and Pestieau (2005), or Lacomba and Lagos (2006, forthcoming).

3. The link between lifetime contributions and benefits is being reinforced in a number of countries, Germany, Italy, Hungary, Mexico, Poland, Sweden, and so on, by shifting from defined benefit to defined contribution systems, see Blondal and Scarpetta.

4. See also Breyer and Kifmann (2002) for an exhaustive analysis of the effect on financial implications of inducing workers to retire later with actuarial adjustments.

We focus on the earlier step: the assumed neutrality of actuarially fair pension systems. This paper examines whether these systems do in fact distort retirement decisions. An actuarial pension system would only be neutral with respect to the retirement age when people have well-defined, consistent, and stable preferences over leisure and other goods and when agents used all available information efficiently.

Although this is a kind of standard assumption in most theoretical analyses, from a behavioral point of view, it is far from trivial that subjects will behave in such a way. People may fail to understand the effects of social security rules or may not correctly anticipate all future benefits from delaying retirement. If so, a pension system that is actuarially fair would still distort retirement decisions. Additionally, the concept old-age pension wealth does not take into account the timing of pension benefits, namely, how these benefits are distributed across time. It is only concerned about the total value of net discount benefits from social security. So, applying the concept of old-age pension wealth should lead to the following simple conclusion: alternative pension systems with the same old-age pension wealth for any retirement age but with different timing of pension benefits' receptions should produce the same optimal retirement age.

The aim of this work is to shed some behavioral light on these issues. In doing so, we first of all analyze whether the timing of pension benefits' reception actually influences the retirement decision or not. Moreover, and given the proposed reforms reinforcing the link between contributions and pension benefits, we focus our test on marginally actuarially fair pension systems, all of them neutral on retirement decisions from a theoretical point of view. The former issue was already suggested by Orszag (2001) related to U.S. social security. He considered that transforming social security's delayed retirement credit (given to people working between the ages of 62 and 65 in the United States) into a lump-sum payment rather than an increased monthly payment would likely encourage people to defer retirement.

To our knowledge, our work is the first experimental approach to retirement decisions. The paper presents a novel experimental test designed to answer two central policy questions. On the one hand, whether the distribution of retirement income benefits across time could help to delay retirement decisions and, on the other hand, whether or not marginally actuarially fair pension systems distort retirement decisions. We compare subjects' choices in three different treatments, where subjects face three different payoff sequences with identical expected value. The only difference between treatments is the timing of the receipt of the payoff (annuity, lump sum, or a combination of both).[5]

Our results suggest that the more concentrated the payments are (shifting from annuity into lump sum), the more postponed the retirement decisions will be. In this sense, reforms aimed to delay effective retirement ages should transform the increases in pensions due to the additional years of work (after the standard retirement age) into a lump-sum payment rather than an increased periodic payment. Moreover, our results show that actuarially fair pension systems may not be neutral in terms of retirement decisions as identical expected payoffs generate different behaviors. That is, recent reforms that encourage the link between lifetime contributions and pension benefits in order to delay the retirement decision should take into account that timing considerations are an important component of retirement decision behavior.

II. A BEHAVIORAL BACKGROUND

Most of the current reforms of social security systems try to avoid any distortion in the retirement decision of the working population. According to Sheshinski (1978) and Crawford and Lilien (1981), introducing a pension system that is actuarially fair does not

5. This analysis does not distinguish between the two basic types of pension plans: defined benefit and defined contribution plans. Defined benefit plans guarantee a certain payout at retirement. They are more widespread in social security systems all over the world and typically pay their benefits as an annuity. Defined contribution plans provide a payout at retirement that is dependent upon the amount of money contributed. They are the dominant form of plan in the private sector in many countries and are often paid as lump sums. However, it has to be noted that many defined benefit plans also allow you to choose between an annuity and a lump-sum payment and that in the defined contribution plans the payout can also be converted to annuity.

affect the retirement decision when there are no borrowing constraints. Namely, with regard to the retirement decision, an actuarially fair pension system is equivalent to the case when there is no pension system, in the sense that optimal retirement ages would be equal.

The aim of this work is to provide evidence as to the importance of the timing of the pension benefits on the retirement decision under actuarially fair pension systems. Several behavioral issues should be considered here. The first could be the time discounting associated with the size of the stake. Most studies that varied outcome size have found that large outcomes are discounted at a lower rate than small ones. That is, subjects seem to be more willing to wait to collect large amounts than small ones.[6]

Individuals may also have a subjective discount rate higher than the social security interest rate used in the calculations of the discounted present value of pension benefits.[7] They may even have discount rates that are not constant over time. Indeed, some studies have found decreasing discount rates, normally referred to as hyperbolic discounting. That is, individuals discount over short horizons at a higher rate than over long horizons. Examples of this literature are, among others, Laibson (1997) and O'Donoghue and Rabin (1999).

People may also be myopic. They may not correctly anticipate the total amount of pension benefits that are equally spread out in annuity payments along the whole retirement period. Moreover, if different payment options are available at retirement, as argued by Steuerle and Bakija (1994), a lump-sum payment may be easier to understand than an increased annuity. These authors also maintain that individuals often underestimate their remaining life expectancies. As a result, individuals may not give adequate weight to sequences of expected payoffs. It has also been empirically observed that explicit sequences of multiple outcomes are discounted differently than outcomes considered one by one.[8]

6. Frederick, Loewenstein, and O'Donoghue (2002) surveyed the literature on time discounting and time preference.

7. See Samwick (1997) or Orszag (2001) for a detailed analysis of this issue.

8. See Frederick, Loewenstein, and O'Donoghue (2002) for an overview of the literature of this issue.

The above-mentioned reasons lead us to the following assumptions: actuarially fair pension systems based on annuity payments are likely to fail in achieving the desired neutrality on retirement decisions. If individuals underestimate the discounted present value of future pension benefits, then an actuarially fair pension system might still impose a subjective implicit tax on postponing retirement. As a consequence, a pension system based on annuity payments, which is actuarially fair, would still distort retirement decisions and imply early retirement. If so, reforms aiming to delay the average retirement age should focus on alternative changes, such as transforming part of pension benefits into a lump-sum payment.

On the other hand, it is likely that this partial transformation including a lump-sum payment would be easier to implement. Fetherstonhaugh and Ross (1999), using a questionnaire, found that more than 75% of the respondents to the survey preferred a one-time bonus to an increased annuity. In this line, in the U.S. private industry, whose retirement benefits may be distributed in several alternative ways, using some type of lump-sum benefit as a payment option has become popular as an alternative to annuity payments.[9]

Moreover, according to Kahneman (1999, p. 215), the particular choice between a lump sum and an annuity could be affected by a cognitive bias, which has been called a "wealth illusion": the lump sum looks like a great deal of money when set against a periodic payment.

III. EXPERIMENTAL DESIGN

Our experimental design tries to capture some actual features of actuarially fair public pension systems. The experiment consists of at most 15 rounds and a single decision. Each round is characterized by a probability of surviving and an associated payoff. As the round number increases, the probability of surviving decreases and the associated payoff increases. In each round reached, the subject either survives or not. A subject reaches a round if, and only if, she has survived all earlier rounds.

Each individual subject makes just one choice. At the beginning of the experiment,

9. See Moore and Muller (2002) or Blostin (2003) for a detailed analysis of this issue.

TABLE 1
Experimental Design

Rounds	Chance	Survival Chance[a]	Expected Payoffs	Payoffs-TR1, Annuity	Payoffs-TR2, Combination	Payoffs-TR3, Lump sum
1	—	1	100	13	13	100
2	14/15	14/15	100	14	14	107
3	13/14	13/15	100	16	16	115
4	12/13	12/15	100	19	19	125
5	11/12	11/15	100	23	23	136
6	10/11	10/15	100	27	23 + 25	150
7	9/10	9/15	100	33	23 + 53	167
8	8/9	8/15	100	42	23 + 85	188
9	7/8	7/15	100	54	23 + 123	214
10	6/7	6/15	100	71	23 + 170	250
11	5/6	5/15	100	100	23 + 232	300
12	4/5	4/15	100	150	23 + 318	375
13	3/4	3/15	100	250	23 + 455	500
14	2/3	2/15	100	500	23 + 716	750
15	1/2	1/15	100	1,500	23 + 1477	1,500

[a]This column denotes the probability of being alive in each round.

the subject must decide the retirement round that determines her payoffs.[10] These payoffs are conditioned to reaching the chosen round. If, for instance, a subject decides to receive the payoff associated with round 7 but this round is not reached, then she receives nothing. If instead, that round is reached, then she gets the payoff associated with that round. Furthermore, the expected present value of the payoff associated with any round is always the same (100 experimental units). The only difference between treatments is the timing of the receipt of the payoffs. Table 1 summarizes some of the main features of our experimental design.

A. The Timing of Retirement Benefits

As a strategy to analyze the effect of the distribution of total pension benefits on the retirement decision, we design three treatments. Each treatment has a different sequence of expected payoffs with the same total discounted value but unequal distribution. That is, the only difference between these sequences of expected payoffs is the timing of the receipt of the payoffs. The three treatments can be summarized as follows:

- *Treatment 1 (TR1)*: A kind of traditional public pension system. Subjects receive specified amounts to be paid at the time of retirement in the form of an annuity. In our design, if a subject chooses Round 7 to determine her payoffs and survives until Round 12, then she gets 33 experimental units (see Table 1) for every round that she has survived from 7 up to 12. If Round 7 is not reached, for example, she survives only up to Round 4, then she gets nothing.
- *Treatment 2 (TR2)*: A combination of both annuity and lump-sum pension systems. Subjects receive an (monthly) amount in the form of an annuity plus a lump sum. In our design, in Round 6 the sequence of payoffs turns into a mixed system. For instance, if a subject chooses Round 7 to determine her payoffs and survives until Round 12, then she gets 23 experimental units (see Table 1) for each round that she has survived from 7 up to 12 plus 53 experimental units as a lump sum. If Round 7 is not reached, then again she gets nothing.
- *Treatment 3 (TR3)*: A pure lump-sum pension system. Instead of receiving an amount

10. As in Crawford and Lilien (1981) or Sheshinski (1978), among others, in most of the literature concerning the effect of the pension system on the retirement decision, agents decide their optimal retirement age before entering the labor force. Therefore, to a certain extent, pension benefits can be interpreted as a sequence of expected and delayed payments.

per month, subjects receive the present value of the total pension benefits as a lump-sum payment immediately upon claiming benefits at retirement age. In our design, if a subject chooses Round 7 to determine her payoffs and survives until that round, then she gets a lump-sum payoff of 167 experimental units (see Table 1). If Round 7 is not reached, then once again she gets nothing.[11]

With this design, we try to investigate whether or not the timing of delayed and expected payoffs affects subjects' decisions. That is, does the temporal distribution of payments lead subjects to choose a later or an earlier moment to start collecting payments? Our three treatments as a whole provide a common environment where subjects perceive that the later they start to collect benefits, the larger these expected benefits will be, but with a lower associated probability.

B. *Actuarially Fair Retirement Benefits*

Reforms aiming to achieve actuarially fair social security systems must adjust pension benefits to keep the net present value of the old-age pension wealth constant across all retirement ages. In the same way, in this experimental design we have adjusted payoffs to keep the same expected present value across rounds. That is, when subjects take their decision, they face sequences of payoffs with identical expected present value.

- Corresponding payments to TR1:

$$\text{Payoffs round}_i = 100/\text{probability of being alive from round}_i \text{ on}$$

- Corresponding payments to TR2:
  - For any round$_i \leq 5$:

$$\text{Payoffs round}_i = 100/\text{probability of being alive from round}_i \text{ on}$$

  - For any round$_i > 5$:

$$\text{Payoffs round}_i = 23 + (100 - 23 \times (\text{probability of being alive from round}_i \text{ on}))/ \times (\text{probability of being alive at round}_i)$$

- Corresponding payments to TR3:

$$\text{Payoffs round}_i = 100/\text{probability of being alive at round}_i$$

For the sake of clarity, consider the following example. The corresponding payments to rounds 2 and 11 at TR3 would be, respectively, 107(14/15) = 100 experimental units and 300(5/15) = 100 experimental units. That is, identical expected payoffs across rounds but with unequal probability of obtaining them.

Furthermore, payoffs have been adjusted to keep the same expected present value across treatments as well. That is, regardless of the type of treatment, the expected present value of choosing one round is the same as choosing any other round at any treatment (100 experimental units). Consider another example. Assume that a subject chooses Round 14 in TR1, TR2, and TR3. In all three cases, she gets an identical expected payoff. Namely, at TR1 the expected payoff would be 500(2/15 + 1/15) = 100 experimental units; at TR2 the expected payoff would be 716(2/15) + 23(2/15 + 1/15) = 100 experimental units; and at TR3 the expected payoff would be 75(2/15) = 100 experimental units. That is, identical expected earnings across treatments with unequal distribution.

From a theoretical point of view, as this design yields identical expected payments across rounds and treatments, marginally actuarially fair pension systems should not distort the retirement decision. Consequently, there should be no differences in the obtained results among the different treatments.

C. *Risk Aversion and Discount Rate*

Whenever decisions involving trade-offs between costs and benefits occurring at different points in time are uncertain, we find it essential to consider individual attitudes toward risk and time discounting. With regard to risk attitudes, the expected utility theory predicts that, regardless of the treatment, if subjects are risk averse then they should choose the first round and if they are risk loving then they should

11. The payoff structure of this treatment is based on that of Cubitt and Sudgen (2001). The only difference is the following. In their paper when a subject reaches a round, her payoffs are multiplied by a constant parameter. In our design, this parameter is adjusted to keep expected payoffs across rounds identical.

choose the last round. With reference to time discounting, neoclassical economic theory predicts that, regardless of the treatment, the more impatient a subject is, the earlier her retirement decision will be.

In order to analyze whether or not these attitudes play a role in retirement decisions, we introduce into our design two additional tests: a risk aversion test and a discount rate test.

Following Holt and Laury (2002), a menu of ten paired lottery choices allows us to measure the degree of risk aversion. The payoffs for Option A are less variable than the potential payoffs for Option B. As the decision number increases, the probability of the high payoff increases. Thus, only risk-loving subjects would take Option B in the first decision and only risk-averse subjects would choose Option B in the second last decision. A risk-neutral subject should cross over to Option B when the expected value of each option is about the same. That is, a risk-neutral subject would choose Option A in the first four decisions before switching to Option B (see the Appendix for details).[12]

An adapted version from Coller and Williams (1999) and Harrison, Morten, and Williams (2002) is used to estimate individual discount rates. Subjects face a fixed array of ten paired "future income" options and choose one for each decision. The payoffs for Option A are fixed, and for Option B they are increasing. In each decision, subjects choose between Options A and B. The point at which subjects switch to Option B indicates a measure of their discount rates (see again the Appendix for details).

IV. EXPERIMENTAL PROCEDURES

A total of 82 undergraduate students in Business and Economics from the University of Valencia took part in the hand-run experiment in April and May 2005. All sessions were run at the Laboratory for Research in Experimental Economics (LINEEX), and the standard electronic recruitment procedures were used to collect the subject pool.

12. Notice that the payoffs for Option A are less variable than the potential payoffs in the "risky" Option B. Therefore, when the probability of the high payoff outcome increases enough, a person should cross over to Option B.

The experiment consisted of three treatments: the *annuity treatment*, the *combined treatment*, and the *lump-sum treatment*, involving the choice situations presented in Table 1 as payoffs-TR1, payoffs-TR2, and payoffs-TR3, respectively. Twenty-eight subjects participated at TR1 and TR3 and 26 subjects at TR2.

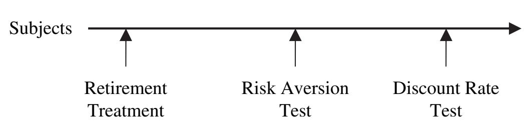
The experiment consisted of two sessions per treatment: the first session was run in April and the second one in May. All participants knew that they would be privately paid according to the outcome generated by both their choice and the random process of passing rounds. At the end of each treatment, all subjects were asked to participate in two additional tests: a risk aversion test and a discount rate test. Both tests were paid independently, and subjects could refuse to participate in the tests. Table 2 shows a time sequence of the experiment.

In both the risk aversion test and the discount rate test, subjects made ten sequential choices between two alternative options, A and B. In the risk aversion test, all participants knew that they would be paid according to the outcome generated by one of their ten choices. In the discount rate test, they knew that only one of the 82 subjects would be paid according to the outcome generated by one of her ten choices.

Instructions were read aloud before the beginning of each stage, and participants only had information about the individual payoffs obtained at the different treatments and tests. At the end of the experiment, subjects were privately paid with an exchange rate of 100 units of lab money = €2 (around USD 2.5, at that time). The experiment took less than 60 min, and average earnings (including a €3 show-up fee) were around €15 (around USD 20), the maximum earnings going above €230 (around USD 275). Experimental instructions are provided in the Appendix. To make sure subjects understood the several instructions, they needed to complete a quiz after the instructions were read aloud to the group and before

TABLE 2

Sequence of Events for Subjects



the experiments began. The explanations were repeated until nobody made a mistake (this was true from the beginning, probably due to the simplicity of the design).

V. RESULTS

We first present a description of our results based on data. A statistical analysis of the significance of the impact of the different variables at work follows.

First, the effects of expected payoffs with identical present value are examined. As mentioned earlier, payoffs were chosen to keep the same expected present value across rounds and treatments. Table 3 shows aggregate data with the percentage of subjects choosing rounds 1–15 in the three different environments.

Note first that choices are indeed quite heterogeneous for all treatments separately. Second, observe that there is an apparent difference in the distribution of choices for each treatment. In the annuity treatment (TR1), most of the choices are concentrated in the first eight rounds. In the lump-sum treatment (TR3), the contrary occurs with most of the choices concentrated in the last ten rounds. However, in the combination treatment (TR2), most of the choices are concentrated in the intermediate rounds (from rounds 5 to 11). That is, sequences of expected payoffs with identical present value yield different choices across rounds and treatments.

TABLE 3
Percentage of Subjects Making Each Choice

Rounds	TR1	TR2	TR3
1	7	15	0
2	4	4	4
3	11	4	0
4	18	0	4
5	29	4	0
6	4	19	11
7	18	8	7
8	7	23	14
9	0	8	25
10	4	4	11
11	0	12	11
12	0	0	4
13	0	0	0
14	0	0	4
15	0	0	7
	100%	100%	100%

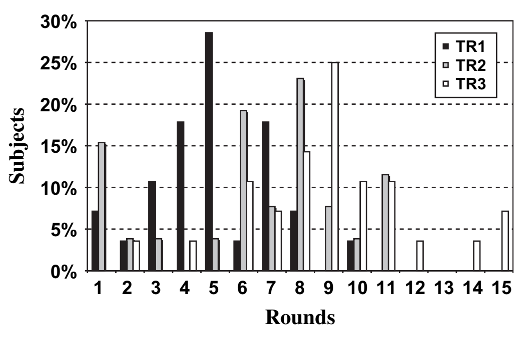
Plotting the data of Table 3 provides a clearer understanding of timing effects on retirement decisions across treatments. Recall that the only difference between the sequences of expected payoffs at TR1, TR2, and TR3 is the timing of the receipt of the payoffs. Figure 1 shows the relative frequencies of choices across treatments and rounds and illustrates the effects on the retirement decision of alternative timing schemes.

Figure 1 stresses some differences between treatments, as these differences seem to follow a pattern. In TR1, the behavior of the majority of subjects could be interpreted as an "early" retirement decision. In TR2, the behavior of the majority of subjects yields an "intermediate" retirement decision. In TR3, the pattern of behavior is consistent with a "late" retirement decision. In short, there is an order of the distribution of choices, and these are lowest for the TR1 case, intermediate for the TR2 case, and highest for the TR3 case.

Table 4 yields a more aggregated view of our results. It shows some basic statistics about "the number of rounds" that subjects chose in all three treatments, TR1, TR2, and TR3, with 28, 26, and 28 observations on each one, respectively.

Again, one can see that the data corresponding to TR1, TR2, and TR3 differ from each other. In line with the previous figure and tables, the statistics suggest that the lump-sum treatment generates a later retirement decision than the combination treatment, and this latter yields a later retirement decision than the annuity treatment.

FIGURE 1
Treatments TR1-TR2-TR3



This later retirement observed in the lump-sum treatments is highlighted when we classify the data considering Round 6 as the point of inflexion (see Table 5).

The percentage of subjects who chose from Round 6 on changes considerably across treatments: 93% of our subjects in TR3 and 73% in TR2 as compared to 32% in TR1. Only 7% of subjects in TR3 opted for an earlier retirement decision. These results again suggest that a lump-sum payment rather than annuity benefits is far more effective in delaying the retirement decision.

TR2 has been designed to answer an interesting additional issue that arises from transforming part of the pension benefits into a lump-sum payment. Incentives to retire later embedded in this proposal could be reversed only 1 or 2 yr after the earliest age at which the lump-sum payment becomes available if this age is seen as a focal point by workers. As Orszag (2001) says, if, for instance, age 68 were this earliest age, "when the worker evaluates whether to delay claiming from age 67 to age 68, the lump-sum alternative makes delaying more attractive than the current system. At age 68, however, the worker would then be foregoing a lump-sum payment in order to earn a larger lump-sum payment at age 69." Thus, if this trade-off were unappealing to the worker, there would be a potential reversal of incentives only 1 yr after the earliest age at which the lump-sum payment was available. We have tried to capture this potential reversal choosing Round 6 in TR2 as the turning point from an annuity system to a mixed system where the sequence of payoffs turns into a combination of annuity and lump-sum payments. The results are enlightening. It can be computed from Table 3 that only 4% of our subjects in TR1 and around 10% in TR3 chose Round 6. However, almost 20% of subjects chose that round in TR2. Moreover, around 50% of subjects in TR2, about 20 points more than in TR1 and TR3, were concentrated between rounds 6 and 8. These results suggest that the introduction of the lump-sum payment in Round 6 in TR2 could induce subjects to see this round as a focal point, reversing the incentives to postpone retirement and conditioning their decisions. Therefore, it might be suggested that transforming the annuity system into a mixed system could provide stronger incentives to delay benefit claiming but that these incentives should mainly be concentrated only in the first or second years after the earliest age at which the lump-sum payment becomes available.

We now move to the statistical analysis that consists of a series of standard nonparametric (Mann-Whitney) tests and ordinary least squares (OLS) regressions. The results of the Mann-Whitney tests confirm the general impression given by the data reported above. The difference between TR1 and TR2 is significant at $p = 0.03$, and the differences between TR1 and TR3 and between TR2 and TR3 are both significant at $p = 0.00$.

Table 6 presents the results of five specifications of OLS regressions, which look at our data from slightly different viewpoints with TR3 as the baseline treatment (as it is the only treatment dummy excluded from the analysis). The "TA" variable refers to the number of times that subjects chose the "safe" Option A for the ten decisions in the risk aversion test. The "TD" variable refers to the number of times that subjects chose the "impatient" Option A for the ten decisions in the discount rate test. "TR1" is a dummy variable that takes the value of 1 in the annuity environment and 0 otherwise. "TR2" takes a value of 1 in the combination treatment and 0 otherwise. The TR1-TR2 row shows the results of a test to check whether the coefficients for TR1 and TR2 are equal. Asterisks show the standard significance levels of 1% (three asterisks) to 10% (one asterisk).

TABLE 4
Descriptive Statistics

	TR1	TR2	TR3
Mean	5.00	6.42	9.00
Median	5.00	7.00	9.00
Mode	5.00	8.00	9.00
Standard deviation	2.13	3.20	2.94

TABLE 5
Reference Point Effect

	TR1 (%)	TR2 (%)	TR3 (%)
Choices before Round 6	68	27	7
Choices from Round 6 on	32	73	93
	100	100	100

TABLE 6
OLS Regressions (Relative to TR3)

	Model				
	1	**2**	**3**	**4**	**5**
Constant	9.872*** (1.632)	8.131*** (0.882)	13.392*** (2.338)	13.945*** (2.413)	11.954*** (1.446)
TA	−0.508** (0.264)	—	−0.687** (0.339)	−0.682** (0.340)	−0.504** (0.230)
TD	—	−0.312* (0.185)	−0.347** (0.168)	−0.343** (0.169)	—
TR1	—	—	−2.660*** (0.941)	−3.253*** (1.130)	−4.095*** (0.739)
TR2	—	—	—	−1.069 (1.126)	−2.326*** (0.765)
TR1-TR2	—	—	—	−2.183** (1.068)	−1.769** (0.773)
R^2	0.045	0.066	0.274	0.291	0.321
Probability $> F$	0.058	0.100	0.006	0.010	0.000

Notes: TA, aversion test; TD, discount test. *, **, and *** denote significance at the 10, 5, and 1 percent levels.

Models 1 and 2 show how well the risk aversion and the discount rates fit the data, respectively. The risk and discount variables have a statistically significant impact, and their coefficients are negative. This implies that the relationships retirement decision-risk aversion and retirement decision-discount rate are inverse: the more risk averse or the more impatient a subject is, the earlier her retirement decision will be. Indeed, the low values of the coefficients denote the minor role of both in explaining retirement decision behavior.[13]

The next three models produce in three different ways very similar results. Models 3, 4, and 5 confirm the general suggestions provided by the figures and descriptive statistics. The more equally spread the timing of payoffs is, the earlier the retirement decisions will be. The TR1 variable is both highly significant and has the expected sign (negative). The same is true of the TR2 variable, with the only exception in Model 4. We find that the differences between the TR1 and the TR2 coefficients are always significant.

13. Since participants knew the outcomes of the earliest part of the experiment prior to the administration of the Holt-Laury and Coller-Williams games, their success or failure at the retirement gamble could have influenced their later choices. However, the results of the risk aversion and discount rate tests are distributed almost identically to the results of Holt and Laury (2002) and Coller and Williams (1999) or Harrison, Morten, and Williams (2002). This fact seems to suggest that the sequence of events has no significant effect on subjects' decisions.

In short, a standard analysis of choices indicates that timing considerations are an important component of behavior in experimental retirement decisions.

VI. DISCUSSION

Our findings in the laboratory have shown that the more concentrated the payments are, the later the retirement decisions will be. The time discounting associated with the size of the stake could explain these results. As Frederick, Loewenstein, and O'Donoghue (2002) suggest, studies of intertemporal choices that find that large amounts are discounted at lower rates than small ones seem to fit our data well.

As mentioned in the motivation for this paper, several reforms aim to delay effective retirement ages by increasing the flexibility of the retirement decision. One example of this flexibility consists of giving higher pension benefits to those who postpone their retirement after the standard age of retirement. Our results support the idea that in order to delay the retirement age, these reforms should transform the increases in pensions due to the additional years of work into a lump-sum payment rather than an increased periodic payment.

In this sense, this study should be considered as a first step in the analysis of the incorporation of a lump-sum payment as a measure to delay retirement decisions.

However, this transformation requires further analysis before receiving full consideration by policymakers. For instance, one important issue would be the impact on the poverty rates of the elderly of such a change. The lump-sum payment may induce workers to postpone retirement after the normal retirement age. As Orszag (2001) suggests, this delay could potentially reduce poverty rates.

On the other hand, people might consume the lump-sum payment rather quickly. If so, Orszag (2001) also states that paying lump-sum payments might result in increases in poverty rates among those who already delay their retirement decisions after the normal retirement age. But the amount of the lump sum that would be quickly consumed is not very clear. Unlike neoclassical theoretical predictions about smooth consumption over time, some experimental works have shown that there is a close relationship between consumption and current income (Carbone and Hey 2004). This suggests that some individuals might quickly consume a large amount of their lump sum. However, Thaler (1992) finds that individuals are more likely to save a larger amount as the size of the lump sum increases, and Hamermesh and Menchik (1987) state that there is a high average level of savings, far above what could be explained solely by planned saving for retirement. They explain this by introducing the bequest motive.

In any case, Orszag (2001) states that empirical evidence suggests that "even if the lump-sum were entirely consumed, the adverse poverty effects may be quite small as long as the system is restricted to those over the normal retirement age," and therefore "the lump-sum system would be very unlikely to cause an increase in elderly poverty rates."

But this conclusion relies on the condition that lump-sump payments should only be associated with the extra benefits paid to workers who remain economically active after the normal retirement age. Orszag (2001) also warns that if lump-sum payments were extended to retirement ages prior to the normal retirement age and they were entirely consumed, there would be important negative effects on elderly poverty rates.[14] Moreover, if lump-sum payments were advanced and the focal point effect above mentioned created a reversal of incentives to postpone retirement, the measure might fail even in achieving its main objective, the delay in effective retirement ages.

Further analysis is therefore needed to study, first, the effect of lump-sum payments on retirement consumption and, second, if the introduction of these payments would create political pressure to extend the reform to ages lower than the standard age of retirement.

VII. CONCLUSIONS

This paper examines the issue of retirement decisions within the current debate on the reform of pension systems. We present a novel experimental test to analyze both whether actuarially fair pension systems distort the retirement decision and how the timing of the receipt of pension benefits during the retirement period influences retirement decisions.

With reference to the success of reforms that attempt to prolong the working period by reinforcing the link between lifetime contributions and pension benefits, we found that individuals who received their payments equally distributed across rounds chose, on average, an earlier retirement. This result suggests that subjects may not perceive the total amount of pension benefits that are equally spread in annuity payments along the whole retirement period. If so, actuarially fair pension systems based on annuity payments would impose a subjective implicit tax on prolonging the working period and would not be neutral on the retirement decision. Consequently, the reforms above mentioned might fail in achieving the desired neutrality on retirement decisions.

Regarding the distribution of retirement benefits, we found evidence to suggest that individuals would be more willing to delay retirement in a lump-sum payment than in an annuity payment. Consequently, and provided the opposition of most individuals to postponing the pensionable age, our research suggests that in order to encourage workers to remain in the labor force, reforms should be aimed at transforming annuity pension benefits, at least to an extent, into a lump-sum pension system.

Summarizing, in this work the results consistently support the need to recognize both the heterogeneity of retirement decisions across individual subjects and the higher effectiveness

14. Orszag (2001) mentions a Social Security Administration study (2000) that finds that "if 100 percent of beneficiaries claimed at age 62, and if the earlier benefits were entirely consumed, the elderly poverty rate would rise significantly, from 12.0 to 13.9 percent."

of lump-sum payments in delaying retirement decisions. These results could have important implications for the redefinition of public pension systems.

APPENDIX

RISK AVERSION TEST

	Option A				Option B					
Decision	**High Payoff**		**Low Payoff**		**High Payoff**		**Low Payoff**		**Option**	
1	1/10	200	9/10	160	1/10	385	9/10	10	A	B
2	2/10	200	8/10	160	2/10	385	8/10	10	A	B
3	3/10	200	7/10	160	3/10	385	7/10	10	A	B
4	4/10	200	6/10	160	4/10	385	6/10	10	A	B
5	5/10	200	5/10	160	5/10	385	5/10	10	A	B
6	6/10	200	4/10	160	6/10	385	4/10	10	A	B
7	7/10	200	3/10	160	7/10	385	3/10	10	A	B
8	8/10	200	2/10	160	8/10	385	2/10	10	A	B
9	9/10	200	1/10	160	9/10	385	1/10	10	A	B
10	1	200	0	160	1	385	0	10	A	B

DISCOUNT RATE TEST

	Option A	Option B		
Decision	**Payment (in 1 wk), €**	**Payment (in 7 wk), €**	**Option**	
1	180	181.04	A	B
2	180	185.26	A	B
3	180	190.64	A	B
4	180	196.15	A	B
5	180	201.79	A	B
6	180	207.57	A	B
7	180	213.49	A	B
8	180	219.54	A	B
9	180	225.74	A	B
10	180	252.02	A	B

INSTRUCTIONS

This experiment has a variable number of rounds from a minimum of one round to a maximum of 15 rounds. The number of rounds depends on the result of the following process: at the end of each round, you have to take a ball out of a bag containing green and black balls. If the ball you take out is green, the experiment continues for you; if it is black, the experiment will have finished for you.

The number of green and black balls changes in each round; so in Round 1, the bag has 14 green balls and one black ball; in Round 2, it has 13 green balls and one black ball; in Round 3, it has 12 green balls and one black ball; and so on until Round 14 in which the bag has one green ball and one black ball. It is important to notice that since the proportion of green and black balls changes in each round, so does the chance of passing from one round to the next. To be precise, the chance of passing from Round 1 to Round 2 is 14/15, the chance of passing from Round 2 to round 3 is 13/14, and so on. Table 1 gives you all the possible chances.

Before extracting balls, your only choice is to decide which round you choose to determine your payoffs, on the condition that you reach that round. These payoffs will be a fixed amount for each round you reach after your chosen round.[15] Table 1 gives you the amounts associated with each round.

For instance, if you choose Round 4 and this is reached, you receive 19 experimental units for each round you reach after Round 4 (including Round 4). So, if you take the black ball out in Round 9, that is, you do not reach Round 10, you will get 114 experimental units (19 per each Round 4, 5, 6, 7, 8, and 9). If you choose Round 4 and you take the black ball out before this round, your payoffs are 0 experimental units.

15. Instructions were slightly modified according to the treatment.

REFERENCES

Blondal, S., and S. Scarpetta. "The Retirement Decision in OECD Countries." OECD Economic Department Working Papers No. 202, OECD Publishing, 1998.

Blostin, A. P. "Distribution of Retirement Income Benefits." *Monthly Labor Review*, 126, 2003, 3–9.

Breyer, F., and M. Kifmann. "Incentives to Retire Later: A Solution to the Social Security Crisis?" *Journal of Pension Economics and Finance*, 1, 2002, 111–30.

Carbone, E., and J. Hey. "The Effect of Unemployment on Consumption: An Experimental Analysis." Royal Economic Society, *Economic Journal*, 114, 2004, 660–83.

Casamatta, G., H. Cremer, and P. Pestieau. "Voting on Pensions with Endogenous Retirement Age." *International Tax and Public Finance*, 12, 2005, 7–28.

Conde-Ruiz, J. I., and V. Galasso. "Early Retirement." *Review of Economics Dynamics*, 6, 2003, 12–36.

———. "The Macroeconomics of Early Retirement." *Journal of Public Economics*, 88, 2004, 1849–69.

Conde-Ruiz, J. I., V. Galasso, and P. Profeta. "Economic Development, Aging and Retirement Decisions." Mimeo, 2003.

———. "The Evolution of Retirement." Center for Economic Policy Research (CEPR) Discussion Papers, No. 4863, London, 2005.

Coller, M., and M. B. Williams. "Eliciting Individual Discount Rates." *Experimental Economics*, 2, 1999, 107–27.

Crawford, V. P., and D. M. Lilien. "Social Security and the Retirement Decision." *Quarterly Journal of Economics*, 96, 1981, 505–29.

Cremer, H., and P. Pestieau. "Reforming Our Pension System: Is It a Demographic, Financial or Political Problem?" *European Economic Review*, 44, 2000, 974–83.

———. "The Double Dividend of Postponing Retirement." *International-Tax-and-Public-Finance*, 10, 2003, 419–34.

Crettez, B., and P. Le Maitre. "Optimal Age of Retirement and Population Growth." *Journal of Population Economics*, 15, 2002, 737–55.

Cubitt, R. P., and R. Sudgen. "Dynamic Decision-Making under Uncertainty: An Experimental Investigation of Choices between Accumulator Gambles." *The Journal of Risk and Uncertainty*, 22, 2001, 103–28.

Fehr, H., W. I. Sterkeby, and O. Thorgersen. "Social Security Reforms and Early Retirement." *Journal of Population Economics*, 16, 2003, 345–61.

Feldstein, M. S. "Social Security and Private Savings: International Evidence in an Extended Life-Cycle Model," in *The Economics of Public Services, Proceedings of a Conference held by the International Economics Association*, edited by M.S. Feldstein and R.P. Inman. London: Macmillan, 1977, 45–72.

Fetherstonhaugh, D., and L. Ross. "Framing Effects and Income Flow Preferences in Decisions About Social Security," in *Behavioral Dimension of Retirement Economics*, edited by H.J. Aaron. Washington, D.C.: Brookings Institution Press, 1999, 187–209.

Frederick, S., G. Loewenstein, and T. O'Donoghue. "Time Discounting and Time Preferences: A Critical Review." *Journal of Economic Literature*, 40, 2002, 351–401.

Gruber, J., and D. Wise, eds. *Social Security Programs and Retirement around the World*. Chicago: University of Chicago Press, 1997.

Hamermesh, D., and P. L. Menchik. "Planned and Unplanned Bequests." *Economic Inquiry*, 25, 1987, 55–66.

Harrison, G. W., L. Morten, and M. B. Williams. "Estimating Individual Discount Rates for Denmark: A Field Experiment." *American Economic Review*, 92, 2002, 1606–17.

Herbertsson, T. T., and M. Orszag. "The Cost of Early Retirement in the OECD." IoES Working Paper No. W01:02, 2001.

Holt, C., and S. K. Laury. "Risk Aversion and Incentive Effects." *American Economic Review*, 92, 2002, 1644–55.

Kahneman, D. Comment on Fetherstonhaugh and Ross "Framing Effects and Income Flow Preferences in Decisions About Social Security," in *Behavioral Dimension of Retirement Economics*, edited by H.J. Aaron. Washington, D.C.: Brookings Institution Press, 1999, 187–209.

Kotlikoff, L. J. "Social Security and Equilibrium Capital Intensity." *Quarterly Journal of Economics*, 93, 1979a, 233–53.

———. "Testing the Theory of Social Security and Life Cycle Accumulation." *American Economic Review*, 69, 1979b, 396–410.

Lacomba, J. A., and F. Lagos. "Population Aging and Legal Retirement Age." *Journal of Population Economics*, 19, 2006, 507–19.

———. Forthcoming. "Political Election on Legal Retirement Age." *Social Choice and Welfare*.

Laibson, D. I. "Golden Eggs and Hyperbolic Discounting." *Quarterly Journal of Economics*, 112, 1997, 443–7.

Moore, J. H., and L. A. Muller. "An Analysis of Lump-Sum Pension Distribution Recipients." *Monthly Labor Review*, 125, 2002, 29–46.

O'Donoghue, T., and M. Rabin. "Doing it Now or Doing it Later." *American Economic Review*, 89, 1999, 103–24.

OECD. *Maintaining Prosperity in an Ageing Society*. Organisation for Economic Co-operation and Development, 2000.

Orszag, P. "Should a Lump-Sum Payment Replace Social Security's Delayed Retirement Credit?" An Issue in Brief, Number 6. Boston: Center for Retirement Research at Boston College, 2001.

Samwick, A. A. "Discount Rate Heterogeneity and Social Security Reform." National Bureau of Economic Research Working Paper No. W6219, 1997.

Sheshinski, E. "A Model of Social Security and Retirement Decisions." *Journal of Public Economics*, 10, 1978, 337–60.

Social Security Administration. *The Impact of Repealing the Retirement Earning Test on Rates of Poverty*. Washington, DC: Office of Policy, 2000.

Steuerle, E., and J. Bakija. *Retooling Social Security for the 21st Century: Right and Wrong Approaches to Reform*. Washington, D.C.: Urban Institute Press, 1994.

Thaler, R. "Intertemporal Choice," in *The Winner's Curse: Paradoxes and Anomalies of Economic Life*, edited by R. Thaler. Princeton, NJ: Princeton University Press, 1992, 50–62.