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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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betting on a long life - the role of subjective life expectancy in the demand for private pension insurance of german households

by Katharina Schulte and Ulrike Zirpel



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

JEL Codes: D82, G22, D91, J26

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List of Abbreviations

AME	Average marginal effect
ASID	Alterssicherung in Deutschland
HRS	Health and Retirement Study
MEA	Mannheim Research Institute for the Economics of Aging
MEM	Marginal effect at the mean
OECD	Organisation for economic co-operation and development
PAYG	Pay-as-you-go
SAVE	Sparen und Altersvorsorge in Deutschland

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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 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 opportunities and limitations of the system, 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 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. Pension insurance insures 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 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-existent¹. 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 and POTERBA (2002, 2004) for the UK and FRIEDMAN and WARSHAWSKY (1990), MITCHELL ET AL. (1999), BROWN (2001) and BROWN ET AL. (2008a) for the US). First empirical evidence by VON GAUDECKER and 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 too early to compensate public pension shortfalls by private pension

¹This view is shared in large parts of the literature; see among others FINKELSTEIN and POTERBA (2004) and ROTHCHILD (2009). See, however, PHILIPSON and BECKER (1998) for a discussion of the existence of moral hazard effects in the market for annuities.

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 and 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), HURD and MCGARRY (1995), HURD and MCGARRY (2002)). Expectations about lifetime therefore represent private information and give a risk selection opportunity to the insureds as return on investment of a pension insurance policy increases with lifetime. Based on this finding, our work now seeks to answer the question of 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 shortly presented in Section 3. Section 4 describes the data and methodology in use and contains estimation results. Section 5 finally 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 and 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 and WARSHAWSKY (1990), BROWN and POTERBA (2000), JAMES and SONG (2001) and JAMES and VITTAS (2004)). 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 that are predicted by the life cycle model 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 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 informa-

tion 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 ROTHCHILD and 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 under study are the automobile and the health insurance market. For the automobile insurance market, the early studies of DAHLBY (1983) and PUELZ and SNOW (1994) suggest a positive coverage-risk correlation, which, however, was not reinforced by subsequent research (CHIAPPORI and SALANIÉ (2000) and DIONNE ET AL. (2001)). Conflicting findings are also available for the health insurance market. While CUTLER and ZECKHAUSER (1998) support the theoretical prediction of positive correlation, CARDON and HENDEL (2001) and FANG ET AL. (2008) reject it. Available studies on the market for life insurance (CAWLEY and PHILIPSON (1999) and MCCARTHY and MITCHELL (forthcoming)) so far consistently suggest absence of adverse selection².

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 and non-annuitants or the general population. 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 actuarially fair premium can be attributed to selection effects. FRIEDMAN and WARSHAWSKY (1988) introduced the money's worth approach which 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 separately calculated 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 and WARSHAWSKY (1990) and MITCHELL ET AL. (1999)) and in the UK (FINKELSTEIN and POTERBA (2002, 2004)). Further examinations have been done for Germany (VON GAUDECKER and 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 and SONG (2001)). MCCARTHY and

²See COHEN and SIEGELMAN (2010) for a recent review of the empirical literature on adverse selection in insurance markets.

MITCHELL (forthcoming) and ROTHSCILD (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 and POTERBA (2002)). Due to data limitations, research taking the micro approach 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-indexed annuity benefit for an immediate lump-sum payment by self-reported health status and subjective survival probabilities. 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. (2009) 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 subjective life expectancy of annuitants is significantly higher than that of their non-policyholding counterparts which points to the presence of adverse selection in the UK annuity market as well.

Our work differs from the existing studies, not only by country and underlying data: 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. (2009), 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.

3 The German Old-Age Pension System

For our further analysis, it is instructive to briefly consider 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. Outstanding generosity was as 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 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 and 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, 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 (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 **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 has also included 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)).

Anybody is at liberty to purchase a private pension policy to raise retirement income. 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, pension 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.

4.1 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 households³.

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 2005⁴. 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.

i) 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

³Details 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 adresssed 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).

⁴The 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.”

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 head⁵ ⁶. 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 losing 100 € and a 50% chance of winning 200 €, 300 € and 400 €, respectively. $RISKAV$ 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.

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

Table 1: Hypothetical choices to elicit risk and time preferences

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. $TIMEPREF$ 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 highest⁷. We are only able to infer preferences of the household head, but not of

⁵We 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.

⁶In a similar manner, BROWN (2001), BROWN ET AL. (2008a) and INKMANN ET AL. (2009) 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.

⁷Comparable 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 behaviour, 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 spouse which, however, is less a concern since the head states to be involved in financial decision-making in 95% of all cases.

ii) 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 ROOIJ ET AL. (2007))⁸.

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 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 total private wealth that can be used to maintain consumption levels during retirement. *NETWEALTH* is the sum of all assets excluding pension insurance. It consists of financial assets, business property, real property and other assets net of total debt. In some estimation specifications, the latter two types of substitutive old-age provision are adjusted by equivalence scales to account for differing financial needs of single and partner households (*OTHINSEQ*, *NETWEALTHSEQ*). We divide insurance balances and net 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.

the length of the financial planning horizon to proxy for time preferences (SALM (2006) and BROWN ET AL. (2008a)).

⁸The related empirical literature uses various other measures to capture financial literacy. BROWN (2001) and INKMANN ET AL. (2009) rely on the general education level, while MOTTOLA and UTKUS (2007) gather from demographic characteristics to financial experience. 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)).

iii) Socioeconomic characteristics

Finally, we control for households' socioeconomic characteristics that we assess to be relevant for the insurance choice. Average age, *AVAGE*, is supposed to represent the maturity status of the household in its life cycle. *AVAGESQ*, the 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 spouse⁹. *EAST* is a dummy variable that characterizes households located in Eastern Germany. *NETINC(EQ)* is the net (equivalent) income of the household that should control for its purchasing power¹⁰.

The original sample size reduces to an estimation sample of 1320 households due to the following exclusion rules: First, only non-retired households where 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). The reason is that missing values were imputed using variables that will be partially included on the right hand side of the regression equation which would otherwise yield a self-made correlation. Means of the variables and their cross-correlations for the estimation sample are given in Tables 2 and 3¹¹.

⁹The 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. (2009)). 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)).

¹⁰In 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.

¹¹Generally 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.

Variable	Estimation Sample		PPI=1		PPI=0	
	N=1320		N=206 (16%)		N=1114 (84%)	
	Mean	Std.Dev.	Mean	Std.Dev.	Mean	Std.Dev.
AVSLE	78.85	7.45	79.98	7.00	78.64	7.52
RISKAV*	0.63	0.48	0.54	0.50	0.62	0.49
TIMEPREF*	0.10	0.30	0.05	0.21	0.11	0.31
FINLIT*	0.22	0.42	0.33	0.47	0.19	0.39
CIVSERV*	0.07	0.25	0.09	0.28	0.06	0.24
WORKER*	0.63	0.48	0.66	0.48	0.63	0.48
SELFEMPL*	0.10	0.30	0.19	0.39	0.08	0.27
NETWEALTH	126391.04	654089.98	158505.88	378974.84	120452.38	690881.82
NETWEALTH	177730.02	963460.62	228605.02	566677.04	168322.22	1016677.22
OTHINSEQ	2060.69	8313.76	3837.97	11988.97	1732.04	7397.30
OTHINS	2917.71	11651.37	5457.61	16848.50	2448.04	10350.31
AVAGE	41.14	10.86	41.10	8.75	41.14	11.21
AVAGESQ	1810.25	888.30	1765.70	715.02	1818.48	916.80
NRCHILD	1.55	1.31	1.46	1.15	1.56	1.34
PARTNER*	0.65	0.48	0.76	0.43	0.64	0.48
MARRIED*	0.58	0.49	0.55	0.50	0.56	0.50
NETINCEQ	1447.86	1687.41	1807.97	2443.28	1381.27	1498.79
NETINC	2465.45	2801.94	3100.61	3410.99	2348.00	2659.40
EAST*	0.30	0.46	0.26	0.44	0.30	0.46

Table 2: Sample means of dependent and independent variables by private pension insurance holdings; averaged over the five datasets; variables marked with * are dummy variables

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 $i = 1 \dots N$. PPI_i takes the value one for households holding a private pension insurance policy in 2005 and occurs with the conditional response probability p_i for given values of the independent variables X_i :

$$PPI_i = \begin{cases} 1 & \text{with probability } p_i = Pr(PPI_i = 1 | X_i) \\ 0 & \text{with probability } (1 - p_i) = Pr(PPI_i = 0 | X_i) \end{cases} \quad (1)$$

It is illustrative to interpret the binary response model as an outcome of an underlying latent variable model where the latent variable PPI_i^* can generally be modeled as

$$PPI_i^* = X_i\beta + \varepsilon_i. \quad (2)$$

In the probit framework, the residual error term is assumed to be standard normally distributed. If the latent dependent variable PPI_i^* exceeds a certain threshold (here

	AVSLE	RISKAV*	TIMEPREF*	FINLIT*	CIVSERV*	WORKER*	SELFEMPL*	NETWEALTHEQ	NETWEALTH
AVSLE	1.00								
RISKAV*	-0.04	1.00							
TIMEPREF*	-0.01	-0.07	1.00						
FINLIT*	0.06	-0.02	-0.12	1.00					
CIVSERV*	0.01	0.01	-0.06	0.10	1.00				
WORKER*	-0.01	0.01	-0.10	0.07	-0.35	1.00			
SELFEMPL*	0.08	0.03	-0.01	0.06	-0.09	-0.43	1.00		
NETWEALTHEQ	0.03	0.03	-0.04	0.11	0.00	-0.04	0.08	1.00	
NETWEALTH	0.02	0.02	-0.03	0.11	0.00	-0.04	0.09	1.00	1.00
OTHINSEQ	0.06	-0.04	-0.04	0.24	-0.04	0.06	0.09	0.15	0.15
OTHINS	0.06	-0.04	-0.04	0.24	-0.04	0.06	0.09	0.16	0.16
AVAGE	-0.05	0.10	-0.05	0.09	0.10	0.02	0.07	0.06	0.07
AVAGESQ	-0.04	0.09	-0.05	0.07	0.10	-0.01	0.06	0.06	0.06
NRCHILD	-0.02	0.11	0.04	-0.01	0.04	0.05	-0.02	0.01	0.02
PARTNER*	0.02	0.06	-0.08	0.19	0.06	0.16	0.12	0.06	0.08
MARRIED*	-0.04	0.09	-0.10	0.17	0.06	0.17	0.05	0.07	0.08
NETINCEQ	0.02	-0.02	-0.09	0.18	0.11	0.01	0.14	0.12	0.12
NETINC	0.03	0.00	-0.09	0.21	0.11	0.03	0.15	0.14	0.15
EAST*	-0.07	-0.02	0.06	-0.11	-0.10	-0.06	-0.01	-0.07	-0.07

	OTHINSEQ	OTHINS	AVAGE	AVAGESQ	NRCHILD	PARTNER*	MARRIED*	NETINCEQ	NETINC	EAST*
OTHINSEQ	1.00									
OTHINS	0.99	1.00								
AVAGE	0.12	0.13	1.00							
AVAGESQ	0.12	0.12	0.99	1.00						
NRCHILD	0.04	0.05	0.40	0.36	1.00					
PARTNER*	0.09	0.12	0.26	0.21	0.34	1.00				
MARRIED*	0.11	0.14	0.34	0.29	0.36	0.78	1.00			
NETINCEQ	0.30	0.27	0.21	0.20	0.06	0.19	0.16	1.00		
NETINC	0.30	0.28	0.20	0.18	0.17	0.32	0.27	0.94	1.00	
EAST*	-0.10	-0.10	0.04	0.04	0.04	-0.10	-0.10	-0.14	-0.15	1.00

Table 3: Cross-correlations of the independent variables averaged over the five datasets

set to zero), the observed outcome PPI_i is equal to one:

$$PPI_i = \begin{cases} 1 & \text{if } PPI_i^* > 0 \\ 0 & \text{if } PPI_i^* \leq 0 \end{cases} \quad (3)$$

Combining equations (1) and (2) allows to express the individual probability of having private pension insurance as $Pr(PPI_i = 1) = F(X_i\beta)$, where the parametric function $F(\cdot)$ is assumed to be the (standard) normal cumulative distribution function. 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* (RUBIN (1987)).

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

$$PPI_i^* = \beta_1 + \beta_2 AVSLE_i + \beta_3 RISKAV_i + \beta_4 TIMEPREF_i + X_i\beta + \varepsilon_i. \quad (4)$$

Table 4 displays average marginal effects calculated using Rubin's Rules for multiply imputed data for a reduced model and five different specifications of the full model¹². Summaries of the estimations are given in Table 7 in the Appendix. The p-values of the likelihood ratio test of the full vs. the intercept-only model in the second rows of each panel are zero. We therefore conclude that the whole model is statistically significant.

Let us first consider the reduced model. 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, 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.

¹²Marginal effects can be either evaluated at fixed values of the independent variables, typically 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 8 in the Appendix).

As expected, a high rate of time preference is associated with a low predicted probability of having private pension insurance. With a p-value of 0.002, this relationship is highly significant in the reduced model.

Now, let us direct our attention to the full model in columns two to six of Table 4. Estimation results for the full model prove to be robust across the five specifications. Compared to the reduced model, our previous results qualitatively remain 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 about 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), DE MEZA and 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 behaviour 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 does not detect a robust relationship 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 and MITCHELL (2006, 2007a, 2007b) and VAN ROOIJ 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. As expected, the marginal effect of a self-employed main earner who is least covered by the public pension system is largest. 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 and 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.

Rather surprisingly, the monetary variables of (equivalent) net wealth, balance in other insurance-type old-age provision and household income do not significantly determine insurance demand. Wealthy households run a lower risk of depleting their assets before death so that total wealth is theoretically supposed to negatively impact the probability of opting for supplementary private pension insurance. However, in accordance with BÖRSCH-SUPAN ET AL. (2008b), BROWN ET AL. (2008a) and INKMANN ET AL. (2009), we do not find this relationship in our data. 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. (2009))¹³. Finally, net (equivalent) household income also does not seem to play a role in the uptake of private pension insurance.

¹³Note, however, that INKMANN ET AL. (2009) only find this for a subsample of stockholders.

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)¹⁴.

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 addressed the matter of old-age provision 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 and SPIVAK (1981). In contrast to BROWN and 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 and NAGL (2009))¹⁵. 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 empirical 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. (2009)).

¹⁴Presumably, 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*.

¹⁵For a detailed income decomposition of the German elderly in the Old and New Laender see BÖNKE ET AL. (forthcoming).

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. 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 who benefit from relatively high public pension replacement rates, 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. 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 13 million contracts in end of 2009. 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.

References

- AGNEW J., ANDERSON L., GERLACH J. and SZYKMAN L. (2008): Who Chooses Annuities? An Experimental Investigation of the Role of Gender, Framing, and Defaults, *American Economic Review*, 98, 2, pp. 418–422.
- AKERLOF G. (1970): The Market for 'Lemons': Quality Uncertainty and the Market Mechanism, *Quarterly Journal of Economics*, 84, 3, pp. 488–500.
- ASID 07 (2009): Alterssicherung in Deutschland 2007 –Tabellenband 3: Deutschland, Kortmann K. and Halbherr V., Bundesministerium für Arbeit und Soziales, Forschungsbericht F392/D.
- BARTUS T. (2005): Estimation of Marginal Effects Using Margeff, *Stata Journal*, 5, 3, pp. 309–329.
- BERNHEIM B. (1991): How Strong are Bequest Motives? Evidence Based on Estimates of the Demand for Life Insurance and Annuities, *Journal of Political Economy*, 99, 5, pp. 899–927.
- BÖNKE T., SCHRÖDER C. and SCHULTE K. (forthcoming): Incomes and Inequality in the Long Run: The Case of German Elderly, *German Economic Review*.
- BROWN J. (2001): Private Pensions, Mortality Risk, and the Decision to Annuitize, *Journal of Public Economics*, 82, 1, pp. 29–62.
- BROWN J., CASEY M. and MITCHELL O. (2008a): Who Values the Social Security Annuity? New Evidence on the Annuity Puzzle, National Bureau of Economic Research Working Paper No. 13800.
- BROWN J., KLING J., MULLAINATHAN S. and WROBEL M. (2008b): Why Don't People Insure Late-Life Consumption? A Framing Explanation of the Under-Annuitization Puzzle, *American Economic Review*, 98, 2, pp. 304–309.
- BROWN J. and POTERBA J. (2000): Joint Life Annuities and the Demand for Annuities for Married Couples, *Journal of Risk and Insurance*, 67, 4, pp. 527–553.
- BÖRSCH-SUPAN A., COPPOLA M., ESSIG L., EYMANN A. and SCHUNK D. (2008a): The German SAVE Study: Design and Results, Mannheim Research Institute for the Economics of Aging.
- BÖRSCH-SUPAN A., REIL-HELD A. and SCHUNK D. (2008b): Saving Incentives, Old-Age Provision and Displacement Effects: Evidence from the Recent German Pension Reform, *Journal of Pension Economics and Finance*, 7, 3, pp. 295–319.

- BÖRSCH-SUPAN A. and WILKE C. (2004): The German Public Pension System: How it Was, How it Will Be, National Bureau of Economic Research Working Paper No. 10525.
- BUCHER-KOENEN T. (2009): Financial Literacy and Private Old-Age Provision in Germany – Evidence From SAVE 2008, Mannheim Research Institute for the Economics of Aging Discussion Paper No. 192–2009.
- CARDON J. and HENDEL I. (2001): Asymmetric Information in Health Insurance: Evidence from the National Medical Expenditure Survey, *RAND Journal of Economics*, 32, 3, pp. 408–427.
- CAWLEY J. and PHILIPSON T. (1999): An Empirical Examination of Information Barriers to Trade in Insurance, *American Economic Review*, 89, 4, pp. 827–846.
- CHIAPPORI P. and SALANIÉ B. (2000): Testing for Asymmetric Information in Insurance Markets, *Journal of Political Economy*, 108, 1, pp. 56–78.
- COHEN A. and SIEGELMAN P. (2010): Testing for Adverse Selection in Insurance Markets, *Journal of Risk and Insurance*, 77, 1, pp. 39–84.
- CUTLER D., FINKELSTEIN A. and MCGARRY K. (2008): Preference Heterogeneity and Insurance Markets: Explaining a Puzzle of Insurance, *American Economic Review*, 98, 2, pp. 157–162.
- CUTLER D. and ZECKHAUSER R. (1998): Adverse Selection in Health Insurance, *Frontiers in Health Policy Research*, 1, 2, pp. 1–31.
- DAHLBY B. (1983): Adverse Selection and Statistical Discrimination: An Analysis of Canadian Automobile Insurance, *Journal of Public Economics*, 20, 1, pp. 121–130.
- DAVIDOFF T., BROWN J. and DIAMOND P. (2005): Annuities and Individual Welfare, *American Economic Review*, 95, 5, pp. 1573–1590.
- DE MEZA D. and WEBB D. (2001): Advantageous Selection in Insurance Markets, *The RAND Journal of Economics*, 32, 2, pp. 249–262.
- DIONNE G., GOURIÉROUX C. and VANASSE C. (2001): Testing for Evidence of Adverse Selection in the Automobile Insurance Market: A Comment, *Journal of Political Economy*, 109, 2, pp. 444–473.
- DOYLE S., MITCHELL O. and PIGGOTT J. (2004): Annuity Values in Defined Contribution Retirement Systems: Australia and Singapore Compared, *Australian Economic Review*, 37, 4, pp. 402–416.

- DUSHI I. and WEBB A. (2004): Household Annuitization Decisions: Simulations and Empirical Analyses, *Journal of Pension Economics and Finance*, 3, 2, pp. 109–143.
- FANG H., KEANE M. and SILVERMAN D. (2008): Sources of Advantageous Selection: Evidence from the Medigap Insurance Market, *Journal of Political Economy*, 116, 2, pp. 303–350.
- FINKELSTEIN A. and POTERBA J. (2002): Selection Effects in the United Kingdom Individual Annuities Market, *Economic Journal*, 112, 476, pp. 28–50.
- FINKELSTEIN A. and POTERBA J. (2004): Adverse Selection in Insurance Markets: Policyholder Evidence from the UK Annuity Market, *Journal of Political Economy*, 112, 1, pp. 183–208.
- FONG W. (2002): On the Cost of Adverse Selection in Individual Annuity Markets: Evidence from Singapore, *Journal of Risk and Insurance*, 69, 2, pp. 193–207.
- FRIEDMAN B. and WARSHAWSKY M. (1988): Annuity Prices and Saving Behavior in the United States, in: Bodie Z. and Shoven J. and Wise D. (Eds.): *Pensions in the US Economy*, University of Chicago Press, pp. 53–77.
- FRIEDMAN B. and WARSHAWSKY M. (1990): The Cost of Annuities: Implications for Saving Behavior and Bequests, *Quarterly Journal of Economics*, 105, 1, pp. 135–154.
- VON GAUDECKER H. and WEBER C. (2004): Surprises in a Growing Market Niche: An Evaluation of the German Private Life Annuities Market, *Geneva Papers*, 29, 3, pp. 394–416.
- HAMERMESH D. (1985): Expectations, Life Expectancy, and Economic Behavior, *Quarterly Journal of Economics*, 100, 2, pp. 389–408.
- HEMENWAY D. (1990): Propitious Selection, *The Quarterly Journal of Economics*, 105, 4, pp. 1063–1069.
- HURD M. (1987): Savings of the Elderly and Desired Bequests, *American Economic Review*, 77, 3, pp. 298–312.
- HURD M. and MCGARRY K. (1995): Evaluation of the Subjective Probabilities of Survival in the Health and Retirement Study, *Journal of Human Resources*, 30, pp. 268–292.
- HURD M. and MCGARRY K. (2002): The Predictive Validity of Subjective Probabilities of Survival, *Economic Journal*, 112, 482, pp. 966–985.
- INKMANN J., LOPES P. and MICHAELIDES A. (2009): How Deep is the Annuity Market Participation Puzzle?, *Central Bank of Cyprus Working Paper No. 2009–5*.

- JAMES E. and SONG X. (2001): Annuities Markets Around the World: Money's Worth and Risk Intermediation, Center for Research on Pensions and Welfare Policies Working Paper No. 16.
- JAMES E. and VITTAS D. (2004): Annuity Markets in Comparative Perspective: Do Consumers Get Their Money's Worth?, World Bank Policy Research Working Paper No. 2493.
- JOHNSON R., BURMAN L. and KOBES D. (2004): Annuitized Wealth at Older Ages: Evidence from the Health and Retirement Study, Final Report to the Employee Benefits Security Administration, US Department of Labor. Washington, DC: The Urban Institute.
- KOTLIKOFF L. and SPIVAK A. (1981): The Family as an Incomplete Annuities Market, *Journal of Political Economy*, 89, 2, pp. 372–391.
- KRENZ S. and NAGL W. (2009): Die Entwicklung der Ansprüche an die Gesetzliche Rentenversicherung bis zum Jahr 2020, ifo Dresden berichtet, 16, 2, pp. 13–23.
- LUSARDI A. and MITCHELL O. (2006): Financial Literacy and Planning: Implications for Retirement Wellbeing, Pension Research Council Working Paper No. 2006–01.
- LUSARDI A. and MITCHELL O. (2007a): Baby Boomer Retirement Security: The Roles of Planning, Financial Literacy, and Housing Wealth, *Journal of Monetary Economics*, 54, 1, pp. 205–224.
- LUSARDI A. and MITCHELL O. (2007b): Financial Literacy and Retirement Preparedness: Evidence and Implications for Financial Education, *Business Economics*, 42, 1, pp. 35–44.
- MCCARTHY D. and MITCHELL O. (forthcoming): International Adverse Selection in Life Insurance and Annuities, in: Tuljapurkar S., Ogawa N. and Gauthier A. (Eds.): *Riding the Age Waves: Responses to Aging in Advanced Industrial States*, Elsevier.
- MITCHELL O., POTERBA J., WARSHAWSKY M. and BROWN J. (1999): New Evidence on the Money's Worth of Individual Annuities, *American Economic Review*, 89, 5, pp. 1299–1318.
- MODIGLIANI F. and BRUMBERG R. (1954): Utility Analysis and the Consumption Function: An Interpretation of Cross-Section Data, in: Kurihara K. (Ed.): *Post-Keynesian Economics*, NJ. Rutgers University Press, pp. 388–436.
- MOTTOLA G. and UTKUS S. (2007): Lump Sum or Annuity? An Analysis of Choice in DB Pension Payout, Vanguard Center for Retirement Research, 30.

- PHILIPSON T. and BECKER G. (1998): Old-Age Longevity and Mortality-Contingent Claims, *Journal of Political Economy*, 106, 3, pp. 551–573.
- PUELZ R. and SNOW A. (1994): Evidence on Adverse Selection: Equilibrium Signaling and Cross-Subsidization in the Insurance Market, *Journal of Political Economy*, 102, pp. 236–257.
- VAN ROOIJ M., LUSARDI A. and ALESSI R. (2007): Financial Literacy and Stock Market Participation, National Bureau of Economic Research Working Paper No. 13565.
- ROTHSCHILD C. (2009): Adverse Selection in Annuity Markets: Evidence from the British Life Annuity Act of 1808, *Journal of Public Economics*, 93, 5-6, pp. 776–784.
- ROTHSCHILD M. and STIGLITZ J. (1976): Equilibrium in Competitive Insurance Markets: An Essay on the Economics of Imperfect Information, *Quarterly Journal of Economics*, 90, 4, pp. 629–649.
- RUBIN D. (1987): *Multiple Imputation for Nonresponse in Surveys*, John Wiley & Sons, New York.
- SALM M. (2006): Can Subjective Mortality Expectations and Stated Preferences Explain Varying Consumption and Saving Behaviors Among the Elderly?, Institut zur Zukunft der Arbeit Discussion Paper No. 2467.
- SCHUNK D. (2007): The German SAVE Survey 2001-2006: Documentation and Methodology, Mannheim Research Institute for the Economics of Aging Discussion Paper No. 109-2006.
- SCHUNK D. (2008): A Markov Chain Monte Carlo Algorithm for Multiple Imputation in Large Surveys, *Advances in Statistical Analysis*, 92, 1, pp. 101–114.
- YAARI M. (1965): Uncertain Lifetime, Life Insurance, and the Theory of the Consumer, *Review of Economic Studies*, 32, 2, pp. 137–150.
- ZIEGELMEYER M. (2009): Documentation of the Logical Imputation Using the Panel Structure of the 2003-2008 German SAVE Survey, Mannheim Research Institute for the Economics of Aging Discussion Paper No. 173-2009.

A Appendix

Derived Variable	Original Variables
PRV	f72m_4_imp
AVSLE	f06s_imp; f10s_imp; f90o1_imp; f90o2_imp; f91o1_imp; f91o2_imp; f91s_imp; f92o1_imp; f92o2_imp; f92s_imp
RISKAV	f59a4_imp; f59a5_imp; f59a6_imp
TIMEPREF	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
NETWEALTHSEQ	f14o_imp; f18o_imp; f68o_imp; f70o_imp; f73eo1_imp; f73eo2_imp; f73eo3_imp; f73eo5_imp; f73eo6_imp; f73eo11_imp; f78o1_imp; f78o2_imp; f78o3_imp; f78o4_imp; f78o5_imp; f82o_imp; f84o_imp
OTHINSEQ	f14o_imp; f18o_imp; f73eo9_imp; f73eo10_imp
AVAGE	f07o_imp; f10s_imp; f11o_imp; year
AVAGESQ	f07o_imp; f10s_imp; f11o_imp; year
NRCHILD	f13o_imp
MARRIED	f09s_imp
PARTNER	f10s_imp
NETINCEQ	f14o_imp; f18o_imp; f54o1_imp; f54o2_imp
EAST	bula

Table 5: Derived variables and their underlying original variables

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

Table 6: Fraction of imputed observations per underlying variable in estimation sample

	Dataset				
	1	2	3	4	5
Reduced model	Number of iterations: 3				
LR chi2(3)	12.89	12.98	12.7	13.65	13.01
Prob > chi2	0.0049	0.0047	0.0053	0.0034	0.0046
Pseudo R2	0.0113	0.0113	0.0111	0.0119	0.0114
Log likelihood	-565.2214	-565.1770	-565.3164	-564.8397	-565.1577
Full model	Number of iterations: 4				
(1)					
LR chi2(15)	108.60	105.78	106.15	107.08	106.49
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.0950	0.0925	0.0928	0.0937	0.0931
Log likelihood	-517.3654	-518.7747	-518.5897	-518.1235	-518.4185
(2)					
LR chi2(15)	106.91	103.98	104.14	105.09	104.56
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.0935	0.0909	0.0911	0.0919	0.0915
Log likelihood	-518.209	-519.677	-519.593	-519.117	-519.385
(3)					
LR chi2(15)	108.71	105.93	106.26	107.33	106.59
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.0951	0.0926	0.0929	0.0939	0.0932
Log likelihood	-517.309	-518.701	-518.536	-517.999	-518.37
(4)					
LR chi2(15)	107.06	104.15	104.28	105.38	104.68
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.0936	0.0911	0.0912	0.0922	0.0916
Log likelihood	-518.135	-519.589	-519.526	-518.973	-519.324
(5)					
LR chi2(15)	108.11	105.26	105.59	106.48	105.96
Prob > chi2	0.0000	0.0000	0.0000	0.0000	0.0000
Pseudo R2	0.0946	0.0921	0.0924	0.0931	0.0927
Log likelihood	-517.608	-519.033	-518.868	-518.426	-518.682

Table 7: Model summaries of probit estimations of the reduced and the five different specifications of the full model for the five imputed datasets

	Reduced Model		(1)			(2)			Full model			(4)			(5)		
	dy/dx	P>z	dy/dx	P>z	dy/dx	dy/dx	P>z	P>z	dy/dx	P>z	P>z	dy/dx	P>z	dy/dx	P>z	P>z	P>z
AVSLE	0.0033**	0.013	0.0028**	0.034	0.0027**	0.041	0.0028**	0.035	0.0027**	0.042	0.0029**	0.032	0.0029**	0.042	0.032	0.032	0.032
RISKAV	0.0058	0.784	0.0076	0.702			0.0075	0.706			0.0072	0.719			0.0072	0.719	0.719
TIMEPREF	-0.0804***	0.002	-0.0409	0.165			-0.0406	0.169			-0.0397	0.180			-0.0397	0.180	0.180
FINLIT			0.0978***	0.000	0.1002***	0.000	0.0968***	0.000	0.0992***	0.000	0.1000***	0.000	0.0992***	0.000	0.1000***	0.000	0.000
CIVSERV			0.1208***	0.010	0.1272***	0.007	0.1219***	0.009	0.1281***	0.006	0.1216***	0.009	0.1281***	0.006	0.1216***	0.009	0.009
WORKER			0.0801***	0.000	0.0842***	0.000	0.0803***	0.000	0.0844***	0.000	0.0816***	0.000	0.0844***	0.000	0.0816***	0.000	0.000
SELFEMPL			0.1850***	0.000	0.1894***	0.000	0.1845***	0.000	0.1889***	0.000	0.1901***	0.000	0.1889***	0.000	0.1901***	0.000	0.000
NETWEALTH			0.0000	0.823	0.0000	0.843	0.0000	0.799	0.0000	0.815	0.0000	0.829	0.0000	0.815	0.0000	0.829	0.829
NETWEALTH			0.0000	0.230	0.0000	0.236	0.0000	0.196	0.0000	0.203	0.0000	0.245	0.0000	0.203	0.0000	0.245	0.245
OTHINSEQ			0.0236***	0.001	0.0238***	0.001	0.0239***	0.001	0.0241***	0.001	0.0239***	0.001	0.0241***	0.001	0.0239***	0.001	0.001
OTHINS			-0.0003***	0.001	-0.0003***	0.001	-0.0003***	0.001	-0.0003***	0.001	-0.0003***	0.000	-0.0003***	0.001	-0.0003***	0.000	0.000
AVAGESQ			-0.0174**	0.047	-0.0178**	0.042	-0.0185**	0.036	-0.0188**	0.031	-0.0165*	0.058	-0.0188**	0.031	-0.0165*	0.058	0.058
NRCHILD			0.0230	0.307	0.0225	0.318	0.0195	0.395	0.0189	0.410			0.0189	0.410			
PARTNER																	
MARRIED																	
NETINCEQ			0.0000	0.287	0.0000	0.272	0.0000	0.283	0.0000	0.262	0.0151	0.490	0.0000	0.262	0.0151	0.490	0.490
NETINC																	
EAST			0.0499**	0.028	0.0496**	0.029	0.0500**	0.028	0.0497**	0.029	0.0500**	0.028	0.0497**	0.029	0.0500**	0.028	0.028

Table 8: Marginal effects at the mean using Rubin's Rule for multiply imputed data for the reduced and five different specifications of the full model;
Note: dependent variable = PPI , sample size $N = 1320$ (non-retired households), * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$