Behavioral Responses to a Policy Treatment of Information about Future Pension Benefits*  

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Abstract  
We evaluate a public policy that provides information to households about future pension benefits, wherein the policy is designed to encourage households to save and/or earn more for retirement. Using regression discontinuity designs and quantile regressions, we find that the treatment might create inequities in behavioral responses between households who process information and households who do not. Specifically, we find that the arrival of pension information encourages wealthy households to increase their retirement savings, while it does not affect the behavior of households with less wealth. To interpret these findings that behavioral responses are asymmetric across the wealth distribution, we construct a life-cycle model with time-inconsistent dynamic optimization in which households have short planning horizons. This model generates predictions that are consistent with our empirical findings, namely that wealthy households (longer planning horizons) are more salient in their behavioral responses to the arrival of information about future pension benefits.  

Key words: pension statements, saving for retirement, short planning horizons, time-inconsistent preferences, financial literacy, quantile regressions; treatment effects.  
JEL Classification: C31, C61, D14, D15, D91, H55.  

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1 Introduction

Information is a key determinant in voting processes. Puviani (1897) elaborated especially the concept of “rational ignorance”, referring to the voter’s lack of information. Then, voters are not encouraged to base their vote on accurate information. According to Martinelli (2006), production information by the media, the interests groups, and other sources, still contribute that elections serve the interest of the majority, provided that individuals make efforts to collect and process costly information.

However reforms are often faced with public controversy due to a general lack of awareness and understanding of the economic context. Some articles have focused on the role of information in the acceptance of reforms, especially pension reforms (Boeri and Tabellini, 2012). Boeri et al. (2001, 2002) arrive to the conclusion that information shapes policy preferences on pension reforms. They show a positive correlation between the support to reforms privatizing partly pension systems and correct information about the net costs for social security. In the United States, more informed individuals are more likely to accept reforms (Blinder and Krueger, 2004). Boeri and Tabellini (2012), by investigating the possible joint determination of policy preferences and information acquisition, arrive also to the conclusion that information “increases political support for pension reform”. However, supporting pension reforms does not mean necessarily reacting adequately to implemented policies. Support or acceptance of reforms cannot guarantee the effectiveness of the public policy.

We study empirically the impact of information as a way to influence individual behaviors and then to impact the public policy efficiency on a representative sample of French citizens. We focus on legal pension information right, implemented to provide households with pension information (pension systems, individual records, pension estimate...).

The case of retirement planning is particularly well suited to our issue. Households have indeed to increase their retirement-related assets to face the consequences of pension reforms and/or increasing longevity (Bloom et al., 2006; De Nardi et al., 2009; El Mekkaoui and Oliveira Martins, 2014). Drastic reforms reinforced rules to obtain a full pension and make it more difficult for individuals to
maintain their standards of living during retirement. In countries where individuals prepare their retirement privately, they have to manage the risk of outliving their accumulated wealth. Improving retirement planning in this context is crucial. Given this necessity, we choose to analyze the impact of information on behaviors. The expected double dividend for policy makers of such a measure is first a better acceptance of reforms (Blinder and Krueger, 2004; Boeri and Tabellini, 2012), and secondly a better awareness of the necessity to save privately to maintain their standards of living after retirement. This latter aim is especially important for households with very low private wealth at their end of the careers.

Our findings are quite alarming for the public policy aiming at informing the most vulnerable households better in order to encourage them to save. This first evaluation of pension information in France suggests that this policy fails to reach the targeted population. First, it will reinforce inequalities between those who already have the highest amounts of wealth and those who are probably the least well-prepared to retirement. Secondly, the results prove that providing information might not be sufficient: offer an adequate institutional framework for pension information is not enough.

This paper contributes to the literature on information and policy efficiency by evaluating a public policy aiming at improving households financial and retirement knowledge. However, unlike in this paper, the previous contributions did not identify the causal effect of information on behaviors. And yet, in the case studied in the present paper, pension information has been implemented in many countries to impact household’s behaviors, more precisely retirement related savings.

The abundant literature on financial literacy shows also how a better understanding of financial mechanisms and environment is crucial to efficiently prepare the retirement, especially in a context of pension reform. Consequently, financial literacy appears to be an essential prerequisite to adapt their private savings in order to manage the risk of outliving their accumulated wealth or to maintain their standard of living. The lack of financial literacy can be interpreted as a manifestation of the agents’ bounded rationality (Simon, 1947; Altman, 2012). Information used to make retirement related decision can also be poor, or the information might be framed in a misleading fashion (Altman, 2012).
Transferring information on public and occupational pensions to households is a way for governments to improve the public understanding (Joo and Grable, 2000; Lusardi, 2008, Van Rooij and al., 2012) as well as to increase support for political reforms. The role of the policy maker is then to improve the information quality to individuals, but also to present it in a non complex manner. The institutional environment can facilitate making a good use of information at hand within an appropriate specific making decision environment (Altman, 2012).

Our objective is to assess the effectiveness of the pension information policy in France and to verify if the pension statement, sent since 2007, contributes that workers are better informed about their benefits, and if it changed their assets accumulation behavior. Better information appears to be a major issue as citizens tend to overestimate their pension benefits and simultaneously to underestimate the costs of public pension systems (Boeri et al.; 2001, 2002).

We examine outcomes after the pension information system has been introduced. Using regression discontinuity designs, combined with quantile regressions, we assess whether the changes in asset holdings are due to the pension information system and then quantify the impact.

We have concluded that the pension statement sent to workers impacts only the wealthiest. Savings for long term investment is impacted by pension information only as concerns highest quartile. The lowest quartile does not have any long term assets, and pension information has no impact on this. When considering financial assets, once again, the pension statement impacts the amounts held by the wealthiest: having received the pension estimate increases this amount by 39 to 46% (depending on econometric specifications) in average among the highest quartile. We find no significant impact for those holding the lowest levels of wealth. This conclusion is in line with part of the existing literature which considers that households’ cognitive resources are limited (Kahneman and Tversky, 2000; Beshears et al., 2008), even if they are well informed. In this case, a personalized assistance to make an effective use of information could be necessary.

The present paper is organized as follows: in section II, we present the literature on financial literacy and retirement-related savings to understand how the existing papers establish the expected link between information and savings behaviors. Section III presents briefly the case studied in this paper: the French pension information system. Section IV and V describe the database used, the
Survey of Health, Ageing and Retirement in Europe, and the methodology. The results are discussed in the sixth section. We conclude in the last session.

2 Information, literacy and expected retirement related savings behavior

The literature on financial literacy has developed very fast over the last decade and contributed to understand why households, in many developed countries, are not economically well prepared to their retirement. Lusardi and Mitchell’s (2011b) explain that part of the workers close to retirement have not even questioned retirement (Lusardi and Mitchell, 2011b), which seems quite alarming. The result is that citizens tend to overestimate their pension benefits (Boeri et al.; 2001, 2002). For these reason, policy maker may intend to encourage workers to increase their retirement related savings.

The theoretical corpus on financial literacy has to be replaced within the pioneer framework explaining why the individual rationality might be bounded, which could prevent individuals to save for their retirement. Only such an extended conceptual framework allows to understand precisely why the role of pension information seems important and why it has been implemented over the past 25 years in Europe and in the United States (Altman, 2012).

Although the homo oeconomicus is supposed to be perfectly rational, Simon (1947) explained very early that this rationality is bounded.

First, individuals’ preferences might be temporal inconsistent because of a strong preference for the present (Strotz, 1956): although households seem to be aware of the necessity to save for retirement, they don’t. They agree that retirement related savings is necessary as they would like to maintain their standard of living after their withdraw from the labor market, but they prefer consume. Akerlof (1991) attributes such a behavior to a lack of imagination: individuals are subject to myopa. According to Laibson (1996), impatience could explain it (Arrondel et al., 2004). This inconsistency appears because present costs are salient in comparison with future costs.
Secondly, complexity in savings choices reveals also the possibly limited rationality of individuals: Beshears and his co-authors (2008) explained biased decisions since people tend to avoid the more complicated choices. Financial literacy traduces the ability to use information and to make appropriate financial decisions, including retirement related savings decisions. Low financially literate individuals do not have this ability and make temporal inconsistent decisions, suffer from cognitive bias, or even do not think about their retirement planning.

Several studies (Lusardi and Mitchell, 2007a, 2007b, 2011a, 2011c and Van Rooij and al., 2012) report the lack of financial literacy and the economic awareness preventing individuals from planning retirement. According to Lusardi and Mitchell (2011c) financially educated individuals are not only more likely to plan their retirement but they also invest more efficiently (Calvert, Campbell, and Sodini, 2006). More educated people have a better propensity to plan, are better able to control their spending and consequently have a more efficient life cycle wealth accumulation (Amelicks et al., 2003). They are able to make long term financial plans and secure their retirement income. In many countries, literature shows that financial literacy is positively and highly correlated with the propensity to plan (Lusardi and Mitchell, 2011b, 2011c; Bucher-Koenen and Lusardi, 2011; Almenberg and Save-Soderbergh, 2011), which ensures that households plan their retirement efficiently.

Conversely, people lacking basic financial literacy or numeracy end up close to retirement with a low assets level (Lusardi and Mitchell, 2007a). Lusardi and Tufano (2009) focus on people with low debt literacy. They show that individuals with lower levels of debt literacy tend to transact in a high-cost manner and accumulate less wealth (Stango and Zinman, 2007).

The conclusion of Lusardi and Mitchell’s (2011b) are quite alarming. According to them, many respondents to the National Financial Capability Survey in the US lack basic knowledge on financial concepts and are exposed to poor financial decisions. Low income earners and less educated people are the most vulnerable.

Von Rooij et al. (2012) show the causal relationship of financial knowledge upon thinking about retirement in the Netherlands and explain that the Dutch propensity to plan for retirement has increased. However, there was little improvement in economic awareness and financial literacy
between 2005 and 2010 despite several policy initiatives to increase financial knowledge. More
generally, financial literacy has had at least a positive impact on the probability to accumulate
retirement related wealth (Fornero and Monticone, 2011; Klapper and Panos, 2011).

In this context, improving financial literacy should be the first concern for policy makers (Gale
and Levine, 2011), and information can be seen as a means. If the lack of financial literacy can be
explained in the Simon theoretical framework of the bounded rationality, public policy has a role to
play to improve the decision making environment. Transferring better quality pension information
and in a non complex fashion will improve the financial decision making. In this context, the public
information (through pension statements sent at home for instance) might otherwise improve the
financial literacy or at least help to plan for retirement and make better investments. Retirement
information could improve consumers’ retirement knowledge and help them to adopt more relevant
behavior (Joo and Grable, 2001). In the US (Mastrobuoni, 2011), the social security statement
improved strongly the knowledge of workers who do not contact the social security administration
(SSA). A recent study conducted by Sass (2015) confirmed that the US social security that provides
estimates of an individual’s benefit adds value to workers by improving their pension knowledge.

Lusardi (2008) insists on the importance to consider effective ways of communication given the
low level of financial education. Targeted programs addressing differences in household preferences,
savings needs as well as financial and economic educational backgrounds could be efficient to improve
retirement planning among different socio-economic groups (Lusardi, Mitchell and Curto, 2009).
Information search is indeed costly for individuals. Financially distressed senior individuals are less
likely to seek pension information. The latter are more vulnerable as they tend to overestimate their
future pensions. According to Kim and Kim (2010), they will face a decrease in their standards of
living. Private pension funding requires long term financial plans and pension information.

From the literature, we may deduce that governmental initiatives on pension information in
many countries are headed in the right direction. By conveying information, they may increase
public understanding, the functioning of private pension systems and foster household retirement
savings. Free, customized information sent home enables the less educated and financially distressed
consumers (as described by Kim and Kim, 2010) to be targeted.
However, Prast, Teppa and Smits (2012) seem quite critical about the effectiveness of measures to deliver pension information in the Netherlands. According to them, this information is not sufficient to encourage individuals to make appropriate choices, and our results seem to be in line with this conclusion. Their conclusion is also in line with Lusardi, Mitchell and Curto’s proposal of targeted programs to improve retirement planning. It might be useful to transfer clear information, but an assistance to interpret it could be necessary if individuals are not able to make an effective use of it. In this context, following the behavioural economics of Kahneman and Tversky (2000), changing the decision environment by providing information might not be enough for enhancing the quality of financial decision making.

Given contradictory conclusions expressed in the literature concerning the impact of information on savings behaviors, we propose to evaluate the impact of the information system, implemented in a European country, France.

3 The French Pension information system

The French law providing information on pensions was introduced with the 2003 pension reform. This law establishes the individual right of individuals to pension information. The law, implemented in August 2003 states: “Each person has the right to obtain, in conditions specified by decree, a statement of their individual situation regarding all the rights that he/she has acquired in legally compulsory pension plans.”

The French GIP-info retraite addresses detailed information on income to those over the age of 35 (see Table 7). For those close to retirement age, this office provides exhaustive information on the individuals’ pension situation at the age of 55. The document, known as the “indicative global estimate” (IGE) (Estimation Indicative Globale, EIG), provides individuals with a detailed estimate of the future pension benefits as well as the earliest date at which they can expect to retire.

1(Article L. 161-17) was implemented on the 23rd of August 2003.  
2The Public Interest Group on the Right to Information (Groupement d’intérêt public droit à l’information), known as the GIP-info retraite, was introduced in 2003, after the "Fillon pension reform". This organization manages all the information and data from the State pension regimes as well as all the mandatory complementary pension organizations. GIP Info Retraite coordinates the information provided by the employers and regimes, as well as the State. From 2014, the GIP Info Retraite became the GIP Union Retraite.
on a full pension rate.

According to the *GIP Info Retraite*, the aim behind providing these statements to all households was to allow them to have the necessary information they may need to make educated decisions concerning their retirement planning.

4 Data and Statistics

We use detailed data from the 4th wave of the Survey of Health, Ageing and Retirement in Europe (SHARE Survey). We focus on French data and use the imputed table to obtain aggregated and imputed wealth variables. This module has the advantage of not being affected by missing data thanks to the imputation procedure implemented in the survey (Christelis, 2011). It is often well known that wealth variables are not very well reported. For this reason, we have used variables from the imputed table to avoid information loss.

We have selected the 4th wave because of the year in which the data was gathered. The transitory period of pension information program implementation ended in 2010. Up to 2011, the implementation of the pension information system was progressive. With the 2011 data, the year of birth 1955 constitutes a threshold in receiving the pension statement: individuals born between 1948 and 1955, still in activity, have received their pension statement. Conversely, people born after 1955 still have not received it.

We need to ascertain that individuals were still in activity when they were supposed to receive their pension statement. We know from French legislation that the cohort 1949 received their estimates in 2007, cohorts 1950 and 1951 in 2008, cohorts 1952 and 1953 in 2009 and cohorts 1954 and 1955 in 2010. As the survey provides the retirement year, we have excluded those who declared being retired at the dates above.

We have selected two variables of interest. The first one is the per capita household savings for long-term investment, which includes amounts on individual retirement accounts, contractual saving and life insurance.\(^3\) The second one is the per capita household gross financial assets, i.e. the

\(^3\) Although the variable is denoted “savings for long term investment” in the survey, we have considered stock variable. This variable indicates assets held over long-term horizons.
sum of the bank accounts, bond, stock and mutual funds, plus the savings for long term investment.

Tables 1 & 2 provide descriptive statistics for both variables of interest. First, we note that individuals in the lowest quartile of the wealth distribution do not hold any savings for long term investments. For 612 observations, this variable is equal to 0. As it is frequent with wealth variables, the median is far lower than the average value for both variables, indicating that some households hold very high wealth levels.

953 observations of our sample received pension estimate, while 792 did not. Savings for long term investment is 59% higher for informed cohorts, while their total financial assets are almost 50% higher (see Table 3). These figures are obviously strongly correlated with age, which has to be controlled through a further relevant econometric analysis, developed in the next section.

5 Methodology

5.1 Estimation Procedure

We have estimated the causal effect of the pension information program on the savings behavior of individuals within households of which one member at least is aged 50 or older. The progressive implementation of the program creates a discontinuity at the age of 56 in 2011. In this year, only cohorts from 1949 to 1955 had received the estimate of their pension. In 2011, being 56 or older implies having been recipient of an information mail, so being exposed to the treatment of pension information. This situation is consequently an application of the regression discontinuity design (Hahn et al., 2001; Imbens and Lemieux, 2008; Lee and Lemieux, 2010). More precisely the example of a sharp regression discontinuity (RD) method has to be considered.

Our aim is to compare observations just below and just above the threshold age of 56 to determine if pension information has already had an impact on holding behaviors in 2011. To have enough observations in the study sample requires including individuals in the age bracket 52-60 in 2011. The treatment group consequently includes individuals born between 1951 and 1955. Individuals born from 1956 to 1959 constitute the control group.
The RD method exploits a discontinuity in the treatment assignment to identify a treatment effect. In our case, the known discontinuity is due to quasi experimental situation implied by the progressive implementation of the economic policy. In the sharp RD design, the treatment assignment depends on a deterministic way on a variable $Z$ with a known discontinuity at point $Z_0$. The assignment of individuals to the treatment “pension estimate mail” is totally age dependent. All people born between 1949 and 1955 are treated, while those born after 1955 are not. Consequently, two important key assumptions are met: the treatment assignment cannot be manipulated by the individual, and spill-over effects of the treatment are not possible.

Let denote $p_i$ the indicator for assignment to the pension information, the rule is then:

$$p_i = \begin{cases} 1, & \text{if } Z_i \leq Z_0 = 1955 \\ 0, & \text{otherwise} \end{cases}$$ (1)

With $Z_i$ the birth year of individual $i$ and $Z_0$ the threshold, fixed at 1955.\(^4\)

This empirical approach exploits the discontinuity in available information at age 56 in 2011. We are interesting in observing if the pension estimate mail reception impacts significantly different wealth variables denoted $Y$. We have analyzed both the savings for long term investment, and the gross financial assets held (in log).

Let $Y_1$ represent the potential outcome if the individual receives the treatment (i.e., the pension information mail) and $Y_0$ the potential outcome in case if she/he does not receive it. The objective is to estimate the average treatment effect at the threshold $Z_0$. This average treatment effect (ATE) can be expressed as $ATE = E[Y_1 - Y_0 \mid Z = Z_0]$.

When the support of $Z$ is continuous, non-parametric and semi-parametric procedures for estimate are appropriate (Hahn et al., 2001; Porter, 2003). However, when the support of $Z$ is discrete, taking $J$ distinct values, Lee and Card (2008) show that parametric methods should be preferred.

\(^4\)To be precise, in 2011 individuals born in 1956 were recipient of their pension estimate mail. However, amounts reported are those of 2010.
Identification of the ATE can be achieved by estimating the following regression function:

\[ E[Y \mid Z = z_j] = \beta_0 p_j + h(z_j) \]  

(2)

Where \( h(\cdot) \) is a continuous function capturing the cohort effect on the outcome variable, \( p_j = 1[z_j \geq 0] \). The assignment variable \( Z \), here the birth year, is normalized so that the discontinuity point is represented by \( z_j = 0 \). As consequence, \( z_j = (1955 - \text{birth year}) \). The link between the birth year, the age and the assignment variable is summarized in Table 4.

The key identification assumption is the continuity of \( h(\cdot) \). With the specification (3), and under this assumption, the treatment effect \( \beta_0 \) is obtained by estimating the discontinuity in the empirical regression at the point where treatment switches from 0 to 1, in our case at age 56, when their birth year is 1955. Introducing covariates \((X)\), equation (2) can be also expressed as:

\[ Y_{ij} = \beta_0 p_j + h(z_j) + \delta X_i + \epsilon_{ij} \]  

(3)

In (3), \( Y_{ij} \) is the wealth variable for the \( i \)-th individual, born in year \( j \) (i.e., the \( j \)-th value of the assignment variable \( Z \)). The hypothesis is that \( h(\cdot) \) is smooth implies that, controlling other characteristics, the reception of the pension information mail (i.e., the treatment) is the only source of discontinuity in the wealth variable at age 56. It is common practice to regress \( Y_{ij} \) on \( h(\cdot) \) assuming it is a low order polynomial function. If the polynomial function assumed is correct, conventional least squares inference is appropriate (Lee and Card, 2008). Three different forms are assumed for \( h(\cdot) \), a linear form, a spline linear, and a quadratic function.

After proposing a classic ordinary least square estimate for the equation (3), given the distribution of our data, we propose quantile regressions (Koenker and Bassett, 1978) to obtain a full characterization of the conditional distribution of the dependent variable. Table 1 shows indeed that a great proportion of the sample does save for the long term. We can deduce from these statistics that distribution effects are particularly important with wealth variables. Following the abundant literature on financial literacy, we may fear that only part of the population is able to receive, un-
derstand and use pension information. For these reasons, we propose estimate the treatment effect for the following quantiles: the 25th percentile, the median and the 75th percentile.

Then, to assess the robustness of our estimates, two subsamples are created to target cohorts closer in age. The first subsample, denoted discontinuity sample 1 (DS1) includes cohorts from 1952 to 1958. Cohorts from 1956 to 1958 constitute the control group. The second subsample, denoted DS2, includes cohorts 1953 to 1957. Once again those born in 1956 and 1957 are the control cohorts. This process could enable the comparison of individuals with probably even more similar accumulation behaviors, however selecting those cohorts, we also exclude observations and restrain the size of our sample. The discontinuity sample 1 includes 1302 observations while the discontinuity sample 2 includes only 951 observations.

5.2 Variables

To investigate the impact of pension information on different wealth variables, we have included control variables such as educational attainment for the individual and his/her partner (years of education and partner’s years of education), household composition (marital status and the number of children within the household), and per capita household disposable income. Dummy variables indicate whether the respondent is self-employed, retired and homeowner. An additional dummy enables capturing health effects if the individual has declared being limited in his/her daily activities.

We do not include any age variables as the function $h(\cdot)$ does. Different forms for $h(\cdot)$ being assumed, we capture a possibly non-linear effect of age on wealth. As suggested in von Rooij et al. (2012), a polynomial for the logarithm of per capita disposable household income with a linear, quadratic and cubic term is included, allowing capturing potential non-linear effect of income on wealth accumulation.

Finally, we introduce an inheritance variable. Inherited wealth is indeed a source of inequalities in the long run (Piketty and Zucman, 2004). In France, individuals inherit on average at the age of 52, precisely within the range of ages that we study. The binary variable of inheritance reports if the household ever received an inheritance of 5000 euros or more. Inherited wealth might be
correlated with social and economic background of each family. For this reason, we also introduce a crossed variable of inheritance and income to control for the risk of multicollinearity.

### 5.3 Graphical Analysis

In case of discreteness of the assignment variable, Lee and Lemieux (2010), first, recommend, to simply compute and graph the mean of the outcome variable for each value of this discrete assignment variable. Figure 1 proposes a first approach of the discontinuity analysis and summarizes the mean per capita household wealth held, by values of the assignment variable $z_j$. A negative value of $z_j$ indicates that individuals did not receive their pension estimate letter. Conversely, if $z_j \geq 0$, individuals were “treated”.

The vertical red line represents the discontinuity, the point where the treatment switches from 0 to 1. It seems difficult to draw conclusions only with a graphical analysis. However, we can note that mean values of financial assets and savings for long term investments held seem to grow with age (i.e., with $z_j$), with a possible visual jump at point $z_j = 0$.

In addition, RD designs require all other covariates being continuous at the point of discontinuity. Figures 2 and 3 report the mean variables according to age (more precisely according to the assignment variable). We see that those variables seem fairly continuous within the age range that we are interested in. The graphical analysis let us confident about the relevance of the chosen methodology.

### 6 Results

Treatment effects for the total sample are reported in Tables 5 and 6.\textsuperscript{5} In those tables, column 1 provides the average treatment effect on the total sample. The following columns give respectively the treatment effect on the median and the 75th percentile.\textsuperscript{6} Results are reported by functional form assumed for $h(\cdot)$.

\textsuperscript{5}See tables 8 and 9 for the complete results of the estimates.
\textsuperscript{6}We do not include the results for the 25th percentile as they are not significant.
We have not detected any impact of pension estimate transmission on mean savings for long term investment nor mean financial assets held. However, quantile regressions reveal a differentiated impact of pension information according to the situation of respondents in the wealth distribution. While there is no impact on lowest percentiles, the wealth stock of the richest seems to be affected. The impact is much stronger on wealth held for long term investment. Having received a pension statement has a significant impact on the 75th percentile: we can denote an impact coefficient between 0.62 and 0.69 according to different functional forms of $h(\cdot)$ (see Table 5). The impact captured with the use of discontinuity sample is stronger (see Table 7), showing that we do not capture only an age effect after age control. An effect on median individuals’ long term wealth is even detected when using the discontinuity samples. Once again, estimating financial wealth with OLS and a regression discontinuity does not provide any significant impact, whatever the form assumed for $h(\cdot)$ (see Table 6). However, taking account of a possibly differentiated impact by percentile shows that the wealthiest behavior is affected by the reception of pension information.

A robust impact on financial wealth is detected for the 75th percentile. We can note an elasticity comprised between 0.39 and 0.46 depending on the form of $h(\cdot)$ for the highest quartile of the distribution.

Part of the population reacts to pension information provided by increasing private savings. As the impact is stronger for long-term savings, we can suppose that some of them adjust their wealth level with appropriate assets for the retirement planning as a priority. Having an increasing retirement horizon also implies more long-term uncertainty. However our results also show that only those already having the highest levels of wealth seem to be impacted. This latter population is also the most aware of the long term issues and challenges for the pension system. The significant impact of the education variable, capturing financial literacy in our regressions, confirms that knowledge is key variable, determining the long term wealth accumulated (Americks et al., 2003; Lusardi and Mitchell, 2011b, 2011c; Bucher-Koenen and Lusardi, 2011; Almenberg and Save-Soderbergh, 2011; Arrondel et al., 2013).

The indicative global estimate mail impact on savings being the largest for the wealthiest households, it might lead to higher inequalities. Such a policy encourages the richest households to
accumulate more for the retirement, but absolutely not the lowest percentiles of the population. In other words, the pension information does not seem to motivate those who are the most in need to adapt their decrease of their public pension. Thus, information does not allow public policy efficiency. The policy fails to achieve its main purpose. Many reasons can explain this result simultaneously:

- Households with the lowest wealth levels are not able to increase their savings, even if they have clear information on their accumulated rights.

- At the same time, those who are at the bottom of the wealth distribution, are also those who can pretend in France to a high replacement rate: as a consequence, they can be not surprised by the pension evaluation received, and consequently can choose not to change their accumulation behavior.

- They might not have a sufficient level of financial literacy and do not make an effective use of information received. In this case, increasing the efficiency of this policy system requires a fundamental prerequisite: increasing the capacity of the population to make an effective use of the information provided. Currently those who have already high level of wealth seem to be able to translate the information provided into a financial decision.

7 Theoretical Model

In this section, we construct a model of time-inconsistent dynamic optimization over the life cycle, as a result of having short planning horizons. The model delivers predictions consistent with the empirical findings presented above. Namely, our model is able to account for the idea that the arrival of pension information is more salient for individuals who have higher incomes or wealth holdings. Based on the evidence that the level of education and financial literacy is positively correlated with the planning horizon length (Lusardi and Mitchell 2007a, 2008, 2009, 2011c), we only need assume

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7In this tradition, see Findley and Caliendo (2009) and Caliendo and Findley (2013).
that wealth is positively correlated with the level of education (which is a well-documented fact), for our model to deliver predictions consistent with our empirical findings above.\footnote{For instance, Lusardi and Mitchell (2007a) document that the accumulated retirement savings of Baby Boomers is positively correlated with their degree of financial literacy and sophistication. The relationship between financial literacy and the degree of planning ahead for retirement survives even after controlling for many key demographic factors, and the impact of the planning horizon on retirement savings also persists after controlling for many of the standards determinants of household saving. For similar findings, see Lusardi (1999, 2002, 2003), Ameriks, Caplin, and Leahy (2003), and van Rooij, Lusardi, and Alessie (2011, 2012) among many others.}

We now present the details of our theoretical model. Age in continuous and indexed by $t$. The representative individual starts work at age $t = 0$, retires at age $t = T$, and passes away with certainty at time $t = T$. The individual receives a gross wage-income flow $w(t) = w\ell(t)$ for $t \in [0, T]$ where $w$ is the market wage and $\ell(t)$ is the longitudinal age-efficiency profile. We model $\ell(t)$ as a fourth order polynomial to capture the increasing hump-shaped pattern wages over the lifecycle, although are results are qualitatively similar when we use other specifications.

We assume that the labor efficiency profile has the following form

$$\ell(t) = \ell_{\text{max}} \exp \left(-\mu(\sigma t - 1)^2\right), \mu \in \mathbb{R}^+, \sigma \in \mathbb{R}^+, \text{ for } t \in [0, T],$$

(4)

which is a continuously differentiable, quasi-normal function. We calibrate $\ell(t)$ to match the salient properties of the life-cycle income profile from Gourinchas and Parker (2002). Note that

$$\sigma^{-1} = \arg \max \{\ell(t)\}. \tag{5}$$

Hence, to match the fact that income peaks at age 50 in Gourinchas and Parker’s sample (which is $t = 25$ in our model since $t = 0$ corresponds to age 25) we set $\sigma = 1/25$. The ratio of peak income to initial income is about 1.4 in Gourinchas and Parker’s sample. We therefore set $\frac{\ell_{\text{max}}}{\ell(0)} = 1.4$, and then we use this information to pin down $\mu$

$$\mu = \ln \left[\frac{\ell_{\text{max}}}{\ell(0)}\right] = 34\%. \tag{6}$$

We normalize $\ell(0) = 1$, which implies $\ell_{\text{max}} = \exp(\mu) = 1.4$. 

For instance, Lusardi and Mitchell (2007a) document that the accumulated retirement savings of Baby Boomers is positively correlated with their degree of financial literacy and sophistication. The relationship between financial literacy and the degree of planning ahead for retirement survives even after controlling for many key demographic factors, and the impact of the planning horizon on retirement savings also persists after controlling for many of the standards determinants of household saving. For similar findings, see Lusardi (1999, 2002, 2003), Ameriks, Caplin, and Leahy (2003), and van Rooij, Lusardi, and Alessie (2011, 2012) among many others.
The individual pays social security taxes at rate \( \theta \) during the working span of the life cycle. The individual receives pay-as-you-go social security benefits \( b = \int_0^T \theta w(t) dt / (\bar{T} - T) \) for \( t \in [T, \bar{T}] \), but before retirement takes places the individual misestimates the amount of social security benefits that he will actually receive. Consumption at each instant in time, \( c(t) \), is the individual’s control variable.

The individual has two different types of saving assets: one is the illiquid public pension account managed by the government on the individual’s behalf; the other asset is liquid, \( k(t) \), and it is managed directly by the short-sighted individual. The liquid asset earns the real market rate of interest, \( r \). We assume that any disposal income (net of payroll taxation) that is not consumed will flow into \( k(t) \) with boundary conditions \( k(0) = 0 \) and \( k(\bar{T}) = 0 \).

The length of the agent’s planning horizon, \( h \), is less than or equal to the length of the retirement period (i.e., the restriction \( h \leq \bar{T} - T \) is imposed for convenience). This restriction is employed to improve the tractability of the model.

The life span of the short-horizon agent is partitioned into four distinct phases:

- **Phase 1**: the agent is working and is not aware of retirement, \( t \in [0, T - h] \)
- **Phase 2**: the agent is working and is aware of retirement, \( t \in [T - h, T] \)
- **Phase 3**: the agent is retired and is not aware of death, \( t \in [T, \bar{T} - h] \)
- **Phase 4**: the agent is retired and aware of death, \( t \in [\bar{T} - h, \bar{T}] \)

The agent’s saving and consumption problem can be solved for each phase, using the appropriate boundary conditions and laws of motion for the private savings asset (capital) \( k(t) \). Each phase is described below.

### 7.1 Phase 1

At any instant \( t_0 \in [0, T - h] \), the individual solves the following control problem

\[
\max_{t_0} \int_{t_0}^{t_0+h} \exp[-\rho(t - t_0)]u[c(t)] \, dt, \tag{7}
\]
subject to

\[
\frac{dk(t)}{dt} = rk(t) + y(t) - c(t), \text{ for } t \in [t_0, t_0 + h],
\]

(8)

\[
k(t_0) = \int_0^{t_0} [y(v) - c_1(v; v)] \exp[r(t_0 - v)] dv,
\]

(9)

\[k(t_0 + h) = 0,
\]

(10)

where \( y(t) \equiv (1 - \theta)w(t) = (1 - \theta)w(t) \) is the disposable income flow, where \( u[c(t)] \) is the instantaneous utility function with the properties \( u_c[c(t)] > 0 \) and \( u_{cc}[c(t)] < 0 \), and where \( v \) is a dummy variable of integration. Note that numerical subscripts (e.g., 1, 2, 3, and 4) on decision variables are used to denote actual behavior during the respective phase of the life cycle. As denoted by (9), the initial condition on this interior control problem reflects the fact that the current state is the result of all of his actual past consumption/saving decisions on the interval \([0, t_0]\).\(^9\)

The dynamic optimization problem given by (7)–(10) can be solved via the Maximum Principle for one-stage optimal control problems with a fixed-endpoint condition. The maximum condition and costate equation will together yield

\[
\exp[-\rho(t - t_0)]u_c[c(t)] = \lambda(t_0) \exp[r(t_0 - t)],
\]

(11)

given a continuously differentiable costate variable \( \lambda(t) \), where \( \lambda(t_0) \) is a constant of integration. Given the properties of the instantaneous utility function, the marginal utility of consumption, \( u_c[c(t)] \), is a one-to-one mapping from consumption. Therefore, \( u_c[c(t)] \) has an inverse \( u_c^{-1}[c(t)] \), and the planned consumption path is

\[
\hat{c}_1(t; t_0) = u_c^{-1} \left[ \lambda(t_0) \exp[(\rho - r)t + (r - \rho)t_0] \right], \text{ for } t \in [t_0, t_0 + h],
\]

(12)

from the perspective of any planning instant \( t_0 \in [0, T - h] \). Combining (12) with (8)–(10) yields

\(^9\)The modeling of impulsive behavior, meaning the divergence between intentions and actual behavior, requires that individuals naively fail to account for their own time inconsistency. See O’Donoghue and Rabin (1999b, 1999c, 2000, 2003), Caillaud and Jullien (2000), Prelec (2004), Beshears, Choi, Laibson, and Madrian (2008), D’Orlando and Sanfilippo (2010), and Herweg and Müller (2011) for more on this idea.
the intended asset path

$$\dot{k}_1(t) = k(t_0) \exp[r(t-t_0)] + \int_{t_0}^{t} (y(v) - u_c^{-1} [\lambda(t_0) \exp[(\rho - r)v + (r - \rho)t_0]]) \exp[r(t-v)]dv, \text{ for } t \in [t_0, t_0+h],$$

(13)

from the perspective of any $t_0 \in [0, T-h]$. Evaluating (13) at $t = t_0 + h$ and then equating it to zero yields

$$k(t_0) \exp[-rt_0] + \int_{t_0}^{t_0+h} y(v) \exp[-rv]dv = \int_{t_0}^{t_0+h} u_c^{-1} [\lambda(t_0) \exp[(\rho - r)v + (r - \rho)t_0]] \exp[-rv]dv$$

(14)

which definitizes $\lambda(t_0)$ in (12) if an explicit functional form is selected for $u[c(t)]$.

$\hat{c}_1(t; t_0)$, as given by (12) in which $\lambda(t_0)$ is identified in principle, is the consumption program that the individual perceives to be optimal and intends to follow for all $t \in [t_0, t_0+h]$ while standing from the perspective of $t_0 \in [0, T-h]$. Yet, a defining feature of the model is that the individual is allowed to reoptimize as time advances, given that new information is taken into account at the individual’s planning horizon slides forward as time advances. Therefore, the actual consumption of the individual at the planning moment $t_0$ is denoted as $\hat{c}_1(t_0; t_0)$, which is the result of evaluating $t = t_0$ in (12). Yet, it should be mentioned again that $t_0$ represents any arbitrary planning point in time on the interval $[0, T-h]$. This suggests that the actual consumption of the individual for all $t \in [0, T-h]$ can be found by replacing all $t_0$ in (12) with $t$. With the subscript “1” used to denote actual variables from Phase 1, this gives

$$c_1(t; t) = u_c^{-1} [\lambda(t)], \text{ for } t \in [0, T-h],$$

(15)

which is the result of setting $t_0 = t$ in (12) given $\lambda(t)$ which solves (14) with $t_0 = t$,

$$k(t) \exp[-rt] + \int_{t}^{t+h} y(v) \exp[-rv]dv = \int_{t}^{t+h} u_c^{-1} [\lambda(t) \exp[(\rho - r)v + (r - \rho)t]] \exp[-rv]dv$$

(16)

It is important to recognize that (15) identifies the individual’s actual consumption at each and every age $t \in [0, T-h]$. But it is also important to also recognize that this expression is in fact an
implicit function of the actual savings asset at time $t$, which in turn is a function of the time path of actual consumption on the interval $[0, t]$ via

$$
\frac{d k_1(t)}{dt} = r k(t) + y(t) - c_1(t; t). \quad (17)
$$

Therefore, to completely identify the actual consumption of the representative individual at each and every age $t \in [0, T-h]$, the system of equations needs to be solved: (15) given (16), along with (17) given $k(0) = 0$. Solving this system of equations characterizes the actual consumption and saving behavior of the individual. Further progress requires an explicit form for $u[c(t)]$.

### 7.2 Phase 2

At any instant $t_0 \in [T-h, T]$ the individual solves

$$
\max \int_{t_0}^{t_0+h} \exp[-\rho(t - t_0)] u[c(t)] \, dt, \quad (18)
$$

subject to

$$
\frac{d k(t)}{dt} = r k(t) + y(t) - c(t) \quad \text{for } t \in [t_0, T] \quad (19)
$$

$$
\frac{d k(t)}{dt} = r k(t) + \hat{b} - c(t) \quad \text{for } t \in [T, t_0 + h] \quad (20)
$$

$$
k(t_0) = \int_0^{T-h} [y(v) - c_1(v; v)] \exp[r(t_0 - v)] dv + \int_0^{t_0} [y(v) - c_2(v; v)] \exp[r(t_0 - v)] dv, \quad (21)
$$

$$
k(t_0 + h) = 0, \quad (22)
$$

where $v$ is a dummy variable of integration.

Using the Maximum Principle for two-stage optimal control problems with a fixed-endpoint condition, the maximum condition, costate equations, and switchpoint condition will together yield

$$
\exp[-\rho(t - t_0)] u[c(t)] = \lambda(t_0) \exp[r(t_0 - t)], \quad (23)
$$

given a continuously differentiable costate variable $\lambda(t)$, where $\lambda(t_0)$ is again a constant of integra-
tion. With \( u_c^{-1}[c(t)] \) again denoting the inverse of marginal utility, the planned consumption path is

\[
\hat{c}_2(t; t_0) = u_c^{-1}[\lambda(t_0) \exp((\rho - r)t + (r - \rho)t_0)], \quad \text{for } t \in [t_0, t_0 + h],
\] (24)

from the perspective of any planning instant \( t_0 \in [T - h, T] \). Combining (24) with (19)–(22) yields the intended asset path

\[
k(t) = k(t_0) \exp[r(t - t_0)] + \int_{t_0}^{t} (y(v) - u_c^{-1}[\lambda(t_0) \exp((\rho - r)v + (r - \rho)t_0)]) \exp[r(t - v)]dv, \quad \text{for } t \in [t_0, T],
\] (25)

\[
k(t) = \int_{t_0 + h}^{t} \left( \hat{b} - u_c^{-1}[\lambda(t_0) \exp((\rho - r)v + (r - \rho)t_0)] \right) \exp[r(t - v)]dv, \quad \text{for } t \in [T, t_0 + h],
\] (26)

from the perspective of any \( t_0 \in [T - h, T] \). Evaluating (25) and (26) at \( t = T \) and then equating yields

\[
k(t_0) \exp[-rt_0] + \int_{t_0}^{T} y(v) \exp[-rv]dv + \int_{T}^{t_0 + h} \hat{b} \exp[-rv]dv = \int_{t_0}^{t_0 + h} u_c^{-1}[\lambda(t_0) \exp((\rho - r)v + (r - \rho)t_0)] \exp[-rv]dv
\] (27)

which definitizes \( \lambda(t_0) \) in (24) if an explicit functional form is selected for \( u[c(t)] \).

\( \hat{c}_2(t; t_0) \), as given by (24) in which \( \lambda(t_0) \) is identified in principle, is the consumption program that the individual perceives to be optimal and intends to follow for all \( t \in [t_0, t_0 + h] \) while standing from the perspective of \( t_0 \in [T - h, T] \). Yet, remember that the individual is free to reoptimize as the short planning horizon advances with time. Therefore, actual consumption during Phase 2 is

\[
c_2(t; t) = u_c^{-1}[\lambda(t)], \quad \text{for } t \in [T - h, T],
\] (28)

---

\(^{10}\) See Tomiyama (1985) and Caliendo and Pande (2005) for more on the technical details of two-stage optimal control problems.
which is the result of setting $t_0 = t$ in (24) given $\lambda(t)$ which solves (27) with $t_0 = t$,

\[
\begin{align*}
    k(t) \exp[-rt] + \int_t^T y(v) \exp[-rv] dv + \int_T^{t+h} \hat{b} \exp[-rv] dv = \int_t^{t+h} u_c^{-1} [\lambda(t_0) \exp[(\rho - r)v + (r - \rho)t_0]] \exp[-rv] dv
\end{align*}
\] (29)

Recognize that (28) identifies the individual’s actual consumption at each and every age $t \in [T - h, T]$. But it is also important to also recognize that this expression is in fact an implicit function of the actual savings asset at time $t$, which in turn is a function of the time path of actual consumption via

\[
\frac{dk_2(t)}{dt} = rk(t) + y(t) - c_2(t; t).
\] (30)

Therefore, to completely identify the actual consumption of the representative individual at each and every age $t \in [T - h, T]$, the system of equations needs to be solved: (28) given (29), along with (30) given the liquid asset balance $k(T - h)$. Solving this system of equations characterizes the actual consumption and saving behavior of the individual. Further progress requires an explicit form for $u[c(t)]$.

### 7.3 Phase 3

At any instant $t_0 \in [T, T - h]$, the individual solves the following control problem

\[
\max \int_{t_0}^{t_0+h} \exp[-\rho(t - t_0)]u[c(t)] \ dt,
\] (31)

subject to

\[
\frac{dk(t)}{dt} = rk(t) + b - c(t), \text{ for } t \in [t_0, t_0 + h] ,
\] (32)
\[ k(t_0) = \int_0^{T-h} [y(v) - c_1(v; v)] \exp[r(t_0 - v)] dv + \int_{T-h}^T [y(v) - c_2(v; v)] \exp[r(t_0 - v)] dv \]
\[ + \int_T^{t_0} [b - c_3(v; v)] \exp[r(t_0 - v)] dv, \quad (33) \]

\[ k(t_0 + h) = 0, \quad (34) \]

where \( v \) is a dummy variable of integration.

The planned consumption path is

\[ \hat{c}_3(t; t_0) = u_c^{-1}[\lambda(t_0) \exp[(\rho - r)t + (r - \rho)t_0]], \quad \text{for } t \in [t_0, t_0 + h], \quad (35) \]

from the perspective of any planning instant \( t_0 \in [T, \bar{T} - h] \). Combining (35) with (32)–(34) yields the intended asset path

\[ \hat{k}_3(t) = k(t_0) \exp[r(t-t_0)] + \int_{t_0}^t (b - u_c^{-1}[\lambda(t_0) \exp[(\rho - r)v + (r - \rho)t_0]]) \exp[r(t-v)] dv, \quad \text{for } t \in [t_0, t_0 + h], \quad (36) \]

from the perspective of any \( t_0 \in [T, \bar{T} - h] \). Evaluating (36) at \( t = t_0 + h \) and then equating it to zero yields

\[ k(t_0) \exp[-rt_0] + \int_{t_0}^{t_0 + h} b \exp[-rv] dv = \int_{t_0}^{t_0 + h} u_c^{-1}[\lambda(t_0) \exp[(\rho - r)v + (r - \rho)t_0]] \exp[-rv] dv \quad (37) \]

which definitizes \( \lambda(t_0) \) in (35) given an explicit form for \( u[c(t)] \).

\( \hat{c}_3(t; t_0) \), as given by (35) in which \( \lambda(t_0) \) has been definitized in principle, is the consumption program that the individual perceives to be optimal and intends to follow for all \( t \in [t_0, t_0 + h] \) while standing from the perspective of \( t_0 \in [T, \bar{T} - h] \). The actual consumption of the individual is

\[ c_3(t; t) = u_c^{-1}[\lambda(t)], \quad \text{for } t \in [T, \bar{T} - h], \quad (38) \]
which is the result of setting $t_0 = t$ in (35) given $\lambda(t)$ which solves (37) with $t_0 = t$,

$$k(t)\exp[-rt] + \int_{t}^{t+h} b \exp[-rv] dv = \int_{t}^{t+h} u_c^{-1}[\lambda(t) \exp[(\rho - r)v + (r - \rho)t]] \exp[-rv] dv$$  

(39)

With $\lambda(t)$ definitized, (38) is an implicit function of the actual savings asset at time $t$, which in turn is a function of the time path of actual consumption via

$$\frac{dk_3(t)}{dt} = rk(t) + b - c_3(t; t).$$

(40)

Therefore, to completely identify the actual consumption of the representative individual at each and every age $t \in [T, T - h]$, the system of equations needs to be solved: (38) given (39), along with (40) given $k(T)$. Solving this system of equations characterizes the actual consumption and saving behavior of the individual. Further progress requires an explicit form for $u[c(t)]$.

### 7.4 Phase 4

Given our assumption that the endpoint on the planning horizon does not extend beyond the date of death, at $t_0 = T - h$ the individual solves a standard control problem

$$\max \int_{T-h}^{T-h} \exp[-\rho t] u[c(t)] \, dt,$$

subject to

$$\frac{dk(t)}{dt} = rk(t) + b - c(t), \text{ for } t \in [T - h, T],$$

(42)

$$k(T - h) = \int_{0}^{T-h} [y(v) - c_1(v; v)] \exp[r(T - h - v)] dv + \int_{T-h}^{T} [y(v) - c_2(v; v)] \exp[r(T - h - v)] dv$$

$$+ \int_{T}^{T-h} [b - c_3(v; v)] \exp[r(T - h - v)] dv,$$

(43)

$$k(T) = 0,$$

(44)

where $v$ is a dummy variable of integration.
The solution to this problem is the actual consumption path. A straightforward method to obtain the actual consumption path is by setting $t_0 = \bar{T} - h$ in (35). This yields

$$c_4(t) = \hat{c}_3(t; \bar{T} - h) = u_c^{-1} \left[ \lambda(\bar{T} - h) \exp[(\rho - r)t + (r - \rho)(\bar{T} - h)] \right], \text{ for } t \in [\bar{T} - h, \bar{T}],$$  \hspace{1cm} (45)

Combining (45) with (42)–(44) yields the actual asset path

$$k_4(t) = k(\bar{T} - h) \exp[r(t - (\bar{T} - h))] + \int_{\bar{T} - h}^{t} (b - u_c^{-1} \left[ \lambda(\bar{T} - h) \exp[(\rho - r)v + (r - \rho)(\bar{T} - h)] \right]) \exp[r(t - v)]dv, \text{ for } t \in [\bar{T} - h, \bar{T}].$$  \hspace{1cm} (46)

Using the boundary condition $k(\bar{T}) = 0$ with (46) definitizes $\lambda(\bar{T} - h)$. Further progress requires an explicit form for $u[c(t)]$.

\section{8 Numerical Simulation}

\subsection{8.1 Specific Functional Forms}

Given that the solutions to our theoretical model are general enough for any instantaneous utility function with the properties $u_c[c(t)] > 0$ and $u_{cc}[c(t)] < 0$, all that is needed is to specify the form of the function. For the remainder of this paper, we assume that the utility function takes the isoelastic form commonly used in quantitative research on life-cycle consumption and saving,

$$u[c(t)] = \frac{c(t)^{1-\phi} - 1}{1 - \phi}. \hspace{1cm} (47)$$

Therefore, the solutions for consumption and the liquid asset balance for each of the four phases can be solved explicitly and expressed analytically. We now report the solutions for each of the four phases, given the assumption of isoelastic instantaneous utility.
Phase 1

\[ \dot{c}_1(t) = \exp\left[\left(1 - \rho \right) / \phi \right] \left( k(t_0) \exp[-rt_0] + \int_{t_0}^{t_0+h} y(v) \exp[-rv] dv \right) \] (48)

\[ c_1(t) = \exp\left[\left(1 - \rho \right) / \phi \right] \left( k_1(t) \exp[-rt] + \int_{t}^{t+h} y(v) \exp[-rv] dv \right) \] (49)

\[ k_1(t) = \exp \left[ \int_0^t \left( r - \frac{\exp\left[\left(1 - \rho \right) / \phi \right] j}{\int_{j+h}^{j+1} \exp\left[\left(1 - \rho \right) / \phi \right] s ds} \right) dj \right] \times \left( \int_0^t \left[ y(v) - \left( \frac{\exp\left[\left(1 - \rho \right) / \phi \right] \int_{v}^{v+h} y(s) \exp[-rs] ds}{\int_{v+h}^{v+1} \exp\left[\left(1 - \rho \right) / \phi \right] s ds} \right) \right] \right) \times \exp \left[ - \int_0^v \left( r - \frac{\exp\left[\left(1 - \rho \right) / \phi \right] j}{\int_{j+h}^{j+1} \exp\left[\left(1 - \rho \right) / \phi \right] s ds} \right) dj \right] dv \right) \] (50)

Phase 2

\[ \dot{c}_2(t) = \exp\left[\left(1 - \rho \right) / \phi \right] \left( k(t_0) \exp[-rt_0] + \int_{t_0}^{T} \exp[-rv] y(v) dv + \int_{t_0}^{t_0+h} \exp[-rv] \dot{b} dv \right) \] (51)

\[ c_2(t) = \exp\left[\left(1 - \rho \right) / \phi \right] \left( k_2(t) \exp[-rt] + \int_{t}^{T} \exp[-rv] y(v) dv + \int_{t}^{t+h} \exp[-rv] \dot{b} dv \right) \] (52)

\[ k_2(t) = \exp \left[ \int_{T-h}^t \left( r - \frac{\exp\left[\left(1 - \rho \right) / \phi \right] j}{\int_{j+h}^{j+1} \exp\left[\left(1 - \rho \right) / \phi \right] s ds} \right) dj \right] k(T - h) \]

\[ + \left( \int_{T-h}^t \left[ y(v) - \left( \frac{\exp\left[\left(1 - \rho \right) / \phi \right] \int_{v}^{v+h} y(s) \exp[-rs] ds + \int_{v+h}^{v+1} \dot{b} \exp[-rs] ds} \right) \right] \right) \times \exp \left[ - \int_{T-h}^v \left( r - \frac{\exp\left[\left(1 - \rho \right) / \phi \right] j}{\int_{j+h}^{j+1} \exp\left[\left(1 - \rho \right) / \phi \right] s ds} \right) dj \right] dv \right) \times \exp \left[ \int_{T-h}^t \left( r - \frac{\exp\left[\left(1 - \rho \right) / \phi \right] j}{\int_{j+h}^{j+1} \exp\left[\left(1 - \rho \right) / \phi \right] s ds} \right) dj \right] \] (53)
\[ \dot{c}_3(t) = \exp\left(\frac{(r - \rho)/\phi}{t}\right) \left( k(t_0) \exp[-rt_0] + \int_{t_0}^{t_0+h} b \exp[-rv] dv \right) \]

\[ c_3(t) = \exp\left(\frac{(r - \rho)/\phi}{t}\right) \left( k_3(t) \exp[-rt] + \int_{t}^{t+h} b \exp[-rv] dv \right) \]

\[ k_3(t) = \exp \left[ \int_{t}^{T} \left( r - \frac{\exp\left[\frac{(r - \rho)/\phi - r}{j}\right]}{\int_{j}^{j+h} \exp\left[\frac{(r - \rho)/\phi - r}{s}\right] ds} \right) dj \right] \]

\[ \times \left( k(T) + \int_{T}^{t} \left[ b - \frac{\exp\left[\frac{(r - \rho)/\phi v}{j}\right]}{\int_{j}^{j+h} \exp\left[\frac{(r - \rho)/\phi - r}{s}\right] ds} \right] \right) \]

\[ \times \exp \left[ - \int_{T}^{T} \left( r - \frac{\exp\left[\frac{(r - \rho)/\phi - r}{j}\right]}{\int_{j}^{j+h} \exp\left[\frac{(r - \rho)/\phi - r}{s}\right] ds} \right) dv \right] \]

\[ c_4(t) = \exp\left(\frac{(r - \rho)/\phi}{t}\right) \left( k(T - h) \exp[rh] + \int_{T-h}^{T} b \exp[r(T - v)] dv \right) \]

\[ k_4(t) = k(T - h) \exp[r(t - (T - h))] + \int_{T-h}^{t} b \exp[r(t - v)] dv \]

\[ + \int_{T-h}^{T-h} \left( \frac{k(T - h) \exp[rh] + \int_{T-h}^{T-h} b \exp[r(T - s)] ds}{\int_{T-h}^{T} \exp[(r - \rho)/\phi - r)v + ((\rho - r)/\phi)(T - h) + rt} ds \right) \]

\[ \times \exp[(r - \rho)/\phi - r)v + ((\rho - r)/\phi)(T - h) + rt] dv \]

\[ \ldots \]

\[ c_4(t) = \exp\left(\frac{(r - \rho)/\phi}{t}\right) \left( k(T - h) \exp[rh] + \int_{T-h}^{T} b \exp[r(T - v)] dv \right) \]

\[ k_4(t) = k(T - h) \exp[r(t - (T - h))] + \int_{T-h}^{t} b \exp[r(t - v)] dv \]

\[ + \int_{T-h}^{T-h} \left( \frac{k(T - h) \exp[rh] + \int_{T-h}^{T-h} b \exp[r(T - s)] ds}{\int_{T-h}^{T} \exp[(r - \rho)/\phi - r)v + ((\rho - r)/\phi)(T - h) + rt} ds \right) \]

\[ \times \exp[(r - \rho)/\phi - r)v + ((\rho - r)/\phi)(T - h) + rt] dv \]

\[ \ldots \]

\[ \text{Phase 4} \]

\[ \text{Phase 3} \]

8.2 Numerical Simulation

8.2.1 Parameter Values

In this section we report our baseline simulation results from our theoretical model. Unless stated otherwise, we assume the following parameter values in the numerical exercises below. We set \( T = 40 \) and \( \bar{T} = 55 \) in order to represent an individual who starts work at age 25, retires at 65, and passes away at 80. We set the interest rate at \( r = 0.01 \) and we also set the private rate of
time preference to $\rho = 0.01$. Regarding the life-cycle wage profile, we set $\sigma = 1/25$ and $\mu = 0.34$, as denoted above. Given that we have normalized $\ell(0) = 1$, as such $\ell_{\text{max}} = \exp(\mu) = 1.4$ meaning that peak wages are 40 percent higher than starting wages. We set the pension contribution rate to $\theta = 0.22$, which is the OECD average. As a result, the pension benefit received by the individual in the model replaces approximately 57 percent of average wages earned over the course of the simulated life cycle. Regarding preferences, the instantaneous utility function is isoelastic in form, and we assume that the inverse elasticity of intertemporal substitution takes on a value of $\phi = 2$, which only matters for parameterizations when $\rho \neq r$. We perform our simulation of the life cycle at the annual frequency, $dt = 1$. The last two parameters of interest are behavioral parameters: the planning horizon length, $h$, and the parameter which determines the misestimation of pension benefits, where $\psi \in \mathbb{R}$ is the percent deviation from true benefits $\hat{b} = (1 + \psi)b$. We perform sensitivity analysis on these two behavioral parameters.

8.2.2 Numerical Results

See Table 11 and Figures 4-7 as preliminary results.

9 Concluding Remarks

This research contributes to the literature on information and policy efficiency by proposing to evaluate a very precise measure of economic policy: the pension information system. The paper aims at shedding new light on the relationship between a particular aspect of financial awareness—pension information—and savings behaviors. We identify in the present paper the causal effect between information and savings behaviors as the pension information right has been specifically implemented in many countries to encourage households increasing their private retirement related wealth. This issue has attracted very little attention up to now mainly because of the lack of data. For example, Boeri and Tabellini (2012) showed that the impact of pension information on the citizens’ willingness to accept pension reforms. To complement the very scarce academic literature on pension information, we have evaluated the impact of the pension information implementation
on long term savings and financial assets. Focusing on this issue appears necessarily as the policy maker has no reason to believe that its reform, even if information allows the public support to reforms (Boeri and Tabellini, 2012), will be efficient.

Taking advantage of the progressive implementation of the measure, which has created the conditions for a quasi-experimentation, we used a regression discontinuity design, combined with quantile regressions, to evaluate whether changes in wealth are due to the introduction of the pension information and quantify the impact.

We have shown that pension estimate transmission implies an increase in long term assets accumulation and more generally in financial assets holding. Pension information has a significant positive impact on accumulation, but only on the highest part of the wealth distribution. With an elasticity for information between 0.62 and 0.67 for the 75th percentile, the impact is much stronger on long term savings than financial assets. We estimate that the elasticity of financial wealth to pension estimate is comprised between 0.39 and 0.46 for households within the 75th percentile of wealth.

Pension statement reinforces the long term savings of those who already hold the highest levels of wealth. Households with the lowest levels of wealth are not impacted by the policy.

The current measure to convey information to households consequently tends to reinforce inequalities between those who have already saved privately and were also probably the most informed and the most financially educated, as well as the part of the population with the lowest levels of wealth. The latter are the least informed and the least financially educated. The policy fails to reach them. We can also fear that this population, even if it realizes the necessity to increase retirement related wealth, will not be able to do this. Consequently, the pension information system, such as designed in France since the 2003 reform, has had perverse effects. Our result confirms that providing information might not be sufficient to influence behaviors in the direction defined by the policy maker. Making an effective use of information requires probably also a personalized assistance. For this reason, we can conclude that information cannot guarantee the effectiveness of public policy.
References


Table 1 Per capita households savings for long-term investments (in euros)

<table>
<thead>
<tr>
<th>Birth year</th>
<th>N</th>
<th>mean</th>
<th>p25</th>
<th>p50</th>
<th>p75</th>
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<td>1951</td>
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<td>900</td>
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<tr>
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<td>199</td>
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<td>11436</td>
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<td>14218</td>
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<td>1956</td>
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<td>9127</td>
<td>0</td>
<td>418</td>
<td>7721</td>
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<td>194</td>
<td>11290</td>
<td>0</td>
<td>2500</td>
<td>11000</td>
</tr>
<tr>
<td>1958</td>
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<td>10614</td>
<td>0</td>
<td>1167</td>
<td>12070</td>
</tr>
<tr>
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<td>183</td>
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<td>0</td>
<td>1650</td>
<td>13809</td>
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<tr>
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<td>52</td>
<td>11057</td>
<td>0</td>
<td>4078</td>
<td>15336</td>
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</table>

Source: SHARE, 4th wave

Table 2 Per capita Household gross financial assets in 2010 (in euros)

<table>
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<tr>
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<th>p50</th>
<th>p75</th>
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<td>1951</td>
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<td>5955</td>
<td>29366</td>
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<td>178</td>
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<td>11969</td>
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<td>210</td>
<td>33124</td>
<td>1167</td>
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<td>26250</td>
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<td>199</td>
<td>28920</td>
<td>1250</td>
<td>8388</td>
<td>26250</td>
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<td>1955</td>
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<td>28251</td>
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<td>9743</td>
<td>26732</td>
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<tr>
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<td>3683</td>
<td>21957</td>
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<td>22264</td>
<td>1667</td>
<td>8506</td>
<td>24068</td>
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<td>185</td>
<td>20273</td>
<td>667</td>
<td>3381</td>
<td>18333</td>
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<td>183</td>
<td>23742</td>
<td>1058</td>
<td>5000</td>
<td>22500</td>
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<tr>
<td>1960</td>
<td>52</td>
<td>18867</td>
<td>2036</td>
<td>9122</td>
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</table>

Source: SHARE, 4th wave

Table 3 Average assets held by cohorts on both sides of the year threshold (euros)

<table>
<thead>
<tr>
<th>N</th>
<th>Per capita savings for long term investment</th>
<th>Per capita financial assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>Birth&lt;=1955</td>
<td>953</td>
<td>17975</td>
</tr>
<tr>
<td>Birth&gt;1955</td>
<td>792</td>
<td>11276</td>
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### Table 4 Assignment variable

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<th>Age in 2011</th>
<th>Birth year</th>
<th>Treatment</th>
</tr>
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<tbody>
<tr>
<td>4</td>
<td>60</td>
<td>1951</td>
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</tr>
<tr>
<td>3</td>
<td>59</td>
<td>1952</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>58</td>
<td>1953</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>57</td>
<td>1954</td>
<td>1</td>
</tr>
<tr>
<td>0</td>
<td>56</td>
<td>1955</td>
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</tr>
<tr>
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<td>55</td>
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<tr>
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<td>1957</td>
<td>0</td>
</tr>
<tr>
<td>-3</td>
<td>53</td>
<td>1958</td>
<td>0</td>
</tr>
<tr>
<td>-4</td>
<td>52</td>
<td>1959</td>
<td>0</td>
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<tr>
<td>-5</td>
<td>51</td>
<td>1960</td>
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</table>

### Table 5 Treatment impact (β₀) on savings for long term investment (log)

<table>
<thead>
<tr>
<th></th>
<th>OLS</th>
<th>50th</th>
<th>75th</th>
</tr>
</thead>
<tbody>
<tr>
<td>h(.) linear</td>
<td>0.333</td>
<td>0.613</td>
<td>0.620*</td>
</tr>
<tr>
<td>(0.45)</td>
<td>(0.98)</td>
<td>(2.15)</td>
<td></td>
</tr>
<tr>
<td>h(.) spline linear</td>
<td>0.436</td>
<td>0.875</td>
<td>0.686**</td>
</tr>
<tr>
<td>(0.56)</td>
<td>(1.31)</td>
<td>(2.21)</td>
<td></td>
</tr>
<tr>
<td>h(.) quadratic</td>
<td>0.410</td>
<td>0.940</td>
<td>0.628**</td>
</tr>
<tr>
<td>(0.55)</td>
<td>(1.47)</td>
<td>(2.12)</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>1700</td>
<td>1700</td>
<td>1700</td>
</tr>
</tbody>
</table>

### Table 6 Treatment impact (β₀) financial assets (log)

<table>
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<th>75th</th>
</tr>
</thead>
<tbody>
<tr>
<td>h(.) linear</td>
<td>-0.0372</td>
<td>0.245</td>
<td>0.391**</td>
</tr>
<tr>
<td>(-0.12)</td>
<td>(1.32)</td>
<td>(2.11)</td>
<td></td>
</tr>
<tr>
<td>h(.) spline linear</td>
<td>0.031</td>
<td>0.328*</td>
<td>0.465**</td>
</tr>
<tr>
<td>(0.09)</td>
<td>(1.75)</td>
<td>(2.46)</td>
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</tr>
<tr>
<td>h(.) quadratic</td>
<td>0.011</td>
<td>0.280</td>
<td>0.428**</td>
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<tr>
<td>(0.04)</td>
<td>(1.50)</td>
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<tr>
<td>N</td>
<td>1700</td>
<td>1700</td>
<td>1700</td>
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</tbody>
</table>
Table 7 Summary of the information available in the pension statements in France

<table>
<thead>
<tr>
<th><strong>French Earnings record</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>• Letter of introduction to the right to pension information</td>
</tr>
<tr>
<td>• Table summarizing the number of qualifying trimesters acquired from basic state and the number of points acquired for the complementary occupational pension schemes</td>
</tr>
<tr>
<td>• Total number of qualifying trimesters from both State and complementary pension schemes</td>
</tr>
<tr>
<td>• Amount of trimesters needed to attain a full pension in 2008 and the amount of trimesters needed to attain a full pension in 2012.</td>
</tr>
<tr>
<td>• A page detailing the time period, earnings (in points or euros) and qualifying trimesters that each regime the individual may have belonged to. There is also an area on each page the regime may choose to display any additional information</td>
</tr>
<tr>
<td>• The contact information for each of the different regimes.</td>
</tr>
<tr>
<td>• The contact information for rectifying or changing personal contact details</td>
</tr>
<tr>
<td>• Description of the GIP Info Retraite website</td>
</tr>
<tr>
<td>• Insert with a description of the French retirement system</td>
</tr>
</tbody>
</table>
Table 8 Estimates of the savings for long term investment (log)

<table>
<thead>
<tr>
<th></th>
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<th>OLS</th>
<th>OLS</th>
<th>q50</th>
<th>q50</th>
<th>q50</th>
<th>q75</th>
<th>q75</th>
<th>q75</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
</tr>
<tr>
<td>Pension estimation</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>received 0/1</td>
<td>0.333</td>
<td>0.436</td>
<td>0.410</td>
<td>0.613</td>
<td>0.875</td>
<td>0.940</td>
<td>0.620**</td>
<td>0.686**</td>
<td>0.628**</td>
</tr>
<tr>
<td></td>
<td>(0.45)</td>
<td>(0.56)</td>
<td>(0.55)</td>
<td>(0.98)</td>
<td>(1.31)</td>
<td>(1.47)</td>
<td>(2.15)</td>
<td>(2.21)</td>
<td>(2.12)</td>
</tr>
<tr>
<td>Normalized assignment</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>variable z</td>
<td>-0.0927</td>
<td>-0.181</td>
<td>-0.0993</td>
<td>-0.133</td>
<td>-0.268</td>
<td>-0.176</td>
<td>-0.108**</td>
<td>-0.200**</td>
<td>-0.104*</td>
</tr>
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<td>(-0.91)</td>
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<td>(-2.26)</td>
<td>(-1.87)</td>
</tr>
<tr>
<td>Years of education (log)</td>
<td>1.521***</td>
<td>1.528***</td>
<td>1.531***</td>
<td>1.075**</td>
<td>1.107**</td>
<td>1.132**</td>
<td>1.630***</td>
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<td>1.689***</td>
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<tr>
<td></td>
<td>(4.36)</td>
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<td>(2.28)</td>
<td>(2.36)</td>
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<td>(7.32)</td>
<td>(7.63)</td>
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<tr>
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<td></td>
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<td>(1.03)</td>
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<td>(0.24)</td>
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<td>(0.12)</td>
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<td>(-1.32)</td>
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<td>(-2.91)</td>
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<td>Divorced</td>
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<td>(0.40)</td>
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<td>(-0.45)</td>
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<td>0.511</td>
<td>0.519</td>
<td>0.535</td>
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<td>0.463</td>
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<td></td>
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<td>(0.64)</td>
<td>(0.51)</td>
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<td>(0.63)</td>
<td>(0.98)</td>
<td>(0.98)</td>
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<tr>
<td>Number of children</td>
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<td>-0.162*</td>
<td>-0.161*</td>
<td>-0.145</td>
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<td>-0.151</td>
<td>-0.497***</td>
<td>-0.457***</td>
<td>-0.456***</td>
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<tr>
<td></td>
<td>(-1.75)</td>
<td>(-1.72)</td>
<td>(-1.70)</td>
<td>(-1.35)</td>
<td>(-1.40)</td>
<td>(-1.38)</td>
<td>(-10.10)</td>
<td>(-8.89)</td>
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<tr>
<td>Limitation with activities</td>
<td>-0.167</td>
<td>-0.163</td>
<td>-0.159</td>
<td>-0.239</td>
<td>-0.259</td>
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<tr>
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<td>Self Employed</td>
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<td>1.273**</td>
<td>1.252**</td>
<td>0.559</td>
<td>0.578</td>
<td>0.565</td>
<td>0.374*</td>
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<td>0.274</td>
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<tr>
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<td>(2.52)</td>
<td>(2.54)</td>
<td>(2.53)</td>
<td>(1.16)</td>
<td>(1.16)</td>
<td>(1.15)</td>
<td>(1.69)</td>
<td>(1.18)</td>
<td>(1.21)</td>
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<tr>
<td>Retired</td>
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<td>-0.383</td>
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<td>(-0.95)</td>
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<td>Homeowner</td>
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<td>2.858***</td>
<td>2.872***</td>
<td>0.925***</td>
<td>0.901***</td>
<td>0.907***</td>
</tr>
<tr>
<td></td>
<td>(4.01)</td>
<td>(3.99)</td>
<td>(4.01)</td>
<td>(6.79)</td>
<td>(6.78)</td>
<td>(6.90)</td>
<td>(4.91)</td>
<td>(4.58)</td>
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- t statistics are reported in parentheses - (1) h(.) linear, (2) h(.) spline linear, (3) h(.) quadratic
- * p<0.1, ** p<0.05, *** p<0.001
Table 9 Estimates of the financial assets (log)

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<td>-0.0273</td>
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<td>1.143***</td>
<td>1.145***</td>
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<td>1.024***</td>
<td>1.025***</td>
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<td>-0.184***</td>
<td>-0.184***</td>
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<tr>
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* t statistics are reported in parentheses - (1) h(.) linear, (2) h(.) spline linear, (3) h(.) quadratic

* p<0.1, ** p<0.05, *** p<0.001
### Table 10 Treatment impacts with discontinuity samples

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* t statistics are reported in parentheses

* p<0.1, ** p<0.05, *** p<0.001
### Table 11. Assets at Retirement with and without Access to Pension Statement.

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<td>-0.91</td>
<td>-1.70</td>
<td>-2.48</td>
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<tr>
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<td>1.44</td>
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<td>1.44</td>
<td>1.44</td>
<td>1.44</td>
<td>1.44</td>
<td>1.44</td>
</tr>
</tbody>
</table>

Note: The top number is accumulated savings assets at the date of retirement. The bottom number is what savings assets would be at the date of retirement, assuming that access to a pension statement helps the individual to correctly anticipate future pension benefits.
Figure 1. Mean amounts held, by assignment variable Z

<table>
<thead>
<tr>
<th>Normalized assignment variable Z</th>
<th>Savings for long term investment</th>
<th>Financial assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>-6</td>
<td>9.4</td>
<td>9.6</td>
</tr>
<tr>
<td>-4</td>
<td>9.8</td>
<td>9.8</td>
</tr>
<tr>
<td>-2</td>
<td>10.0</td>
<td>10.2</td>
</tr>
<tr>
<td>0</td>
<td>10.4</td>
<td>10.4</td>
</tr>
<tr>
<td>2</td>
<td>10.2</td>
<td>10.2</td>
</tr>
<tr>
<td>4</td>
<td>10.0</td>
<td>10.0</td>
</tr>
</tbody>
</table>
Figure 2. Evolution of covariates according to the assignment variable (1)
Figure 3. Evolution of covariates according to the assignment variable (2)
Figure 4.

Earnings and consumption over the life cycle, $h = 15$ and $\psi = 0.2$.
Figure 5.

Earnings and consumption over the life cycle, $h = 15$ and $\psi = 0$.
Figure 6.

Earnings and consumption over the life cycle, $h = 5$ and $\psi = 0.2$.
Figure 6.

Earnings and consumption over the life cycle, $h = 5$ and $\psi = 0$.