

A Work Project, presented as part of the requirements for the Award of a Master Degree in
Finance from the NOVA – School of Business and Economics

The Role of Guarantees in Pension Plan Design: Pension Saving Decisions

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A Project carried out on the Master in Finance Program, under the supervision of:

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January 8, 2015

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Abstract

This study centers on the assessment of psychological value of guarantees in pension products and the behavior biases associated with choice. When a guarantee on a product increases from 99% to 99,5% less than half of respondents show willingness to pay in contrast with 73% when going from 99,5% to 100%. Out of 105 respondents, 55 show that their choices concerning pension products are inconsistent with classic utility theory. Financial background proves insignificant thus pointing to behavioral biases. As individuals make choices that leave them worse-off, we argue that pension plan design would highly benefit from public policy interventions.

Keywords: Pensions, Uncertainty, Choice, Behavior

Acknowledgements: I would like to thank my family and boyfriend for their unconditional support and constant advice. Furthermore, I would like to thank Professor João Pedro Pereira for his valuable comments and guidance which were essential to the completion of this thesis. Finally, I have to thank my closest friends for their understanding and constant support throughout this challenging phase.

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1. Introduction

The next few years are to be shaped by the increasing concern on the unsustainability of traditional pension plans. As the Baby Boomers' generation enters retirement, the focus turns to the substantial disparity between their previous conditions of living and the one their retirement savings will allow for. The prevailing retirement plan in most countries continues to be the defined benefit plan. Individuals contribute monthly to Social Security or a Government Plan while working and receive monthly sums throughout their retirement. However, such plans are demonstrating severe weaknesses, with lack of funding to pay for increasing retirees. This problem becomes even larger when one considers the ageing of population that is expected to increase even further. As a consequence, individuals are pressured to diversify their retirement savings with complementary funded private pensions. Furthermore, governments are pressured to gradually alter their retirement plan designs leading them towards defined contribution ones. Individuals will then be forced to make their own investment choices and what will result of those will be their retirement income. If individuals wish to maintain their living conditions then complementary private savings will also be of importance. All in all, the focus will turn to individual decision-making.

As a direct consequence, pension plans have become the focus of increased research in the last decades. As the search for the best possible pension insurance product continues, insecurity prevails. Families and individuals are required to deal with a multitude of risks in their older years; however, such risks are not totally covered by existing products. When a given product is able to account for more risks, it becomes more expensive. Individuals must analyze the different risks they face and what their preferences are when choosing a pension savings' product. When decisions are faced, individuals will behave differently from each other.

As economic theory dictates one path, years of analyzing individuals' choices seem to point to a somewhat different path. It is of extreme importance that individuals' behavior biases can be studied further so as to conceptualize the pension products that best fit. Only when we are able to understand different aspects influencing economic agents' behavior will it be possible to construct efficient answers to people's needs.

Rational economic theory uses the concept of utility to describe individuals' behavior when faced with choices. Utility is used as a measure of preference over a certain good or service. It is believed that every person behaves according to a specific utility function individually designed. If that were so, any choice could be described by such a model. However, by conducting simple choice games it is possible to assert that sometimes people's behavior falls

out of expected utility theory. These biases have been studied further and have resulted in a theory known as Prospect Theory, which allows for a behavioral component in classic models, thus capturing situations where people do not behave rationally economically wise.

Considering this occurs in simple choice games, one must understand that such biases may exist in several other areas as well. Combining the importance of the pensions' world today with the notion that individuals do not always behave in the manner economic theory would expect them to, this study intends to find out whether the same happens when people make choices that relate to their pension savings. Realizing this is so should influence public policy concerning pensions to incorporate behavioral aspects into the used economic models.

Several studies have made use of the idea that this influence exists while others have come to prove this idea through surveys or analysis of people's choices. Still, possibilities are numerous. Pension design is a very wide area requiring immediate attention. Although much has been done, there is still a lot of specialized research lacking in order to further quantify behavioral biases and determine how they alter traditional economic models.

Firstly, one intends to study the influence individuals' risk aversion may have on the arising of behavioral biases when making choices. An individual is seen as risk averse if, when faced with two economically equivalent choices, he prefers the one which offers less risk. When one refers to economically equivalent choices it means that both options offer the same expected return and vary only in the risk attached to them. Secondly, it is interesting to assess how much more individuals are willing to pay when the riskier option becomes less risky, that is, when a higher level of guaranteed return is offered. By carrying out such a study it is possible to assess whether pension products should focus more on the guarantees offered or not. Going from a 90% to a 95% probability of receiving a certain amount may not be valued the same as going from a 95% to a 100% probability. Although this is something that has been studied broadly, it is important to turn the focus onto something more specific. Only then can we conclude that the same happens in the context of pensions. This study intends to assess the amount individuals are willing to pay for increased certainty. Even with studies asserting that individuals are willing to pay more for extra guarantees, one does not know the amount. And it may just be that different levels of guarantees relate to different levels of willingness to pay. If one can infer on this subject, then it is possible to create more efficient products in the future, targeting behavior instead of using economic models for pricing.

All this contributes to the construction of a more efficient pension savings product. A last study of interest relates to what is known as the annuity puzzle. An annuity offers a fixed stream of income for life in exchange for a front-payment at the beginning. With life expectancy

increasing, a risk that most people face is the possibility of outliving one's funds. Given the prevalence of risk averse individuals predictions indicate that the demand for annuities should be higher than it actually is.

Behavioral analysis is best perceived through the analysis of experiments/surveys. In daily life agents find a multitude of options from which to choose from. In order to get a better understanding of these small biases, one needs to focus on small options in order to identify where these incongruences originate.

This study is based on a survey conducted to 105 individuals as to their preferences between the options presented. When a choice was offered between two products with the same expected return over 65% of the respondents turned towards the product that gave a certain guarantee instead of the risky one. However, proving risk aversion alone is not something new. What is required at this stage is that previously used economic concepts can be adapted in a pension context, thus allowing for a better understanding of which concepts adapt and which are wrongly used even though they do not entirely adapt. By further analyzing the choices of the respondents, utility theory's failure is observed. Little over half of the respondents demonstrated preferences that directly violate the axioms in expected utility theory. Although we are working with a very small sample, one can use it as an example of the population in general, especially when one considers the diversity in the sample. Although these results are important they seem to be applicable to a broader rather than more specific universe. In the case of this particular study, the focus rests upon the additional amount individuals are willing to pay in order to decrease the uncertainty on the outcome to be received.

Understanding how people value these different levels of certainty is a crucial aspect of developing pension savings' products. Even more, it is of crucial importance to the defining of pension systems. With constant procurement of more efficient pension systems, States will turn to Defined Contribution Plans, where individuals need to rely on their own investments. Instead of being guaranteed a certain lump-sum on retirement, individuals need to conduct investment choices. The performance obtained from such investments will dictate the amount to be received upon retirement. Attached to it is the idea that individuals are in fact capable of making the decision that best serves their interests. However, the survey presented next will show that behavioral biases sometimes cloud individuals' best judgement thus opening doors to decisions that leave the individual worse off. If this is proved to be true then it is fundamental to estimate these biases in the best possible way so as to incorporate them in pension plan design.

This thesis will start by clearly outlining the theory behind the topic, in the Literature Review chapter. Thereafter, the research design will be introduced where the survey method choice will

be explained. In the following chapter results to our research will be presented, followed by a discussion and interpretation of the outcome of the thesis. The Conclusion chapter will outline major contributions, limitations of the study, and introduce possibilities for further research.

2. Literature Review

Expected Utility Theory

This theory dictates that individuals behave according to their own utility function. Agents assert value to payoffs themselves, so that they are free to attribute the value they so desire to all possible results of the choice they make: $EU(X) = \sum_x p(x).u(x)$. The most common specification is $EU = E(r) - \frac{1}{2}A\sigma^2$ where A represents the measure of risk aversion. This brings us to one of the central concepts used in this study. An investor displays risk aversion in case he/she wishes to avoid what is called a “fair gamble”. If A is equal to zero then the investor is said to be risk neutral. The higher the value of A , the higher the degree of risk aversion. Expected return is the same, the only difference is attached to the level of risk in the prospect being offered. We can look at the function for utility by analyzing a “fair gamble”. The investor has an amount Y as certain, and is offered the gamble $(+x, -x, prob(+x), prob(-x))$. One usually looks at the probabilities as being equal, that is, $\frac{1}{2}$ each. Still, and for the purpose of this specific study, other probability values will be used. As long as $Y + (+x) * prob(+x) + (-x) * prob(-x) = Y$, then the investor is offered a fair gamble. What is displayed here is the same as having $E[U(Y)] > E[U(Y + G)] \Rightarrow U(Y) > \frac{1}{2}U(Y + x) + \frac{1}{2}U(Y - x)$, where G represents the gamble. As such, if the individual prefers Y to the fair gamble mentioned, then he/she is risk averse. By computing such a function, one obliges it to be strictly concave. When one’s wealth increases, the utility gained from more wealth diminishes. The numbers arising from a utility function serve the purpose of ranking hypotheses, and have no specific meaning as to their precise magnitude.

Utility theory became the prevailing theory to be used in the economic analysis of decision making under uncertainty and risk. It is proved that, under four main axioms of rational behavior, the individual will act as he is maximizing the expected value of his utility function defined over the final possible outcomes (Von-Neumann and Morgenstern, 1947).

Prospect Theory

Prospect Theory is a theory of choice much like utility theory. However, whereas the latter assigns value to final assets and attaches probabilities to each state, prospect theory assigns value to gains and losses and attributes probability weights rather than real world probabilities

(Kahneman and Tversky, 1979, 1986). By doing so, the value function obtained is concave for gains and convex for losses, as individuals tend to be risk averse when the possibilities offered relate to gains whilst risk seeking when these relate to losses only. Equivalent prospects written in different ways result in different choices which contribute to certainty increasing the aversiveness of losses and the desirability of gains (MacCrimmon and Larsson, 1979).

The element of major interest for the purpose of this thesis concerns what is called the isolation effect: factors that are common to all possibilities are usually discarded from people's thinking process – leading to inconsistent preferences; a number of prospects can be decomposed into common and distinctive components in more than one way, and different decompositions sometimes lead to different preferences. Individuals attain value/utility to changes in their wealth and not their final income position that includes their current wealth.

A concept of much importance is that of Probabilistic Insurance. According to this concept, instead of paying for full protection, one can pay a smaller amount and reduce the probability of an undesirable event without completely eliminating it. In a trial carried out in 1975 (Kahneman and Tversky, 1979), 95 Stanford students were faced with the following problem: they wished to insure property but were indifferent between doing so or not, on consideration of risks and premium that would need to be paid. They are offered a specific product where they only pay half of the regular premium. In case of damage, they have a 50% possibility of paying the remaining premium and being covered for their losses. They have a 50% possibility of getting back the premium paid and covering their losses by themselves. Under such circumstances, 80% of respondents decided they would not purchase probabilistic insurance.

One can directly conclude that reducing the probability from a certain p to $\frac{p}{2}$ is less valuable to individuals than the reduction from $\frac{p}{2}$ to 0. If one uses expected utility theory (with a concave utility function), then probabilistic insurance is considered superior to regular insurance. In the same paper, the mathematical proof is seen as if one is at an asset position w , and is just willing to pay a premium y to insure against a probability p of losing a certain amount x . Then we would conclude that the individual would definitely be willing to pay a smaller premium ry ($0 < r < 1$) to reduce the probability attached with losing that amount x to $(1 - r)p$. In formal terms, when one is indifferent between having $(w - x, p; w, 1 - p)$ and $(w - y)$ then one is expected to prefer $(w - x, (1 - r)p; w - y, rp; w - ry, 1 - p)$ over $(w - y)$.

This aspect is fundamental in understanding the role of guarantees in pension products. Decreasing uncertainty may be wrongly judged when evaluated as the same in all levels of uncertainty. One actually expects that individuals value certainty the most, that is, the 0% level

of uncertainty. If that is so, then switching from 99% to 99,5% certainty is to be valued differently than the change occurring between 99,5% and 100% certainty. If different levels of certainty are valued differently by individuals then this must be incorporated in pension product design and, consequently, in pension plan design.

Thesis Context

The survey conducted here offered choices that required respondents to invest in order to participate. Whereas choices in more common Prospect Theory studies are offered towards wealth that is not the individual's own wealth, the questions presented here will oblige the person to choose between products where they are required to invest. Furthermore, it is based on random gambles and one wishes to acknowledge if they apply to the pension context.

One is both interested in the existence of behavioral biases as well as the possible connection it has with investor risk aversion. The disposition effect (Shefrin and Statman, 1985) relates the risk aversion of an investor with the unwillingness to take on investment losses while deciding upon a premature realization of investment gains. This clear investor aversion to the realization of losses is what stands out the most in individual behavior when making decisions.

Longevity Risk

The Life-Cycle Theory (LCT) tells us that individuals will accumulate assets for retirement that should be sufficient to cover any unexpected wealth declines and to maintain their standard of living. However, one is unaware of how long he will live. The possibility of living longer than expected can become quite expensive. Insurers and pension funds face higher than expected cash-flows, especially when in the form of defined benefit plans or annuity products. On the other hand, pensioners face the possibility of outliving their assets.

When one looks at the old-age dependency rate (analyzing the average across OECD countries) the enormous increase that occurred from 1950 to today is very clear. In 1950, there were 14 individuals aged 65 or more for every 100 working age individuals (20 to 64 years). In 2015, this ratio has doubled to 28%. Projections for 2025 indicate 35 people over 65 for every 100 working age individuals whereas projections for 2075 already point to a ratio of 55% (*OECD Pensions at a Glance 2015*). This clear unsustainability in costs relating to pensions is the reason for reforms in the pension system being made recently. However, these have been regarded as being not enough, and this is where private funded pensions come into scene.

In the period from 2010-2015 on average in the OECD countries, women aged 65 were expected to live for 20 years more while men could expect an additional 17,4 years. However, forecasts for the period between 2060-2065 point towards women being expected to live 25,8 years

longer whilst men an additional 22 years (with the base age considered being 65) (*OECD Pensions at a Glance 2015*).

The Annuitization Puzzle

When one combines the two main issues discussed above, there are specific products which one would expect to be in high demand with annuities being one of these cases. An annuity is a product which requires a lump-sum investment by the retiree guaranteeing him an income stream for life. Although one is obliged to invest a lump-sum amount in the annuity, therefore being impossible to invest it elsewhere, one guarantees not to outlive his own funds. It seems likely that retirees would be keen to acquire annuities in order to safeguard against longevity risk. However, market demand shows the opposite. The annuity puzzle has been studied under multiple perspectives. One can refer to its high costs or the illiquidity of the money invested as causes for the problem. However, the most common problem referred to relates to bequest motives. Even so, these have proven insufficient to fully explain the annuitization puzzle (Davidoff et al., 2005). Many extensions can be made to the rational consumer model for annuity demand; however, it is likely that the answer is partly related to psychological biases that individuals carry with them when deciding on an annuity purchase (Brown, 2007).

For the purpose of this thesis the annuity puzzle will be evaluated from the perspective of one's belief on one's own life expectancy. By controlling for factors such as bequest motives, illiquidity and the possibility of higher returns elsewhere, it will be possible to attach a certain degree of impact arising from an individual's idea on how much more they live.

Pension Plan Design and Behavioral Finance

Thaler and Sunstein (2003) argue that there is a "paternalistic libertarianism": individuals should be able to make their own investment saving decisions in the context of pensions. However, pension plan design is able to shape the choices offered in a way so as to help individuals make more informed and efficient choices thus benefiting individuals.

Although there is significant literature on all subjects mentioned so far, it is hard to quantify all these behavioral characteristics without clearly questioning individuals on the subject. Much of this literature, though very enlightening, is based on theoretical approaches to these behavioral biases where reasons are proposed as to why people behave in specific ways (e.g. Mitchell and Utkus, 2003). The best way to clearly capture these biases and assert on their existence is through the conduction of surveys.

The next section will outline the survey conducted in order to target these specific behavioral biases mentioned. Although the specific sample is somewhat small it can already shed some

light on a number of remarkable characteristics of individual decision making under uncertainty. The possibility of expanding this study to a more significant sample of the population in a mandatory manner may help better clarify how individuals behave when facing choices and why that is so. Should it be proved that these biases distort behavior making people worse off it should be clear that public intervention would improve the general conditions in the pension savings context.

3. Research Design

Experiment/Survey vs. Other Methods

A survey was conducted in order to analyze people's choices in the context of pension savings. We are aware of all reservations on the conduction of surveys yet it is the only method that can present practical and usable results in light of the current research.

Although rightful questioning on the method used arises, it can be seen that no other can achieve the same results. Whereas surveys are subject to doubts as to the validity of the results provided or even as to how general they actually are, all other commonly used methods suffer from several other drawbacks. Concerning actual choices which is what we are studying in this thesis, these can be investigated either in the field (through observations on economic behavior, either naturalistic or statistical) or in the laboratory. The former is unable to correctly use probabilities and utilities as these cannot be adequately measured thus eliminating the potential for quantitative results; laboratory experiments are able to completely remove the previously mentioned problem for field tests but appear to be very limited. These are "contrived gambles for small stakes" and often times use repetitions thus adding complexity to the analysis of results and even grating those little generality. Consequently, and by default, presenting hypothetical choices to individuals appears to be the best possible method. It is a simple procedure allowing the investigation of a great number of theoretical questions. Furthermore, one believes that individuals would behave likewise in real situations of choice, especially considering that there is no specific reason for people to disguise their true preferences in these anonymous questionnaires (Kahneman and Tversky, 1979).

Survey

The survey has three main parts.¹ One relates to the period of entry in the workforce and the necessity to start saving for retirement and is called part A. Individuals are told to ignore inflation or any tax issues in order to simplify and permit for focusing on our specific study.

¹ The complete survey can be found in the Appendix

The purpose of this survey is to understand how risk aversion influences choices relating to uncertain outcomes. By relating these questions to the pension context one is able to assert whether pension decisions are in mainly explained by utility theory or if investment sentiment and behavior particularities come into play.

The first 3 questions of the survey target typical risk aversion behavior. Respondents are asked to choose between two products: a Life Insurance which guarantees a pre-defined terminal value at the end of a 42-year investment period and a Defined Contribution Plan which offers the same expected return (€150.000). The difference lies in the fact that the return of the latter product is only an expected one, that is, there is a possibility of earning more or less, depending on investment performance. Both instruments are equivalent as the investor will contribute €2.500 per year (totaling €105.000 at the end of the 42-year period).

Risk aversion is observed in any situation where an individual prefers a certain return $E(x) = a$ to a risky product offering the exact same expected return $E(p_1x_1 + \dots + p_nx_n) = a$. In the first three questions, respondents are faced with two different ways of receiving the expected return of €150.000. Investors are considered risk averse if they prefer the Life Insurance. The questions from 4 to 6 target the same concept, but this time offer a higher return for the product with uncertainty. If $E(x) = a$ for the first product then the second product will now offer $E(p_1x_1 + \dots + p_nx_n) = a + pr$ ("pr" is a specific premium on top of the €150.000). The difference between questions 2 and 3 when compared to question 1 comes from the absolute values and percentages presented in the risky product. In question 2 investors are faced with a possible loss (they invested €105.000 and it is possible that they only receive €100.000). If the answers to question 1 differ from those to question 2 that means that the respondent is sensitive to this particular situation. In question 3, the probabilities offered are 99% and 1%. This will test whether individuals are indifferent to very extreme possibilities and do not account for them or if the answer remains unaltered. Questions 5 and 6 (as that of questions 2 and 3) follow the same logic only with increased expected return for the risky product.

In questions 7 to 10, the typical utility model is challenged. According to Prospect Theory, individuals usually reflect the so-called "certainty effect" in their decisions. The certainty effect relates to the underweighting of prospects that are only probable in comparison to those offered with certainty. If this is the case, then utility theory cannot deliver such results, as probabilities are not seen as decision weights, which is what happens when people "interpret" probabilities. For question 7, respondents can choose between the certainty of receiving €150.000, and a product B that offers €151.429 with a 35% probability, €150.000 with a 64% probability and

€100.000 with a 1% probability. In what concerns utility, what we are measuring here is nothing more than the relation between $u(150.000)$ and $0,35u(151.429) + 0,64u(150.000) + 0,01u(100.000)$ which is the same as comparing $0,36u(150.000)$ to $0,35u(151.429) + 0,01u(100.000)$. If one preferred the certain €150.000 to the second prospect in the former comparison they are expected to continue to prefer the €150.000 with a 36% probability when compared to the second prospect in the latter comparison. In question 8, respondents can choose between Product A, which offers a 35% chance of receiving €151.429 and a 65% chance of receiving €100.000. Product B offers 36% chance of receiving €150.000 and 64% chance of receiving €100.000. One can see that this is nothing more than the comparison between $0,35u(151.429) + 0,65u(100.000)$ and $0,36u(150.000) + 0,64u(100.000)$, which is the same as $0,35u(151.429) + 0,01u(100.000)$ compared with $0,36u(150.000)$. It can now be seen that the choice is exactly the same. The comparison between the answers given to these two questions will help understand if this certainty effect bias does exist and conclude that classical utility theory would need some changing so as to be able to model individuals' choices when it comes to pension savings products. If one is able to conclude that individuals make incoherent choices due to framing and wrong interpretation of probabilities this points out the need for some intervention relating to the choice of pension saving products.

Questions 9 and 10 model the exact same thing but with different expected returns. This may trigger a different perception in the respondents that may feel compelled to answer differently. Interestingly enough, there were in fact some changes in response. However, not all went from incoherent to coherent choices, some did the inverse path.

Questions 11 to 15 target the extra amount individuals would be willing to pay when more certainty is given. The intervals provided are calculated based on the extra cost which the company would have to support so as to provide such guarantees. The purpose is to understand whether the choice relating to question 15 differs from the previous one. In question 14 respondents are given an extra 5% certainty. Question 15 offers exactly the same, but now attaining 100% certainty. Furthermore, individuals who portrayed risk aversion in the answers to these questions are expected to be willing to pay more than the ones who made choices equivalent to risk neutrality. Again, these results are further evaluated in the following sections. Questions 16 to 21 focus on annuities, and do not measure any particular concept. Instead they attempt to understand which characteristics of an annuity may make it more attractive. One would expect risk averse investors to be more willing to purchase annuities. That is the first conclusion to be retrieved from these answers. Moreover, one expects to assertively see which

characteristics individuals most appreciate in an annuity. If an individual does not normally purchase annuities, but changes his decision when the annuity changes one specific characteristic, then we can ascertain on his reason(s) for not purchasing the product initially.

Sample

This study gathered responses from 105 individuals on their preferences concerning pension products. The diversified sample includes 45% women and 55% men. Literature points towards women being generally more risk averse. However, contextual framing may bring different results (Eckel and Grossman, 2008). Watson and McNaughton (2007) contextualize this study using the Australian University Sector as a sample. Controlling for other factors, their findings suggest that women do in fact make more conservative choices on investments, especially when related to lower income. Of extreme importance is the difference between individuals in the financial/economic area and those in other areas. 75% of our sample belongs to the first group. If a significant difference is found between these two groups then one of the explanations of the existence of behavioral biases may be related to financial illiteracy. Close to 50% of the individuals included in the sample are aged between 18 and 25 years, 30% between 26 and 45 years and 20% older than 46 years. The amount of Portuguese respondents sums up to 80%. One can analyze such a diverse sample by looking for significant differences in the answers provided by different groups. The diversity in the sample will validate conclusions as to whether these characteristics can be found in any individual independent of gender, age, nationality or background. If that is so, then one can conclude that these are in fact biases and not originated by culture or lack of financial knowledge.

Study Methodology

The survey on its own allows for multiple data interpretation. The Results section will incorporate two methodologies. The first will be the just referred to analysis of raw results. The second relates to the building of simple regressions that may provide further insight to possible existing connections between the answers provided.

Considering the particularities of the survey conducted most answers provided are non-numerical and are usually one of two or three options. The only part of the survey that allows for discrete variable analysis is the one related to guarantees in pension plans. Consequently, two main models will be used. For the analysis of guarantees one can use the generally used Least Squares method in order to retrieve an explanatory regression. For all other variables to be characterized as dependent variables a binomial model must be used in order for this variable to take up values between zero and one only. Logistic Regression Models uses a logarithmic

transformation on the outcome variable thus allowing for the modeling of nonlinear associations in a linear way. Having a categorical outcome variable would violate the assumption of linearity in the traditional Ordinary Least Square (OLS) models.

Considering the particularity of the data retrieved one is aware that any possible model will lack explanatory variables. Individuals answer questions using multiple behavioral insights unaware to us or even impossible to proxy. However, one is interested in understanding whether certain specific characteristics do influence the outcome or not. The magnitude with which they influence this result or even what the actual result will be is not a priority. Multicollinearity is avoided by using only one predictor variable originated from the questions. The remaining predictor variables are dummy variables relating only to personal characteristics such as age or gender. Again on account of the nature of the data collected, errors will be independent.

Risk Aversion and Prospect Theory

Firstly, one is interested in realizing whether individuals that show risk aversion are more likely to show preferences that violate classic utility theory. A Logit Model is used where the answers to Questions 7 and 8 were used as the outcome variable. There are four possible combinations of answers to these two questions. Two of these relate to individuals that show preferences that are in accordance with utility theory whereas the remaining two show the opposite. The dependent variable shows exactly this relation and it can only be 0 or 1. The independent variables chosen are taken for Question 2 and from personal data on respondents. In case the respondent stated preference for the Life Insurance Product even where the products were equal (except for the risk factor) the investor was considered risk averse (question 2); consequently, the dummy variable takes on the value of one. In the case where the respondent answered to being either indifferent between products or to preferring the DC Plan he was considered non risk averse; as such, the dummy variable takes on the value of zero.

Furthermore, four other dummy variables were imputed as control variables. The dependent variable was named *dummyprosp*, and measures the likelihood of a specific respondent showing preferences which go against utility theory. The main explanatory variable here is named *dummyriskavers1b*, taking the value 1 if the respondent evidenced risk averse behavior. Only one variable is used so as to avoid multicollinearity between variables (Questions 1 to 6 are all very much related, targeting the same behavior characteristics). The dummy variables that will always be studied are the following:

	<i>dummyage</i>	<i>dummygender</i>	<i>dummyback</i>	<i>dummynation</i>
= 1 if	>25	Female	Finance/Economics	Portuguese
= 0 if	≤25	Male	Otherwise	Otherwise

The first regression targets the influence of risk aversion on failures in the classic utility theory:

$$\begin{aligned}
 \text{dummyprosp} = & \beta_0 + \beta_1 \text{dummyriskavers1b} + \beta_2 \text{dummyage} + \beta_3 \text{dummygender} \\
 & + \beta_4 \text{dummyback} + \beta_5 \text{dummynation} + \varepsilon
 \end{aligned}
 \tag{3.1}$$

The various β 's will tell us which relations exist between the dependent variable and the independent variables; it is interesting to understand whether this relation is significant and if it's a negative or a positive relation.

If an individual was initially characterized as risk averse then he is expected to more likely experience the non-utility model behavior and thus we are expecting β_1 to be positive. It is usually considered that older people are more conservative and as such we are expecting a positive β_2 . Women are also seen as more risk averse thus triggering a positive β_3 . β_4 is predicted to be negative as individuals with a financial background are expected to behave in a more rational manner than individuals who lack such background. Finally, β_5 is expected to be positive considering that the Portuguese population is usually defined as more conservative than their main Western European counterparts (all but one individual within the foreign sample is from a Western European country). For the purpose of this analysis we expect these variables to be insignificant and as such prove that behavioral biases are not inherent to one specific personal characteristic but rather applicable to all individuals.

Guarantees and Risk Averse Behavior

In this particular case one wishes to understand whether individuals that are more risk averse are in fact more likely to be willing to pay more to ensure extra guarantees in pension products. Considering that the survey allowed for quantification at this point, one can use a continuous variable to describe the respondents' willingness to pay. Throughout the five questions ranging from question 11 to 15, respondents will assert on how much more they are willing to pay for the increased certainty offered. The dependent variable here will be the value individuals place on decreased uncertainty measured by the accumulated amount up to Question 15. Amounts considered were the average of intervals provided. For the last interval provided in every question written as "more than €x", the amount considered for the purpose of this analysis was that same x. The possible interval ranges from €0 to €22.400.

	a)	b)	c)	d)	e)
0%	€0	€400	€1.000	€1.600	€2.000
50%	€0	€2.000	€5.000	€8.000	€10.000
99%	€0	€2.000	€5.000	€8.000	€10.000
99,5%	€0	€40	€100	€160	€200
100%	€0	€40	€100	€160	€200
Interval	€0				€22.400

The independent variables to be considered here are exactly the same as in the previous equation so all of them are categorical. The dependent variable is named *guarantee1* and it represents the accumulated amount individuals are willing to spend up to the time when total certainty on the returned amount is assured. As mentioned previously, this variable takes on values of between €0 and €22.400. The independent variables were further explained in the previous subsection of this research. The regression is as follows:

$$\begin{aligned}
guarantee1 = & \beta_0 + \beta_1 dummyriskavers1b + \beta_2 dummyage + \beta_3 dummygender \quad (3.2) \\
& + \beta_4 dummyback + \beta_5 dummynation + \varepsilon
\end{aligned}$$

Other variables were not used in the regression considering these are highly interdependent. All first six questions are related to risk averse behavior. Using the answers provided to one of these questions as an independent variable makes it useless to input any other information in the remaining five questions as these are clearly collinear. The same happens for the variable that targets behavior similar to that present in prospect theory. As seen before, this behavior was proven somewhat dependent of risk averse behavior. Consequently, the regressions used were simplified as much as possible to avoid this type of statistical inaccuracies.

It is expected that risk averse individuals be more likely to invest more, in order to guarantee a specific return, thus indicating a positive β_1 . It is also assumed that the older someone gets the more likely they are to be willing to pay so as to avoid risk, thus resulting in a positive β_2 . Again we can refer to literature that indicates women to show more risk averse behavior. If we consider risk averse individuals to be willing to pay more in exchange for less uncertainty we can assume that women are more likely than men to have this behavior which would therefore point towards a positive β_3 . Background should not have an influence here. However, it is possible to consider that better informed agents will be less likely to pay such high amounts for less uncertainty as they can best understand the products and probabilities they face. If that is the case then β_4 will most likely be negative. Finally, the dummy relating to nationality will

most likely show a positive sign. Considering the dummy to take value 1 if the individual responding is Portuguese then it is likely that Portuguese people are more willing to pay for extra certainty considering their conservative nature. If that proves right then β_5 will have a positive sign attached to it.

Annuitization

The main purpose of this thesis is portrayed in the sections up to this one. However, it is interesting to study a particular product amongst the pension products context that is also a target of severe behavioral biases. Besides the theoretical analysis to individuals' responses that will be done in the Results section, we intend to again target risk aversion as a possible influence on the demand for annuities. Apart from that variable, it also strikes us as evident that people who believe they have a longer life expectancy will be those who will show preference in annuitizing part of their retirement income.

Again, the regression used was computed by using a Logit Model for the same reasons previously mentioned. The dependent variable is categorical seeing as it takes the value of one if people are willing to annuitize a part of their income. Should they answer a) 0% to question 16 the dummy takes the value of zero. For independent variables one uses the same variables used before plus a life expectancy variable, information of which is retrieved from question 17. In this latter question respondents have to indicate how much longer they were expecting to live from age 67 onwards. The regression was constructed to be:

$$\begin{aligned} & \text{dummyannuity} \\ & = \beta_0 + \beta_1 \text{dummylife} + \beta_2 \text{dummyriskavers1b} + \beta_3 \text{dummyage} \quad (3.3) \\ & + \beta_4 \text{dummygender} + \beta_5 \text{dummyback} + \beta_6 \text{dummysnation} + \varepsilon \end{aligned}$$

The variable named *dummylife* takes the value of one in case the respondent states that he believed to live until the age of 80 or more and zero if longer than 80. If one believes his life expectancy is very high then it would make sense to invest in an annuity thus avoiding the longevity risk. Consequently, one expects β_1 to be positive. β_2 is somewhat unknown. We have reason to believe someone demonstrating risk averse behavior would be more likely to buy an annuity so as to avoid longevity risk. On the other hand risk averse individuals may evaluate an annuity investment from the perspective of illiquidity. Following the same line of thinking one is unaware of what the relation is between gender or nationality and the likelihood of purchasing an annuity. If someone has a financial or economical background then we could assume him to better understand financial products and so financial illiteracy would not be a problem;

consequently, β_5 should take a positive value. Finally, given the nature of an annuity we would assume that the older one becomes the more likely it is that he will purchase an annuity as this product becomes “cheaper” with the passing of time. Again, if so, β_3 will also have a positive sign. The analysis of the answers of questions 16 to 21 will be further analyzed later on.

4. Results

Utility Theory vs. Prospect Theory

The preference axiom in utility theory failed in little over 52% of the individuals’ responses. Participants were given the possibility to choose between Product A and Product B. This first table summarizes the gambles proposed in Questions 7 and 8 and it represents how the respondents should have analyzed them.

Question 7				Question 8			
Product 7A		Product 7B		Product 8A		Product 8B	
Amount	Prob.	Amount	Prob.	Amount	Prob.	Amount	Prob.
€150.000	1	€150.000	0,35	€100.000	0,64	€100.000	0,65
		€100.000	0,01	€150.000	0,36		
		€151.429	0,64			€151.429	0,35

Schematizing the possibilities offered and attaching probabilities in a different manner allows for a divergent understanding of the problem. The major struggle with this gamble comes from the fact that individuals do not mentally proceed with the untangling of what is being offered, but rather face this question as if being completely new. One other very important aspect is that no product is now completely certain. Considering the investment made is €105.000 and participants now have a possibility of attaining only €100.000 at the end of the investment period (meaning a €5.000 loss), individuals tend to become somewhat more risk seeking. While in Question 7 participants may choose Product A, they are now faced with two products where both are capable of creating losses, thus giving room for investors to look at absolute value of return and underestimate probabilities.

Question 7				Question 8			
Product 7A		Product 7B		Product 8A		Product 8B	
Amount	Prob.	Amount	Prob.	Amount	Prob.	Amount	Prob.
€150.000	0,35	€150.000	0,35	€100.000	0,64	€100.000	0,64
€150.000	0,65	€100.000	0,01	€150.000	0,36	€100.000	0,01
		€151.429	0,64			€151.429	0,35

Let us notice that when we move from Question 7 to Question 8, Product A evidences a reduction of 64% certainty in the State of Nature that offers €150.000. Concerning Product B, the 64% certainty is also removed from the first two options. It is possible to conclude that if one agent chooses Product A in Game 1, then utility theory would indicate that his/her choice would not alter when moving to Game 2. If one individual prefers Product A to product B in Game 1 that means that no matter what his/her utility function looks like, the following will be observed: $u(€150.000) > 0,64u(€151.429) + 0,35u(€150.000) + 0,01u(€100.000) \Leftrightarrow 0,36u(€150.000) > 0,35u(€151.429) + 0,01u(€100.000)$. If the same particular respondent chooses Product B in Game 2 that means that his preferences give us the following expression: $0,36u(€150.000) + 0,64u(€100.000) < 0,35u(€151.429) + 0,65u(€100.000) \Leftrightarrow 0,36u(€150.000) < 0,35u(€151.429) + 0,01u(€100.000)$. One can infer that, independently of the specific utility function that better portrays this individual's choices, the preference axiom does not hold at this point. The respondent shows a clear mismatch between choices, with preferences altering due to changes in the framing of the question and due to the misreading of probabilities.

Of the respondents to this particular survey, little over 52% revealed a behavioral bias through incoherent choices. 51% of the women showed this same behavior compared with 53% of men leading us to conclude that there is no significant difference between the two groups. An interesting point is that a significant difference between individuals in the field of economics/finance when compared to those in other fields was not observed. Actually, concerning men, it is possible to state that within those in the related field, close to 56% demonstrated these incoherent preferences. Within the group of men from the other non-financial areas, close to 46% showed the same behavior. One can therefore conclude that this a behavioral bias, not triggered by financial illiteracy or lack of knowledge but rather the sentiment involved in making choices.

Risk Aversion and Prospect Theory

The results on regression (3.1) are as follows:

$$\begin{aligned} dummyprosp = & -1,766^{***} + 1,959^{***} \times dummyriskavers1b + (-0,335) \times dummyage \\ & + (-0,204) \times dummygender + 0,565 \times dummyback + 0,297 \times dummynation \end{aligned}$$

The results provided by the computing of this equation will only be analyzed from an influence perspective and not on magnitude or behavior of the *dummyprosp* variable.² *dummyriskavers1b* is statistically significant even at the 1% level (p-value of 0,003). β_1 indicates a positive relation between the two variables which suggests that individuals who show risk aversion are more likely to demonstrate preferences that violate the classic theory of utility in preferences. One very interesting remark is that all dummy variables appear to be statistically insignificant. Age and Gender appeared to have a negative relation with the dependent variable, thus demonstrating that being over 25 years or of female gender would result in less likelihood of violating utility theory axioms. However, these are not statistically significant at any levels, therefore no conclusions can be drawn on whether age or gender actually influencing this specific behavior. Background and Nationality are also statistically insignificant. Their coefficients would indicate a positive relation with the explained variable pointing towards behavior differing from that predicted by the utility model to be more likely, when one is Portuguese and has a Financial/Economical background. Seen as all dummy variables are insignificant one can safely assume that there is no actual evidence that personal characteristics influence behavior which means that any individual is subject to possible behavioral biases and incoherent choices.

Guarantees in Pension Products

Understanding the presence of such behavioral biases is of the utmost importance. However, targeting them is what most preoccupies researchers.

When we are not aware of an outcome, choices become rather difficult. One would assume that any product that is able to offer less uncertainty would be higher valued. As such, the purpose of the second part of the survey is to understand how much more individuals would be willing to pay so as to decrease the uncertainty on their return.

The base Product that we refer to is one where there is an 80% probability of receiving €162.500 and a 20% probability of receiving €100.000. The investment made was €105.000, meaning that the investor either receives 162,5% or a slightly over 95% on his investment. Again the initial investment is €105.000 so as to make comparisons easier.

Initial Scenario	Payment	States of Nature		$E[r]$
		80%	20%	
	€105.000	€162.500	€100.000	€150.000

² The E-Views output is shown in the Appendix. The program was used due to its easiness when computing simple equations as these. No further statistical and econometric analysis was made.

Throughout the five questions included in the survey, the probabilities of each state of nature do not alter and neither does the amount received in the up state (€162.500). The amount received in the down state is modified every question, representing the decrease in uncertainty. Risk is unchanged in order to best perceive the value individuals attribute to extra certainty. The gamble above represents the actual market predictions for the particular product. Every question adds an amount to the €100.000 offered in the low-state, thus increasing expected return. If the insurance company insures this extra amount they are incurring a loss of that value. As such, what individuals are willing to pay is what compensates the firm. We are interested in knowing how individuals value these decreases in uncertainty, and whether they value them enough to come close to covering the insurers' cost.

The first question guarantees the amount invested. The state of nature corresponding to the 20% probability will now pay €105.000. At this stage the investor will pay in order to guarantee the total of his initial investment. Either the return is 162,5% or 100%. At this point, close to 46% of the respondents were unwilling to pay an extra amount for this change. Considering the offering of a 100% guarantee on investment the cost for an insurer sums up to €1.000 per buyer. The possible answers provided the intervals for willingness to pay ranges between: a) nothing; b) €1 to €800; c) €801 to €1.200; d) €1.201 to €2.000 and e) more than €2.000.

As mentioned before, every next stage sees an increase in the amount offered in the state of nature that has a 20% likelihood of occurring. The table presented next provides a summary of the main indicators of each phase proposed to the respondents.

	20% SN	Average	Guarantee³	%Guarantee⁴
Phase I	€105.000	€106.000	0,0%	0,0%
Phase II	€127.491	€111.000	50,0%	121,42%
Phase III	€149.550	€116.000	99,0%	142,43%
Phase IV	€149.775	€116.100	99,5%	142,64%
Phase V	€150.000	€116.200	100,0%	42,86%

For the purpose of this analysis we will always use the average value in these intervals as a reference. The interval a) always indicates a respondent that is unwilling to pay any extra amount for the improved product. The interval in b) considers individuals that are willing to pay extra but realize they do not want to bear the full cost. In case of the first phase we referred

³ This Guarantee is calculated through the following formula $\frac{\text{Guaranteed Lump Sum} - \text{Initial Investment}}{\text{Market Value for the Product} - \text{Initial Investment}}$. The Guaranteed Lump Sum is the amount that changes in every question. The Initial Investment is always €105.000 whereas the Market Value for the Product is always €150.000.

⁴ The %Guarantee is the actual return on the €105.000 invested.

that the extra cost would be €1.000 per person. As such, interval b) is set to be between €1 and €800. Interval c) is always set to have the total cost for the insurer as its average. In this specific case it is between €801 and €1.200, thus having €1.000 as its average value. The interval indicated in d) presents a willingness to pay that goes beyond the extra cost. This would indicate that the individual would be willing to pay even more than what it actually costs to provide the extra certainty. And interval e) exists only to allow for all possible values to be attributed to the willingness to pay.

Right from the start we realize that any respondent that indicates preference for either option d) or e) is clearly left worse-off. They are willing to pay more than the actual cost of giving them that extra certainty. If we assume individuals to be accurately responding to the survey, then the extra guarantee provided eludes them into paying more than it is actually worth and so they incur in a loss rather than actually pay for an increase in the expected return.

There are many interesting results yielding at this point in time. 45,7% of the respondents show that they do not place any value on the guarantee of their invested amount; 31,4% indicate the payment of an extra amount between €1 and €800 in order to be guaranteed at least €105.000 at the end of the investment period. 19% indicated a willingness to pay which represented the extra cost for the insurer. There were 2 respondents showing a preference for option d) and two other pointing towards e). One considers these latter responses as lacking significance due to their small representativeness. The answers to Question 11 are showed below.

€0	€1-€800	€801-€1.200	€1.200-€2.000	(Over) €2.000
45,7%	31,4%	19,0%	1,9%	1,9%

In the second phase, there is one important consideration. All respondents who showed unwillingness to pay for this 50% increase in certainty had already showed unwillingness to pay in the previous question. The two respondents that had previously replied e) did so again. Option d) gathered 5 responses. Once again due to lack of representativeness one considers these answers as being misinterpretation rather than actual belief or preference. All in all such an increase targeted massive response compared to the previous increase offered. Over half of the respondents showed willingness to pay above zero but below total cost for the insurer. 19% showed willingness to pay in the interval that included this cost of providing extra certainty. The answers to Question 12 are shown below.

€0	€1-€4.000	€4.001-€6.000	€6.001-€10.000	(Over) €10.000
21,0%	53,3%	19,0%	4,8%	1,9%

This difference shows that people value the decrease of uncertainty in different ways depending on the level where they are at already. The probability change is not proportional to the amount of respondents willing to pay extra which shows that individuals not only value a change in the probability offered but also the level at which this change in probability is offered. All respondents that indicate unwillingness to pay at a certain point have been showing that unwillingness to pay up to that point. There is no phase at which a respondent indicates an unwillingness to pay when he had already chosen to pay something in a previous phase. In the third phase the answers seem to be more diversified.

€0	€1-€4.000	€4.001-€6.000	€6.001-€10.000	(Over) €10.000
19,0%	37,1%	27,6%	14,3%	1,9%

Respondents showed increased willingness to pay at this stage. Again two respondents show their willingness to pay over the last interval provided. However, the respondents that were previously regarded as being insignificant should now be analyzed as being in fact significant. 14,3% of respondents showed a preference for the interval that was above the total cost of providing for this increase in certainty thus making the individual worse off. This close to 15% response is related to the preferences of 15 respondents which cannot be discarded. Consequently, it is fair to assume that when the decrease in uncertainty offered is close to completely eliminating uncertainty individuals are compelled to invest even more than such a decrease is actually worth.

Our main goal at this stage is to compare answers 14 and 15 as they represent the changes in certainty offered from 99% to 99,5% and from 99,5% to 100%, respectively. Although they both attain a 0,5% decrease in uncertainty they are offered at different levels which could trigger different behaviors. The answers to these questions are shown below and show significant differences between one another:

Answers	€0	€1-€80	€81-€120	€121-€200	(Over) €200
14	53,3%	29,5%	9,5%	1,9%	5,7%
15	26,7%	28,6%	20,0%	10,5%	14,3%

Going from 99% to 99,5% guarantee results in over half of respondents' unwillingness to pay any further. Considering the difference to be very small, individuals seem to be classifying it as insignificant. Close to 30% of respondents still show willingness to pay even if only bearing part of the cost.

On the other hand, when we analyze the willingness to pay relating to the increase from 99,5% to 100%, respondents significantly change their attitude. Although this 0,5% change seemed to be uninteresting to respondents when offered in Question 14 it now seems to have been regarded rather differently. 20% of individuals are now willing to pay between €81 and €120 extra in order to be certain of receiving at least what the product is worth in the market. Close to one quarter of total respondents show willingness to pay above what it actually costs for the insurer to provide this extra certainty.

All in all, 9 out of 105 respondents assert they are unwilling to pay any extra in anyone of these phases. There are two respondents amongst the total that are to be considered as outliers as they have consecutively demonstrate willingness to pay above all maximum values indicated in each interval. This behavior would mean the individual would be willing to pay a lot more than the extra amount that is now offered with certainty. Consequently, one would assume this to be a result of misinterpretation of the questions in the current part of the survey under analysis.

If respondents already had 99% certainty on their return that the extra 0,5% made little difference resulting in with well over 80% of individuals asserting they would either pay below the cost of providing that extra certainty or nothing. A completely different attitude is observed when the base probability is already at 99,5% and the extra guarantee now results in complete certainty on return. Here individuals show higher predisposition to pay extra amounts in order to attain complete certainty.

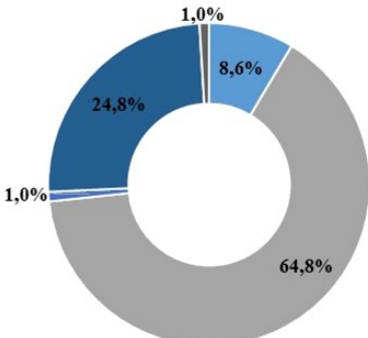
Concerning the focus of our analysis, the amount an investor is willing to pay is what interests us the most. Let us consider that the investor paid €105.000 for this specific product and is aware that in 42 years it is worth €150.000. The performance of such an investment can go in two different directions with the terminal value being equal to €162.000 or €100.000, the first of which with a 80% probability of occurrence and the second with the remaining 20%.

In order to assure the investor receiving €150.000 if not more, one has to guarantee that amount. Considering the low state's probability of occurrence of 20% one estimates the total extra cost of insuring this value to be €10.000⁵.

The willingness to pay an extra amount portrayed here will indicate how much the consumer is willing to pay for the product with a 100% guarantee of the return of the fair value. If €10.000 is the extra cost then that is to be our threshold. If an investor is willing to pay that exact amount then this would mean that he would be paying for this increased certainty himself which would

⁵ The probability of the low state occurring is 20% and the amount received in that state is €100.000. Consequently, for the insurer to guarantee €150.000 it would have to provide for those extra €50.000 which is equivalent to €10.000 (20% of €50.000).

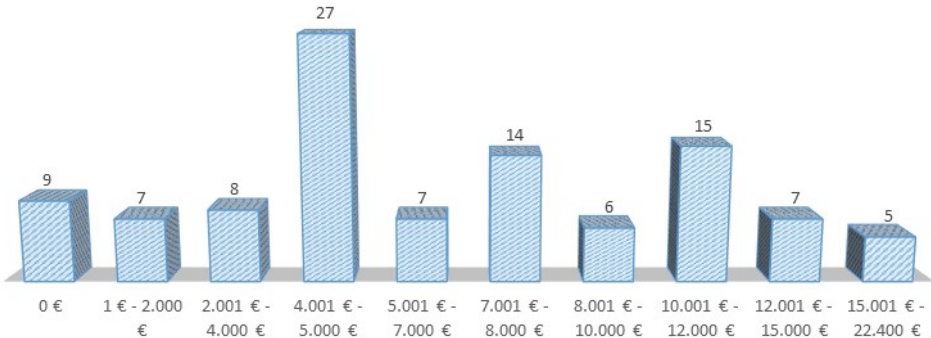
leave him at the same point as he started. However, all values ranging from €0 to €10.000 represent amounts that would leave the individual better off as the guarantee offered would be higher than the respective cost. One expects all individuals to respond within this interval. If an individual affirms that he is willing to pay above that threshold then they are worse-off. This might reflect a high degree of risk aversion or a misinterpretation of the question. All in all both answers provide for an interesting analysis. Knowing how much more individuals are willing to pay for increased certainty sheds light onto the creating of pension savings products. On the other hand, if there is a significant number of respondents claiming they would pay above market cost then this means pension plan decisions should in fact have some intervention from companies or the State.



The percentage of respondents who claimed willingness to pay in each interval is represented on the left. Close to 65% of individuals who answered the survey were in fact willing to pay extra; however, they would only bear part of the cost.

What is more important is understanding how much the individuals belonging to the 64,8% and 24,8% slices are willing to pay, that is, to know such amount in more detail. Below we show a graph indicating the number of respondents that revealed a determined preference:

■ 0 € ■ 1 € - 9.999 € ■ 10.000 € ■ 10.001 € - 22.399 € ■ 22.400 €



Over a quarter of the respondents showed willingness to pay half the amount they were securing. 13% were willing to pay close to three quarters of the total cost whereas 14% actually showed the willingness to pay above the respective cost.

Risk Averse Behavior and Willingness to Pay

Finally we are interested in ascertaining whether there is any relation between the willingness to pay more for a certain guarantee and a risk averse individual. As such, one computed a regression with the willingness to pay as a dependent variable (continuous) and risk averse

behavior (question 2) as a categorical independent variable. There were also four control dummies in order to remove effects from personal characteristics. The regression yielded the following results:

$$\begin{aligned} \textit{guarantee1} = & 8049,9^{***} + 2803,0^* \times \textit{dummyriskavers1b} + (-1954,3) \times \textit{dummyage} \\ & + (-1562,3) \times \textit{dummygender} + 1501,0 \times \textit{dummyback} + 3630,3^{**} \\ & \times \textit{dummynation} \end{aligned}$$

As expected, individuals who show a risk averse behavior are more likely to want to pay extra in order to guarantee a more certain return on their investment. Although only significant at a 10% level it is a variable we were expecting to be significant. Age and gender have negative signs attached contrary to general explanations provided in the Methodology section of the thesis. The same applies to background. One can safely assert that the respondents of the survey showed that their personal characteristics have no influence on their behavior when faced with choices. One believes that this is caused by the fact that such behavioral biases can be present in any individual. It is a matter of sentiment of choice rather than understanding of the questions. The dummy related with nationality showed significance at both a 5% and a 10% level. This means that Portuguese individuals showed that they were more likely to invest in guarantees than foreign respondents. This fits in with our predictions, once again characterizing the Portuguese people as more conservative in comparison to the remaining of Western Europe.⁶

Annuities

This part of the survey intends to further explore the relations previously observed. These behavioral biases can be studied in diverse ways. However, the annuitization puzzle seems to be a very good case within the pension context.

Annuities are a product that protects individuals against longevity risk in a society where the life expectancy is rapidly increasing and is projected to continue as such. Therefore, one would expect the demand for these products to be high. However, that is not the case. Except for rational reasons relating to bequests or illiquidity, which have proven to be significant in previous literature, much is yet to be explained. Firstly we try to understand if characteristics existed that had the capability of increasing the attractiveness of these kinds of products. Secondly, it was important to understand whether people who believe they will live longer are aware of the longevity risk, one that may affect them.

⁶ The complete E-views output is shown in the Appendix.

Of the total respondents to the survey, 20% asserted they would not invest any part of their income on an annuity. The majority of respondents (55,2%) stated the preference for investing between 1% and 24% of their retirement income on this product. It is interesting to note that no individual decided on investing his whole retirement saving on an annuity. The investing of only part of one's income somewhat eliminates the problems of illiquidity, risk of incurring in sudden costs or the bequest motives.

In regard to the life expectancy question, a division between two groups was conducted. On the one hand individuals who believed they will live until 80 years of age at most and on the other hand people who stated the idea that they would live up to 80 or more. Considering the purpose of an annuity it is safe to assume that people who believe they will live the longest are those who would be more inclined to purchase an annuity. The regression conducted at this point targeted this and other possible influences:

dummyannuity

$$= 3,388^{***} + (-0,632) \times \text{dummylife} + (-0,528) \times \text{dummyriskavers1b} \\ + (-1,512)^{***} \times \text{dummyage} + 0,648 \times \text{dummygender} + 0,323 \times \text{dummyback} \\ + (-0,791) \times \text{dummynation}$$

By using the answers from the 105 respondents to the survey it is not possible to find a significant link between risk averse behavior or life expectancy and the will to purchase an annuity. However, *dummyage* proves significant and it actually reflects that the older people who responded to the survey were less inclined to buying such a product.⁷

Questions 19 to 21 allowed modifications of the traditional annuity product with question 18 offering a simple traditional annuity. In question 19 respondents are offered the possibility of purchasing an annuity that allows for withdrawals of up to 10%. In question 20 an annuity is offered that has the possibility of deferral, that is, one can contribute to it upon retirement but only start receiving income streams a number of years after retirement. Question 21 gives the investor the possibility of buying an annuity whilst choosing its investment strategy. It brings variability into the equation. The monthly stream of payments will be dependent upon the performance of this chosen behavior.

One last interesting analysis concerns the individuals who stated they would not annuitize any percentage of their retirement income. Questions ranging from 18 to 21 permitted changes to the basic annuity product and targeted changes in preference. Out of 21 respondents, 14 chose to receive 100% as a lump-sum even when changes to the annuity product were offered.

⁷ The complete E-views output is shown in the Appendix.

Question 18 offered a simple annuity product which would mean that none of the respondents who had before shown no interest in purchasing an annuity with any part of their income should now choose the option to purchase one. However, there was one respondent who did so. Although he also stated that the possibility of withdrawing and deferring appealed to him, this should not be considered a valid choice because questions 16 and 18 are exactly the same only under a different framing.

Of the remaining six individuals, three stated a change in preference when investment freedom was offered. Two respondents asserted they would purchase an annuity in case this product allowed for a deferral. And one individual stated both options as something that would make him purchase an annuity with 20% of their retirement income.

The annuitization puzzle could be explained by rational reasons such as the ones presented before. However, those are not enough to explain the total dimension of this puzzle. Unfortunately, one was unable to retrieve any significant conclusions from this study. Although changing the product characteristics would make the annuity more attractive there are factors that still remain unaccounted for. These relate to behavioral characteristics that should be further studied in the hopes of enlightenment of not only this particular puzzle but the pension context in general. Out of 21 respondents, 14 claimed to not change their thinking on annuities even after changes were made to the product. These changes were all rational motives for people who tend not to annuitize. Brown, Kapteyn, Luttmer, and Mitchell (2013) prove that one very important factor is related to an individuals' difficulty in conducting a proper valuation of annuities thus helping to explain the low demand for these products. Independently of all these factors, economic theory has proved that a risk averse individual without bequest motives would find it optimal to invest the totality of his/her wealth in an annuity⁸.

All in all, annuities seem to be a product which suffers from various behavioral biases that affect the pension industry as a whole. Of course it is necessary to observe that there are countries in which this discussion is more applicable than others due to the availability of these types of products in the market.

5. Limitations and Further Research

Given the difficulty of obtaining a large public to answer the survey it is clear that a larger sample would be beneficial for the accuracy, determination and enforcement of such a study. It

⁸ Yaari (1965); Later on, Bernheim (1987) and Davidoff, Brown and Diamond (2005) proved the same theory.

may have shown that some variables would reflect a stronger significance if the sample itself was more significant. However, one believes this to be a good starting point.

The development of a survey is something very important but rather subject to inaccuracies. One tries to provide the information as clear as possible by making it as simple as possible without influencing people as to their responses. The survey in question is somewhat difficult in context as it presents difficult choices that involve probabilities and require people to think carefully. Not only does this affect the accuracy of results but it may also result in misinterpretation of questions. However, everyone is required to make pension saving decisions and it is necessary that these terms are understood. All in all, the survey was carefully constructed and one believes it to be a good proxy for the answers we expected to obtain. The results yielded are compatible with expectations and prove the need for further research.

The statistical part of this thesis was very small, only necessary to prove a small number of results which it effectively did. No attention was given to magnitude or absolute values of the coefficients. Rather, we were looking for positive or negative relations between the variables and which ones could be considered to be more significant. Considering that the data retrieved is collected from a survey makes it more complicated to build a strong statistical analysis though one believes the answers to the survey themselves were the core of our analysis.

Considering the importance of pension plans it becomes extremely important to understand the area to the fullest. However, this area is highly influenced by individuals' decisions which is what needs understanding. Pension plan design should allow for the autonomy of individuals in the making of choices whilst somehow guiding them. If larger studies can predict this sort of behavior then it is clear that some intervention may be beneficial.

6. Conclusion

This research was conducted in order to show the existence of behavioral biases in the pension context. Firstly, what one is trying to prove is that some financial phenomena could be better understood if models used for this purpose incorporated the idea that some individuals do not act in a fully rational sense. This has been shown in multiple studies and is the basic idea behind Prospect Theory. It is important to verify if it applies to the pension context.

First of all, we were interested in testing whether pension saving decisions triggered risk averse behavior or not. The first three questions of the survey targeted just that. The minimum amount of respondents showing a risk averse behavior for all three questions was 65%. Question 2 actually showed 73% with a risk averse behavior. This is a starting point to the first discussion

we wish to begin with this thesis. The fact that individuals commonly show a certain degree of risk aversion can have repercussions.

There were two very important studies developed. Firstly, relating to utility theory and its failures. Although utility theory still remains as the most accepted economic theory, we have been alerted to its possible failure at times. The conduction of the survey particularly questions 7 and 8, allowed this observation to be made. Over half of the respondents to the survey showed behavior that violated utility theory's basic axioms. These answers were shown to be incoherent utility wise. As such, one knows that individuals make decision choices based on sentiment rather than rationality. It was also possible to observe that individuals who had already portrayed a risk averse behavior were more likely to verify this less coherent behavior.

The next focus of this research related to guarantees offered in pension saving products. Previously individuals were able to choose between a Life Insurance product that offered a certain return and a Defined Contribution alternative that offered an investment outcome enduring risk. In this next phase of the study individuals only had a product bearing risk in order to simulate a DC Plan available. The product was said to be worth €150.000 and it was created to render that exact expected return. The up state provided a €162.000 return with a 80% probability whereas the down state provided a €100.000 return with a 20% probability. In order to simplify the information respondents should really focus on, the up state was never modified. The down state suffered gradual increases in the amount guaranteed. Considering that the individual invested €105.000 in order to buy this product the guarantee given was firstly a 0% return that is, receiving back the €105.000. Then the guaranteed amount gradually increased until the €150.000 was fully covered by the company selling this product. At this stage we wanted to understand if individuals were willing to pay more for this increased certainty in outcome and evaluate how much more they were actually willing to pay.

Only 9 out of 105 respondents stated that they would not pay extra for any of the guarantees offered. Furthermore, as expected, 65,7% of respondents (equivalent to 69 individuals) chose the interval where the amount payable is below the cost (including the latter). If €150.000 is guaranteed in a low state where €100.000 was to be the outcome then the total cost for the insurer is €10.000 (the €50.000 difference valued with a 20% probability). 69 individuals indicated that they would pay between €1 and €10.000 more if they were guaranteed that amount. However, there were still 27 respondents (equivalent to 25,7% of the total sample) that indicated they would pay more than €10.000 in order to benefit from the increased guarantee. In fact what happens here in this case is that these individuals will be paying more for the guarantee than the return that it will actually provide. Consequently, they will be left worse-off.

This is important evidence of what was mentioned before. People make sentimental choices rather than rational ones.

At this point it was also proven that risk averse individuals were more eager to pay higher amounts in order to be assured of the investment outcome. Portuguese individuals were also shown to be willing to pay higher amounts when provided with guarantees pointing to their more conservative nature.

The second very relevant analysis conducted was in relation to the individuals' willingness to pay for different guaranteed levels. If one thinks merely rationally, increasing from a 99% to a 99,5% certainty should be identical to moving from a 99,5% to a 100% certainty. The 0,5% relates to the same increased amount, it is just based on different levels. In the case of our analysis in question 13, the amount guaranteed in the low state was €149.550. In question 14 this amount was increased by €225, which represented a 0,5% increase in certainty. In question 15 the certain amount was also increased by €225, again representing a 0,5% increase in certainty. However, the first began at €149.550 and the amount increased to €149.775 whereas the second started at the last value and increased to €150.000, thus representing the fair value of the product and as such representing a 100% guarantee.

Answers showed a significant difference between these two situations. In Question 14, less than half of the respondents stated their unwillingness to pay any further. However, question 15 showed that 73% of respondents were willing to pay something. One can only conclude that this results from the sentimental element people place in their choices. The fact that complete certainty was offered resulted in individuals valuing that option a lot more than they would have in any other similar offer if on another stage of the process.

The main purpose of the research conducted was to arrive at the conclusions mentioned so far. The reality nowadays shows an aged population whose retirement plans depend on the savings they have made throughout their lives. Even so, many countries have a pension system that is usually called a Funded Pension System. Retirees are paid by the utilization of contributions made by the current workforce. When increased ageing of the population becomes even greater these type of plans become less suitable as they tend to be unsustainable. Many countries have already adapted different plans and use Defined Contribution Plans in order to solve that problem. We have to accept that the future will evolve towards this type of pension systems and so we must become aware of the best possible ways to adapt such programs.

It is clear that individuals are pressured into creating their own savings and making their own investment decisions. What is important is to realize whether all individuals are in fact capable of doing so in a way that will best serve them. By showing these types of behavioral biases one

can safely conclude that a large majority of individuals exist that do not always make the most rational decisions as possible and as such are not always left better off.

Defined Contribution Plans are a good option in allowing individuals to choose their own investment and saving decisions generally. However, public policies could help steer individuals in the right direction and the pension context seems to be a sector that could highly benefit from this.

If pension plan design is moving towards participant choice then it is assumed that the individual making the choice is well informed and will rationally decide towards achieving the maximization of his/her self-interest. The answers to this thesis' survey proved otherwise. Public policy is crucial for the development of new and more efficient pension systems.

7. References

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