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When and How?

Behavioral Challenges to the Retirement Decision

Inauguraldissertation
zur Erlangung des akademischen Grades
eines Doktors der Wirtschaftswissenschaften
der Universität Mannheim

vorgelegt im Herbst-/Wintersemester 2014/2015

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Tag der mündlichen Prüfung: 12.11.2014

Für Marga und Jürgen

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Acknowledgements

This thesis is the result of a three years and eight month working period during my time at the University of Mannheim between 2011 and 2014. I have to thank many for their encouragement and help during this period.

I am greatly indebted to my supervisor, Prof. Dr. Dr. h.c. Martin Weber, for most helpful suggestions, numerous discussions, and invaluable motivating support. Also Prof. Dr. Dr. h.c. Martin Weber made the cooperation with the Frankfurter Allgemeine Zeitung possible. Without this cooperation, the empirical analysis presented in this thesis would not have been possible. Many thanks are also due to Prof. Dr. Peter Albrecht, my second examiner.

I appreciate insightful remarks by David Becker, Dr. Christian Ehm, Dr. Justus Heuer, Dr. Heiko Jacobs, Dr. Christine Kaufmann, Philipp Marquardt, Dr. Christoph Merkle, Dr. Sebastian Müller, Dr. Sven Nolte, Tobias Regele, Dr. Ulrich Seubert, Martin Siddiqui, Dr. Daniel Smith, Dr. Sascha Steffen, Tianyi Zheng, and seminar participants at the University of Mannheim.

I am very grateful to the Frankfurter Allgemeine Zeitung for conducting the study with us. Intensive discussion with two journalists, Anne-Christin Sievers and Patrick Bernau, helped to considerably improve the questionnaire used in this thesis. Also I would like to thank many unnamed referees, discussants as well as participants at about a dozen conferences for their valuable suggestions and comments.

Chapter 1

General Introduction

1.1 Motivation

In 2007, a *google* search on the term "retirement planning" resulted in about 1.2 million hits, giving guidance for decisions regarding saving and investment for retirement (see Brown, 2007). Seven years later, in 2014, the same google search results in over 24 million hits, showing the importance and rapid development in this area. However, the main focus still lies on the wealth accumulation part of retirement planning whereas how to spend retirement savings only gets little attention. The same picture emerges in the scientific literature. The majority of research on retirement planning deals with strategies for wealth accumulation and problems thereof. Thereby, the literature can be split in two categories. The first category studies common saving and investment mistakes by individual households. Typical examples, for insights emerged from this category, are the findings that individuals are underdiversified (e.g. French and Poterba, 1991), underlie the equity home bias (e.g. Coval and Moskowitz, 1999) and tend to sell winner assets too early and hold losers too long (e.g. Weber and Camerer, 1998). The second category applies principles from psychology and behavioral finance to develop tools to overcome these common mistakes. For example, Madrian and Shea (2001) show that individuals savings rate can be increased by simply changing the savings decision from an opt-in to an opt-out decision. Moreover, reducing the investment choices within a retirement plan can increase participation: offering workers too many investment choices can produce "choice overload" and increases the complexity of the decision. As a result, pension plan participation is reduced (Sethi-Iyengar et al., 2001). Probably the most famous example is the "Save More Tomorrow" program by Thaler and Benartzi (2004). They showed that retirement savings can be heavily increased by applying a combination of different principles from psychology and behavioral economics. The program became a success in a midsized manufacturing company and as a result, it is now offered by more than half of the large employers in the United States, and a variant of the program was incorporated in the Pension Protection Act of 2006 (Benartzi, 2011).

The intake of psychological and behavioral aspects into the savings and investment decision literature contributed to a better understanding of individual behavior. However, these aspects only slowly enter the literature dealing with decisions made close to retirement. When retirement is near, two decisions become important: 1) one has to think about *when* to retire, i.e. plan the retirement age. 2) When entering retirement, one has to decide *how* to spend the accumulated savings. On an individual level, these decisions belong to the economically most important decisions in ones life since they influence the financial well-being for a long time. As stated by Brown (2007):

> "*While wealth accumulation is an important ingredient in any financial plan, it is not sufficient to ensure financial well-being in retirement. A particularly glaring shortcoming of the focus on wealth accumulation is that it fails to consider how ones assets will be converted into a stream of consumption in retirement. A comprehensive retirement planning strategy requires that one think more than about how to save: it also requires thinking about how to spend.*"

This thesis contributes to the literature by studying the retirement decision (*"when and how"*) from a behavioral economics point of view. Thereby, depending on the type of pension insurance, the question when to retire or how to retire is more pronounced. Therefore, in the following I will descirbe the German pension system and the decisions accompanied by when retiring. The German pension system is based on three pillars. 1) The mandatory state pension insurance (*gesetzliche Rentenversicherung*), 2) the occupational pension insurance which is provided within an employer-employee relationship (*betriebliche Altersvorsorge*) and 3) private pension insurance (*private Altersvorsorge*). In the following, the development and importance of each of the three pillars is illustrated. Furthermore, from the view of an individual decision maker, it is outlined which decisions he or she faces when entering retirement and which consequences arise with respect to each pillar.

1) State pension insurance

The necessity of a social security system became apparent at the end of the nineteenth century. Until then, old-age provision was provided within an extended family. The employed generation provided financial support for both, their children and parents. However, with the industrial revolution the, until then, classical family structure was replaced by smaller families. The few employed family members, therefore, could not provide enough income anymore (see e.g. Rosen and Windisch, 1997). As part of the "social law", Otto van Bismarck introduced the German pension system in 1891. On account of this, Germany has the oldest formal pension system in the world.

After the second world war, the statutory pension insurance system was fundamentally reformed. To mention are important reforms of 1957, 1972, 1992 and 2007[1]. In 1957, the wage-indexed pension formula was introduced. Pensions were tied to the gross income of the workforce. Therefore, also retirees could benefit from the general development of wages. To finance pensions, the system was shifted to a pay-as-you-

[1] After 1972, the pension system has also been reformed in 1978, 1983, 1984, 1986, 1997, 1998, 1999, 2000, 2001, 2002, 2003 and 2004.

go system where pensions are financed through contributions made by those still actively employed. This reform lead to a well-financed pension system and therefore, in 1972, the system was opened up to the the self-employed and to housewives. In addition, flexible age limits, depending on the occupation, have been introduced and a minimum-income pension was established. However, these reforms weighed heavy on the system and twenty years later additional reforms were necessary. In 1992, it was decided that the wage-index should not be based on the gross income anymore, but on the net income (see e.g. Wolter, 2002). Moreover, the entry coefficient which represents a penalty for early retirement, was introduced to take pressure off the pension system. However, an increasing life expectancy combined with low birthrates made an additional reform necessary. In 2007, a stepwise increase of the full retirement age to 67 was decided. Before 2007, the full retirement age has been 65 [2].

The legal basis for the currently valid form of the pension system is the social act (*Sozialgesetzbuch*, SGB). In particular, laws regarding the pension system are formulated in the 6^{th} book of the social act (SGB, VI). With the system in place, the amount of monthly pension payments (MP) depends on the product of four factors (see §64, SGB VI):

(1) Number of accumulated earning points.

(2) Entry coefficient.

(3) Pension coefficient.

(4) Current pension value.

The number of earning points (EP) a person accumulates each year depends on his or her gross income. The gross income is divided by the average gross income in Germany to calculate the number of EPs in a specific year (see §70, SGB VI). Thereby, two specific features have to be taken into consideration: 1) The maximum number

[2] The reform of 2007 is described in more detail in chapter 3.

of EPs per year is restricted by the income threshold (*Beitragsbemessungsgrenze*). In 2013 the maximum number was about 2.1. 2) To account for wage differences between the eastern and western states of Germany, the EPs of East German inhabitants are multiplied by a constant factor. In 2014, the factor amounts to 1.1873 according to §254d, SGB VI and attachment 10, SGB VI.

The second factor of the pension formula, the entry coefficient (EC), is determined by the age of the claimant. If social security benefits are claimed at the full retirement age, the EC amounts to 1.000. For each month benefits are claimed before the full retirement age, the EC is reduced by 0.003. Claiming after the full retirement age results in an increase of 0.005 per month (§77 SGB VI). For example, claiming pension benefits 2 years prior to the full retirement age would result in an EC of $1 - 2 \cdot 12 \cdot 0.003 = 0.928$.

The pension coefficient (PC) only plays a minor role in this thesis. It depends on the type of pension benefits claimed. For old-age pensions the PC equals 1 (§67, SGB VI). Other forms are for example pension because of reduced earning capacity (PC=0.5) or orphan's pension (PC=0.2). In all studies presented in this, thesis old-age pensions are regarded. Therefore, the PC is neglected in the following analyses.

The last factor, the current pension value (CPV), is the link between the pension benefits and the general wage development. Each year, on July 1^{st}, the CPV is determined. According to §68, SGB VI, new pension value (CPV_t) is calculated as the product of the old pension value (CPV_{t-1}) with the change in 1) the gross income per employee, 2) the contribution to the pension system and 3) a factor which relates the number of employees to the number of retirees (*Nachhaltigkeitsfaktor*). In 2014, the CPV amounts to 28.61.

Following the formula presented in §64, SGB VI, monthly pension payments (MP) are calculated as $MP = \sum EP \cdot EC \cdot PC \cdot CPV$. If old-age pensions are considered, the PC equals one and the formula simplifies to $MP = \sum EP \cdot EC \cdot CPV$. Since the

CPV is determined by the government, the individual facing the retirement decision has no influence on it. The only two factors he or she can influence are the entry coefficient and the earning points. Both increase if retirement is delayed and decrease if benefits are claimed earlier. Therefore, the main decision regarding the first pillar is the answer to the question: "*When* should I retire and claim social security benefits?" Chapter 3 and 4 focus on factors that influence that decision.

2) Occupational pension insurance

The occupational pension insurance is an employer-employee contract where the employer commits to support the employees old-age provision. The legal basis is the occupational pension law (*Betriebsrentengesetz*, BetrAVG), which came into force in 1974. As in many countries, the commitment of the employer can be of two types: 1) A defined benefit (DB) plan or 2) A defined contribution (DC) plan (§1, BetrAVG). In a DB-plan, pension benefits are determined by a formula which takes into account the number of years of employment and the wage or salary (e.g. Bodie et al., 1988). Therefore, the employer promises a specified monthly benefit as long as the employee is alive. On the other hand, in a DC-plan, the employer commits to make a contribution into an individual account for each employee. In most cases, also the employee contributes some amount into that account. All contributions are then invested and investment returns are credited to the account to which the employee has access at retirement. Benefits depend on the total contributions and investment earnings of the accumulation in the account (Bodie et al., 1988).

From the point of view of an employee, the main advantage of the DB-plan is that it provides a certain income stream in retirement as long as the employee is alive. Therefore, the DB-plan provides insurance against longevity. From the point of view of an employer, however, DB-plans are costly: in years of low earnings or if the number of employees entering retirement increases, retirement benefits heavily affect the firm's financial well-being. Since DC-plans do not guarantee a certain retirement benefit but a certain contribution during the employee's working life, they provide less uncertainty and financial risk for the employer. Therefore, in most countries, a shift from DB- to DC-plans can be observed (e.g. Pang and Warshawsky, 2010).

The shift to DC-plans puts more responsibility on the employee. During the accumulation phase, he or she has to undertake several investment decisions. Also, at retirement, the account holder hast to decide how to transform the the account balance into a stream of consumption in retirement. One way of doing so is purchasing a life annuity. Annuities are financial contracts designed to insure against longevity risk by allowing an individual to exchange a lump sum of wealth for an income stream that is guaranteed to last for the rest of the annuitant's life (Brown, 2007). Therefore, regarding the second pillar of the German pension system, one of the main questions an individual has to answer at retirement is "*how* to transform accumulated wealth into a stream of consumption." Chapter 2 of this thesis concentrates on behavioral factors that influence the answer of this particular question.

3) Private pension insurance

In the past ten years, the third pillar of the German pension system, the private pension insurance, became more and more important. Reasons therefore are the first pillar being under pressure due to unemployment, a decrease of the overall volume of work, the demographic change, and the costs of the German reunification (see Miegel, 2000). This leads to a decrease in trust towards the social security system (e.g. Föste and Janssen, 1997; DIA, 2002). Politics reacted to this development by introducing different tax-deductible and government-sponsored private pension schemes. The two most famous schemes are called Riester-Rente and Rürupp-Rente and were introduced in 2002 and 2005, respectively. The legal basis is the Altersvermögensgesetz, AvmG. Besides these government-sponsored pension schemes, any scheme into which individuals contribute from their earnings is classified as a private pension insurance. In many cases, investments are made into saving schemes or mutual funds run by insurance companies.

The private insurance market offers a very diverse set of products and investment opportunities. However, most of these products only differ in the accumulation phase. What they have in common is that, with the beginning of the retirement phase, the retiree faces the decision how to transfer the accumulated wealth into consumption. Similar to the second pillar, the main question when entering retirement is *how* to best consume the accumulated wealth (chapter 2).

In summary, the decision *when* to retire and *how* to consume during retirement are studied in this thesis. Thereby, the focus lies on behavioral factors that influence these decisions. In particular, the influence of time preferences and the presentation format of the decision is studied. The next section will give a brief introduction in the time preference literature.

1.2 Time preferences

Almost every decision in our everyday life can be classified as an intertemporal choice - a decision involving tradeoffs among costs and benefits occurring at different times (Frederick et al., 2002). This applies for day-to-day decisions such as deciding where to have lunch as well as for more important decisions such as investing a certain amount into a pension plan. In the lunch case, for example, the tradeoff can be between the *immediate* benefit of tasty but unhealthy fast food and the possible weight gain that occurs some days *later*. The investment for a pension plan represents the tradeoff between today's and future consumption.

The idea of intertemporal choice was first introduced by John Rae (1834), who studied wealth differences among nations and identified the "*desire of accumulation*" as an important factor. In the nineteenth and early twentieth century, many scholars were concerned with the idea of intertemporal choice and considered time preferences as an interaction of different motives and factors (for example Jevons, 1888; Böhm-Bawerk, 1989; Fisher, 1930)[3]. This view changed when Samuelson (1937) introduced

[3]For a detailed overview of the development in the nineteenth and early twentieth century see Frederick et al. (2002) p.352–355.

the discounted utility model (DU-model). The model incorporates all motives and factors into a single discount rate, δ. Today's utility (U_0) of an outcome at a future date t (x_t) is described as:

$$U_0 = \delta_t \cdot U(x_t).$$

Furthermore the DU-model describes a decision maker's utility over consumption profiles ($x_0, \cdots, x_T$) by:

$$U_0 = \sum_{t=0}^{T} \delta_t \cdot U(x_t)$$

Even though if Samuelson himself was concerned about the normative and descriptive validity of his model (" *In the first place, it is completely arbitrary to assume that the individual behaves so as to maximise an integral of the form envisaged in [the DU-model].*") it became the most prominent framework for intertemporal choice. This development is mainly owed to two features of the DU-model. First, its simplicity and analytical tractability and second, its axiomatic foundation by Koopmans. Koopmans (1960) showed that the model can be derived by a set of intuitive axioms. In addition to Koopmans (1960), also Lancaster (1963), Fishburn (1970), Meyer (1976), Fishburn and Rubinstein (1982) and others presented an axiom system for the DU-model. The main axioms of Koopmans (1960) are:

(1) Continuity
(2) Sensitivity
(3) Non-Complementarity (independence)
(4) Stationarity

Thereby, axioms (1) to (3) are standard axioms in utility theory. In brief, the continuity axiom states that slight variations in a consumption profile do not lead to drastic changes in the utility assigned to it. Sensitivity requires that utility assigned to a profile can be changed by changing the consumption vector in any particular period (Koopmans, 1960, p. 290). The non-complementarity or independence axiom states that if there are two consumption profiles that differ only in one period, then the identical periods are not relevant when comparing the two profiles.

The most famous and most discussed axiom is axiom (4), stationarity. It says that the preference relation between two consumption profiles remains the same if both profiles are put forward or backward in time. For example, assume a decision maker prefers the consumption profile $C^A = (x_0, x_1, \cdots, x_T)$ over the profile $C^B = (x_0^{'}, x_1, \cdots, x_T)$. If now both profiles are shifted forward by $n = 1$ period, the *stationary* decision maker will also prefer profile $C^{\overline{A}} = (0, x_0, x_1, \cdots, x_T)$ over $C^{\overline{B}} = (0, x_0^{'}, x_1, \cdots, x_T)$. This implies that the discount rate between any two consecutive periods t and $t + 1$ has to be constant. For example, consider two profiles with consumption over two periods, C_{today} and $C_{tomorrow}$. Each profile, thereby, only consists of one outcome with $C_{today} = (x_0, 0)$ and $C_{tomorrow} = (0, x_1)$. Then, with respect to time preferences, only the time distance between the two outcomes (today vs. tomorrow) but not how far these outcomes are away from today matters for the preference relation. Or, as stated by Kirby and Herrnstein (1995):

> "*if you would like a chocolate bar next Tuesday twice as much as an apple next Wednesday, you would like them in the same ratio for successive Tuesdays and Wednesdays a month, a year, or 10 years from now.*"

The only discount function that fulfills the stationary axiom is the exponential discount function. Therefore, the DU-model can be written as:

$$U_0 = \sum_{t=0}^{T} \delta_t \cdot U(x_t), \text{ with } \delta_t = \frac{1}{(1+\rho)^t}.$$

In the late twentieth century, researchers started to empirically study time preferences of human and animal subjects. One of the first studies was conducted by Ainslie and Herrnstein (1981)[4]. They studied the behavior of six male white Carneaux pigeons. The subjects were trained to chose between a smaller but earlier reward and

[4]The study builds on an analysis by Chung and Herrenstein (1967).

a larger reward received later by pecking on the respective button. In the first setting, the earlier reward was received immediately and the later was delayed by 4 seconds. All subjects preferred the smaller reward on all trails. In the second setting, both rewards were delayed by 2, 4, 6, 8, 10 or 12 seconds. For all subjects in almost every trail a preference reversal for the later outcome could be observed. This behavior conflicts with the idea of stationarity since only the time difference between two outcomes should matter for the decision. However, for the Carneaux pigeons, it was also important how far the outcomes were away from right now (immediate consumption).

Solnick et al. (1980) were the first to investigate preference reversal in human behavior. In their study, the reward was a period of silence during a 180 seconds interval of noise. The results supported the idea of preference reversal since the small, immediate reward was preferred when no delay was added, but the larger, later reward was preferred when both rewards were delayed. These results were confirmed by many other studies with different types of rewards and delays (see for example Millar and Navarick, 1984; Green et al., 1994; Kirby and Herrnstein, 1995).

One way of explaining the phenomenon of preference reversals is a declining discount rate. Thaler (1981) elicited discount rates from human subjects by asking them to state the amount of money, received in T month, that would make them indifferent to receiving 15 USD today. Thereby, T could take the values 1 month, 12 month and 120 month. On average, the implied annual exponential discount rate declined from 345 percent (T=1) over 120 percent (T=12) to 19 percent (T=120)[5]. A discount function that incorporates declining discount rates, which can lead to preference reversals, has to be more convex compared to the exponential function. From the *hyperbolic* shape of such a function the term “hyperbolic discounting” or “hyperbolic discount function” originated. Such a function in most cases fits the observed data better than an exponential function (see e.g. Howard et al., 1991; Myerson and

[5] Similar results were obtained by Redelmeier and Heller (1993), Chapman and Elstein (1995), Pender (1996) and Chapman (1997).

Green, 1995; Kirby and Marakovic, 1995; Kirby, 1997; Ahlbrecht and Weber, 1997; Abdellaoui et al., 2010).

Since the late twentieth century, the influence of hyperbolic discounting on intertemporal choice has been studied for many economic and non-economic decisions. The axiomatic foundation of the hyperbolic discount function by Loewenstein and Prelec (1992) as well as the introduction of quasi-hyperbolic discounting by Laibson (1997) and O'Donoghue and Rabin (1999) helped to speed up the development[6]. The main feature of the quasi-hyperbolic discount function is its good analytical tractability without giving up the main properties of the general hyperbolic function. With this tool at hand, the relevance of how individuals perceive and weight time became more and more apparent. In the following, a few examples will be given[7]:

- Hyperbolic discounting on an aggregate level can explain, among other things, the comovement of consumption and income (Laibson, 1997) as well as declining national savings rates in developed countries (Laibson et al., 1998).
- On an individual level, Meier and Sprenger (2010) find that people who behave as if they would discount the future hyperbolically are more likely to have credit card debt and to have higher amounts thereof. They also delay debt paydown more frequently (Kuchler, 2014), participate less in financial literacy programs (Meier and Sprenger, 2013) and use illiquid savings (Ashraf et al., 2006; Beshears et al., 2011) and deadlines (Ariely and Wertenbroch, 2002) as a commitment device.
- Time preferences can explain individuals workout patterns (DellaVigna and Malmendier, 2006).
- Medical studies find that smokers have decreasing discount rates over time and therefore put too much weight on immediate rewards and costs even in tasks

[6]Thereby, Laibson (1997) and O'Donoghue and Rabin (1999) build on the work of Strotz (1955), Phelps and Pollak (1968) and Akerlof (1991).

[7]For a detailed overview, see for example DellaVigna (2009) and Kuchler (2014).

not related to smoking (see for example Bickel et al., 1999; Baker et al., 2003; Reynolds and Fields, 2012).

The above list only abstracts a very small fraction of the time preference literature and is meant to give an idea of the importance in economic and day-to-day decisions. This thesis extends the literature by relating time preferences with the retirement decision.

1.3 Cooperation with the Frankfurter Allgemeine Zeitung

Most of the empirical analysis in this thesis is based on an online survey conducted in cooperation with the Frankfurter Allgemeine Zeitung (FAZ). In particular, the online department of the FAZ (FAZ.NET) agreed to post a link to our survey on their website. The survey ran on a server, independent from FAZ.NET. In addition, in the weekly print edition, which is published every Sunday (Frankfurter Allgemeine Sonntagszeitung, FAS), the survey was promoted twice. Readers of FAZ.NET and FAS could participate from October 14^{th}, 2012 to November 5^{th}, 2012. The FAS promoted the survey on Sunday, October 14^{th} and Sunday, October 28^{th}. Appendix A.1 presents the first promotion in the print edition and appendix A.2 presents the survey. Since participants are assigned to different treatments, appendix A.2 is only exemplary.

Figure 1.1 shows the distribution of participants per hour over the first five days. After the survey went online, the link was placed very prominent on the first page of FAZ.NET. Therefore, the majority of participants participated at the first two days ($N_{Sunday} = 2,076$ and $N_{Monday} = 1,157$). Afterwards, when new articles were posted and the survey was moved further back, participation flatted rapidly. From Tuesday, 16^{th} to Thursday, 18^{th} only 321 participants came on top. From Friday, 19^{th} until the end of the survey participation stayed on a very low level (not reported in figure 1.1). Also the second promotion in the print edition did not help to boost participation again. Overall, 3,077 participants filled out the survey up to the last page. However, not all of them answered every question and therefore, observations are below 3,077 for most variables. A detailed summary statistic will be given in chapter 2. In addition, since different aspects of the survey are of interest for different research questions, also chapter 3 and 4 describe specific parts of the survey in detail.

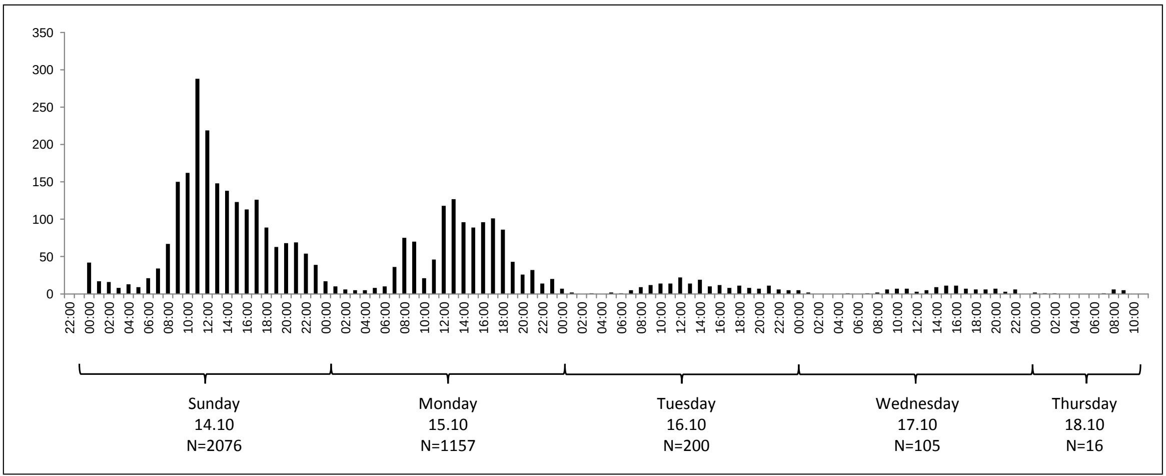

Figure 1.1: **Participants per hour**

1.4 Outline of the thesis and main results

In this thesis, three main research questions are studied:

(1) Which individual specific factors influence the annuitization decision? What is the role of time preferences in general and specifically hyperbolic discounting?

(2) How does the way in which the retirement decision is presented influence the decision when to retire? Can the presentation format be used to induce a greater actual retirement age?

(3) Do hyperbolic time preferences empirically lead to a time inconsistent retirement decision? Is the temptation of early retirement stronger, the closer retirement comes?

Chapter 2 (joint work with Martin Weber) studies the decision whether to have the balance of a retirement savings account paid out as a lump sum or to annuitize this amount (*annuitization decision*). Thereby, the main focus lies on the influence of time preferences: a hyperbolic decision maker exhibits impatience towards the near future but is patient when it comes to outcomes in the more distant future. Relating this feature of empirically observed time preferences to the annuitization decision shows that theoretically the age at which the decision is made should be important. Young people should prefer to annuitize retirement benefits whereas older individuals should prefer the lump sum. Hyperbolic discounting leads to undervaluation of earlier payments and overvaluation of later payments (compared to exponential discounting). Older decision makers expect less later payments than young decision makers, simply due to a shorter remaining lifetime. Therefore, older hyperbolic decision makers overvalue fewer expected payments and the annuity seems unattractive to them. We test this hypothesis using the online survey described above (FAZ survey) and find that indeed young people have a strong preference for annuities whereas older people tend to prefer lump sum payments. This effect is considerably stronger for survey participants that answer simple time preference questions inconsistently. These findings suggest to think about precommitment devices for the annuitization decision.

The third chapter (joint work with Martin Weber) stands out in the sense that the research question does not focus on time preferences. It relates the willingness-to-accept (WTA)/ willingness-to-pay (WTP) disparity to the retirement decision and shows that the presentation of the decision problem strongly influences the decision when to retire. According to standard theory, under a few assumptions, the maximum price a decision maker is willing to pay for a specific good (WTP) should equal the minimum price at which he or she accepts selling the good (WTA). In the retirement context, the good of *early retirement* is considered. We show that in this case the willingness-to-accept is more than twice as high as the corresponding willingness-to-pay. Using the reduction in German social security benefits for early retirement as a market price also shows that the presentation of the retirement decision as a willingness-to-accept problem can induce early retirement. In addition, also the cause for the WTA/WTP disparity is analyzed. It is shown that the disparity gets stronger with stronger loss aversion of participants. However, this is due to a significant decrease of the WTP. The WTA is not affected by loss aversion. The main results are robust when the analysis is repeated with a representative panel survey for Germany (SAVE panel).

Chapter 4 (joint work with Martin Weber) analyzes the empirical relation between the decision when to retire and time preferences. Implications proposed in recent theoretical work about the influence of quasi-hyperbolic discounting on the savings and retirement decision of individuals (e.g. Zhang, 2013; Findley and Feigenbaum, 2013) are tested. These studies suggest that hyperbolic discounting leads to an inconsistent retirement decision. Thereby, inconsistent retirement means that an individual initially plans on working until a specific retirement age but then reverse his plan by actually retiring before that planned retirement age. Therefore, dynamic inconsistent decision makers will decrease their planned retirement age with increasing age. The main analysis is carried out using the FAZ survey and the SAVE panel. To test for dynamic inconsistency three main analyses are performed: 1) the effect of age on the planned retirement age is considered. 2) In a panel framework we track individuals over time and analyze the effect of ongoing time on the planned retirement age. 3) The effect of different proxies for hyperbolic discounting on the actual retirement age of retirees is studied. The analysis shows that participants of both studies decrease their planned retirement age with increasing age. The temptation of early retirement seems to get stronger, the closer retirement comes. In a panel specification, it is shown that the result is not driven by birth cohorts. Analyzing the actual retirement decision of retirees, we find that on average participants classified as hyperbolic discounters retire 2 years earlier. This behavior has consequences for the financial well-being during retirement: the German pension system punishes an early retirement of 2 years by a constant decrease of about 12% in monthly pension benefits. These results indicate that, even after controlling for demographics and personal characteristics, time preferences strongly influence the budget in retirement.

Chapter 2

Time Inconsistent Preferences and the Annuitization Decision

2.1 Introduction

Winning the state lottery of California is a beautiful thing but it is accompanied by a tough decision: The SuperLOTTO Plus jackpot can either be paid out in 26 annual installments or as one big lump sum payment[1]. Unfortunately, most of us won't have to deal with this kind of decision problem as a consequence of winning the jackpot of some national lottery. However, at time of retirement people are increasingly faced with the decision to take out a lump sum of money from their retirement account or to opt for an annuity payment (for example in 401(k) plans). Based on standard theoretical analysis, people should opt for the annuity payment to maximize expected utility. However, empirically people by a vast majority opt for the lump sum, both in the retirement and lottery case. This behavior is called the "annuity puzzle". Since Yaari (1965) there has been plenty of research focusing on how to model the observed behavior in the retirement case, i.e. explain the annuity puzzle. But even the intake of a bequest motive, background risk, incomplete markets, adverse selection and many

[1] The jackpot payment options can be found on the official California Lottery website.

other factors only partly explains the low demand for annuities. One aspect which all these models have in common is that they assume rational behavior of modeled agents. Brown (2007) states that "*[. . .] the mixed success of explaining annuitization behavior in a fully rational context suggests that other factors are at play.*" These others factors can be found in the behavioral economics literature of retirement saving and planning. The recent literature on the annuity puzzle incorporates factors such as framing, loss aversion, endowment effects and others to explain real life decisions.

In this paper, we focus on peoples' time preference and its importance in a choice between a monthly payment and a lump sum payment. It is well known that decision makers time preferences can best be described by hyperbolic discounting (see for example Ainslie and Herrnstein, 1981; Thaler, 1981; Benzion et al., 1989; Ahlbrecht and Weber, 1997). Hyperbolic discounting leads to strong discounting for outcomes in the near future and subsequently weaker discounting for distant ones which might lead to time inconsistent behavior.

To our knowledge, a connection between time preferences and the annuitization decision has not been studied yet. We investigate which annuitization decisions are implied by hyperbolic discounting and test this implication using a questionnaire study. We conduct a large online survey in cooperation with one of the biggest German newspapers, "Frankfurter Allgemeine Zeitung" (FAZ). Throughout the whole study subjects had to choose between a lump sum payment and a fair annuity. We used two conditions: In what we call the immediate case, subjects are asked to choose between a lump sum paid out today and a (fair) annuity also starting today (comparable to the decision problem when winning the California lottery). In the future case, participants choose between an annuity starting at retirement age and a lump sum also received when entering retirement. Each subject was asked to choose between the annuity and the lump sum followed by a consecutive question to choose an annuitization rate between 0% and 100% in steps of 10%. Note that, by definition, the expected value of the lump sum is equal to the expected value of the fair annuity.

Taking hyperbolic discounting into account, simple calculations show that older people will prefer the lump sum over the annuity. The effect reverses for younger people where hyperbolic discounting leads to a preference for annuity payments. This is true for the immediate and the future decision.

The data shows that in both cases young people have a strong preference for annuities whereas older people tend to prefer lump sum payments. We find an increase of about 20% in annuitization from the oldest 10% to the youngest 10%. Also, the annuitization rate increases by about 12% from the oldest to the youngest decile. This finding is in line with other studies empirically investigating real and hypothetical annuity choices (see Brown et al., 2013; Hurd and Panis, 2006; Beshears et al., 2012; Shu et al., 2013). The age effect gets stronger for participants whose answers to simple time preference questions indicate that they follow stronger hyperbolic discounting. Since a negative effect of age on the annuity demand can not only be driven by hyperbolic discounting but also other factors, we rule out these other explanations by introducing and confirming two further hypotheses that are specific to hyperbolic discounting. It is shown, that the results indeed are driven by participants time preferences.

Further results show that risk preferences and subjective life expectancy are important factors to understand the annuitization decision. The more risk averse participants are, the less likely they are to choose the lump sum leading to a corresponding increase in the annuitization rate. Comparing the most risk averse to the least risk averse participants results in a difference of about 15% points in probability of choosing the annuity. The effect of subjective life expectancy is strong. We find that the longer someone expects to live the more likely he/she is to annuitize.

The findings are particular important as people face the annuitization decision late in life and therefore, following hyperbolic discounting, are more likely to choose a lump sum. In the future case, the switch of preferences can be seen as a self-control problem of participants as they make the optimal decision (according to expected utility theory) when thinking about what to choose in the future but they reverse the decision once the day of the actual decision has arrived. These results imply that there are two ways to increase annuitization. 1) By introducing a commitment device allowing people to bind or precommit their behavior (see Strotz, 1955). If people choose the lump sum because of self-control problems a precommitment device is a powerful tool to help people overcome this problem (see for example Thaler and Shefrin, 1981; Laibson, 1997; Beshears et al., 2011). This would also have the advantage of a reduced adverse selection problem: real life annuities pay only about 80% - 90% of the fair annuity value, where part of this deduction is due to adverse selection as potential annuity buyers have more information about their own life expectancy. However, if people would be able to make a binding annuity choice in younger years, the information asymmetry regarding their future condition would be reduced. The annuity seller could offer annuities closer to the fair value and create an incentive to make a binding decision. 2) Making it mandatory to determine the payout scheme at the beginning of the contract when people are (still) young and not at retirement, is another way to increase real life annuitization rates. Reversing this decision has to be associated with a cost (either monetary or effort-wise, e.g. paperwork).

2.2 Overview of related literature

Yaari (1965) was the first to extend the standard life-cycle hypothesis and include mortality risk. He showed that in a model of rational decision making, a risk averse individual with no bequest motive should annuitize 100% of his wealth to maximize utility. This result was confirmed forty years later by Davidoff et al. (2005) in a model with less restrictive assumptions. In contrast to these results the empirically observed annuitization rates are very low[2]. As a consequence, a large body of work concentrates

[2] See for example Health and Retirement Study (HRS) 1998 - 2008, Buetler and Teppa (2007) or for a summary Johnson et al. (2004).

on explaining these low rates of annuitization. In the following it is distinguished between the "rational" and "behavioral" reasons against full annuitization:

2.2.1 Rational aspects

a) Bequest motive

If an individual wants to leave a bequest it is not optimal for him/her to fully annuitize because annuity payments immediately stop after death. Friedman and Warshawsky (1990) study a model of saving and annuity demand and find that a bequest motive in combination with actuarial unfairly priced annuities can reduce annuity demand. Ameriks et al. (2011) also conclude that the bequest motive is an important factor to determine the individual annuity demand. In contrast, Hurd (1989) finds that the utility of a bequest is small and therefore desired bequests are small on average. He also finds that elderly households with children do not dissave more rapidly than those without children and concludes that both households have the same (small) interest in leaving a bequest. Brown (2001) examines a life-cycle model of consumption and finds that neither the presence of children nor the self reported bequest motive has any influence on the annuity demand.

b) Family compensation

Kotlikoff and Spivak (1981) compare family insurance with perfect market insurance and find that family insurance can substitute a considerable proportion of the market insurance. Brown and Poterba (2000) find that the utility gain from annuitization is smaller for couples than it is for single individuals. Also, Brown (2001) finds that marital status is an important source of variation in the annuity decision, with married couples being less likely to annuitize.

c) Background risk

Horneff et al. (2009) build a framework where the investor faces uninsurable shocks to housing, medical expenses, health, and income during the work life and retirement.

They find that these uninsurable shocks increase the preference for liquid savings (e.g., bonds) only marginal. Also, Pang and Warshawsky (2010) find that health shock risk leads to precautionary savings and a shift from risky equities to riskless bonds. But with increasing age, annuities become superior to equity and bonds even in the presence of health shock risk.

d) Further rational aspects

Other possible explanations are adverse selection problems and the resulting unfair annuity prices (Mitchell et al., 1999; Murthi et al., 2000; Finkelstein and Poterba, 2004; Brunner and Pech, 2006), incomplete annuity markets (Davidoff et al., 2005) and the crowding out of private annuitization by the government (Mitchell and Moore, 1998; Dushi and Webb, 2004; Purcal and Piggott, 2008). Despite all the efforts to explain the annuity puzzle, the success of the studies and models described above is only moderate. Even models that incorporate most of the previously mentioned factors can explain only parts of the low demand for annuities. Therefore, it seems logical to search for additional factors that may help to understand the puzzle.

2.2.2 Behavioral aspects

The more recent literature has a focus on behavioral considerations which potentially could influence the annuity demand. The most prominent factors are loss aversion and framing. Hu and Scott (2007) calculate reservation prices for annuities under the standard expected utility model (EUT) and under cumulative prospect theory (CPT). Results show that under expected utility reservation prices are always above one, indicating that the annuity is attractive for the EUT-decision maker. Under CPT, because of loss aversion, almost all values are below one and therefore the annuity seems unattractive to the CPT-decision maker.

Brown et al. (2008) examine framing as a possible explanation for low annuity demand. They argue that under a consumption frame an annuity should be attractive because it serves as a form of insurance. But under a narrow investment frame the annuity can appear riskier than a bond for example, because it's payments depend on a random variable (i.e. time of death). Results of their survey study show, that if people were presented an annuity in a consumption frame, the majority chooses the annuity (72%). In contrast, when people were faced with the same decision problem in an investment frame, only 21% preferred the annuity. Agnew et al. (2008) also find strong effects of framing on the annuitization decision. In addition Benartzi et al. (2011) examine the fixed, immediate payout annuity market and also propose loss aversion and framing (among others behavioral explanations) as an explanation for the low annuity demand.

Further aspects are the complexity of annuity products (Brown et al., 2012) and myopic extrapolation of stock market returns (Previtero, 2012; Chalmers and Reuter, 2012).

From a marketing perspective Shu et al. (2013) show that some attributes of an annuity (e.g. a period-certain guarantee) are particular important as they seem to affect decision makers utility beyond their influence on the actuarial present value of the annuity.

2.2.3 Hyperbolic discounting and measuring time preferences

Hyperbolic discounting

Most of the theoretical work dealing with the annuity puzzle assumes rational behavior and all of it assumes that investors have stationary time preferences. According to Koopmans (1960), the only discount function that fulfills these assumptions is the exponential discount function given by $\delta(t) = \delta^t$ with $\delta \in (0, 1]$. The stationarity of the exponential discount function leads to the constant discount rate $\delta = \frac{\delta^t}{\delta^{t-1}}$ between two consecutive periods. In the 1980s scientists started eliciting discount rates from decision tasks with different subjects[3]. Many studies find anomalies in behavior compared to what a stationary discount function would predict (e.g., Thaler, 1981;

[3]The first experiments were conducted with pigeons (see for example Ainslie and Herrnstein, 1981) and the observed effects correspond with the effects observed later in human behavior.

Benzion et al., 1989; Ahlbrecht and Weber, 1997). One of the most robust findings is that individual's exhibit impatience in their decisions. This leads to strong discount rates for outcomes that are in the near future and weak discount rates for more distant ones. Thaler (1981) describes this behavior with the following example:

(A) Choose between: (A1): One apple today and
(A2): Two apples tomorrow.
(B) Choose between: (B1): One apple in one year and
(B2): Two apples in one year and one day.

If A1 over A2 is preferred stationarity would imply that B1 over B2 is preferred. However almost nobody chooses B1 over B2 whereas some people might prefer A1. This inconsistent behavior can't be explained by exponential discounting.

One way of dealing with this phenomena is by assuming a hyperbolic discount function with relatively high discount rates for outcomes in the near future and relatively low discount rates for distant outcomes (see for example Ainslie, 1975; Loewenstein and Prelec, 1992; Kirby and Marakovic, 1995; Frederick et al., 2002). Strotz (1955) was one of the first to analyze declining intertemporal discount rates in a theoretical framework. He showed that if discount rates are not constant, a planner will not stick to the optimal plan evaluated at some point in time t. This plays an important role in the literature dealing with self-control problems. People with low self-control put too much weight on the near future disregarding long-term costs and benefits. For example, DellaVigna and Malmendier (2006) find that most people plan to attend the gym on a regular basis when signing the membership contract, but actual attendance is much lower (for further evidence on self-control problems see DellaVigna, 2009; Beshears et al., 2011). One way to overcome these problems is to bind or precommit one's own behavior (see for example Strotz, 1955; Thaler and Shefrin, 1981; Laibson, 1997; Sorger, 2007). However, commitment devices are only useful if the decision maker is aware of his self-control problem, which means that he is not a *naive* but a *sophisticated* hyperbolic discounter. This distinction between naive and sophisticated decision makers is important for possible policy implications of our results and will be discussed in more detail in section 2.6.

Time preferences also seem to matter in many other economic and non-economic fields. For example, Meier and Sprenger (2010) find that people who behave as if they would discount payments hyperbolically are more likely to have credit card debt and to have higher amounts thereof. Meier and Sprenger (2013) find that hyperbolic decision makers participate less in financial literacy programs. Medical studies find that smokers have decreasing discount rates over time and therefore put too much weight on immediate rewards and costs even in tasks not related to smoking, see for example Bickel et al. (1999).

Measuring time preferences

In experimental economics choice based and matching based approaches are popular (see Hardisty et al., 2013). Choice methods ask participants in a set of questions to choose between a smaller earlier payment (or reward) and a later larger payment. Thereby the later payment is constantly increased or the earlier payment constantly decreased to find participants switching point, which is then used to calculate a lower and a upper bound for the discount rate. The matching approach in contrast directly asks for indifference points. Participants have to state which earlier payment would make them indifferent to later payments or vice versa. This has the advantage that not only an upper and lower bound but an exact discount rate can be calculated. Frederick et al. (2002) present a broad discussion of further advantages and disadvantages of these two methods. To test for hyperbolic discounting in both methods payments (the earlier and later) are delayed by the same amount of time. Declining discount rates for the delayed payments are treated as evidence of hyperbolic discounting. We follow the standard eliciting procedure in decision analysis literature (see for example Ahlbrecht and Weber, 1997; Sayman and Oencueler, 2009)[4].

2.3 Hypotheses

In the following, we derive five hypotheses about how time preferences influence the annuitization decision. In the analysis, a decision maker who has to choose between a lump sum and an annuity is considered. The starting point is the expected present value (EPV) of the annuity. By definition the EPV of a fair annuity equals the lump sum if the decision maker has exponential time preferences. This is compared to a decision maker who follows hyperbolic discounting. In this case the absolute EPV and also its change with the decision maker's age will be regarded. The EPV presents a natural starting point for our analysis as therewith an easy comparison of the annuity with the lump sum is possible. In addition, the EPV is a well known and simple method to value investment decisions. Brown et al. (2008) show that peoples tendency to perceive an annuity as an investment can help to understand the low empirical annuitization rates. We therefore also abstain from introducing a consumption based model. Also, introducing risk preferences would lead to a preference for the annuity (for an EU-maximizer) and would make the annuities more preferable in all cases (for exponential and hyperbolic decision makers). We base the formal analysis on risk neutrality as we are primarily interested in the effect of time preferences[5]. We regard fair annuities as it is already well known from prior studies that unfair prices decrease the annuity demand (e.g. Mitchell et al., 1999; Finkelstein and Poterba, 2004).

In the analysis two conditions are used: the first case is called the "immediate case" where we take a look at immediate annuities, meaning that a decision maker has to decide between an annuity starting today and a lump sum also received today. The second case is the "future case". In this scenario the person faces the decision

[4] Very recently a new procedure to elicit time preference has been proposed by Andreoni and Sprenger (2012) which caused ongoing debate about (see Epper and Fehr-Duda, 2014; Drichoutis and Nayga, 2013)

[5] In addition we elicit risk preferences in the survey and control for them in the empirical analysis.

between an annuity starting at retirement age and a lump sum also received when entering retirement. To be precise, the future case looks at an immediate annuity starting at retirement age but being evaluated today by a x year old decision maker with x being less than retirement age.

2.3.1 Discount functions

To derive the hypotheses we assume a specific form of the hyperbolic function. In general, discount functions can be written as $DF = (1+i)^{-\alpha(t)}$ with i being an interest rate and $\alpha(t)$ being a function that describes how time is perceived (see Ahlbrecht and Weber, 1997). For example, if time is weighted in a linear way and $\alpha(t) = t$ we arrive at the exponential discount function. In the following two further discount functions are considered. First, the Harvey (1986) discount function with $\alpha(t) = \frac{r}{\ln(1+i)} \ln(1+t)$ leading to $DF_{Harvey}(t) = (1+t)^{-r}$. [6] Second, the quasi-hyperbolic discount function proposed by Phelps and Pollak (1968) and Laibson (1997) with $\alpha(t) = t + \frac{\ln(\frac{1}{\beta})}{\ln(1+i_Q)}$ and therefore $DF_{QHB} = \beta(1+i_Q)^{-t}$. Figure 2.1a graphs the exponential function, the Harvey function and the quasi-hyperbolic function. In this example an interest rate of $i_{EXP} = 4.5\%$ is chosen[7]. The parameter r is calculated in such a way that the hyperbolic and exponential function assign the same weight to period 15. For the quasi-hyperbolic function $\beta = 0.7$ and $i_Q = 2.04\%$ are chosen to also assign the same weight to period 15 (see Laibson et al., 2003). It can be seen that both the Harvey and the quasi-hyperbolic function lead to stronger discounting in earlier periods compared to the exponential function. Therefore, hyperbolic decision makers are often described as *present biased* as they have a strong preference for immediate outcomes.

Figure 2.1b presents the values for the functions $\alpha(t)$. Discounting exponentially implies $\alpha(t) = t$. Also, the quasi-hyperbolic function leads to a linear function $\alpha(t)$

[6] Note that the Harvey function is a special case of the general hyperbolic function $DF = (1+\gamma t)^{-\frac{\alpha}{\gamma}}$ proposed by Loewenstein and Prelec (1992) with $\gamma = 1$ and $\alpha = r$.

[7] 4.5% is used as this is the average return German insurance companies yielded on their assets in the last 10 years (2002 - 2012).

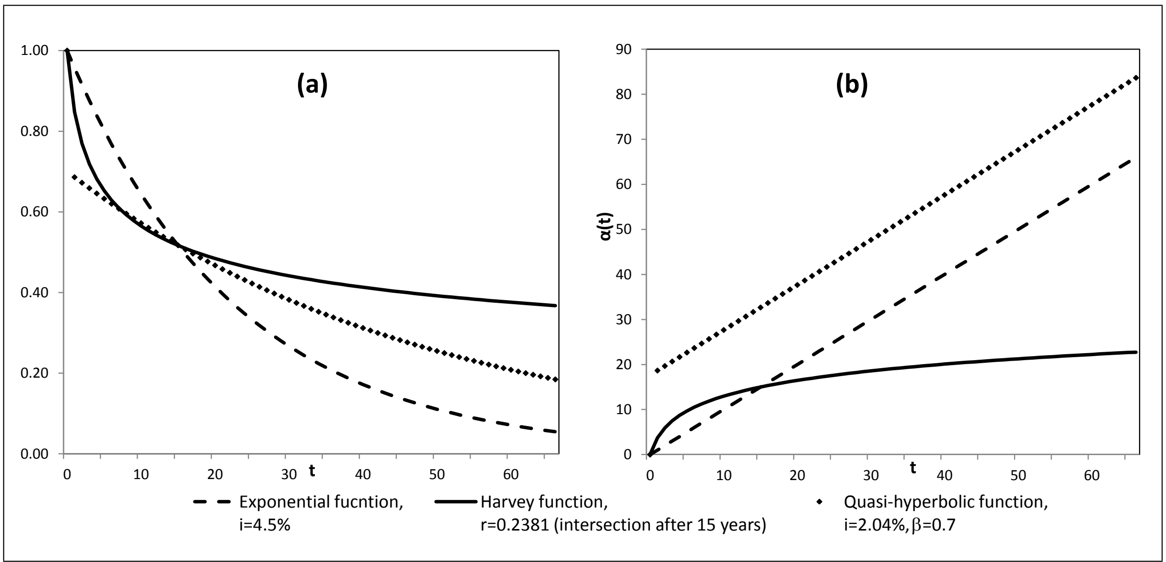

Figure 2.1: **Discount functions.** Figure 1a reports the exponential discount function $DF_{EXP}(t) = (1+i)^{-t}$ with $i = 4.5\%$, the Harvey function $DF_{HB}(t) = (1+t)^{-r}$ with $r = 0.2381$ and the quasi-hyperbolic discount function with $i = 2.04\%$ and $\beta = 0.7$. Figure 1b reports the function $\alpha(t)$ for the three discount functions.

for $t > 0$. Only the Harvey function leads to a non-linear weighting of time as in this case $\alpha(t)$ is a logarithmic function. This implies that, e.g., the time difference between period 4 and 5 is weighted larger than the difference between periods 14 and 15. The quasi-hyperbolic function is designed for easy analytical tractability and therefore, only introduces the hyperbolic feature between period 0 and 1. Afterwards the quasi-hyperbolic and exponential function are identical. As the decision whether to take a lump sum or an annuity also affects the very distant future the features of the Harvey function are especially useful for our analysis. In addition, Abdellaoui et al. (2010) test the validity of different discount functions and find that the Harvey (1986) model fits their data best. Therefore, we use the Harvey (1986) approach with $DF_{HB}(t) = (1+t)^{-r}$. The exponential function is defined as $DF_{EXP}(t) = (1+i)^{-t}$ with i being the interest rate.

2.3.2 Hypothesis 1: the age effect

Hypothesis 1a - immediate case

We consider an immediate annuity that pays a yearly amount of y and a decision maker who has to choose between this annuity and a lump sum L (paid out immediately). Let $p(x+t|x)$ be the probability of an x year old person being alive after t additional years. Assuming for the purpose of simplicity that the maximum age is 120 leads to $p(x+t > 120|x) = 0, \forall\ x$. Discounting future annuity payments exponentially with interest rate i leads to the following expected present value of the immediate annuity:

$$EPV_{EXP}(x) = y(x) \sum_{t=0}^{120-x} p(x+t|x)(1+i)^{-t} \tag{2.1}$$

If the annuity is fair the EPV of the annuity equals the lump sum[8]. Therefore:

$$y^{fair}(x) = \frac{L}{\sum_{t=0}^{120-x} p(x+t|x)(1+i)^{-t}} \tag{2.2}$$

Now consider an investor who discounts future payments hyperbolically. The EPV of the fair annuity is:

$$EPV_{HB}(x) = L\frac{\sum_{t=0}^{120-x} p(x+t|x)(1+t)^{-r}}{\sum_{t=0}^{120-x} p(x+t|x)(1+i)^{-t}} \tag{2.3}$$

We compare the expected present value of the annuity, following hyperbolic discounting, with the lump sum payment L. Figure 2.2 displays the difference $D(x) = EPV_{HB}(x) - L$ for $x \in [0, 1, \ldots, 66]$, three hyperbolic parameters and a lump sum payment of $L = 100,000$ EUR. The maximum age x for which $D(x)$ is calculated is 66.

[8] For the derivation of all hypotheses fair annuity payments $y(x)^{fair}$ are assumed. Using actuarial unfair monthly payments $\varphi y(x)^{fair}$ with $\varphi \in (0;1)$ only scales all annuity payments by the factor φ but does not change the hypotheses.

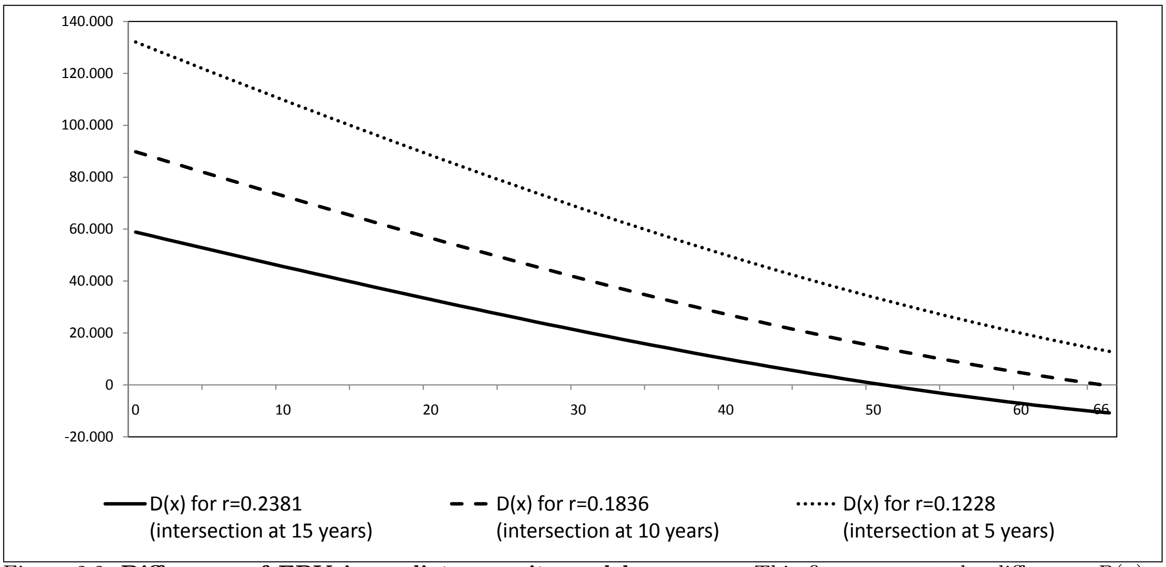

Figure 2.2: **Difference of EPV immediate annuity and lump sum.** This figure reports the difference $D(x)$ of the expected present value of a fair immediate annuity and a lump sum payment of $L = 100,000 EUR$ for a hyperbolic decision maker. "Intersection" indicates for which period the weight of the hyperbolic function equals the weight of an exponential discount function with $i = 4.5\%$.

The graph shows that for all parameters r, the relation between the decision maker's age and the difference of the EPV_{HB} of the annuity and the lump sum is negative. As the lump sum payment is constant, this implies a decreasing EPV_{HB} with age. For example, the difference between the EPV_{HB} of the annuity and the lump sum for a 20-year old hyperbolic decision maker is about 33,000 EUR (for $r = 0.2381$), in favor of the annuity. If the same decision is made 46 years later at the age of 66, the difference shrinks by 43,000 EUR to about -10,000 EUR, leading the decision maker to now prefer the lump sum. Note that for exponential time preferences $D(x) = 0$ for all x. Therefore, it follows for hypothesis 1a that:

H1a: The hyperbolic decision maker's age has a negative effect on the attractiveness of fair, immediate annuities.

The critical age at which the difference $D(x)$ becomes negative depends on the parameter r. For larger parameters the critical age gets smaller (see figure 2.3). For example, if $r = 0.3841$ it holds that $D(0) = 0$ and $D(x) < 0$ for all $x > 0$. Abdellaoui et al. (2010) estimate different discount functions and find a hyperbolic parameter of

$r = 0.19$. For this parameter the critical age is at about 64 years. This is important in particulars, as most people face the annuitization decision at about that age.

The intuition behind this hypothesis is as follows: hyperbolic discounting leads to undervaluation of earlier payments and overvaluation of later payments (compared to exponential discounting). Older decision makers expect less later payments than young decision makers, simply due to a shorter remaining lifetime. Therefore, older hyperbolic decision makers overvalue fewer expected payments and the annuity seems unattractive to them.

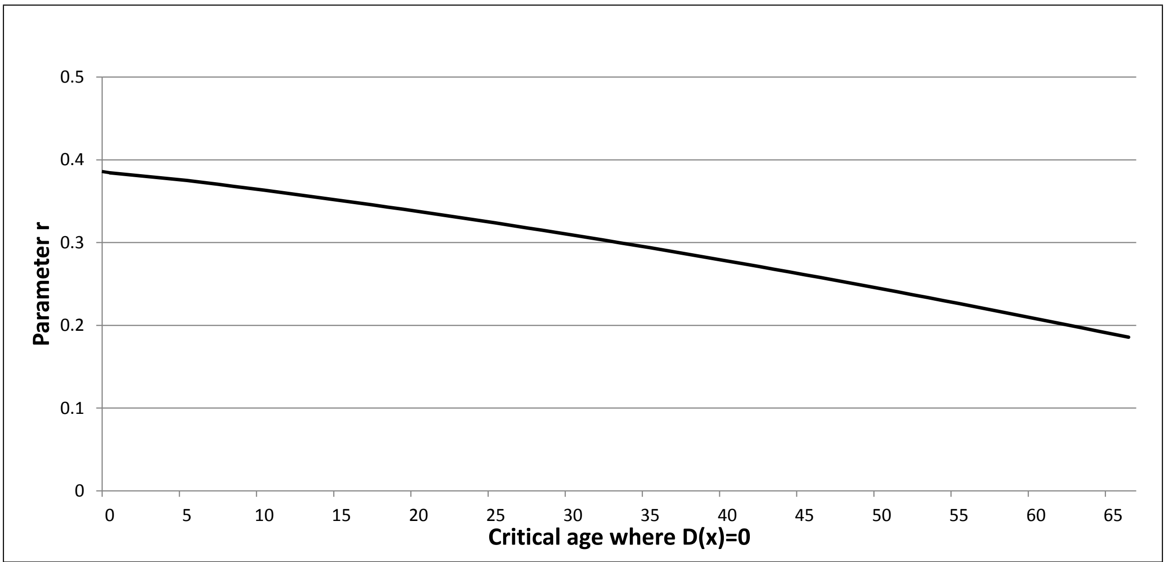

Figure 2.3: **Critical age dependent on hyperbolic discounting parameter r.** This figure reports the critical age for which $D(x) = 0$ dependent on the parameter r of the hyperbolic discount function $DF_{HB} = (1 + t)^{-r}$.

Hypothesis 1b - future case

In the future case, the decision maker has to decide today between an annuity starting at the age of 66 (retirement age) and the corresponding fair lump sum also received at the age of 66. Using equation (2.2) the fair annuity payment conditional on reaching the age of 66 is:

$$y^{fair}(66) = \frac{L}{\sum_{t=0}^{(120-66)} p(66 + t|66)(1 + i)^{-t}} \quad (2.4)$$

For exponential discounting, the EPV of the annuity for an x-year old investor is:

$$EPV_{EXP}(x) = y \sum_{t=0}^{(120-66)} p(66+t|66)(1+i)^{-(t+66-x)} \tag{2.5}$$

Now consider a decision maker who follows hyperbolic discounting. The EPV of the annuity is:

$$EPV_{HB_a}(x) = L\frac{\sum_{t=0}^{(120-66)} p(66+t|66)(1+(t+66-x))^{-r}}{\sum_{t=0}^{(120-66)} p(66+t|66)(1+i)^{-t}} \tag{2.6}$$

To compare $EPV_{HB_a}(x)$ with the lump sum, the EPV of the lump sum is calculated:

$$EPV_{HB_L}(x) = \frac{L}{(1+(66-x))^r} \tag{2.7}$$

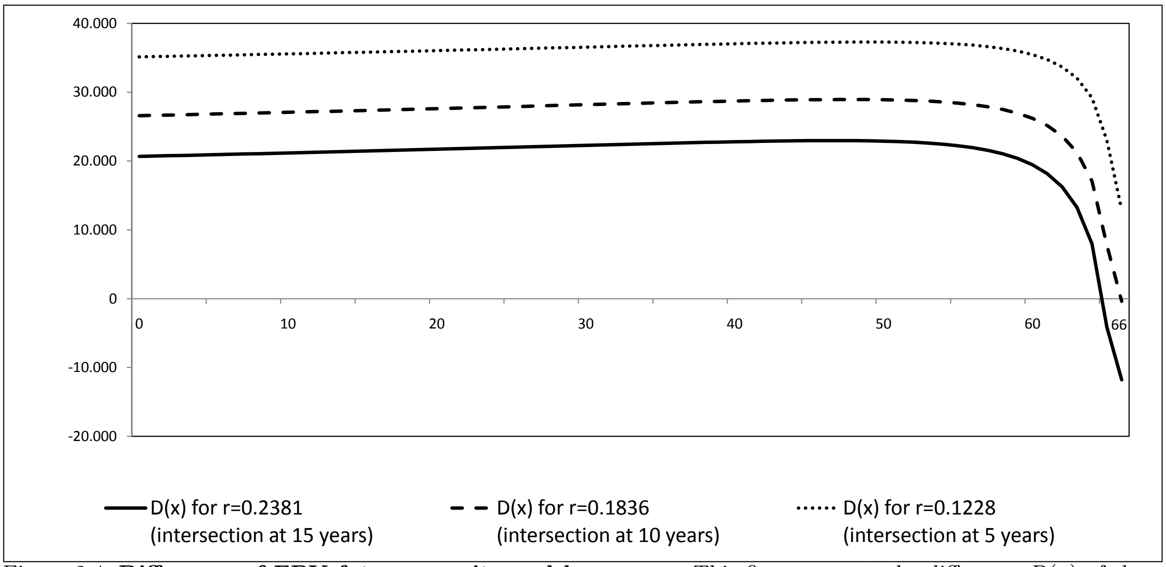

Figure 2.4: **Difference of EPV future annuity and lump sum.** This figure reports the difference $D(x)$ of the expected present value of a fair future annuity and a future lump sum payment of $L = 100,000EUR$ for a hyperbolic decision maker. "Intersection" indicates for which period the weight of the hyperbolic function equals the weight of an exponential discount function with $i = 4.5\%$.

Figure 2.4 displays the difference $D(x)$ between the EPV of the annuity ($EPV_{HB_a}(x)$) and the EPV of the lump sum ($EPV_{HB_L}(x)$) for $x \in [0, 1, \ldots, 66]$, three hyperbolic parameters and a lump sum payment of $L = 100,000$ EUR. With increasing age, D(x) is also increasing until a critical age (depending on the paramter

r) is reached. After that point D(x) strongly declines with age. Overall the relation between age and the EPV of the annuity is negative:

> *H1b: The hyperbolic decision maker's age has a negative effect on the attractiveness of fair, future annuities.*

2.3.3 Hypotheses 2-4: is the age effect driven by hyperbolic discounting?

We are aware that a possible negative effect of age on the annuity demand can be driven by many factors and not only hyperbolic discounting. For example, the uncertainty of ones lifespan is decreasing with age and therefore, an annuity could be more attractive in younger years. In this case we control for the subjective life expectancy in the analysis, however, it is not difficult to come up with other possible explanations for an age effect. Therefore, three further hypothesis which are specific to hyperbolic discounting are derived to empirically rule out other explanations.

Hypothesis 2 - immediate vs. future condition

When the immediate case is comapred to the future case it can be shown that the effect of age should be different in the two cases: In the immediate case the EPV of the annuity monotonically decreases with the decision makers age (figure 2.2). In the future case however, we expect a structural break in the age gradient: if the age effect is caused by hyperbolic discounting, no effect should be observed for younger participants, whereas a negative effect should be present for participants with age above 50 (figure 2.4)[9]. This leads to hypothesis 2:

> *H2: There will be a structural break in the age gradient only in the future case.*

[9]The exact age at which the structural break should be observed depends on the exact form of the hyperbolic discount function. This is taken into account in the empirical analysis.

Hypothesis 3 - time inconsistent vs. time consistent decision makers

According to the definition of the fair annuity, the age effect should only be prevalent for participants that behave time inconsistent. This should be true for both, the immediate and the future case:

> *H3: Decision maker's age only has a negative effect for a sample consisting of time inconsistent participants and no effect for time consistent participants.*

Hypothesis 4 - Harvey function parameter estimation

The last hypothesis takes into account the specific form of the Harvey (1986) function with $DF_{Harvey}(t) = (1+t)^{-r}$. It is considered how changes in the hyperbolic parameter r influence the expected present value of the annuity. For the immediate case the first derivative of the difference between the expected present value of the annuity and the lump sum payment, i.e. $D(x) = EPV_{HB} - L$, with respect to r is negative (see B.1). For higher values of r the annuity becomes less attractive. However, in the future case the sign of the derivative depends on r itself. Therefore, only the effect of changes in r in the immediate case are considered. In addition the difference between $D(x+1)$ and $D(x)$ is taken into account. B.2 shows that the derivative of $\Delta D(x) = D(x+1) - D(x)$ with respect to r is positive indicating that an increase in r results in an increase in $\Delta D(x)$. This also means that the (negative) difference between $D(x+1)$ and $D(x)$ gets smaller. If the previous results are caused by hyperbolic discounting a smaller difference between $D(x+1)$ and $D(x)$ should result in a weaker age effect.

> *H4: Higher values of the hyperbolic parameter r decrease the attractiveness of the annuity and weaken the age effect in the immediate case.*

2.4 Survey design and summary statistics

2.4.1 Survey design

To test the hypotheses developed in section 2.3 an online survey was conducted in cooperation with the "Frankfurter Allgemeine Zeitung (FAZ)". The FAZ promoted our survey in the print edition and posted a link on their online portal. To avoid biasing potential participants, the FAZ agreed to only promote and post the link and to write an article about the topic after the study was finished. 3,077 participants with age ranging from 18 to 86 completed the survey in on average 11 minutes. Participants were asked to make hypothetical choices about retirement planning and to answer a set of questions regarding their time preferences, demographics and some additional control questions. In particular, the survey asked participants to choose between a monthly payment (annuity) and a lump sum in two different scenarios: in the immediate case, subjects chose between a lump sum paid out today and a fair annuity also starting today. In the future case, participants chose between an annuity starting at retirement age and a lump sum also received when entering retirement. Each participant was randomly assigned to one of the two scenarios. As a robustness test a further question is introduced where he/she had to choose an annuitization rate between 0% and 100% in steps of 10%.

Retirement scenario

The retirement scenario was designed to test the future case. Participants were asked: "Imagine you plan to retire at age 66 . At this time your retirement account has a balance of EUR L to which you then have access to. There are two ways to withdraw the money." Option 1 was a lump sum payment and participants were told that they will receive the whole account balance on retirement. Option 2 was a fair annuity and participants were told that option 2 guarantees a monthly payment of EUR y as long as they are alive. We randomly varied the amount L between subjects from EUR 100,000 to EUR 1,000,000 in five steps and calculated EUR y as the fair monthly annuity at age 66 with respect to gender assuming a constant interest rate of 4.5% . Table 2.1 shows the payout options for the five different amounts of L. After participants made their decision we changed the possible payout options in a consecutive question. Now participants could determine annuitization rates in 10% steps from 0% to 100%[10]. The amount L remained the same as in the previous question and participants could always see to what payouts their decision would lead.

Lottery scenario

The lottery scenario tests the immediate case. Participants are asked the same two questions as explained above with two important differences. 1) They are told that they won an amount of L in the national lottery today and that they have to choose the payout scheme. The major difference here is that the payments in this scenario start immediately (and not at age 66). 2) To calculate the fair annuity gender, an interest rate of 4.5% and the actual participants' age is used. Therefore 83 different fair annuities (for ages 18 to 100) per gender are calculated. Note that the lottery and retirement scenario presented the same situation for participants at age 66. We again varied L between subjects from EUR 100,000 to EUR 1,000,000 in 5 steps.

Amount (L) in EUR	**Fair monthly annuity male at age 66**	**Fair monthly annuity female at age 66**
100,000	763.76	649.08
300,000	2,291.28	1,947.24
500,000	3,818.80	3,245.40
700,000	5,346.32	4,543.56
1,000,000	7,637.60	6,490.80

Table 2.1: **Annuity choices.**Possible choices between a lump sum of L and the corresponding fair annuity. We assumed a constant interest rate of 4.5% and used latest life tables for Germany. The objective life expectancy for a 66 year old male (female) was 82.74 (85.84).

Retirement vs. lottery scenario

The two scenarios differ in the point in time at which payments are received and in the wording. In the immediate case the word "lottery" is used, whereas in the future case we use the word "retirement". To test the effect of differences in wording, we

[10]This implies that an annuitization rate of 60% corresponds to 60%·y paid out every month and 40%·L being paid out as a lump sum.

consider a subsample of participants with an age close to 66 (see section 2.5). Besides wording, for these participants there is almost no difference between the immediate and the future case as payments in the latter case start at age 66. A second concern one could have regarding the lottery scenario is that winning a national lottery is a very rare event and therefore not in participants mindset. However, a representative study conducted by the Federal Centre for Health Education (BZgA) in 2011 shows that about 65% of the 16 to 65 year old participants ever played the national lottery and that more than 50% participated in the last year. Also the drawing of the winning numbers is broadcasted live on television since 1965 each Saturday evening and should therefore also be present in peoples mindset.

Time preferences

As stated earlier, there is no clear evidence which method of eliciting time preferences leads to the best results. Therefore we choose a procedure that is as simple as possible but allows to distinct between subjects that behave time consistent and subjects that are time inconsistent (see Harrison et al., 2002; Ifcher and Zarghamee, 2011; Meier and Sprenger, 2013). In a choice-based task, participants had to decide between a tax refund T that is obtained earlier and a refund T(1+i) that is obtained later in time. In three questions the earlier payment is received immediately and the later one is received in 10 months with $i = 3.3\%$, 11.3% and 31.3%. The second set of questions uses the same interest rates with the difference that all payments are shifted 18 months into the future (earlier payment in 18 months, later in 28 months). If participants have time consistent preferences only the difference between the two payments (10 months for all questions) should matter and for each interest rate the decision between the earlier or later payment should be the same. All six questions are displayed on the same screen, put in a pair-wise manner together (paired by interest rate) and participants are made aware of the fact that there are no right or wrong answers.

For the survey we used hypothetical choice questions. There are three reasons for this: 1) using real money choices can lead participants do consider future payments as uncertain and therefore a present-bias or hyperbolic discounting pattern can be generated even for subjects with time consistent preferences (see for example Read, 2005; Sutter et al., 2013) 2) real stakes can also cause a self-selection problem. If real money is paid it could be that subjects that are in need of immediate money are attracted and results are biased in the direction of hyperbolic discount (see Noor, 2009; Sutter et al., 2013) and 3) there is no clear evidence that incentivized decisions lead to better results (see Frederick et al., 2002).

Controls

We use participants self-reported loss and risk attitude to proxy for loss and risk aversion. Earlier studies find that self-reported risk attitude on a Likert scale is a good predictor of actual risk taking (see e.g. van Rooij et al., 2011; Nosic and Weber, 2010). On a seven-point Likert scale participants have to agree to the statements "I'm a risk averse person" as a measure for risk aversion and "I'm very afraid of losses" as a measure of loss aversion.

To elicit a financial literacy score, participants answer six questions (see appendix C.1). We choose one of the basic questions from Lusardi and Mitchell (2007), three advanced questions from van Rooij et al. (2011) and develop two more complicated questions on our own. We do so because the FAZ newspaper has a focus on financial markets and previous studies find that subjects, with similar characteristics are remarkable financially literate. (see Mueller and Weber, 2014).

One of the most important factors that influences the annuitization decision should be individuals' subjective life expectancy. The method of the Survey of Consumer Finances and Mirowsky (1999) is adopted. Participants are asked (directly) to think about their life expectancy and give an estimate thereof.

In addition participants indicate at what age they plan to retire, if they own private pension insurance and how they rate the certainty of social security benefits guaranteed by the government today.

2.4.2 Summary statistics

Table 2.2 displays summary statistics on subjects annuitization decision, demographics, time preferences and controls. We excluded subjects with age above 66 as in the later analysis only participants up to that age are considered[11]. More than half of the participants (57%) choose the annuity in the simple 0/1 framework and the average person chooses an annuitization rate of 56%. The option to partially annuitize makes annuities more attractive as for this question almost 80% of participants choose to annuitize at least to some extend, confirming Beshears et al. (2012). The average age is about 42 years (median 43) and participants are between 18 and 66 years old. Men are overrepresented in our study (83% male) reflecting the fact that the majority of FAZ readers are male (62%) and that men are more likely to participate in online surveys of our kind (see Mueller and Weber, 2014). Subjects report a relatively high after tax income of about EUR 3,400 (median 3,000) per month (compared to a German average after tax income of about EUR 1,470 in 2011[12]) and are well educated with 91% having received the German equivalent to a high school diploma and 66% having graduated from a university. Half of the participants are married. Also, in section 2.5.3 we analyze if our results are driven by this high income - high education dataset.

Given a fixed interest rate, peoples' choices are defined as inconsistent if they choose the earlier payment in the today-setting and the later payment in the 18-month-setting. Depending on the interest rate (3%, 11% or 31%), between 18% and 25% of participants made an inconsistent decision of which about 7% of participants always chose inconsistently.

[11] Also 2 participants which were younger than 66 but have already been retired are excluded.
[12] Source: German Federal Statistical Office 2012

Variable	**Mean**	(Median)	**Std. Dev.**
Annuity Choice			
Annuity 0/1	0.57		0.50
Annuitization Rate	0.56		0.37
Demographics			
Age	41.77	(43.00)	13.16
Gender	0.83		0.37
Income	3,443.41	(3,000.00)	3,162.56
Number of Children	0.84		1.19
High School Degree	0.91		0.28
University Degree	0.66		0.47
Married	0.51		0.50
Time Preferences			
Time Inconsistent i=3%	0.20		0.40
Time Inconsistent i=11%	0.25		0.44
Time Inconsistent i=31%	0.18		0.39
Always inconsistent	0.07		0.26
Controls			
Risk Aversion (1-7)	3.90		1.47
Loss Aversion (1-7)	4.30		1.60
Financial Literacy Score van Rooij (0-4)	3.49		0.73
Financial Literacy Score Extra (0-2)	0.59		0.73
Life Expectancy (Males)	83.29		8.02
Life Expectancy (Females)	83.87		7.43
Planed Retirement Age	64.70		4.53
Owns Private Pension Insurance	0.63		0.48
Certainty of Social Security (1-7)	3.05		1.82

Table 2.2: **Online survey summary statistics.** Included are participants with age below 67. Number of observations vary between 2672 (income) and 2944.

Asking participants about their risk- and loss aversion on a 1 to 7 Likert scale leads to an average of 3.90 and 4.30 respectively. As expected, participants did extremely well in standard financial literacy questions with on average 3.49 / 4 correct answers. Introducing the two more difficult questions helped to separate the sample as subjects answered only 0.59 / 2 questions correctly. Directly asking participants about their subjective life expectancy leads to estimates which, with an average of 83.29 years for male participants, are above the objective life expectancy for an average German male and, with 83.87 for female participants, are close to the average objective life expectancy[13]. However, as the life expectancy increases with wealth and education, we can not conclude whether participants overestimate or underes-

[13]The average male participant in our sample is 43.61 years old, the average female participant is aged 40.14 years old. Using the latest German life tables a 43.61 year old German male on average lives until the age of 78.76 and a 40.14 year old German female on average lives until the age of 83.19.

timate their personal objective life expectancy. The average planned retirement age of about 65 is close to the actual retirement age in Germany.

2.5 Results and robustness

The empirical results are presented in three steps: 1) results regarding the effect of age on the annuitization decision are presented. 2) three tests of whether the age effect is indeed driven by participants time preferences are presented. 3) the section closes with two robustness tests.

2.5.1 Results - Hypothesis 1: the age effect

In the following analysis we investigate the immediate case (lottery scenario) as well as the future case (retirement scenario). One might be concerned that possible differences arise as a consequence of the different wording in the two scenarios ("lottery" vs. "retirement"). For participants with an age close to 66 the only difference between the two cases is the wording ("lottery" or "retirement"). Table 2.3 presents results of a logistic regression with participants choice in the 0/1 framework (1=annuity, 0=lump sum) as dependent variable and age(c), a scenario dummy (0=lottery, 1=retirement) and the interaction between age(c) and scenario as explanatory variables. The analysis is restricted to participants with an age between 61 and 66. The variable age(c) is the mean-centered age of participants in this subsample. Centering the age variable is necessary as otherwise the null effect of the scenario dummy would be the effect for age equal to zero (see Irwin and McClelland, 2001; Spiller et al., 2013). The interaction coefficient and t-value are calculated based on Norton et al. (2004). Neither the scenario nor the interaction of age and scenario have a significant effect on the annuitization decision in this subsample.

Table 2.4 presents results of two logistic regressions where the dependent variable again is a dummy that equals 1 if subjects chose the annuity and 0 if they chose the lump sum in the 0/1 framework. Column 2 and 3 present results for participants

Variable	**Coeff.**	**Std. Error**
Age(c)	-0.245**	0.116
Scenario	-0.366	0.258
Interaction Age(c)-Scenario	0.029	0.037
N=254		

Table 2.3: **Lottery vs. retirement: results of logistic regression**. Dependent variable is annuity0/1, an indicator variable that equals 1 if participants choose the annuity and 0 if they choose the lump sum. ***, ** and * indicate significance on the 1%, 5% and 10%-level. Sample consisting only of participants aged between 61 and 66. Age(c) is the mean-centered age variable for this subsample.

in the lottery scenario (immediate case) and columns 4 and 5 present results for the retirement scenario (future case). For both scenarios coefficients and odds ratios are reported. An odds ratio above one can be interpreted as the factor by which the odds of choosing the annuity increases for any person[14]. In both scenarios the negative effect of age is highly significant and economically strong with coefficients of -0.024 and -0.020, respectively. To understand the magnitude of this effect the odds ratio of the age coefficient in the lottery scenario is taken into account. A value of 0.976 implies, that the odds of choosing the annuity decrease by 2.40% per year. Note that this effect is constant and not dependent on values of the other explanatory variables. In the retirement case the effect is slightly weaker with an odds ratio of 0.980 translating to an decrease in odds of choosing the annuity by 2.00% per year. In both scenarios older participants tend to choose the lump sum whereas younger participants prefer the annuity. Therefore, the main hypotheses 1(a) and 1(b) are confirmed. This finding is in line with previous studies which analyzed the annuitization decision: Brown et al. (2013) find a negative age effect using real decisions from Croatian retirees who had to choose between an immediate pension payment or a larger stream of delayed payments. Hurd and Panis (2006) study data form the health and retirement study and find that the probability of cashing out a defined contribution plan increases with age. In addition, Beshears et al. (2012) and

[14]For example, if person X is 40 years old and has a 30% probability of choosing the annuity, the odds of choosing the annuity for this person are $\frac{30\%}{70\%} = 0.43$. An odds ratio now gives the change in the odds of choosing the annuity if age is increased by one unit. To be precise, the odds ratio in this example reports the ratio between the odds of choosing the annuity for a 41 year old and a 40 year old person. An odds ratio of 1.1 for example translates to odds of choosing the annuity of $0.43 \cdot 1.1 = 0.473$, resulting in a new probability of choosing the annuity of 32%. The odds ratio can range from 0 to ∞ with an odds ratio of 1 implying no effect of the explanatory variable.

Shu et al. (2013) also find a negative effect of age on the attractiveness of annuities using a hypothetical questionnaire study.

Annuity 0/1	***Lottery Scenario***		***Retirement Scenario***	
	(immediate case)		*(future case)*	
Variable	**Coeff.**	**Odds Ratio**	**Coeff.**	**Odds Ratio**
Demographics				
Age	-0.0243***	0.9760	-0.0202***	0.9800
Gender	0.0038	1.0038	-0.1580	0.8538
Income (log)	0.0912	1.0955	0.1001	1.1053
Number of Children	-0.0157	0.9844	-0.0852	0.9184
High School Degree	-0.3998	0.6704	0.1440	1.1549
University Degree	0.0489	1.0501	0.2038	1.2260
Married	-0.1380	0.8711	-0.0919	0.9122
Controls				
Risk aversion (1-7)	0.1309**	1.1399	0.0749	1.0777
Loss aversion (1-7)	-0.0442	0.9568	-0.0412	0.9596
Financial Literacy Score (0-6)	0.0332	1.0337	0.0490	1.0502
Life Expectancy	0.0442***	1.0452	0.0563***	1.0579
Planed Retirement Age	0.0010	1.0010	-0.0012	0.9988
Owns Private Pension Insurance	0.1495	1.1613	0.5719***	1.7717
Certainty of Social Security	0.0501	1.0514	0.0655	1.0677
Magnitude Controls				
Magnitude2 (lump sum = 300k)	0.1481	1.1596	-0.1890	0.8278
Magnitude3 (lump sum = 500k)	-0.3348	0.7155	-0.0211	0.9791
Magnitude4 (lump sum = 700k)	-0.2401	0.7865	-0.4242*	0.6543
Magnitude5 (lump sum = 1,000k)	-0.0386	0.9621	-0.4711**	0.6243
Magnitude Relatively Low	-0.4130	0.6617	-0.4422	0.6426
Time Sum	0.0003	1.0003	0.0008**	1.0008
Constant	-3.4181***	0.0328	-5.4382***	0.0043
Number of Obs	1113		1103	
Correctly Classified	64.15%		65.46%	
Area under ROC Curve	0.6413		0.6842	

Table 2.4: **Hypotheses 1a and 1b: Results of logistic regression**. Dependent variable is annuity0/1, an indicator variable that equals 1 if participants choose the annuity and 0 for the lump sum. The sample is split by scenario (lottery vs. retirement). ***, ** and * indicate significance on the 1%, 5% and 10%-level.

In the lottery scenario 2 out of 9 controls are significant. The more risk averse participants are, the more likely they are to insure against longevity risk by choosing the annuity. Also, Brown (2007) states that loss aversion could be a reason for low annuitization rates if people see the annuity as a risky gamble. The effect for loss aversion is negative but not significant. The effect of the subjective life expectancy is highly significant. Participants who expect to live longer choose the annuity. With an odds ratio of 1.045, meaning the odds of choosing the annuity increases by 4.5% per additional year the participant expects to live longer, this finding is also economically meaningful. In contrast to the lottery scenario, risk aversion proves not to be significant in the retirement scenario. However, owning private pension insurance leads to the tendency to favor the annuity. One could expect that demand for annuities decreases because in this case the annuity could be crowded out by already existing private annuitization (see for the crowding out argument Mitchell and Moore, 1998; Dushi and Webb, 2004; Purcal and Piggott, 2008). Nevertheless, owning private pension insurance seems to proxy more for participants who have a general preference for insurance against longevity risk.

The magnitude of payments only seems to matter in the retirement scenario. For high payments (lump sum = EUR 750,000 or EUR 1,000,000) participants indicate that they would prefer the lump sum when they retire[15]. Other studies find that an increase in magnitude leads to a decrease of exponential discount rates of participants (see for example Loewenstein and Prelec, 1992; Baucells and Heukamp, 2012). Therefore, one could expect a positive influence on the probability of choosing the annuity. However, it is not clear in what way an increase of magnitude influences discount rates of hyperbolic decision makers. Future research is needed to answer this question.

Relatively low payments (lump sum and annuity) compared to participants monthly income ($\frac{income}{lumpsum} > 5\%$) and the time needed to answer the survey have no significant or economically strong effect.

[15] Taking into account the question about the annuitization rate we find that the absolute annuity payment increases in magnitude, even if the annuitization rate decreases. We find that the relation between the magnitude of the lump sum and the absolute magnitude of the annuity is positive yet decreasing (concave) in magnitude. Therefore, it could be that in the 0/1 framework higher magnitudes lead to a preference for the lump sum as partial annuitization is not possible (see section 2.5.3 Robustness).

2.5.2 Results - Hypotheses 2-4: is the age effect driven by hyperbolic discounting?

Hypothesis 2 - immediate vs. future case

Hypothesis 2 refers to the difference between the retirement and lottery scenario. It is hypothesized that there will be a structural break for the age gradient at an age of about 50 in the retirement scenario only (compare figures 2.2 and 2.4). However, the exact age after which we should observe a negative effect of age depends on the exact form of the hyperbolic discount function. Therefore 10 tests are conducted for a critical age between 45 - 54. For each age we test whether the slope of the age coefficient for participants with age smaller than the critical age differs from the age coefficient for participants older or equal to the critical age. Table 2.5 presents the results.

Columns 2 - 4 show the results for the lottery scenario (immediate case). The difference in age coefficients for the younger (age $<$ critical age) and older (age $\geq$ critical age) subsample is between 0.0012 and 0.0177. Since this difference is never significant a structural break in the age gradient is not observed. For the retirement scenario (future case), in contrast, a structural break can be observed (columns 4 - 7). The difference between the age coefficients is about five to ten times higher (between 0.0174 and 0.0599) and significant on a 10% level for a critical age of 47, 48 and 49 respectively. In addition, figure 2.5 shows the distribution of the difference in age coefficients for critical ages between 45 and 54. In the lottery scenario (rectangles) the difference is distributed around zero with no clear pattern. Thereby, the difference is sometimes positive and sometimes negative. On average it is close to zero (average: 0.0045). For the retirement scenario (rhombuses), however, the average is about 10 times higher (average: 0.0441) and an inverse U-shaped pattern can be observed. The data shows that there is a difference between younger and older participants in the retirement scenario as predicted by the calculations in section 2.3. This provides

	Lottery Scenario (*immediate case*)			Retirement Scenario (*future case*)		
	participants with age			*participants with age*		
	$<$ *critical age*	$\geq$ *critical age*		$<$ *critical age*	$\geq$ *critical age*	
Critical age	**age coefficient**	**age coefficient**	**diff.**	**age coefficient**	**age coefficient**	**diff.**
45	-0.0373	-0.0362	-0.0012	-0.0260	-0.0547	0.0288
46	-0.0393	-0.0379	-0.0014	-0.0266	-0.0639	0.0374
47	-0.0379	-0.0467	0.0088	-0.0240	-0.0701	0.0461*
48	-0.0386	-0.0402	0.0016	-0.0236	-0.0798	0.0562*
49	-0.0298	-0.0272	-0.0026	-0.0163	-0.0690	0.0527*
50	-0.0319	-0.0437	0.0118	-0.0186	-0.0697	0.0512
51	-0.0323	-0.0334	0.0012	-0.0149	-0.0664	0.0515
52	-0.0298	-0.0409	0.0111	-0.0162	-0.0736	0.0574
53	-0.0273	-0.0450	0.0177	-0.0146	-0.0568	0.0421
54	-0.0244	-0.0225	-0.0020	-0.0141	-0.0315	0.0174

Table 2.5: **Hypothesis 2:** Results of 40 logistic regressions and 20 Chow tests of a structural break in the age coefficients. Dependent variable in each regression is annuity0/1, an indicator variable that equals 1 if participants choose the annuity and 0 for the lump sum. The sample is split by scenario (lottery vs. retirement) and by (critical) age. ***, ** and * indicate significance of difference in coefficients on the 1%, 5% and 10%-level.

evidence that the age effect is indeed driven by hyperbolic discounting and not by other factors.

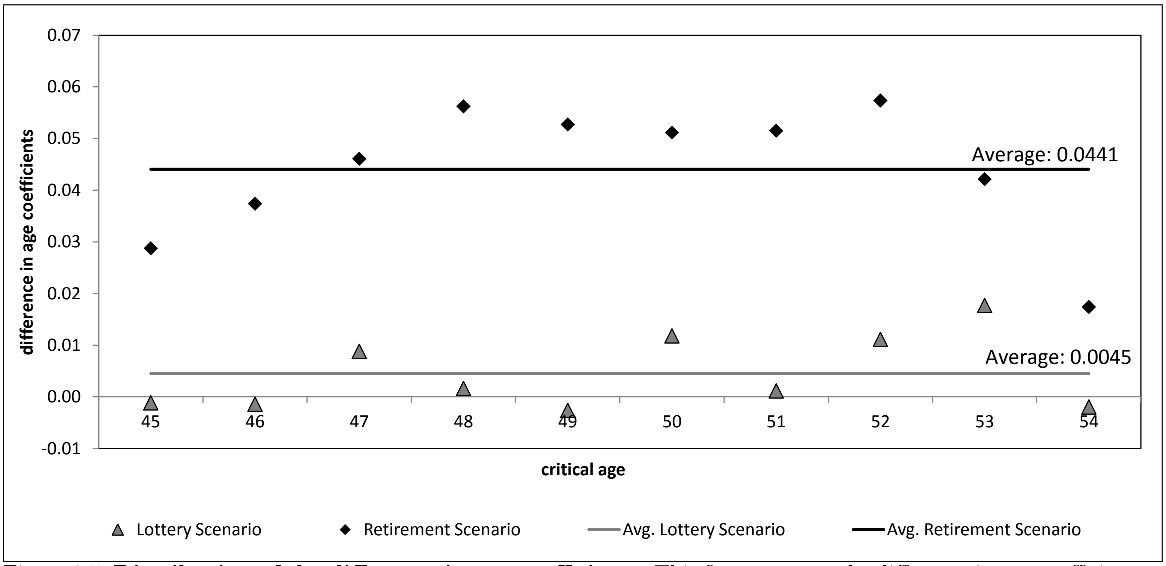

Figure 2.5: **Distribution of the difference in age coefficients.** This figure reports the difference in age coefficients for critical ages between 45 and 54. Thereby, the sample is split by scenario (lottery vs. retirement) and by critical age. As shown in table 2.5, the difference in age coefficients is significant (structural break)

Hypothesis 3 - time inconsistent vs. time consistent decision makers

Hypothesis 3 states that there is an age effect on the annuitization decision for time inconsistent participants and no effect for participants who behave time consistent. To test this hypothesis the sample is split into time consistent and time inconsistent participants and it is analyzed whether the age effect is present in only the time inconsistent subsample. Thereby, the sample is split according to the answers participants gave regarding six tax refund questions. Subsample one includes only participants who chose in a time inconsistent manner in at least two of the three cases (time inconsistent group). The second subsample consists of participants who gave consistent answers in at least two of the three cases (time consistent group). For this analysis both scenarios (lottery and retirement) are pooled. We do so as a negative age effect is observed in both scenarios (see table 2.4). Hypothesis 3 refers to the difference between time consistent and time inconsistent participants. Columns 2 and 3 of table 2.6 present coefficients and odds ratios for the time inconsistent group and columns 4 and 5 for the time consistent group, respectively.

Annuity 0/1	*Time inconsistent*		*Time consistent*	
Variable	**Coeff.**	**Odds Ratio**	**Coeff.**	**Odds Ratio**
Demographics				
Age	-0.0292***	0.9712	-0.0181***	0.9820
Gender	0.3122	1.3664	-0.1463	0.8639
Income (log)	-0.0039	0.9961	0.0379*	1.0386
Number of Children	0.2218*	1.2483	-0.0980**	0.9067
High School Degree	0.4719	1.6031	-0.2727	0.7613
University Degree	-0.3669	0.6929	0.2476**	1.2809
Married	-0.7262**	0.4838	0.0098	1.0098
Constant	-5.4311**	0.0044	-3.2497***	0.0388
Controls	yes		yes	
Magnitude Controls	yes		yes	
Number of Obs	392		1845	
Correctly Classified	65.56%		65.37%	
Area under ROC Curve	0.6939		0.6573	

Table 2.6: **Hypothesis 3: Results of logistic regression** for a subsample of time inconsistent and consistent participants. Dependent variable is annuity0/1, an indicator variable that equals 1 if participants choose the annuity and 0 for the lump sum. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

In both subsamples we find a negative and significant effect of age. However, the coefficient for the inconsistent group is, in absolute terms, about two times stronger. The effect measured by the odds ratio for the inconsistent subsample is also almost two times as strong compared to the consistent subsample (odds ratio of 0.969, resulting in a 3.31% decrease of the odds of choosing the annuity vs. 0.983, decreasing the odds by 1.7%.). In summary, a strong and significant negative age effect on the probability of choosing the annuity is obtained (table 2.4), with this effect becoming stronger for "hyperbolic" participants and weaker for "less hyperbolic" ones (table 2.6).

Hypothesis 4 - Harvey function parameter estimation

To test hypothesis 4 the hyperbolic parameter r of the function $DF_{Harvey}(t) = (1+t)^{-r}$ has to be determined. Thereby, we are only able to calculate a range of r for each participant using the tax refund questions. For example answering the first pair of tax refund questions inconsistently means that the participant prefers a tax refund of EUR 1,100 today over a refund of EUR 1,130 in ten months, but she also prefers a refund of 1,130 in 28 months over a refund of 1,110 in 18 month. Therefore $1,100 \geq \frac{1{,}130}{(1+\frac{10}{12})^r}$ and $\frac{1{,}100}{(1+\frac{18}{12})^r} \leq \frac{1{,}130}{(1+\frac{28}{12})^r}$. This results in $0.0444 < r < 0.0935$. Answering the second (third) pair of tax refund questions inconsistently results in $0.1436 < r < 0.3025$ ($0.3741 < r < 0.7883$). A problem of this method is that only participants that answer exactly one pair of tax questions inconsistently can be taken into account. Answering more than one question inconsistently results in multiple, incompatible conditions for the parameter r.[16]. This problem arises due to our survey design which was intended to separate time inconsistent participants from time consistent ones. Overall 595 participants answer exactly one question inconsistently.

Hypothesis 4 states that an increase in r has two effects: 1) it decreases the attractivness of the annuity (see B.1) and 2) it also weakens the age effect (see B.2). However, this predicition is only true in the lottery scenario as in the retirement scenario the effect depends on r itself. Therefore, the effect of changes in r is tested in a subsample consisting of participants assigned to the lottery scenario (immediate case) that answered exactly one tax refund question inconsistently. This results in N=292 observations.

Column 2 of table 2.7 presents results of a logistic regression with the annuity choice in the 0/1 framework as the dependent variable. Due to limited degrees of freedom in all regressions presented in table 2.7, only control variables that have been significant in earlier regressions (see table 2.4) are included. Table 2.7 shows a significant age effect in the (full) subsample with a coefficient of -0.0349 (column *full sample*). Two dummy variables (parameter r medium, parameter r large) indicate a medium (large) parameter r (equals one if the answer to the second (third) pair of tax refund questions is inconsistent). Both coefficients of the dummy variables have the expected sign. The larger the parameter r, the lower the probability of choosing the annuity. The effect is significant at the 10%-level for large parameters.

[16]To our surprise this issue receives not much attention in the literature using the choice approach. Note that the incompatibility also arises for quasi-hyperbolic discounting.

Annuity 0/1 **Variable**	*full subsample* **Coeff.**	*r=small* **Coeff.**	*r=medium* **Coeff.**	*r=large* **Coeff.**
Age	-0.0349***	-0.0614***	-0.0375***	-0.0216
Parameter r medium	-0.3188			
Parameter r large	-0.6524*			
Constant	-1.4499	-2.1276	-3.4075	-0.1238
Other Demographics	only if significant in previous regressions			
Controls	only if significant in previous regressions			
Magnitude Controls	only if significant in previous regressions			
Number of Obs	292	96	125	71
Correctly Classified	71.92%	72.92%	71.20%	59.15%
Area under ROC Curve	0.6849	0.7532	0.6966	0.6404

Table 2.7: **Hypothesis 4: Results of logistic regressions** for four subsamples of participants in the lottery scenario with different time preferences (measured by parameter r). Dependent variable is annuity0/1, an indicator variable that equals 1 if participants choose the annuity and 0 for the lump sum. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

To test the second prediction, the subsample of 292 participants is split into three smaller subsamples using the size of parameter r. Columns 3, 4 and 5 of table 2.7 present logistic regression results for a subsample of participants with r being small (column 3), medium (column 4) and large (column 5). A significant negative effect of age is present in the first two subsamples. As predicted, the coefficient of the age variable gets less negative and less significant for an increase in r (coefficient of -0.061*** for r=small, compared to -0.038*** for r=medium and -0.022 for r=large), confirming the idea that the previous results are driven by hyperbolic discounting.

2.5.3 Robustness

Annuitization rate

To test robustness of the results presented above, the annuitization rate question is used as the dependent variable. Participants indicate which fraction of the lump sum they want to annuitize (in steps of 10%). Figure 2.6 shows that in both scenarios more than 50% of participants either choose full annuitization (25.96% in the lottery scenario = immediate case, 18.84% in the retirement scenario = future case), the 50/50 choice (12.81% in the lottery scenario, 13.77% in the retirement scenario) or zero annuitization (22.52% in the lottery scenario, 20.14% in the retirement scenario). In between, annuitization rates of more than 50% are popular. This could indicate that people have some immediate use for a larger sum (e.g., repaying debt or buying a new car) but still want to annuitize most of the lump sum.

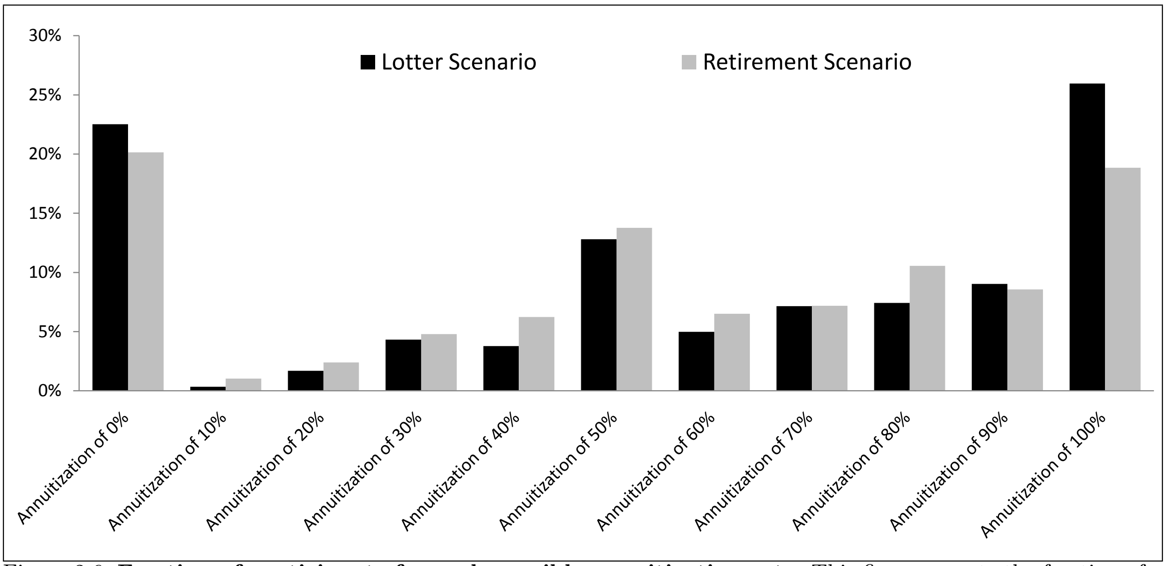

Figure 2.6: **Fraction of participants for each possible annuitization rate.** This figure reports the fraction of participants for each possible annuitization rate.

We repeat the analysis regarding hypotheses 1 - 4 using the annuitization rate as dependent variable. For all hypothesis a OLS regression is conducted. Demographic variables, controls and magnitude controls presented in table 2.4 are included. Table 2.8 presents a summary of the results and reports the age coefficient for different subsamples. Thereby, the results of four out of the five hypotheses are robust to the use of the annuitization rate: A significant and negative effect of age on the annuitization rate is obtained in both scenarios, confirming hypotheses 1a and 1b (column 2 and 3). The effect becomes stronger and more significant for a subsample of time inconsistent participants (hypothesis 3, column 5). Also, the hyperbolic parameter r has the predicted effect (hypothesis 4, column 6). Solely hypothesis 2 cannot be confirmed. Column 4 presents the difference in age coefficents between a younger and older subsample (critical age=48) for both scenarios. Neither of the differences is significant. There proofs to be no structural break in the age gradient in the lottery and retirement scenario.

	Age coeffiecent in an OLS regression regarding. . .				
subsample	. . . **hypothesis 1a**	. . . **hypothesis 1b**	. . . **hypothesis 2**[a]	. . . **hypothesis 3**	. . . **hypothesis 4**
lottery scenario	-0.0042***	-	-	-	-
retirement scenario	-	-0.0020*	-	-	-
lottery scenario, critical age 48	-	-	-0.0158	-	-
retirement scenario, critical age 48	-	-	-0.0068	-	-
time inconsistent	-	-	-	-0.0052***	-
time consistent	-	-	-	-0.0020**	-
parameter r=small	-	-	-	-	-0.0061**
parameter r=medium	-	-	-	-	-0.0063***
parameter r=large	-	-	-	-	-0.0021
Robust	yes	yes	no	yes	yes

Table 2.8: **Hypothesis 1-4: Results of OLS regressions.** Columns 1, 2, 4 and 5 present the **age coefficient** of seven OLS regressions with the annuitization rate as dependent variable. In all regressions demographic variables, controls and magnitude controls presented in table 2.4 are included. Columns 3 presents the difference in age coefficients similar to table 2.5. Thereby, 48 is used as critical age. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

[a] This column presents the difference in age coefficients for a younger and older subsample with a critical age of 48.

Variance analysis

As a second robustness check the variance of the annuitization rate by age is taken into account. As the exact form of the hyperbolic discount function for each person is unknown, the exact critical age at which the lump sum becomes more attractive than the annuity cannot be calculated. Consequently, the impact of a hyperbolic discount function should be clear for old and young participants. Young individuals should prefer the annuity; old individuals should prefer the lump sum, (more or less) independent of the exact form of the discount function. For middle aged people the effect is not that clear, as it depends on the exact form of the discount function. This also means that younger and older people as a group should act more uniformly in their decision regarding the annuitization rate. Young people choose a high rate, whereas old people prefer a low rate. Middle aged participants decisions, however, should vary more strongly as someone might have a strong hyperbolic function, while others may only have weak hyperbolic functions. Therefore, the variance of the annuitization rate by age should have an inverted U-form. In particular, this should be true for the lottery scenario as here the expected present value monotonically decreases with age. For the retirement scenario the effect should be weaker as there should be no influence of age on the annuitization decision for participants below an age of about 50. Figure 2.7 shows the variance of the annuitization rate for all age groups from 18 to 66, for both scenarios. The solid line represents fitted values from a linear regression model with age and age squared as explanatory variables. An inverse U-shape can be seen in both scenarios. Also, the effect is stronger in the lottery scenario. Coefficients for age and age squared are highly significant (not reported) with R^2 of 0.2451 in the lottery scenario and only 0.0340 in the retirement scenario. This pattern supports the idea of hyperbolic discounting leading to the observed effects.

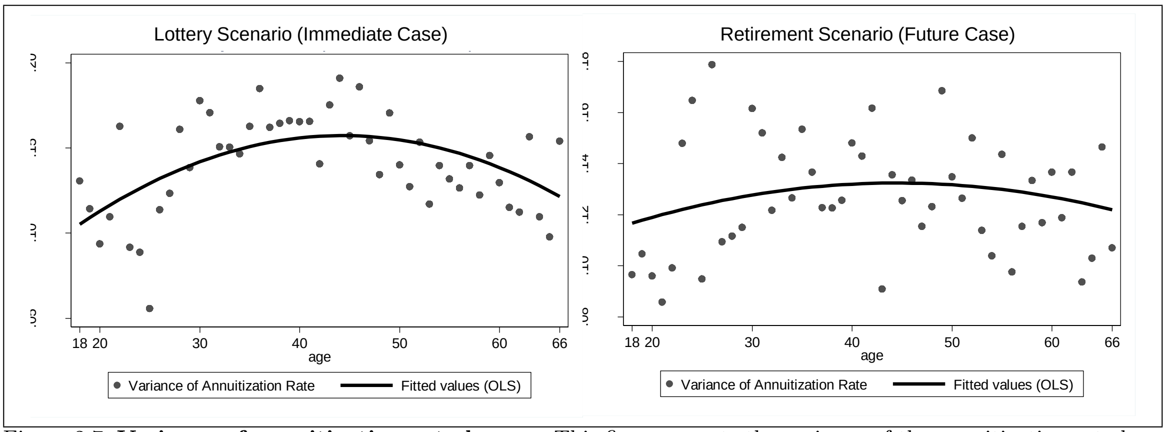

Figure 2.7: **Variance of annuitization rate by age.** This figure reports the variance of the annuitization rate by age (18-66) for the lottery and retirement scenario. Solid line represents fitted values from an OLS regression with age and age squared as explanatory variables.

Representativeness of the dataset

An important issue for the policy implications discussed in the next section is external validity of our results. We are aware that our dataset is not representative for Germany and therefore it has to be analyzed whether the results are driven by this non-representativeness. When comparing summary statistics in table 2.2 with a representative sample of German households[17] two major deviations have to be noted: 1) the average monthly income in the FAZ survey data is more than two times higher compared to an average German household and 2) more than 65% of our participants obtained a university degree whereas this is only true for about 11% of the population. To test whether the results are driven by these high income - high education participants we repeat the analysis presented in table 2.4 for different subsamples. The upper part of table 2.9 presents results for a median income split. Participants with an income higher the median income (median = 3,000 EUR) are assigned to the high income group whereas the low income group represents participants with an income smaller than or equal to the median income[18]. The average

[17] We use the SAVE 2010 survey to compare our dataset with. SAVE is a representative panel study of German households conducted since 2001 by the Munich Center for the Economics of Aging (MEA). For additional information about SAVE see Börsch-Supan et al. (2009).

[18] The median split results in overall 1412 participants in the low income group vs. 804 participants in the high income group. The difference occurs because participants could choose to directly enter their income or choose an income range. Therefore, 656 participants indicated an income of 3,000. However, results are unchanged if these participants are assigned to the low income group.

income in the low income group is EUR 1,355.47 which is comparable to the average income in Germany of EUR 1,470. In the lottery scenario (columns 2 and 3) both age coefficients are negative and significant. The magnitude of the coefficients (-0.022 in the low income group and -0.036 in the high income group) is comparable to the full sample effect of -0.024 presented in table 2.4. In the retirement scenario (columns 4 and 5) only the age coefficient in the low income group is significant. In addition the magnitude of the effect in the low income group is with -0.026 about 30% higher compared to the full sample coefficient of -0.020. Therefore, our main effect seems not to be driven by the fact that our sample over-represents wealthy households as, if anything, the effect gets stronger for low income households. The lower part of table 2.9 presents a similar analysis but now the sample is split by whether a participant obtained a university degree or not. Now in both, the lottery scenario and retirement scenario, the age coefficients are significant and negative. Also the magnitude of the effect in all subsamples is comparable to the full sample effect in table 2.4. Therefore, we conclude that our results are not driven by a non-representative dataset.

2.6 Commitment and policy implications

The findings in section 2.5 of this paper provide evidence on the usefulness of a commitment device to increase real life annuitization. For considerations that speak in favor of commitment devices the results of the future case (retirement scenario) are particular interesting: Here participants seem to make the optimal decision (according to expected utility theory) by choosing the annuity when thinking about what they would do in the future but reverse that decision once the day of the actual decision has arrived. This reversal can be the result of a decision maker with a self-control problem. Self-control problems can be overcome if the decision maker is aware of the problem (sophisticated hyperbolic discounter) and if a commitment device exists that allows him or her to bind future behavior. There is evidence that in a financial context sophisticated hyperbolic discounters are willing to use commitment devices in order to increase savings by constraining withdrawals from their

	Sample Split by Median Income (Low vs. High)			
	Lottery Scenario		**Retirement Scenario**	
	Low	High	Low	High
Variable	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
Age	-0.022***	-0.036***	-0.026***	-0.021
Other Demographics	yes	yes	yes	yes
Time Preferences	yes	yes	yes	yes
Other Controls	yes	yes	yes	yes
Scenario Controls	yes	yes	yes	yes
Number of Obs	727	386	685	418
Correctly classified	62.91%	61.85%	64.53%	71.05%
Area under ROC Curve	0.6447	0.6787	0.6808	0.7390

	Sample Split by Education (University Degree)			
	Lottery Scenario		**Retirement Scenario**	
	Degree=0	Degree=1	Degree=0	Degree=1
Variable	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
Age	-0.028**	-0.022***	-0.026**	-0.019**
Other Demographics	yes	yes	yes	yes
Time Preferences	yes	yes	yes	yes
Other Controls	yes	yes	yes	yes
Scenario Controls	yes	yes	yes	yes
Number of Obs	372	741	331	772
Correctly classified	68.82%	64.37%	66.47%	65.80%
Area under ROC Curve	0.6831	0.6317	0.7129	0.6854

Table 2.9: **Robustness representativeness of the dataset: Results of logistic regression** for four subsamples of participants in each scenario. Column 2 and 3 present results for a sample split by median income and columns 4 and 5 present results for a sample split by whether or not a participant has obtained a university degree. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

saving account (see Ashraf et al., 2006; Beshears et al., 2011). In our study we do not discriminate between naive and sophisticated decision makers as we are primary interested in what drives the low annuitization demand. The introduction of a commitment device in the annuity context would be the second step to overcome the problem. However, combining our results of time inconsistent preferences as a driver for low annuity demand with the empirical evidence of Ashraf et al. (2006) and Beshears et al. (2011) suggest that commitment devices could be one way to increase real life annuitization. Therefore, if policy makers are interested in increasing real life annuitization rates they could implement a simple commitment device, which allows people to undertake a binding annuitization decision earlier in life. This could also result in the reduction of adverse selection problems. Real life annuities pay only about 80% - 90% of the fair annuity value (see Mitchell et al., 1999; Murthi et al., 2000). Part of this deduction is due to adverse selection in the annuity market (Finkelstein and Poterba, 2004). If potential annuity buyers have more information about their own life expectancy (e.g. strong smoker, medical history of family members, etc.) the annuity seller cannot use standard life tables to calculate prices. This information asymmetry is higher if the annuitization decision is made close to retirement and therefore close to the start of annuity payments. However, if people would be able to make a binding decision earlier in life the information asymmetry would be reduced because the annuity buyer would have less information about his/her future condition. Therefore the annuity seller could offer annuities closer to the fair value. This creates an incentive for people to bind their behavior and stick to their decision.

2.7 Conclusion

This paper relates the effect of inconsistent time preferences to the choice between a lump sum payment and a monthly payment. Conducting a large online survey in cooperation with a major German newspaper, this study shows that young individuals have a preference for annuities whereas older individuals tend to prefer lump sum payments. In this study participants are assigned to two different conditions. In the immediate case participants choose between a fair immediate annuity and the corresponding lump sum. In the future case participants choose between a fair annuity starting at retirement age and a lump sum also received when entering retirement. In both cases subjects are asked in a consecutive question to choose an annuitization rate between 0% and 100% in steps of 10%. The probability of choosing an annuity over a lump sum increases in both cases by almost 20% from the oldest to the youngest 10% of the sample, whereas the annuitization rate increases by about 12%. Hyperbolic discounting, compared to exponential time discounting, should lead to an undervaluation of payments in the near future and an overvaluation of later payments. In the annuity context, this means for young people, because of their high survival probabilities, that only relatively few (expected) payments are undervalued and most payments are overvalued resulting in an overvaluation of the annuity. The opposite is true for older individuals. By splitting the sample into a group of subjects who answered simple time preference questions inconsistently and a group that gave time consistent answers it is shown that this effect indeed is driven by the time preferences of participants. The finding is robust to the inclusion of various control variables. Additional important factors are subjective life expectancy, financial literacy and risk aversion. Expecting a long life results in high annuitization rates. Also, participants who are more financially literate and more risk averse prefer annuities over lump sums and choose higher annuitization rates. These findings not only help to better understand the annuity puzzle but might also be used to increase real life annuitization rates. In the future case the switch of preferences over time can be seen as a self-control problem. Therefore, introducing a commitment device allowing people to bind or precommit their behavior could help to increase real life annuitization.

Chapter 3

The Willingness to Pay, Accept and Retire

3.1 Introduction

40 years ago the time spent in retirement for an average German employee was about 10 years, whereas this number almost doubled until today. The lifespan after retirement steadily increases due to an increasing life expectancy and a decreasing effective retirement age. The decision when to retire and claim social security benefits therefore becomes more and more important as it influences a person's well-being for many years. The German social security system allows people to claim benefits when they first reach the age of 63. However, similar to the US social security system, retiring before the full retirement age (FRA) results in a constant decrease of pension benefits for the rest of one's life. For example, retiring at age 63 instead of 67 reduces monthly benefits by about 22%, making the retirement decision one of the most economically important decisions in general[1]. Despite the financial incentive to delay retirement and claiming benefits, the majority of workers in most developed countries

[1] The reduction of 22% is calculated as the reduction due to retiring earlier than the FRA ($-4 \cdot 3.6\% = 14.4\%$) and the reduction due to less accumulated earning points ($\approx 7.6\%$). See section 2 for a detailed description.

choose to retire early (see for example Behaghel and Blau, 2012; Gruber and Wise, 2004; Börsch-Supan, 2000). In Germany, for example, more than 65% of employees retiring in 2011 did so before reaching their full retirement age[2]. This implies that, among other factors, the reduction in monthly social security payments provides not enough incentive to postpone retirement. The price for early retirement therefore is smaller than the reservation price of those individuals.

In this paper, we focus on the reservation price for early retirement. The reservation price for a good can be elicited as the minimum price at which someone would be willing to accept selling the good. Also, the maximum price someone would be willing to pay can be regarded as the reservation price. Standard economic theory predicts that the willingness-to-accept (WTA) and willingness-to-pay (WTP) should not differ if there are no income effects and transaction costs (Willig, 1976). However, there is striking evidence that the WTA can be between 2 and about 100 times larger than the WTP, depending on the good for which reservation prices are elicited (for a detailed overview of the WTA/WTP literature see Horowitz and McConnell, 2002). For example, endowing participants with a coffee mug and eliciting selling prices (WTA) leads to reservation prices about twice as high as when participants are asked for a buying price (WTP) for the same mug (Kahneman et al., 1990). This difference is too big to be explained by an income effect, suggesting that the elicitation method of reservation prices directly influences the outcome.

Every worker is naturally endowed with a full and an earliest possible retirement age, where *early retirement* in this study is considered as tradeable. The price for early retirement is measured in the change in monthly social security benefits. The "market price" in the German social security system for retiring 1 month earlier than the FRA is c.p. 0.3% of monthly benefits[3]. Depending on whether the full retirement age or an earlier retirement age is used as a reference point, the decision can be seen

[2]Source: Statistik der deutschen Rentenversicherung 2012. The FRA for employes retiring in 2011 was 65. However, in 2007 the pension system was reformed and a stepwise increase of the FRA from 65 to 67 was resolved. We use the new FRA in our survey.

[3]Section 2 of this paper provides an overview on how social security benefits are calculated.

as a willingness-to-pay or willingness-to-accept problem. The official information by the German government about social security payments includes both, information about payments at the full and the earliest retirement age. This is therefore one of few economically meaningful problems that is naturally presented in a WTA and WTP framework.

To study the WTA/WTP difference in a retirement context, a large online survey in cooperation with one of the biggest German newspapers, "Frankfurter Allgemeine Zeitung" (FAZ), has been conducted (FAZ-survey). Participants answered a set of demographic and retirement related questions. They were randomly assigned to one of two different treatments (between subjects). In the willingness-to-pay treatment subjects indicated the maximum amount of monthly benefits they would be willing to give up in order to retire at the earliest age possible (63) instead of the full retirement age (67). In the willingness-to-accept treatment, in contrast, the minimum increase of monthly payments in order to delay retirement from age 63 to age 67 was elicited. Thereby, in both treatments, participants were given hypothetical monthly benefits as a reference point amounting to 65% of their current income (level 1). In a consecutive question (within subjects) participants answered the same question again but for a hypothetical pension value of 110% of their current income (level 2).

Our data shows that the reservation price for early retirement in the WTA treatment is about two times higher than in the WTP treatment. Most important, when compared to the fair price (according to the social security system) the WTA on average lies above the fair price whereas the average WTP is below the fair price indicating that early retirement is attractive only in the WTA treatment. Using logistic regression, we find that the probability of retiring early is on average increased by about 30 percentage points in the WTA treatment. The result is robust to the inclusion of various control variables including risk aversion, loss aversion, financial literacy and planned retirement age. Also results are confirmed using a representative panel survey dataset for Germany (SAVE panel).

In a second step, the cause of the WTA/WTP disparity is analyzed. In most studies, the disparity is attributed to loss aversion (e.g. Thaler, 1980; Kahneman et al., 1990; Bateman et al., 1997). We compare participants self reported loss aversion with their WTA and WTP, respectively. The WTA/WTP ratio indeed increases strongly with loss aversion, however, this increase is caused by a decreasing WTP, the WTA is not influenced by loss aversion. Participants seem to perceive the exchange of money for early retirement as a loss and therefore are willing to pay less the more loss averse they are.

This study contributes to two strands of literature. We show that the WTA/WTP disparity also exists in a retirement context for the good of *early retirement*. Also, so far there is no study that directly relates an empirical measure of loss aversion to a measure of WTA and WTP. The most important contribution concerns the literature on retirement planing. The majority of past research focuses on economic, socio-economic and health considerations when explaining the retirement decision (e.g. Börsch-Supan, 2000; Lund et al., 2001; Decshryvere, 2006). Other factors beyond economical considerations are often neglected. It seems plausible, however, that behavioral factors, which proof to have a strong influence on retirement saving and planning (see for example Benartzi and Thaler, 2007) also affect the decision when to retire. Thereby, the WTA/WTP disparity is of particular interest for two reasons: 1) policy makers can easily change the presentation format of the retirement decision. For example, in Germany the government provides information about social security benefits by a yearly information letter. Small changes to that letter could change the way people think about the retirement decision (WTA vs. WTP). The same holds for the US Social Security Administration (SSA), which provides information on the impact of different claiming ages. 2) The presentation format has a strong impact. In our study, on average, participants in the WTA scenario implicitly decide to retire early. In contrast, WTP participants implicitly choose to postpone retirement. This effect is significant and survives various robustness tests. Our findings are also in line with related studies, which use the planned retirement age as variable of interest. Fetherstonhaugh and Ross (1999) show, that presenting the retirement decision in a *loss frame* results in significantly higher planned retirement ages. Also Brown et al. (2013) elicit a hypothetical retirement age and find that especially a gain vs. loss frame and different reference ages significantly influence the planned retirement age.

3.2 Social Security in Germany

The German pension system, dating back to 1891, was the first formal pension systems in the world (Coppola and Wilke, 2010). The pay-as-you-go system is based on earnings points (EP) where the accumulated points determine the monthly social security payments after claiming. For each year a person is employed he or she earns points in relation to his or her yearly gross income ($EP_t = \frac{\text{gross income}_t}{\text{average gross income in Germany}_t}$)[4]. When claiming social security the sum over all earnings points is multiplied by the current pension value in Germany and an entry coefficient, depending on the persons claiming age[5]. The pension value is determined on the 1^{st} of July each year and amounts to EUR 28.14 (28.61) for 2013 (2014). The entry coefficient equals 1 for people who claim at their full retirement age (FRA) and is decreased by 0.003 for each month a person claims before the FRA. Delaying claiming, however, increases the entry coefficient by 0.005 per month delay. In 2007 the pension system was reformed and a stepwise increase of the FRA from 65 to 67 was resolved. The increase started 2012 for people born after 1946. The FRA is increased from 65 to 66 in steps of one month per year of birth for people being born from 1947 - 1958 and from 66 to 67 in steps of two month per year of birth for people being born from 1959 - 1964. For cohorts born after 1963 the new FRA of 67 is effective[6]. Similar to the German system, claiming social security and leaving the workforce in the US has not to happen at the same time. However, in Germany as well as in the US most people claim social security when leaving the workforce

[4]The EP per year are capped at 2.1066.

[5]The pension formula is explained in detail in the following legal text: §64, SGB VI.

[6]For a more detailed view on the German pension system and the 2007 reform see Wilke (2009)

(Greenwald et al., 2010). Therefore, we follow Brown et al. (2013) and keep the survey as simple as possible and do not distinguish between retiring and claiming social security.

3.3 Hypotheses

3.3.1 WTA/WTP

WTA/WTP Disparity

In general, a reservation price for a given good can be defined in two ways: 1) as the maximum price a person would be willing to pay for this good or 2) the minimum price a person would demand in order to sell the good. In both cases, the economic rent for the person who buys or sells the good would be zero. Standard theory implies that for most goods the willingness-to-accept should equal the willingness-to-pay (Willig, 1976). Experimental studies, however, report a significant difference (see Horowitz and McConnell, 2002). For example Kahneman et al. (1990) conduct an experiment where half of the subjects are endowed with a Cornell University coffee mug and participants are allowed to trade the mugs among each other. The average minimum selling price (WTA) was more than two times greater than the average maximum buying price (WTP), resulting in a very low trading volume. This effect of high WTA/WTP ratios has been widely observed and on average cannot be explained by an income effect. Horowitz and McConnell (2002) conduct a meta-analysis including 45 studies which all report WTA/WTP ratios significantly greater than one. They find that the high WTA/WTP ratio is not significantly different for real money experiments and hypothetical questions, that the effect is *not the result of experimental design features that would be suspect* and that for "ordinary market goods" the effect gets weaker[7].

[7] see Horowitz and McConnell (2002) p. 427ff.

WTA/WTP and Social Security

The importance of the WTA/WTP difference is mostly discussed in the context of property rights and environmental policy (see e.g. Horowitz and McConnell, 2002; Knetsch, 1990). However, the retirement context provides an interesting framework as every worker is naturally endowed with a full and earliest possible retirement age. Depending on how retirement information is provided, the decision is framed as a WTA or WTP problem. Assume *early retirement* is the good of interest for which a reservation price, in form of reduction of monthly payments compared to regular retirement, is considered. If the information on how the retirement age will influence benefits takes the full retirement age as a starting point, people are automatically put in a WTP framework. The reference point then would be the full retirement age and the good *early retirement* would not be "in possession" of the decision maker. Thinking about early retirement, the decision maker has to ask him- or herself "what amount of monthly benefits am I willing to give up in order to retire early". On the other hand, if the earliest possible retirement age is used as a starting point the question would be "what amount of monthly benefits would compensate me for retiring later (working longer)" and the decision would be a WTA problem.

In Germany, the official information about social security payments is provided by the government. It provides information about the current account value, the current monthly benefits and an estimate of monthly benefits at full retirement age. Also the earliest possible date to claim social security and resulting benefits are mentioned and the calculation of benefits is explained (see D). Depending on which part people put most attention the full or earliest retirement age is salient. Therefore, the retirement decision in Germany is naturally presented in both, a willingness-to-accept and willingness-to-pay frame.

In the US the Social Security Administration (SSA) provides information on the impact of different claiming ages. Until 2008 the approach used by the SSA was the so called “break-even analysis”. People were given the amount of monthly benefits they would receive if they claim at the earliest age possible. This is then compared to different later claiming ages with higher monthly benefits and it is calculated how long one has to live to break even (see Brown et al., 2013). This approach puts individuals in a willingness-to-accept frame as the starting or reference point of the analysis is the earliest claiming age possible. Delaying claiming (selling *early retirement*) increases monthly benefits by some fixed amount (*selling price*). Since 2009 the SSA uses a more neutral way of presenting information about the social security system. However, according to Brown et al. (2013) the break even analysis is still widely used not only by SSA filed offices but also by private financial advisers.

3.3.2 Hypothesis 1

The WTA/WTP difference has been reported for numerous goods including public or non-market goods (e.g. density of trees, Brookshire and Coursey, 1987), health and safety goods (e.g. health risk of insecticides, Viscusi et al., 1987), ordinary private goods (e.g. coffee mugs, Kahneman et al., 1990), risky and ambiguous lotteries (e.g. Eisenberger and Weber, 1995; Harless, 1989) and intangible goods (e.g. travel time, Ramjerdi and Dilln, 2007). In all these studies the WTA/WTP-ratio has been found to be significantly greater than one. Nevertheless, to our knowledge the relation between WTA/WTP has not been studied in a retirement context. It is difficult to assign the good of early retirement to one of the categories mentioned above. On the one hand deciding when to retire has features of a lottery, as it is an intertemporal decision under uncertainty where one does not know how long one will live (and therefore also the time spend in retirement is unknown). On the other hand it also could be considered as a good which affects individuals health status (depending on the kind of employment) which falls in the category of an intangible assets. As the $\frac{WTA}{WTP}$ ratio depends on the kind of good considered, it is difficult to hypothesize about the exact magnitude of the ratio for early retirement. That is why we keep hypothesis 1 as simple as possible and state:

H1a: The reservation price for early retirement in the willingness-to-accept treatment will be significantly higher than the reservation price in the willingness-to-pay treatment.

The difference of our study to the studies of Fetherstonhaugh and Ross (1999) and Brown et al. (2013), who investigate framing effects on the retirement decision, is that we do not ask for a planned or expected retirement age but for a willingness-to-accept or willingness-to-pay for early retirement. This procedure allows us to compare subjects reservation prices with the actuarial fair price. In both treatments (WTA and WTP) a reservation price greater than the fair price indicates that the participant would choose to retire early.

H1b: Participants in the willingness-to-accept treatment are more likely to choose early retirement than participants in the willingness-to-pay treatment.

3.3.3 Hypothesis 2

Even if the WTA/WTP disparity has been studied for almost forty years, the source of the disparity is not well understood. Several explanations have been put forward. Randall and Stoll (1980) and Brookshire et al. (1980) suggest that *transaction costs* can cause the maximum amount someone would be willing to pay to be smaller than the amount he or she would be willing to accept. They argue that when someone builds a price for a good in a WTA treatment, he or she adds the transaction or search costs associated with replacing that good to the reservation price. Other economic explanations that are suggested by Hanemann (1991) are *income effects* and *substitution effects*. If the value of the considered good is high, owning the good (WTA) causes an income effect which leads to a higher reservation price. However, WTA/WTP disparity is also found for low value goods like coffee mugs (see Kahneman et al., 1990). Also Horowitz and McConnell (2003) study the income effect as possible explanation and conclude that *"[...] the ratio WTA/WTP is too high to be consistent with neoclassical preferences"*.

As economic reasons lack to fully explain the huge differences between WTA and WTP, also psychological and methodological reasons are studied. Plott and Zeiler (2005) suggest *subjects misconception* as an alternative explanation. They conduct an experiment, where they simultaneously control for all dimensions of concern over possible subject misconceptions found in the literature and find no difference between elicited WTA and WTP. On the other hand, Loomes and Sugden (1982) argue that *ambiguity* can cause the WTA/WTP disparity. A risk averse person might increase the selling price of a good if he or she is not sure about its value. Additionally the experiment design itself can possibly cause the effect. In Bateman and Willis (2002) several explanations are put forward. They argue that, among other reasons, an open end *question design* can cause the observed effect.

The most prominent explanation put forward for the WTA/WTP disparity, however, is an *endowment effect* in combination with *loss aversion*. Thaler (1980) called the WTA/WTP disparity an *endowment effect stemming from loss aversion*. People have a higher reservation price for a good that is in their possession because giving up this good is perceived as a loss. This interpretation is put forward by most WTA/WTP studies (e.g. Thaler, 1980; Knetsch and Sinden, 1984; Coursey et al., 1987; Borges and Knetsch, 1998; Knetsch et al., 2001; Brown, 2005). Surprisingly, to our knowledge, there is no study that relates the WTA/WTP-ratio to a direct measure of loss aversion.

The basic idea is simple: the more loss averse a person is, the less willing he or she is to give up a good in his or her possession. For the WTA/WTP ratio, we therefore hypothesize the following:

> *H2a: The more loss averse participants are, the higher the WTA/WTP ratio.*

In a second step we focus on the effect of loss aversion on the WTA and WTP separately. The argument put forward by most former studies implies that selling a good creates a loss and buying creates a gain (see Brown, 2005). However, there is an ongoing debate, whether money outlays are also perceived as a loss. Kahneman et al. (1990) and Novemsky and Kahneman (2005) argue that giving up goods, which are intended to be exchanged (e.g. money) are not evaluated as losses. Following this argument loss aversion should only influence the WTA decision. In contrast, Bateman et al. (1997) and Bateman et al. (2005) find that the WTA/WTP disparity is caused by both, loss aversion in the good (WTA) and in money (WTP). To introduce hypothesis 2b we follow the argument of Bateman et al. (1997) and Bateman et al. (2005). Table 3.1 gives an overview about the hypothesized influence of loss aversion on WTA and WTP.

	good in possession	**can be traded for**	**loss aversion will**
WTA	early retirement	money	*increase* WTA
WTP	money	early retirement	*decrease* WTP

Table 3.1: **Hypothesized influence of loss aversion on the willingness-to-accept and willingness-to-pay**

H2b: The increase of the WTA/WTP ratio in loss aversion is caused by both, an increase of WTA and a decrease of WTP.

3.4 Survey Design and Summary Statistics

3.4.1 Survey Design

Subject Recruitment and General Procedure

An online survey was conducted from October 14^{th} to November 5^{th} 2012 in cooperation with the "Frankfurter Allgemeine Zeitung" (FAZ). The survey covered the field of retirement savings and planing. Summary statistics and control variables are also presented in 2. Therefore, this section gives a detailed overview of the WTA/WTP related questions and only a brief overview of the summary statistics and control variables.

Subjects were recruited through a link on the newspapers homepage and two announcements (on October 14^{th} and 28^{th}) in the print edition. 3,077 participants completed the survey in on average eleven minutes. Participants answered hypothetical questions about retirement planning and time preferences, and also data on demographics, risk preferences, financial literacy and some additional controls were collected. In particular, the survey asked for a reservation price regarding early retirement in a willingness-to-pay and a willingness-to-accept treatment. We choose hypothetical, non incentivized questions for three reasons: 1) this design allows us to corporate with the FAZ newspaper and recruit a large subject pool. 2) Rubinstein (2001) replicated more than 40 experiments without monetary rewards and in almost all cases there were no qualitative differences in results compared to incentivized experiments. 3) and more specific to our research question Kühberger et al. (2002) find that framing effects in hypothetical and real decisions do not substantially differ and also Horowitz and McConnell (2002) state that this is also true for the willingness-to-accept/willingness-to-pay difference in particular.

Willingness-To-Accept treatment

In experimental economics, one has to distinguish between choice based and matching based approaches (see for example Hardisty et al., 2013). Choice methods ask participants to choose between two outcomes. Thereby, one of the outcomes is constantly increased (or decreased) to find participants switching point. The matching approach, in contrast, directly asks for indifference points. Participants have to state which outcome would make them indifferent to a second outcome. In our survey we choose the matching based approach. In the WTA treatment participants are asked to state an amount of money by which their monthly pension payment would have to increase (reservation price) for them to retire 4 years later:

> *Suppose you have the opportunity to retire at age 63. At this time you would receive a pension of EUR y per month. Please imagine that you would be able to delay retirement by four years and retire at age 67. This*

would lead to an increase in monthly pension payments. What would the minimum monthly increase have to be, so that you would be willing to delay retirement from age 63 to age 67?

Thereby, the given monthly pension of y depends on participants income. In a first scenario y amounted to 65% (=level 1) and in a consecutive scenario (within subjects) y was increased to 110% (=level 2) of participants income. Subjects then entered the amount they additionally demanded. We choose these numbers for two reasons: 1) the average monthly social security benefits for an individual, who has been employed for 40 years with an income of 1.5 times the average income for Germany, amounts to about 65% of his or her monthly income[8]. We choose a higher than average income as a starting point, as the readers of the *FAZ* typically earn a higher than average income (see Mueller and Weber, 2014). 2) Simply multiplying subjects current income by 0.65 has the disadvantage that real income growth until retirement is neglected and younger participants will face a decision problem with a very low hypothetical pension. Therefore the second question within subjects is introduced for robustness.

Willingness-To-Pay treatment

In the WTP treatment participants are asked to state an amount of monthly pension payments they would be willing to give up in order to retire 4 years earlier:

> *Suppose you have the opportunity to retire at age 67. At this time you would receive a pension of EUR y per month. Please imagine that you would be able to speed up retirement by four years and retire at age 63. This would lead to a decrease in monthly pension payments. What maximum amount of monthly pension payments would you be willing to give up in order to be able to retire at age 63 instead of age 67?*

[8]Monthly benefits are calculated according to the pension formula presented in section 2. This calculation is sensitive to assumptions regarding tax payments, martial status, number of kids and other demographic factors.

Thereby, the monthly pension of y was calculated in the same way as for the WTA scenario. In the level 1 (level 2) question y amounted to 65% (110%) of participants income. Subjects then entered the amount they would be willing to give up.

Loss aversion

We use participants self-reported loss attitude to proxy for loss aversion. Earlier studies find that self-reported risk attitude on a Likert scale is a good predictor of actual risk taking (see e.g. van Rooij et al., 2011; Nosic and Weber, 2010). On a seven-point Likert scale participants have to indicate whether they agree to the statement "I'm very afraid of losses" as a measure of loss aversion.

Controls

Participants risk aversion is elicited similar to loss aversion on a seven-point Likert scale. Participants indicate whether they agree to the statement "I'm a risk averse person". In addition, the planned retirement age is elicited directly, and participants are asked "*at what age do you plan to retire?*" Participants also answer six financial literacy questions consisting of one of the basic questions from Lusardi and Mitchell (2007), three advanced questions from van Rooij et al. (2011) and two more complicated questions developed by us (see appendix C.1). We do so because the FAZ newspaper has a focus on financial markets and previous studies find that subjects with similar characteristics are remarkably financially literate (see Mueller and Weber, 2014). Additional controls are participants subjective life expectancy (elicited directly) and participants indicate if they own private pension insurance as well as how they rate the certainty of social security benefits guaranteed by the government today.

3.4.2 Summary Statistics

Table 3.2 presents summary statistics. Numer of observations range from 2,142 to 2,297. The following observations were excluded: Participants who were already retired, participants with zero or missing income[9] and participants with age below 18.

The average reservation price for early retirement is about EUR 550 per month in the 65% treatment (level 1) and about EUR 970 in the 110% treatment (level 2). In both cases the median is considerably lower, indicating a positive skewness (skewness: 5.30 for level 1 and 4.32 for level 2). Also the increase from level 1 to level 2 is almost linear with the mean being 1.77 times greater for level 2 and the hypothetical monthly pension being $\frac{110\%}{65\%} = 1.69$ times greater. The average planned retirement age of about 64.58 years is close to the former full retirement age in Germany (65). The average age is about 40 years. Men are overrepresented (84%

Variable	**Mean**	(Median)	**Std. Dev.**
Reservation Price			
Reservation Price - Level 1 (65%)	549.07	(300.00)	835.95
Reservation Price - Level 2 (110%)	973.84	(500.00)	1544.45
Demographics			
Age	40.37	(40.00)	12.34
Gender	0.84		0.36
Income	3,436.92	(3,000.00)	3,118.14
Number of Children	0.79		1.19
High School Degree	0.92		0.27
University Degree	0.68		0.47
Married	0.47		0.50
Controls			
Risk Aversion (1-7)	3.87		1.47
Loss Aversion (1-7)	4.23		1.60
Financial Literacy Standard (0-4)	3.51		0.71
Financial Literacy Extra (0-2)	0.62		0.74
Life Expectancy (Males)	83.33	(84.00)	8.12
Life Expectancy (Females)	84.33	(85.00)	6.95
Planed Retirement Age (in month)	777.14	(780.00)	50.77
Owns Private Pension Insurance	0.64		0.48
Certainty of Social Security (1-7)	2.97		1.78

Table 3.2: **Online survey summary statistics**

male) reflecting the fact that the majority of FAZ readers are male (62%) and that men are more likely to participate in online surveys of our kind (see Mueller and Weber, 2014). Subjects report a relatively high after tax income of about EUR 3,400 (median 3,000) per month (compared to a German average after tax income of about

[9]This was necessary as the income was used to calculate a hypothetical pension value, see section 4.1.

EUR 1,470 in 2011[10]) and are well educated with 92% having received the German equivalent to a high school diploma and 68% having graduated from a university. Half of the participants are married.

Asking participants about their risk- and loss aversion on a 1 to 7 Likert scale leads to an average of 3.87 and 4.32 respectively. As expected, participants did extremely well in standard financial literacy questions with on average 3.51 / 4 correct answers. However, only 0.61 / 2 answers of the additional questions are correct. Directly asking participants about their subjective life expectancy leads to estimates which, with an average of 83.33 years for male participants, are above the average life expectancy in Germany and, with 84.33 for female participants, are close to the average life expectancy. Given the on average wealthier and more educated sample, a self reported life expectancy above the population average is a realistic estimate[11].

3.5 Survey Results

3.5.1 The fair price of early retirement and the fair WTA/WTP disparity

Analyzing the WTA/WTP disparity in a retirement context has the advantage, that reservation prices can be compared to a market price provided by the social security system. However, this also makes things more complicated, as in our survey design the fair price depends on the treatment (WTA vs. WTP). This is best illustrated by a simple example: assume two participants with an income of $W =$ EUR $1,000$, whereof one is assigned to the WTA treatment an the other one to the WTP treatment. Both participants are given a hypothetical pension value of $y = 0.65 \cdot W = 0.65 \cdot 1000 = 650$ for the level 1 question. According to the German social security formula (§64, SGB VI; presented in section 2), it is implicitly assumed that for both participants $650 = EP \cdot EC \cdot CPV$ with EP being the accumulated earning points, EC being the entry coefficient and CPV being the current pension

[10]Source: German Federal Statistical Office 2012.
[11]For a more detailed description of summary statistics of this survey see 2.

value. To calculate the fair price, three assumptions have to be made: 1) We assume for each participant that he or she has been employed for 40 years when reaching an age of 63. 2) it is assumed that the relation between participants income and the average income in Germany is constant. Therefore, an additional year of employment increases the earning points by 1/40. 3) A full retirement age of 67 is assumed.

In the WTA treatment the fair price for delaying retirement by four years has to be calculated. The entry coefficient now increases from 0.856 to 1 and the earning points increase by 10%. The fair increase in monthly benefits therefore would be $\frac{1}{0.856} \cdot 1.1 - 1 = 28.50\%$, resulting in EUR 185.3. Correspondingly, the fair decrease in the WTP treatment is calculated as $1 - 0.856 \cdot \frac{1}{1.1} = 22.18\%$ resulting in EUR 144.2. Therefore, the *fair* WTA/WTP ratio would be $\frac{185.3}{144.2} = 1.285$. This is true for all income levels W. We account for this in two ways: 1) the empirically obtained WTA/WTP ratio is compared to the fair ratio of 1.285 and not to a ratio of one. 2) the fair price is included in the regression analysis to test, whether the treatment affects the reservation price beyond the fair price.

3.5.2 Hypothesis 1a - the WTA/WTP difference

Figure 3.1 presents the reservation price for early retirement of participants in the willingness-to-accept and willingness-to-pay treatment as well as the WTA/WTP ratio and the *fair* ratio of 1.285. The average monthly amount participants additionally demand to retire at age 67 instead of age 63 (WTA) is EUR 763.56 if the hypothetical pension value y amounts to 65% of participants income (Level 1). On the other hand, the monthly amount participants are willing to give up in order to retire at age 63 instead of age 67 (WTP) only amounts to EUR 327.09 at level 1. This difference is highly significant (t-value of -12.68). The $\frac{WTA}{WTP}$-ratio is 2.33. The p-value of a Wald test, comparing the WTA/WTP ratio to a ratio of 1.285, is smaller than 0.0001. Almost the same picture emerges for the level 2 question where the hypothetical pension value y is increased to 110% of participants income. The reservation price in the WTA treatment (1275.38) is about 1.9 times higher compared to the WTP treatment (668.66). Again the difference is significant on the 1%-level (t-value: -9.33, not reported) and the ratio of 1.9 is also significantly higher than 1.285 (Wald test p-value: < 0.0001). The small decrease in $\frac{WTA}{WTP}$-ratio from level 1 to level 2 is caused by a disproportional increase of the WTP compared to the increase of y. From level 1 to level 2 y is increased by $\frac{1.1}{0.65} - 1 = 69.23\%$. The WTA increases almost proportional (+67.03%). However, the WTP increases more strongly from EUR 327.09 to 668.66 (+104.43%) causing the $\frac{WTA}{WTP}$-ratio to decline from 2.33 to 1.91. Results are similar for the median reservation price. For the level 1 treatment a median WTA/WTP ratio of 2.5 is obtained. Also, the ratio declines in the level 2 treatment to 1.5. A ratio of about two is on average observed for lotteries (see table IIIA in Horowitz and McConnell, 2002), whereas health and safety goods exhibit a much higher average ratio of about 10. As the good early retirement has features of a lottery our result is in line with the previous literature. The WTA/WTP difference is further tested

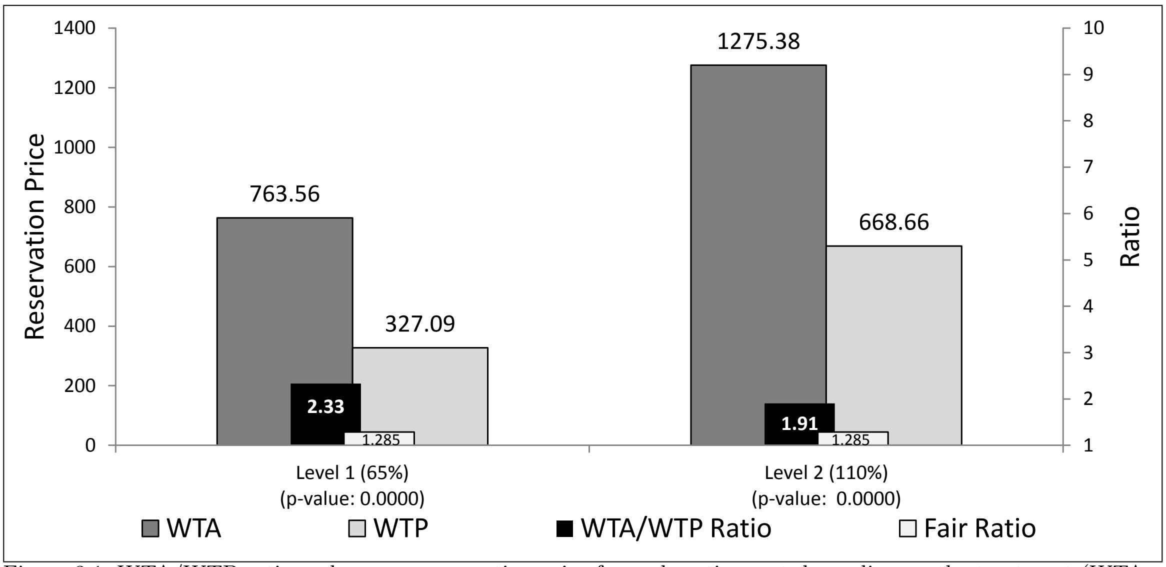

Figure 3.1: WTA/WTP ratio and average reservation price for early retirement depending on the treatment (WTA vs. WTP) and level (65% or 110%)

in a regression framework. Figure 3.2 shows the distribution of the reservation price for the full sample (not separated by WTA and WTP) as well as of logarithmized reservation prices for level 1 and 2. The distribution of the reservation price (upper row) resembles the log-normal distribution. Therefore, the logarithmized reservation prices (bottom row) are used in all further regressions[12]. Columns 2 and 4 of table

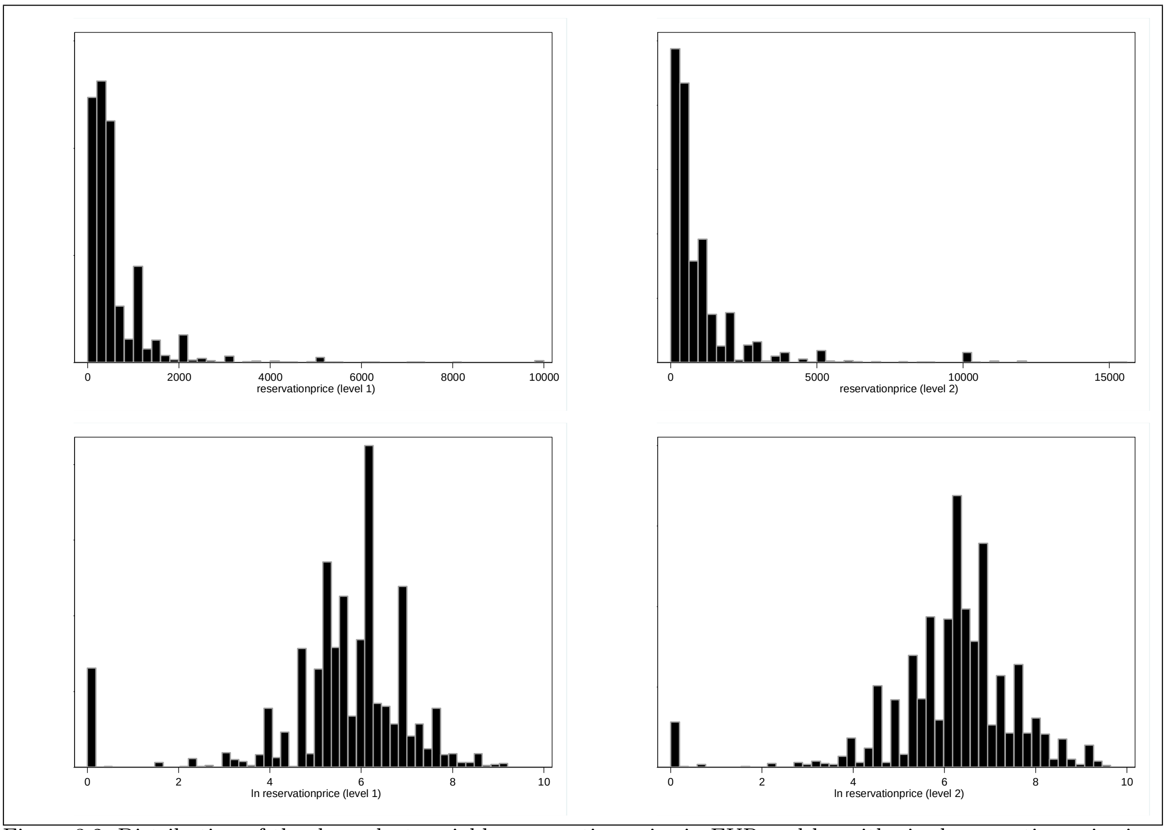

Figure 3.2: Distribution of the dependent variable, reservation price in EUR and logarithmized reservation price in EUR, by level.

3.3 present coefficients of an OLS regression with the logarithmized reservation price as dependent variable, columns 3 and 5 the corresponding t-values. In addition to the treatment dummy demographic (including the logarithmized fair price) and control variables are included[13]. The main result from figure 3.1 can be confirmed. For both, level 1 and level 2, the reservation price is significantly higher in the WTA treatment (significant on 1%-level). This WTA/WTP effect therefore survives the inclusion of the fair price. The interpretation of the magnitude of the effect is not straightforward. For a continuous variable, the coefficient multiplied by 100 gives the percentage effect of that variable on the dependent variable. However, this is not

[12]Participants who indicated a reservation price of 0 EUR are treated as if they indicated a price of 1 EUR and the logarithmized reservation price is set to zero. In section 6 we repeat the analysis without participants who indicate a reservation price of zero.

[13]Participants income is not included in this regression as the fair price by construction is highly correlated (correlation of 0.9899) with income.

true for dummy variables. Therefore, we calculate effects according to Halvorsen and Palmquist (1980) and Kennedy (1981)[14]. For the level 1 regression (columns 2 and 3) this leads to a reservation price for early retirement in the WTA treatment that is 313.55% higher compared to the WTP treatment[15]. For level 2 (columns 4 and 5) the reservation price increases by 110.29%. Therefore, the WTA/WTP effect is not only robust to the inclusion of additional variables but also gets stronger in the level 1 regression, as the percentage increase of the reservation price for level 1 is 233% when only the mean reservation price is taken into account (see figure 3.1). The treatment influences participants reservation prices beyond the effect it has on the fair price. In summary hypothesis 1a can be confirmed.

Reservation Price (log)	**Level 1** 65%		**Level 2** 110%	
Variable	Coeff.	t-value	Coeff.	t-value
Demographics				
Age	0.004	0.86	0.005	1.05
Gender	0.131	1.15	0.196	1.61
Fair Price (log)	0.512***	9.58	0.451***	7.87
Number of Children	-0.077**	-2.02	-0.032	-0.80
High School Degree	-0.054	-0.33	-0.151	-0.87
University Degree	0.119**	1.23	0.169*	1.65
Married	0.274***	2.88	0.266***	2.63
Treatment				
WTA treatment	1.423***	18.39	0.747***	9.11
Controls				
Risk Aversion	0.044	1.29	-0.011	-0.32
Loss Aversion	-0.038	-1.21	0.013	0.41
Financial Literacy Score	0.033	0.92	0.029	0.75
Life Expectancy	-0.006	-1.15	-0.008	-1.62
Planed Retirement Age	-0.064***	-8.76	-0.056***	-7.16
Owns Private Pension Insurance	0.058	0.72	0.115	1.35
Certainty of Social Security	0.017	0.77	0.001	0.05
Constant	5.376***	7.19	5.957***	7.41
Number of Obs.	2123		2093	
Adj. R^2	0.2471		0.1418	

Table 3.3: **Hypothesis 1a:** results of OLS regressions with the logarithmized reservation price as dependent variable. The WTA treatment dummy indicates whether participants where assigned to the WTA or WTP treatment. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

[14]The effect is calculated as $exp(\widehat{d} - \frac{1}{2}V(\widehat{d})) - 1$. With $\widehat{d}$ being the estimated coefficient of the dummy variable and $V(\widehat{d})$ being the variance of the estimate.

[15]$exp(1.4226 - \frac{1}{2}0.077344^2) - 1 = 313.55\%$. For all following regressions, with a logarithmized dependent variable, the effect of dummy variables are calculated similarly.

Besides the treatment, the fair price for early retirement influences participants reservation price. The fair price is calculated depending on participants income. A 1% increase in the fair price (corresponding to a 1% increase in income) will increase the reservation price on average by 0.51% for level 1 and by EUR 0.45% for level 2. As for a 1% increase in income the reservation price increases less strongly ($< 1\%$), the relative reservation price (reservation price in relation to participants income) decreases with an increase of income. For robustness, we also repeat the analysis with the relative reservation price calculated as $\frac{reservationprice}{income}$ and obtain the same results as presented in table 3.3 (results not reported).

Also, participants who graduated from university indicate a reservation price that is on average 12.13% (level 1) or 17.84% (level 2) higher, compared to participants with no university degree. In both regressions being married increases the reservation price. This is in line with Lund et al. (2001) who find that having a partner is a significant predictor of transition to early retirement. In our analysis being married (dummy variable) increases the reservation price for early retirement by 30.94% (level 1) and 29.78% (level 2), respectively.

Additionally, only one of the eight control variables proofs to be significant. Participants planned retirement age has a significant and negative effect on the reservation price. For each year a person plans to retire later, the reservation price is decreased by 6.4% and 5.6%. This effect makes intuitively sense: Participants who have already planned to retire late should have a weaker preference for early retirement compared to a person who plans to retire early and therefore should have a lower reservation price. The effect of loss aversion is not significant in both regressions. However, as it is stated by hypothesis 2b that loss aversion influences the WTA and WTP differently, this is not surprising as participants in the WTA and WTP scenario are pooled in these regressions.

3.5.3 Hypothesis 1b - probability of early retirement

Whether or not the WTA/WTP disparity can induce early retirement depends on the reservation price in relation to the fair price. If the fair price is smaller than the reservation price people are willing to buy the good. The fair price for early retirement can be measured in reduction of monthly social security benefits due to early retirement. Figure 3.3 shows the average WTA, WTP and the average fair price in both treatments. As the average sample income is high, also high fair prices of 631.22 and 500.05 (level 1) and 1068.23 and 846.24 (level 2) are obtained. The average reservation price in the WTA scenario is for both levels above the average fair price, indicating that under the WTA treatment early retirement seems attractive. In contrast, the average reservation price in the WTP treatment is below the fair price for both scenarios. This gives a first impression on how the WTA/WTP disparity can induce early retirement. To test hypothesis 1b in a regression framework an

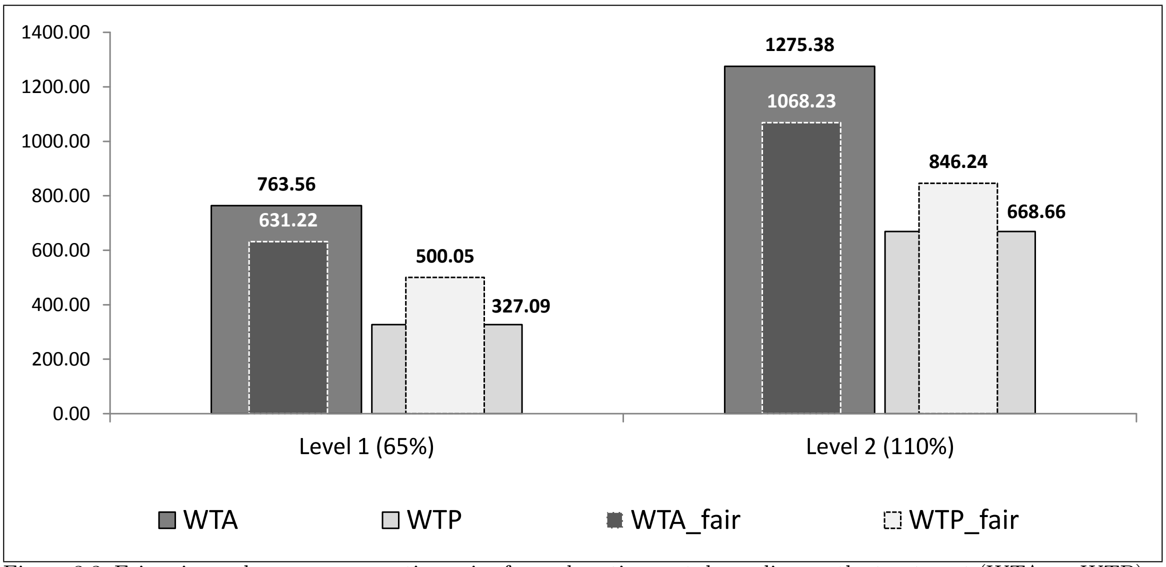

Figure 3.3: Fair price and average reservation price for early retirement depending on the treatment (WTA vs. WTP) and level (65% or 110%)

indicator variable, *late retirement*, is constructed. For each participant the fair price of early retirement is calculated and compared to his or her reservation price. The indicator equals one if the reservation price is smaller than the fair price, indicating that early retirement is not desirable. For a reservation price higher than the fair price the indicator equals zero. Columns 2 and 4 of table 3.4 now present coefficients of a logistic regression of *late retirement* as dependent variable on demographics, the WTA dummy and additional control variables. Columns 3 and 5 present the corresponding z-values. The WTA treatment dummy is highly significant (1%-level) and negative, indicating that the probability of late retirement decreases if the decision is presented in the WTA treatment. Also in terms of magnitude the effect is strong. The average marginal effect (over all observations) of a change in the WTA dummy is -29.46% (level 1) and -17.84% (level 2), respectively. The probability for retiring late therefore decreases on average by 29.46 (17.84) percentage points in the WTA scenario.

Income and having graduated from university are two out of seven demographic variables with a significant effect in both regressions. Even though income (indirectly measured by the fair price for early retirement) increases the reservation price for early retirement (see table 3.3), it also increases the probability of late retirement. To understand this effect the calculation of the fair price has to be considered. The fair price according to the German pension formula, increases linearly with income. The reservation price also increases with income, however, less strongly. Therefore, the positive effect of income on the probability of late retirement is obtained. Previous research also finds that *wages are inversely correlated with the acceptance of early retirement* (Ruhm, 1989; Kim and Feldman, 1998). The effect of having a university degree on the probability of late retirement is in line with its effect on the reservation price. Participants with a university degree have a higher reservation price for early retirement and are therefore also more likely to retire early. Also, for the planned retirement age the effect is unchanged. The higher the planned retirement age the higher is the probability of late retirement.

In summary hypothesis 1b can be confirmed. The probability of late retirement is significantly reduced when the decision problem is presented in a willingness-to-

Late Retirement	**Level 1**		**Level 2**	
	65%		110%	
Variable	Coeff.	z-value	Coeff.	z-value
Demographics				
Age	0.003	0.51	-0.009*	-1.69
Gender	0.004	0.02	-0.079	-0.54
Income (log)	0.742***	8.94	0.597***	7.71
Number of Children	-0.076	-1.41	-0.033	-0.65
High School Degree	-0.370	-1.60	-0.093	-0.43
University Degree	-0.242*	-1.80	-0.325**	-2.53
Married	0.112	0.84	-0.054	-0.43
Treatment				
WTA treatment	-1.717***	-15.08	-0.908***	-9.00
Controls				
Risk Aversion	-0.046	-0.98	-0.055	-1.24
Loss Aversion	0.030	0.68	0.023	0.57
Financial Literacy Score	0.075	1.52	0.042	0.91
Life Expectancy	0.007	0.96	0.011*	1.67
Planed Retirement Age	0.083***	7.08	0.070***	6.42
Owns Private Pension Insurance	0.249**	2.25	0.134	1.28
Certainty of Social Security	0.030	0.98	0.023	0.80
Constant	-9.867***	-8.08	-8.184***	-7.19
Number of Obs.	2123		2093	
Correctly classified	0.7373		0.6946	
Area under ROC Curve	0.7698		0.6865	

Table 3.4: **Hypothesis 1b:** results of logistic regressions with an indicator variable for late retirement as dependent variable. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

accept treatment compared to a willingness-to-pay treatment. Combined with the fact that in Germany as well as in the US information regarding retirement often is presented with the earliest retirement age as a starting point, the WTA/WTP disparity (among many other factors) can help to better understand why people retire on average before the full retirement age.

3.5.4 Hypothesis 2a - WTA/WTP ratio and loss aversion

To analyze the effect of loss aversion on the WTA/WTP ratio, an average reservation price per participant is calculated. As each participant indicates a reservation price in the level 1 question (y=65% of participants income) and a second reservation price in the level 2 question (y=110% of participants income) the average reservation price is calculated as $\frac{1}{2}(\frac{price_{level1}}{0.65} + \frac{price_{level2}}{1.1})$, labeled $\overline{WTA}$ and $\overline{WTP}$ respectively.

Participants are then sorted according to their self reported loss aversion. The $\overline{WTA}/\overline{WTP}$ ratio can be calculated as the average $\overline{WTA}$ divided by the average $\overline{WTP}$. Figure 3.4 graphs the average $\overline{WTA}/\overline{WTP}$ ratio for each of the seven loss aversion categories. Also p-values of a Wald test with the null-hypothesis of the WTA/WTP ratio being equal to 1.285 are reported. Observations in the seven categories range from 60 (loss aversion of 1) to 501 (loss aversion of 5). The $\overline{WTA}/\overline{WTP}$ ratio increases almost monotonically with loss aversion. The lowest ratio of 1.39 is obtained for participants who indicate to be "not at all" loss averse, where the difference between the $\overline{WTA}$ and $\overline{WTP}$ is not statistically significant (t-value of -1.11, not reported) and also the WTA/WTP ratio is not significantly different from 1.285 (p-value of 0.7827). The $\overline{WTA}/\overline{WTP}$ ratio increases then to 1.87 and 2.32 for participants who indicate a loss aversion of 2 or 3, respectively. The WTA/WTP ratio is now significantly greater than 1.285 on a 10% and 1% level. The ratio drops to 1.83 for participants with a loss aversion of 4, to increase monotonically afterwards. The highest $\overline{WTA}/\overline{WTP}$ ratio is observed for the most loss averse participants (ratio of 2.70). Also the ratio of 2.70 is significantly greater than the lowest ratio of 1.39 (5% level, Wald test). Overall, hypothesis 2a is supported as.

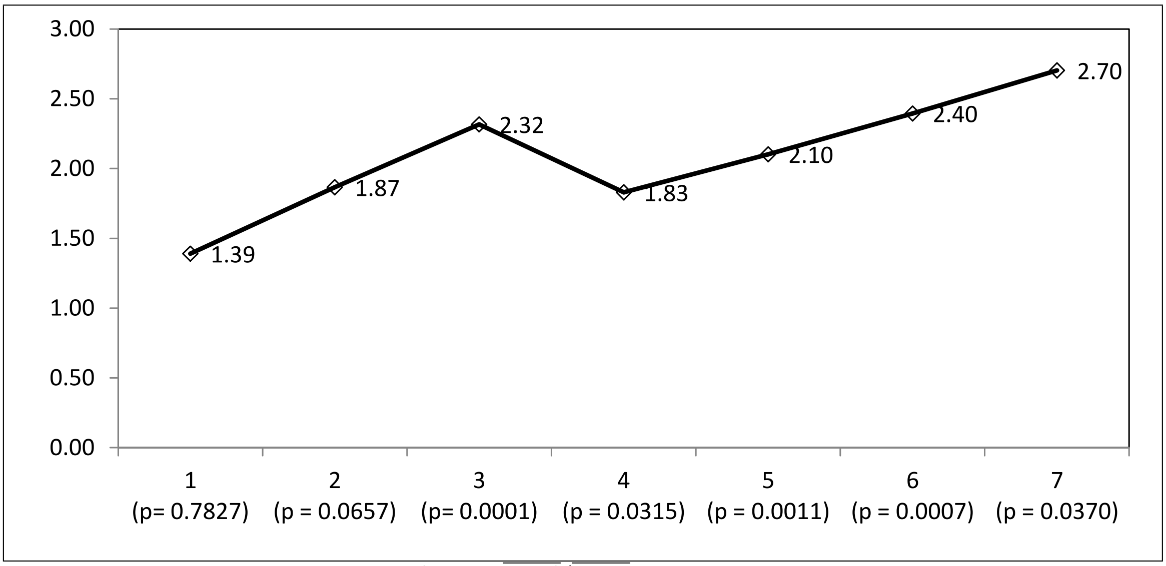

Figure 3.4: Average $\overline{WTA}/\overline{WTP}$ ratio by loss aversion

3.5.5 Hypothesis 2b - WTA, WTP and loss aversion

According to hypothesis 2b, the increase in the average $\overline{WTA}/\overline{WTP}$ ratio by loss aversion should be caused by both, an increase in $\overline{WTA}$ and a decrease in $\overline{WTP}$. To get a first impression, figure 3.5 now displays the average $\overline{WTA}$ and $\overline{WTP}$ separately for each of the seven loss aversion categories. There does not seem to be a relation between loss aversion and the WTA. Therefore, the first part of hypothesis 2a cannot be confirmed by this descriptive analysis. The second part, however, can be confirmed. The average $\overline{WTP}$ strongly decreases with loss aversion. Participants who are "not at all" loss averse indicate on average the highest $\overline{WTP}$ of EUR 1,695. The $\overline{WTP}$ decreases by almost 50% to EUR 904 for the most loss averse participants. Table 3.5 presents results of two OLS regressions, analyzing the $\overline{WTA}$

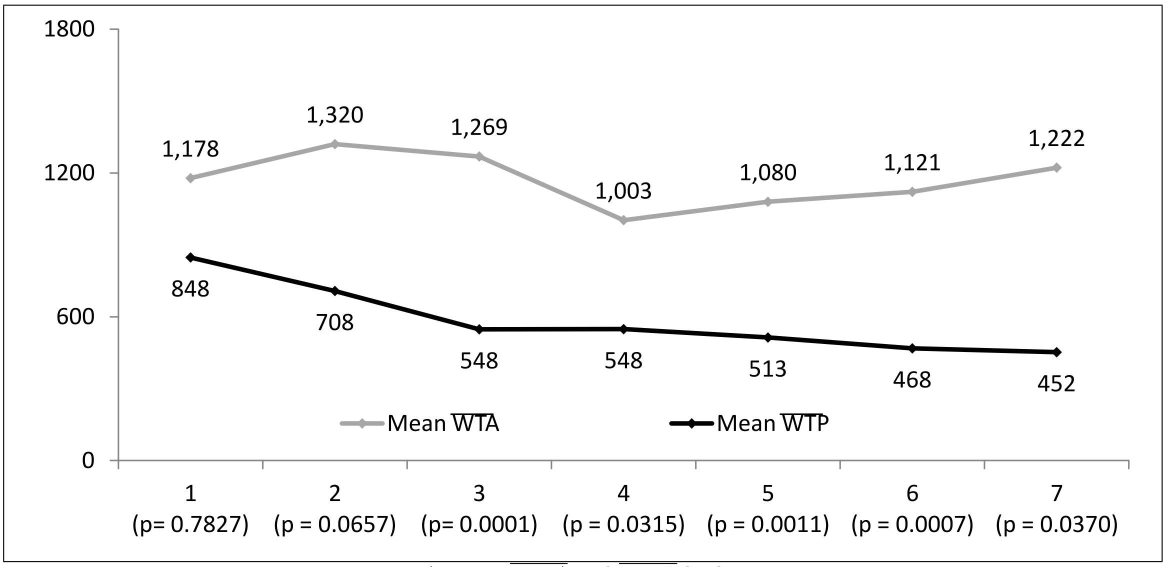

Figure 3.5: Average $\overline{WTA}$ and $\overline{WTP}$ by loss aversion

and $\overline{WTP}$ separately. The dependent variable is the logarithmized $\overline{WTA}$ (Columns 2 and 3) or $\overline{WTP}$ (Columns 4 and 5) per participant, respectively.

First, the logarithmized $\overline{WTA}$ is considered. The coefficient for loss aversion is positive, indicating an increase in $\overline{WTA}$ of about 2% per unit increase in loss aversion.

	$\overline{WTA}$ **(log)**		$\overline{WTP}$ **(log)**	
Variable	**Coeff.**	**t-value**	**Coeff.**	**t-value**
Loss Aversion				
Loss Aversion (1-7)	0.021	0.85	-0.101***	-3.44
Demographics				
Age	0.001	-0.31	0.011***	2.84
Gender	0.005	0.05	0.262**	2.30
Income (log)	0.403***	9.45	0.603***	11.99
Number of Children	-0.046	-1.22	-0.012	-0.41
High School Degree	0.127	0.99	-0.142	-0.93
University Degree	0.102	1.36	0.396***	4.36
Married	0.159**	2.01	0.286***	3.29
Controls				
Risk Aversion (1-7)	-0.010	-0.34	0.073**	2.28
Financial Literacy Score (0-6)	0.038	1.34	-0.026	-0.77
Life Expectancy [years]	-0.001	-0.22	-0.010**	-2.54
Planned Retirement Age [years]	-0.045***	-7.52	-0.013**	-1.97
Owns Private Pension Insurance	0.042	0.65	0.003	0.04
Certainty of Social Security	0.004	0.24	-0.004	-0.18
Constant	6.276***	9.90	3.007***	4.11
Number of Obs.	1046		930	
Adj. R^2	0.0834		0.3153	

Table 3.5: **Hypothesis 2b:** results of OLS a regressions with the logarithmized $\overline{WTA}$ and $\overline{WTP}$ as dependent variable. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

However, the coefficient is insignificant. As suggested by figure 3.5, loss aversion, therefore, seems to have no effect on the $\overline{WTA}$.

Only one of the six control variables proofs to be significant. The $\overline{WTA}$ decreases by about 5% for each year a participant plans to retire later. This negative effect is of the same magnitude and significance as for the pooled regressions in table 3.3. Neither risk aversion, financial literacy, the subjective life expectancy nor owning private pension insurance have a significant effect on the $\overline{WTA}$. Also only two demographic variables significantly influence the $\overline{WTA}$. Per 1% increase of income, the $\overline{WTA}$ is increased by about 0.4%. As the income effect in the pooled regression (table 3.3) is stronger, income seems to effect the $\overline{WTA}$ less than it influences the $\overline{WTP}$. This makes sense, as the income is a upper bound for the WTP (you cannot give up more than all monthly benefits) but not for the WTA. Additionally, being married (dummy) increases the $\overline{WTA}$ by 16.83%.

The second part of table 3.5 presents OLS regression results for the $\overline{WTP}$. Loss aversion has a highly significant and economically meaningful effect. On average the $\overline{WTP}$ for early retirement decreases by 10.10% for a one unit increase in self reported loss aversion. The effect is robust to the inclusion of control variables and demographics. Therefore, hypothesis 2b can partly be confirmed. Loss aversion increases the $\overline{WTA}/\overline{WTP}$ ratio by significantly decreasing the $\overline{WTP}$. The $\overline{WTA}$, however, is not affected by participants loss aversion. Three out of seven control variables have significant effects on the $\overline{WTP}$. Participants life expectancy as well as their planned retirement age decreases the reservation price in the WTP scenario by about 1% per additional year. The effect of risk aversion is also significant. More risk averse participants have a higher reservation price for early retirement. This result is in contrast with Coile et al. (2002) who theoretically show that delaying retirement is more attractive with risk aversion.

In contrast to the $\overline{WTA}$, the $\overline{WTP}$ depends highly on participants demographics. Per year of age the $\overline{WTP}$ increases by 1.1%. The closer participants are to retirement, the more they are willing to pay to retire early. The $\overline{WTP}$ increases by about 0.6% per 1% increase in income. This effect is about 50% stronger than for the $\overline{WTA}$. Also being male, being married and having obtained a university degree increases the $\overline{WTP}$. All three effects are economically strong with an increase of 29.15% (male), 32.62% (married) and 47.94% (university degree), respectively.

The explanatory power of the $\overline{WTP}$ regression is more than 3 times as high as for the $\overline{WTA}$ regression (adjusted R^2 of 31.53% vs. 8.34%). This is driven by the demographic variables. Even if the income is not included, the adjusted R^2 remains by about 20% (not reported). It seems that the $\overline{WTP}$ highly depends on demographics, whereas the $\overline{WTA}$ seems to be driven by factors that are not captured in our study.

In summary, hypothesis 2b can be confirmed only partially. We observe the predicted effect of loss aversion only on the $\overline{WTP}$ but not on the $\overline{WTA}$. In a narrow focus this can partly be treated as evidence for the Bateman et al. (1997) and Bateman et al. (2005) argument as we find loss aversion in money. On the other hand, participants may not see the decision as a classic money vs. good problem. The WTP decision could be interpreted as an exchange of distant future consumption for near future leisure. Therefore, as loss aversion clearly exists in consumption (see e.g. Horowitz and McConnell, 2002), our results can also be treated as evidence for the Novemsky and Kahneman (2005) argument. This view can explain why we do not find any loss aversion in the WTA case. The exchange of near future leisure for distant future consumption seems to be perceived as a gain of future consumption. Therefore, loss aversion does not effect the decision.

3.6 Robustness

The robustness of the previous results is analyzed using two datasets. First, the FAZ-survey is used to test robustness regarding the hypothesis 1a. As already stated in section 3.5.1, the market price for early retirement depends on the treatment (WTA vs. WTP). This leads to a fair WTA/WTP ratio of 1.285. Therefore, a relative measure of the reservation price and an inflated WTP is constructed. In addition, the analysis is repeated with reduced samples, where first participants who indicated a WTP of zero are excluded, second, participants who indicated a WTA larger than the hypothetical pension payment are excluded and third, only participants who are close to retirement are taken into account.

The second dataset comes from a representative panel survey for Germany. The German SAVE panel is conducted since 2001 by the Munich Center for the Economics of Aging (MEA) to understand savings and retirement decisions of German households. The panel focuses on savings behavior, financial assets and old-age provision and includes numerous demographic, economic and psychological characteristics of participating households. Two waves are used: 1) the cross-section of the 2009 wave of the SAVE study where 2,222 households participated and 2) the cross-section of the 2011/2012 wave with 1,660 participants. Two different waves are used as in the 2011/2012 wave some of the control variables are not elicited and therefore, the two waves are merged to get a complete dataset. We are only able to test robustness of hypothesis 1a and 1b, as in the SAVE study 2009 and 2011/2012 no information about participants loss aversion is provided. For a detailed description of the survey methodology (e.g. imputation of missing values) see Börsch-Supan et al. (2009).

3.6.1 FAZ-survey

Relative reservation price

The relative reservation price used in the following analysis is based on the social security benefits at age 63. To understand the relative measure we go back to the example in section 5.1, where two participants with an income of EUR 1,000 are assigned to the two different treatments. Both participants are given a hypothetical pension value of EUR 650 per month. Assume both participants have the same relative reservation price of for example +50% based on benefits at age 63. This would lead to a absolute reservation price of $650 \cdot 1.5 - 650 = 325$ in the WTA treatment and to $650 - 650 \cdot \frac{1}{1.5} = 217$ in the WTP treatment. A WTA/WTP ratio of $\frac{325}{217} = 1.5$ would be observed, even if relative reservation prices are equal.

Table 3.6 presents results of an OLS regression with the logarithmized relative reservation price (based on benefits at age 63) as dependent variable. Columns 2 and 4 present regression coefficients, columns 3 and 5 the respective t-values. Besides the treatment dummy, demographics (including the fair price) and control variables are included. The treatment dummy is highly significant and negative, confirming the results of section 5.2. However, the magnitude of the effect is weaker, compared to the original analysis. The relative reservation price increases by 69.56% (level 1) and 63.36% (level 2) in the WTA treatment. In addition, the negative effect of the fair price is in line with the previous analysis. An increasing income leads to an increasing fair price. Participants seem to increase their reservation price less strongly, leading to a negative effect of the fair price on the *relative* reservation price. The absolute reservation price, however, increases with the fair price (see table 3.3).

Relative Reservation Price (log)	**Level 1** 65%		**Level 2** 110%	
Variable	Coeff.	t-value	Coeff.	t-value
Demographics				
Age	0.004	1.49	-0.001	-0.39
Gender	-0.007	-0.09	0.071	0.92
Fair Price (log)	-0.473***	-13.23	-0.341***	-8.71
Number of Children	0.068***	2.84	-0.015	-0.57
High School Degree	0.199*	1.96	0.045	0.41
University Degree	0.065	1.06	0.166**	2.55
Married	-0.062	-1.05	0.160**	2.52
Treatment				
WTA treatment	0.529***	10.97	0.492***	9.58
Controls	Yes		Yes	
Number of Obs.	2101		2056	
Adj. R^2	0.1247		0.0751	

Table 3.6: **Robustness Hypothesis 1a:** results of OLS regressions with the logarithmized relative reservation price, based on pensions at age 63, as dependent variable. The relative reservation price is defined as $\frac{WTA}{income}$ and $\frac{WTP}{income-WTP}$, respectively. The WTA treatment dummy indicates whether participants where assigned to the WTA or WTP treatment. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

Inflated WTP

A second robustness test regarding hypothesis 1a is conducted using an inflated measure of the willingness-to-pay. In the previous analysis it is shown, that the fair WTA/WTP ratio in our survey design is about 1.285. Therefore, the first inflated measure of the WTP is constructed as $WTP \cdot 1.285$. However, comparing the average WTP in the level 1 and level 2 question in figure 3.1, it can be seen that the WTP increase more strongly than the hypothetical pension value. The WTP increases by +104.43% whereas the hypothetical value only increases by $\frac{1.1}{0.65} - 1 = 69.23\%$. To account for this "overreaction" a second inflated measure of the WTP is constructed as $WTP \cdot \frac{2.0443}{1.6923} \cdot 1.285 = WTP \cdot 1.552$.

Table 3.7 presents results of four OLS regressions with the logarithmized reservation price as dependent variable. Thereby the WTP is inflated by 1.285 (columns 2 - 5) and 1.552 (columns 6 - 9) respectively. In all cases the treatment dummy is positive and remains significant to the 1% level, confirming the robustness of hypothesis 1a.

Reduced sample: WTP of zero

Indicating a WTP of zero implies that someone would not even be willing to forgo one Euro of monthly pension benefits in order to retire four years earlier. This could for example be due to a high job satisfaction or a really constrained budget. A third reason could be that participants did not want to answer the question and therefore, simply typed in a value of zero. However, since we did not force participants to indicate a reservation price at all (they could also leave the field blank) this explanation seems unlikely. In our sample, 175 (level 1) and 92 (level 2) participants indicated a zero WTP. In contrast, only 27 (level 1) and 47 (level 2) participants indicated a WTA of zero. To analyze whether our results are driven by this difference, the analysis from section 5.2 is repeated without the participants that indicate a WTP of zero. Thereby the average WTP increases from 327.09 to 394.18 (level 1) and from 668.66 to 733.90 (level 2). Table 3.8 presents the reduced sample regression results. The treatment dummy is significant in both regressions, level 1 and level 2. The overall effect of an increasing reservation price in the WTA treatment is confirmed. However, excluding participants with a WTP of zero weakens the results in two ways: 1) the t-value of the treatment dummy decreases from about 18 to 10 (level 1) and from 9.5 to 3.5 (level 2), respectively. 2) Also the magnitude of the effect decreases strongly. In the level 1 (level 2) regression, being assigned to the WTA treatment now increases the reservation price by only 75.80% (26.04%), compared to 313.55% (110.29%) for the analysis presented in table 3.3. In summary, parts of the significance and magnitude of the WTA/WTP effect in the original analysis is driven by participants which indicate a WTP of zero. However, the main effect remains robust to the exclusion of these participants.

Reservation Price (log)	**WTP inflated by 1.285**				**WTP inflated by 1.552**			
	Level 1 (65%)		Level 2 (110%)		Level 1 (65%)		Level 2 (110%)	
Variable	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value	Coeff.	t-value
Demographics								
Age	0.003	0.82	0.005	1.05	0.003	0.78	0.005	1.05
Gender	0.133	1.13	0.194	1.57	0.134	1.11	0.193	1.54
Fair Price (log)	0.518***	9.43	0.453***	7.77	0.522***	9.31	0.454***	7.69
Number of Children	-0.081**	-2.07	-0.033	-0.81	-0.084**	-2.10	-0.034	-0.81
High School Degree	-0.066	-0.39	-0.154	-0.87	-0.075	-0.44	-0.156	-0.87
University Degree	0.124	1.25	0.167	1.60	0.127	1.25	0.166	1.57
Married	0.284***	2.90	0.268***	2.60	0.291***	2.91	0.270***	2.58
Treatment								
WTA treatment	1.213***	15.24	0.518***	6.22	1.055***	12.98	0.346***	4.10
Controls	Yes		Yes		Yes		Yes	
Number of Obs.	2123		2093		2123		2093	
Adj. R^2	0.2119		0.1218		0.1886		0.1108	

Table 3.7: **Robustness Hypothesis 1a:** results of OLS regressions with the logarithmized reservation price as dependent variable. The WTP thereby is inflated by a factor of 1.285 or 1.522, respectively. The WTA treatment dummy indicates whether participants where assigned to the WTA or WTP treatment. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

Reservation Price (log)	**Level 1** 65%		**Level 2** 110%	
Variable	Coeff.	t-value	Coeff.	t-value
Demographics				
Age	0.006*	1.95	0.003	0.76
Gender	0.103	1.29	0.226**	2.28
Fair Price (log)	0.431***	11.48	0.430***	9.27
Number of Children	0.013	0.44	-0.010	-0.31
High School Degree	0.200*	1.80	-0.088	-0.63
University Degree	0.029	0.43	0.239***	2.87
Married	0.065	0.98	0.225***	2.74
Treatment				
WTA treatment	0.566***	10.51	0.234***	3.50
Controls	Yes		Yes	
Number of Obs.	1948		2001	
Adj. R^2	0.1906		0.1288	

Table 3.8: **Robustness Hypothesis 1a:** results of OLS regressions with the logarithmized reservation price as dependent variable. Participants who indicated a WTP of zero are excluded from the sample. The WTA treatment dummy indicates whether participants where assigned to the WTA or WTP treatment. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

Reduced sample: WTA > retirement income

In an open end survey design the WTA/WTP disparity could be driven by the fact that the WTA is not subject to a budget constraint. In our case, for example, the maximum amount of pension payments someone is willing to give up (WTP) can not exceed total pension payments. That is, someone cannot give up more than he or she has. However, the WTA does not underlie that constraint as someone can easily demand an increase in pension payments that is higher than the total retirement income. To test whether the results are driven by participants who indicate a WTA > retirement income, the analysis is repeated for a subsample that excludes these participants. Table 3.9 presents OLS regression results for the reduced sample. The treatment dummy is significant in both regressions, level 1 and level 2. Also, the magnitude of the effect is almost not affected by the reduced sample. On average the reservation price increases by 223.69% (level 1) and 65.19% (level 2), respectively. The main result, therefore, remains robust.

Reservation Price (log)	**Level 1** 65%		**Level 2** 110%	
Variable	Coeff.	t-value	Coeff.	t-value
Demographics				
Age	-0.004	-0.95	-0.006	-1.33
Gender	0.031	0.27	0.054	0.44
Fair Price (log)	0.930***	14.63	0.851***	12.39
Number of Children	-0.101***	-2.65	-0.047	-1.17
High School Degree	-0.128	-0.78	-0.129	-0.74
University Degree	0.022	0.22	0.019	0.18
Married	0.157	1.64	0.134	1.32
Treatment				
WTA treatment	1.178***	14.95	0.505***	6.09
Controls	Yes		Yes	
Number of Obs.	1974		1960	
Adj. R^2	0.2806		0.1647	

Table 3.9: **Robustness Hypothesis 1a:** results of OLS regressions with the logarithmized reservation price as dependent variable. Participants who indicate a WTA greater than the hypothetical pension value (y) are excluded. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

Reduced sample: participants close to retirement

In this last robustness test it is analyzed whether participants with age close to their planned retirement behave different from the rest of the sample. Possible reasons could be that this particular subsample is more informed about the social security system and the fair price. Also it could be that they already spent some time thinking about the retirement decision and therefore are less likely to be influenced by the treatment effect. Therefore the analysis is repeated with participants who have less than ten years to their planned retirement age. Table 3.10 shows that also for this subsample the treatment effect is significant and economically strong. In the level 1 (level 2) regression being assigned to the WTA treatment increases the reservation price by 179.57% (57.19%). However, compared to the full sample effect presented in table 3.3 the magnitude of the treatment effect is reduced by about 40% and 50% in the level 1 and level 2 regression, respectively. Participants closer to their planned retirement age are less strongly influenced by the treatment.

Reservation Price (log)	**Level 1**		**Level 2**	
	65%		110%	
Variable	Coeff.	t-value	Coeff.	t-value
Demographics				
Age	0.022	0.62	-0.010	-0.25
Gender	0.181	0.59	0.326	0.89
Fair Price (log)	0.410***	3.88	0.289**	2.26
Number of Children	-0.040	-0.47	-0.032	-0.33
High School Degree	-0.333	-1.02	-0.058	-0.15
University Degree	0.229	0.90	-0.035	-0.12
Married	0.557**	2.48	0.610**	2.37
Treatment				
WTA treatment	1.046***	5.58	0.475**	2.24
Controls	Yes		Yes	
Number of Obs.	359		346	
Adj. R^2	0.1722		0.0408	

Table 3.10: **Robustness Hypothesis 1a:** results of OLS regressions with the logarithmized reservation price as dependent variable. Only participants who have less than ten years to their planned retirement age are taken into account. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

3.6.2 SAVE Panel

Robustness SAVE - hypothesis 1a

Using the SAVE panel for robustness comes with the advantage of a representative sample of the German population. We are able to test whether the results obtained in the previous analysis are driven by the fact that FAZ readers present a high income - high education sample. Nevertheless, there are also two drawbacks: 1) the WTA/WTP questions in SAVE are not identical to our questions as they refer to working one year longer or one year shorter compared to a planned retirement age. 2) The questions were not mandatory and therefore, only few participants answered them. However, even if the questions are not identical to our survey, they give a good impression of the robustness of our results.

In the 2011 wave of the SAVE panel the following question for participants who will receive social security benefits in the future was included: "*in order to retire one year earlier, would you be willing to give up a part of your monthly benefits?*" Participants could then indicate a percentage of their monthly benefits they would be willing to give up or answer with “no” or “I don’t know”. Of the 1,660 participants 835 were already retired (775) or indicated that they will not receive social security benefits in the future (60). Of the remaining 825 participants, 148 gave a percentage value, 345 indicated that they would not be willing to give up any monthly benefits and 332 answered with “I don’t know”. We treat this question as a willingness-to-pay scenario as participants indicate a reservation price for early retirement from a perspective where they have to retire later. Only the 148 observations of participants indicating a percentage value are used. A second question, within subjects, in the 2011/2012 SAVE survey is used as willingness-to-accept scenario: “*would you be willing to retire one year later if your social security benefits would be increased?*” Again participants could indicate a percentage, or answer with “no” and “I don’t know”. Here 87 participants gave a percentage value, 459 indicated that they would not be willing to work longer, 279 “did not know”. Again, only the 87 participants indicating a percentage value enter the analysis. Robustness therefore is tested using the reservation price in percent decrease or increase of monthly social security benefits. Similar to our survey, the SAVE survey includes a set of financial literacy questions (9 questions, see appendix C.2), the subjective life expectancy, the planned retirement age and whether or not participants own private pension insurance.

Since the sample presents only a small selection of the whole SAVE dataset, we test whether participants in our sample systematically differ from participants which answered “no” or “I don’t know”. A logistic regression with an indicator variable that equals one if a participant indicated a percentage value and zero otherwise shows that gender, subjective life expectancy and financial literacy are significant predictors for indicating a percentage value (regression results not reported). A mean comparison test confirms these results. There are 54.22% male participants in the sample indicating a percentage value, whereas only 40.45% of participants in the “no or I don’t know sample” are male. The significant difference in life expectancy and financial literacy is economically weak. Participants who enter a percentage value indicate a life expectancy that is on average only 1.66% higher compared to the "no or I don't know sample". Also, the average financial literacy is only 6.11% higher. The small sample does not differ strongly from the representative SAVE dataset and therefore is used to test the robustness of our results.

Figure 3.6 present the reservation price for early retirement in the SAVE panel under the WTA and WTP treatment as well as the $\frac{WTA}{WTP}$ ratio and the t-statistic of a difference in means test. The average reservation price in the WTA treatment (23.31%) is about 3.3 times larger than in the WTP treatment (7.11%). This difference is highly significant with a t-statistic of -7.05. The ratio of 3.3 is higher compared to the results in our survey presented in figure 3.1. Table 3.11 presents

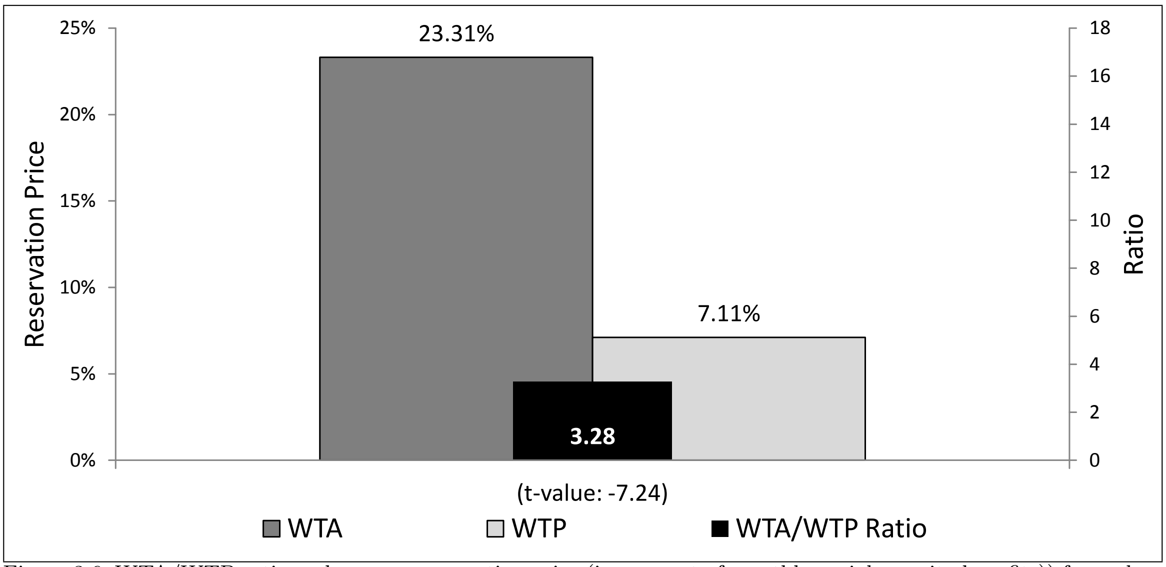

Figure 3.6: WTA/WTP ratio and average reservation price (in per cent of monthly social security benefits)) for early retirement depending on the treatment (WTA vs. WTP). Data used for robustness is from the German SAVE panel, waves 2009 and 2011/2012.

results of an OLS regression with the logarithmized reservation price as dependent variable and demographic and controls as independent variables[16]. As in the main analysis, the effect of the WTA dummy is positive and highly significant. The reservation price increases on average by $exp(1.1604 - \frac{1}{2}0.1271^2) - 1 = 216.55\%$ in the WTA treatment. The magnitude of the effect is also comparable to the effect in the

[16]Similar to the absolute EUR values in the FAZ-survey, the percentage values follow a log-normal distribution.

Reservation Price [%]

Variable	**Coeff.**	**t-value**
Demographics		
Age	-0.004	-0.60
Gender	-0.271**	-2.19
Income (log)	0.008	0.06
Number of Children	-0.031	-0.45
High School Degree	-0.185	-1.18
University Degree	-0.267	-1.42
Married	-0.130	-0.86
Treatment		
WTA treatment	1.160***	9.13
Controls		
Financial Literacy Score (0-9)	-0.042	-0.66
Life Expectancy	-0.013	-1.63
Planned Retirement Age (years)	-0.048***	-2.67
Owns Private Pension Insurance	-0.092	-0.76
Constant	6.437***	4.29
Avg. Number of Obs.	240	
Avg. Number of Clusters	225	
Avg. Adj. R^2	0.3489	

Table 3.11: **Robustness - Hypothesis 1a: results of OLS regressions** with the logarithmized reservation price for early retirement as dependent variable. The reservation price is measured in per cent of expected social security benefits per month. Data used for robustness is from the German SAVE panel, waves 2009 and 2011/2012. ***, ** and * indicate significance on the 1%, 5% and 10%-level. The SAVE data is multiply imputed with five different implicates. All five implicates are used. Coefficients and standard errors are calculated according to Rubin (1987).

main analysis for the level 1 regression (increase of 313% in the WTA treatment; see table 3.3). The main result therefore is confirmed using the representative SAVE dataset. In addition, the gender dummy is now significant. 45% of SAVE participants who indicated a percentage value in the WTA/WTP question are female. In the main analysis (FAZ-survey), this is only true for 16%. The higher variation in the gender dummy may explain the now significant effect. Women seem to have a stronger preference for early retirement and therefore indicate a higher reservation price. This result is in line with Munnell et al. (2004) and Moen and Flood (2013) who report that women are more likely to retire early.

Robustness SAVE - hypothesis 1b

In the German pension system, the percentage increase of social security benefits for an additional year of employment depends on 2 factors: 1) the age of the employee compared to his full retirement age determines whether the benefits are increased by 3.6% (if the age is at least one year below the full retirement age) or 6.0% (if the age is equal or greater than the full retirement age). 2) The income in the additional year determines the additional earning points added to the social security account of the employee. The question in the SAVE survey refers to working one year longer or shorter than planned. Therefore, to calculate an indicator for late retirement the planned retirement age and the full retirement age of each participant is taken into account. In the **WTA question**, participants are asked for a percentage change in social security benefits for working one year longer than planned. If the planned retirement age is equal or greater than the full retirement age the fair price would be 6.0% + the percentage increase in earning points. For a planned retirement age smaller than the full retirement age the fair price would be 3.6% + the percentage increase in earning points. The **WTP question** refers to working one year shorter. Therefore the fair price is 6.0% + the percentage decrease in earning points if the planned retirement age is greater than the full retirement age and 3.6% + the percentage decrease in earning points if planned retirement age is smaller or equal to the full retirement age. It is assumed that all participants are employed since the age of 25 and that the income in the additional/deducting year equals the average income. Therefore, the percentage change in earning points is calculated as $\frac{1}{PRA-25}$, with PRA being the planned retirement age. The indicator variable *late retirement* equals 1 if a participant's reservation price is smaller than his or her fair price and 0 otherwise. This indicator equals 1 for 121 of the 239 observations (50.63%).

Table 3.12 presents result of a logistic regression with *late retirement* as dependent variable. Asking participants for an WTA significantly decreases the likelihood of late retirement. The coefficient of -2.690 is significant on the 1%-level. With an average marginal effect over all observations of -47.43% percentage points, the effect is also economically strong. The gender dummy has a significant and positive effect. Being male increases the probability for late retirement on average by 11.80 percentage points. The effects of the planned retirement age and owning a private pension insurance are also positive, however, only marginal significant.

In summary, both hypotheses, 1a and 1b, can be confirmed using the SAVE dataset. The results therefore, seem not to be driven by more wealthy and highly educated participants in the FAZ survey.

Late Retirement

Variable	Coeff.	z-value
Demographics		
Age	-0.019	-1.02
Gender	0.646*	1.82
Income (log)	0.385	0.81
Number of Children	0.037	0.20
High School Degree	-0.170	-0.37
University Degree	0.741	1.35
Married	0.128	0.30
Treatment		
WTA treatment	-2.300***	-6.01
Controls		
Financial Literacy Score (0-9)	0.030	0.17
Life Expectancy	-0.001	-0.03
Planned Retirement Age (years)	0.102*	1.89
Owns Private Pension Insurance	0.574*	1.73
Constant	-9.141*	-1.81
Avg. Number of Obs.	240	
Avg. Number of Clusters	225	
Avg. Correctly classified	0.7114	
Avg. Area under ROC Curve	0.7905	

Table 3.12: **Robustness - Hypothesis 1b: results of logistic regressions** with an indicator variable for late retirement as dependent variable. Data used for robustness is from the German SAVE panel, waves 2009 and 2011/2012. ***, ** and * indicate significance on the 1%, 5% and 10%-level. The SAVE data is multiply imputed with five different implicates. All five implicates are used. Coefficients and standard errors are calculated according to Rubin (1987).

3.7 Policy Implications

Pay-as-you-go pension systems of many developed countries are put under pressure through increasing life expectancy, decreasing birthrates and the baby boomers generation entering retirement. As a result, the ratio of working people to retirees is constantly decreasing. Governments of Germany, the US, U.K, France and many other European countries reacted to this development by increasing the full retirement age. This step was necessary as in most countries people retire significant earlier than the full retirement age (see for example Behaghel and Blau, 2012; Börsch-Supan, 2000). Therefore, it is important to understand what drives peoples retirement decision besides the full retirement age.

Before we get to possible policy implications, it has to be analyzed who will be affected by the different treatments of the decision problem. If a participant's WTA is smaller than the price of early retirement, we can assume that his or her decision will not be affected by a different presentation of the problem. This is because a reduction in his or her reservation price would not lead to a different decision and, in general, the WTA is greater than the WTP. The same holds for participants who indicate a WTP that is already greater than the fair price. A participant, therefore, is classified as *possibly affected* by the presentation of decision problem if the $WTA >$ fair price or $WTP <$ fair price. Following this classification, in the level 1 scenario of the FAZ-survey 1,538 (64.65%) and in the level 2 scenario 1,469 (59.25%) participants are possibly affected. Therefore, implications are relevant for the majority of participants. A second important issue is the external validity of our results. The income in our sample is significantly higher than the average income in Germany. Therefore it is tested, whether there is a relation between being *possibly affected* and participants income. A simple mean comparison test shows that the average income of the 1,538 participants who are classified as *possibly affected* (level 1) is significantly (1%-level) lower (- 410.62 EUR per month) compared to the *not affected* group. This result is also confirmed in a logistic regression with demographic and control variables (not reported). A second indication towards the external validity comes from the representative SAVE data. Here the number of participants who are possibly affected is with 70.29% even bigger compared to the FAZ-survey. Therefore, we conclude that our results have implications for the majority of the population.

The results of this study have two important implications: 1) we find that the WTA/WTP disparity also exists in a retirement context. People on average indicate a reservation price for early retirement which is lower than the fair price if the decision is presented in a WTP context. The opposite is true for the presentation in a WTA context. Policy makers, therefore, should pay massive attention on how they present information about social security payments. 2) As stated above, one way to increase the retirement age is to increase the full retirement age. However, also the social security information letter that is provided by the government represents a powerful tool to increase the effective retirement age. Former studies show that already small changes in a presentation format can lead to different decisions (e.g. Choi et al., 2013). Combined with the results of this study, policy makers should consider changes in the information letter as a second device, next to increasing the full retirement age.

3.8 Conclusion

This paper relates the retirement decision with the willingness-to-accept/willingness-to-pay disparity. In an online survey participants indicate their reservation price for early retirement as their WTA or WTP, respectively. In line with the WTA/WTP literature, we find that the WTA is about two times greater than the WTP. When comparing the market price for early retirement, measured as reduction of monthly social security benefits according to the German pension system, with participants reservation price, we find that early retirement seems especially attractive for participants answering the WTA question. The average probability of early retirement is about 28-37 percentage points higher when the reservation price is elicited as a WTA compared to a WTP. Additionally, we analyze the cause of the high WTA/WTP ratio. Loss aversion significantly increases the ratio, however, not by increasing the WTA but by decreasing the WTP. This finding is in contrast with the most prominent explanation for the WTA/WTP disparity, namely an endowment effect caused by loss aversion. Participants seem to perceive the exchange of money for early retirement as a loss and therefore are willing to pay less the more loss averse they are. Giving up early retirement in exchange for money, however, is not perceived as a loss and loss aversion has no significant effect on the WTA.

Chapter 4

Inconsistent Retirement

4.1 Introduction

"The question isn't at what age I want to retire, it's at what income"

∼ *George Foreman*

When to stop working and enter retirement is one of the most important decisions that almost everybody will face at one point in his or her life. Thereby, income during retirement highly depends on the timing of retirement since in most countries social security benefits are payed according to the number of years one has been employed. Also, the decision becomes more and more important since the lifespan after retirement is constantly increasing due to an increasing life expectancy. Most studies analyzing the retirement decision focus on health and economic status (see e.g. Kim and Feldman, 1998; Blau and Gilleskie, 2001; Coile et al., 2002; Munnell et al., 2004; Li et al., 2008). They have found that bad health conditions (unsurprisingly) are an important driver for early retirement and that individuals with a higher socioeconomic status tend to retire later. Besides these (clearly important) rational considerations also behavioral factors influence the retirement decision (e.g.

Knoll, 2011). This study focuses on one of these behavioral factors, namely peoples time preferences.

The retirement decision presents an intertemporal consumption decision under uncertainty. In this context, time preferences play an important role. They can be interpreted as individuals' valuation of a good at an earlier date compared to its valuation on a later date. This paper empirically analyzes the relation between hyperbolic discounting and the decision when to retire. A decision maker with hyperbolic time preferences exhibits stronger discount rates in the near future and weaker ones in the more distant future. This behavior can lead to the problem of dynamic inconsistent decisions. A dynamic inconsistent decision maker will evaluate an optimal plan at some point in time, but reevaluate that plan at a later point in time and not necessarily stick to it (e.g. Strotz, 1955). In the retirement context, a dynamic inconsistent decision maker could, for example, evaluate an optimal retirement age during work life. However, when the actual decision comes closer, he or she may reevaluate the planned retirement age and chose to retire earlier or later.

Time preferences are described using a discount function. Thereby, the exponential discount function and the hyperbolic discount function are the two most prominent ones. The former assumes that the discount rate between two periods only depends on the time distance between these two periods and not on how far they are away from today. This assumption of stationarity leads to a constant discount rate between two consecutive periods. However, the majority of empirical studies finds that most individuals exhibit non-constant discount rates (see for example Thaler, 1981; Frederick et al., 2002). This behavior can be described by a hyperbolic discount function.

The question how hyperbolic discounting affects the retirement decision has been addressed by recent theoretical work (see Diamond and Köszegi, 2003; Holmes, 2010; Zhang, 2013; Findley and Caliendo, 2013; Findley and Feigenbaum, 2013). Thereby, these models focus on the savings decision of hyperbolic agents when retirement is endogenous. Therefore, predictions about the retirement decision which can be tested empirically are made: In a theoretical context, hyperbolic discounting compared to exponential discounting leads c.p. to early retirement. The decision maker puts too much weight on the near future and is therefore tempted to trade immediate leisure against future consumption. However, hyperbolic discounting can also lead to under-saving. The decision maker might not have accumulated sufficient wealth to finance early retirement and is therefore forced to retire later (e.g. Diamond and Köszegi, 2003). Since, in Germany, contribution to the social security system is mandatory and relatively high pension benefits are provided, we focus on the former effect of hyperbolic discounting and hypothesize that it will lead to early retirement.

We contribute to the literature by addressing this question empirically and testing predictions made by the theoretical models. In the analysis, two sources of data are used: 1) For the main analysis, an online survey in cooperation with the *Frankfurter Allgemeine Zeitung* (FAZ) was conducted. The FAZ is one of Germany's largest daily newspapers. They promoted the survey in the print edition and posted a link on their website, which redirected people directly to the survey. Participants answered a set of questions regarding their retirement plans and expectations. In addition, different proxies for participants time preferences were elicited. The survey also included questions regarding risk preferences, loss aversion, financial literacy and the subjective life expectancy. 2) Data from a representative panel survey in Germany is used to test robustness (SAVE panel).

To study dynamic inconsistency in the retirement context, first, the effect of age on the planned retirement age is taken into account. Following the theoretical literature, dynamic inconsistent decision makers will decrease their planned retirement age with increasing age, since they are more and more tempted to retire early. The data shows that this prediction can be confirmed: we find a highly significant and economically strong negative effect of age on the planned retirement age. On average, participants plan to retire about 0.7 month earlier by each year that they get older. This effect is robust to the inclusion of numerous demographic and control variables. To rule out other explanations besides time preferences, two more specific predictions are tested. We find that the age effect is between 3 and 10 times stronger for participants that can be classified as "more time inconsistent". Also, participants closer to retirement exhibit a stronger negative effect of age. In addition, the panel structure of the SAVE dataset allows to rule out possible cohort effects. The analysis of participants who participated in at least two of the SAVE waves from 2008, 2009 and 2010 shows that they indeed significantly decrease their planned retirement age with ongoing time.[1]

In a second step, it is analyzed whether time inconsistent decision makers follow their plans. Therefore, participants who are already retired are taken into account. In the FAZ dataset as well as in SAVE, retirees who can be classified as more time inconsistent retired about 2.5 years earlier. This result is robust to the inclusion of demographic and control variables as well as variables related to health. It shows that "time inconsistent" decision makers not only reduce their planned retirement age with ongoing time, but also actually retire significantly earlier than "time consistent" decision makers.

This behavior has serious consequences for the financial well-being during retirement. The German pension system allows people to retire earlier than their full retirement age. However, this will result in a constant decrease of monthly benefits. We find that participants who plan to retire early beforehand, compensate the reduction in social security benefits by private pension insurance. However, hyperbolic discounting leads to early retirement but does not increase the likelihood of owning private pension insurance. Therefore, the reduction in social security benefits is not compensated. Even after controlling for demographics (e.g. income, marital status, number of children, etc.) and personal characteristics such as risk and loss aversion, financial literacy and subjective life expectancy, time inconsistent participants retire about 2.5 years earlier than consistent ones. This 2.5 year difference in actual

[1] Thereby, waves before 2007 are not included, since with the reform of the German pension system in 2007, the full retirement age was increased to 67. This change would present a structural break in longer panel datasets.

retirement age results in a decrease of retirement benefits of about 15% for the inconsistent group. The results indicate that simply the fact of exhibiting a different discount function strongly influences a person's financial budget in retirement.

This paper proceeds as follows: section 2 discusses the connection between hyperbolic discounting and the retirement decision. In section 3, the data and methodology is introduced. Section 4 presents results and robustness tests. Before section 6 concludes, we discuss financial implications in section 5.

4.2 Hyperbolic discounting and the retirement decision

4.2.1 Hyperbolic Discounting

Time preferences can be described as the relative preference of a good at an earlier date compared to its preference on a later date (e.g. Frederick et al., 2002). Thereby, the good of interest can be very concrete, e.g. a chocolate bar or money, or more abstract like leisure time or personal health. In all cases, a discount function tries to describe how individuals weight an earlier outcome compared to a later outcome, i.e. describe individuals' time preferences. Since Samuelson (1937) introduced the discounted-utility model, a standard assumption regarding discount functions has been stationarity. The only discount function that fulfills this assumption is the exponential discount function. Stationarity leads to a constant discount rate between two consecutive time periods. This implies that the difference between an outcome today and tomorrow weighs the same as the difference between this outcome in e.g. 100 and 101 days. However, when scientists began to elicit discount rates in experiments, concerns about the descriptive validity of the model have been expressed. Many studies find that discount rates are not constant and individuals exhibit stronger discount rates for outcomes in the near future and weaker discount rates for more distant ones (see for example Thaler, 1981; Laibson, 1997; Frederick et al., 2002). This behavior can lead to dynamic inconsistent decisions. For example, as stated by Laibson et al. (1998), a person might prefer a 30 minutes work-break in 101 days over a 15 minutes break in one hundred days, however, if time passes she might reverse that decision and take a 15 minutes break today instead of a 30 minutes break tomorrow. This impatient behavior in the short run and patient behavior in the long run can be described by a hyperbolic discount function.

Loewenstein and Prelec (1992) presented an axiomatic foundation of the hyperbolic discount function $DF_{hb}(t) = (1 + \alpha t)^{-\frac{\gamma}{\alpha}}$. Figure 4.1 graphs the general hyperbolic function and the exponential function $DF_{EXP}(t) = (1 + i)^t$ with the values proposed by Laibson (1997) ($\alpha = 25 \cdot 10^4$, $\gamma = 10^4$) and $i = 5\%$. Compared to the exponential function, the hyperbolic function leads to stronger discounting in the beginning and to weaker discounting in later periods. This feature can predict dynamic inconsistency (see e.g. Ainslie, 1975; Kirby and Marakovic, 1995; Ahlbrecht and Weber, 1997; Frederick et al., 2002).

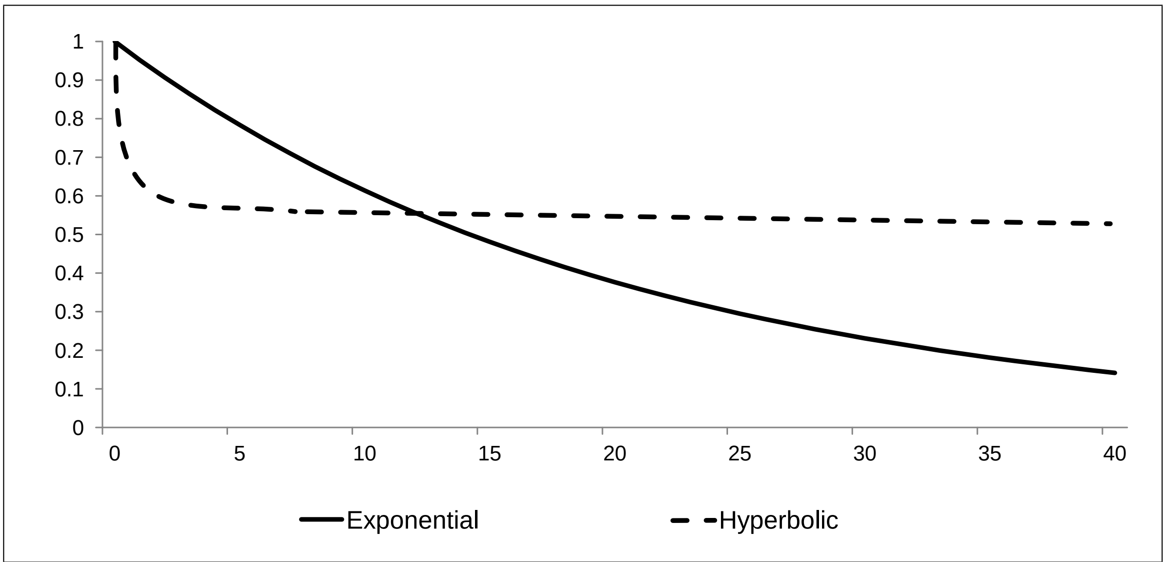

Figure 4.1: **Discount functions:** this figure reports the exponential discount function $DF_{EXP}(t) = (1 + i)^t$ with i = 5% and the general hyperbolic function $DF_{hb}(t) = (1 + \alpha t)^{-\frac{\gamma}{\alpha}}$, with $\alpha = 25 \cdot 10^4$ and $\gamma = 10^4$.

A dynamic inconsistent decision maker will evaluate an optimal plan at some point in time t, but reevaluate that plan at a later point in time $t + 1$ and therefore, not necessarily stick to it (e.g. Strotz, 1955). Typical examples for inconsistent behavior can be found in the literature regarding *self-control problems*. A person who today (t=0) conceives the plan to stop smoking next month may reevaluate that plan one month later (t=1) and decide to stop smoking next month. Thereby, it is important whether the decision maker is aware of his hyperbolic preferences or not (sophisticated vs. naive hyperbolic decision maker; see O'Donoghue and Rabin (1999).). The naive hyperbolic decision maker thinks at t=0 that he will stick to his optimal plan. Therefore, he does not foresee the possibility that he will change his optimal plan in later periods (and e.g. will never be able to quit smoking). The sophisticated decision maker, however, already anticipates his lack of self-control and therefore tries to bind or precommit his behavior (e.g. by telling others the plan to quit and remove all tobacco) (e.g. Strotz, 1955; Thaler, 1981; Sorger, 2007). In the following subsection, a brief overview of the theoretical literature dealing with dynamic inconsistency in the retirement context is given and 4 hypotheses are derived.

4.2.2 Retirement Decision

The decision when to retire and claim social security benefits is one of the economically most important decisions in one's life. For example, in Germany, retiring at the earliest age possible (63) instead of the full retirement age (67) results in a constant decrease of about 22% in social security benefits (see chapter 2). In addition, due to an increasing life expectancy and a decreasing or constant effective retirement age, the average time spent in retirement steadily increases.

The question addressed in this section is how hyperbolic preferences influence retirement plans. Following the argumentation of Zhang (2013), a hyperbolic decision maker puts too much attention on the near future. In the retirement context this has two consequences: first, the hyperbolic decision maker prefers instantaneous consumption, thereby neglecting the long term costs of undersaving. As a consequence, he or she will not be able to save enough for retirement and thus has to work longer compared to an exponential decision maker (e.g. Laibson, 1997). The first prediction, therefore, would be that hyperbolic preferences lead to late retirement due to financial constraints. The second prediction takes into account that the decision to retire early represents a tradeoff between future consumption against immediate leisure time. The hyperbolic decision maker is tempted to retire early since he puts too much weight on the utility gained from immediate leisure but too less weight on the utility loss due to reduced future consumption. Therefore, for any given level of accumulated wealth, the hyperbolic decision maker is c.p. more likely to retire early. There are three models and two extensions to them, which study savings decisions when retirement is endogenous in the context of hyperbolic discounting, and which model these two conflicting arguments.

The model by Diamond and Köszegi (2003)

Diamond and Köszegi (2003) study the effect of endogenous retirement decisions on savings behavior in a model with sophisticated quasi-hyperbolic decision makers[2]. In a three-period setting, the decision maker has to work in period -1. In period 0, he or she can decide whether to work or retire; and in period 1, he or she has to retire. Working in period -1 gives an income which the decision maker can (partly) consume and save. Therefore, in period 0, he or she holds wealth of $W_0 \geq 0$. Working in period 0 gives additional wealth of Δ and costs effort of $e > 0$. The remaining wealth for periods 0 and 1 will be W_0, if the decision maker retires, and $W_0 + \Delta$ otherwise. It is shown, that there are wealth levels W_0, for which the decision maker would not work in period 0, but would like to work from the perspective of period -1. This means, that there are wealth levels for which the decision maker initially (in period -1) plans to retire late (in period 1) but, with ongoing time, reevaluates that plan and chooses to retire early (in period 0) – displaying a dynamic inconsistency. Since the sophisticated quasi-hyperbolic decision maker will foresee the behavior of the future-self, he or she can incorporate it into the initial plan. This can lead to two outcomes: either the savings in period -1 can be reduced such that W_0 is sufficiently low to force the period-0-self to work ("strategic undersaving") or savings can be

[2]The concept of quasi-hyperbolic discounting is adopted from Laibson (1997). The quasi-hyperbolic discount function is a discrete time function with values $\{1, \beta\delta, \beta\delta^2, \beta\delta^3, \cdots\}$, with $\delta = \frac{1}{1+i}$ and $\beta \leq 1$. It combines most features of the general hyperbolic function with a good analytical tractability.

increased such that both, the self in period -1 and 0 prefer to retire early. Whether or not hyperbolic discounting leads to early retirement, therefore depends on the level of accumulated wealth.

There are two extensions to the Diamond and Köszegi (2003) model. First, Holmes (2010) shows that, in such a three-period model, dynamic inconsistency in the retirement decision will never occur, since the level of saving required to cause it is too high. A decision maker with hyperbolic time preferences would never save an amount sufficiently high to cause unplanned early retirement. However, in a second extension, Findley and Feigenbaum (2013) show that time-inconsistent retirement can exist in a three-period setting with a slight generalization of the underlying assumptions. Again, depending on the level of wealth, hyperbolic discounting leads to planned late retirement but actual early retirement.

The models by Zhang (2013) and Findley and Caliendo (2013)

Zhang (2013) argues that, empirically both, undersaving and early retirement can be observed. In the US, for example, the majority of workers choose to retire early (e.g. Behaghel and Blau, 2012; Gruber and Wise, 2004). Also, the aggregated savings rate has been declining since the 1980s (e.g. Laibson, 1997). She studies a three-period model which differs from the Diamond and Köszegi (2003) model in three ways: 1) The decision maker chooses an amount of labor supply l in period 0. Therefore, the decision whether to work or to retire is continuous. 2) Both, naive and sophisticated hyperbolic decision makers are taken into account and 3) early retirement and undersaving is defined relative to a decision maker who discounts the future exponentially. As a result, she shows that hyperbolic discounting can lead to parallel undersaving and early retirement. This holds for naive as well as sophisticated decision makers.

Findley and Caliendo (2013) also study the effect of hyperbolic discounting on saving behavior in a continuous-time model with endogenous retirement. Thereby, they focus on naive decision makers and compare them to exponential discounters. They find that, in their setting, hyperbolic discounters plan to retire early but then delay retirement. This is caused by insufficient savings. The hyperbolic decision maker fails to stick to previous saving plans, and therefore, has to increase the actual retirement age.

4.2.3 Hypotheses

Summarizing the theoretical literature, it can be seen that hyperbolic discounting can have a direct and indirect effect on retirement timing. On the one hand, hyperbolic decision makers are c.p. tempted to retire early and trade immediate leisure against future consumption. On the other hand, they might not have sufficient savings to finance early retirement and therefore, retire late. This paper studies the empirical relationship between hyperbolic discounting and the retirement decision in Germany. The social security system in Germany provides relatively high pension benefits (see e.g. Bassi, 2008). In addition, contribution to the system is mandatory for almost every employee in Germany. Therefore, a certain amount of pension benefits is guaranteed. We argue that for this reason, the direct effect of hyperbolic discounting on the retirement decision should be stronger and focus on the time inconsistency that can arise due to hyperbolic discounting. In theory, an individuals' retirement decision is defined as time inconsistent if he or she plans on working until a certain period t, and then reverses his original plan by actually retiring earlier. Empirically, this behavior would lead to a reduction in the planned retirement age with increasing age of the hyperbolic decision maker. Our first hypothesis states:

> *Hypothesis 1a: time inconsistent decision makers will decrease their planned retirement age with increasing age.*

Thereby, the magnitude of the effect should depend on the level of hyperbolic discounting:

Hypothesis 1b: the negative effect of age on the planned retirement age will be stronger for decision makers that can be classified as "more time inconsistent".

The idea of inconsistent retirement is also supported by a finding of Bidewell et al. (2006) who conduct an experiment, in which participants choose between early and late retirement depending on hypothetical savings, enjoyment of retirement and chances of good health during retirement. They find that participants who are closer to their planned or expected retirement age are more impatient towards early retirement as they are willing to give up more future retirement income in order to retire early. However, they do not attribute their finding to hyperbolic discounting. Following their result, we hypothesize:

Hypothesis 1c: the negative effect of age on the planned retirement age will be stronger for decision makers closer to retirement.

According to the theoretical literature (e.g. Zhang, 2013; Findley and Feigenbaum, 2013), the quasi-hyperbolic discounter not only plans to retire early but also sticks to that plan. To analyze the outcome of the retirement plan, the actual retirement age is taken into account:

Hypothesis 2: time inconsistent decision makers will retire earlier than time consistent decision makers.

4.3 Data and methodology

4.3.1 Data

In this study, two sources of data are used: first, for the main analysis, an online survey was conducted in cooperation with a large German newspaper, the "Frankfurter Allgemeine Zeitung" (**FAZ-Survey**). Second, to test robustness of the main results, we use a representative panel survey for Germany. The German **SAVE panel** has been conducted since 2001 by the Munich Center for the Economics of Aging (MEA) in order to understand savings and retirement decisions of German households. The panel focuses on savings behavior, financial assets and old-age provision and includes numerous demographic, economic and psychological characteristics of participating households (Börsch-Supan et al., 2009).

Main analysis - FAZ Data[3]

The survey was conducted from October 14^{th} to November 5^{th} 2012. The *FAZ* posted a link on their website and announced the survey two times in its print edition (on October 14^{th} and 28^{th}). Overall, 3,077 participants completed the survey. They answered several questions regarding retirement savings and planing. In the FAZ survey, the planned and actual retirement age was elicited directly. Participants indicated whether they were already retired or not and depending on their answer they were asked for their planned or actual retirement age (see Table 4.1). Both, the planned and actual retirement age is used as dependent variable in the analysis.

To distinguish between time inconsistent and time consistent participants, two questions according time preferences were introduced: 1) Quasi-hyperbolic or present-biased decision makers are impatient regarding near future consumption. To proxy for discounting, participants had to agree on a seven-point Likert scale to the statement: "*I'm an impatient person*". 2) In a choice-based task, participants had to decide between a tax refund T that would be obtained earlier and a refund $T(1+i)$ that would be obtained later in time. In three questions the earlier payment would received immediately and the later one would be received in 10 months with $i = 3.3\%$, 11.3% and 31.3%. For the second set of questions, all payments were shifted 18 months into the future (earlier payment in 18 months, later in 28 months). If participants have time consistent preferences only the difference between the two payments (10 months for all questions) should matter and for each interest rate the decision between the

[3]Data from the FAZ survey is also used in chapter 2. They focus on another part of the survey where the main questions are about choices between an annuity and a lump sum.

earlier or later payment should be the same. The second proxy for time preferences therefore measures the number of inconsistent answers from 0 to 3.

The set of control variables starts with risk and loss aversion. Both are self-assessed and elicited directly on a 1-7 Likert scale. Participants also answered a set of 6 financial literacy questions. Since the FAZ newspaper has a focus on financial markets, only one of the basic questions from Lusardi and Mitchell (2007) was used. In addition, three of the advanced questions (van Rooij et al., 2011) and two more complicated questions were introduced (see appendix C.1). Additional controls are participants' subjective life expectancy (elicited directly), a dummy that equals one if participants own private pension insurance, and an indication about how save the German social security system is perceived. Also demographics (age, gender, income, number of children, education and martial status) were elicited and the time needed to complete the survey was recorded.

Robustness - SAVE panel

From SAVE the waves of 2008, 2009 and 2010 are used in the analysis. Thereby, we take advantage of the panel structure and the cross section of the wave 2010. The dependent variables (planned retirement age and actual retirement age) as well as demographics are the same as in the FAZ survey (see Table 4.1). However, neither the waves of 2008, 2009 and 2010 nor any other wave of the SAVE panel allows to explicitly control for hyperbolic discounting. A variable that is related to time preferences is participants' smoking habit. Smokers are found to be more impulsive and impatient than non-smokers, which is also true for tasks not related to smoking (e.g. Bickel et al., 1999; Baker et al., 2003; Reynolds and Fields, 2012). Therefore, a common approach is to use smoking-habits as a proxy for time preferences in general, or hyperbolic discounting in particular (see for example Munasinghe and Sicherman, 2006; Kan, 2007; Khwajaa et al., 2007; Grignon, 2009). All waves provide information about the smoking behavior of participants which is used as a proxy for time preferences. Since smoking and early retirement can also be related due to health issues, three variables regarding participants health status are included. 1) Participants self-assess their health status on a 1-5 Likert scale, 2) they indicate how happy they are with their current health status on a 1-10 scale and 3) they indicate whether they suffer or suffered from a prolonged disease.

The control variables in SAVE include a financial literacy score, the subjective life expectancy of participants and whether or not a private pension insurance is owned. Financial literacy, thereby, includes 9 questions from Lusardi and Mitchell (2007) and van Rooij et al. (2011) (see appendix C.2). The subjective life expectancy is elicited in a two step procedure: first, participants make a best guess on the average life expectancy of a person of their age and gender. Second, they indicate by how many years they expect to live longer or shorter than the average person.

Variable	**FAZ Survey**	**SAVE Panel**
Dependent variable		
Planned retirement age	planned retirement age in month (at what age do you plan to retire?).	planned retirement age in month (at what age do you plan to retire?).
Actual retirement age	actual retirement age in years (at what age did you retire?).	actual retirement age in years (at what age did you retire?).
Demographics		
Age	year of the survey - year of birth.	year of the survey - year of birth.
Gender	0=female, 1=male.	0=female, 1=male.
Income	net income.	net income.
Number of Children	number of children.	number of children.
High School Degree	0=no, 1=yes.	0=no, 1=yes.
University Degree	0=no, 1=yes.	0=no, 1=yes.
Married	0=no, 1=yes.	0=no, 1=yes.
Proxy for time preferences		
Impatience Scale	Impatience from 1-7 (are you an impatient person? 1=not at all, 7=very impatient).	-
Number of inconsistent answers	number of inconsistent answers from 0-3 answers to 3 pairs of questions regarding a tax refund.	-
smoker	-	0=no, 1=yes (are you a smoker?).

Table 4.1: Overview of variables used in the analysis.

Variable	FAZ Survey	SAVE Panel
Controls		
Risk Aversion	Risk aversion from 1-7 (are you a risk averse person? 1=not at all, 7=very risk averse).	-
Loss Aversion	Loss aversion from 1-7 (are you a loss averse person? 1=not at all, 7=very risk averse).	-
Financial Literacy Score	6 financial literacy questions. Scale goes from 0-6. (see appendix C.1)	6 financial literacy questions. Scale goes from 0-10. (see appendix C.2)
Life Expectancy	subjective life expectancy elicited directly.	subjective life expectancy elicited indirectly
Owns Private Pension Insurance	0=no, 1=yes (do you own private pension insurance?).	0=no, 1=yes (do you own private pension insurance?).
Certainty of Social Security	indication about how save the social security system is percived from 1-7 (1=not save at all, 7=very save).	-
Time Sum	Time needed to complete the survey.	-
Full Retirement Age	Full retirement age.	Full retirement age.
Health		
Health status	-	health status on a scale from 1-5 (1=very good, 5=very poor).
Happiness health status	-	happiness with health status (0-10) (0=very unhappy, 10=very happy).
prolonged disease	-	0=no, 1=yes (any prolonged diseases?).

Overview of variables used in the analysis continued.

4.3.2 Summary statistics

FAZ and SAVE

Table 4.2 displays summary statistics on subjects planned and actual retirement age, demographics, time preferences and control variables. The average planned retirement age is similar in both studies and ranges from ranges from 775 month (FAZ) to 779 month (SAVE). The actual retirement age of retirees in the FAZ survey (61.5) is about 2.7 years higher compared to the SAVE survey (58.9). This difference, however, is not statistically significant.

A stronger variation between the surveys can be observed for demographic variables. Compared to the representative SAVE survey, where about 50% of participants are female, women are underrepresented in the FAZ survey (85.3% males). Moreover, the FAZ sample can be classified as a high education - high income sample. The average income in the FAZ survey (EUR 3.2k) is about 3.5 times higher than the average income in the SAVE panel. Education is measured by the fraction of participants that obtained a high school and/or university degree. In the FAZ sample, about 85% obtained the former and 63% the latter, compared to 19% and 11% in the SAVE survey. Concerning the average age and the fraction of married participants, there are no significant differences between the datasets.

All in all, three different proxies for time preferences are used. In the FAZ survey, participants indicated impatience on a Likert scale. Participants indicated an average of 3.9 (measured on a 1-7 scale). The average, thereby, is slightly below the center of the scale (4). The average number of inconsistent answers in the FAZ survey is 0.7. Thereby, about 40% of participants answerd at least one of the tax refund questions inconsistently. The third proxy is the smoker dummy in the SAVE 2010 survey. About 23% of participants indicated that they are smokers.

The FAZ survey includes 7 control variables. Asking participants about their risk- and loss aversion on a 1 to 7 Likert scale led to an average of 3.90 and 4.5 respectively. As expected, participants did extremely well in the financial literacy task. On average, 4.0 / 6 answers were correct. In contrast, out of the 9 financial literacy questions in the SAVE survey, participants gave only 2.9 correct answers on average. Directly asking participants about their subjective life expectancy led to an average of 83.8 years (FAZ). In SAVE, the subjective life expectancy is only 79.5 on average. However, as the life expectancy increases with wealth and education, a higher average in the FAZ survey seems reasonable. Therefore, it cannot be concluded whether participants in the FAZ survey overestimate their personal objective life expectancy or not. About one quarter of the SAVE participants own private pension insurance whereas this is true for about half of the FAZ participants. Participants completed the FAZ survey in 11 minutes (683.6 seconds) on average.

Variable	**FAZ Survey**	**SAVE 2010**
Dependent variable		
Planned retirement age	774.551	779.147
	(62.465)	(35.713)
Actual retirement age	61.486	58.880
	(4.484)	(6.903)
Demographics		
Age	53.687	57.839
	(9.069)	(9.438)
Gender	0.853	0.486
	(0.355)	(0.499)
Income	3.202	0.900
	(3.590)	(1.037)
Number of Children	1.188	0.543
	(1.170)	(0.773)
High School Degree	0.849	0.191
	(0.343)	(0.391)
University Degree	0.630	0.110
	(0.481)	(0.313)
Married	0.634	0.619
	(0.452)	(0.486)
Proxy for time preferences		
Impatience Scale	3.898	-
	(1.705)	
Number of inconsistent answers	0.706	-
	(0.992)	
smoker	-	0.232
		(0.408)
Controls		
Risk Aversion	3.931	-
	(1.496)	
Loss Aversion	4.465	-
	(1.606)	
Financial Literacy Score	3.995	2.945
	(1.114)	(1.055)
Life Expectancy	83.849	79.472
	(7.565)	(7.755)
Owns Private Pension Insurance	0.491	0.265
	(0.477)	(0.388)
Certainty of Social Security	3.574	-
	(1.893)	
Time Sum	683.643	-
	(169.817)	
Health		
Health status	-	2.630
		(0.816)
Happiness health status	-	5.975
		(2.382)
prolonged disease	-	0.559
		(0.479)
Number of Obs	2551	2023

Table 4.2: **Summary statistics**: This table presents summary statistics for the FAZ survey and the SAVE Survey 2010. Standard deviations are displayed in parentheses. The number of observations indicates the maximum number of observations per survey and variable.

4.3.3 Methodology

Dependent variable: Δ PFRA

To test the hypothesis 1a-1c, the planned retirement age is used as dependent variable. However, the full retirement age (FRA) in Germany depends on the year of birth. A stepwise increase of the FRA was decided within the 2007 reform of the pension system. Individuals being born before 1947 could claim full retirement benefits at age 65 and for individuals born after 1963 the FRA was raised to 67. In between the FRA is raised in steps of one or two months. Figure 4.2 shows the FRA depending on the year of birth.

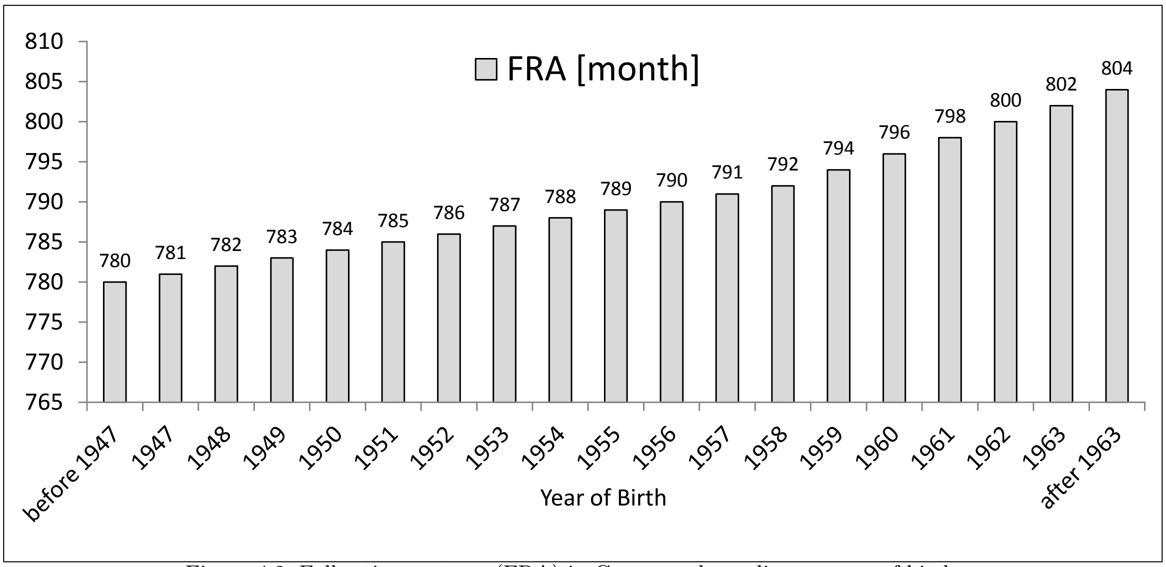

Figure 4.2: Full retirement age (FRA) in Germany depending on year of birth.

The difference in the FRA causes the following problem: assume that two individuals, A and B, plan to retire one year prior to their FRA. Thereby, A is 30 years old and his FRA is 67. B is 60 years old and therefore, her FRA is 65. The planned retirement age of A would be 66 whereas it would be 64 for B. Regressing the planned retirement age on age would now lead to a negative effect of age even if both, A and B, have the same retirement plan (retire 1 year prior to the FRA). To account for this, the difference between the full retirement age and the planned retirement age

($\Delta PFRA$) is used as dependent variable. Thereby, negative values indicate that a participant plans to retire earlier than his or her full retirement age and vice versa.

In the analysis, only participants who are not yet retired are taken into account. This results in a conservative estimate of the negative effect, since the planned retirement age of all participants in the sample has to be greater than their actual age. Therefore, for example, someone who is of age 63 and retired, but actually planned to retire at 65 would potentially strengthen our results but is not taken into account.

Main analysis

The main analysis is carried out with the FAZ dataset. In the base specification, the general effect of age on $\Delta PFRA$ is tested. The following regression is estimated:

$$\Delta PFRA_i = \beta_0 + \beta_{age} \cdot age_i + \beta_D \cdot D_i + \beta_{TP} \cdot TP_i + \beta_C \cdot C_i + \epsilon_i \tag{4.1}$$

with D being a vector of demographic variables (except age), TP being a proxy for time preferences and C being a vector of additional control variables presented in table 4.1. This specification allows to assess the general effect of age and time preferences on $\Delta PFRA_i$, i.e. test hypothesis 1a.

In a second specification, hypotheses 1b and 1c are tested. In addition to the variables in the base specification, two interaction terms are included in the regression:

$$\Delta PFRA_i = \beta_0 + \beta_{age} \cdot age_i + \boxed{\beta_{age^2} \cdot age(c)_i^2 + \beta_{AT} \cdot age_i \cdot TP_i} + \beta_{TP} \cdot TP_i + \beta_D \cdot D_i + \beta_C \cdot C_i + \epsilon_i \tag{4.2}$$

The term $age_i \cdot TP_i$ allows the age effect to depend on participants time preferences. Hypothesis 1b states that the magnitude of the negative age effect should increase with increasing hyperbolic discounting. Therefore, we expect the interaction to be negative. The second term that is added is $age(c)_i^2 = (age_i - \overline{age})^2$, the squared mean centered age. To avoid a high correlation between age and age^2, the age variable has to be centered. Following hypothesis 1c, the second non-linear term is expected to be significantly negative and therefore increase the magnitude of the age effect for participants closer to retirement.

At last, hypothesis 2 aims at the actual retirement age (ARA) of participants. The FAZ survey provides information about the retirement status and the actual retirement age. The following regression model is estimated:

$$ARA_i = \beta_0 + \beta_D \cdot D_i + \beta_{TP} \cdot TP_i + \beta_C \cdot C_i + \epsilon_i \tag{4.3}$$

Thereby, the variable of interest is the time preference proxy. Following hypothesis 2, we expect time inconsistent participants to retire earlier than time consistent participants.

Robustness

The data used for robustness comes from the waves 2008, 2009 and 2010 from the SAVE panel. The cross section used in the main analysis allows to estimate an age effect on $\Delta PFRA$. However, a possible effect could also be driven by the birth cohort and should therefore not be attributed to participants time preferences. The panel structure of SAVE allows to rule out such an explanation. Thereby, using the time preference proxy, the sample is split in a subsample of participants that can be classified as *time inconsistent* and a *time consistent*. In a second step, the following panel regression model is estimated for both subsamples:

$$\Delta PFRA_{i,j} = \beta_0 + \beta_{year} \cdot year_{i,j} + \beta_D \cdot D_{i,j} + \beta_{TP} \cdot TP_{i,j} + \beta_C \cdot C_{i,j} + \epsilon_{i,j} \tag{4.4}$$

with year capturing the time effect, D being a vector of demographic variables, TP being a proxy for time preferences and C being a vector of additional control variables. The demographic variables do not include participants age since it is perfectly correlated with the *year* variable. This specification allows to test whether or not participants decrease the planned retirement age with ongoing time or whether the cross section effect is driven by the birth cohort.

In addition to the panel analysis, the analysis regarding hypothesis 2 is repeated with the SAVE 2010 cross section since only about 200 participants in the FAZ dataset are already retired. Table 4.3 gives an overview of the regressions and predicted outcomes for each dataset.

	FAZ	SAVE	Prediction
Equation (4.1) (Hypothesis 1a)	✓	-	$\beta_{age} < 0$
Equation (4.2) (Hypotheses 1b, 1c)	✓	-	$\beta_{age} < 0$, $\beta_{age^2} < 0$, $\beta_{AT} < 0$
Equation (4.3) (Hypothesis 2)	✓	✓	$\beta_{TP} < 0$
Equation (4.4) (Hypothesis 1a - panel)	-	✓	$\beta_{year} < 0$

Table 4.3: Overview of regressions and predicted outcomes.

4.4 Results and Robustness

4.4.1 Main analysis

The age effect

Table 4.4 shows results of two OLS regressions presented in equation (4.1). In both regressions, a significant negative effect of age on $\Delta PFRA$ is obtained. The dependent variable measures the difference between the planned and full retirement age. Therefore, a decrease in $\Delta PFRA$ can be driven by a decrease in the planned retirement age or an increase in the full retirement age. However, the full retirement age is the same for the majority of participants (everyone born after 1963). Furthermore, the negative effect of age would imply an increase in the full retirement age with age. The full retirement age is increased for younger generations, though. Therefore, the decrease in $\Delta PFRA$ is clearly driven by a reduction in the planned retirement age. The age effect is economically strong: participants on average decrease the planned retirement age by about 0.72 months per year they get older. This implies a reduction by one year for every 17 years increase of age[4].

[4] If the planned retirement age is used without the correction for the full retirement age, results are stronger and more significant. This is nor surprising, since the full retirement age is smaller for older participants. Therefore, if

In addition, 4 out of 7 demographic variables are significant. Income reduces the planned retirement age. This result is in line with Munnell et al. (2004) and Li et al. (2008), who also find a negative relationship between wealth or income and retirement age. The number of children on average increases the planned retirement age by about 2.8 months per child. Being married, however, reduces the planned retirement age by about 5.0 months. Participants with university degree plan to retire later. This could, on the one hand, be driven by a higher job satisfaction due to more responsibility (see e.g. Helman et al., 2008) or, on the other hand, due to a better understanding of how retirement age influences monthly benefits (e.g. Coile et al., 2002).

The regressions differ by the variable that is used as a proxy for time preferences. Column 1 shows results for the self-assessed impatience on a 1-7 scale and column 2 for the number of inconsistent answers. Thereby, participants self assessed impatience has a highly significant effect on the planned retirement age. For each unit increase on the 1 to 7 scale, the planned retirement age decreases by about 1.6 months. This indicates that time inconsistent participants plan to retire remarkably earlier than time consistent participants. On the other hand, however, the second proxy, the number of inconsistent answers regarding three pairs of tax refund questions (column 2), is insignificant. Moreover, including both, the impatience scale and the number of inconsistent answers shows that only the impatience scale predicts $\Delta PFRA$ (not reported in table 4.4). Therefore, in the following analysis we focus on the specification presented in column 1.

Regarding the control variables, financial literacy, the subjective life expectancy and owning private pension insurance significantly predict the planned retirement age. More financial literate participants plan to retire about 2 months earlier per correct answer. However, one has to keep in mind that the sample is already highly financially literate and therefore, the effect is driven by a few participants who answer

we would not correct the planned retirement age for the different full retirement ages we would overestimate the age effect.

each out of the six questions correctly. Participants that indicate a high subjective life expectancy plan to retire later, which is maybe due to the fact that they expect to spend a long time in retirement anyway. Furthermore, retiring later increases social security benefits and participants who expect to live longer need to finance their consumption for a longer time period. In addition, the full retirement age has a negative effect. The effect is significant, even if the dependent variable already accounts for the fact that the full retirement age has been increased for participants born after 1947. This implies that participants do not fully adjust their planned retirement age to the new full retirement age. Surprisingly, risk aversion has no effect on $\Delta PFRA$. Coile et al. (2002) predict an increase of retirement age for more risk averse individuals, however this can not be confirmed by the FAZ survey.

In summary, we find a negative effect of age and impatience on the planned retirement age. therefore, hypothesis 1a can be confirmed.

The age effect and time preferences

The second specification focuses on how the age effect depends on time preferences (hypothesis 1b) and whether or not the effect is linear (hypothesis 1c). To answer these questions, first, the model presented in equation (4.2) is estimated and second, the analysis presented in equation (4.1) is repeated with subsamples of time inconsistent and time consistent participants. To split the sample, the self-assessed impatience is used. Participants who indicate an impatience equal or greater the median (=4) are classified as *time inconsistent*, whereas the other group is classified as *time consistent*. The median split results in 1,192 inconsistent and 936 consistent participants[5].

Table 4.5 presents results of three OLS regressions. Column 1 shows results for the full sample with interaction terms. The age effect is robust to the inclusion of the two nonlinear terms. With a coefficient of -0.88*** the effect is slightly stronger compared

[5]The different number of observations comes from participants who indicated the median impatience of four. Results are robust if these participants are assigned to the time consistent group.

$\Delta PFRA$	(1)	(2)
Demographics		
Age (years)	-0.721***	-0.723***
	(0.138)	(0.142)
Gender	2.097	2.738
	(2.636)	(2.688)
Income (log)	-3.817***	-3.811***
	(1.263)	(1.304)
Number of Children	2.738***	2.696***
	(0.909)	(0.927)
High School Degree	2.160	2.748
	(3.753)	(3.878)
University Degree	7.294***	7.732***
	(2.266)	(2.308)
Married	-5.361**	-5.091**
	(2.219)	(2.260)
Proxy for time preferences		
Impatience Scale	-1.597***	-
	(0.550)	
Number of inconsistent answers	-	0.098
		(1.030)
Controls		
Risk Aversion	1.001	1.073
	(0.789)	(0.809)
Loss Aversion	-1.366*	-1.373*
	(0.725)	(0.741)
Financial Literacy Score	-2.030**	-1.980**
	(0.839)	(0.862)
Life Expectancy	0.496***	0.541***
	(0.117)	(0.119)
Owns Private Pension Insurance	-6.430***	-6.415***
	(1.875)	(1.917)
Certainty of Social Security	-0.633	-0.590
	(0.506)	(0.516)
Time Sum	-0.001	0.002
	(0.005)	(0.005)
Full retirement age	-1.790***	-1.784***
	(0.238)	(0.244)
constant	1443.833***	1424.942***
	(194.364)	(199.819)
Number of Obs	2128	2060
Adj. R^2	0.0654	0.0624

Table 4.4: **Hypothesis 1a**: results of two OLS regressions with $\Delta PFRA$ as dependent variable. Standard errors are displayed in parentheses. Data used for the analysis comes from the FAZ survey. Column (1) and (2) differ in the proxy used for time preferences. Column (1) presents results for the impatience scale (1-7) and column (2) presents results for the number of inconsistent answers. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

to the baseline specification. The interaction terms have the predicted effects: the more impatient participants are (hypothesis 1b) and the closer participants are to retirement (hypothesis 1c), the stronger is the negative age effect. Both interaction terms are significant on the 5%-level. Their magnitude is best illustrated by an example. Assume two participants who only differ in age and self-assessed impatience. Participant A is 10 years older than the average participant (age-centered=10) and rates himself as very impatient (imaptience=7). Person B on the other side, is as old as the average participant (age-centered=0) and not impatient at all (imaptience=1).

For Person A, a one year increase in age would on average result in a decrease of the planned retirement age of $\beta_{age} \cdot \Delta age + \beta_{age^2} \cdot \Delta age^2 + \beta_{AT} \cdot \Delta age \cdot TP$. With $\Delta age = 1$, $\Delta age^2 = 11^2 - 10^2 = 21$ and $TP = 7$ the average effect would be $-0.880 \cdot 1 + -0.029 \cdot 21 + -0.030 \cdot 1 \cdot 7 = -1.699$. For Person B, however, the overall effect of an one year increase in age would be only $-0.880 \cdot 1 + -0.029 \cdot 1 + -0.030 \cdot 1 \cdot 1 = -0.939$. Both results confirm the idea that the age effect is driven by time preferences since it becomes stronger for older and "more" time inconsistent participants.

In columns 2a and 2b results of a sample split are presented. We do so to allow all other variables to vary with time preferences[6]. Column 2a presents results for the time inconsistent subsample and 2b for the time consistent one, respectively. The negative effect of age for time inconsistent participants is more than 3 times stronger compared to the time consistent group (coefficients of -1.87*** vs. -0.50). In addition, the effect is highly significant for the former group, whereas it is insignificant for the latter. A chow test rejects the null hypothesis that both coefficients are equal on the 5%-level (p-value of 0.0406).

For most of the additional demographic variables, no significant difference between the two groups is obtained. Two exceptions are the university degree dummy and the being-married dummy. Having a university degree is only significant in the time consistent subsample. Moreover, compared to the base regression in table 4.4, the effect gets stronger. On average, time consistent participants with a university degree plan to retire about 11 months later than time consistent participants without a university degree. In contrast, being married only affects the time inconsistent group. The planned retirement age is decreased by about 6.5 month for married participants in the time inconsistent subsample.

[6] A second way to allow all variables to vary with time preferences would be to interact all demographic and control variables with time preferences. Results are robust to this method (not reported), however, it has two drawbacks: 1) Some of the interaction terms are highly correlated which causes a multicollinearity problem. 2) The interpretation of the time-preference-effect would be difficult since it would depend on the values of all other variables. Therefore, only the additional results for the sample split are reported.

Delta PFRA	**Full Sample**	**Sample split by time preference proxy**	
	(1)	**(2a)**	**(2b)**
Demographics			
Age (years)	-0.880***	-1.874***	-0.506
	(0.200)	(0.557)	(0.417)
Age (c) squared	-0.029**	-	-
	(0.015)		
Interaction age-TP	-0.030**	-	-
	(0.013)		
Gender	2.170	2.349	2.148
	(2.634)	(3.509)	(4.063)
Income	-4.494***	-2.408	-5.571***
	(1.298)	(1.736)	(1.856)
Number of Children	2.889***	3.085***	1.638
	(0.911)	(1.135)	(1.536)
High School Degree	3.064	1.846	3.017
	(3.780)	(5.117)	(5.571)
University Degree	6.172***	4.544	10.374***
	(2.336)	(3.034)	(3.422)
Married	-5.564**	-6.703**	-3.525
	(2.221)	(2.955)	(3.398)
constant	2170.167***	1529.315***	1280.638***
	(417.937)	(264.702)	(291.336)
Controls	yes	yes	yes
Number of Obs	2128	1192	936
Adj. R^2	0.0655	0.0472	0.0865

Table 4.5: **Hypothesis 1b and 1c**: results of three OLS regressions with $\Delta PFRA$ as dependent variable. Standard errors are displayed in parentheses. Data used for the analysis comes from the FAZ survey. The sample is split by the self-assessed impatience (1-7 scale). Participants who indicate an impatience $\geq$ median (=4) are classified as time inconsistent (column 2a) and vice versa (column 2b). ***, ** and * indicate significance on the 1%, 5% and 10%-level.

Time preferences and the actual retirement age

Hypothesis 2 refers to the actual retirement age of retirees. In the following analysis, only participants who are already retired are included. The actual retirement age (ARA in years) is used as dependent variable to estimate model (4.3) from section 4.3.3. In the FAZ survey, the mean retirement age is about 61.72 years. In 2012, the average retirement age in Germany was 62.1 for males and 61.6 for females[7]. Since in the FAZ data 85% of participants are male, an average close to 62 makes sense.

Table 4.6 presents results from three OLS regressions with the actual retirement age as dependent variable. In column 1, only the time preference proxy is included. In columns 2 and 3, we subsequently add demographic and control variables. In all three regressions, the time preference proxy significantly (1%-level) predicts the actual retirement age of retirees. The magnitude of the effect is robust to the inclusion

[7]source: OECD statistic.

of demographic and control variables. On average, a one unit increase of self-assessed impatience decreases the actual retirement age by 0.47 years (column 3). This implies an average difference of about 2.82 years between the least and the most impatience participants in our sample and confirms hypothesis 2.

Adding demographic and control variables (columns 2 and 3) shows that education and financial literacy have the same effects on the actual retirement age as they have on the planned retirement age. On average, participants who obtained a high school degree retire 1.8 years later. Financial literacy, on the other side, reduces the actual retirement age by about one year per correct answer. This effect is driven by retirees who answered only one or two of the questions correctly. They retired on average about one year later compared to participants answering more than two questions correct. Both results are in line with the previous analysis (see table 4.4). In addition, the gender dummy is also significant in column 3. Males on average retire 2.5 years later than women.

Interestingly, the number of children seems not to affect the actual retirement age. In a theoretical model, Kotlikoff and Spivak (1981) compare family insurance with perfect market insurance and find that family insurance can substitute a considerable proportion of the market insurance. Having children, therefore, could have the same effect as owning private pension insurance. However, empirically we neither find a significant effect for the number of children nor for owning private pension insurance.

In all regressions, the age variable is excluded from the vector of demographic variables. We do so because participants age is per definition highly correlated with the actual retirement age for two reasons: 1) a person that retired at an age of X has to be at least X years old and 2) in the FAZ dataset the majority of retirees is between 60 and 70 years old, which leads to a small variation in age. Including age in the analysis weakens some of the effects of other demographic variables. However, the main result is robust to the inclusion of the age variable.

ARA (years)	**(1)**	**(2)**	**(3)**
Proxy for time preferences			
Impatience Scale	-0.435***	-0.433***	-0.469***
	(0.158)	(0.164)	(0.171)
Demographics			
Gender		1.216	2.481**
		(0.928)	(1.000)
Income (log)		-0.341	-0.318
		(0.222)	(0.224)
Number of Children		0.073	0.057
		(0.265)	(0.277)
High School Degree		1.866**	1.953**
		(0.914)	(0.944)
University Degree		-0.234	-0.531
		(0.755)	(0.799)
Married		0.119	0.001
		(0.797)	(0.858)
Controls			
Risk Aversion			-0.361
			(0.247)
Loss Aversion			0.069
			(0.229)
Financial Literacy Score			-1.229***
			(0.320)
Life Expectancy			0.025
			(0.045)
Owns Private Pension Insurance			-0.645
			(0.645)
Certainty of Social Security			0.219
			(0.154)
Time Sum			0.003
			(0.002)
constant	63.161***	63.208***	63.348***
	(0.680)	(1.896)	(4.836)
Number of Obs	248	230	212
Adj. R^2	0.026	0.0465	0.1254

Table 4.6: **Hypothesis 2**: results of three OLS regressions with the actual retirement age (ARA) as dependent variable. Subjects are retirees. Standard errors are displayed in parentheses. Data used for the analysis comes from the FAZ survey. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

Satisfaction with the retirement decision

An important question is whether time inconsistent decision makers are ex post satisfied with their decision. One could argue, that a decision made out of impulsivity or impatience will be regretted afterwards. In the case of the decision when to retire e.g., a time inconsistent decision maker may ex post wish that he or she had retired later. The FAZ survey allows to analyze this questions. Participants who indicated that they are already retired, answered some extra questions about their retirement decision. Thereby, they indicated whether they would make the same decision again or prefer retiring earlier or later. Figure 4.3 shows the distribution of answers for the group of impatient and patient participants, respectively. Again, we use the self-assessed impatience to split the sample of retirees in these two groups. Thereby, participants who indicate an impatience equal or greater the median (=4) are classified as *time inconsistent*, whereas the other group is classified as *time consistent*.

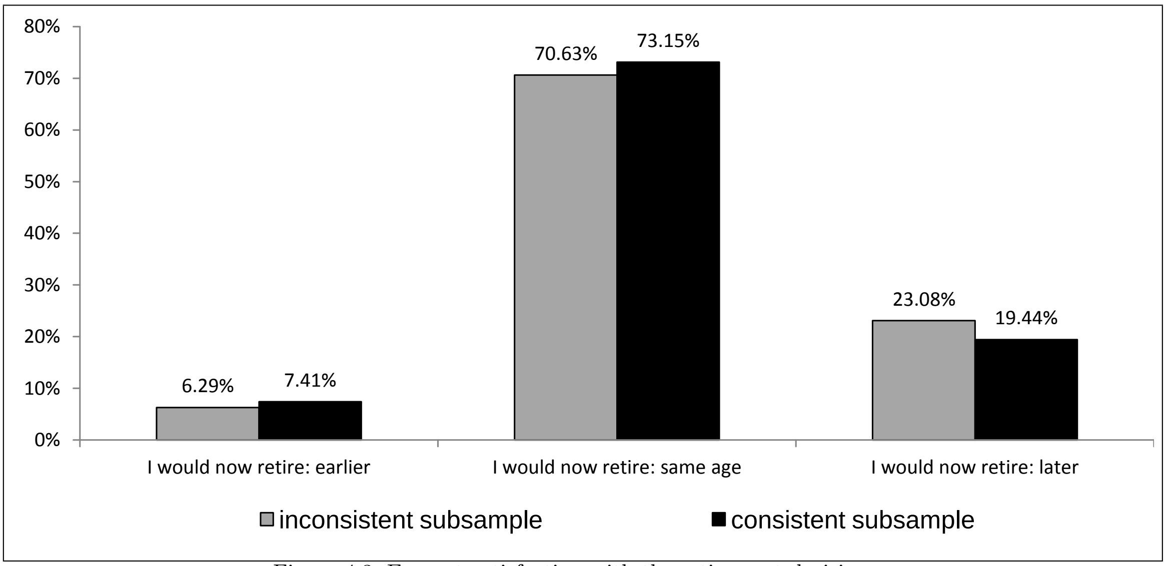

Figure 4.3: Ex post satisfaction with the retirement decision.

In both groups, the majority of participants would choose to retire at the same age again (70.6% in the *inconsistent* subsample vs. 73.15% in the *consistent* subsample). In addition, only a small fraction of participants would now choose to retire earlier than they actual did (6.3% vs. 7.4%). The category of interest is the one where participants indicated that they would now choose to retire later. Since the hypothesis that time inconsistent participants retire significantly earlier than consistent ones was confirmed (table 4.6), we would hypothesize that time inconsistent participants are more likely to regret their decision and therefore wish that they had retired later. Figure 4.3 provides only weak evidence for this hypothesis. The proportion of retirees who indicated that they would now chose to retire later is 23.1% in the inconsistent group and 19.4% in the consistent group. The difference of 3.7% points is not statistically significant. Therefore, even if retirees that can be classified as time inconsistent retire significantly earlier than time consistent participants, they do not seem to regret their early retirement decision ex post.

4.4.2 Robustness

The age effect - panel analysis

The first robustness test makes use of the panel structure of the SAVE data. The analysis is restricted to participants who participated in at least two of the SAVE waves from 2008, 2009 and 2010. We use these three years for two reasons: 1) waves before 2007 are not included since, with the reform of the German pension system, the full retirement age was increased to 67. In line with Behaghel and Blau (2012), we find that people use the full retirement age as an anchor for the planned retirement age. Therefore, the change of the full retirement age presents a structural break in the data. 2) In the wave of 2011/2012, the planned retirement age is not elicited.

Control variables presented in table 4.1 are not included as they are not elicited in all of the three waves. Following the previous analysis, the sample is split in a group of time inconsistent and time consistent participants. However, the SAVE survey does not provide specific information about time preferences. Therefore, the question regarding smoking habits is used. Participants who classified themselves as smokers in all of the three waves, are assigned to the time inconsistent group. All other participants are assigned to the time consistent subsample. This results in 357 observations in the time inconsistent group and 759 in the time consistent group. Thereby, it is important that we control for participants health status as possible effects in the smoker subsample could be driven by health issues.

Table 4.7 presents results of three OLS fixed effects panel regression with $\Delta PFRA$ as dependent variable. The SAVE data is multiply imputed and all five imputations are used. The Hausman test rejects the null hypothesis that the coefficients estimated by the random effects estimator are not different from the ones estimated by the fixed effects estimator. Therefore, fixed effects are used in all three regressions.

The main explanatory variable, therefore, is not age but the year of the survey. The effect found in the previous analysis could also be interpreted as a cohort effect, where individuals born in earlier cohorts indicate a smaller planned retirement age. However, if the ongoing time (represented by the variable *year*) negatively affects the planned retirement age, the effect cannot (only) be attributed to the birth cohort. Results in column 1 concern the full sample. The effect of *year* is negative and significant on the 10%-level. On average, participants decrease their planned retirement age by about 0.09 month per year. The effect is smaller compared to the cross section analysis presented in tables 4.4 and 4.5. However, if the sample is split by the time preference proxy (columns 2 and 3), results are economically and significantly stronger for the time inconsistent subsample. Thereby, the effect in the inconsistent group is about 5 times stronger compared to the consistent group. As hypothesized, the ongoing time has no significant effect in the time consistent subsample (coefficients of -0.20** vs. -0.04). Therefore a significant effect is found, despite the small number of observations in the inconsistent subsample and the short panel. In the time inconsistent subsample, participants decrease their planned retirement age by 0.2 months per year on average.

In summary, hypothesis 1 can be confirmed. In the baseline regression we found that age has a significant negative effect on the planned retirement age. By extension, this effect is significantly stronger for participants who could be classified as time inconsistent. Finally, the negative effect of age or ongoing time not only has been found in the cross section, but also in a three year panel. Thereby, the effect is again stronger for participants classified as time inconsistent.

Time preferences and the actual retirement age

As a second robustness test, the analysis regarding the actual retirement age (see table 4.6) is repeated with data from the SAVE 2010 cross section. In the FAZ survey, only about 200 retirees participated. In SAVE, however, about 900 participants indicated that they are already retired. The advantages of this robustness test are

$\Delta PFRA$	full sample (1)	time inconsistent (2)	time consistent (3)
Demographics			
Year	-0.077*	-0.191**	-0.035
	(0.046)	(0.098)	(0.054)
Gender	-	-	-
Income (log)	-0.396***	-0.252	-0.446***
	(0.132)	(0.345)	(0.169)
Number of Children	0.020	-0.038	0.019
	(0.141)	(0.286)	(0.166)
High School Degree	0.309	1.148	0.167
	(0.365)	(0.925)	(0.397)
University Degree	-0.242	-0.507	-0.170
	(0.386)	(0.816)	(0.439)
Married	0.064	0.158	0.030
	(0.258)	(0.461)	(0.324)
constant	222.758**	450.169**	139.846
	(93.266)	(196.582)	(107.362)
Proxy for time preferences	no	no	no
Controls	no	no	no
Health controls	yes	yes	yes
Number of groups (participants)	1653	340	1180
Overall R^2	0.0082	0.0075	0.0130

Table 4.7: **Robustness hypothesis 1**: results of three OLS fixed effects panel regressions with $\Delta PFRA$ as dependent variable. Standard errors are displayed in parentheses. Data used for the analysis comes from SAVE 2008, 2009 and 2010. The sample is split using a dummy for participants which indicated to smoke in all three waves. Thereby, smokers are classified as time inconsistent (column 2) and non smokers as time consistent (column 3). The gender dummy is omitted since its effect is captured by the fixed effect model. ***, ** and * indicate significance on the 1%, 5% and 10%-level. The SAVE data is multiply imputed with five different implicates. All five implicates are used.Coefficients and standard errors are calculated according to Rubin (1987).

therefore the higher number of observations and the more representative dataset. A drawback, on the other hand, is that time preferences have to be proxied by participants' smoking habits. Smoking has negative effects on health and negative health effects influence the actual retirement age. Therefore, we include variables regarding participants health status in the analysis. A second concern is a potential survivorship bias. Studies that analyze the effect of regular smoking on life expectancy find that it is on average decreased by ten years (see e.g. Doll et al., 2004; Sakata et al., 2012; Jha et al., 2013). Therefore, the health status of the smokers in the dataset is biased upwards. However, for our analysis this actually is an advantage since we are interested in the part of the smoking dummy that is correlated with time preferences and not with health.

Table 4.8 presents results of three OLS regressions with the actual retirement age as dependent variable. In column 1, only the time preference proxy is included.

In column 2, control variables regarding participants health status are added and column 3 presents the full specification with demographics, controls and health controls. In all three specifications, the smoking dummy significantly reduces the actual retirement age. Thereby, the average difference between smokers and non smoker is 3.6 years (column 1). Adding health variables only slightly reduces the effect. The smoking dummy has about the same magnitude and significance compared to the simple specification in column 1. However, bad health predicts early retirement. The self-assessed health status on a 1-5 scale is significant on the 1%-level. Higher values indicate poor health. On average, a one unit increase in the scale reduces the retirement age by about 1.5 years. In the full specification (column 3), the magnitude of the smoking dummy is weakened. Here, participants who indicate to be a smoker on average retired 2.5 years earlier compared to non-smoker participants. Since we control for health variables, life expectancy and other personal characteristics, this effect seems to be driven by other factors differing between smokers and non-smokers. As stated in section 4.3.1, a pronounced difference between these two groups are time preferences with smokers being more likely to follow hyperbolic discounting (e.g. Bickel et al., 1999; Baker et al., 2003; Reynolds and Fields, 2012). In summary, in the SAVE 2010 cross section, participants that can be classified as more time inconsistent also retire significantly earlier. The robustness of hypothesis 2 can be confirmed.

Additional robustness: participants born after 1963

For this robustness test, only participants born after 1963 are taken into account. This allows to test whether the increase in the full retirement age for younger participants affects the results and provides additional evidence for time preferences as the driver of our results:

1) In the previous analysis, it is shown that age negatively influences the difference between the planned and full retirement age. Even if the effect becomes stronger for more time inconsistent and older participants, one could argue that the effect is partly

ARA	**(1)**	**(2)**	**(3)**
Proxy for time preferences			
smoker	-3.604***	-3.548***	-2.532***
	(0.709)	(0.700)	(0.708)
Demographics			
Gender			1.354***
			(0.460)
Income (log)			-0.264***
			(0.068)
Number of Children			-2.778***
			(0.423)
High School Degree			1.732**
			(0.811)
University Degree			-0.211
			(0.894)
Married			-0.369
			(0.485)
Controls			
Financial Literacy Score			-0.077
			(0.221)
Life Expectancy			0.131***
			(0.035)
Owns Private Pension Insurance			-3.389***
			(0.820)
Health			
Health status		-1.577***	-0.904*
		(0.503)	(0.497)
Happiness health status		0.017	0.075
		(0.162)	(0.160)
prolonged disease		0.397	0.535
		(0.661)	(0.636)
constant	59.395***	63.506***	51.554***
	(0.259)	(2.062)	(3.506)
Number of Obs	907	907	905
Adj. R^2	0.0325	0.0622	0.1895

Table 4.8: **Robustness hypothesis 2**: results of an OLS regression with the actual retirement age (ARA) as dependent variable. Subjects are retirees. Standard errors are displayed in parentheses. Data used for the analysis comes from the SAVE 2010 survey. ***, ** and * indicate significance on the 1%, 5% and 10%-level. The SAVE data is multiply imputed with five different implicates. All five implicates are used. Coefficients and standard errors are calculated according to Rubin (1987).

driven by other factors. One of these other factors is the fact that not all participants in our sample have the same full retirement age (FRA). Figure 4.2 shows the full retirement age for different birth cohorts. Especially participants born between 1947 and 1963 may not be aware of their exact full retirement age since for them it is not a whole number in terms of years. Therefore, to test the robustness of the results regarding hypothesis 1, the FAZ sample is reduced. All participants born before 1964 are excluded from the analysis.

2) Hypothesis 1c states that the age effect should be stronger for participants close to retirement since the closer retirement comes, the more tempted they are to

retire early. The oldest person in a subsample in which everyone born before 1964 is excluded is 49 years old. Therefore, we expect no increasing negative effect of age for participants close to retirement since no one is close to retirement.

Table 4.9 presents results of four OLS regressions with $\Delta PFRA$ as dependent variable. The specification is identical with the one presented in table 4.5. Interaction effects are included (column 1) and participants are assigned to a group of time inconsistent (column 2) an time consistent (column 3) participants. Thereby, the self-assessed impatience is used to split the sample and only participants with a full retirement age of 67 years are included.

PRA	**Full sample**	**Sample split by time preference proxy**	
	(1)	**(2a)**	**(2b)**
Demographics			
Age (years)	-0.711**	-2.112**	0.223
	(0.337)	(0.963)	(0.670)
Age (c) squared	0.045	-	-
	(0.077)		
Interaction age-TP	-0.055***	-	-
	(0.018)		
Gender	3.195	4.401	1.183
	(3.174)	(4.210)	(5.010)
Income	-7.090***	-3.901	-6.672***
	(1.757)	(2.401)	(2.385)
Number of Children	3.521***	3.313**	2.766
	(1.194)	(1.434)	(2.181)
High School Degree	2.587	-1.659	5.283
	(5.324)	(7.216)	(7.976)
University Degree	6.590**	7.169*	10.831***
	(2.885)	(3.760)	(4.161)
Married	-4.222	-5.576	-1.470
	(2.811)	(3.701)	(4.433)
constant	20.056	79.943*	-53.415
	(22.762)	(42.700)	(38.680)
Controls	yes	yes	yes
Number of Obs	1541	858	683
Adj. R^2	0.0653	0.0398	0.0891

Table 4.9: **Robustness: hypotheses 1b and 1c**: results of three OLS regressions with $\Delta PFRA$ as dependent variable. Standard errors are displayed in parentheses. Data used for the analysis comes from the FAZ survey. Only participants with a full retirement age of 67 are taken into account. The sample is split by the self-assessed impatience (1-7 scale). Participants who indicate an impatience median (=4) are classified as time inconsistent (column 2a) and vice versa (column 2b). ***, ** and * indicate significance on the 1%, 5% and 10%-level.

The main results from the previous analysis can be confirmed. In the specification with interaction terms (column 1), age as well as the interaction of age with time preferences is significant and negative. Coefficients are of similar magnitude compared to the main analysis. The split of the subsample into a group of time inconsistent and time consistent participants (columns 2a and 2b) also confirms the main analysis. The age effect is significant and negative in the former group and insignificant in the latter. Coefficients of the two groups are significantly different (5%-level) from each other. Therefore, the main effect is not driven by the fact that participants exhibit different FRAs. In addition, the effects of other demographic variables are similar to the ones in the previous analysis.

In contrast to the analysis presented in table 4.5, the squared mean centered age ($age(c)^2$) now has no effect on the planned retirement age[8]. As predicted, the negative effect of $age(c)^2$ is driven by participants close to retirement.

4.5 Discussion

How important is the age effect?

This paper analyzes the relation of time preferences and the decision when to retire. Empirical results show that people who behave as if they discount the future hyperbolically plan to retire earlier with increasing age and in fact, follow that plan. The question addressed in this section is whether this inconsistent decision is really unplanned and how it affects the financial well being in retirement. To analyze the first part of this question, information regarding participants private pension insurance is used. The idea, here, is as follows: if the plan to retire early increases the likelihood of owning private pension insurance, then people seem to incorporate their retirement plans into their savings decision. However, as hyperbolic discounting leads to early retirement, the question is whether it also increases the likelihood of owning private pension insurance. If this is not the case, as suggested by the models presented in section 4.2, the early retirement decision of hyperbolic discounters can be classified as inconsistent and unplanned. Thereby, the causality of the effect is

[8]The mean centered age in this analysis differs from the one in the main analysis. Since only participants born after 1963 are taken into account, the mean age of this subsample is smaller compared to the full sample. Therefore, the age variable has to be centered again using this smaller mean.

not of interested. Whether people who save more plan to retire early or vice versa does not effect our conclusion.

Table 4.10 presents results of three logistic regressions with an indicator, that equals 1 if the participant owns private pension insurance, as dependent variable. Specification one presents result for the full sample. $\Delta PFRA$ has a highly significant and negative effect on the probability of owning private pension insurance. Therefore, the plan to retire later ($\Delta PFRA \uparrow$) decreases the probability of owning private pension insurance. Looking at it the other way round, the plan to retire early ($\Delta PFRA \downarrow$) increases the probability of owning private pension insurance. The effect of the time preference proxy is now important. The self-assessed impatience is negative and insignificant. Columns 2 and 3 of table 4.10 show results for two subsamples. The first subsample includes participants with ages below 50 (column 2) and the second the respective other group (column 3). It can be seen that the effect of $\Delta PFRA$ on the probability of owning private pension insurance is only present in the former group. This means that participants who initially plan to retire early incorporate their retirement plan into their savings decision. However, this is not the case for older participants. Therefore, changes in the decision when to retire are not affected by the savings decision or vice versa. Combining our previous results with this finding gives the following result: being more time inconsistent leads to early retirement. Since early retirement is not planned from the beginning, the decision to retire early is not taken into account within the savings decision. In addition, being more time inconsistent does not increase the probability of owning private pension insurance. The retirement decision of hyperbolic discounters can therefore be classified as inconsistent and unplanned[9].

[9] We obtain a similar result using the SAVE 2010 cross section (not reported). Thereby, the time preference proxy even reduces the probability of owning private pension insurance. This result is in line with the predictions made by the theoretical models presented in section 4.2.

Private Pension (0/1)	**Full sample**	**Participants with age**	
		< 50	≥ 50
	(1)	**(2)**	**(3)**
Demographics			
$\Delta PFRA$	-0.004***	-0.004***	-0.002
	(0.001)	(0.001)	(0.003)
Age (years)	0.009	0.012	-0.240**
	(0.007)	(0.009)	(0.121)
Gender	0.006	0.069	-0.239
	(0.137)	(0.158)	(0.291)
Income (log)	0.254***	0.290***	0.244**
	(0.068)	(0.087)	(0.114)
Number of Children	-0.052	-0.093	0.046
	(0.048)	(0.060)	(0.083)
High School Degree	-0.064	0.245	-0.662**
	(0.195)	(0.263)	(0.318)
University Degree	0.147	0.010	0.538**
	(0.118)	(0.140)	(0.236)
Married	0.284**	0.324**	0.109
	(0.118)	(0.144)	(0.215)
Proxy for time preferences			
Impatience Scale	-0.016	-0.028	0.016
	(0.029)	(0.035)	(0.055)
Controls			
Risk Aversion	-0.043	-0.078	0.034
	(0.042)	(0.050)	(0.077)
Loss Aversion	-0.038	-0.030	-0.057
	(0.038)	(0.046)	(0.071)
Financial Literacy Score	-0.009	-0.071	0.188**
	(0.044)	(0.051)	(0.093)
Life Expectancy	0.020***	0.019**	0.026*
	(0.007)	(0.008)	(0.014)
Certainty of Social Security	-0.006	-0.004	-0.014
	(0.027)	(0.033)	(0.048)
Full retirement age	0.027**	-	-0.152*
	(0.013)		(0.088)
Time Sum	0.000	0.000	0.000
	(0.000)	(0.000)	(0.001)
constant	-24.413**	-3.010***	129.805
	(10.380)	(1.036)	(76.775)
Number of Obs	2128	1541	587
Correctly classified	0.6553	0.6571	0.6407
Area under ROC curve	0.6239	0.6352	0.6377

Table 4.10: **Importance**: results of a logistic regression with an indicator that equals 1 if the participant owns private pension insurance as dependent variable. Data used for the analysis comes from the FAZ survey. Column (1) presents results for the full sample. In columns (2) and (3) results for a sample split are presented. Thereby, the sample is split by age. In column (3) only participants who are older or equal to 50 years of age are taken into account. Column (2) presents results for participants younger than 50 years of age. ***, ** and * indicate significance on the 1%, 5% and 10%-level.

Financial impact

In a second step, the financial consequences of the unplanned and inconsistent retirement decision is analyzed. The difference in actual retirement age from the least to the most impatient participants in the FAZ sample is about 2.8 years. A similar result is found using the SAVE 2010 dataset, where the actual retirement age of smokers and non-smokers differs by about 2.5 years. The pension system in Germany allows people to retire earlier than their full retirement age. However, this will result in a constant decrease of monthly benefits. It is important to understand the financial consequences of behaving more impatient or impulsive, because the lifespan after retirement steadily increases due to an increasing life expectancy, and therefore, the decision when to retire influences a persons well-being for many years.

In Germany, social security benefits are determined according to the social security formula for old age pension benefits[10], presented in equation (4.5).

$$Benefits = EP \cdot EC \cdot CPV \tag{4.5}$$

The pension system is based on earnings points (EP) where the accumulated points determine the monthly social security benefits after claiming. For each year that a person is employed, he or she earns points relative to his or her yearly gross income. Thereby, per year t, $EP_t = \frac{\text{Gross Income}_t}{\text{Average Gross Income in Germany}_t}$ are accumulated. However, the maximum EP per year are capped at 2.1066. When claming social security benefits, all accumulated earning points EP enter equation (4.5). The second factor is the entry coefficient (EC). It equals 1 for people who claim at their full retirement age and is decreased by 0.3% points for each month a person claims before the FRA. Delaying claiming, however, increases the entry coefficient by 0.5% points per month delay. The last factor, the current pension value (CPV), is determined on the 1^{st} of July each year by the government. In 2013 it amounts to EUR 28.14.

[10]The pension formula is explained in detail in: §64, SGB VI.

The decision to retire earlier affects the accumulated earnings points (EP) as well as the entry coefficient (EC). Thereby, the reduction in monthly benefits due to a decrease in the entry coefficient can be calculated easily. The participants classified as time inconsistent in the previous analysis retired on average 2.5 years earlier compared to the consistent group. This results in a reduction of the entry coefficient of $0.003 \cdot 30 = 9.0\%$. To calculate a lower estimate for the reduction due to a decrease in earning points, two assumptions have to be made: 1) we assume that a person is employed for 40 years when entering retirement. 2) The income that is forgone due to retiring 2.5 years earlier is assumed to be equal to the average income of that person. Since the income normally increases with years of employment, assumption 2 results in a conservative estimate of the reduction in social security benefits. With these two assumptions, the reduction in earning points can be calculated as $\frac{\text{Number of Years Retired Earlier}}{40+\text{Number of Years Retired Earlier}}$. In our case, the number of years participants retire earlier is 2.5, leading to a reduction of $\frac{2.5}{42} = 5.95\%$[11].

Overall, monthly social security benefits are reduced by about 15% ($9.0\% + 5.95\% = 14.95\%$). Time inconsistent decision makers suffer a remarkable loss of pension payments due to early retirement. Thereby, it is important to keep in mind, that only the difference in impatience (i.e. time preferences) leads to the reduction in retirement age. In the regressions presented in section 4.4.1 and 4.4.2, we control for demographics and personal characteristics such as risk and loss aversion, financial literacy and subjective life expectancy. The results indicate that simply the fact that a person is more or less patient strongly influences his or her financial well being in retirement.

Future research: international comparison

In the theory section of this paper, three models who study how hyperbolic discounting influences the savings decision when retirement is endogenous are presented

[11] The second reason why we classify this estimate as conservative is the fact that it does not take the forgone income into account. Retirement benefits in Germany only cover about 65% of the income earned close to retirement. Therefore, if the median income the FAZ participants (EUR 3,000) is taken into account, 2.5 years of early retirement also results in about $2.5 \cdot 12 \cdot 3,000 \cdot (1 - 65\%) = 31,500$ forgone income.

(see section 4.2 or Diamond and Köszegi, 2003; Zhang, 2013; Findley and Feigenbaum, 2013). All models make predictions about how hyperbolic discounting influences the retirement decision. The main results are twofold: 1) hyperbolic discounting leads to early retirement since the decision maker is tempted to trade future income against immediate leisure time. However, 2) hyperbolic discounting also leads to undersaving and therefore might result in later retirement since the decision maker fails to accumulate enough wealth to finance early retirement. The German social security system is designed to cover the main fraction of old-age insurance. According to the 2012 pension report by the German government, about 75% of the income of retirees consist of social security benefits[12]. Therefore, for Germany, we focus on the first prediction and show that indeed hyperbolic discounting leads to early retirement. In contrast, the U.S social security system is designed to only guarantee a basic financial security at old age. The fraction of old age income due to social security amounts to about 50% (e.g. Banerjee, 2013). According to the theory, lower social security benefits combined with hyperbolic discounting lead c.p. to "less early retirement". Therefore, one possible direction for future research is to compare the effect of time preferences across different countries and thereby study how differences in the social security system influences the retirement decision.

4.6 Conclusion

This paper empirically relates the decision when to retire with individuals' time preferences. Thereby, the effect of hyperbolic discounting on the planned and actual retirement age is analyzed. Two sources of data enter the analysis: 1) an online survey which is conducted in cooperation with a large German newspaper and 2) the representative German SAVE panel. We find that inconsistent retirement exists in the following way: participants of both surveys decrease their planned retirement age with increasing age. The temptation of early retirement seems to get stronger, the closer retirement comes. In a panel specification we show that the negative age effect

[12] source: Alterssicherungsbericht 2012, Bundesministerium fuer Soziales und Arbeit.

is not an effect of a specific birth cohort. Since we attribute this effect to hyperbolic discounting, additional tests to confirm the idea are conducted: the sample is split into a time inconsistent and time consistent group using variables that proxy for participants' time preferences. We find that the negative age effect becomes between 3 and 10 times stronger in the time inconsistent group and mostly fades away in the time consistent group. Moreover, the effect gets stronger for participants who are closer to retirement. Therefore, the behavior seems indeed to be driven by time preferences. In the last specification, the actual retirement age of already retired participants is used to analyze the effect of the time preferences on the actual retirement decision. It is shown that participants classified as time inconsistent not only plan to retire earlier than consistent ones but also follow that plan. On average, time inconsistent participants retire 2.5 years earlier. This behavior has financial consequences during retirement. In the German social security system, early retirement of 2.5 years results in a constant decrease of retirement benefits of about 15%.

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Appendix A

Online Survey

A.1 Promotion in FAS

Leseraktion der Frankfurter Allgemeinen Sonntagszeitung

Wie soll Ihre Altersvorsorge aussehen?

So machen Sie mit

Wer eine private Rentenversicherung abgeschlossen hat, steht mit Eintritt in den Ruhestand vor einer schwierigen Frage: Soll ich mir bis zum Lebensende eine monatliche Rente auszahlen lassen – oder die ganze Summe auf einmal nehmen? Die F.A.S. und die Universität Mannheim wollen wissen, was Ihnen lieber ist. Machen Sie mit und füllen Sie den Fragebogen auf FAZ.net aus. Sie können einen Gutschein „Kleine Köstlichkeiten“ von Mydays sowie fünf Exemplare des Buches „Genial einfach investieren“ gewinnen. Die Daten werden anonym erhoben und vertraulich behandelt. Eine erste Auswertung erhalten Sie gleich nach dem Ausfüllen. Das Ergebnis der Umfrage und für wen sich welche Altersvorsorge lohnt, erfahren Sie am 4. November in der F.A.S. *ancs.*

Details finden Sie unter **www.faz.net/altersvorsorge**

Figure A.1: **Promotion in the FAS**, published on October 14^{th}.

A.2 Survey

Figure A.2: Page 1 of the online survey for an exemplary participant.

UNIVERSITÄT MANNHEIM

Dear participant,

On the following pages you will find a survey of **University of Mannheim** in cooperation with **FAZ.NET.** We will ask you to answer a number of questions about retirement planing, financial literacy and personal preferences. All data is collected anonymous and will be treated confidentially.

If you are interested, we will send you a detailed analysis of the results by e-mail after the survey is completed.

All participants have the chance to win a **mydays voucher "little delicacies"** and five copies of the book **"Genial einfach investieren"** by Prof. Martin Weber of the University of Mannheim.

Thank you for your participantion!

Next

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Page 2 of the online survey for an exemplary participant.

UNIVERSITÄT MANNHEIM

We want to start our survey with a financial **quiz**. The following six questions are all related to the field of financial markets, good luck!

1. **Suppose you had $100 in a savings account and the interest rate was 4% per year. After 10 years, how much do you think you would have in the account if you left the money to grow? [F502]**

◉ More than EUR 140
○ Exactly EUR 140
○ Less than EUR 140
○ Don't know/ don't want to answer

2. **Normally, which asset displays the highest fluctuations over time? [F505]**

○ Savings accounts
○ Bonds
◉ Stocks
○ Don't know/ don't want to answer

3. **Which of the following statements is correct? [F508]**

○ Once one invests in a mutual fund, one cannot withdraw the money in the first year
◉ Mutual funds can invest in several assets, for example invest in both stocks and bonds
○ Mutual funds pay a guaranteed rate of return which depends on their past performance
○ None of the above
○ Don't know/ don't want to answer

4. **Consider a call-option with a stock as underlying. Please judge the following statement: "The price of the call-option should increase if the volatility of the underlying stock increases" [F522]**

◉ The statement is true
○ The statement is false
○ The statement can't be judged with the information given
○ Don't know/ don't want to answer

Page 3 of the online survey for an exemplary participant.

5. **If the interest rate falls, what should happen to bond prices? [F509]**

- (x) Rise
- ( ) Fall
- ( ) Stay the same
- ( ) Don't know/ don't want to answer

6. **What is measured by a stocks "beta"? [F523]**

- ( ) The stocks book to market value
- ( ) The stocks volatility
- (x) The sensitivity of the stock price to price changes of a benchmark index
- ( ) None of the above
- ( ) Don't know/ don't want to answer

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Page 4 of the online survey for an exemplary participant.

UNIVERSITÄT MANNHEIM

Thank you for answering the quiz.

The following questions are about your personal preference, so there are no right or wrong answers.

Suppose you receive a tax refund. You are give two options regarding the point in time when the payment is received. If you choose option A the money is transferred to you earlier compared to option B where you will receive the money later. Please indicate for all six situations which option you would prefer:

Question [F402]

- A: you receive EUR 1,100 **immediatley**
- B: you receive 1,130 € **in 10 month**

Question [F403]

- A: you receive EUR 1,100 **immediatley**
- A: you receive EUR 1,200 **in 10 month**

Question [F404]

- A: you receive EUR 1,100 **immediatley**
- A: you receive EUR 1,380 **in 10 month**

Question [F405]

- A: you receive EUR 1,100 **in 18 month**
- A: you receive EUR 1,130 **in 28 month**

Question [F406]

- A: you receive EUR 1,100 **in 18 month**
- A: you receive EUR 1,200 **in 28 month**

Question [F407]

- A: you receive EUR 1,100 **in 18 month**
- A: you receive EUR 1,380 **in 28 month**

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Page 5 of the online survey for an exemplary participant.

UNIVERSITÄT MANNHEIM

Below we ask you to evaluate some statements.

Please indicate on a scale of 1 - 7 how strong you agree to the each statement (1 = not at all, 7 = fully agree).

Question [F516]

	not at all						fully agree
	1	2	3	4	5	6	7
"I'm a risk averse person."	○	○	○	○	○	○	○

Question [F517]

	not at all						fully agree
	1	2	3	4	5	6	7
"I'm afraid of losses"	○	○	○	○	○	○	○

Question [F401]

	not at all						fully agree
	1	2	3	4	5	6	7
"I'm an impatient person."	○	○	○	○	○	○	○

Question [F520]

	not at all						fully agree
	1	2	3	4	5	6	7
" I'm confident that the Government will fullfill its pension payment commitment."	○	○	○	○	○	○	○

Next

Page 6 of the online survey for an exemplary participant.

UNIVERSITÄT MANNHEIM

For the second part of our survey, we need some personal information. Therefore we ask you to answer the following questions:

7. **Are you... [F101]**

- ○ Male
- ○ Female

8. **What year were you born? [F102]**

[Please choose]

9. **What is your highest education level? [F103]**

- ○ Unfinished high school
- ○ High school
- ○ Secondary School
- ○ Bachelor’s Degree
- ○ Master’s Degree
- ○ PhD

10. **What is your maritial status? [F106]**

- ☐ married, live together
- ☐ married, live seperate
- ☐ unmarried, live together with partner
- ☐ single
- ☐ divorced
- ☐ widowed

11. **Do you have children? [F107]**

- ○ Yes, I have ☐ child/ children
- ○ No

Page 7 of the online survey for an exemplary participant.

12. **Do you ave grandchildren? [F109]**

- Yes, I have [ ] grandchild/ grandchildren
- No

13. **Are you retired? [F108]**

- Yes
- No

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Page 8 of the online survey for an exemplary participant.

UNIVERSITÄT MANNHEIM

Below we ask you to answer some questions about your current job and your retirement plans:

For some questions in this questionnaire, we need information regarding your monthly net income (for example to calculate a corresponding pension).

Therefore we ask you to make a statement about your net monthly income. If you prefer, you can also specify a range and later questions will refer to this range then.

I want to give my net monthly income:

Question [F204]

- After tax income: [ ] EUR per month

I want to specify a range for my monthly net income:

Question [F207]

- less than EUR 1,000.-
- EUR 1,000.- to EUR 2,000.-
- EUR 2,000.- to EUR 4,000.-
- EUR 4,000.- to EUR 6,000.-
- EUR 6,000.- to EUR 10,000.-
- more than EUR 10,000

14. **Please indicate how strong you agree to the following statements: [F201]**

	not at all						fully agree
	1	2	3	4	5	6	7
"I'm happy with my current job"	○	○	○	○	○	○	○

15. **I will later receive a monthly pension from private pension insurance or receive this already.**

Page 9 of the online survey for an exemplary participant.

[F521]

- Yes
- No

16. **At what age do you plan to retire? [F203]**

I plan to retire at age [ ]

17. **If you think about it, how old are you expecting to get? [F515]**

[ ] years.

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Page 10 of the online survey for an exemplary participant.

UNIVERSITÄT MANNHEIM

18. **Please consider the following situation:**

At the end of your working life (at age 66) you saved up for retirement an **amount of EUR 300,000** which you now have access to. There are two different payout schemes available:

You can have the entire **EUR 300,000** paid out as a lump sum, or
You will receive a monthly payment of **EUR 2.354,16** for the rest of your life.

[VF01]

Which option would you choose?

- Option 1: the lump sum
- Option 2: the monthly payment

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Page 11 of the online survey for an exemplary participant.

UNIVERSITÄT MANNHEIM

19. **Now consider the following situation:**

At the end of your working life (at age 66) you saved up for retirement an **amount of EUR 300,000** which you now have access to. There are now different payout schemes available:

You can have the entire **EUR 300,000 paid out as a lump sum**, or

get everything or only parts of it as a lifetime monthly payment.

The more you take directly (lump sum), the lower the monthly payment.

[VF03]

Please indicate, what fraction you want to have paid out as a lump sum (immediately) and what fraction you want to have paid out as a monthly payment:

- 100% lump sum (**300,000.00** EUR) and no monthly payment
- 90% lump sum (**270,000.00** EUR) and 10% monthly payment (**235.42** EUR/month)
- 80% lump sum (**240,000.00** EUR) and 20% monthly payment (**470.83** EUR/month)
- 70% lump sum (**210,000.00** EUR) and 30% monthly payment (**706.25** EUR/month)
- 60% lump sum (**180,000.00** EUR) and 40% monthly payment (**941.66** EUR/month)
- 50% lump sum (**150,000.00** EUR) and 50% monthly payment (**1,177.08** EUR/month)
- 40% lump sum (**120,000.00** EUR) and 60% monthly payment (**1,412.50** EUR/month)
- 30% lump sum (**90,000.00** EUR) and 70% monthly payment (**1,647.91** EUR/month)
- 20% lump sum (**60,000.00** EUR) and 80% monthly payment (**1,883.33** EUR/month)
- 10% lump sum (**30,000.00** EUR) and 90% monthly payment (**2,118.74** EUR/month)
- no lump sum and 100% monthly payment (**2,354.16** EUR/month)

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Page 12 of the online survey for an exemplary participant.

UNIVERSITÄT MANNHEIM

20. Suppose you receive **a monthly rent of EUR 1.625,00** given **you retire at age 67**.

You are given the opportunity to retire earlier, at age 63, but you would have to give up a portion of your monthly pension.

What amount would you be willing to give up if you could retire at age 63 instead of 67 and pension payments would start at 63? **[F301]**

I would be willing to give up an amount of EUR ______ per month

Next

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Page 13 of the online survey for an exemplary participant.

UNIVERSITÄT MANNHEIM

21. Now you receive **a monthly rent of EUR 2.750,00** given **you retire at age 67**.

Now you are given the opportunity to retire earlier, at age 63, but you would have to give up a portion of your monthly pension.

What amount would you be willing to give up if you could retire at age 63 instead of 67 and pension payments would start at 63? **[F304]**

I would be willing to give up an amount of EUR ______ per month.

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Appendix B

Derivations with respect to r

B.1 Derivation of D(x) with respect to r

Immediate case

In the immediate case D(x) is defined as $EPV_{HB}(x) - L$:

$$EPV_{HB}(x) - L = L\frac{\sum_{t=0}^{120-x} p(x+t|x)(1+t)^{-r}}{\sum_{t=0}^{120-x} p(x+t|x)(1+i)^{-t}} - L. \tag{B.1}$$

The first derivative of D(x) with the respect to r is:

$$\begin{aligned} \frac{\delta[EPV_{HB}(x) - L]}{\delta r} &= \frac{\delta[EPV_{HB}(x)]}{\delta r} \\ = -L\frac{\sum_{t=0}^{120-x} p(x+t|x)(1+t)^{-r}\ln(1+t)}{\sum_{t=0}^{120-x} p(x+t|x)(1+i)^{-t}} &< 0. \end{aligned} \tag{B.2}$$

The probability $p(x+t|x)$, the hyperbolic discount factor $(1+t)^{-r}$, the exponential discount factor $(1+i)^{-t}$ and the term $\ln(1+t)$ are always positive. Therefore the whole fraction is positive and multiplied by $-L$ which results in a negative first derivative of D(x) with respect to r.

Future case

In the future case D(x) is defined as $EPV_{HB_{annuity}}(x) - EPV_{HB_{lumpsum}}(x)$:

$$D(x) = L\frac{\sum_{t=0}^{(120-66)} p(66+t|66)(1+(t+66-x))^{-r}}{\sum_{t=0}^{(120-66)} p(66+t|66)(1+i)^{-t}} - \frac{L}{(1+(66-x))^{r}} \tag{B.3}$$

The first derivative of D(x) with the respect to r is:

$$\frac{\delta[EPV_{HB_{annuity}}(x) - EPV_{HB_{lumpsum}}(x)]}{\delta r} \tag{B.4}$$

$$\Leftrightarrow -L\frac{\sum_{t=0}^{(120-66)} p(66+t|66)(1+(t+66-x))^{-r}\ln(1+(t+66-x))}{\sum_{t=0}^{(120-66)} p(66+t|66)(1+i)^{-t}} + L\frac{\ln(1+(66-x))}{(1+(66-x))^{r}} \tag{B.5}$$

$$\Leftrightarrow -L[\frac{\ln(1+(66-x))}{(1+(66-x))^{r}}] \cdot \left[\frac{\sum_{t=1}^{(120-66)} p(66+t|66)(1+(t+66-x))^{-r}\ln(1+(t+66-x))}{\sum_{t=0}^{(120-66)} p(66+t|66)(1+i)^{-t}} - 1\right] \tag{B.6}$$

The part outside the square bracket is always negative for $x < 66$.[1] The part inside the square bracket is always positive if :

$$\sum_{t=1}^{(120-66)} p(66+t|66)(1+(t+66-x))^{-r}\ln(1+(t+66-x)) > \sum_{t=0}^{(120-66)} p(66+t|66)(1+i)^{-t} \tag{B.7}$$

Assuming $i = 0$ gives an upper bound for the right side of the inequality. Using the latest German life tables leads to:

$$\sum_{t=1}^{(120-66)} p(66+t|66)(1+(t+66-x))^{-r}\ln(1+(t+66-x)) > 16.11. \tag{B.8}$$

This inequality is only fulfilled for all x as long as $r < 0.3479$. Therefore the sign of the first derivative of D(x) with respect to r strongly depends on the parameter r.

[1] For $x = 66$ the derivative of D(x) would be zero as the immediate case would then be considered.

B.2 Derivation of ΔD(x) with respect to r

Immediate case

$\Delta D(x)$ is defined as $D(x+1) - D(x) = EPV_{HB}(x+1) - L - (EPV_{HB}(x) - L)$ which can be written as $EPV_{HB}(x+1) - EPV_{HB}(x)$. Therefore the first derivative of $\Delta D(x)$ with respect to r is:

$$\frac{\delta \Delta D(x)}{\delta r} = \frac{\delta D(x+1) - D(x)}{\delta r} = \frac{\delta D(x+1))}{\delta r} - \frac{\delta D(x))}{\delta r} \tag{B.9}$$

this leads to:

$$\begin{aligned}\frac{\delta \Delta D(x)}{\delta r} = -L\frac{\sum_{t=0}^{119-x} p(x+1+t|x+1)(1+t)^{-r}\ln(1+t)}{\sum_{t=0}^{119-x} p(x+1+t|x+1)(1+i)^{-t}} \\ +L\frac{\sum_{t=0}^{120-x} p(x+t|x)(1+t)^{-r}\ln(1+t)}{\sum_{t=0}^{120-x} p(x+t|x)(1+i)^{-t}}.\end{aligned} \tag{B.10}$$

The difference between the two fractions depends on the difference of the survival probability of an x+1 year old decision maker and the survival probability of an x year old one ($p(x+1+t|x+1)$ vs. $p(x+t|x)$). Using the latest German life tables results in:

$$\begin{aligned}L\frac{\sum_{t=0}^{119-x} p(x+1+t|x+1)(1+t)^{-r}\ln(1+t)}{\sum_{t=0}^{119-x} p(x+1+t|x+1)(1+i)^{-t}} \\ < L\frac{\sum_{t=0}^{120-x} p(x+t|x)(1+t)^{-r}\ln(1+t)}{\sum_{t=0}^{120-x} p(x+t|x)(1+i)^{-t}},\end{aligned} \tag{B.11}$$

$\forall\ x \in [0;120]$ and $i, r \in (0;\infty)$. Therefore the first derivative of $\Delta D(x)$ is positive.

Future case

For the future case the sign of the first derivative of $\Delta D(x)$ depends on the parameter r. This can be seen by writing $\frac{\delta \Delta D(x)}{\delta r}$ as:

$$\frac{\delta \Delta D(x)}{\delta r} = \frac{\delta D(x+1) - D(x)}{\delta r} = \frac{\delta D(x+1))}{\delta r} - \frac{\delta D(x))}{\delta r} \tag{B.12}$$

It follows that the sign of $\frac{\delta D(x+1))}{\delta r}$ and $\frac{\delta D(x))}{\delta r}$ depends on the parameter are and therefore also the sign of the whole derivative depends on it.

Appendix C

Financial literacy questions

C.1 FAZ Survey

1. Suppose you had EUR 100 in a savings account and the interest rate was 4% per year. After 10 years, how much do you think you would have in the account if you left the money to grow?
   (i) More than EUR 140; (ii) Exactly EUR 140; (iii) Less than EUR 140; (iv) Do not know/Refusal.

2. Normally, which asset described below display the highest fluctuations over time:
   (i) Savings accounts; (ii) Bonds; **(iii) Stocks**; (iv) Do not know/Refusal.

3. Which of the following statements is correct?
   (i) Once one invests in a mutual fund, one cannot withdraw the money in the first year; **(ii) Mutual funds can invest in several assets, for example invest in both stocks and bonds**; (iii) Mutual funds pay a guaranteed rate of return which depends on their past performance; (iv) None of the above; (v) Do not know/Refusal.

4. Consider a call-option with a stock as underlying. Please judge the following statement: "The price of the call-option should increase if the volatility of the underlying stock increases"
   (i) True; (ii) False; (iii) The statement cannot be judge with the information given; (iv) Do not know/Refusal.

5. If the interest rate falls, what should happen to bond prices:
   (i) Rise; (ii) Fall; (iii) Stay the same; (iv) None of the above; (v) Do not know/Refusal.

6. What is measured by a stocks “beta”?

   (i) The stocks book to market value; (ii) The stocks volatility; **(iii) The sensitivity of the stock price to price changes of a benchmark index**; (iv) None of the above; (v) Do not know/Refusal.

C.2 SAVE Survey

1. Suppose you had EUR 100 in a savings account and the interest rate was 2% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?
   (i) More than EUR 102; (ii) Exactly EUR 102; (iii) Less than EUR 102; (iv) Do not know/Refusal.

2. Suppose you had EUR 100 in a savings account and the interest rate was 20% per year. After 5 years, how much do you think you would have in the account if you left the money to grow?
   (i) More than EUR 200; (ii) Exactly EUR 200; (iii) Less than EUR 200; (iv) Do not know/Refusal.

3. Imagine that the interest rate on your savings account was 1% per year and inflation was 2% per year. After 1 year, how much would you be able to buy with the money in this account?
   (i) More than today; (ii) Exactly the same; **(iii) Less than today**; (iv) Do not know/Refusal.

4. Suppose that in the year 2012, your income has doubled and prices of all goods have doubled too. In 2012, how much will you be able to buy with your income?
   (i) More than today; **(ii) The same**; (iii) Less than today; (iv) Do not know/Refusal.

5. Normally, which asset described below displays the highest fluctuations over time:
   (i) Savings accounts; (ii) Bonds; **(iii) Stocks**; (iv) Do not know/Refusal.

6. Which of the following statements describes the main function of the stock market?
   (i) The stock market helps to predict stock earnings; (ii) The stock market results in an increase in the price of stocks; **(iii)The stock market brings people who want to buy stocks together with those who want to sell stocks**; (iv) None of the above; (v) Do not know/Refusal.

7. Buying a company stock usually provides a safer return than a stock mutual fund?
   (i) True; **(ii) False**; (iii) Do not know/Refusal.

8. Which of the following statements is correct?
   (i) Once one invests in a mutual fund, one cannot withdraw the money in the first year; **(ii) Mutual funds can invest in several assets, for example invest in both stocks and bonds**; (iii) Mutual funds pay a guaranteed rate of return which depends on their past performance; (iv) None of the above; (v) Do not know/Refusal.

9. If the interest rate falls, what should happen to bond prices:
   (i) Rise; (ii) Fall; (iii) Stay the same; (iv) None of the above; (v) Do not know/Refusal.

Appendix D

Social Security Information

Figure D.1: Page 1 of the social security information letter with short translation.

[redacted]

Deutsche Rentenversicherung

Bund

Deutsche Rentenversicherung Bund · 10704 Berlin

[redacted]

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Datum 16.09.2013

Rentenauskunft - kein Rentenbescheid

[redacted]

[redacted]

mit dieser Auskunft unterrichten wir Sie
- über die Höhe einer Rente wegen voller Erwerbsminderung
- über die Höhe der Altersrente nach Erreichen der Regelaltersgrenze (Regelaltersrente)
- über die gespeicherten rentenrechtlichen Zeiten (s. Anlage 2)
- inwieweit die Voraussetzungen für verschiedene Rentenleistungen erfüllt sind
- über die persönlichen Entgeltpunkte (s. Anlage 6)

nach jetzigem Stand.

Die **Rente wegen voller Erwerbsminderung** würde **715,86 EUR** monatlich betragen, wenn von einem am **16.09.2013** eingetretenen Leistungsfall ausgegangen würde.

Die Rente wegen teilweiser Erwerbsminderung würde die Hälfte des errechneten Betrages ergeben.
Wir haben nicht geprüft, ob eine Erwerbsminderung vorliegt.

Die **Regelaltersrente**, die nach Erreichen der Regelaltersgrenze gezahlt werden kann, würde **736,79 EUR** monatlich betragen, wenn der Berechnung ausschließlich die bisher gespeicherten rentenrechtlichen Zeiten sowie der bis zum 30.06.2014 maßgebende aktuelle Rentenwert zugrunde gelegt werden. Sie erreichen die **Regelaltersgrenze am 03.08.2017.** a

Die Berechnung der Monatsrente ergibt sich aus der Anlage 1.

Sollten für Sie bis zum Erreichen der Regelaltersgrenze Beiträge wie im Durchschnitt der letzten fünf Kalenderjahre gezahlt werden, bekämen Sie ohne Berücksichtigung von Rentenanpassungen von uns eine monatliche Regelaltersrente von **882,40 EUR.** b

Zukünftige Anpassungen

Aufgrund zukünftiger Rentenanpassungen kann die errechnete

a **Pension benefits** („Regelaltersrente“) that can be paid if the full retirement age is reached amounts to **736,79 EUR** per month. For this calculation only the contributions until today are taken into account. You will **reach full retirement age on 03.08.2017**.

b If you contribution until you reach full retirement age would amount the average contribution of the last five years, pension benefits would amount to **882,40 EUR** per month at full retirement age.

Page 5 of the social security information letter with short translation.

Deutsche Rentenversicherung

[redacted]

Seite 5

geleistet werden kann.

Bezogen auf den für diese Rentenauskunft angenommenen Leistungsfall 16.09.2013 ergeben sich für die anteilige Rente wegen voller Erwerbsminderung folgende monatliche Hinzuverdienstgrenzen

in den	alten Bundesländern und im Ausland	neuen Bundesländern
- Zahlung zu 3/4:	ca. 1.450 EUR	ca. 1.330 EUR
- Zahlung zu 1/2:	ca. 1.960 EUR	ca. 1.800 EUR
- Zahlung zu 1/4:	ca. 2.390 EUR	ca. 2.190 EUR

Auch die Höhe der Rente wegen teilweiser Erwerbsminderung ist vom erzielten Hinzuverdienst abhängig. Sie wird entweder in voller Höhe oder zur Hälfte geleistet. Für die Rente wegen teilweiser Erwerbsminderung ergeben sich folgende Hinzuverdienstgrenzen

in den	alten Bundesländern und im Ausland	neuen Bundesländern
- volle Zahlung:	ca. 1.960 EUR	ca. 1.800 EUR
- Zahlung zu 1/2:	ca. 2.390 EUR	ca. 2.190 EUR

Bei Überschreiten der für die jeweilige Rentenart geltenden höchsten Hinzuverdienstgrenze werden die Renten wegen Erwerbsminderung nicht geleistet.

[redacted]

Bestandteil der Berechnung der Hinzuverdienstgrenzen für Bezieher einer anteiligen Rente wegen voller oder teilweiser Erwerbsminderung ist u.a. die monatliche Bezugsgröße. Diese verändert sich regelmäßig jeweils zum 01.01. eines Jahres, so dass ab diesem Zeitpunkt andere Hinzuverdienst-grenzen gelten.

Im Laufe eines Kalenderjahres darf - ohne Folgen für die jeweilige Ren-tenhöhe - zweimal bis zum Doppelten der jeweils maßgebenden Hinzuver-dienstgrenze verdient werden.

Wir weisen noch darauf hin, dass bei Vorliegen von Berufsunfähigkeit auch ein Anspruch auf Rente wegen teilweiser Erwerbsminderung bis zum Erreichen der Regelaltersgrenze gegeben sein kann, sofern die sonstigen Voraussetzungen erfüllt sind.

E Altersrenten C

Außer der Regelaltersrente, die nach Erreichen der Regelaltersgrenze gezahlt werden kann, besteht die Möglichkeit, Altersrenten zu einem früheren Zeitpunkt in Anspruch zu nehmen. Dies kann allerdings zu einem Rentenabschlag führen, der sowohl für die gesamte Bezugsdauer einer Altersrente als auch für eine eventuell nachfolgende Hinterbliebenenrente bestehen bleibt.
Der Rentenabschlag beträgt für jeden Kalendermonat der vorzeitigen Inanspruchnahme einer Altersrente 0,3 %, er kann jedoch durch eine besondere Beitragszahlung zur Rentenversicherung ganz oder teilweise ausgeglichen werden.

Voraussetzung für die Inanspruchnahme einer Altersrente ist, dass die sonstigen persönlichen und versicherungsrechtlichen Voraussetzungen

C Besides pension benefits at full retirement age it is also possible to claim benefits earlier. This will permanently reduce pension benefits as well as a possible dependent's pension.

The reduction amounts to 0.3% per each month of early claiming.

Page 8 of the social security information letter with short translation.

[redacted]

Seite 8

Ob die Voraussetzungen dieser Vertrauensschutzregelung erfüllt sind, konnte nicht geprüft werden.

Werden die Anspruchsvoraussetzungen für diese Rente erfüllt, ergibt sich für Sie Folgendes:
Kein Rentenabschlag bei einem Rentenbeginn ab 01.05.2015.
Mit Rentenabschlag frühester Rentenbeginn ab 01.05.2012.
Die vorzeitige Inanspruchnahme dieser Rente zu dem genannten Zeitpunkt würde zu einer Minderung der Rente um 10,8 % führen.

H Altersrente für langjährig Versicherte

Die Altersrente für langjährig Versicherte kann bei erfüllter Wartezeit gezahlt werden, wenn das maßgebende Lebensalter erreicht ist und die Hinzuverdienstgrenze nicht überschritten wird.

Die Wartezeit für diese Rente beträgt 35 Jahre mit Beitragszeiten, Ersatzzeiten, Anrechnungszeiten und Berücksichtigungszeiten. Diese Wartezeit ist erfüllt.

Die Altersgrenze von 65 Jahren ist für Versicherte der Geburtsjahrgänge ab 1949 durch das RV-Altersgrenzenanpassungsgesetz auf 67 Jahre angehoben worden. Für Versicherte der Geburtsjahrgänge 1949 bis 1963 erfolgt eine stufenweise Anhebung der Altersgrenze von 65 auf 67 Jahre.

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Die Altersgrenze für die vorzeitige Inanspruchnahme dieser Rente ist für Versicherte der Geburtsjahrgänge ab 1948 auf 63 Jahre angehoben worden.

Die Altersgrenzen werden nicht angehoben für Versicherte, die vor dem 01.01.1955 geboren sind und vor dem 01.01.2007 mit ihrem Arbeitgeber Altersteilzeit im Sinne des Altersteilzeitgesetzes vereinbart haben oder die Anpassungsgeld für entlassene Arbeitnehmer des Bergbaus bezogen haben (Vertrauensschutzregelung).

Ob die Voraussetzungen dieser Vertrauensschutzregelung erfüllt sind, konnte nicht geprüft werden.

Werden die Anspruchsvoraussetzungen für diese Rente erfüllt, ergibt sich für Sie Folgendes:
Kein Rentenabschlag bei einem Rentenbeginn ab 01.09.2017.
Mit Rentenabschlag frühester Rentenbeginn ab 01.03.2015.
Die vorzeitige Inanspruchnahme dieser Rente zu dem genannten Zeitpunkt würde zu einer Minderung der Rente um 9,0 % führen. d

I Altersrente für besonders langjährig Versicherte

Die Altersrente für besonders langjährig Versicherte kann bei erfüllter Wartezeit gezahlt werden, wenn das 65. Lebensjahr vollendet ist und die Hinzuverdienstgrenze nicht überschritten wird.

Die Wartezeit für diese Rente beträgt 45 Jahre mit Pflichtbeitragszeiten, Ersatzzeiten, Monaten aus Zuschlägen an Entgeltpunkten aus geringfügiger versicherungsfreier Beschäftigung und Berücksichtigungszeiten. Pflichtbeitragszeiten aufgrund des Bezuges von Arbeitslosengeld, Arbeitslosengeld II und Arbeitslosenhilfe werden

d (The following is true for people that contributed at least 35 years):
You will receive full pension benefits at 01.09.2017 (NRA). The earliest you can claim benefits is 01.03.2015. Claiming early will lead to a reduction of 9% of benefits.

CV - Philipp Schreiber

Ausbildung

Seit 04/2011	**Universität Mannheim, Mannheim/Deutschland** Ph.D. Kurse in Finance.
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08/2008 - 12/2008	**Universit Commerciale Luigi Bocconi, Mailand/Italien** Studium der Betriebswirtschaftslehre.
07/2003	**Ludwig Marum Gymnasium, Pfinztal/Deutschland** Allgemeine Hochschulreife, Abschlussnote: 1,7.

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07/2009 - 03/2011	**Wüstenrot & Württembergische AG, Stuttgart/Deutschland** Assistent des Vorstandsvorsitzenden der Württembergischen Lebensversicherung AG.
02/2009 - 06/2009	**Zentrum für europäische Wirtschaftsforschung, Mannheim/Deutschland** Research Assistant im Bereich Arbeitsmärkte.
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Seit 06/1991	**VfB Grötzingen 04 e.V.** Aktives Mitglied der Herrenmannschaft.
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Sprachen:	Deutsch (Muttersprache), Englisch (fließend), Französisch (basic), Italienisch (basic).
IT-Kenntnisse:	MS Office, STATA, LaTeX, HTML.