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Time Inconsistency and Delayed Retirement Decision: the French Pension Bonus

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Abstract

With the increase in life expectancy and demographic shocks, several public policies in the last decades aim to encourage individuals to postpone retirement. One of them, the pension bonus, gives an increased pension if individuals retire beyond their Full Retirement Age. Previous ex post analyses found that the responsiveness to this type of financial incentives, which encourage to postpone retirement, is heterogeneous among agents and that the global effect is rather limited. Deriving from previous research in Behavioural Economics, this article analyses the impact of time inconsistency in the decision to delay retirement to get the bonus. Using public national survey data, short-term and long-term impatience are measured with questions on retiring motivations. After controlling for the endogeneity of the bonus knowledge, econometric results show that time-inconsistent agents are less likely to retire with the bonus.

JEL codes: C35, D91, J26.

Keywords: Time inconsistency; Claiming benefits; Pension Bonus

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I. Introduction

Due to demographic shocks and the increase in life expectancy, most of OECD economies have implemented pension reforms to ensure and improve the sustainability of pension funds in the short and the long term. Among them, the introduction of financial incentives aims to encourage people to postpone retirement[1], by offering a pension bonus when they remain in employment after their Full Retirement Age (FRA). Conversely, if they claim their retirement benefits before their FRA, the benefits are reduced by a penalty.

Ex post evaluations reveal the significant but heterogeneous impact of these financial incentives among agents, mainly because of non-linear careers or lack of information. In France, the pension bonus, introduced by the 2003 reform, increases retirement benefits by 1.25% per additional quarter worked. The proportion of retirements with a bonus has been increasing since 2003 and represents 13.70% of the employees of the private sector in 2015, accounting for a significant part of claiming benefits (DREES, 2017). Nevertheless, few analyses have studied the underlying patterns of these behaviours which could have several implications for public policies. For instance, a survey conducted by the DREES[2] (2015) shows that, among individuals who retired with a bonus in 2012–2013, only about one quarter declared they had delayed their claiming benefits for financial reasons. On the contrary, the first declared motivation is to continue to work. Moreover, as discussed by the COR (2011), applying the same pension rules for all individuals, with heterogeneity in preferences (such as leisure) and life expectancy, raises the issue of potential deadweight effects. That is, as motivations to retire include non-financial preferences, some agents would probably still delay claiming their benefits in the absence of a bonus.

Such behaviours could be explained by non-rational decision-making. Research in Psychology and Economics (known as Behavioural Economics) explores the role of nonstandard preferences, nonstandard beliefs and nonstandard decision-making for different economic decisions (DellaVigna, 2009). Contrary to the standard model, agents are procrastinators, loss-averse, altruist and use heuristics to solve complex maximization problems. In particular, time inconsistency occurs as agents with high short-term discounted rates overweight short-term utility (or disutility) and change their decision over time. Principally because of a decreasing discounted rate over time (or hyperbolic discounting), an

[1] As pointed out by Knoll (2011), 'retirement' may refer to different things. Hence, in the analysis, 'retirement' means claiming pension or Social Security benefits rather than stop working.
[2] « Direction de la recherche, des études, de l'évaluation et des statistiques » is the statistics/economic studies and public policies evaluations unit of the French Social Affairs Ministry.

agent initially chooses an action and reevaluates it (or does not stick to it) as the action approaches. For instance, in the job search theory, DellaVigna and Paserman (2005) and Paserman (2008) show that time inconsistency leads to overweighting the disutility from the search cost, and pushes individuals into postponing (again and again) search activities without revising downwards the reservation wage. This results in extended unemployment. In terms of retirement savings, time-inconsistent agents save less than time-consistent agents—because they overweight the instantaneous utility from consumption—and accumulate a suboptimal level of savings for retirement.

This article intends to mix the two types of literature, by analysing the impact of time inconsistency on the decision to delay retirement, in order to explain the relatively limited effectiveness of the bonus. Using data from the third wave of 'motivations de départ en retraite' French survey (DREES, 2014), ordinal synthetic scores, proxies of short-term and long-term impatience, are constructed with questions on motivations to retire (Arrondel and Masson, 2014). Moreover, given the potential simultaneity of finding out information about pension rules and actually retiring, the econometric strategy control for the endogeneity of the bonus knowledge by the estimation of a recursive bivariate probit model. Econometric results show that the probability of retiring with a bonus is negatively impacted by both short-term and long-term impatience. Thus, time-inconsistent agents are less likely to delay retirement to get a bonus compared to time-consistent agents.

The article is organized as follows: the following section presents the French public retirement system as well as the literature about *ex post* evaluations and behavioural underlying factors; the third section is devoted to the description of the data, the scoring methodology for the construction of time preferences scores and a brief descriptive analysis; the fourth section presents the econometric strategy and the results. The fifth section offers a conclusion.

II. Institutional Background and Literature

II.1. French Pension System

The mandatory French public retirement system is composed of several basic pension funds, all based on a Pay-As-You-Go scheme, and covers all sectors (First pillar). It provides early retirement pensions, old age pensions, disability pensions and survivor benefits. Even though pension funds rules differ, the eligibility to retire and the calculation of benefits are

based on three elements: an 'assessment basis,' the number of insurance years and the legal retirement ages.

The 'assessment basis' or 'average annual salary' corresponds to the average earnings over the best years (25 years for the private sector employee pension fund). After applying an upper limit for earnings each year, the average constitutes a base for the calculation of the benefits. The number of insurance years includes contribution years (contributions during employment) and additional validated years (periods of unemployment, sickness or invalidity, maternity leave and military service). An official reference insurance duration is set for each generation, which has been steadily and gradually increased since the 2003 reform. As for the legal retirement ages, two references are used: an Early Retirement Age (ERA) and a Normal Retirement Age (NRA).

An agent can retire with full benefits[3] (individual Full Retirement Age) once he has reached the official reference insurance duration (full career) or the Normal Retirement Age. In order to improve the sustainability of the PAYG pension system, one of the measures consists in implementing financial incentives to encourage individuals to delay their retirement: if they decide to retire before their FRA, they can retire from the ERA onwards, but with a penalty. In this case, pension is reduced by 1.25% per 'missing' quarter[4]. In 2003, a reform introduced another financial incentive: from the ERA onwards, if their insurance duration is at least equal to the reference insurance duration (full career and eligible for full benefits), individuals get a pension bonus if they continue working. In that case, since April 2009, pension is increased by 1.25% per additional quarter worked (beyond the reference insurance duration). Among new retirees in 2013, 12% of public and private sector employees and 31% of State's civil servants retired with a bonus (COR, 2015).

The 2003 reform also implemented specific rules for long careers. Agents who started working very early and contributed during a longer period[5] are not penalized and can retire before the ERA without penalty. In 2013, 21.2% of public and private sector employees and 11.3% of State's civil servants benefited from this measure. The same rule applies for individuals who are not able to work due to severe health conditions (disability pension) or handicap. In 2013, they represented respectively 7.4% for public and private sector employees

[3] The 'assessment basis' is multiplied by a rate depending on pension funds. For example, for the private sector employee pension fund, the basic rate for full benefits (hence, without penalty or bonus) is 0.5.
[4] This penalty must be added with 'proratisation.' In addition to the penalty, the pension is decreased by another ratio equals to actual insurance duration divided by reference insurance duration.
[5] The number of contribution years must be equal to at least the official reference number of insurance years since 2014.

and 6.6% for State's civil servants. Nevertheless, these two types of workers have to reach the ERA and work at least one additional quarter to gain access to the bonus. Finally, a minimum pension is guaranteed for people who contributed little or did not participate much in the labour force.

II.2. Pension Reforms, Financial Incentives and Behavioural Underlying Factors

As several OECD countries have implemented pension rules reforms to ensure the sustainability of pension systems in the long term, the progressive introduction of these new regulations has permitted *ex post* evaluations, which revealed mitigated results on the effectiveness of these incentives on delaying retirements. In France, Bozio (2011) founds an elasticity of the retirement age of 0.93 year for one extra year in the reference insurance duration (1993 French reform). Benallah (2011) notes a significant positive impact of the bonus introduction (2003 reform) on the probability to remain employed after 60 years old (on condition that the agent has a full career), as well as on the age of retirement. The impact is nonetheless different according to gender: men are more responsive to financial incentives because they generally reach the eligibility conditions earlier than women.

Despite different pension rules, *ex post* analyses in other OECD economies give the same conclusions and provide other perspectives. For the United States, Mastrobuoni (2009) shows that for an increase of 2 months in NRA, people respond by delaying the claim of their benefits by one month (relative change of about 50%). In Austria (Staubli and Zweimüller, 2013) and in Germany (Engels, Geyer and Haan, 2017), the responsiveness to an increase in NRA is heterogeneous, depending on health status and wage. Healthy high-wage workers tend to remain employed longer, while poor health or low-wage workers bridge the gap by using unemployment insurance. In Belgium, López-Novella (2012) analyses the impact of the 1997 reform which increased the ERA and introduced a temporary bonus. The results tend to confirm previous conclusions: the increase in the ERA has a significant impact on retirement timing whereas the bonus has mixed effect, probably because of the weak knowledge of agents.

Rational reasons, other than financial, are advanced in the literature to explain these behaviours. Notably, marital status is an important predictor, as spouses make decisions together rather than making optimal choice in purely individual settings (Gustman and Steinmeier, 2000; Legendre, Pedrant and Sabatier, 2018). Lack of information also seems to explain a large part of the heterogeneity in behaviours. According to Chan and Stevens (2008), the effect of measures aiming to postpone retirements is almost entirely led by informed

individuals, while uninformed people respond to their subjective perception of pension rules, and make decisions deemed as not optimal. In the same way, financial literacy[6] constitutes another reason for the limited impact of the bonus (Lusardi and Mitchell, 2014). In the French context, agents may misunderstand the combination between insurance duration and legal retirement ages. Moreover, the mandatory retirement system is composed of many funds, based on a mix between annuity and point systems, which make the calculation of future pension benefits throughout life difficult. El Mekkaoui de Freitas and Legendre (2015) analyse the impact of a personalized statement, with information about projected pension benefits, sent to all individuals aged 55 or more in France[7]. Results show that the statement has little and heterogeneous effects on retirement planning: information is only integrated by the wealthiest and more financially literate agents who have planned retirement more thoroughly (private savings).

But behavioural factors can also explain these tendencies (Knoll, 2011). ERA and NRA could be considered as references or social norms. Behaghel and Blau (2012) show that 'rational' reasons (like the life-cycle model hypothesis, liquidity constraint or interaction with disability program) cannot entirely account for the spike in the benefit claiming hazard observed at the legal ages. They interpret these behaviours as the result of reference dependent preferences, with loss aversion. Merkle, Schreiber and Weber (2017a) confirm this hypothesis, with experimental data and SAVE survey data, highlighting the presence of an endowment effect (when early retirement is presented as a good) in terms of retirement timing.

Time inconsistency can be another factor impacting retirement timing. Usual theoretical models analyse retirement time decision as an intertemporal trade-off (Stock and Wise, 1990; Belloni, 2008). Agents are assumed to be time-consistent (exponential discounting), implying that more impatient agents prefer to retire sooner and plan retirement according to their preferences. But time-inconsistent agents (non-constant or hyperbolic discounting) can make preference reversal decision depending on time: they exhibit stronger discount rates in the near future and weaker ones in the distant future, which lead to dynamic inconsistent decisions (Thaler, 1981). Agents who exhibit these intertemporal preferences suffer from a lack of *self-*

[6] 'Peoples' ability to process economic information and make informed decisions about financial planning, wealth accumulation, debt, and pensions' or 'The ability to do some simple calculations and knowledge of some fundamental financial concepts' (Lusardi and Mitchell, 2014).

[7] The statement, named 'Estimation Indicative Globale' (indicative global estimate), include information on projected pension benefits for every potential retirement age between the Early Retirement Age (ERA) and the Normal Retirement Age (NRA). See El Mekkaoui de Freitas and Legendre (2015).

control. Faced with a trade-off between two outcomes in the distant future, they are patient and prefer the more important one, even though it comes later. But as the future gets near, impatience intensifies: even if it is the same interval of time between the outcomes, they prefer the smaller outcome, as long as it comes sooner. Hence, a time-inconsistent agent can initially choose an optimal action and reevaluate it as the action approaches: he plans to retire at an optimal date during his working period and does not stick to it as retirement gets close.

Hyperbolic discounting can lead to two opposite effects. One effect is direct: when retirement approaches, instant leisure is preferred to future consumption, because of the overweighting of instantaneous disutility from labour effort. Thereby, time-inconsistent agents retire earlier than planned. Conversely, the indirect effect is that, during the working period, agents do not accumulate enough wealth in preparation for retirement, due to the overweighting of instantaneous utility from immediate consumption. Therefore, because of a suboptimal level of savings, not sufficient to smooth consumption (or to support themselves after they have stopped working), they have to delay the claim of their benefits and work longer than time-consistent agents. Moreover, the distinction between 'sophisticated' and 'naïve' agents has to be emphasized (O'Donoghue and Rabin, 1999; DellaVigna, 2009). A sophisticated agent, being aware of his self-control problem, has good expectations about his future time preferences and can take actions to limit the negative impact of preference reversal. He can adopt two strategies: save more during his working period to have the same preferences whatever the time of decision or save little ('strategic undersaving') to be forced to work longer before retiring (Diamond and Köszegi, 2003).

Some theoretical models, with endogenous retirement time decision, incorporate hyperbolic discounting and found important predictions in comparison to the exponential discounting model. For instance, Zhang (2013) uses a three-period model with endogenous labour supply and shows how hyperbolic discounting can lead to both undersaving and early retirement, regardless of the type of agent (Sophisticated/Naïve). On the contrary, Findley and Caliendo (2015) also use a three-period model with continuous work/retire decision and found that the indirect effect prevails, focusing on naïve agents. They show that hyperbolic discounters borrow less than exponential discounters during the working period, start to save earlier and retire with almost the same balance in the savings asset. However, although hyperbolic discounters retire later than earlier planned (because of insufficient savings), the timing of retirement is not different from that of exponential discounters.

For the empirical part, Merkle, Schreiber and Weber (2017b) use survey data to measure non-stationary preferences by lotteries. Their results confirm the significant impact of

inconsistent preferences on planned retirement age: time-inconsistent agents tend to retire at an earlier age than planned and are more likely to regret their decisions. Huffman, Maurer and Mitchell (2017) study the interaction between retirement age and time discounting using HRS survey data (Health and Retirement Study) in the United States. They could not find any significant impact of their measure of annual Internal Rate of Return (IRR, defined as the annual time discount rate) and of their 'procrastinator score' either on the retirement claiming age, or on the difference between expected and actual retirement age.

Deriving from the literature, two sets of hypotheses can be formulated. First, to know if time-inconsistent agents (hyperbolic discounters) behave differently than time-consistent agents (exponential discounters), one wants to verify if short-term impatience impacts retirement behaviour:

1: retiring with the bonus is impacted by short-term impatience and long-term impatience.

2: retiring with the bonus is only impacted by long-term impatience.

Moreover, as the predictions of theoretical models are contradictory on the impact of hyperbolic discounting (direct and indirect effects):

3: time inconsistency leads to earlier retirement, without a bonus.

4: time inconsistency leads to later retirement, with a bonus, because of suboptimal savings.

Finally, previous results suggest that agents get information at the same time as they plan their retirement age. In the USA, Mastrobuoni (2011) finds that the probability to contact the Social Security Administration (to get information and to compute expected retirement benefits) increases with age: most workers find out about their expected pension when they are close to retirement. He also shows that, among elder workers who did not contact the Social Security Administration, sending an annual social security statement (record of past earnings and estimated benefits) reduces significantly the proportion of workers unable to provide a benefit estimate around the early retirement age. Thus, the likely simultaneity of information must be taken into account in the study of the retirement decision.

III. Data and summary statistics

III.1. The Data

The study uses national survey data from the third wave of the French survey 'Motivations de départ en retraite,' conducted by the DREES institute in 2014. It contains information on new retirees who claimed their benefits between July 2012 and June 2013 and contributed at least one year to the private sector employee pension fund. Individuals are mainly asked about their situation before retirement, their self-perception of their knowledge about pension rules and their motivations to retire.

Because retirement decision could be impacted by the liquidity constraint, individuals who do not have a source of income before retirement are removed from the sample. Furthermore, as pointed out by Engels, Geyer and Haan (2017), unemployment or disability can be a strategic decision before retiring, used as a bridge into retirement. Hence, the analysis focuses only on individuals who were active before retirement (unemployed, disabled, inactive or progressive/partial retirement is not considered). From the 2008 reform, self-employed workers, employees of the public and private sector and 'non-active'[8] civil servants born after 1947 contribute to pension funds with the same eligibility rules. Moreover, as stated above, the ERA and NRA increased gradually, starting from 60–65 years for the 1948 generation to 62–67 years for the 1952 generation. Individuals born after April 1952 do not have access to the bonus (yet) since the period of the survey is July 2012 to June 2013. Hence, to avoid potential bias, only these three types of retirees, born between 1948 and April 1952, are taken into account.

[FIGURE 1]

Declarative data are merged with administrative data from the private sector pension fund, allowing the measure of the difference between perceived and real pension rules, as for individual careers: the actual insurance duration when the agent retired[9], the reference insurance duration (full career) and the two legal ages (ERA and NRA). This information allows the construction of two binary variables: knowledge of the actual insurance duration and knowledge of the reference insurance duration. For instance, for the reference insurance duration,

[8] Among civil servants, the French system distinguishes active workers (like policemen or firemen) whose work implies particular risks or intense tiredness from other workers (non-active). Active civil servants can take advantage of more generous retirement rules.
[9] The number of validated quarters used to compute pension benefits.

individuals are considered as uninformed if they are unable to respond or if the difference between the perceived and the true duration is higher than 3 quarters. The survey also asks respondents about their knowledge of different measures including the penalty (retirement before the FRA), the bonus (retirement after the FRA, conditional on having a full career) and the minimum pension.

Administrative data also provide information on the actual retirement date (penalty, full benefits or bonus), the 'average annual salary' and the age of first contribution to a pension fund. Occupation before retirement (self-employed, public/private sector employee, 'non-active' civil servant) and whether individuals contribute to more than one pension fund are also available. Furthermore, the French social system has a special policy for stay-at-home parents. Administrative data allow the computation of the number of stay-at-home years between 1972 and 2012 (40 years preceding retirement). It constitutes an index for participation in the labour force. In addition, a dummy indicator of the eligibility to retire before the ERA (early retirement) after a long career is also created. Since these agents cannot get the bonus before reaching the ERA, the financial incentive is less attractive. Socio-demographic variables such as gender, the presence of more than one source of income in the household (proxy for marital status) and whether the agent was a full-time (respectively part-time) worker are also provided. Questions about retirement motivations integrate the health dimension ('You decided to retire because you had health problems that made work difficult'), allowing the creation of 4 classes (dummies) for health status. Finally, other questions, principally related to work lassitude, information and leisure, allow the construction of synthetic scores to measure time and risk preferences (described hereafter).

[TABLE 1]

Table 1 presents some basic characteristics of the final sample, composed of 1032 observations. The sample is well balanced for gender with 50.48% of women. As the average retirement age of agents who retire with a bonus is not significantly different from that of the full sample, agents generally reach their Full Retirement Age (or further) by the insurance duration. The average retirement age is 62 and the average insurance duration is about 170 quarters, very slightly more than the national average retirement age and insurance duration (DREES, 2017). Finally, the sample is mainly composed of retirees who were employees of the private sector (62.69%), although 41.67% contributed to more than one basic public pension funds.

III.2. Ordinal synthetic scores for time and risk preferences

In the survey, the respondents had to indicate on a four-modality scale ('strongly agree,''agree,''disagree,''strongly disagree') if different motivations had impacted their retirement decision. In line with Arrondel and Masson's scoring methodology (2014), these questions are used to construct synthetic and ordinal scores for time and risk preferences under the key assumption of independence between motivations to retire *per se*, and motivations to keep working after the FRA (conditional on having a full career). Formally, non-stationarity, a key component of time inconsistency, is traditionally captured by the (β, δ) quasi-hyperbolic discounting function (Laibson, 1997). With u_t the per-period utility and U_t the overall utility at time *t*:

$$U_t = u_t + \beta\delta u_{t+1} + \beta\delta^2 u_{t+2} + \ \ldots \tag{1}$$

where $\beta \in [0,1]$ is the degree of short-term impatience (or present-bias). The lower the β, the more the agent is time-inconsistent because of the overweighting of immediate outcomes (utility or disutility)[10]. The conventional exponential discounting factor is δ, as:

$$\delta^t = \frac{1}{(1+r)^t} \tag{2}$$

with *r* the discounted rate. Thus, a short-term impatience score (proxy of the present-bias β) and a long-term impatience score (proxy of δ) are constructed to capture time-inconsistent behaviours.

As pointed out by Arrondel and Masson (2014), batteries of vague and global questions are good predictors of saving and economic behaviours. Using several questions permits to globally limit the potential bias (due to a specific subject) and measurement error of each question. Since retirement is a unique decision in the life of an agent and since the time interval of the decision can be very long (e.g. a decade for a forward-looking agent), experimental measures in the laboratory cannot easily capture discounting structures. Particularly, the survey of Frederick, Loewenstein and O'Donoghue (2002) shows the significant variation in experimentally elicited discounted rates. In experiments, hypotheses which are assumed for identification of present bias (expected-utility maximization, future marginal utility of money

[10]In fact, when an agent chooses between two outcomes from today to the next period, the implied discount factor is βδ, while for two outcomes between any two periods in the future, the implied discount factor is δ (DellaVigna, 2009).

is known and shock independent) are numerous and not easily respected[11]. Furthermore, qualitative survey questions are often used to measure unobserved time and risk preferences (Ameriks *et al.*, 2007). Pinger (2017) shows that survey questions capturing present-bias have good properties: they are related to experimentally discounted rates and are stronger predictors for real-life economic outcomes (investment in financial assets and human capital as education).

Table 2 describes the questions used for the construction of the two impatience scores. For instance, 'You decided to retire that year because of the lack of information on earlier/later retirement possibilities' is more related to short-term impatience due to the overweighting of the disutility from immediate search cost. In contrast, 'You decided to retire because your future pension was sufficient' implies the anticipation of the future incomes and is then more related to long-term impatience. Questions are neither too general nor too precise: they do not refer to any global economic decision (as consumption) or specific constraint (spouse in disability situation). Answers are recoded in such a way that most impatient agents have the highest scores. Then, answers are aggregated and standardized to constitute two final unique scores with 0 mean and a variance of 1. For each score, all questions, taken separately, must be at least correlated at 10% with the score formed by the other questions, measured by item-rest correlations[12].

[TABLE 2]

In addition to short-term and long-term impatience scores, risk aversion dummies are constructed by using two additional questions on motivations: 'You decided to retire because, in any case, it does not prevent you from continuing to work or working again in the future if you want to' and 'You decided to retire because you fear a decrease in your pension due to a future reform.' Again, answers are recoded so that more risk averse agents have higher scores. The aggregation of the two answers constitutes a final score varying between -2 and 4. Three

[11] See Pinger P. R. (2017)

[12] Although many psychometricians deplore their use, reliability is often measured by Cronbach's alpha or Guttman's lower bounds. These latter and other similar measures rely on hypotheses, not respected with the data (especially the normality assumption). In addition, they are not appropriated with items based on different areas or subjects, although this is the aim of questions on motivations to retire (Cronbach and Shavelson, 2004). Even if simulations show that it underestimates the true reliability value (Trizano-Hermosilla and Alvarado, 2016), the Greatest Lower Bound is reported as an indication (calculated with 'psych' R package).

classes of risk aversion are formed: small-risk aversion (-2 and -1), medium-risk aversion (0 and 1) and high-risk aversion (2, 3 and 4).

In the survey, one question is related to self-control: 'Concerning your retirement decision, have you claimed your benefits as soon as possible or later?' Time-inconsistent agents with a high degree of impulsiveness are likely to retire as soon as possible. External validity of impatience scores is then tested by the estimation of the probability to retire 'as soon as possible' with a simple probit model. The results are in Table 3 (appendix). All other things being equal, both impatience scores are significant: the probability to retire 'as soon as possible' increases both with short-term and long-term impatience. The construction of the scores thus appears as coherent.

III.3. Descriptive analysis

Summary statistics for principal socioeconomic and information variables, displayed in Table 4, give an overview of informed agents and of agents who retire with a bonus. The first column compares informed and uninformed agents; the second compares agents who retire with a bonus and those who do not. Each socioeconomic or information variable comes with a Student test or a nonparametric independence test (Wilcoxon-Mann-Whitney or Pearson chi-squared), depending on the type of variable.

[TABLE 4]

Informed agents show a smaller level of short-term impatience. Long-term impatience and risk aversion are, however, not relevant to describe knowledge. Conversely, all preference variables are linked to delayed retirement, as time-inconsistent and more risk-averse agents retire earlier, before reaching the bonus.

Health status and salary are also important. They are both related to knowledge and delayed retirement. Both informed agents and agents who retire with a bonus are healthier and have higher wages. Hence, the introduction of the bonus to get a higher pension does not seem to affect agents whose income will not be sufficient to support them during retirement. Gender inequalities are present as well: women are less represented among informed agents (45.80%) and among those who retire with a bonus (47.48%), probably due to career constraints or coordinated retirement decision between spouses. The latter can also explain the smaller percentage of people who have another income source in the household among retirements with a bonus (63.66%).

Interestingly, participation in the labour force is seemingly more important than the duration of the career: informed agents start to work later (18.36 compared to 17.84) but have a smaller use of stay-at-home parents' insurance (0.9502 compared to 0.8837). Nonetheless, this difference is also present for delayed retirement, although to a lesser extent. However, being informed of the actual and reference insurance duration is only linked to the knowledge of the bonus, which shows that claiming retirement benefits is not only a strategic financial decision.

Finally, as expected, the bonus knowledge is strongly linked with delayed retirement. This supports the assumption of simultaneity between the decision to retire and the fact of finding out information about pension rules. Furthermore, despite the correlation between knowledge and delayed retirement, only a relatively small percentage of people who retire with a bonus are informed (52.94%). Although data are not representative, the relatively small proportion of informed people among agents who retire with bonus shows some first signs of deadweight effects for the public pension fund. Indeed, in the absence of financial incentives, uninformed agents would probably still delay the claim of their retirement benefits.

IV. Econometric analysis

IV.1. Econometric strategy

To measure the impact of intertemporal preferences on delayed retirement, two binary dependent variables are used: knowledge of the bonus and retirement with a bonus. Different models are estimated (Table 5). The first is a simple probit model (column 1), with 'retirement with a bonus' as dependent variable. The second is a two-step probit model. The predicted probability of the bonus knowledge, estimated by a first probit model, is included in the second (retirement with a bonus) equation estimated by a second probit model (column 2).

The last specification is estimated to address endogeneity concerns. Indeed, the endogeneity of the bonus knowledge may be due to two sources. First, the decision to find out information about pension rules and the decision to postpone retirement to get the bonus are likely to be both affected by common elements of unobservable heterogeneity (omitted variable bias). Second, as stated above, these two decisions are probably simultaneously determined (reverse causality). Thus, a recursive bivariate probit model (Heckman, 1978; Maddala, 1983) is estimated to test and control the endogeneity of the bonus knowledge as:

$$\begin{cases} y_1^* = X_1\beta_1 + \alpha Z + \varepsilon_1, & y_1 = 1(y_1^* > 0), \\ y_2^* = X_2\beta_2 + \gamma y_1 + \varepsilon_2, & y_2 = 1(y_2^* > 0) \end{cases} \tag{3}$$

With the bonus knowledge denoted by y_1 and retirement with a bonus by y_2. The sets of explanatory variables are X_1 and X_2, and Z is the set of instruments (discussed hereafter). Both error terms are assumed to be normally distributed by a bivariate normal distribution as:

$$\begin{pmatrix}\varepsilon_1\\ \varepsilon_2\end{pmatrix} \rightarrow N\left(\begin{pmatrix}0\\0\end{pmatrix}, \begin{pmatrix}1 & \rho\\ \rho & 1\end{pmatrix}\right) \tag{4}$$

where ρ is the correlation between the error terms. From the econometric point of view, this specification allows testing and controlling potential endogeneity of the bonus knowledge (y_1) by ignoring his endogenous nature, notably from simultaneity (Greene, 2011)[13]. The model is estimated with maximum likelihood estimator. In addition, the bivariate normal distribution assumption of the error terms is tested by a Murphy test (2007)[14]. For endogeneity concerns, the following hypothesis system is tested with a Wald test:

$$H_0: \rho = 0 \tag{5}$$
$$H_1: \rho \neq 0$$

where H_0 corresponds to the exogeneity of the bonus knowledge. Hence, if H_0 is rejected, the bonus knowledge is endogenous and the two equations must be jointly estimated. The results are in column 3.

In all specifications, time and risk preference variables are in the second (retirement with a bonus) equation. The explanatory variables included in the two equations are the Average Annual Salary (2 dummies), a part-time/full-time job indicator, a woman indicator and health status (3 dummies). A likely difference in the availability of information between job sectors is controlled by dummies for occupation before retirement (public sector employee, private sector employee, civil servant or self-employed worker). Likewise, because pension funds have slightly different rules, another dummy indicator of contributions to more than one pension funds is also included. The likely coordination between spouses is captured by an additional dummy indicator of the presence of another source of income in the household, introduced only in the second equation.

As only contributed quarters beyond the reference insurance duration are taken into account for the bonus, the access to the bonus is conditional on having a relatively long career.

[13] The demonstration is in chapter 17, page 746. The endogenous nature of y_1 does not modify the likelihood of the standard bivariate probit.

[14] Chiburis, Das and Lokshin (2011, 2012) show with simulations that Murphy's test has good performance with both recursive and non-recursive bivariate probit models.

In other words, agents who have contributed a small number of quarters during their careers do not gain access to the bonus. Although the latter retire without the bonus, their decision is rather based on the impossibility to reach the eligibility conditions than on a real decision not to delay retirement. Administrative data do not allow the control of the insurance duration at the early retirement age (Benallah, 2011). This constitutes a limit to the delayed retirement choice modelling even if this potential bias is limited: as stated above in section III.1, most of the individuals who retired with full benefits have reached their Full Retirement Age by the insurance duration (and not by the Normal Retirement Age). Hence, the age of first contribution (main cause of low insurance duration) is introduced in the second equation to control individuals who do not have access to the bonus. It is also included in the first equation, as starting to work early should encourage people to find out information about pension rules.

For the recursive bivariate probit model, three instruments are used: knowledge of the actual insurance duration, knowledge of the reference insurance duration and the participation in the labour force index. The intuition is that a better global knowledge of pension rules should improve the probability of being informed about the bonus. Although global knowledge directly impacts the decision to retire globally earlier or later, it affects, in all likelihood, only indirectly the specific decision to delay retirement through the impact of the bonus knowledge. Moreover, partly because it is regularly discussed as a social issue in public debate (particularly with past reforms), the reference insurance duration is one of the best-known pension rules for individuals who are close to retirement (DREES, 2017). Likewise, as stated above, the personalized statement, addressed to all individuals close to retirement, gives information on the actual insurance duration and projected pension benefits for different potential retirement ages between the ERA and the NRA. With this statement, one can easily learn about his reference insurance duration and his potential Full Retirement Age (FRA). Thus, knowledge of actual and reference insurance duration is the most likely to be exogenously changed. This is overall the same for participation in the labour force index. A person who is in employment and participates in the labour force can get information more easily (reduction in search cost), especially through information campaigns. These intuitions are notably reinforced by the results of the descriptive analysis: knowledge of the reference duration and knowledge of the actual duration are significantly related to the bonus knowledge, but not to delayed retirement (Table 4.).

Finally, as stated above, agents with a long career (eligible for early retirement before the ERA) are not as disposed to postpone retirement because the bonus takes into account only

quarters worked after the ERA. To capture this difference in incentives, another dummy variable included in the second (Retirement with a bonus) equation measures the effect of being eligible for early retirement, before the ERA.

IV.2. Econometric Results

IV.2.1 Main Results

The major highlight is about time preferences explanatory variables. In all specifications, both short-term and long-term impatience are significant at 1% level and impact negatively the probability of retiring with a bonus. To the extent that the significance and the sign of coefficients associated with preferences explanatory variables are similar across specifications, it confirms the robustness of the results. Thus, hypotheses 1 and 3 (Section II.2) are verified. Oddly, risk aversion dummies are not significant in all specifications. Despite the fact that reforms quite often change pension rules, risk aversion does not seem to impact delayed retirement.

In line with the theory, more impatient rational agents (exponential discounting) have a lower probability to retire with a bonus. In addition, as short-term impatience is significant, time-inconsistent agents, characterized by a high degree of present bias, retire earlier than time-consistent agents. Consequently, retirement is not a strategic forward-looking decision for a substantial proportion of workers. Despite a likely suboptimal level of savings, time-inconsistent agents do not take advantage of the pension bonus, and end up with a likely insufficient income to support themselves after they have stopped working. The impact of time inconsistency (hyperbolic discounting) is then in line with the findings of Merkle, Schreiber and Weber (2017b) and Zhang (2013). Moreover, as expected, the bonus knowledge impacts positively the probability of retiring with a bonus. It is consistent with the previous analysis showing that the responsiveness to financial incentives is stronger among informed agents (Chan and Stevens, 2008).

For the recursive bivariate probit model (column 3), the Wald test rejects the nullity assumption of ρ, confirming the endogeneity of the bonus knowledge. The value of ρ can be interpreted as the correlation between the disturbances in the equations, thus, the omitted factors. It measures (roughly) the correlation between the two decisions, once the impact of included factors has been taken into account (Greene, 2011). At least two unobserved factors could explain this highly negative value. First, the accumulated private savings, which could be positively correlated with knowledge, and negatively with retirement with a bonus; second, the Temporary/Permanent job status that could incite an individual to find out information as

retirement gets near, although he wants to retire at the end of the job contract, before reaching the FRA.

Regarding the instrument variables, only the knowledge of reference insurance duration and the participation in the labour force index are significant. For the latter, the previous intuition in descriptive analysis is verified: in terms of information, actual participation in the labour force matters more than the overall duration of the career. This interpretation is also confirmed by the non-significance of the full-time job dummy. Likewise, the latter influences the decision to retire with a bonus, probably due to liquidity constraints, so that full-time workers are more likely to postpone their retirement.

IV.2.2 The Effects of Time Inconsistency and Knowledge

Based on the results of the recursive bivariate probit model (Table 5, column 3), the average predicted probabilities of retiring with a bonus, all other things being equal, are computed (Figure 2) by setting the value of short-term or long-term impatience and leaving the other significant explanatory variables at their true values. The effect of short-term impatience appears significantly: the average probability decreases from 50.30% for the most patient agents to 32.66% for the most impatient agents, therefore, a 17.64 percentage decrease (Graphic A). The effect of long-term impatience is also important, although to a lesser extent: the average probability decreases from 51.63% for the most patient agents to 37.00% for the most impatient agent (graphic B).

[FIGURE 2]

Graphics C and D show further results by also setting the value of the bonus knowledge. The effects of both short-term and long-term impatience are quite similar for informed and uninformed agents. For instance, in terms of short-term impatience (graphic C), the decrease in average probability of retiring with a bonus between the most patient and the least patient agents is about 19.67% (from 80.92% to 61.25%) for an informed agent; the comparative decrease is about 15.59% for an uninformed agent. For long-term impatience (graphic D), the comparative decrease in average probability is about 15.27% for an informed agent and 13.91% for an uninformed agent, confirming the significant impact of both types of impatience.

Considering now the effect of knowledge, the difference in average probability of retiring with a bonus is sizable. Based on graphic C, the absolute change in average probability between informed and uninformed agents is -49.74% for agents who are the most impatient in the short term (-53.82% for those who are the least impatient in the short term). The effect is

quite similar in the case of long-term impatience (graphic D): the comparative absolute change in average probability is about -52.22% for the most impatient agents and about -53.58% for the least impatient agents.

Finally, to have an overview of the global effect of time inconsistency, we can compute the average predicted probability for the two types of agents: a time-consistent agent (with the smallest degree of both short-term and long-term impatience) and a time-inconsistent agent (with the highest degree of both short-term and long-term impatience). The difference in average predicted probability of retiring with a bonus is then -31.24% (55.30% compared to 24.06%). The effect is, however, heterogeneous depending on knowledge. For informed agents, the average difference is -36.67% (85.19% compared to 48.52%) while for uninformed agents, it is -26.32% (32.56% compared to 6.24%). Hence, knowledge and time inconsistency appear as key determinants in the decision not to delay retirement to get the bonus.

IV.2.3 Other Covariates Results

The results of other explanatory variables reveal important trends and enable a better understanding of the link between knowledge and retirement with a bonus. Regarding health status, healthier individuals are more likely to be informed. However, for retiring with a bonus, the results are less evident: unhealthy agents do not behave differently compared to healthiest agents. It seems that, overall, unhealthiest agents make their claiming decisions considering their health constraint rather than financial motivations. This can therefore explain why they do not find out about financial incentives.

As regards the Average Annual Salary, a higher wage leads to a higher probability of knowledge and a higher probability of retirement with a bonus too. Although expected, this result has important implications. Agents with a future high income for retirement are more likely to be informed even though, compared to other agents, the need to postpone retirement to get a better pension is reduced. Hence, the introduction of the bonus seems to affect more prepared agents. This result echoes previous findings by El Mekkaoui de Freitas and Legendre (2015) showing that, after receiving the retirement statement, best prepared (and wealthiest) agents are more likely to integrate the information and to put it into action.

Concerning occupation before retirement, non-active civil servants are better informed and have a smaller probability to retire with a bonus, compared with employees of the private sector. On the contrary, self-employed workers are less informed and do not retire differently. This can be interpreted as a difference in available information about pension rules between the

different job sectors. This intuition is confirmed by the significance of the contribution to more than one pension fund, impacting positively only the knowledge of the bonus.

Results also suggest the presence of a gender effect. Women have a higher probability to be informed about the bonus but do not behave differently compared to men. This is not at odds with previous analyses which found that women retire later than men (Magnac, Rapoport and Roger, 2006). Indeed, Benallah (2011) emphasizes that, due to a non-linear career or a later first participation in the labour force, women reach the bonus conditions (the insurance duration) later than men. Likewise, the results also show some signs of spouses coordinated decision: individuals who have another income source in their household are more likely to retire without a bonus. But this last effect is significant at 5% in only one specification (column 3).

Finally, the difference in incentives to delay retirement for individuals who are eligible for early retirement (because of a long career) is verified by the significant negative effect of the eligibility on the probability to retire with a bonus. Likewise, the potential bias caused by individuals who do not delay retirement because they do not have access to the bonus (impossibility to reach the eligibility conditions) is controlled by the significant negative impact of the age of first contribution in the second equation.

V. Conclusion

This paper analyses the impact of time inconsistency in the decision to delay retirement to get a bonus, using data from the French 'motivations de départ en retraite' survey (DREES, 2014). According to the literature on behavioural economics, hyperbolic discounting (a higher discounted rate in the short-term) can lead to reversal preferences, depending on the time of the decision. This discounting structure has for consequences that an agent can initially choose an optimal action and does not stick to it as this action gets closer. In retirement timing context, theoretical models that incorporate hyperbolic discounting give contradictory predictions. On the one hand, due to the overweighting of utility from consumption, hyperbolic discounters accumulate a suboptimal level of savings during their working period and have to delay retirement to be able to support themselves when they have stopped working. On the other hand, due to the overweighting of utility from leisure, these same agents retire earlier than planned.

In empirical analyses, the (β, δ) quasi-hyperbolic discounting function (Laibson, 1997) is often used to measure this discounting structure. Hence, two impatience synthetic ordinal scores are constructed to capture short-term and long-term impatience based on questions about

motivations to retire (Arrondel and Masson, 2014). In addition, to account for the potential simultaneity of finding out information about pension rules and making the decision to retire, a recursive bivariate probit model (Heckman, 1978) is estimated.

The results show a significant negative impact of both short-term and long-term impatience scores on the probability of retiring with a bonus. Time-inconsistent agents are less likely to delay retirement to get the bonus, compared to time-consistent agents. This finding provides another explanation of the relatively limited impact of financial incentives policies, because of non-strategic decision-making based on impulsivity. Another important highlight of the econometric results is the endogeneity of the bonus knowledge and its positive impact on the probability of delaying retirement. This finding is in line with previous articles showing that a significant proportion of agents are not informed about pension rules and that the effect of financial incentives aiming to postpone retirements is principally led by informed individuals (Chan and Stevens, 2008). However, further analysis, using richer data, could control for private savings, or job status before retirement, and confirm these findings and limit the impact of unobserved heterogeneity.

Finally, these behavioural patterns have several implications. As time inconsistency is relevant to explain claiming benefits behaviours, retirement is not always a strategic financial decision. This highlights the importance of taking into account heterogeneous non-rational preferences in designing an optimal financial incentives public policy, together with measuring potential deadweight effects. Furthermore, inspired by previous research in behavioural economics and *nudging* (Benartzi and Thaler, 2007; Thaler and Sunstein, 2008), the frame of pension rules information (or, for example, the personalized statement sent to individuals who are close to retirement) can be improved to limit the impact of nonstandard preferences like loss aversion or time inconsistency.

References

Ameriks, J., Caplin, A., Leahy, J., Tyler, T., 2007. 'Measuring self-control problems.' *The American Economic Review* 97(3): 966-972. DOI: 10.1257/aer.97.3.966

Arrondel, L., Masson, A., 2014. 'Mesurer les préférences des épargnants : comment et pourquoi (en temps de crise) ?' *Economie et Statistique* 467-468 : 5-49. DOI: https://doi.org/10.3406/estat.2014.10244

Behaghel, L., Blau, D. M., 2012. 'Framing social security reform: behavioral responses to changes in the full retirement age.' *American Economic Journal: Economic Policy* 4 (4): 41-67. DOI: 10.1257/pol.4.4.41

Belloni, M., 2008. 'The option value model in the retirement literature: the trade-off between computational complexity and predictive validity.' Working Paper 6, ENEPRI Research report n. 50, European Network of Economic Policy Research Institutes, April. Available at SSRN: https://ssrn.com/abstract=2027853

Benallah, S., 2011. 'Comportements de départ en retraite et réforme de 2003. Les effets de la surcote.' *Economie et statistique* 441-442 : 79-99. DOI : 10.3406/estat.2011.9614

Benartzi, S., Thaler, R. H., 2007. 'Heuristics and biases in retirement savings behavior.' *Journal of Economic Perspectives* 21(3): 81-104. DOI: 10.1257/jep.21.3.81

Bozio, A., 2011. 'La réforme des retraites de 1993 : l'impact de l'augmentation de la durée d'assurance.' *Economie et statistique* 441-442 : 39-53. DOI: 10.3406/estat.2011.9612

Chan, S., Stevens, A. H., 2008. 'What you don't know can't help you: pension knowledge and retirement decision-making.' *The Review of Economics and Statistics* 90(2): 253-266, may. DOI: https://doi.org/10.1162/rest.90.2.253

Chiburis, R. C., Das, J., Lokshin, M., 2011. 'A practical comparison of the bivariate probit and linear iv estimators.' Policy Research Working Paper 5601, The World Bank, March.

Chiburis, R. C., Das, J., Lokshin, M., 2012. 'A practical comparison of the bivariate probit and linear IV estimators.' *Economics Letters* 117: 762-766. DOI: https://doi.org/10.1016/j.econlet.2012.08.037

COR (Conseil d'Orientation des Retraites), 2011. 'Prolongation d'activité, liberté de choix et neutralité actuarielle : décote, surcote et cumul emploi retraite.' Réunion du Conseil du 26 janvier 2011. Conseil d'Orientation des Retraites. Available at: http://www.cor-retraites.fr/article384.html.

COR, 2015. 'Les conditions de liquidation, l'âge de liquidation d'une pension, la surcote et la décote. Les comportements et les âges de départ à la retraite (2),' séance plénière du 27 Mai. Conseil d'Orientation des Retraites. Available at: http://www.cor-retraites.fr/IMG/pdf/doc-2784.pdf

Cronbach, L. J., Shavelson, R. J., 2004. 'My current thoughts on coefficient alpha and successor procedures.' *Educational and Psychological Measurement* 64(3): 391-418. DOI: 10.1177/0013164404266386

DellaVigna, S., Paserman, M. D., 2005. 'Job search and impatience.' *Journal of Labor Economics* 23(3): 527-588. DOI: https://doi.org/10.1086/430286

DellaVigna, S., 2009. 'Psychology and economics: evidence from the field.' *Journal of Economic Literature* 47(2): 315-372. DOI: 10.1257/jel.47.2.315

Diamond, P., Köszegi, B., 2003. 'Quasi-hyperbolic discounting and retirement.' *Journal of Public Economics* 87: 1839-1872. DOI: https://doi.org/10.1016/S0047-2727(02)00041-5

DREES (Direction de la recherche, des études, de l'évaluation et des statistiques), 2014. 'Enquête sur les motivations de départ à la retraite' – Ministère de la Santé [producteur], ADISP-CMH [diffuseur]. http://drees.solidarites-sante.gouv.fr/etudes-et-statistiques/open-data/retraites/article/l-enquete-motivations-de-depart-a-la-retraite.

DREES, 2015. 'Retraites : le recul de l'âge minimal a peu d'effet sur les motivations de départ.' *Etudes et Résultats* n°902, Direction de la Recherche, des Etudes, de l'Evaluation et des Statistiques, janvier. Available at: http://drees.solidarites-sante.gouv.fr/IMG/pdf/er902.pdf

DREES, 2017. 'Les retraités et les retraites.' Panoramas de la Drees, Direction de la Recherche, des Etudes, de l'Evaluation et des Statistiques. Available at: http://drees.solidarites-sante.gouv.fr/IMG/pdf/retraites-2017.pdf

El Mekkaoui de Freitas, N., Legendre, B., 2015. 'Pension information and retirement planning in France. An evaluation of public policy.' Netspar Discussion Paper No. DP 11/2015-072. DOI: http://dx.doi.org/10.2139/ssrn.2744582

Engels, B., Geyer, J., Haan, P., 2017. 'Pension incentives and early retirement.' *Labour Economics* 47: 216-231.DOI: https://doi.org/10.1016/j.labeco.2017.05.006

Findley, T. S., Caliendo, F. N., 2015. 'Time inconsistency and retirement choice.' *Economics Letters* 129: 4-8. DOI: https://doi.org/10.1016/j.econlet.2015.01.027

Frederick, S., Loewenstein, G., O'Donoghue, T., 2002. 'Time discounting and time preference: A critical review.' *The Journal of Economic Literature* 40(2): 351-401. DOI: 10.1257/002205102320161311

Greene, W. H., 2011. Econometric analysis. 7th edition, chapter 17: 745-759.

Gustman, L. A., Steinmeier, L. T., 2000. 'Retirement in dual-career families: a structural model.' *Journal of Labor Economics* 18(3): 503-545. DOI: https://doi.org/10.1086/209968

Heckman, J. J.,1978. 'Dummy endogenous variables in a simultaneous equation system.' *Econometrica*, 46(4): 931-959. DOI: 10.2307/1909757

Huffman, D., Maurer, R., Mitchell, O. S., 2017. 'Time discounting and economic decision-making in the older population.' *The Journal of the Economics of Ageing*. DOI: https://doi.org/10.1016/j.jeoa.2017.05.001

Knoll, M. A., 2011. 'Behavioral and psychological aspects of the retirement decision.' *Social Security Bulletin* 71(4): 15-32, November.

Laibson, D., 1997. 'Golden eggs and hyperbolic discounting.' *The Quarterly Journal of Economics* 112 (2): 443-478. DOI: https://doi.org/10.1162/003355397555253

Legendre, B., Pedrant, A., Sabatier, M., 2018. 'Should I stay or should I go? An econometric analysis of retirement decisions by couples.' *Applied Economics*, forthcoming. DOI: 10.1080/00036846.2018.1488067

Lusardi, A., Mitchell, O. S., 2014. 'The economic importance of financial literacy: theory and evidence.' *Journal of Economic Literature* 52(1): 5-44.DOI: 10.1257/jel.52.1.5

López-Novella, M. 2012. 'Analysing the impact of eligibility and financial measures aiming at delaying early retirement in Belgium: a "difference-in-differences" approach using panel data.' Working Paper 14-12, Federal Planning Bureau. Available at: https://ideas.repec.org/p/fpb/wpaper/1214.html

Maddala, G. S., 1983. Limited dependent and qualitative variables in econometrics. Cambridge: Cambridge University Press.

Magnac, T., Rapoport, B., Roger, M., 2006. 'Fins de carrière et départs à la retraite : l'apport des modèles de durée. Perspectives et comportements en matière de retraite,' *Dossiers solidarité et santé* 3, DREES: 101-117.

Mastrobuoni, G., 2009. 'Labor supply effects of the recent social security benefit cuts: empirical estimates using cohort discontinuities.' *Journal of Public Economics* 93: 1224-1233. DOI: https://doi.org/10.1016/j.jpubeco.2009.07.009

Mastrobuoni, G., 2011. 'The role of information for retirement behavior: evidence based on the stepwise introduction of the Social Security Statement.' *Journal of Public Economics* 95: 913-925. DOI: https://doi.org/10.1016/j.jpubeco.2011.01.003

Merkle, C., Schreiber, P., Weber, M., 2017a. 'Framing and retirement age: the gap between willingness-to-accept and willingness-to-pay.' *Economic Policy* 32(92): 757-809. DOI: https://doi.org/10.1093/epolic/eix014

Merkle, C., Schreiber, P., Weber, M., 2017b. 'Inconsistent retirement timing.' *Working Paper*, Available at SSRN: https://ssrn.com/abstract=2778578, December.

Murphy, A., 2007. 'Score tests of normality in bivariate probit models.' *Economics Letters* 95(3): 374-379. DOI: https://doi.org/10.1016/j.econlet.2006.11.010

O'Donoghue, T., Rabin, M., 1999. 'Doing it now or later.' *The American Economic Review* 89(1): 103-124.DOI: 10.1257/aer.89.1.103

Paserman, M. D., 2008. 'Job search and hyperbolic discounting: structural estimation and policy evaluation.' *The Economic Journal* 118(531): 1418-1452. DOI: 10.1111/j.1468-0297.2008.02175.x

Pinger, P. R., 2017. 'Predicting experimental choice behavior and life outcomes from a survey measure of present bias.' *Economics Bulletin* 37(3): 2162-2172.

Staubli, S., Zweimüller, J., 2013. 'Does rising the early retirement age increase employment of older workers?' *Journal of Public Economics* 108: 17-32. DOI: https://doi.org/10.1016/j.jpubeco.2013.09.003

Stock, J. H., Wise, D. A., 1990. 'Pensions, the option value of work, and retirement.' *Econometrica* 58(5): 1151-1180, September. DOI: 10.2307/2938304

Thaler, R. H., 1981. ‘Some empirical evidence on dynamic inconsistency.’ *Economics Letters* 8(3): 201-207. DOI: https://doi.org/10.1016/0165-1765(81)90067-7

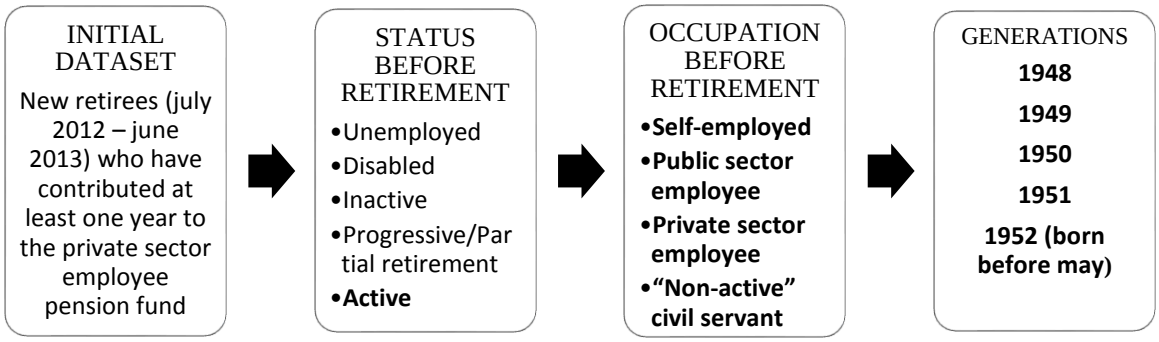
Thaler, R. H., Sunstein, C. R., 2008. Nudge: improving decisions about health, wealth, and happiness. New Haven, CT: Yale University Press.

Trizano-Hermosilla, I., Alvarado, J. M., 2016. ‘Best alternatives to cronbach’s alpha reliability in realistic conditions: congeneric and asymmetrical measurements.’ *Frontiers in Psychology* 7(769). DOI: 10.3389/fpsyg.2016.00769

Zhang, L., 2013. ‘Saving and retirement behavior under quasi-hyperbolic discounting.’ *Journal of Economics* 109(1): 57-71. DOI: https://doi.org/10.1007/s00712-012-0302-8

Appendices

Figure 1. The final sample



Individuals in the final sample are in bold.

Table 1. Summary statistics.

	All	Retire with bonus
Retire with a penalty (%)	10.85	-
with full benefits (%)	43.02	-
with bonus (%)	46.12	-
Gender (Female=1) (%)	50.48	47.48
Insurance duration (quarters)	170.23	176.82
Retirement age	62.05	62.52
Occupation before retirement (%)		
private sector employee	62.69	68.07
public sector employee	6.20	6.30
non-active civil servant	22.29	18.49
self employed	8.82	7.14
Contribution to more than one pension fund (%)	41.67	41.18
Obs	1032	-

Table 2. Items for short-term and long-term impatience scores.

		Item-rest correlation
Short-Term Impatience		
1	"You decided to retire because you had reached the Early Retirement Age (ERA)."	0.1319
2	"You decided to retire because you were not satisfied with working conditions in your job."	0.3046
3	"You decided to retire because no job adaptation was offered (working hours adjustment, redeployment, etc.)."	0.3600
4	"You decided to retire that year because of the lack of information on earlier/later retirement possibilities."	0.2717
5	"You decided to retire due to tiredness caused by commuting."	0.2465
GLB.fa = 0.59 $CI_{0.95}$(0.4897 ; 0.6613)*		
Long-Term Impatience		
1	"You decided to retire because you wanted to enjoy retirement as long as possible."	0.3217
2	"You decided to retire because you had not evolution or training possibilities in your job."	0.2092
3	"You decided to retire because you had other personal projects (association engagement, art projects, etc.)."	0.1776
4	"You decided to retire because your pension was higher than your previous income sources (wages or social benefits just before retirement)."	0.1361
5	"You decided to retire because your future pension was sufficient."	0.2568
6	"You decided to retire because of the weariness about work."	0.2844
GLB.fa = 0.67 $CI_{0.95}$(0.5734 ; 0.7155)*		

*Confidence intervals estimated by bootstrap.

Correlation between the two scores = 0.3698

Table 3. Probability to retire "as soon as possible"

Average Annual Salary (ref: less than 12500)	
12500 to 25000 euros	-0.202
	(0.121)*
More than 25000 euros	-0.418
	(0.134)***
Preferences	
Short-term impatience	0.222
	(0.049)***
Long-term impatience	0.199
	(0.046)***
Small risk aversion (ref: Medium risk aversion)	-0.098
	(0.116)
High risk aversion	-0.041
	(0.105)
Occupation before retirement (ref: private sector employee)	
Non-active civil servant	0.068
	(0.126)
Employee of the public sector	-0.051
	(0.176)
Self-employed worker	0.450
	(0.165)***
Contribution to more than one fund	-0.173
	(0.092)*
Full-time job	-0.103
	(0.119)
More than one income source	0.108
	(0.088)
Woman	-0.012
	(0.090)
Health status (ref: very good health)	
Good health	-0.017
	(0.163)
Poor health	-0.089
	(0.156)
Very poor health	0.041
	(0.142)
Constant	0.415
	(0.178)**
N	1002
Log-likelihood	-644.839
LR-test (16)	93.31

* p<0.1; ** p<0.05; *** p<0.01; (.) robust standard errors

Table 4. Statistics about information and retirement with bonus

	Knowledge of the bonus			Retire with bonus		
	0	1	Student test (S), Wilcoxon-Mann-Whitney test (Z), Pearson chi-squared test (P)	0	1	Student test (S), Wilcoxon-Mann-Whitney test (Z), Pearson chi-squared test (P)
Short-term impatience	0.0750	-0.1006	S = 2.7999***	0.1569	-0.1833	S = 5.5261***
Long-term impatience	-0.0066	0.0088	S = -0.2437	0.1301	-0.1519	S = 4.5587***
Risk aversion (score between -2 and 4)	1.0321	0.9184	Z = 0.960	1.0665	0.8866	Z = 1.988**
Health status (score between 1 and 4)	3.34	3.61	Z = -3.744***	3.32	3.61	Z = -4.633***
Average Annual Salary	19568.72	23129.15	S = -5.8977***	19657.33	22763.85	S = -5.1656***
Gender (woman=1)	53.98%	45.80%	P = 6.7458***	53.06%	47.48%	P = 3.1926*
Another source of income in the household	66.33%	67.57%	P = 0.1768	69.60%	63.66%	P = 4.0959**
Knowledge of the actual insurance duration	26.73%	38.78%	P = 16.8613***	33.09%	30.46%	P = 0.8176
Knowledge of the reference insurance duration	35.53%	56.24%	P = 43.8519***	42.27%	46.85%	P = 2.1817
Age of the first contribution	17.84	18.36	S = -3.3091***	17.99	18.14	S = -0.9800
Participation in the labour force index	0.8837	0.9502	S = -7.4737***	0.8894	0.9387	S = -5.5091***
Knowledge of the bonus				33.99%	52.94%	P = 37.6252***

Interpretation: Among agents who are aware of the bonus, the average short-term impatience is -0.1006 and 67.57% have another source of income in their household.

* p<0.1; ** p<0.05; *** p<0.01

Table 5. Econometric Results

Knowledge of the bonus	Probit (1)	Two-step Probit (2)	Recursive bivariate probit (3)
Average Annual Salary (ref: less than 12500)			
12500 to 25000 euros		-0.017	-0.048
		(0.124)	(0.123)
More than 25000 euros		0.418	0.398
		(0.141)***	(0.141)***
Occupation before retirement (ref: private sector employee)			
Non-active civil servant		0.312	0.286
		(0.127)**	(0.131)**
Employee of the public sector		0.189	0.213
		(0.180)	(0.178)
Self-employed worker		-0.417	-0.441
		(0.172)**	(0.170)***
Full-time job		-0.028	-0.029
		(0.122)	(0.121)
Contribution to more than one fund		0.182	0.186
		(0.093)*	(0.093)**
Woman		0.218	0.196
		(0.098)**	(0.098)**
Instruments			
Participation to the labour force index		1.810	1.991
		(0.411)***	(0.414)***
Knowledge of actual insurance duration		0.103	-0.009
		(0.098)	(0.087)
Knowledge of reference insurance duration		0.411	0.328
		(0.091)***	(0.098)***
Health status (ref: very good health)			
Good health		0.142	0.123
		(0.163)	(0.166)
Poor health		-0.201	-0.173
		(0.162)	(0.151)
Very poor health		-0.456	-0.532
		(0.148)***	(0.147)***
First contribution age		0.032	0.034
		(0.017)*	(0.017)**

Constant		-2.997	-3.086
		(0.485)***	(0.502)***
Retire with bonus			
Average Annual Salary (ref: less than 12500)			
12500 to 25000 euros	0.384	0.362	0.292
	(0.123)***	(0.123)***	(0.120)**
More than 25000 euros	0.263	0.094	-0.092
	(0.139)*	(0.166)	(0.165)
Preferences			
Short-term impatience	-0.159	-0.160	-0.121
	(0.049)***	(0.049)***	(0.041)***
Long-term impatience	-0.124	-0.130	-0.109
	(0.046)***	(0.046)***	(0.042)***
Small risk aversion	0.047	0.086	0.058
	(0.119)	(0.118)	(0.095)
High risk aversion	-0.024	-0.016	-0.005
	(0.105)	(0.104)	(0.083)
Occupation before retirement (ref: private sector employee)			
Non-active civil servant	-0.230	-0.307	-0.350
	(0.131)*	(0.138)**	(0.128)***
Employee of the public sector	-0.076	-0.108	-0.131
	(0.170)	(0.171)	(0.156)
Self-employed worker	-0.340	-0.248	-0.103
	(0.164)**	(0.169)	(0.166)
Full-time job	0.385	0.382	0.299
	(0.120)***	(0.120)***	(0.115)***
Woman	-0.005	0.001	0.008
	(0.088)	(0.088)	(0.080)
Contribution to more than one fund	0.080	0.030	-0.037
	(0.092)	(0.096)	(0.090)
More than one income source	-0.164	-0.156	-0.140
	(0.089)*	(0.088)*	(0.070)**
Health status (ref: very good health)			
Good health	-0.375	-0.402	-0.368
	(0.168)**	(0.167)**	(0.160)**
Poor health	-0.077	-0.016	0.026
	(0.156)	(0.161)	(0.134)

Very poor health	-0.271	-0.155	-0.039
	(0.148)*	(0.158)	(0.148)
Knowledge of the bonus	0.429		1.584
	(0.085)***		(0.198)***
Predicted knowledge of the bonus		1.108	
		(0.390)***	
First contribution age	-0.035	-0.047	-0.045
	(0.019)*	(0.020)**	(0.018)**
Eligible for early retirement	-0.412	-0.426	-0.325
	(0.109)***	(0.108)***	(0.096)***
Constant	0.106	0.114	0.034
	(0.385)	(0.383)	(0.351)
N	1032	1032	1032
Log-likelihood	-643.09	-651.50	-1,265.75
Rho			-0.82
Wald test (rho=0)			4.61
p-value Wald test (rho=0)			0.0316
Murphy's statistic			12.36
p-value Murphy Test			0.1939

* p<0.1; ** p<0.05; *** p<0.01; (.) robust standard errors

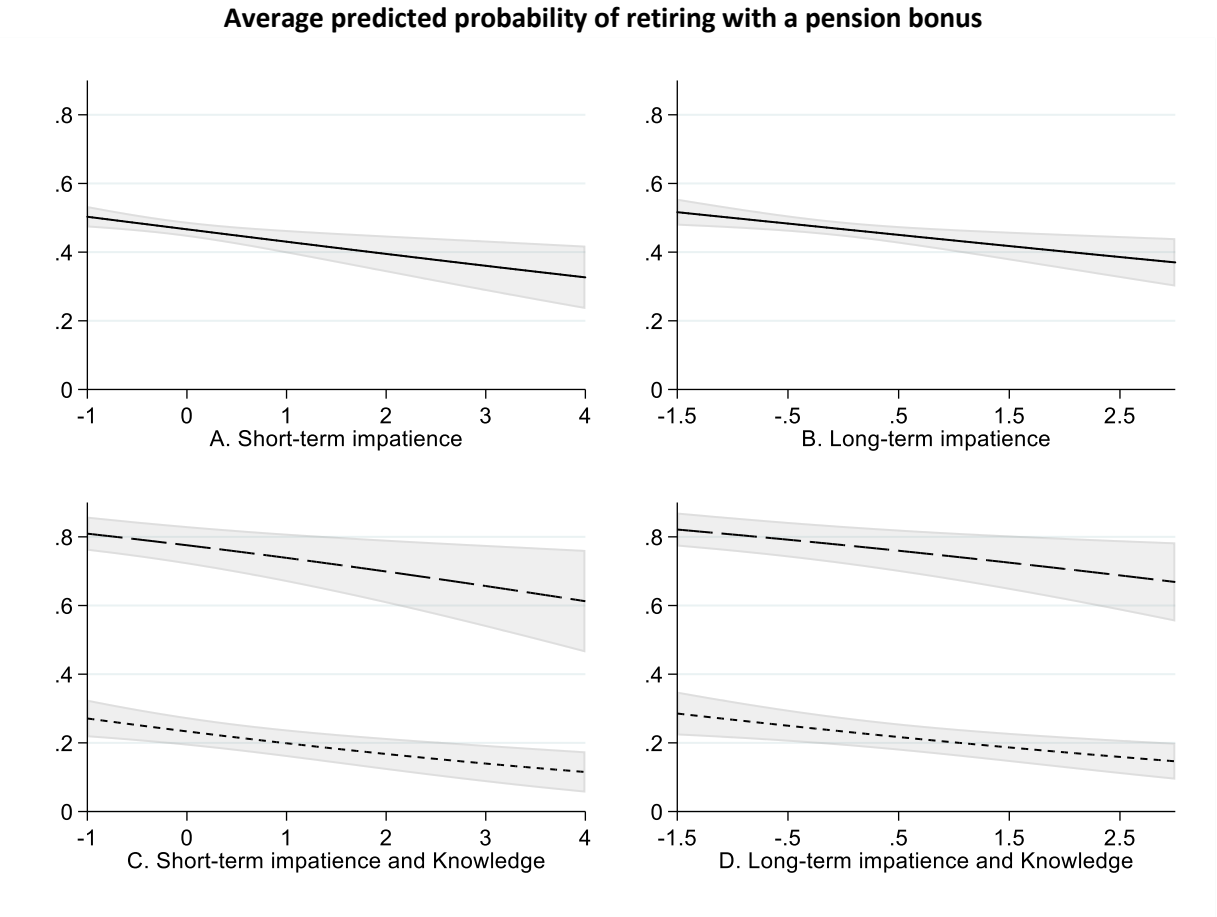


Figure 2. The effects of short-term and long-term impatience on retirement with bonus decision. All other things being equal, the solid curve is the average predicted probability of retiring with bonus. The long-dashed curve is the average predicted probability for informed agents. The short-dashed curve is the average predicted probability for uninformed agents. For each curve, the gray area is the 95% confidence interval. **Interpretation (graphic C)**: if all individuals in the sample were informed and had a short-term impatience score of -1 (the most patient), the average probability of retiring with bonus would be close to 80%.