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Betting on a Long Life – the Role of Subjective Life Expectancy in the Demand for Private Pension Insurance of German Households

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Abstract

With a view to investigating the presence of adverse selection in the private pension insurance market, we analyze determinants of private pension insurance uptake of German households. Using the SAVE 2005 survey data on savings and old-age provision, we estimate a probit model of insurance holdings. We find that subjective life expectancy is positively related with the probability of having supplementary private pension insurance. This indicates that the German private pension insurance market is in fact characterized by adverse selection. As expected, pre-existing entitlements to benefits from the public pension system tend to be a substitute to private insurance. Furthermore, financial literacy enhances the uptake of private pension insurance. We also find evidence for a bequest motive in old-age provision, but see no indication for pooling longevity risk within couples.

JEL Classification: D82, G22, D91, J26

1. Introduction

The German welfare state comprises a public pay-as-you-go (PAYG) pension system designed to prevent old-age poverty and to maintain the standard of living after withdrawal from working life. In contrast to funded systems, a PAYG plan is directly financed from current contributions and therefore requires a nearly permanent balance of contributions and payments. Population aging and negative incentive effects have increasingly threatened the German system and triggered a reform process to keep its financing sustainable. This has been accompanied by a lively discussion of the system's opportunities and limitations,

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that has created awareness of falling replacement rates from the public statutory system and the need for supplementary private old-age provision. In addition to pure accumulation of financial and non-financial assets, investment in private pension insurance policies presents one possible way to raise retirement income and concomitantly insures against outliving one's wealth. Consequences of shifting substantial parts of old-age provision from the public to the private sector, however, depend on the efficiency of this market.

A main concern over insurance markets raised by theoretical research, is the presence of information asymmetries between insurers and the insured that lead to market failure due to moral hazard and adverse selection. As pension insurance covers the financial risk related to longevity, moral hazard would be present if pension insurance coverage induced life-prolonging behavior that cannot be observed by the insurer. Adverse selection would be present if the length of life could be more accurately predicted by the insurant himself than by the insurer, and people expecting relatively long life systematically purchased larger pension insurance coverage. Concerning moral hazard, most people agree that in developed countries like Germany individual life-prolonging activities can be seen as independent of pension insurance coverage. Moral hazard is therefore reasonably assumed to be quantitatively negligible, if not non-existent.[1] In contrast, adverse selection in pension insurance markets is a concern. As a consequence of adverse selection, premiums rise and eventually become prohibitively high for low-risk individuals who are pushed out of the market.

In an attempt to explain the observed low uptake of annuities – the *annuity puzzle* – related studies consistently provide evidence for adverse selection in the UK and the US annuities market (Finkelstein / Poterba, 2002, 2004 for the UK and Friedman / Warshawsky, 1990, Mitchell et al., 1999, Brown, 2001 and Brown et al., 2008a for the US). First empirical evidence by von Gaudecker / Weber (2004) suggests that the German private pension market is also characterized by adverse selection. If this was the case, it might be too expensive for individuals who expect to die early to compensate public pension shortfalls by private pension insurance.

Our work contributes to the literature on adverse selection in annuity markets. In contrast to most related studies that take the *Money's Worth* approach introduced by Friedman / Warshawsky (1988), we investigate the existence of adverse selection on the micro level. Our main interest is the explanatory power of subjective life expectancy in the uptake of private pension insurance. According to previous research, subjective life expectancy is a remarkably good predictor of actual lifetime. In particular, it is superior to predictions based on mortality tables as made by the insurers (Hamermesh, 1985 and Hurd / McGarry,

[1] This view is shared in large parts of the literature; see among others Finkelstein / Poterba (2004) and Rothschild (2009). See, however, Philipson / Becker (1998) for a discussion of the existence of moral hazard effects in the market for annuities.

1995, 2002). Expectations about lifetime therefore represent private information and give a risk selection opportunity to the insurants as return on investment of a pension insurance policy increases with lifetime. In the same vein, a study on formation and updating of subjective life expectancy by Steffen (2009) finds correlations of subjective life expectancy with private information like individual health behavior and health status as well as rational updating of expectations after e. g. adverse health shocks. Based on these findings, our work now seeks to answer the question whether people actually make use of their private information about lifetime when deciding about old-age provision. If, conditional on other relevant determinants, subjective life expectancy was positively associated with the probability of having supplementary private pension insurance, this would indicate adverse selection in this market.

We will test this hypothesis using the German SAVE survey data on savings and old-age provision. Guided by the theory of savings and the life cycle with uncertain time of death beginning with Yaari (1965) and previous empirical studies, we provide an in-depth analysis of the determinants of pension insurance uptake of German households with a special focus on the role of subjective life expectancy. The remainder of this paper is organized as follows: Section 2 gives an overview of the related theoretical and empirical literature. The German Old-Age Pension System is presented in Section 3. Section 4 describes the data and methodology in use and contains estimation results. Section 5 concludes.

2. Related Literature

Within an overall assessment of the determinants of pension insurance uptake, we specifically focus on the role of subjective life expectancy to understand whether the German private pension market is characterized by adverse selection. Our work thus mainly relates to two broad strands in the literature. First, we refer to the theoretical and empirical literature on life cycle savings and annuity demand dealing with optimal annuitization in portfolio choice and practically relevant determinants of the annuitization decision. Second, we refer to the theoretical and empirical discussion of adverse selection in insurance markets in general and in annuity markets in particular.

Yaari (1965) was the first who incorporated uncertain lifetimes in the classical life cycle savings theory of Modigliani/Brumberg (1954). His model is a theoretical conjunction of mortality expectations and time and risk preference parameters in determining optimal annuitization. The main implication of his theory of consumption under the presence of longevity risk is that risk averse utility maximizing consumers who face actuarially fair insurance prices should fully annuitize their wealth, provided that they do not have any bequest motive. Davidoff et al. (2005) later confirmed the complete annuitization result within a more general framework.

Compared to the theoretical predictions of full or at least high annuitization, observed uptake of annuities is surprisingly low (Friedman / Warshawsky, 1990, Brown / Poterba, 2000, James / Song, 2001 and James / Vittas, 2000). This gap between theory and reality has caused a large body of literature dedicated to resolve this so called *annuity puzzle*. Among potential explanations for the puzzle are adverse selection, administrative load factors, bequest motives, risk-sharing within families, pre-existing annuities from social security, financial illiteracy and precautionary savings for the event of unexpected expenditure shocks. In this context, Brown (2001) empirically investigates the behavioral relevance of Yaari's life cycle model by relating a utility measure of annuity value to actual household decisions. Following the life cycle model, he calculates the utility measure – the *annuity equivalent wealth* – based on cohort mortality tables and survey data on risk aversion, marital status, and the presence of pre-existing annuity flows from social security. Brown (2001) finds that households for which the life cycle model predicts to have a higher valuation of annuities are in fact more likely to annuitize their retirement resources. However, in accordance with the annuity puzzle, much of the variation in the actual decision remains unexplained by the life cycle model. He therefore considers several additional factors that might influence the annuitization decision where he identifies individual health status and time horizon for financial decision-making to be the most relevant.

Related to our research purpose, the importance of individual health status in explaining the actual annuitization decision conditional on average mortality from life tables is particularly interesting. It points to the fact that people use private information on health status and expected longevity in the old-age provision decision which would be consistent with the presence of adverse selection in annuity markets. A general theoretical framework of adverse selection was introduced by Akerlof (1970) which Rothschild / Stiglitz (1976) later applied to the insurance market. The basic idea is that private information about individual risk gives insurants an information advantage over the insurer which allows higher-risk individuals to self-select into insurance contracts. Pooled risks are then comparatively high, insurance premiums rise and crowd lower-risk individuals out of the market. Thus, the theory of adverse selection predicts a positive correlation between insurance coverage and risk.

A wide body of literature studies the empirical importance of adverse selection in insurance markets. Two markets that have been frequently studied are the automobile and the health insurance market. For the automobile insurance market, the early studies of Dahlby (1983) and Puelz / Snow (1994) suggest a positive coverage-risk correlation, which, however, was not reinforced by subsequent research (Chiappori / Salanié, 2000 and Dionne et al., 2001). Conflicting findings are also available for the health insurance market. While Cutler / Zeckhauser (1998) support the theoretical prediction of positive correlation, Cardon / Hendel (2001) and Fang et al. (2008) reject it. Available studies on the

market for life insurance (Cawley / Philipson, 1999 and McCarthy / Mitchell, 2010) so far consistently suggest absence of adverse selection.[2]

Concerning annuity markets, the empirical literature rather uniformly concludes that these are characterized by adverse selection. From a methodological point of view, two different strands of empirical investigations of adverse selection in the market for annuities can be distinguished. Roughly, the first strand compares mortality data of annuitants with mortality data of non-annuitants or the general population, respectively. This strand includes the large number of studies that apply the concept of *Money's Worth* to identify how much of an insurance premium's deviation from the actuarily fair premium can be attributed to selection effects. Friedman / Warshawsky (1988) introduced the money's worth approach that was later refined by Mitchell et al. (1999). By now, the money's worth is commonly understood as the expected net present value of payouts in relation to premium costs which is calculated separately using population and insurance mortality tables. Several studies applied this concept to investigate the extent of adverse selection in annuity markets in various countries. Most frequently studied are the markets in the US (Friedman / Warshawsky, 1990 and Mitchell et al., 1999) and in the UK (Finkelstein / Poterba, 2002, 2004). Further examinations have been done for Germany (von Gaudecker / Weber, 2004), Australia (Doyle et al., 2004) and Singapore (Doyle et al., 2004 and Fong, 2002), as well as for Canada, Chile, Israel and Switzerland (James / Song, 2001). McCarthy / Mitchell (2010) and Rothschild (2009) also compare mortality tables of policyholders with those of the general population, but do not explicitly calculate the money's worth. All these studies find evidence for adverse selection which, however, can only partially explain the annuity puzzle due to its limited extent.

The more recent second strand, where our study belongs to, analyzes adverse selection from the perspective of the policyholder using micro level data. While the focus of the first strand lies on a quantitative estimation of the effects of adverse selection on insurance premiums, the second strand is able to simultaneously assess the relevance of subjective life expectancy and other determinants of annuity uptake. In addition, the money's worth does not allow to distinguish between active mortality selection based on asymmetric information about health and expected longevity and passive mortality selection reflecting other differences such as wealth and income that are also correlated with mortality (Finkelstein / Poterba, 2002). Due to data limitations, research on the micro level is less frequently done. Most closely related to our analysis, is the study by Brown et al. (2008a) who use data from the US Health and Retirement Study (HRS). They investigate self-reported willingness of the elderly population to exchange part of their social security inflation-in-

[2] See Cohen / Siegelman (2010) for a recent review of the empirical literature on adverse selection in insurance markets.

dexed annuity benefit for an immediate lump-sum payment by self-reported health status and subjective survival probabilities relative to actuarial life tables. Their results are consistent with predictions of standard theoretical models of adverse selection, since individuals with poor health-status and pessimistic life expectations are less likely to annuitize, but tend to prefer lump-sum payments. Another related study by Inkmann et al. (2011) uses the English Longitudinal Study of Aging and investigates actual annuity uptake in the UK. In line with Brown et al. (2008a), they find that the subjective survival probabilities of annuitants are significantly higher than those of their non-policyholding counterparts which points to the presence of adverse selection in the UK's annuity market as well.

Our work differs from the existing studies in several aspects: Compared to the US and the UK, Germany is characterized by a dominant public statutory system which leaves a relatively smaller scope for supplementary private insurance. Consequently, selection effects in the private pension insurance market in Germany are likely to differ from those observed in the US and the UK. In contrast to Brown et al. (2008a) who consider stated intentions to annuitize retirement income, we are able to observe actual demand for private pension insurance of households. Compared to Inkmann et al. (2011), we dispose of a more comprehensive set of variables, as we are able to build proxies for preference parameters reflecting risk aversion and time preference that are not included in their data. Unlike Brown et al. (2008a) and Inkmann et al. (2011), we use subjective life expectancy in years instead of subjective survival probabilities in percent. This overcomes the difficulties respondents might have with thinking in probabilities, especially when it comes to very low or very large probabilities as suggested by prospect theory (Kahneman / Tversky, 1979).

3. The German Old-Age Pension System

For our further analysis, it is instructive to briefly examine the German old-age pension system which consists of three coexisting pillars. Three things should be noted from the following description. First, the public first pillar is still by far the most important source of old-age income. Second, benefit levels from the first pillar differ for different population groups mainly depending on their type of employment. Third, the private pension insurance considered in our work is part of the third pillar and allows anyone to supplement pre-existing benefits.

Introduced by Otto von Bismarck in 1889 as a fully funded system, the German public old-age pension system was gradually converted into a PAYG system from 1957 on. Generosity was a key characteristic of the German system after the 1972 reform in terms of both replacement rates and flexibility of retirement age. However, increasing life expectancy in times of low fertility and the

resulting population aging coupled with negative incentive effects as well as the additional financing need after the German reunification began to threaten the system. Starting with a major reform in 1992, benefit cuts were implemented in an effort to stabilize its functioning (Börsch-Supan / Wilke, 2004). Nowadays, the so-called *first pillar* of the three-pillar old-age provision system comprises statutory pension insurance for all employees covered by the German social security system, old-age security for farmers, professional provision for certain groups of self-employed like physicians, lawyers and architects as well as the civil-service pension scheme. Except for the self-employed who are at liberty to participate and some other occupational groups like farmers or soldiers who can apply for exemption from compulsory insurance, the whole work force is subject to mandatory coverage within the first pillar. Although the relative importance of the three pillars has changed in disfavor of the first pillar, it still constitutes the most important source of old-age income. In 2007, the public pension scheme covered about 92 % of the German elderly and accounted for about 76 % of total gross old-age income of all retirees (ASID 07, 2009).

The various subsystems within the first pillar, like the old-age security for farmers or the civil-service pension scheme have neither historically been equally generous, nor have they undergone benefit cuts in an equal measure. In particular, in 2007, persons of age 65 and older whose last position was denoted as civil-servant, drew an average monthly gross pension of €2670 from the public system. This amounted to an average of €1195 for former blue- and white-collar worker and to only €813 for former farmers and self-employed who were least secured by the public scheme (ASID 07, 2009).

Employees in the private and the public sector are free to supplement their benefits from the mandatory statutory pension insurance by an occupational pension scheme within the capital funded *second pillar*. This is typically organized in form of deferred compensations, where employees waive part of their salary in favor of employer-provided retirement benefits. In 2007, benefits from occupational pension plans represented about 8% of total old-age income and accrued to 27% of the retirees (ASID 07, 2009). Private old-age provision as the *third pillar* involves additional accumulation of assets like investment funds, shares, real-estate, private pension insurance and life insurance that can be depleted during retirement. From 2002 and 2005 on, the third pillar also includes the state-subsidized Riester- and Rürup pension plans. Overall, the third pillar accounted for 10% of total old-age incomes in 2007 (ASID 07, 2009).[3]

Our analysis of adverse selection in pension insurance focuses on the uptake of private pension insurance within the third pillar because access to private pension insurance is open for everybody and the uptake is purely voluntary. In our definition, private pension insurance includes investment funds within the

[3] The remaining part of total gross old-age income that is not accounted for by the three pillars is income from employment during retirement.

so-called *Altersvorsorge-Sondervermögen* as their functioning is equivalent to regular private pension insurance. This type of investment fund that was introduced in 1998 is specifically designed for the provision of old age income and underlies a special regulation (see §§ 87 – 90 of the German Investment Law). Riester- and Rürup pension plans are excluded because of the state subsidies that distort their uptake and the unability to fully control for eligibility for these subsidies with the data at hand.[4]

Anybody is at liberty to purchase a private pension policy to raise retirement income. Individual premiums are generally calculated based on insurance mortality tables by age and gender. While benefits are usually paid out as a monthly pension, most insurance companies offer the option of a single lump-sum payment, instead. In both cases, a minimum benefit is guaranteed, while any profit bonus is uncertain and depends on the development of the capital market. Insurance companies offer various supplemental agreements for the standard policy, mostly related to dependants' protection. In a standard contract, pensions are paid until the policyholder dies. In order to avoid highly negative returns of investment, guarantee periods, survivor's pensions or contribution refund in case of early death can be agreed upon with the insurer. These additional agreements all come at some cost in the sense of lower pensions for a given monthly contribution. Finally, it should be noted that redemption of a purchased policy is financially highly disadvantageous, since contributions for the first years are used to cover broker remuneration and administrative expenses.

4. Empirical Analysis of Insurance Determinants

We now investigate the determinants of private pension insurance demand of German households in a probit model. Section 4.1 describes the data and the derived variables. The methodology is explained in Section 4.2 that also contains estimation results.

[4] The coexistence of subsidized and non-subsidized private pension products raises the question why anybody takes up a non-subsidized product while a subsidized one is available. The main reasons are: (i) a number of people are not eligible for the Riester subsidies like e. g. most self-employed, marginally employed, students, social welfare recipients and people receiving disability benefits (see § 10a of the German Income Tax Act for the rather complex eligibility criteria), (ii) subsidies do not automatically imply a high rate of return if the general contract conditions are disadvantageous (Kleinlein, 2011) (iii) under the current legislation, Riester products are unattractive for those who intend to spend their retirement abroad as they would have to pay back the subsidies in that case and finally, (iv) in particular right after the introduction of the Riester pensions, the closing of a contract was accompanied by a heavy administrative burden for the insurant (Oehler, 2009).

4.1 Data and Derived Variables

The cross-sectional data in use is the 2005 wave of the German SAVE study consisting of 2305 households. SAVE is a nationally representative survey of German households held by the Mannheim Research Institute for the Economics of Aging (MEA). With the main focus on savings behavior, financial assets and old-age provision, the survey also includes data on demographic, economic and psychologic characteristics of households. A first experimental wave was launched in 2001. From 2005 on, SAVE is an annually conducted panel of more than 2000 households.[5]

We choose the level of the analysis to be the household because we view old-age provision as a household and not an individual task. Furthermore, the data only contains information on insurance contracts of households and does not allow to distinguish between different policyholders within households. Our attention is restricted to non-retired households where neither the head nor the spouse has retired because old-age provision occurs before retirement. The dependent variable *PPI* in our probit regression is a binary variable indicating whether a household holds a private pension insurance policy in 2005.[6] Independent variables are grouped into i) the theoretically motivated explanatory variables life expectancy, risk and time preferences, ii) control variables for substitutive old-age provision and financial literacy and iii) control variables for other household socioeconomic characteristics.

We base our analysis on the 2005 wave for two main reasons: First, this wave exclusively contains relevant information on risk attitudes and time preferences. Second, uptake of the alternative state-subsidized Riester pensions introduced in 2001 was low until 2005, but gained momentum from that year on when the Retirement Income Act greatly facilitated the subsidy procedure (BMAS, 2008). As the data constraints do not allow us to fully control for subsidy eligibility, we restrict the sample to the 2005 wave where Riester uptake is still low and thus, demand for private pension insurance should be still rather unaffected.

The original sample size reduces to an estimation sample of 1320 households due to the following exclusion rules: First, only non-retired households where

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[5] Details on the the design of the SAVE study can be found in Schunk (2007) and Börsch-Supan et al. (2008a). Item nonresponse in SAVE is adressed by an iterative multiple imputation procedure using a Markov chain Monte Carlo algorithm. Provided a properly performed imputation, regression based on multiply imputed data leads to efficiency gains and avoids potential biases from systematic nonresponse. We will therefore take advantage of the five imputed data sets for SAVE 2005 provided by MEA. For further information on the imputation procedure used in SAVE see Börsch-Supan et al. (2008a), Schunk (2008) and Ziegelmeyer (2009, 2011).

[6] The precise wording in the survey is 'Other contractually agreed private pension scheme, e. g. investment funds geared specifically to the provision of pension cover, private pension insurance policies which are not promoted by the state or which were taken out before such support was available.'

neither the head nor the spouse has retired are considered (836 observations). Second, we drop households with inconsistent estimates of individual life expectancy, where the indicated average life expectancy of people of their age and sex is less than current age (5 observations). Third, all households with a missing value for the dependent variable *PPI* are excluded (144 observations).[7] 16% of the final estimation sample hold a private pension insurance.

4.1.1 Life Expectancy, Risk Aversion and Time Preference

Average subjective life expectancy per household is calculated in three steps. First, respondents are asked to estimate average life expectancy of men and women of their age group ($AVLE_{male}$ and $AVLE_{female}$). Second, they indicate the number of years they expect themselves to deviate from the average life expectancy of people of their sex and age ($EXPYEARSDEV_{head}$). Also, they indicate the number of years they expect their partner to deviate from the average life expectancy of his/her sex and age ($EXPYEARSDEV_{spouse}$). Subjective life expectancy for the household head is implicitly given by this information and can be calculated as $SLE_{head} = AVLE_{(fe)male} + EXPYEARSDEV_{head}$. Calculation of subjective life expectancy for the spouse relies on two (weak) assumptions: first, sex of the spouse is assumed to be opposite to the one of the head, and, second, age of the spouse is assumed to be about the same as the one of the head.[8,9] It is then given by $SLE_{spouse} = AVLE_{(fe)male} + EXPYEARSDEV_{spouse}$.

Risk attitudes and time preferences of the household head are indirectly inferred from hypothetical choices inquired in the survey. Table 1 displays the two sets of options that are used for their derivation. In the first set, people are requested to choose between options A and B in three different hypothetical lotteries. A is always a certain zero, while B implies a 50% chance of loosing €100 and a 50 % chance of winning €200, €300 and €400, respectively. *RISKAVERSE* is a dummy variable that is equal to one for the most risk averse individuals who always opt for A, even in the third lottery where potential payment in B is highest. This is the case for 65 % of our sample.

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[7] We exclude observations with an imputed dependent variable for two reasons; first, estimation efficiency and second and more importantly, robustness to problems with the underlying imputation model (see von Hippel, 2007 for a discussion of imputed dependent variables in regression analysis.). However, to verify insensitivity of the results to the inclusion of cases with missing dependent variable, we provide estimation results including these observations in Table 8 in the appendix.

[8] We view even the latter assumption as non-critical, since, on average, the household head is only 0.17 years older than his or her spouse in the 864 partner households with a standard deviation of 5.31 years.

[9] In a similar manner, Brown (2001), Brown et al. (2008a) and Inkmann et al. (2011) refer to individual expected survival probabilities. Data limitations force most other studies to make either use of aggregate mortality tables or the less nuanced self-assessed health status as a proxy.

Table 1

Hypothetical choices to elicit risk an time preferences

First Set	1	2	3
A 100 %	0	0	0
B 50 %	–100	–100	–100
50 %	200	300	400
Second Set	1	2	3
A now	–800	–800	–800
B in 10 months	–825	–870	990

Source: The German SAVE study 2005.

In the second set, the hypothetical choice is not between certain and uncertain payments, but between payments at different points in time. In each scenario, A is an immediate payment of €800, while B is a payment of €825, €870 and €990 in 10 months. *IMPATIENT* is a dummy variable that is equal to one for the most impatient individuals that always opt for paying in 10 months even if the postponed payment is highest.[10] 11 % of the sample are classified as impatient here. We are only able to infer preferences of the household head, but not of the spouse which, however, is less a concern since the head states to be involved in financial decision-making in 95 % of all cases.

4.1.2 Financial Literacy and Substitutive Old-age Provision

Since old-age provision is a complex matter that requires a certain degree of knowledge in financial affairs, we account for the financial literacy of households by their stock market participation. More precisely, *FINLIT* is a dummy variable indicating whether the household holds equity and real-estate funds or other financial assets like equity bonds, discount certificates, hedge funds, wind power funds, film funds and other financial innovations. Stock market participation is an appropriate proxy for financial literacy as investment in this type of assets reveals a certain level of financial sophistication (van Rooji et al., 2007).[11,12]

[10] Comparable measures for risk aversion based on hypothetical lottery choices inquired in surveys are used by Salm (2006) and Brown et al. (2008a). Cutler et al. (2008) furthermore suggests indicators like drinking and smoking behavior, job-based mortality risk, preventive care and the use of seat belts that are also frequently used. An analogous measure of time preference is derived by Brown et al. (2008a) from an experimental module in the 2004 HRS. Other studies rely on the length of the financial planning horizon to proxy for time preferences (Salm, 2006 and Brown et al., 2008a).

[11] The related empirical literature uses various other measures to capture financial literacy. Brown (2001) and Inkmann et al. (2011) rely on the general education level, while Mottola / Utkus (2007) gather from demographic characteristics to financial experience.

As private pension insurance is only one component of overall old-age provision, we need to take into account expected benefits from the first and second pillar as well as other types of third pillar old-age provision like real estate property, Riester pension plans, equity funds etc. We use the type of employment of the main earner in order to approximate the expected benefit level from the first pillar of the old-age provision system due to the previously noted substantially varying benefit levels by type of employment. Employment is classified in four categories: civil servant (*CIVSERV*), white/blue-collar worker (*WORKER*), self-employed (*SELFEMPL*) and unemployed (*UNEMPL*).

Part of the population is eligible to occupational pension schemes and the government-subsidized Riester pension plans. We control for benefits from these sources by a variable containing the end of December 2004 balances of occupational pension schemes and Riester contracts (*OTHINS*). We also control for private wealth, separately for financial wealth and other rather illiquid types of wealth. *FINWEALTH* is the sum of all net financial assets excluding pension insurance in €1000. *OTHWEALTH* contains all other types of net wealth, i.e. business property, real property and other assets in €10000. In some estimation specifications, these types of substitutive old-age provision are adjusted by equivalence scales to account for differing financial needs of single and partner households (*FINWEALTHEQ*, *OTHWEALTH*, *OTHINSEQ*). We divide insurance balances and wealth by 1.5 for partner households following the modified OECD equivalence scale that assigns a weight of 0.5 to the second adult in a household. Additionally, we include the squared equivalence scale adjusted wealth (*FINWEALTHEQ*2 and *OTHWEALTH*2) to take possible nonlinear effects into account.

4.1.3 Socioeconomic Characteristics

Finally, we control for households' socioeconomic characteristics that we assess to be relevant for the insurance choice. Average age, *AGE*, is supposed to represent the maturity status of the household in its life cycle. *AGE*2, the

Yet others use contact with tax advisors (Börsch-Supan et al., 2008b) or create indices by dint of direct investigations in surveys (Agnew et al., 2008, Brown et al., 2008a and Bucher-Koenen, 2009).

12 From 2007 to 2009, SAVE contains quiz-like questions to capture the respondents' financial literacy. Assuming financial literacy to be constant over time and applying this measure to households for which it is available, however, would result in a loss of sample size of about 30%. Instead, we use these later waves to validate our proxy: Correlations between stockmarket participation and correctness of answers to the financial literacy questions are substantial and highly significant. For instance, the tetrachoric correlation between stockmarket participation and a binary variable indicating three out of three correctly answered questions lies between 0.4 and 0.5 depending on the wave and is significantly different from zero at levels of less than 0.001.

squared average age, is included to allow for a possible nonlinear effect of age. *PARTNER* is a dummy variable designed to distinguish partner and single households. Alternatively, we include *MARRIED* that identifies married respondents. *NRCHILD* equals the number of children and stepchildren of the head and his spouse.[13] *EAST* is a dummy variable that characterizes households located in Eastern Germany. $INCOME(EQ(2))$ is the net (equivalent(squared)) income of the household that should control for its purchasing power and possible nonlinear effects.[14]

Generally note the following: We observe holdings of private pension insurance and household characteristics in 2005 or end December 2004. Theory suggests that starting from a situation without an insurance policy, a household implicitly calculates his net benefit from buying insurance in any given period. If this benefit is positive, the household buys a private pension insurance policy. In consecutive periods, the problem changes into the one of keeping or selling the previously bought policy. Selling a policy implies a financial loss due to administrative expenses. A critical point in our analysis is that we are unable to distinguish between new and old policyholders. Hence, there might be households in our sample that keep a policy though they would not buy it if they could newly decide in 2005. It would therefore be meaningful to run a similar analysis on the uptake of private pension insurance policies with panel data which, however, requires a larger sample size and a stable panel structure. Means of the variables and their cross-correlations for the estimation sample are given in Tables 2 and 3.

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[13] The presence of children is accounted for to capture a possible bequest motive in old-age provision (Hurd, 1987, Bernheim, 1991, Johnson et al., 2004, Börsch-Supan et al., 2008b and Inkmann et al., 2011). Yet other authors rely on self-reported importance of bequest motives (Brown, 2001) or the existence of a will or trust (Brown et al., 2008a).

[14] In contrast to the substitutive old-age provision where we only adjust for a partner, we also account for children when calculating net equivalent income. The reason is that the ability to pay insurance premiums from current income depends on the presence of children, whereas retirement income typically only serves the financial needs of the parents. Calculation of net equivalent income of a household conceptually again follows the modified OECD equivalence scale. Some specifications contain the net equivalent income, others the unadjusted net income. We also considered an alternative income measure roughly adjusted for subsistence income as defined by the Hartz IV regulations which, however, left our results unaffected.

Table 2

Sample means of dependent and independent variables by private pension insurance holdings

Variable	Estimation Sample $N = 1320$		***PPI* = 1** $N = 1320$		***PPI* = 0** $N = 1114$ (84%)	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
AVSLE	78.85	7.55	80.12	7.01	78.62	7.63
RISKAVERSE*	0.65	0.48	0.66	0.47	0.65	0.48
IMPATIENT*	0.11	0.32	0.06	0.24	0.12	0.33
FINLIT*	0.22	0.41	0.39	0.49	0.19	0.39
UNEMPL*	0.22	0.42	0.07	0.26	0.25	0.43
CIVSERV*	0.06	0.23	0.08	0.28	0.05	0.23
WORKER*	0.62	0.48	0.67	0.47	0.62	0.49
SELFEMPL*	0.09	0.29	0.18	0.39	0.08	0.27
AGE	40.41	11.12	40.29	8.87	40.43	11.48
NRCHILD	1.50	1.32	1.42	1.16	1.51	1.35
PARTNER*	0.63	0.48	0.74	0.44	0.61	0.49
MARRIED*	0.57	0.50	0.65	0.48	0.56	0.50
EAST*	0.32	0.47	0.33	0.47	0.32	0.47
FINWEALTHEQ	1.73	14.84	2.92	6.91	1.51	15.83
FINWEALTH	2.44	22.18	4.10	9.86	2.14	23.71
OTHWEALTHEQ	10.08	53.32	11.57	34.00	9.82	55.75
OTHWEALTH	14.01	77.77	16.70	50.82	13.53	81.17
INCOMEEQ	1362.52	1576.31	1745.27	2413.73	1294.35	1365.06
INCOME	2305.68	2638.93	2970.89	3366.50	2187.20	2470.17
OTHINSEQ	1862.82	7881.20	3454.93	11322.42	1579.26	7062.55
OTHINS	2625.38	10998.41	4885.96	15799.32	2222.77	9854.25

Note: Sample means are weighted using sample weights and averaged over the five datasets. Variables marked with * are dummy variables.

Source: The German SAVE study 2005. Own calculations.

Table 3

Correlations of the independent varaibles weighted by sampling weights and averaged over the five datasets

	AVSLE	RISK-AVERSE	IM-PATIENT	FINLIT	UNEMPL	CIVSERV	WORKER	SELF-EMPL	AGE	NR-CHILD	PARTNER
AVSLE	1										
RISKAVERSE	–0.03	1									
IMPATIENT	–0.01	–0.07	1								
FINLIT	0.07	–0.03	–0.12	1							
UNEMPL	–0.07	–0.04	0.16	–0.18	1						
CIVSERV	0.00	0.01	–0.06	0.10	–0.13	1					
WORKER	0.01	0.01	–0.11	0.07	–0.69	–0.32	1				
SELFEMPL	0.08	0.03	–0.01	0.06	–0.17	–0.08	–0.42	1			
AGE	–0.06	0.10	–0.05	0.07	–0.11	0.08	0.02	0.07	1		
NRCHILD	–0.02	0.11	0.05	–0.01	–0.08	0.03	0.06	–0.01	0.42	1	
PARTNER	0.02	0.06	–0.07	0.20	–0.31	0.05	0.17	0.12	0.22	0.34	1
MARRIED	–0.04	0.09	–0.10	0.17	–0.27	0.05	0.17	0.05	0.31	0.36	0.78
EAST	–0.06	–0.03	0.07	–0.11	0.14	–0.10	–0.06	–0.01	0.05	0.04	–0.09
FINWEALTHEQ	0.03	0.03	–0.03	0.14	0.01	0.01	–0-03	0.03	0.06	–0.02	0.05
FINWEALTH	0.02	0.03	–0.03	0.14	0.01	0.01	–0.03	0.03	0.06	–0.01	0.06
OTHWEALTHEQ	0.02	0.03	–0.04	0.09	–0.02	0.00	–0.04	0.09	0.05	0.02	0.06
OTHWEALTH	0.02	0.02	–0.03	0.09	–0.02	0.00	–0.04	0.09	0.06	0.03	0.08
INCOMEQ	0.02	–0.01	–0.09	0.19	–0.19	0.12	0.03	0.12	0.19	0.06	0.20
INCOME	0.02	0.00	–0.09	0.21	–0.21	0.11	0.05	0.13	0.18	0.18	0.33
OTHINSEQ	0.05	–0.03	–0.04	0.24	–0.11	–0.04	0.06	0.08	0.11	0.04	0.09
OTHINS	0.05	–0.03	–0.04	0.24	–0.11	–0.04	0.06	0.09	0.11	0.05	0.12

Continued next page

Continue Table 3

	MAR-RIED	EAST	FIN-WEALTH-EQ	FIN-WEALTH	OTH-WEALTH-EQ	OTH-WEALTH	INCOME-EQ	INCOME	OTHINS-EQ	OTHINS	
MARRIED	1										
EAST	–0.09	1									
FINWEALTHEQ	0.06	–0.05	1								
FINWEALTH	0.07	–0.04	1.00	1							
OTHWEALTHEQ	0.07	–0.07	0.62	0.63	1						
OTHWEALTH	0.08	–0.07	0.64	0.64	0.99	1					
INCOMEEQ	0.17	–0.14	0.14	0.12	0.11	0.12	1				
INCOME	0.28	–0.15	0.14	0.13	0.13	0.14	0.94	1			
OTHINSEQ	0.12	–0.10	0.13	0.12	0.13	0.14	0.31	0.30	1		
OTHINS	0.14	–0.10	0.13	0.12	0.14	0.15	0.27	0.29	0.99	1	

Source: The German SAVE study 2005. Own calculations.

4.2 Estimation and Results

To estimate determinants of private pension insurance uptake, we specify a probit model with the dichotomous dependent variable PPI_i for all households $i = 1 \ldots N$. PPI_i takes the value one for households holding a private pension insurance policy in 2005. As usual, we estimate the probit model by maximum-likelihood estimation. To deal with item non-response, we take advantage of the five multiply imputed data sets provided by MEA and combine the separate complete-data results by the method known as *Rubin's Rule*. This method averages estimated coefficients across datasets and takes within-imputation and between-imputation variances into account when calculating standard errors of the estimates (Rubin, 1987).

We distinguish between a model with purely theory-led explanatory variables and six different specifications where vectors of previously derived control variables X_i are included. The underlying latent model is thus specified as

$$(1) \qquad PPI_i^* = \beta_1 + \beta_2 AVSLE_i + \beta_3 RISKAVERSE_i + \beta_4 IMPATIENT_i (+X_i\beta) + \varepsilon_i \ .$$

Table 4 displays average marginal effects calculated using Rubin's Rules for multiply imputed data for the model without control variables and six different specifications with control variables.[15] Let us first consider the model without control variables. As illustrated in the first column of Table 4, estimation results closely correspond to our expectations. In particular, average subjective life expectancy significantly positively influences the demand for private pension insurance. Other things being equal, households who expect to become old, are more likely to purchase supplementary private pension insurance than those who expect to die young. Quantitatively, the effect seems to be small, i. e. if subjective life expectancy increases by one year, the probability of having *PPI* increases by 0.3 percentage points, but it is statistically significant at a level of 1.3 percent. Risk averse individuals should be more willing to insure their longevity risk and thus exhibit a larger likelihood of having private pension insurance. Correspondingly, the marginal effect of risk aversion on private pension insurance uptake is positive, but insignificant. Since investment in pension insurance postpones today's consumption to tomorrow, individuals with high time preference should buy private pension insurance less frequently than their patient counterparts. As expected, a high rate of time preference is associated with a low predicted probability of having private pension insurance.

[15] Marginal effects can be either evaluated at fixed values of the independent variables, typcially the means, or averaged over all observations. The first are called marginal effects at the mean (MEM), while the latter are referred to as average marginal effects (AME). The main argument in favor of AME is the fact that sample means used during the calculation of MEM might refer to either nonexistent or nonsensical observations (Bartus, 2005). For comparison, we also calculated the MEM which are almost identical to the AME (see Table 7 in the Appendix).

Table 4

Average marginal effects using Rubin's Rule for multiply imputed data for the model without control variables and six different specifications of the model with a vector of control variables

	Without control variables		With control variables											
			(1)		(2)		(3)		(4)		(5)		(6)	
	dy/dx	*P > z*	*dy/dx*	*P > z*	*dy/dx*	*P > z*	*dy/dx*	*P > z*	*dy/dx*	*P > z*	*dy/dx*	*P > z*	*dy/dx*	*P > z*
AVSLE	0.003**	0.013	0.003**	0.036	0.003**	0.043	0.003**	0.037	0.003**	0.044	0.003**	0.034	0.002*	0.091
RISKAVERSE	0.006	0.784	0.007	0.729			0.007	0.730			0.007	0.746	0.000	0.987
IMPATIENT	–0.081***	0.002	–0.0043	0.172			–0.042	0.175			–0.041	0.186	–0.042	0.181
FINLIT			0.097***	0.000	0.099***	0.000	0.096***	0,000	0.098***	0.000	0.099***	0.000	0.090***	0.001
CIVSERV			0.173**	0.011	0.185***	0.007	0.175**	0.010	0.186***	0.007	0.176**	0.010	0.187***	0.007
WORKER			0.095***	0.001	0.101***	0.000	0.095***	0.001	0.101***	0.000	0.097***	0.000	0.111***	0.000
SELFEMPL			0.246**	0.000	0.255***	0.000	0.245***	0.000	0.254***	0.000	0.253***	0.000	0.260***	0.000
AGE			0.024***	0.002	0.024***	0.001	0.025***	0.001	0.025***	0.001	0.025***	0.001		
AGE2			–0.000***	0.001	–0.000***	0.001	–0.000***	0.001	–0.000***	0.001	–0.000***	0.001		
NRCHILD			–0.017*	0.055	–0.018**	0.049	–0.018**	0.042	–0.019**	0.037	–0.016*	0.067	–0.017*	0.051
PARTNER			0.024	0.310	0.023	0.320	0.020	0.395	0.019	0.410			0.036	0.119
MARRIED											0.015	0.501		
EAST			0.050**	0.027	0.050**	0.028	0.051**	0.027	0.050**	0.027	0.051**	0.027	0.050**	0.029
FINWEALTHEQ			0.001	0.433	0.001	0.424					0.001	0.434	0.005	0.157
FINWEALTHEQ2													0.000	0.964
FINWEALTH							0.001	0.476	0.001	0.467				
OTHWEATHLEQ			–0.000	0.527	–0.000	0.533					–0.000	0.531	0.001	0.339
OTHWEALTHEQ2													0.000	0.665
OTHWEALTH							–0.000	0.545	–0.000	0.551				
INCOMEEQ			0.000	0.315	0.000	0.299					0.000	0.302	0.000	0.868
INCOMEEQ2													0.000	0.696
INCOME							0.000	0.305	0.000	0.283				
OTHINSEQ			0.000	0.252	0.000	0.259					0.000	0.267	0.000	0.823
OTHINS							0.000	0.206	0.000	0.214				

Note: Dependent variable = *PPI*, sample size $N = 1320$ (non-retired households), * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: The German SAVE study 2005. Own calculations.

With a p-value of 0.002, this relationship is highly significant in the model without the vector of control variables.

Now, let us direct our attention to the model specifications with control variables in columns three to eight of Table 4. Estimation results for this model prove to be robust across the six specifications. Compared to the model without control variables, our previous results remain qualitatively stable. As before, the probability of having private pension insurance significantly increases with average subjective life expectancy. We therefore conclude that people rationally take expectations about lifetime into account when deciding on old-age provision. Combined with the predictive power of subjective expectations of lifetime, this indicates risk-based selection due to private information. Hence, our investigation of the German annuity market confirms the common finding that annuity markets are in fact characterized by adverse selection.

The impact of risk aversion on pension insurance is again estimated to be insignificantly positive. Thus, preference-driven selection based on risk aversion does not seem to play a major role in the annuitization decision. This conflicts the emerging literature on propitious or advantageous selection based on risk aversion that emphasizes selection effects driven by risk attitudes instead of riskiness (Hemenway, 1990 and De Meza / Webb, 2001). Besides the admittedly noisy proxy, a potential explanation is collinearity of risk aversion and subjective life expectancy. This would hold, if risk aversion increased life expectancy due to more cautious health behavior and if individuals rationally took this effect into account when building their expectations about lifetime. Simple cross-correlation analysis as given in Table 3, however, throws doubt on this explanation because the correlation coefficient is close to zero and even slightly negative. Instead, we attribute insignificance of the marginal effect of risk aversion to a framing effect (Brown et al., 2008b). People might view private pension insurance policies as a type of investment rather than insurance. Due to its dependency on the ex ante unknown lifetime, return on investment in private pension insurance policies is relatively uncertain. In this regard, risk averse people should less frequently invest in pension insurance. Our result closely corresponds to Brown et al. (2008a) who use a similar proxy for risk aversion. In most of their specifications, more risk averse people do not exhibit a significantly higher likelihood of taking annuities instead of a lump-sum payment. In contrast, Cutler et al. (2008) find the expected relationship between risk-related behavior and annuitization. Smokers or individuals with risky jobs are less likely to be covered by annuities, whereas individuals that undertake preventive health activities or those who always wear seatbelts are more likely to be covered by annuities.

While it is still estimated to be negative, the marginal effect of time preference on the probability of having private pension insurance becomes insignificant once the control variables are taken into consideration. Using an analogous proxy for time preference, Brown et al. (2008a) also do not detect a robust rela-

tionship between time preference and annuity uptake. According to his result, patient individuals tend to be less likely to prefer the annuity over the lump-sum payment which, however, is significant at the 10 percent level in only two out of five specifications. We conclude that the effect is mainly attributed to other characteristics of the household than their time preference. A possible candidate is financial literacy which seems to play an outstanding role in the demand for private pension insurance. The probability of having private pension insurance is about 10 percentage points higher in financially literate than in financially illiterate households which is significant at the 1 percent level. This result is in line with the recent literature on the relationship between financial literacy, retirement planning ability and retirement saving (Lusardi / Mitchell, 2006, 2007a, 2007b and van Rooji et al., 2007) and is also supported by Brown et al. (2008a) and Bucher-Koenen (2009).

Benefit levels from the first pillar proxied by the type of employment also have substantial explanatory power. With the base category being the unemployed, the marginal effect of a self-employed main earner who is least covered by the public pension system is largest as expected. Thus, pre-existing annuities tend to crowd out private pension insurance uptake which ought to be the case according to Mitchell et al. (1999) and Dushi / Webb (2004) and is empirically confirmed by Bernheim (1991). According to our results, the predicted probability also increases with being a worker or a civil servant. There, the marginal effect of being a civil servant exceeds that of being a worker. At first glance, this seems counterintuitive due to the relatively more generous benefit levels for civil servants. An explanation might be a more cautious and provident attitude of civil servants on average that is not covered by other regressors.

On the one hand, wealth, in particular financial wealth, increases the affordability of private pension insurance. On the other hand, it works as a substitute to insurance. Rather surprisingly, the monetary variables of (equivalent) net wealth, balance in other insurance-type old-age provision and household income do not determine insurance demand. Wealthy households run a lower risk of depleting their assets before death so that wealth is theoretically supposed to negatively impact the probability of opting for supplementary private pension insurance. This effect should be particularly pronounced for illiquid assets like housing or business property that reduce the required replacement rate from pension insurance. In contrast, for liquid financial assets a positive impact might dominate due to the increasing affordability of private pension insurance. Actually, the signs of our estimated effects point into these directions. However, in accordance with Börsch-Supan et al. (2008b), Brown et al. (2008a) and Inkmann et al. (2011), we do not find any significant relationship in our data. A likely reason are the opposing effects of increased substitution and increased affordability with rising wealth. In a similar manner, other insurance-type old-age provision can be seen as a substitute to private pension insurance such that a

negative relationship is expected again. However, we again do not see evidence of substitution between different sources of old-age income. Instead, ahead thinking households tend to rely on several sources of old-age income. This finding is in line with other studies that also find a positive relationship between participation in alternative old-age provision and uptake of private pension plans (Börsch-Supan et al., 2008b and Inkmann et al., 2011).[16] Finally, net (equivalent) household income also does not seem to play a role in the uptake of private pension insurance. While Börsch-Supan et al. (2008b) estimate a weakly significant positive impact of income on pension insurance uptake, our result corresponds to Brown et al. (2008a).[17]

As the average age of its members increases, a household's probability to purchase private pension insurance increases, but at a decreasing rate. Aggravating population aging and raising awareness of decreasing replacement rates of the public pension system should lead to a larger probability of supplementary pension insurance in young households. The youngest households, however, possibly have not yet fully adressed the matter of old-age provion which explains the observed nonlinearity. Whether the respondent is married or lives in a partner household, does not seem to influence the insurance decision. Thus, we do not find evidence for intra-household risk pooling theoretically suggested by Kotlikoff/Spivak (1981). In contrast to Brown/Poterba (2000) who find higher annuity demand among singles than couples, our results correspond to Brown et al. (2008a).

Households in Eastern Germany are more likely to purchase private pension insurance than their Western German counterparts. This might be explained by lower expected public pension replacement rates of the Eastern German population due to less continuous employment biographies and lower average income subject to contribution payments (Krenz/Nagl, 2009).[18] Interestingly, if the number of children increases by one, the probability of having private pension insurance falls by about two percentage points. We interpret this statistically significant effect as evidence for a bequest motive or expected intergenerational transfer from children to their parents during retirement. As mentioned by Bernheim (1991), children's altruism might function as a 'safety net' that makes pension insurance less needed. Our finding corresponds to the em-

16 Note, however, that Inkmann et al. (2011) only find this for a subsample of stockholders.

17 Presumably, household income is an important determinant of the amount of insurance purchased because of higher purchasing power and higher standard of living that needs to be insured. In principal, we could estimate a two-stage model with the amount as the dependent variable in the second stage. Unfortunately, data on private pension insurance premium in force and contributions to the scheme prove to be unreliable such that we restrict our attention to the binary variable *PPI*.

18 For a detailed income decomposition of the German elderly in the Old and New Laender see Bönke et al. (2010).

pirical results by Bernheim (1991). However, quite a number of studies does not find an empirical indication of bequest motives in old-age provision (Hurd, 1987, Brown, 2001, Börsch-Supan et al., 2008b, Brown et al., 2008a and Inkmann et al., 2011).

5. Conclusion

We investigate determinants of private pension insurance uptake of German households using the 2005 SAVE survey on savings and old-age provision. In a comprehensive assessment of the relevant factors suggested by theory and previous empirical work, we simultaneously estimate their importance in a multivariate framework. Our main finding is that households take advantage of private information on expected lifetime in the pension insurance choice. Conditional on other relevant variables, households expecting to become old, are relatively more likely to take up supplementary private pension insurance. More precisely, the probability of having supplementary private pension insurance increases by about 0.3 percentage points with each additional year of expected lifetime. This indicates the presence of adverse selection in the German annuities market.

We also find financial literacy and pre-existing annuities to play a prominent role in the insurance decision. Financially literate households, identified by their active participation in the stock market, are significantly more likely to hold private pension insurance policies. Pre-existing annuities from the quantitatively most important public pension system, tend to crowd out private insurance. Civil servants and workers are less likely to have supplementary private insurance than households with a self-employed main earner who are typically not covered by the public system, though this difference is significant only for the case of the workers. In addition, the number of children is negatively related to the probability of private pension insurance. This can be interpreted as an indication of bequest motives or expected intergenerational altruism. According to our results, uptake of private pension insurance does not differ between single and partner households.

In addition, we only find very limited evidence for the theoretically suggested importance of risk aversion and time preference. Our measure of risk aversion has no explanatory power in the pension insurance choice. This might be explained by the fact that a pension policy cannot only be seen as insurance, but also as a type of investment. On the one hand, the insurance character of private pensions that protects the insurant from longevity risk should be appreciated by risk averse households. On the other hand, the relatively uncertain return on a pension policy that depends on the ex ante unknown length of life tends to retain risk averse households from purchase. These two opposing effects might therefore explain the lacking explanatory power of our measure of

risk aversion. Time preference has the expected negative coefficient, but it becomes insignificant as control variables are taken into account.

This work contributes to the literature on adverse selection in annuities markets. Our result is in line with a number of related studies primarily focusing on the UK and US that also find evidence for adverse selection in annuities markets. While most of these studies make use of the money's worth concept to detect adverse selection, we use micro level data and approach the issue from the perspective of the insurant. To our knowledge, we are the first to investigate adverse selection in the German annuities market at the household level. From the policy point of view, our work suggests that the private pension insurance market is in fact characterized by inefficiencies related to adverse selection. Difficulties arise for low risk individuals for whom insurance in the private pension market is prohibitively expensive. Policy makers should therefore keep in mind that privately insuring longevity risk is not without difficulty for part of the population.

For future research, it would be meaningful to conduct a comparable analysis using panel data that allows to observe household characteristics directly at the time of annuity purchase. Since our indicators of risk and time preferences are rather rough, we additionally consider it worthwhile to construct more sophisticated measures of preferences in surveys. This would provide deeper insight in preference-driven selection in insurance markets. Finally, it would be interesting to follow the development of the German pension system and address to adverse selection in Riester pension plans. While cautiously demanded in the beginning, holding of these increased to about 14 million contracts in end of 2010. Possibly, the design of the subsidy scheme that strongly incentivizes specific parts of the population to take up Riester plans, outruns the importance of life expectancy for profitability of the policies and thus reduces adverse selection.

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Appendix

Table 5

Derived variables and their underlying original variables

Derived Variable	Original Variables
PPI	f72m_4_imp
AVSLE	f06s_imp; f10s_imp; f90o1_imp; f90o2_imp; f91o1_imp; f91o2_imp; f91s_imp; f92o1_imp; f92o2_imp; f92s_imp
RISKAVERSE	f59a4_imp; f59a5_imp; f59a6_imp
IMPATIENT	f59c1_imp; f59c2_imp; f59c3_imp
FINLIT	f73eo6_imp; f73eo11_imp
CIVSERV	f24s1_imp; f24s2_imp; f54o1_imp; f54o2_imp
WORKER	f24s1_imp; f24s2_imp; f54o1_imp; f54o2_imp;
SELFEMPL	f24s1_imp; f24s2_imp; f54o1_imp; f54o2_imp;
FINWEALTH(EQ)	f73eo1_imp; f73eo2_imp; f73eo3_imp; f73eo5_imp; f73eo6_imp; f73eo11_imp; f78o3_imp; f84o4_imp; f78o5_imp; (f10s_imp)
OTHWEALTH(EQ)	f82o_imp; f68o_imp; f70o_imp; f84o_imp; f78o1_imp; f78o2_imp; (f10s_imp)
OTHINS(EQ)	f73eo9_imp; f73eo10_imp; (f10s_imp)
AGE	f07o_imp; f10s_imp; f11o_imp; year
NRCHILD	f13o_imp
MARRIED	f09s_imp
PARTNER	f10s_imp
INCOME(EQ)	f54o1_imp; f54o2_imp; (f14o_imp; f18o_imp)
EAST	bula

Source: The German SAVE study 2005.

Table 6

Fraction of imputed observations per underlying variable in estimation sample

Variable	Fraction of imputed observations
f06s_ind	0.00
f07o_ind	0.02
f09s_ind	0.00
f10s_ind	0.00
f11o_ind	0.00
f13o_ind	0.01
f14o_ind	0.00

f18o_ind	0.01
f24s1_ind	0.03
f24s2_ind	0.02
f54o1_ind	0.15
f54o2_ind	0.13
f59a4_ind	0.04
f59a5_ind	0.04
f59a6_ind	0.04
f59c1_ind	0.01
f59c2_ind	0.02
f59c3_ind	0.03
f68o_ind	0.03
f70o_ind	0.03
f72m_4_ind	0.00
f73eo1_ind	0.14
f73eo2_ind	0.12
f73eo3_ind	0.15
f73eo5_ind	0.04
f73eo6_ind	0.09
f73eo9_ind	0.13
f73eo10_ind	0.08
f73eo11_ind	0.03
f78o1_ind	0.02
f78o2_ind	0.04
f78o3_ind	0.04
f78o4_ind	0.04
f78o5_ind	0.03
f82o_ind	0.02
f84o_ind	0.02
f90o1_ind	0.02
f90o2_ind	0.03
f91o1_ind	0.03
f91o2_ind	0.03
f91s_ind	0.02
f92o1_ind	0.03
f92o2_ind	0.03
f92s_ind	0.02
N	1320

Note: N is sample size (non-retired households).

Source: The German SAVE study 2005. Own calculations.

Table 7

Marginal effects at the mean using Rubin's Rule for multiply imputed data for the model without control variables and six different specifications of the model with a vector of control variables

	Without control variables		With control variables											
			(1)		(2)		(3)		(4)		(5)		(6)	
	dy/dx	*P > z*	*dy/dx*	*P > z*	*dy/dx*	*P > z*	*dy/dx*	*P > z*	*dy/dx*	*P > z*	*dy/dx*	*P > z*	*dy/dx*	*P > z*
AVSLE	0.003**	0.013	0.003**	0.036	0.003**	0.043	0.003**	0.036	0.003**	0.044	0.003**	0.033	0.002*	0.097
RISKAVERSE	0.006	0.784	0.007	0.729			0.007	0.730			0.007	0.746	0.000	0.987
IMPATIENT	–0.080***	0.002	–0.041	0.165			–0.041	0.168			–0.040	0.179	–0.040	0.183
FINLIT			0.096***	0.000	0.098***	0.000	0.095***	0.000	0.098***	0.000	0.098***	0.000	0.088***	0.003
CIVSERV			0.179**	0.015	0.192***	0.010	0.181**	0.014	0.193***	0.009	0.182**	0.013	0.192**	0.011
WORKER			0.095***	0.001	0.100***	0.000	0.095***	0.001	0.100***	0.000	0.097***	0.000	0.109***	0.000
SELFEMPL			0.255***	0.000	0.265***	0.000	0.254***	0.000	0.263***	0.000	0.262***	0.000	0.266***	0.000
AGE			0.024***	0.001	0.024***	0.001	0.024***	0.001	0.024***	0.001	0.024***	0.001		
AGE2			–0.000***	0.001	–0.000***	0.001	–0.000***	0.001	–0.000***	0.000	–0.000***	0.000		
NRCHILD			–0.017*	0.054	–0.017**	0.048	–0.018**	0.041	–0.018**	0.036	–0.016*	0.067	–0.016*	0.055
PARTNER			0.023	0.309	0.022	0.320	0.019	0.394	0.019	0.410			0.035	0.124
MARRIED											0.015	0.501		
EAST			0.050**	0.029	0.049**	0.030	0.050**	0.028	0.050**	0.029	0.050**	0.029	0.049**	0.034
FINWEALTHEQ			0.001	0.432	0.001	0.423					0.001	0.433	0.005	0.145
FINWEALTHEQ2													0.000	0.960
FINWEALTH							0.000	0.475	0.001	0.467				
OTHWEALTHEQ			–0.000	0.527	–0.000	0.533					–0.000	0.531	0.001	0.306
OTHWEALTHEQ2													0.000	0.643
OTHWEALTH							–0.000	0.545	–0.000	0.551				
INCOMEEQ			0.000	0.315	0.000	0.299					0.000	0.302	0.000	0.866
INCOMEEQ2													0.000	0.695
INCOME							0.000	0.305	0.000	0.283				
OTHINSEQ			0.000	0.253	0.000	0.261					0.000	0.269	0.000	0.820
OTHINS							0.000	0.208	0.000	0.215				

Note: Dependent variable = *PPI*, sample size $N = 1320$ (non-retired households), * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: The German SAVE study 2005. Own calculations.

Table 8

Average marginal effects using Rubin's Rule for multiply imputed data for the model without control variables and six different specifications of the model with a vector of control variables; sample includes observations with imputed dependent variable

	Without control variables		With control variables											
			(1)		(2)		(3)		(4)		(5)		(6)	
	dy/dx	$P > z$	dy/dx	$P > z$	dy/dx	$P > z$	dy/dx	$P > z$	dy/dx	$P > z$	dy/dx	$P > z$	dy/dx	$P > z$
AVSLE	0.003**	0.034	0.003*	0.065	0.003*	0.067	0.003*	0.066	0.003*	0.069	0.003*	0.060	0.002	0.135
RISKAVERSE	0.003	0.887	0.001	0.972			0.001	0.979			0.000	0.994	–0.005	0.819
IMPATIENT	–0.072***	0.007	–0.035	0.263			–0.035	0.265			–0.034	0.279	–0.035	0.264
FINLIT			0.095***	0.000	0.097***	0.000	0.094***	0.000	0.096***	0.000	0.097***	0.000	0.087***	0.001
CIVSERV			0.175**	0.016	0.183**	0.011	0.176**	0.016	0.184**	0.010	0.178**	0.015	0.184**	0.013
WORKER			0.094***	0.001	0.097***	0.001	0.094***	0.001	0.097***	0.001	0.095***	0.001	0.108***	0.000
SELFEMPL			0.233**	0.000	0.238***	0.000	0.232***	0.000	0.237***	0.000	0.240***	0.000	0.249***	0.000
AGE			0.023***	0.002	0.024***	0.002	0.024***	0.002	0.024***	0.002	0.024***	0.002		
AGE2			–0.000***	0.001	–0.000***	0.001	–0.000***	0.001	–0.000***	0.001	–0.000***	0.001		
NRCHILD			–0.018*	0.062	–0.019*	0.058	–0.019**	0.043	–0.020**	0.039	–0.017*	0.073	–0.017**	0.043
PARTNER			0.027	0.255	0.027	0.257	0.023	0.343	0.022	0.348			0.037	0.107
MARRIED											0.018	0.462		
EAST			0.051**	0.025	0.051**	0.025	0.051**	0.025	0.051**	0.025	0.051**	0.026	0.054**	0.016
FINWEALTHEQ			0.001	0.490	0.001	0.486					0.001	0.496	0.006	0.134
FINWEALTHEQ2													0.000	0.848
FINWEALTH							0.000	0.523	0.000	0.520				
OTHWEALTHEQ			–0.000	0.634	–0.000	0.640					–0.000	0.642	0.001	0.314
OTHWEALTHEQ2													0.000	0.617
OTHWEALTH							–0.000	0.637	–0.000	0.642				
INCOMEEQ			0.000	0.166	0.000	0.154					0.000	0.152	0.000	0.907
INCOMEEQ2													0.000	0.754
INCOME							0.000	0.166	0.000	0.153				
OTHINSEQ			0.000	0.285	0.000	0.280					0.000	0.304	0.000	0.868
OTHINS							0.000	0.245	0.000	0.241				

Note: Dependent variable = *PPI*, sample size $N = 1320$ (non-retired households including imputed dependent variables), * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Source: The German SAVE study 2005. Own calculations.