EXPERIMENTAL ANALYSIS OF RETIREMENT

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1. INTRODUCTION

Pension systems in virtually all OECD countries in the mid-1990s made it financially unattractive to work after the age of 55. The general consensus in the theoretical literature related to Social Security and retirement decisions is that pension systems create enormous incentives to leave the labour force early. 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 one year 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 focussed on the reduction of this implicit tax on prolonging the working period.

The increase in older workers' participation rates 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 Orzag (2001) show that early retirement costs are around 7% of GDP in OECD countries. Fehr et al (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 labour income tax revenues might be used to finance the rise in pension benefits.

The aim of our research is not to analyze the potential positive effects of delaying the retirement age due to actuarial reforms. We first focus on the earlier step: the assumed neutrality of actuarially fair pension systems. Our research 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 agents used all available information efficiently.

This is a kind of standard assumption in most theoretical analyses. But, from a behavioural point of view, it is far from trivial that actual 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 which 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.

We focus our test on marginally actuarially fair pension systems, all of them neutral on retirement decisions from a theoretical point of view. But, some marginally actuarially fair pension systems may be better received than others. Fetherstonhaugh and Ross (1999), using a questionnaire, find evidence that people would be more willing to delay retirement if they received a lump-sump payment rather than an increased annuity. So, it is likely that this transformation including a lump-sum payment would be easier to implement. 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 (see Moore and Muller, 2002, Blostin, 2003).

However, the incorporation of a lump-sum payment as a measure to delay retirement decisions requires further analysis before receiving full consideration by policymakers. As Orszag (2001) also states, paying lump-sum payments might result in increases in poverty rates among those who already delay their retirement decisions after the normal retirement age if the lump sums were mostly consumed rather than saved.

Little is known about how quickly retirees would spend down their lump-sum payments, or how these reforms would affect consumption patterns. This is precisely the second aim of our work: to provide additional empirical evidence to this debate. To this end, we consider an experimental investigation to test the potential effects on consumption behavior of implementing a lump-sum payment in a public pension system. We also analyze how closely the predictions of the optimality theory fit the actual behavior of subjects in a lab.

2. THE EXPERIMENTAL METHODOLOGY

We develop experiments to test models of behavior, using the methodology of experimental economics. Experiments in economics differ from those in other fields in two aspects. First, subjects are paid in cash their earnings in the experiment. This practice, termed "induced valuation" by Smith (1976), ensures that the incentives assumed in the models are salient for the participants. Because their earnings are real, the decisions they make are consequential for them, reducing or eliminating some of the problems associated with experiments in other fields (experimenter demand, etc.). The second way in which economics experiments differ is that we do not deceive our experimental participants. This practice is designed to ensure that subjects are playing the game we think they are playing, and not attempting to uncover the 'true purpose' of the experiment.

Economics experiments have several advantages in studying retirement decisions and retirement policies. An experiment is akin to a formal theoretical model, in that it is an abstraction from the world, simplifying in order to focus on key aspects or elements of a particular situation. Thus, like their mathematical cousins, experiments are not "realistic" simulations of retirement situations, but rather are designed to isolate and examine separately the critical aspects of particular situations. This ability to isolate one or more key factors is one advantage of the experimental approach.

A second advantage is the superior control over the data generating process that the lab affords. The quality of data on retirement decisions is especially difficult to control in the field, because these decisions are taken once in a lifetime; it is hard to think of natural retirement experiments due to its potentially negative consequence. In addition, employees and employers will not always be willing to reveal private information in surveys. In the lab we avoid these problems, and also gain the ability to build experimental models that replicate most of the assumptions of formal models, thus testing the theory 'on its own domain'. As Plott (1986) has pointed out, if a model is true in the field, it should also be true in the lab.

However, experiments have limitations as well. In particular, the question is always raised about whether the behavior of subjects (typically students) in a laboratory setting sufficiently resembles the relevant retirement situation. We minimize this limitation in two ways. First, we do not merely examine behavior, but focus instead primarily on 'comparative statics' – i.e., how behavior changes when the conditions change. While those who choose to retire are different from the general (US) population, and may play a given game differently, there is no reason to think that their reactions to changes in the game will be different.

Our goal is to identify when models are good descriptions of behavior, and when behavior deviates from the predictions of the game (Schotter 2005). Experiments are an especially useful methodology to identify robust deviations from predicted behavior, due to psychological forces like heuristics and biases, which would presumably apply across a wide variety of individuals. Deviations are important to identify on two dimensions.

First, a better understanding of behavior in response to a particular game structure can help to improve our decision-making by de-biasing our own behavior. Second, it can bring a deeper understanding of others' behavior. The ability to accurately predict the decisions of an opponent depends on accurate beliefs. An opponent might at first appear to be irrational, instead becomes predictable once we understand the psychology underlying the decisions. Better predictions means we can better anticipate their actions, and choose better responses.

These systematic aspects of behavior can be used to build better models, and to design better policies. Retirement policies must be designed to affect the behavior of people in the field, and a better understanding of how and to what extent their behavior deviates from the rational actor model is necessary for effective policy design.

To our knowledge, our work is the first experimental approach to retirement decisions. Our research introduces 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). In a second stage, we analyze consumption paths in an experimental design with two central features: first, there exists a decreasing probability of surviving which implies an uncertain future income; and, secondly, there are two sequences of income, one when individual works and another when she is retired.

3. 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, the subject must decide the retirement round that determines her payoffs. These payoffs are conditioned to reaching the chosen round. If, for instance, a subject decides to receive the payoff associated with round seven 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.

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: an risk aversion test and a discount rate test. Both tests were paid independently and subjects could refuse to participate in the tests.

Table 1 summarizes some of the main features of our first experimental design:

Table 1
Experimental Design

Rounds	Chance	Survival Chance	Expected Payoffs	Payoffs- TR1 Annuity	Payoffs- TR2 Combinatio n	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	1500	23 + 1477	1500

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.

- *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.

- *Treatment 3 (TR3)*: A pure lump-sum pension system. Instead of receiving an amount per month, subjects receive the present value of the total pension benefits as a lump-sum payment immediately upon claiming benefits at retirement age.

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. 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).

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.

Our second experimental design tries to capture some actual features of an actuarially fair public pension system with a unique lump-sum payment. The experiment consists of three sequences of at most 30 rounds and one decision per round. Each round is characterized by a probability of surviving. As the round number increases, the probability of surviving decreases. In each round reached, subject either survives or not. A subject reaches a round if, and only if, she has survived all earlier rounds.

During the first *R-1* rounds, similar to wage earnings, subject receives 85 experimental units in each reached round (*Income*). In round *R*, subjects receive the present value of the total pension benefits as a unique lump-sum payment. As a strategy to analyze the effect of the length of the retirement period on savings and spending decisions, we design two treatments. In *Treatment 1* (hereafter LS10) the round *R* is the 10^{th} and in *Treatment 2* (hereafter LS15) the round *R* is the 15^{th}.

We consider a gross wage of 100 experimental units and a tax rate of 15%. Thus, in order to reflect an actuarially fair pension system, the lump-sum payment in LS10 is equal to 191.25 experimental units (with R=10) and in LS15 is equal to 345 experimental units (with R=15) following equation (5).

Table 2: Second Experimental Design

Rounds	P of surviving	LS10 Income	LS15 Income	Avail. Cash	Consumption	Savings	Points
1	1	85	85	85	---	---	---
2	29/30	85	85				
…	…	…	…				
10	21/22	85	85				
11	20/21	191,25	85				
12	19/20		85				
…	…		…				
15	16/17		85				
16	15/16		345				
17	14/15						
…	…						
30	1/2						
							0,00

In the remaining rounds subjects receive no income at all. Therefore, in LS10 and in LS15 subjects have at most 19 and 14 rounds with no income, respectively. In each round subjects have to make a unique decision about how to divide the *Available Cash* into consumption and savings. The available cash comes from the addition of the income received in that period and what is not consumed in previous rounds (their cumulative savings). So, income can be saved to provide wealth but savings earn no interest and borrowing is not allowed, that is, subjects cannot spend more than their *Available Cash*.

Let *C* denote the amount of experimental units converted into points by subjects in each round (their consumption). Subjects are informed of the conversion scale (from experimental units to points, converted into real euros at the end of the experiment): *C* experimental units generate *20*Square Root (C)* points. A table mapping how different consumption choices are converted into points (euros) is given separately to subjects.

As mentioned above, subjects play three sequences. They are told that at the end of the experiment they will be privately paid in cash the total amount of points converted from experimental units of one of the three sequences (randomly chosen). They are also told that any unconverted experimental unit remaining at the end of any sequence is worthless.

At the beginning of the experiment, subjects entered the laboratory and were randomly seated in a private cubicle. Experimental instructions were read aloud by the experimenter (instructions are provided in the Appendix). To make sure subjects understood the logic of the game, subjects completed a quiz before the experiment began. Explanations were repeated until all subjects passed the quiz (nobody made a mistake almost from the beginning, quiz available from authors upon request).

At the end of the experiment subjects were privately paid with an exchange rate of 125 experimental units = €1 for one of the three sequences, chosen at random. On average an experimental session lasted less than 90 minutes, the average earnings were around €27 and the maximum earnings peaked above €40. The experiment consisted of two treatments: LS10 and LS15. 20 subjects participated at LS10 and 19 subjects at LS15.

4. RESULTS

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 to 15 in the three different environments.

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%

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.

Figure 1 shows the relative frequencies of choices across treatments and rounds and illustrates the effects on the retirement decision of alternative timing schemes.

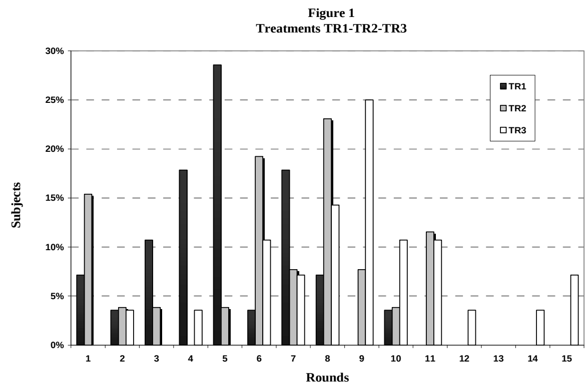


Figure 1 stresses some differences between treatments, as these differences seem to follow a pattern. In TR1 the behaviour of the majority of subjects could be interpreted as an "early" retirement decision. In TR2 the majority behaviour of subjects yields an "intermediate" retirement decision. In TR3 the pattern of behaviour 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.

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

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.

Table 5 presents the summary statistics of the individuals' decisions about consumption in our second experiment, their cumulative savings and available cash at the beginning of each period, for both the LS10 and LS15 treatments, by sequences. The number of survived periods in the last row denotes the average number of rounds that subjects were alive and making decisions. Average life is almost identical in both treatments (21.96 versus 21.31, as expected in a pure randomly driven process).

TABLE 5: DESCRIPTIVE STATISTICS

	LS10				LS15			
Averages	Total	Seq = 1	Seq = 2	Seq = 3	Total	Seq = 1	Seq = 2	Seq = 3
Consumption	43,82	49,32	40,27	43,74	66,22	65,89	68,11	65,11
	[44,20]	[50,51]	[44,61]	[36,62]	[44,65]	[50,35]	[44,18]	[40,47]
Cum. Savings	152,8	148,0	149,6	161,4	101,4	111,8	89,4	102,5
	[187,35]	[198,69]	[187,81]	[176,36]	[135,31]	[144,99]	[128,05]	[132,75]
Available cash	196,6	197,3	189,9	205,2	167,6	177,7	157,5	167,6
	[191,28]	[197,28]	[196,21]	[179,00]	[135,89]	[144,09]	[127,74]	[135,25]
# Survived periods	21,96	19,76	24,37	20,64	21,31	20,91	19,13	23,18
	[7,12]	[8,04]	[5,95]	[6,75]	[7,08]	[7,96]	[7,50]	[5,43]
# Obs.	1002	275	418	309	945	281	278	386

Std errors in brackets

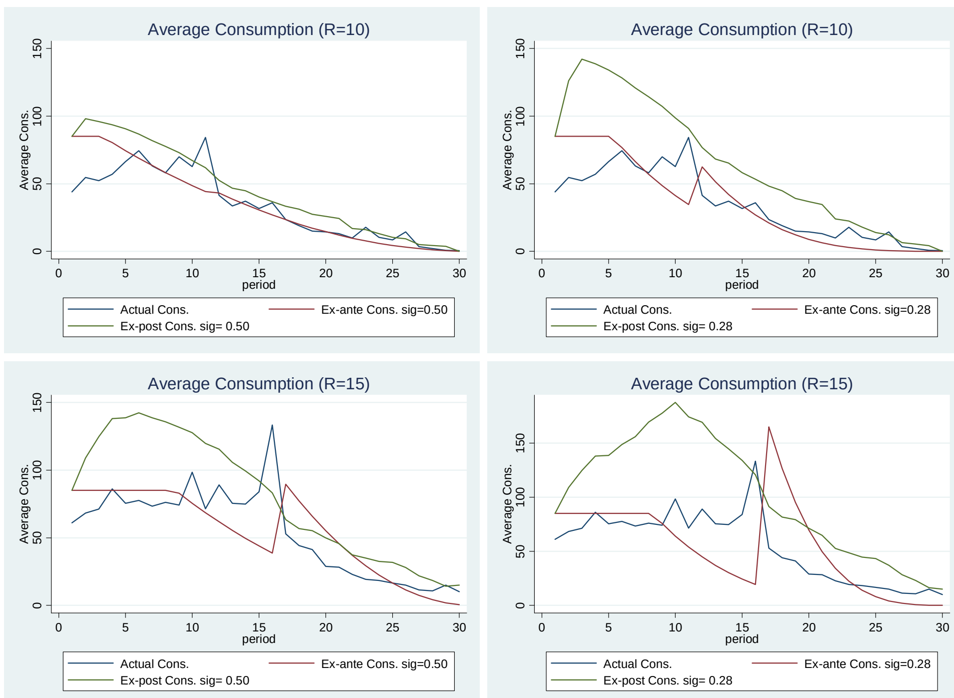
By pure inspection, average consumption is higher in LS15 than in LS10. This follows the experimental design, as subjects get a higher lump-sum and get a positive income during a higher number of periods in LS15. However, the more interesting information regarding treatment effects comes from the next two variables. Both the average cumulative savings and the available cash are a direct consequence of subjects' decisions in both treatments. Again, by pure inspection, subjects save considerably more in LS10 (152.8) than in LS15 (101.4): the difference is around 50%. This suggests that subjects in the worst scenario are able to save more to protect themselves from the higher number of periods with no income. Moreover, the average available cash is larger in LS10, in spite of the fact that available cash is the sum of cumulative savings and income (by definition, larger in LS15 than in LS10). Over-saving behaviour in LS10 more than compensates this difference.

No clear differences are observed across sequences within each treatment in consumption and savings. The actual consumption and saving choices do not show a clear (increasing or decreasing) trend as participants play more sequences. However, the standard deviation falls as subjects make more decisions. Besides, this reduction in the standard deviation across sequences seems to be systematic for all available variables. That is, in a very preliminary way, subjects seem to adjust better as the number of decisions increases.

We include two measures of divergence between actual and optimal behaviour. In our view, there are two plausible ways of thinking about optimality in this context. The first way is to define optimal consumption as the level of consumption calculated in the first period for the rest of the life-time profile. We will call this optimal consumption the ex-ante optimal consumption (EAOC). The second approach to optimality takes as the natural analysis unit the per-round individual decision. For every subject and every available cash amount, based on her previous decisions, we compute the optimal consumption for every period, contingent on the fact that (i) she is alive and (ii) owns a given actual positive wealth. This alternative approach is a kind of natural basis for assessing the optimality of subjects' decisions dynamically. We call this ex-post optimal consumption (EPOC).

To facilitate the comparison of actual and optimal consumption levels over all individuals we plot them. Figure 2 and 3 correspond to average consumption in LS10 (LS15), relative to EAOC and EPOC. Both a risk aversion rate of .50 and a risk aversion rate of .28 are used to check whether our results are robust to changes in risk aversion rates.

FIGURES 2 AND 3: CONSUMPTION IN TREATMENTS LS10 AND LS15



Unlike previous experimental papers, we find no evidence of over consumption in the first rounds. On the contrary, our participants under-consume in this earliest periods. This under-consumption behaviour lasts until round 5 in LS10 and round 10 in LS15 using the EAOC as a benchmark, while it holds in almost all rounds when the EPAC measure is used. The results are qualitatively identical for both risk aversion measures.

From an ex ante perspective, and before the lump-sum period comes, consumption exhibits some inertia and subjects fail to smooth it. Relative to the EAOC path, subjects over consume temporarily around the lump-sum period, in rounds 8 to 11 in LS10 and rounds 11 to 15 in LS15. However, this over consumption disappears when EPOC is used as the reference point. With the exclusion of the very same period when the lump sum is received, and only under a high risk aversion rate, subjects under consume in all periods relative to the optimal path.

Interestingly, after the lump-sum payment period, when subjects get no income at all, participants in the experiment performed relatively well adjusting their behaviour to the optimal path. Rather to consume their available income immediately after the lump-sum period, they keep on smoothing their consumption and adjust it to the optimal path in a more than reasonable way.

5. CONCLUSIONS

We have briefly presented here some of our research (Fatas et al. [2007], Lacomba and Lagos [2006, 2007]). In summary, our results suggest that the more concentrated the payments (shifting from annuity into lump-sum), the more postponed the retirement decisions. 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 behaviours. 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 behaviour.

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.

One of the proposals to delay the effective retirement age is to transform the increases in pensions due to the additional years of work into a lump-sum payment rather than an increased periodic payment. However, this measure risks increasing poverty rates. People who do not annuitize much of their retirement wealth might spend too quickly the lump-sum payment reducing income at very old ages.

We then consider the consequences of the incorporation of a lump-sum payment as a measure to delay retirement decisions. We have tested in the laboratory the potential effects on consumption behavior of implementing a lump-sum payment. Our main conclusion is that this might not be the case. The introduction of a unique lump-sum payment generates a behavioral overreaction in the opposite direction: rather than consuming too much, too fast, our subjects show a persistent precautionary saving behavior.

The policy consequences of our experiment are that transforming (at least, partially) pension benefits into lump-sum payments might not increase elderly poverty rates. An additional risk, comes from the political pressure to extend lump-sum payments to those who are younger than the regular retirement age. Such an extension would raise the risk of increasing elderly poverty rates. The analyses of results in our LS10 treatment, relative to the LS15, suggest the opposite: the earlier and the lower the lump-sum payment, the stronger the saving reaction.

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