The upcoming gap in German public pensions: How households are prepared to cope with it

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1. Introduction

The German pension system was the first formal pension system in the world, designed by Bismarck nearly 120 years ago. It has been very successful in providing a high and reliable level of retirement income in the past at reasonable contribution rates, becoming a model for many social security systems worldwide. Today, the system is in great financial distress. On the one hand, expenditures have risen as pensions have to be financed for a longer time due to continuous increases in life expectancy and an early retirement age induced by generous early retirement options. On the other hand, revenues have not kept up as younger working cohorts have become smaller, thus accounting for fewer contributors. This situation is projected to deteriorate even further when the baby boom generation will enter retirement around 2015.

A series of parametric reforms in the 1990s attempted to curtail the generosity of the system by imposing stricter retirement options narrowing down the retirement window. More fundamental reform measures were instituted in 2001, 2004 and 2007. Since then, the system has been subject to major changes, converting the once exemplary and monolithic Bismarckian pension insurance system into a complex, sustainable multi- pillar system.

As a consequence of these recent reforms, pension levels in the German public pension system will decline by roughly 20% within the next three decades.[1] Thus, private old age income will become increasingly important for future pensioners in order to close the upcoming pension gap. With the state-subsidized Riester pension the government set an incentive for people to accumulate additional private old age provision. Börsch-Supan and Wilke (2003) showed that the recommended 4% savings rate for younger cohorts will be more than sufficient to close the gap if these contribute to a Riester plan right from the beginning. Based on empirical data, Essig and Reil-Held (2003) also find that a savings rate of 4% of gross wages is sufficient for most households to close the gap.

However, people may as well rely on other income sources in old age. Therefore, in this paper the total wealth situation of households will be analyzed, taking account of all sources of retirement income. The central question here is whether German households are prepared to close the impending pension gap if they continue to save as they do today. As people are likely to adjust their behaviour in response to the latest reforms, this part of the analysis should be regarded as a pure thought experiment.

A second consequence of the latest German pension reforms is the rise in the statutory retirement age from 65 to 67 until 2030. Such a rise in the retirement age can also (at least partly) close the upcoming gap in public pensions. Prolonging retirement entry can lead to higher pension benefits in two respects: (1) longer contribution periods increase the size of future pension claims (both to public and private pension schemes) and (2) shorter pension periods allow for higher annuities in the case of private pension schemes. The central question here is to what extent households have shifted their retirement expectations in response to the latest reforms.

For this analysis, expectations regarding the individual retirement age and life span play a decisive role; both factors determine the volume of assets necessary to finance retirement

[1] See e.g. Börsch-Supan and Wilke (2003) and Börsch-Supan, Reil-Held, and Wilke (2004)

income. Data on such expectations as well as on wealth holdings and savings behavior is provided by the German SAVE survey.

This paper is based on two earlier versions by Börsch-Supan and Essig (2005b) and Börsch-Supan, Essig, and Wilke (2005). It adds several new aspects:

- In contrast to Börsch-Supan and Essig (2005b) and Börsch-Supan, Essig, and Wilke (2005) which both draw on the 2003/2004 wave of the SAVE survey, the analysis in this paper includes the new SAVE waves of 2005, 2006 and 2007. Thus, more information is available on households' reactions to the ongoing pension reform process in Germany. This is important in face of the dynamic development of private old age provision in Germany in the last few years[2].

- Moreover, several pension reforms followed the 2001 and 2004 reforms that constituted the status quo in the two mentioned studies. The increase in the statutory retirement age from 65 to 67 enacted in 2007 is of particular relevance. I will take these new regulations into account.

- The studies by Börsch-Supan and Essig (2005b) and Börsch-Supan, Essig, and Wilke (2005) are conducted solely for households with the male household member serving as the household head in couple households. Thanks to new variables on income shares by household members introduced in the SAVE 2005 wave, the following analysis can be conducted for households and individuals.

The structure of this paper is as follows. Section 2 briefly presents the SAVE data and discusses selected data issues. Section 3 depicts individual expectations of retirement age and life span and looks at whether respondents and their partners have a clear understanding of their individual replacement rate at retirement. Section 4 shows the current income, savings and wealth situation of German households. On the basis of today's income data individual pension claims are extrapolated until the time of retirement for both, respondents and partners, in section 5. A comparison of pre and post reform outcomes gives the size of the individual pension gap. For these projections, I focus on the SAVE RR 2003 and 2007 sample in order to evaluate how the situation has changed between these years. In order to find out whether the gap can be closed, accumulated savings and wealth at retirement are projected for both household members in section 6. Section 7 finally presents the key results and looks at whether the gap can be closed and if not, how large the remaining gap is. These results are first presented for individuals and subsequently aggregated to households. The sensitivity of these results with regard to the underlying capital market rates of return and growth assumptions is shown in section 7.4. Section 8 concludes.

2. The SAVE Data

The German survey SAVE is run by the Mannheim Research Institute for the Economics of Aging (MEA) and was first conducted in 2001. Further waves followed in 2003/2004, 2005, 2006

[2]See also Börsch-Supan, Reil-Held, and Schunk (2007).

and 2007.[3] Waves are conducted on the basis of a so-called Access Panel (TPI)[4] and a Random Route sample (RR)[5]. This paper only draws on the representative RR samples available for the years 2003, 2005, 2006 and 2007[6]. A pooled data set of all TPI and RR samples cannot be used since the two samples significantly differ for some of the crucial variables in this analysis.[7]

Cross-sectional and panel data. SAVE has a panel structure, but the size of the panel is still small due to high attrition between the first waves (70% between the RR 2003 and 2005 samples). For later waves, the retention rate of the SAVE panel is high, however, the time period covered is too small for the purpose of this analysis. Most parts of this paper therefore refer to cross-sections of the respective RR samples. The panel structure is only used occasionally in order to compare findings from the cross-sectional data to the effects if individuals are followed over time.

Relevant SAVE variables. All SAVE samples contain data on expected retirement ages, current wealth, income and savings from which future public pension income and future private old age income can be computed. Missing values are imputed[8]. All values presented in this paper are weighted values according to age and income based on the German microcensus as a representative standard of comparison[9][10]. Detailed questions on subjective life expectancy were included in the questionnaire in 2004 and are thus not available for the 2003 RR sample. This data was imputed in the studies by Börsch-Supan and Essig (2005b) and Börsch-Supan,

[3] See (Börsch-Supan and Essig 2005a) as well as Essig (2005a) for a description and results of the 2001 to 2003/2004 waves and Börsch-Supan, Coppola, Essig, Eymann, and Schunk (2008) for a practical documentation of all waves up to 2007. For detailed methodological descriptions of the SAVE data see Essig (2005b) and Schunk (2006).

[4] The abbreviation is derived from a subsidiary of TNS Infratest, a German test panel institute (TPI), which maintains a permanent panel ("access") from which these sub samples were taken.

[5] The expression Random Route refers to a sampling method where households are selected at random from a given sampling frame with a specific starting point and a specified route. This is a frequently used method for the selection of household samples.

[6] For a structural overview of the various waves and the corresponding sub samples, see appendix A.

[7] A two independent samples t-test on selected variables such as subjective life expectancy and household net income for each of the 2005-2007 RR and TPI samples rejected the null hypothesis of equal means at the 5% level.

[8] As in many surveys, non-response to sensitive questions such as for example financial questions also occurs in SAVE (see e.g. Essig and Winter (2003) for a discussion of this topic). A restriction to complete cases would thus lead to biased inference. In order to prevent this, missing values in SAVE are imputed according to an iterative multiple imputation procedure, see Schunk (2008). In contrast to single imputation, multiple imputation simulates the distribution of the missing data and therefore allows for a more realistic assessment of variances. Based on a Markov-Chain Monte-Carlo method, missing data is replaced by draws from estimates of the conditional distribution of the data. This analysis uses the fully imputed SAVE data.

[9] The microcensus of the German Federal Statistical Office contains the official representative statistics of the German population and labor market, annually surveying 1% of all households in Germany (continuous household sample survey).

[10] There are different types of weights that are provided with the SAVE data. For a detailed description of the design of weights in SAVE, see Schunk (2006).

Essig, and Wilke (2005) on the basis of the 2004 TPI sample. I follow this approach but draw on the most current 2007 sample instead[11].

Household and individual data. SAVE is a household survey. While some variables such as age, expected retirement age or subjective life expectancy are recorded for individuals (respondents and partners) other variables such as wealth, income and savings are recorded for households. Table 26 in appendix A gives an overview of the variables available for individuals and households in the different SAVE waves that are relevant for the analysis in this paper.

For the pension gap computations, individual and household variables need to be combined. Two different approaches can be conducted. Either the pension gap is computed for individuals and household variables must be split into individual variables for respondents and partners according to some rule. Or the gap is computed for households and variables only available for individuals must be assigned to the household according to some rule. I choose the first approach since it is more accurate and allows to aggregate individual pension gaps to a household pension gap afterwards. This approach is possible from 2005 onwards as respondents and partners can now be attributed their share of total household income.[12] For 2003, these income shares are not available. Following the same argumentation as for the subjective life expectancy variables above, I therefore impute these income shares based on the RR 2007 sample. For the individual level computations, household savings are assigned to respondents and partners according to their respective income shares. Wealth variables are split up equally among respondents and partners.

Selected sub sample. For the analysis in this paper, I create a sub data set for each RR sample where I exclude self-employed, freelance professionals, civil-servants and farmers who are not covered by the German public pension insurance. In the case of couple households where only one spouse belongs to this group I compute the gap only for the insured spouse. In addition, single households with respondents below age 40 and couple households with both partners below this age are excluded from the sample. This is done in order to take account of the fact that younger households face considerably higher uncertainties than older households in the sense that they may not yet have finished their professional education, may still be looking for a partner etc. Furthermore, it can be shown that the savings behavior of individuals is very different at younger ages than from age 40 onwards.[13] The basic assumption

[11] As mentioned, the TPI data for some variables is significantly different from the RR sample data and answers on subjective life expectancy questions here turned out considerably higher. From the other available RR 2005, 2006 and 2007 samples it can be seen that variables on subjective life expectancy fluctuate across waves but not greatly and without following a clear trend. Averages across all waves are best reflected in the 2007 data and many of the control variables are also most similar between the 2003 and 2007 waves while the 2005 and 2006 data in many cases show different results as we will see in sections 3 and 4.

[12] See Variables f54o1,2 and f55o1 respectively. Note that the studies by Börsch-Supan and Essig (2005b) and Börsch-Supan, Essig, and Wilke (2005) used the second approach. Calculations for couples were based on the expected retirement age and subjective life expectancy of the male head of household. However, this approach tends to underestimate resulting pension gaps with respect to the length of the retirement period as men retire later and live shorter.

[13] See e.g. Börsch-Supan, Coppola, Essig, Eymann, and Schunk (2008) for an illustration of this effect in the SAVE data. This is actually what we would expect according to the predictions of the life cycle

Table 1 – Expected Individual Retirement Ages in SAVE

		2003	*2005*	*2006*	*2007*
Men	Mean	63.53	63.99	64.62	65.02
	Median	65	65	65	65
	Standard error	0.12	0.14	0.16	0.14
	Observations	692	626	479	442
Women	Mean	62.86	63.65	63.88	64.90
	Median	63	65	65	65
	Standard error	0.13	0.18	0.12	0.16
	Observations	798	763	593	555

Source: SAVE RR 2003 to 2007 cross-sections, reduced as described in section 2. Values are weighted according to age and income.

of this analysis that savings rates will remain stable until retirement thus is not a reasonable one for younger age groups.

3. Retirement Expectations

This section describes individuals' expectations of their retirement period and whether these expectations have changed since 2003. When do people plan to retire? What replacement rate do they expect for their public (and private) pensions? How long do they think they will live? In order to check the validity and consistency of these expectations, the descriptive results from SAVE will be compared to available official data and other surveys.

3.1. Expectations Regarding the Retirement Age

Table 1 shows the expected retirement ages in SAVE for respondents and partners. While the median expected retirement age of men is equal to the statutory retirement age of currently 65 and has remained unchanged between 2003 and 2007, the median expected retirement age of women has jumped from 63 in 2003 to 65 in 2005 and thereafter. This change reflects the increase in the statutory retirement age for women from 63 to 65 in the context of the 1992/1998 reforms. The phase-in of these new regulations only started in 2003 and it seems plausible that women have not yet been aware of it in 2003 but they finally were by 2005.

The average expected retirement age increases constantly from 2003 to 2007 for both, men and women (for women the increase is even a bit higher). This development reflects the current adjustment in retirement entry behavior as a response to the 1992/1998 reforms. However, the rise of the average expected retirement age is significantly higher here than in the official figures that report average retirement ages of 62.9 for 2003 that rise to 63.3 and 63.2 in 2006

theory. Classical life-cycle theory goes back to Modigliani and Brumberg (1954) and Friedman (1957) and derives consumption and saving behavior from a well-defined inter-temporal optimization problem that assumes rational and forward-looking agents who face a deterministic income path and smooth the utility of consumption over their life-cycle.

Table 2 – Expected Individual Retirement Ages in SAVE by Age Group

		< 40	*40 – 49*	*50 – 59*	*60 – 65*	*66 +*
				2003		
Men	Mean	64.15	63.43	63.63	67.03	70.60
	Median	65	65	65	65	71
	Std. error	0.41	0.17	0.20	0.37	0.18
	Observations	20	360	266	94	55
Women	Mean	62.74	62.55	62.58	65.13	69.83
	Median	63	63	63	65	71
	Std. error	0.29	0.17	0.18	0.38	0.42
	Observations	121	357	263	62	30
				2007		
Men	Mean	66.56	65.51	64.25	67.70	70.40
	Median	67	66	65	65	71
	Std. error	0.82	0.19	0.20	0.44	0.23
	Observations	12	233	165	60	57
Women	Mean	65.47	64.75	65.00	64.29	69.88
	Median	65	65	64	65	71
	Std. error	0.33	0.17	0.18	0.33	0.43
	Observations	59	239	193	48	24

Source: SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Values are weighted according to age and income.

for men and women respectively[14]. The quick increase in mean expected retirement ages up to age 65 for both men and women may therefore more likely already reflect a reaction to the intensive reform discussions to further increase the statutory retirement age from 65 to 67. This topic has been present in the media since the reform proposal by the Rürup-Commission in 2003 until the run-up to the 2007 age limit act.

Table 2 shows the expected individual retirement ages in SAVE by age for the RR 2003 and 2007 samples. The median expected individual retirement age for younger men (< age 40) increased from 65 in 2003 to 67 in 2007 while the mean rose by more than two years from 64.15 in 2003 to 66.56 in 2007. The mean value for younger women in 2007 is above 65 (65.47) though the median value remains at this age. Note also, that individuals above age 60 but still working expect a considerably higher retirement age (3 to 4 years) than individuals in their fifties.

3.2. Expectations Regarding the Replacement Rate

In SAVE, respondents and partners are asked about their expected individual replacement rates defined as the ratio of (future) public pension benefits to individual last income from work. Since 2005, a question asks for the size of the expected replacement rate when second

[14]See Deutsche Rentenversicherung Bund (DRV) (2007), p.101.

Table 3 – Expected Individual Replacement Rates in SAVE

		2003	*2005*	*2006*	*2007*
Men					
Repl. rates	Mean	59.72	55.43	56.61	58.52
	Median	60	60	60	60
Repl. rates including private pensions	Mean		68.76	69.76	71.57
	Median		70	70	75
Women					
Repl. rates	Mean	58.04	54.10	54.14	56.06
	Median	60	60	60	60
Repl. rates including private pensions	Mean		64.58	64.65	67.59
	Median		65	60	70

Source: SAVE RR 2003 to 2007 cross-sections, reduced as described in section 2. Values are weighted according to age and income. The number of observations is identical to that displayed in Table 1.

and third pillar pension income is taken into account as well. Table 3 summarizes the results across waves and differentiated by gender.

The mean expected individual replacement rates restricted to public pension income lie between 55% and 60%. For women they are generally one to two percentage points lower than for men. The median values are 60% for both and remain constant across all waves. There is no official data to which these values can be compared to. However, a study by Börsch-Supan and Wilke (2006) based on the Survey of Health, Aging and Retirement in Europe (SHARE) computed replacement rates of around 62% for today's German pensioners. If the respondents in the SAVE survey also consider second and third pillar pension income, mean expected individual replacement rates turn out about 8 to 13 percentage points higher. Börsch-Supan and Wilke (2006) find a smaller increase by around 6 to 7 percentage points if private pension income is included in the replacement rate computations. However, their study is based on data of today's pensioners and the importance of second and third pillar pensions is going to increase for future pensioners[15]. We will see later in section 5 which replacement rates individuals in SAVE could achieve if they continued to save as they do today.

Moreover, note that expected individual replacement rates restricted to public pension income in SAVE have increased continuously since 2005, though not up to 2003 levels. This trend can also be observed for the 2005-2007 panel data. One explanation could be that people's awareness about the financial distress of the German public pension system increased during the extensive reform discussions in 2003, but that since 2005 they gained confidence in the stabilizing effect of the implemented reforms. Another explanation could be that people expect higher replacement rates in accordance with their higher anticipated retirement ages. But simple linear regressions of the expected replacement rate using expected retirement age as explanatory variable turn out insignificant for all waves. Correlation of the two variables is less than 5%.

[15]Note also that income categories from SHARE and SAVE are only partly comparable. On the importance of underlying income concepts for replacement rate computations, see also Hurd and Rohwedder (2006).

Replacement rates including private pensions have increased even stronger than the public pension replacement rate since 2005. Here, the trend is also reflected in the medians. This corresponds to results by Börsch-Supan, Reil-Held, and Schunk (2007) and Coppola (2008) who report an increase in private pension provision over the past few years in the SAVE data. Whether the increase in private pension provision translates into higher savings in general will be shown in section 4(for our restricted sub sample of the data).

3.3. Expectations Regarding Subjective Life Expectancy

Subjective life expectancy is a key component of the computations in this paper. If individuals underestimate their subjective life expectancy, they will save too little, if they overestimate their life expectancy they will save too much and leave unwanted bequests for their children.

In the literature, most studies use age-specific average values from the official mortality tables instead of subjective life expectancy measures. There are two objections to this approach. First, mortality tables based on historical values, owing to their design, respond only slowly to environmental changes such as medical achievements that may allow for prolonged, healthier lives. Individuals, however, may already consider recent developments if these have been taken up by the media. Second, average values do not reflect individual differences e.g. between healthy and ill or optimistic and pessimistic individuals. Subjective life expectancy accounts for these individual differences and thus can better explain individual behavior than average values.[16]

3.3.1. Asking for Expectations on Average and Subjective Life Expectancy

Subjective life expectancy in SAVE is asked for in a multi-phase process in order to avoid a direct question on personal death:

- The first question asked is to what age the respondents believed men and women in the same cohort lived on average (*average life expectancy*).
- The next question is whether the respondents believed they themselves would live longer or shorter than their cohorts' average, followed by the request to express this difference in years (*personal life expectancy*).
- Respondents were then presented with three possible explanations for why they thought they would live longer or shorter lives than the average.[17] This question ensures validity of the previous answers.

The interview procedure is repeated in the same way with the respondent's partner. The subjective life expectancy measure for the computations in this paper is derived for both respondent and partner from the stated average life expectancy[18] plus the difference in years

[16] See also Hurd and McGarry (1997) for a discussion of the predictive validity of subjective survival probabilities.
[17] A fourth option was an open field in which other reasons could be entered.
[18] A flaw is that the question on average life expectancy is only asked to the respondent (though for men and women) and thus only refers to the respondent's cohort but also serves as the basis for the computation of

Table 4 – Expected Average Life Expectancy in SAVE

		2003	*2005*	*2006*	*2007*
	Observations	–	885	668	639
Men	Mean	–	76.13	75.17	76.66
	Median	–	75	75	76
	Standard error	–	0.18	0.21	0.21
	Mortality tables	75.59[1)]	76.64[2)]		–
	Dynamic life expectancy[3)]	81.23	81.59	81.68	81.81
Women	Mean	–	80.62	79.97	80.94
	Median	–	80	80	80
	Standard error	–	0.19	0.22	0.21
	Mortality tables	81.34[1)]	82.08[2)]		–
	Dynamic life expectancy[3)]	87.17	87.43	87.50	87.60

[1)] German official mortality tables 2001/2003 (www.destatis.de): Life expectancy at birth.
[2)] German official mortality tables 2004/2006 (www.destatis.de): Life expectancy at birth.
[3)] Only mean values, based on life expectancy data of the Rürup Commission applied to the SAVE data (Kommission für die Nachhaltigkeit in der Finanzierung der Sozialen Sicherungssysteme (2003)).
Source: SAVE RR 2005 to 2007 cross-sections, reduced as described in section 2. For the RR 2003 sample, detailed questions on life expectancy were not yet included. Values are weighted according to age and income. The number of observations is identical to that displayed in Table 1.

between this average age and the age to which the respondent or partner, respectively, expects to live.

3.3.2. Expected Average Life Expectancy

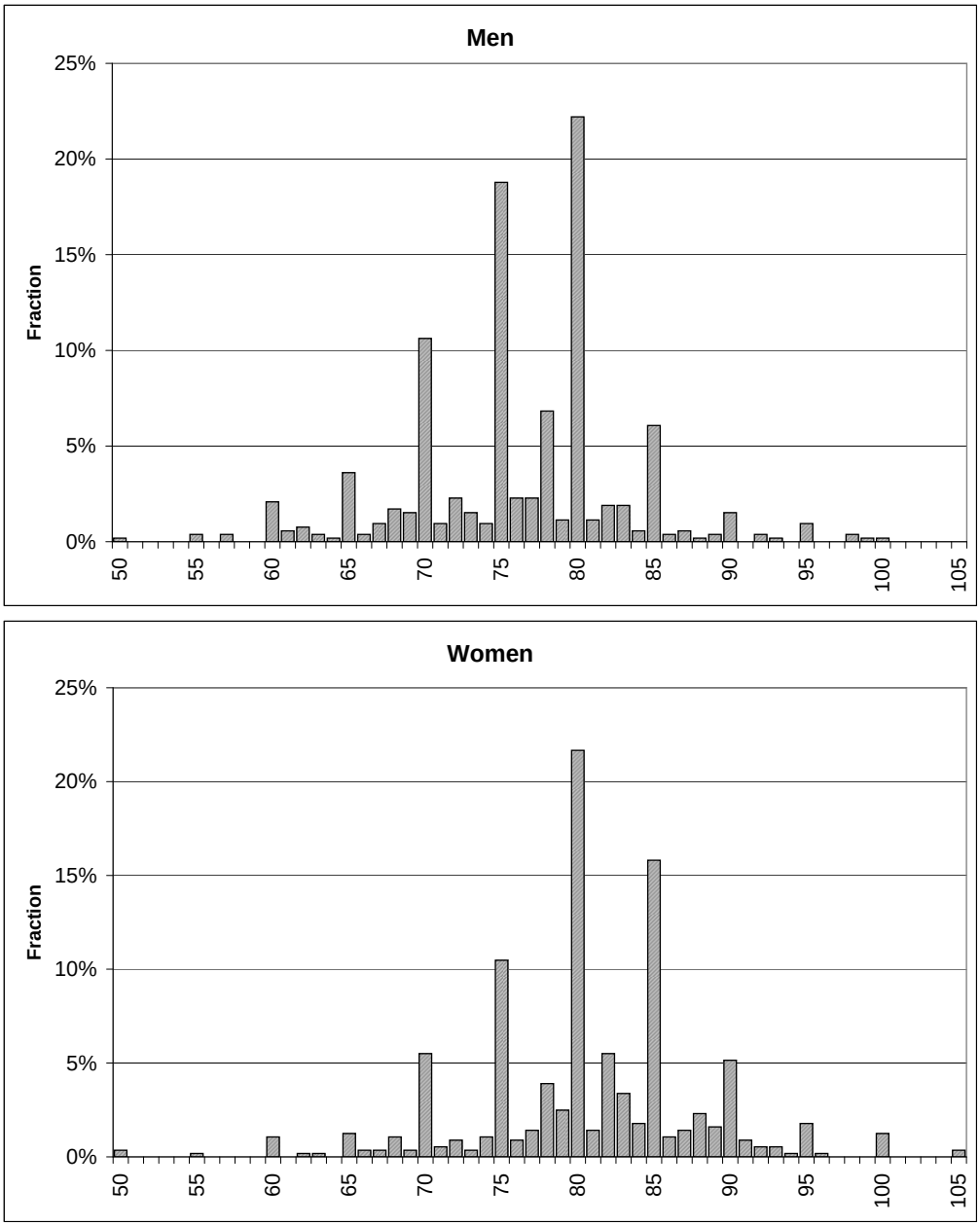
Figure 1 shows the distribution of estimated average life expectancies by respondents for the RR 2007 sample.

It can be seen that most of the responses are concentrated around so-called focal points between age 70 and 90. For women, the distribution is shifted rightwards. The modal value is 80 in both distributions, however. This pattern can also be perceived for the RR 2005 and 2006 samples. Table 4 summarizes the means, medians, standard errors and number of observations for these three RR samples.

The means for average life expectancies lie between 75 and 77 years for men and 80 and 81 years for women with the medians at the lower bounds of these bands. Note that there is no clear (upward) trend perceivable over the years. RR 2005-2007 panel data gives the same results.

the subjective life expectancy of the partner. However, as the average age difference between partners in SAVE is around 3 years only, this should not have any considerable effects on the result. I will show later in this section that the life expectancy statements hardly vary over the four waves in our sample and do not show a clear (upward) trend. Moreover, an additional question on the expected average life expectancy of the partner may be confusing.

Figure 1 – Expected Average Life Expectancy in SAVE



Source: SAVE RR 2007 cross-section, reduced as described in section 2. Values are weighted according to age and income.

If compared to the 2004/2006 official mortality tables by the Federal Statistical Office, the mean values in SAVE are surprisingly close. This is important: it means that individuals have a good picture of the static currently promoted life expectancy. For men, the 2007 mean is almost identical to the official value, for women it is approximately one year lower. From the psychological and actuarial literature it is known that women tend to underestimate while men tend to overestimate their average life expectancy[19]. This effect can be found here only for women. However, if one re-adds the younger households below age 40 that have been dropped for the purpose of this analysis, the effect can be found for men, too. In each case, the difference in life expectancy between men and women is underestimated. For the RR 2007 sample the difference is 4.28 years, 1.16 years less than the difference in the official mortality tables which is 5.44 years.

However, the official mortality tables are only valid for past and present. So-called dynamic life expectancy calculations also account for future developments such as medical progress. Such computations have been used by the Rürup Commission for its demographic scenario[20]. The last line of Table 4 shows the resulting average life expectancies if this approach is applied to the individuals in our SAVE samples. It can be seen that this leads to an almost six years higher average life expectancy than in the SAVE data.

3.3.3. Expected Subjective Life Expectancy

We now want to see what individuals assume about their own life expectancy. Table 5 shows the subjective life expectancy estimates for both respondents and partners in the RR 2003, 2005, 2006 and 2007 samples. Note that the values for 2003 are imputed values, they are displayed for comparison.[21] As with the average life expectancy, an upward trend across years 2005-2007 cannot be found here. Again, this is the same when looking at the panel data. It seems that three years are not enough in order to thoroughly capture changes in subjective life expectancy. However, it has been shown by Börsch-Supan and Essig (2005b) for the 2001 to 2003/2004 waves in SAVE that expectations of life expectancy are rather stable over time.

An analysis of the development of life expectancy over age reveals a tendency towards a u-shaped form (see Table 6): younger persons (below age 40) anticipate a longer life span than middle-aged or older persons, while older persons have a higher subjective life expectancy than middle-aged persons. This u-shaped curve is due to the interaction of two opposing effects. On the one hand, the remaining life expectancy for a given cohort rises with age. A person aged 60 has already survived a number of risks which a person aged 50 still faces in the following ten years. This explains the high life expectancy values for the older persons. On the other hand, younger cohorts have a higher life expectancy than older cohorts thanks to the hygienic and medical achievements. This explains the higher individual life expectancy of the very young.

[19] See e.g. Society of Actuaries (2006).

[20] See Kommission für die Nachhaltigkeit in der Finanzierung der Sozialen Sicherungssysteme (2003) for an overview of the demographic assumptions. See Statistisches Bundesamt (2006a) for the original German report and Statistisches Bundesamt (2006b) for an English summary.

[21] Selected aspects of the imputation will be described below.

Table 5 – Expected Subjective Life Expectancy in SAVE

		2003	*2005*	*2006*	*2007*
Men	Mean	76.92	76.80	74.66	76.31
	Median	77	76	75	76
	Standard error	0.11	0.27	0.32	0.32
	Observations	795	757	571	527
Women	Mean	80.79	80.96	79.40	80.68
	Median	81	80	80	80
	Standard error	0.12	0.26	0.31	0.32
	Observations	833	788	604	563

Source: SAVE RR 2003 to 2007 cross-sections, reduced as described in section 2. Values are weighted according to age and income.

The official mortality tables only account for the first effect but neglect the second. Therefore, life expectancy in mortality tables increases monotonously with age, see Table 6. Dynamic life expectancy computations such as those by the Rürup Commission consider both effects. This second effect is stronger than the first and results in a continuous rise in life expectancy from cohort to cohort, so that younger persons experience a higher life expectancy than older ones, see again Table 6.

While the past-driven official mortality tables provide a bad estimate for the life expectancy of younger people, they are good approximations for older people. Compared to these, older persons aged 60+ in SAVE underestimate their life expectancy by more than five years. Similarly, younger persons below age 40, whose life expectancy is more adequately reflected in the Rürup Commission's dynamic life expectancy tables, underestimate their life expectancy (men by about 3 years, women by 8 years in the RR 2007 sample). This underestimation of individual life-spans can lead to serious problems when estimating the necessary accumulation of wealth to finance retirement income. This will be shown in section 7.

3.3.4. Imputing Subjective Life Expectancy for the RR 2003 sample

As explained in section 2, subjective life expectancy for the RR 2003 sample is imputed based on the RR 2007 sample. This is done by regressing subjective life expectancy on a large set of explanatory variables that reflect observable individual and household characteristics. The multivariate regressions are done separately for respondents and partners but on the household level so that household composition is preserved. The estimated coefficients of these regressions are then used for the same set of independent variables in the RR 2003 sample in order to predict subjective life expectancy in 2003. This prediction can only be made if the regressions show a high explanatory power. In the following, I will show that this is the case. The detailed regression tables are displayed in appendix B.

The set of explanatory variables contains possible determinants of subjective life expectancy such as age, gender, income, education and occupational variables, current or previous smoking behavior, current health and health expectations as well as softer variables such as optimism,

Table 6 – Expected Subjective Life Expectancy in SAVE by Age Group

		< 40	*40 – 59*	*59 – 59*	*60 +*
			2003		
Men	Mean	76.35	75.89	76.72	79.51
	Median	77	76	77	79
	Std. error	0.29	0.20	0.09	0.28
	Observations	20	360	266	149
	Mortality tables 2000/2002[1)]	76.66	77.33	78.64	83.81
	Dynamic life expectancy[2)]	82.17	82.14	81.7	80.11
Women	Mean	80.35	80.21	80.97	82.78
	Median	81	81	81	83
	Std. error	0.50	0.16	0.17	0.27
	Observations	121	357	263	92
	Mortality tables 2000/2002[1)]	82.03	82.42	83.22	87.06
	Dynamic life expectancy[2)]	88.01	87.98	87.61	85.95
			2007		
Men	Mean	80.32	75.87	75.17	78.87
	Median	80	75	75	80
	Std. error	1.30	0.52	0.50	0.57
	Observations	12	233	165	117
	Mortality tables 2004/2006[1)]	77.31	78.32	79.56	84.62
	Dynamic life expectancy[2)]	83.29	82.58	81.50	80.80
Women	Mean	80.43	80.33	81.03	81.40
	Median	80	80	80	83
	Std. error	1.11	0.51	0.54	0.81
	Observations	59	239	193	72
	Mortality tables 2004/2006[1)]	82.53	83.13	83.88	87.59
	Dynamic life expectancy[2)]	88.75	88.37	87.41	86.70

[1)] German Federal Statistical Office (www.destatis.de).

[2)] Kommission für die Nachhaltigkeit in der Finanzierung der Sozialen Sicherungssysteme (2003).

Source: SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Values are weighted according to age and income.

pessimism and satisfaction with lifestyle. In addition, the various reasons respondents could give for why they believe that they themselves or their partner would live shorter or longer than the average of their cohort are included in the regressions. Since the respondent answers these questions also on behalf of his partner, selected respondent variables are also included in the partner regression as they may affect answers.

The gender and age effects that reflect the mere biological differences are significant in both regressions. Women clearly have a higher subjective life expectancy than men, even more so in the partner regression (3.0 vs. 5.4 years). The negative age and positive age squared effects reflect the u-shaped pattern explained in section 3. Household income variables are

only significant for the partner regression and show the expected inverted u-shape pattern. Education variables turn out insignificant in both regressions. This seems to contradict the results by Von Gaudecker (2004) who finds that the effect of socioeconomic status on mortality is considerably strengthened by the level of educational attainment. The study, however, refers to actual and not subjective mortality. The significant negative effects of unemployment and part-time employment in the partner regression go into a similar direction. The expectations regarding future health are significant in the respondent regression. The effect of self-assessed contentedness with life style is significant: the higher this value (on a scale from 0 to 10), the higher the subjective life expectancy. Among the eight dummy variables offering possible explanations for shorter or longer life expectancy respectively (sickness, habits, early or late death of family members and other) six turn out to be significant. Only the effect of today's health situation on longer subjective life expectancy remains insignificant in both regressions. In summary, the variables very effectively map subjective life expectancy as the R^2 of 0.54 for the respondent and 0.49 for the partner regression show.

3.3.5. Expected Length of the Retirement Period

The expected retirement age and the expectations on subjective life expectancy jointly determine the expected length of the retirement period. For women it is on average 17.5 years and for men 12.5 years long. This is unrealistically short. Taking the dynamic life expectancy computations by the Rürup Commission, the expected retirement period increases to 24.2 years for women and 17.4 years for men - assuming the same expected retirement ages. The male respondents thus underestimate their pension period by up to almost 5 years whereas women underestimate their pension period by even more than 6 years. This translates into an underestimation of provision by roughly 40% for men and women.

4. Current Income, Savings and Wealth

This section describes the current income, savings and wealth situation of households for the RR 2003 to 2007 samples. Note that while in the previous section we analyzed individuals in SAVE, we will now deal with household data and only occasionally look at individuals.

4.1. Current Income and Savings

Data on income and savings is collected on a household level in SAVE. However, income shares are available for respondents and partners since the 2005 wave. In the following, we will therefore split up household income and savings also on an individual level.

Table 7 – Household Income and Savings in SAVE

	Household		
	Income	*Savings*	*Savings rates*
		2003	
Mean	2,985	278.87	10.11%
Median	2,000	83.33	3.85%
Std. error	186.39	19.87	0.66%
Observations	907	907	907
		2007	
Mean	2,363	262.53	8.42%
Median	2,000	41.67	2.45%
Std. error	63.98	30.84	0.80%
Observations	639	639	639

Source: SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Monthly values, ppp-adjusted in constant 2003 euros and weighted according to age and income.

4.1.1. Household Income and Savings

Household income in SAVE is average monthly net household income of the previous year[22]. Savings are annual household savings of the previous year[23]. Table 7 shows *monthly* values of household net income and absolute savings as well as the savings rate for the RR 2003 and 2007 cross-sections.

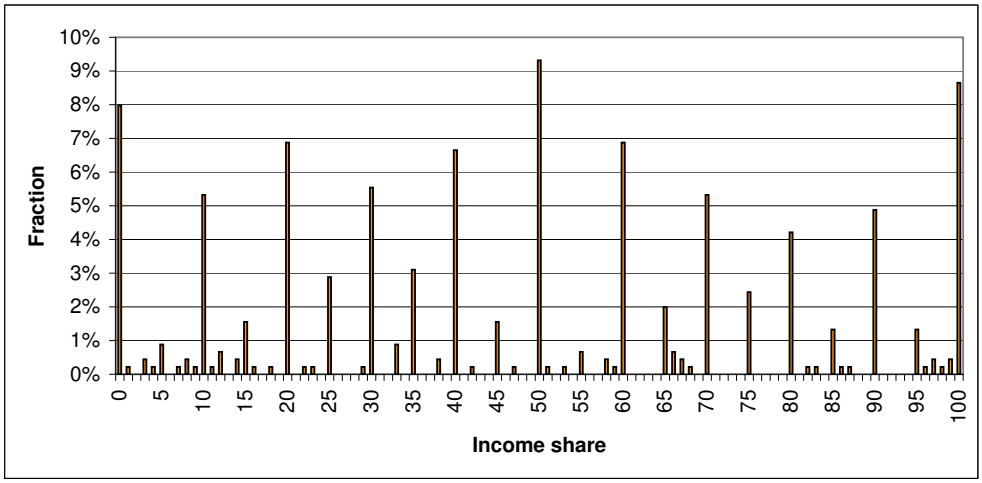
The mean monthly household income in our samples is between 2,400 and 3,000 euros with the medians being lower. Household savings are on average between 260 and 280 euros and resulting savings rates are between 8% and 10%. However, as it has been pointed out by Essig (2005c) and Coppola (2008), SAVE respondents do not seem to perceive certain forms of savings as savings and therefore might forget to include them in their answer. The values displayed in Table 7 thus might underestimate the true rates. For the analysis in this paper, this is critical at least in two respects. First, occupational pensions claims are likely to be underreported in SAVE as in all other household surveys. This applies in particular to employer-financed occupational pension claims that, in Germany, are often not transparent. Second, coverage rates of state-subsidized Riester pensions in SAVE on average are lower than the official reported figures probably due to comparably high non-response. In addition, there is some evidence that the subsidies itself are not reported correctly by many respondents in SAVE[24]. This must be kept in mind.

[22] The (translated) wording of the question is: "If you now add it all up: How high is the net income after taxes and social security contributions that you and your partner have received out of all these sources in the year ... on average per month?" The previous question contains a detailed list of possible income resources.

[23] The (translated) wording of the question is: "Could you tell us how much money you and your partner have saved in total in the year ...?" The answered amount is referred to as gross savings. Net savings are derived by subtracting household's net borrowing (loans minus repaid debt). For the analysis in this paper, gross savings are used.

[24] See Börsch-Supan, Reil-Held, and Schunk (2007) for a comparison.

Figure 2 – Income Share of Respondents in the RR 2007 Sample



Source: SAVE RR 2007 cross-section, reduced as described in section 2. Values are weighted according to age and income. Note that only couple households are included.

Over time, it can be seen that household income as well as savings on average are higher for the 2003 than for the 2007 sample. The same applies to savings rates. Looking at the RR 2003-2007 panel data gives the same results.

4.1.2. Splitting Household Income and Savings into Individual Income and Savings

Figure 2 first shows the distribution of respondents' answers on how large their share of household income is for the RR 2007 sample. The largest fraction of respondents claims 50%, followed by 100% and then 0%. In between, answers mainly state the focal points. Overall, it becomes obvious that the respondent in SAVE not necessarily earns the highest income in the household - on the contrary, the distribution is surprisingly well spread.

Imputing income shares for the RR 2003 sample. As mentioned in section 2, income shares for the RR 2003 sample are imputed on the basis of the RR 2007 sample. The same method as explained above for subjective life expectancy imputations is applied. The regression is run for the respondent only (as the partner's share can be directly computed from the respondent's) but contains also educational and occupational variables of the partner as explanatory variables. For details, consult the regression table in appendix B. Women have lower income shares than men. In East Germany, income shares of the respondents are significantly higher which may be explained by more single-earner households due to high unemployment. Education is highly significant: high education of the respondent (university degree) positively affects the income share while a high education of the partner (high school degree) affects the share negatively. Somewhat striking is the effect that minimum and part-time work significantly increase the share while part-time employment of the partner negatively affects the share. The dummy variables for being a housewife, a pensioner or unemployed however turn out significant and

Table 8 – Individual Income and Savings in SAVE

	Individual		
	Income	*Savings*	*Savings rates*
		2003	
Mean	1677	156.73	10.38%
Median	1133	41.27	4.63%
Std. error	105.12	9.18	0.49%
Observations	1608	1608	1608
		2007	
Mean	1379	153.08	9.17%
Median	1087	12.5	3.33%
Std. error	39.1	14.28	0.67%
Observations	1012	1012	1012

Source: SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Monthly values, ppp-adjusted in constant 2003 euros and weighted according to age and income.

show the correct signs. Altogether, the variables sufficiently map the respondent's income share ($R^2 = 0.62$).

Individual income and savings. From these income shares individual income is computed. Individual savings are derived by assuming that individuals contribute to household savings in the same proportions as they contribute to household income. Individual income, savings and savings rates are displayed in Table 8. Mean monthly individual income in our samples turns out between 1,400 and 1,600 euros, individual savings are on average around 150 euros and savings rates lie between 9% and 10%. As for households, the values for 2007 on average are lower than for the RR 2003 sample.

Table 9 summarizes individual savings rates according to income quintiles. As expected, savings rates are lowest for the bottom and highest for the top quintiles. This means that, even though public pension gaps are proportional to income (as we will understand in the next section), individuals with higher income are better prepared to close their (higher) gaps than lower income individuals are prepared to close their (lower) gaps. Note that total individual savings rates both for the RR 2003 and the RR 2007 sample are slightly lower than the rates at the household level. This reflects the slightly higher savings rates of couple households.

Table 10 shows individual savings rates across age groups. The savings rates increase in the RR 2003 sample from around 7.8% for men below age 40 to 13.39% for men aged 60 and older. For women, the same pattern can be observed. This picture changes in the RR 2007 sample. Here, savings rates for younger individuals below 40 turn out surprisingly high, above 10%. This could already reflect an increased awareness of the need to save among younger age groups compared to 2003. Note, however, that the number of observations here is small due to our sample restrictions. In contrast, older individuals from age 50 on record lower savings rates compared to the RR 2003 sample.

Table 9 – Individual Savings Rates in SAVE by Income Quintile

	Total	*1st Q*	*2nd Q*	*3rd Q*	*4th Q*	*5th Q*
			2003			
Mean	10.4%	8.6%	9.6%	9.4%	10.9%	13.5%
Median	4.6%	0.0%	0.0%	4.9%	6.3%	8.3%
Std. error	0.49%	0.97%	1.17%	0.84%	1.20%	1.23%
Observations	1608	305	326	330	322	325
			2007			
Mean	9.2%	6.1%	8.0%	6.8%	12.3%	11.6%
Median	3.3%	0.0%	1.6%	1.0%	4.6%	5.7%
Std. error	0.67%	1.07%	1.08%	0.88%	2.22%	1.57%
Observations	1012	148	216	212	218	218

[1)] Imputed values, see appendix B.
Q = Quintile
Source: SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Values are weighted according to age and income.

Table 10 – Computed Individual Savings Rates in SAVE by Age

		Total	*<40*	*40–49*	*50–59*	*60 +*
				2003[1]		
Men	Mean	10.43%	7.82%	8.35%	11.49%	13.39%
	Median	5.00%	0.00%	3.76%	5.59%	7.40%
	Std. error	0.67%	4.28%	0.62%	1.52%	1.60%
	Observations	790	20	356	266	148
Women	Mean	10.33%	7.48%	9.01%	11.50%	14.77%
	Median	4.38%	3.00%	4.62%	4.90%	4.92%
	Std. error	0.71%	1.03%	0.71%	1.25%	4.11%
	Observations	818	118	351	257	92
				2007		
Men	Mean	9.54%	10.41%	8.64%	9.52%	11.86%
	Median	3.96%	7.25%	3.33%	3.70%	5.55%
	Std. error	0.96%	3.18%	1.16%	1.97%	2.59%
	Observations	508	12	228	155	113
Women	Mean	8.80%	10.55%	8.90%	8.36%	7.96%
	Median	2.87%	4.20%	2.38%	2.00%	4.71%
	Std. error	0.96%	3.09%	1.57%	1.59%	1.45%
	Observations	504	47	217	177	63

[1)] Imputed values, see appendix B.
Source: SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Values are weighted according to age and income.

4.2. Current Wealth

The current wealth situation of households is depicted in Table 11 which shows the values of households' financial, housing (owner-occupied and other real estate), business and other

wealth, their outstanding debt and the resulting total net worth.

Housing assets are by far the largest fraction of households assets with means between 13,000 and 160,000 euros over the years. However, this results from the high value of residential property of those households owning houses. From the size of the medians can be concluded that a large share of households do not own any residential property at all. For 2007 this share is 45.28%, for 2003 it is 47.14%. Conditional means (only positive values are taken into account) are a lot higher and for some years almost double.

Financial assets make up the second largest asset category for the households in our sample. Means are around 40,000 euros. Here, less than a quarter of the households have zero financial assets and medians are thus clearly above zero for all waves. Around 5% of the households own business and approximately 10% own other asset types. Note that conditional means for business asset holdings are even larger than the corresponding values for housing assets. The (unconditional) means for any outstanding debt stretch from 7,000 in 2003 to 11,000 euros in 2007. Note that mortgages are not included here. Between half and two-thirds of the households have no debt at all so that medians are zero and conditional means more than double.

The resulting total net worth is between 160,000 to 220,000 euros. Just 10% of the households in our samples have a negative net worth and a further 10% have zero net worth. The remaining 80% of households have mean values for net worth from 200,000 to 270,000 euros across the two waves.

Altogether, the wealth situation of households varies (partly significantly) between 2003 and 2007, however, no upward trend in wealth holdings can be perceived. On the contrary: households in 2003 on average held more assets than in 2007.

Finally, the fact that housing assets make up the largest share of households' assets is problematic regarding the household's asset position upon entering retirement. Residential property is seldom divisible. It is of course possible to sell one's property and to reshuffle one's assets by converting real estate into financial wealth. However, this also entails a substantial increase in the household's consumption expenditure in the form of rental payments for alternative rented property. The subsequent projections will thus focus on (net) financial wealth. Housing as well as business assets are mentioned only briefly.

5. Projected Pension Claims and the Size of the Gap

This section describes individual pension benefit claims from the public pension system before the 2001 Riester reform and after the subsequent pension reforms that will lead to a stepwise reduction in pension levels causing the so-called pension gap. For the RR 2003 sample, the projections refer to the status quo after the 2004 but before the 2007 reform. For the RR 2007 sample, projections refer to the current status quo after the 2007 reform. I compare the results for the two samples in order to show how

- the projected size of the pension gap,
- the income and wealth situation of individuals and households and their savings behavior as well as

Table 11 – Current Wealth in SAVE

		Gross financial wealth	*Real wealth*			*Outstanding debt*	*Total net worth*
			Housing assets	*Business assets*	*Other assets*		
				2003			
Uncond. values	*Mean*	40,869	161,455	16,849	3,816	7,130	215,859
	Median	16,186	50,000	0	0	0	75,000
Cond. values	*Mean*	52,926	305,467	322.679	40,750	29,202	266,478
	Median	26,872	214,865	100,000	15,000	12,926	150,000
				2007			
Uncond. values	*Mean*	37,176	127,499	7,447	1,194	10,608	162,708
	Median	14,200	60,000	0	0	0	76,000
Cond. values	*Mean*	46,486	233,002	162,460	13,695	30,547	201,493
	Median	22,500	185,000	50,000	10,000	15,968	135,688

Source: SAVE RR 2003 to 2007 cross-sections, reduced as described in section 2. Values are ppp-adjusted in constant 2003 euros and weighted according to age and income.

- their expectations on the retirement period (mainly the expected retirement age)

have changed since 2003 and how this will affect individuals' and households' capability to close the gap. In the following it will first be explained how pension claims are derived for each individual before the individual gap is computed in section 7.

5.1. Future Pension Claims

Individual pension benefits are computed on the basis of the following formula:

$$P_{i,t} = EP_i \times AF_{RA,c} \times PV_t \tag{1}$$

with $P_{i,t}$ ... pension of individual i at time t,
EP_i ... sum of accumulated earnings points of individual i,
$AF_{RA,c}$ ... pension adjustment factor depending on retirement age r and cohort c to which individual i belongs,
PV_t ... current pension value at time t.

Pre and post reform computations for the 2003 and 2007 samples differ in two regards:

1. The value of the pension adjustment factor $AF_{RA,c}$ changes. In the pre-reform and 2003 post-reform computations it does not depend on the birth cohort. The factor is smaller (larger) than one, if retirement starts before or after the current statutory retirement age of 65. In the post-reform computations for the RR 2007 sample it accounts for the increase in the statutory retirement age from 65 to 67: Thus the factor's reference point is shifted and the factor additionally depends on the birth cohort as changes are phased-in slowly (starting with the 1947 cohort) and therefore affect different cohorts differently.

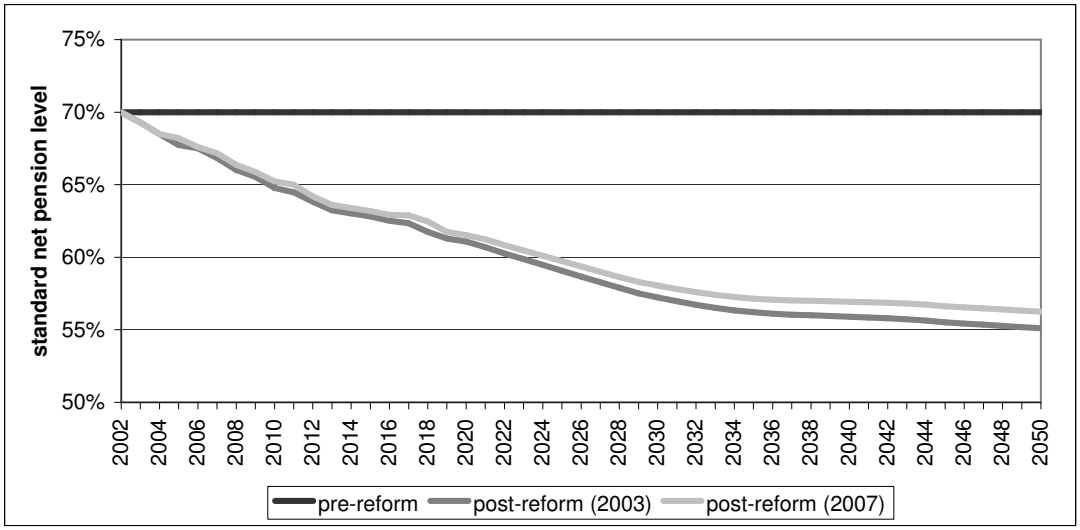
2. The current pension value PV_t changes over time according to the pre- and post-reform projections which are summarized below.

5.1.1. Projected Development of Public Pension Levels

The pension level describes the development of the current pension value PV_t in relative terms. It is defined as the ratio of the standard pension[25] to average wages. This analysis will be restricted to net pension levels[26] since the SAVE data provides *net* household income.[27] Effects of the introduction of deferred taxation will be neglected. Instead I implicitly assume that tax savings during the contribution period equal tax expenses during the pension period. Thus, the pension gap for households that use their tax savings in order to build up additional old age provision is overestimated, while the pension gap for households that use their tax savings for

[25] A standard pensioner is a person with 45 earnings points and an adjustment factor equal to one.
[26] See appendix **??** for an overview of the various German pension level concepts.
[27] Note that a similar development as for net pension levels is projected for gross pension levels. It can be found that net pension levels shrink slightly less than gross pension levels. Therefore, the pension gap is underestimated.

Figure 3 – Projected Development of Net Pension Levels



Source: Author's computations.

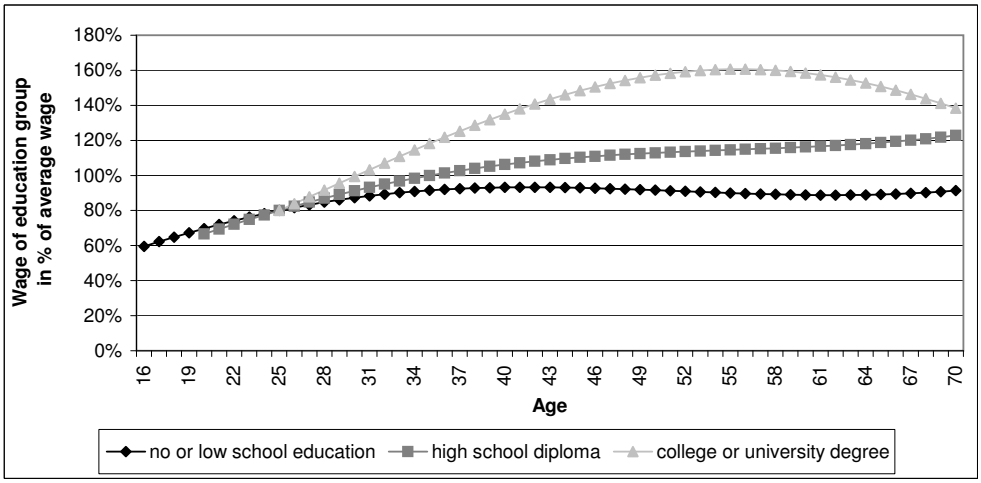
immediate consumption is underestimated. Note also, that the SAVE data only provides total household income. In the following, this is assumed to be equal to wage income. For households in SAVE that report additional income sources, the pension gap thus is overestimated.

Figure 3 depicts the development of net pension levels before and after the reforms. Net pension levels would have remained at 70% before the reforms. After the reforms, the 2001 Riester component and the 2004 sustainability factor lead to a reduction in future pension levels. This reduction is greater for the 2003 than for the 2007 sample computations because of the increase in the statutory retirement age that leads to higher revenues and lower expenditures for the German pension insurance in the mid-term.[28]

The pension gap is the difference between the pre-reform and the respective post-reform graph. It applies to all households proportional to their income and according to their annual social security contributions. This gap will be 8.6 PP in 2020, 12.8 PP or 12.1 PP for the 2003 and 2007 post-reform scenarios in 2030, 14.1 PP or 13.3 PP for the 2003 and 2007 post-reform scenarios in 2040 and 14.9 PP or 13.9 PP for the 2003 and 2007 post-reform scenarios in 2050. This means that net pension levels in 2040 will be up to 20% lower than pre-reform pension levels. However, note that the smaller gap after the 2007 reform only applies if people adjust their behavior such that they still reach the same amount of (adjusted) earnings points despite the shift in the adjustment factors.

[28] Note that the 2003 post-reform development of net pension levels depicted in Figure 3 is approximately 2 percentage points lower (in 2050) than the net pension level development presented in Börsch-Supan, Essig, and Wilke (2005). The reason is that the projections in this book are based on updated assumptions regarding the development of other social security contributions and account for institutional changes in this field since 2003. Here all projections are based on identical assumptions to focus on the changes in pension regulations which are of primary interest here.

Figure 4 – Wage Profiles for Germany by Education Groups



Source: Author's computations based on estimations by Fitzenberger, Hujer, McCurdy, and Schnabel (2001).

5.1.2. Projected Earnings Points

The projected sum of earnings points for each individual at retirement entry depends on (a) the total number of contribution years and (b) the respective individual income in each of these years.

Number of contribution years. The total number of contribution years is derived from the difference between the individual expected retirement age provided in the SAVE data (see section 3) and an estimate of the individual labor entry age according to school education. I define an entry age of 16 years for individuals with no school certificate at all or a certificate from the lowest and middle German school types (*Hauptschule* and *Realschule*), an entry age of 20 for those who attained a high school degree and 25 for college or university graduates. In addition, the sum of contribution years is reduced by one if the individual has been unemployed for a period longer than six months.[29]

Annual individual income. The annual individual income for all years is derived from estimated wage profiles for Germany by Fitzenberger, Hujer, McCurdy, and Schnabel (2001). Using their estimation results, I create three wage profiles that correspond to the above defined education groups. They are depicted in Figure 4.

[29] This is a simplification that tries to capture that in Germany, the labor offices in fact continue to pay public pension contributions for their unemployed members. However, these contributions are based on only 80% of the last net pay and do not go on endlessly. Given that an unemployment period of more than six months is a passable indicator for a long-time unemployed person, the deduction of a whole year at least partly captures the longer absence from work.

These wage profiles describe the relative earnings position of individuals of a specific age and education group in relation to the German average gross wage in the same year:

$$WP_{ed,a} = \frac{AGW_{ed,a}}{\sum_{a}\sum_{ed} AGW_{ed,a}} \tag{2}$$

with $WP_{ed,a}$ ... wage profile for education group ed and
$AGW_{ed,a}$ ... average gross wage for education group ed at age a

Each individual i in SAVE is attributed a certain point in this graph according to his individual net income in year t relative to average German net wages in year t. This gives the relative income position of the individual i to his education-dependent wage profile, which will be referred to as the wage factor WF_i for individual i. The income $Inc_{i,ed,a}$ of individual i in year t can thus be described as:

$$Inc_{i,ed,a} = \frac{\frac{Inc_{i,ed,a}}{AGW_{t=c+a}}}{WP_{ed,a}} \times WP_{ed,a} \times AGW_{t=c+a} \tag{3}$$

This relative income position is assumed to remain constant over time. Earnings points EP_t for each year t can then be computed as:

$$EP_{i,ed,a} = \frac{Inc_{i,ed,a}}{AGW_{t=c+a}} = WP_{ed,a} \times WF_{i,ed} \tag{4}$$

The sum of accumulated earnings points at the time of retirement thus is:

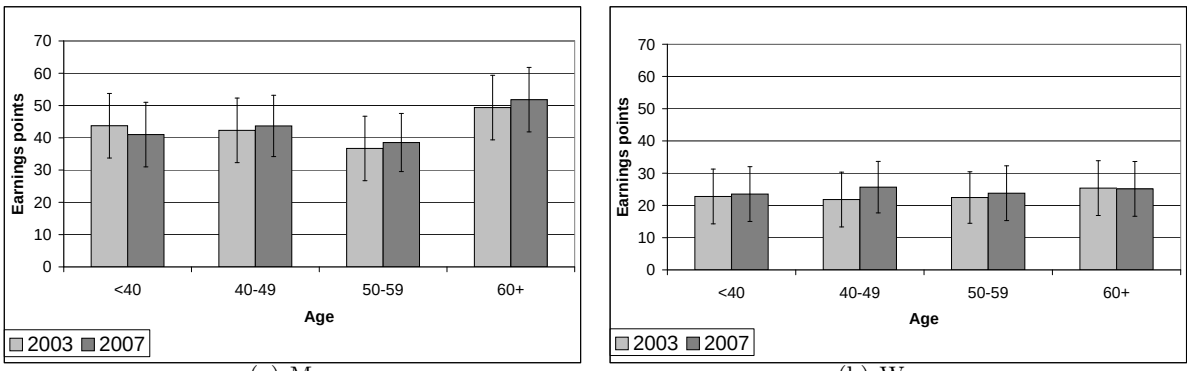
$$\sum_{a=a_0}^{RA-1} EP_{i,ed,a} = \sum_{a=a_0}^{RA-1} WP_{ed,a} \times WF_{i,ed} \tag{5}$$

Note that these accumulated earnings points at retirement are still to be adjusted by the adjustment factor $AF_{RA,c}$ if the individual does not retire at the statutory retirement age.

Figure 5 summarizes the projected sum of (already adjusted) earnings points at retirement for men and women according to age classes, for the RR 2003 and RR 2007 samples. The average accumulated sum of earnings points for men is in the range of the 45 earnings points of the standard pensioner while women acquire considerably less earnings points (around 25) during their working lives. Note further that older men (age 60+) acquire considerably more earnings points until retirement than younger individuals. This result is mainly driven by the high expected retirement ages of older men. For women, earnings points across age groups hardly vary. Accumulated earnings points for both men and women are slightly higher for the RR 2007 sample. In total, the distribution of earnings points quite well fits the administrative data of the pension insurance even though earnings points here are computed based on overall household (individual) income instead of labor income[30].

[30] See e.g. Deutsche Rentenversicherung Bund (DRV) (2007).

Figure 5 – Projected Accumulated Adjusted Earnings Points at Retirement



(a) Men (b) Women

Source: Author's computations based on SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Values are weighted according to age and income.

5.2. The Size of the Public Pension Gap

Table 12 presents the pre- and post-reform absolute monthly pension benefits, pension levels and replacement rates as well as the resulting pension gap for both the RR 2003 and RR 2007 sample. It shows that, in the 2007 sample, post-reform pensions in the first pension year on average turn out 14% lower than pre-reform pensions. This is equal to an absolute monthly gap of around 126 euros. Before the increase in the statutory retirement age, for the 2003 sample, the pension gap on average is lower, around 12% corresponding to an absolute value of 95 euros. Median values are around 25% lower. The pension gap has thus increased by 30% on average since 2003.

Despite the higher public standard pension level the average individual pension gap is higher for the 2007 than for the 2003 sample. This is because individuals now have to work longer if they want to obtain the same amount of pension benefits as before. Given they reach the same level of (adjusted) earnings points by working longer, their pension level will be higher after the 2007 than after the 2003 reform. Individuals in SAVE indeed adjusted expectations regarding their retirement age between the years 2003 and 2007: Men increased expected retirement age about 1.5 years and women by 2 years. This also explains that the estimated pre-reform pensions obtained from 2007 values are higher than the estimated pre-reform pensions obtained from 2003 values: individuals are projected to work longer and gain more earnings points in the RR 2007 sample. However, the longer working period cannot compensate for the higher adjustment factors. As a result, the gap widens.

If individuals had not adjusted their expected retirement ages from 2003 to 2007 and planned to retire as they planed to in 2003, pre-reform pensions would have been on a similar level as for the 2003 post-reform scenario. However, the projected gap would have still been even higher because of the larger reductions in earnings points at retirement by the modified adjustment factor.

Table 12 – Pre- and Post-Reform Pensions, Pension Levels and Replacement Rates and the Resulting Gap

	Pre-reform pensions			*Post-reform pensions*			*Pension Gap*	
	Pension in euros	Indiv. pension level [1)]	Repl. rate [2)]	Pension in euros	Indiv. pension level	Repl. rate	Pension gap in euros	Gap in % of pre-reform pension
					2003			
Mean	774.31	48.97%	58.17%	679.42	43.48%	51.70%	94.89	12.06%
Median	686.03	43.38%	56.11%	598.12	38.28%	50.37%	74.67	11.58%
Std. error	12.97	0.82%	0.35%	11.38	0.73%	0.31%	1.99	0.12%
Observations					1569			
					2007			
Mean	846.56	53.53%	60.62%	721.02	46.18%	52.46%	125.54	14.24%
Median	741.92	46.92%	58.42%	633.61	40.59%	51.36%	91.45	14.40%
Std. error	17.02	1.08%	0.37%	14.39	0.92%	0.33%	3.57	0.22%
Observations					983			

[1)] Individual pension in percent of average wages.
[2)] In % of last income according to profiles in Figure 4 and individual wage factor.
Source: Author's computations based on SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Values are ppp-adjusted in constant 2003 euros and weighted according to age and income.

A comparison of the average individual replacement rate with the expected figures from Table 3 shows that individual's expectations are not in line with the results from the projections. While people's expectations of individual replacement rates increased over the last few years, the calculations reveal that their replacement rates in reality have on average decreased since the 2003 reform - despite a higher expected retirement age. This is an alarming result and we will see whether individuals can make up for this higher gap by higher savings and wealth.

The figures in Table 12 comprise young and old individuals. Differentiation by age shows that relatively young individuals (age 40 to 49) have a substantially higher pension gap of around 195 euros per month (2007 post-reform) as they retire around 2035 when standard pension levels have already dropped considerably. Older individuals (age 50 to 59) have a much lower monthly pension gap of 73 euros on average in their first pension year while the oldest age group retiring on average within the next five years records a monthly pension gap of 36 euros.

However, once in retirement the size of the pension gap does not remain constant since net standard pension levels continue to decline for *all* pensioners. Especially for the oldest age group, the reported pension gap will rise considerably because pension levels have only started to decrease when this age group enters into retirement. For the youngest individuals in our sample the pension gap will not increase much further during their retirement period as pension levels have already dropped substantially.

6. Projected Private Old Age Income

The previous section has described the size of the public pension gap. In this section the amount of private old age income that might fill this gap is projected. Projections are pursued on an individual level that allows to compare individual private old age income with the computed individual pension gap before aggregating households. As explained in section 4, for couples, half of the household's financial and real wealth (and debt) is assigned to each partner.

6.1. Wealth at Retirement Entry

Current wealth further increases until retirement for two reasons. First, current assets earn interest and compound interest. The following projections are based on real interest rates in order to maintain today's assets' purchasing power. I use a real interest rate of 2.8% which is the rate the Rürup Commission used for its 2003 pension reform computations. At this rate, current wealth doubles in 25 years.

Second, annual savings are added to the wealth stock each year. It is assumed that savings rates remain constant up to retirement. This is the basic assumption of this ceteris paribus analysis. For savings, the same real interest rate of 2.8% applies.

Thus, wealth at retirement consists of current wealth (minus debt) and the gained compound interest on it plus accumulated savings and their accrued interest and can be computed as:

Table 13 – Projected Accumulated Individual Wealth at Retirement Entry

	Gross financial wealth	*Net financial wealth*	*Savings*	*Net financial wealth plus savings*	*Conditional housing wealth*	*Conditional business wealth*
				2003		
Mean	29,816	25,997	23,852	49,850	222,812	269,971
Median	12,690	9,511	6,830	23,281	160,062	75,660
Std. error	2,261	2,280	1,262	2,725	8,217	121,354
Observations	1,569	1,569	1,569	1,569	886	86
				2007		
Mean	31,857	25,818	58,846	84,665	184,904	136,948
Median	13,380	9,123	8,078	29,637	149,585	39,978
Std. error	1,864	1,903	4,868	5,676	6,562	29,281
Observations	983	983	983	983	582	51

Source: Author's computations based on SAVE RR 2003 and 2007 cross-section, reduced as described in section 2. Values are ppp-adjusted in constant 2003 euros and weighted according to age and income. A real interest rate of 2.8% is assumed.

$$PW_i = \sum_{t=a}^{RA-1} W_{i,t}\,(1+r_t) + \sum_{t=a}^{RA-1} \left(S_{i,t}\,(1+r_t) + (sr_i \times Inc_{i,t})\right) \tag{6}$$

Table 13 shows projected accumulated assets at retirement for the 2003 and 2007 sample. On average, individuals have accrued financial wealth of around 50,000 euros in 2003 and 85,000 euros in 2007. For the 2007 sample, the largest part of this asset stock is acquired by future savings plus interest while net financial assets are much lower. For the 2003 sample, projected accumulated wealth from savings is roughly the same size as accumulated net financial wealth. This seems striking, especially since current household income and savings rates were shown to be lower in the 2007 sample. The reason for this effect is the adjustment of the expected retirement age: savings are accumulated over a longer working life than for the 2003 sample and compound interest effects are thus larger. In addition, a higher ratio of less educated individuals in the 2003 sample (by a third) leads to lower wage profiles on average and thus lower savings over time. For the median individual financial wealth at retirement entry is between 23,000 euros and 30,000 euros. Thus, the wealth distribution is skewed to the right.

6.2. Transforming Wealth into Life-Long Annuities

This wealth stock at retirement entry provides the resources households can draw upon during their retirement phase. However, there is no strict rule how households may spend this wealth stock over their entire retirement period. Households could basically spend all their assets in the first year of retirement or they could plan to bequeath all wealth to their children.[31] For

[31] See Dus and Maurer (2007) for a thorough study on possible rules for self-annuitization.

this analysis, the wealth stock will be transformed into a flow of regular payments. Lump-sum expenses and planned bequests will thus be neglected. This flow of regular payments allows best to analyze the extent to which households will be able to close the upcoming pension gap.

There are basically two options how to convert retirement wealth into a pension annuity. One possibility is to simply divide wealth by the number of expected retirement years. However, in case of a life span longer than expected, zero wealth would remain and individuals would entirely rely on their public pensions. The second possibility is to convert retirement wealth into a lifelong annuity that is paid until death and thus takes account of the possibility that the individual may live longer than expected. The following projections are based on this second option because payments from private old age income can then be directly compared to public pension income.

Computing progressive annuities. Annuities can be computed as constant or progressive annuities. For the projections in this paper I use progressive annuities where it is assumed that the annuity rises each year by a certain factor, namely 3% in order to adjust for inflation (1.5%) and real wage growth (1.5%). This ensures comparability to public pension benefits that are annually adjusted to wage growth. In fact, since public pension levels will decrease in the future, public pensions be will adjusted for less than nominal wage growth. If private annuities are to close this gap they have to make up for this decrease. A progressive annuity therefore takes account of the fact that the gap will widen further during retirement (especially for older persons), recall the discussion in section 5.

Based on the accumulated wealth at retirement, the life-long annuity can be computed as follows:

$$A_{i,t} = PW_i \times \frac{(\frac{1}{1+r}) \times (\delta - r)}{(\frac{1+\delta}{1+r})^n - 1} \tag{7}$$

with
- $A_{i,t}$ ... annuity of an individual i in year t after retirement entry,
- PW_i ... accumulated wealth at retirement,
- r ... interest rate,
- $1+\delta$ ... annual rise in annuity and
- n ... remaining life expectancy from RA on

Note that this is only the pension annuity for the first year in retirement. Subsequent nominal annuities will rise according to the set factor of 3%. In the following, all figures will be presented in today's purchasing power so that the pension value in the first year of retirement is equal to all subsequent annuities received thereafter.

Computations are based on the subjective life expectancies given in the SAVE data. However, since these subjective life expectancies tend to underestimate the true life expectancy as discussed in section 3, alternative computations based on different, higher life expectancy assumptions as well as the dynamic life expectancy provided by the Rürup Commission will be pursued.

Table 14 – Computed Lifelong Annuities Based on Subjective Life Expectancy

	Gross financial wealth	*Net financial wealth*	*Savings*	*Net financial wealth plus savings*	*Conditional housing wealth*	*Conditional business wealth*
				2003		
Mean	195.47	171.64	154.95	326.59	1,387.67	1,668.72
Median	69.76	49.96	40.10	129.49	888.92	371.48
Std. error	23.36	23.45	15.28	28.72	62.98	830.46
Observations	1,569	1,569	1,569	1,569	886	86
				2007		
Mean	238.12	183.01	564.42	747.44	1,619.80	1,212.54
Median	88.69	58.37	52.85	197.76	906.66	215.00
Std. error	14.57	14.84	105.37	110.24	124.20	567.74
Observations	983	983	983	983	582	51

Source: Author's computations based on SAVE RR 2003 and 2007 cross-section, reduced as described in section 2. Monthly values, ppp-adjusted in constant 2003 euros, weighted according to age and income, progressive annuity with 3% increase in order to adjust for inflation (1.5%) and wage growth (1.5%).

Housing and business wealth. The following projections will be restricted to net financial wealth plus savings. As discussed in section 4, converting housing wealth into life-long annuities is often not possible and also not necessarily in the interest of the individual, especially since 'reverse annuity mortgages' are quasi non-existent in Germany. For the sake of completeness annuities including housing and business wealth will be presented in this section. However, the pension gap computations in the remainder of this paper will be based on annuities including net financial wealth plus savings solely.

Projection results. Table 14 shows the annuities based on the subjective life expectancy measure. Values are euros in today's purchasing power, thus corrected for inflation and wage growth. Resulting mean values of the life-long annuities are quite high. Annuities of net financial wealth for the RR 2003 sample are about 170 euros on average, and around 180 euros for the 2007 sample. If savings are continued according to today's rates and are annuitized at retirement, an additional annuity of around 155 euros in the RR 2003 sample and 565 euros in the RR 2007 sample, respectively, can be obtained. This difference is striking. A part of it can be attributed to higher accumulated savings wealth at retirement, see Table 13 while the effect is strengthened further by the postponed retirement in the RR 2007 sample that results in a shorter pension period. The two annuities available in order to close the gap add up to around 330 and 750 euros for the two RR samples.

Annuities out of housing or business wealth on average are clearly above 1,000 euros a month – given that individuals have a house or business they could liquidate. While the business wealth annuity can be used to fill the gap annuities from housing may not. Housing wealth is not easily liquidated as discussed before.

Table 15 – Computed Lifelong Annuities Based on Dynamic Life Expectancy

	Gross financial wealth	*Net financial wealth*	*Savings*	*Net financial wealth plus savings*	*Conditional housing wealth*	*Conditional business wealth*
				2003		
Mean	126.57	110.36	102.94	213.30	962.73	1,183.55
Median	51.39	37.80	30.23	98.30	644.70	290.88
Std. error	9.67	9.77	7.13	12.70	38.10	582.70
Observations	1,569	1,569	1,569	1,569	886	86
				2007		
Mean	145.84	118.02	348.51	466.54	895.01	532.38
Median	56.68	37.26	38.46	133.34	625.88	166.00
Std. error	8.85	9.01	55.01	59.30	48.32	111.16
Observations	983	983	983	983	582	51

Source: Author's computations based on SAVE RR 2003 and 2007 cross-section, reduced as described in section 2. Monthly values, ppp-adjusted in constant 2003 euros, weighted according to age and income, progressive annuity with 3% increase in order to adjust for inflation (1.5%) and wage growth (1.5%).

Due to the skewed wealth distribution, median values are much lower than the means. The individual at the center of the distribution receives an annuity of 25 euros in 2003 and 90 euros in 2007 on the basis of net financial wealth. Annuities from savings amount to 40 and 50 euros respectively. The median annuity for both is roughly 90 euros in 2003 and 135 euros in 2007, that is less than a fourth of the mean values.[32]

Finally, the annuities displayed in Table 14 are based on subjective life expectancies. If higher and more realistic life expectancies are used, annuities turn out to be 20% to 30% lower (see Table 15).

7. Closing the Gap

So far we have seen the projected size of the public pension gap and the projected size of private wealth holdings available to close it. The remaining questions are to what extent the gap can be closed, who can close it and who cannot and how the results change for households.

7.1. How Well Can the Gap Be Closed

Table 16 compares the annuities computed in the previous section (Table 14 on the facing page) and the computed pension gap from Table 12 on page 28 for both the RR 2003 and the RR 2007 sample. A positive residual means that individuals can more than fill the gap, a negative residual would mean that individuals cannot fill the gap.[33] Recall that we assumed

[32] Note that the medians – in contrast to the means – cannot be added since the median individual in the middle of the financial distribution is not necessarily the same as the one in the middle of the savings distribution.

[33] Again, note that the difference between the medians is not equal to the median of the individual differences.

Table 16 – Filling the Gap

	Pension gap in euros [1)]	*Life-long annuity in euros* [2)]	*Residual in euros*	*% of gap that can be filled*	*% of individuals that cannot fill the gap*
			2003		
Mean	94.88	326.59	231.70	527%	37.54%
Median	74.67	129.49	55.28	190%	
Std. error	1.99	28.72	28.33	41%	
Observations	1,569	1,569	1,569	1,569	
			2007		
Mean	125.54	747.44	621.89	807%	38.35%
Median	91.45	197.76	102.72	216%	
Std. error	3.57	110.24	109.87	86%	
Observations	983	983	983	983	

1) See Table 12 on page 28, column 7.
2) Computations are based on accumulated net financial wealth plus savings at retirement entry and subjective life expectancy (see column 4 in Table 14 on page 32).
Source: Author's computations based on SAVE RR 2003 and 2007 cross-section, reduced as described in section 2. Monthly values, ppp-adjusted in constant 2003 euros and weighted according to age and income.

that individuals continue to save the same proportion of their income as they currently do. The last column in Table 16 shows the share of individuals that are not able to close the gap.

On average individuals save enough in order to close the gap. Based on subjective life expectancy, the annuity out of net financial wealth and savings is more than five times as high as the gap for the 2003 sample and eight times as high for the 2007 sample. However, for the median individual this picture looks quite different and resources roughly cover the gap about twice in both samples. Overall around 38% of individuals in both samples cannot fill the gap. How do these results change if higher, more realistic life expectancy measures are used for the computations?

Different life expectancy assumptions. Table 17 compares the results if subjective life expectancy is 3, 5 or 10 years higher; it furthermore includes results based on the dynamic life expectancy projections by the Rürup Commission. Even if a ten year longer life expectancy is assumed, individuals can on average fill the gap easily. Note, results for the 2003 and 2007 sample become more similar the higher the assumed life expectancy. This can be explained by the fact that individuals in the 2007 sample anticipated a lower subjective life expectancy than individuals in 2003. The more years are added to it, the less relevant this difference becomes for the computations.

An analysis of the median values reveals that with rising life expectancy the gap eventually can only just be filled as the residual gets clos to zero for a 10 year longer life expectancy in the 2003 sample. Almost half of the individuals in the 2003 sample (48%) would then not be able to close the gap.

Table 17 – Filling the Gap – Accounting for Different Life Expectancy Assumptions

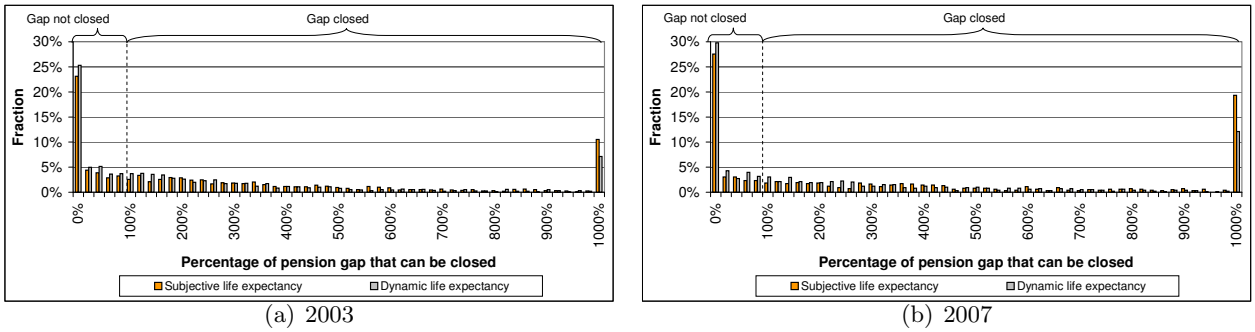
		Pension gap in euros	*Life-long annuity in euros* [2)]	*Residual in euros*	*% of gap that can be filled*	*% of indiv. that cannot fill the gap*
			2003			
Subj. LE	Mean	94.88	326.59	231.70	527%	37.54%
	Median	74.67	129.49	55.28	190%	
Subj. LE + 3 yrs	Mean	94.88	251.29	156.41	433%	40.73%
	Median	74.67	108.31	32.25	154%	
Subj. LE + 5 yrs	Mean	94.88	220.19	125.31	389%	42.77%
	Median	74.67	97.47	22.76	137%	
Subj. LE + 10 yrs	Mean	94.88	169.73	74.84	311%	47.61%
	Median	74.67	77.04	4.41	108%	
Dynamic LE	Mean	94.88	123.30	118.41	389%	42.77%
	Median	74.67	98.30	21.97	136%	
			2007			
Subj. LE	Mean	125.54	747.44	621.89	807%	38.35%
	Median	91.45	197.76	102.72	216%	
Subj. LE + 3 yrs	Mean	125.54	481.89	356.35	555%	41.30%
	Median	91.45	155.53	60.63	176%	
Subj. LE + 5 yrs	Mean	125.54	408.38	282.84	476%	42.12%
	Median	91.45	139.77	44.19	156%	
Subj. LE + 10 yrs	Mean	125.54	303.11	177.57	360%	46.49%
	Median	91.45	106.96	16.11	118%	
Dynamic LE	Mean	125.54	466.53	341.00	488%	43.95%
	Median	91.45	133.34	29.51	143%	

[1)] See Table 16, column 1.
[2)] Computations are based on accumulated net financial wealth plus savings at retirement entry. For subjective LE, see also Table 14 on page 32, column 4, for dynamic life expectancy, see also Table 15 on page 33, column 4.
Source: Author's computations based on SAVE RR 2003 and 2007 cross-section, reduced as described in section 2. Monthly values, ppp-adjusted in constant 2003 euros and weighted according to age and income.

Distribution of individuals that can and cannot fill the gap. Figure 6 shows the distribution of individuals that can (>=100%) and cannot (<100%) fill the gap. This unequal distribution partly mirrors the underlying financial distribution. On the one hand, a quarter of all individuals in the RR 2003 sample does not own any wealth nor do they save. In the RR 2007 sample, this ratio increases to a third. Their pension gap thus cannot be filled at all. On the other hand, many individuals have much higher wealth and savings that are more than enough to fill the gap. Around 40% (2003) and 30% (2007) of individuals have a coverage of 100% to 500% while another 15% can close the gap more than ten times in the 2003 sample. For the 2007 sample, even 23% reach this coverage of 1000%. About 20% in both samples will have accumulated some wealth until retirement but it won't be sufficient in order to close the gap.[34]

[34]Note that the fraction of individuals with zero annuities is lower than the fraction of households with zero annuities computed by (Börsch-Supan, Essig, and Wilke 2005). This is because single households tend to

Figure 6 – Distribution of Pension Gap Coverage



(a) 2003 (b) 2007

Source: Author's computations based on SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Values are weighted according to age and income.

7.2. Differentiation According to Socioeconomic Characteristics

Up to this point we just looked at the average and median individual in our sample. However, the ability to close the gap varies greatly with socioeconomic characteristics such as gender, age, income and education. This is shown in Tables 18 to 21, which focus on the median values. The presented results are based on the subjective life expectancy figures from SAVE. If dynamic life expectancy values are used instead, the number of individuals not able to close the gap would turn out even higher.

It can be seen that women in general are in a better position to fill the upcoming pension gap then men (Table 18). However, this is mainly because women also record a considerably lower pension gap than men. Since wealth is split up equally between spouses, they thus can fill the gap more easily. Note that the difference in the fraction of individuals that are not able to close the gap is not as large.

Among younger age groups, the share of individuals not being able to fill the gap is higher in the RR 2003 but lower in the RR 2007 sample, see Table 19. This is due to (1) the increased savings rates for the lowest age group in 2007 as shown in section 4 and (2) the increases in the expected retirement age of this age group as depicted in Table 2. In both samples, the oldest age group records the lowest percentage of individuals that are not to close the gap. This age group has comparably high savings and low pension gaps.

As expected, differences among income groups are also large (Table 20). It is surprising that the percentage of the gap that can be filled does not increase from the lowest to the upper quintile. The median individual in the lowest quintile can fill the gap more than twice, just as the median individuals in the upper income quintile. This is mainly due to the extremely low pension gap as well as high wealth holdings that might have been accumulated jointly with a well earning spouse. However, what does decrease over income quintiles is the share of individuals that cannot close the gap. Nevertheless, even in the uppermost income quintile roughly 30% of the individuals cannot fill the gap.

record higher non-coverage than couple households as we will see below.

Table 18 – Filling the Gap – By Gender

	2003		2007	
	Men	*Women*	*Men*	*Women*
Pension gap in €	104	49	127	68
% of gap filled	168.20%	213.32%	198.41%	273.99%
% of individuals that cannot fill the gap	39.92%	35.25%	38.74%	37.95%
Observations	769	800	493	490

Source: Author's computations based on SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Median values, ppp-adjusted in constant 2003 euros and weighted according to age and income.

Table 19 – Filling the Gap – By Age

	< 40	*40 – 49*	*50 – 59*	*60+*	*All*
			2003		
Pension gap in €	100	105	61	43	
% of gap filled	142.54%	167.11%	194.27%	309.00%	190.33%
% of individuals that cannot fill the gap	42.02%	39.60%	36.32%	30.34%	37.54%
Observations	138	707	523	201	1,569
			2007		
Pension gap in €	140	146	49	48	
% of gap filled	358.70%	152.87%	283.64%	373.45%	216.13%
% of individuals that cannot fill the gap	32.20%	43.49%	35.84%	30.61%	38.35%
Observations	59	445	332	147	983

Source: Author's computations based on SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Median values, ppp-adjusted in constant 2003 euros and weighted according to age and income.

Better education decreases non-coverage as Table 21 shows. The share of individuals not able to fill the gap is much smaller for the group with a college degree. The effect is somewhat less pronounced for the RR 2007 sample. One might presume that this is due to a higher associated income, but that is not the case. They are much the same for the second and the third group, but their financial wealth and savings is not. The share of individuals with zero savings is much smaller in the group with the highest schooling. One explanation for this could be that individuals with a college degree are more disciplined and self-controlled concerning their financial planning and foresight.

7.3. Re-aggregation of individuals to households

So far, we have looked at the individual pension gaps. In this section, individual pension gaps are aggregated to households' pension gaps. For single households, obviously, nothing

Table 20 – Filling the Gap – By Income

	1^{st} Q	2^{nd} Q	3^{rd} Q	4^{th} Q	5^{th} Q
			2003		
Pension gap in €	20	52	88	124	177
% of gap filled	240%	190%	159%	161%	209%
% of individ. that cannot fill the gap	36.91%	40.25%	41.32%	39.31%	29.43%
Observations	317	318	317	318	299
			2007		
Pension gap in €	27	70	115	158	228
% of gap filled	215.05%	139.57%	212.53%	187.80%	230.60%
% of individ. that cannot fill the gap	39.61%	46.51%	38.20%	34.28%	30.21%
Observations	207	215	212	210	139

Q = Quintile

Source: Author's computations based on SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Median values, ppp-adjusted in constant 2003 euros and weighted according to age and income.

Table 21 – Filling the Gap – By Education

	Lowest or middle school degree	*High school degree*	*University degree*
		2003	
Pension gap in €	39	74	113
% of gap filled	20.98%	194.45%	266.28%
% of individuals that cannot fill the gap	59.09%	37.26%	23.19%
Observations	198	1095	276
		2007	
Pension gap in €	78	87	120
% of gap filled	51.62%	235.23%	235.47%
% of individuals that cannot fill the gap	55.05%	37.26%	34.14%
Observations	89	730	164

Source: Author's computations based on SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Median values, ppp-adjusted in constant 2003 euros and weighted according to age and income.

changes. For couple households, the absolute gaps are summed up. For civil-servants, self-employed persons and free-lancers no gaps arise as they are not insured with the public pension system; Their gaps are zero. Equally, spouses with zero income are also attributed a gap of zero. Table 22 shows the resulting gaps of households. Non-coverage is significantly higher among single households. Couple households have higher wealth than single households so that mean and median coverage is much higher.

7.4. Sensitivity Analysis

This section looks at whether the results presented in the previous sections hold under different underlying assumptions. So far, a real interest rate of 2.8% and a real wage growth rate of 1.5% with an inflation rate of 1.5% have been assumed. A real interest rate of 2.8% seems rather high compared to the current capital market situation but rather low compared to the long-term average since the 1970s. Similarly, a wage growth rate of 1.5% appears rather high compared to today's limited growth but Germany has seen much higher wage growth in the past decades. Current reforms aim at strengthening productivity and regaining higher growth rates. However, the baby boom baby bust phenomenon as well as the process of population aging will slow down economic growth and reduce the probability to reach long-run growth rates of 1.5% or more.

In the following, alternative projections are run for higher and lower interest and wage growth rates. In a first step, the growth rate is kept unchanged at 1.5%, while the interest rate will be varied (r=2,0% , 2,8% , 3,5%, see Table 23), while in the second comparison, interest rates will be held constant and growth rates are varied (g=1,0%, 1,5%, 2,0%, see Table 24). In a third step, a pessimistic scenario is compared to an optimistic one (r=2,0% and g=1,0% versus r=3,5% and g=2,0%, see Table 25). The subsequent tables only refer to the 2007 sample.

Overall the projection results do not change qualitatively with different assumptions concerning interest and wage growth. A higher interest rate clearly raises the level of coverage of the pension gap, while lower interest rates makes this task more difficult. However, the number of individuals unable to fill the gap does not change substantially. Even a high interest rate cannot make up for the low (or non-existent) savings of these individuals. A stronger wage growth rate leads to higher public pensions and thus increases the gap – recall that the gap is proportional to the pension size. On the contrary, the pension gap would be lower with lower growth rates. However, the size of the effect is rather small – at least as long growth rates remain in the realistic range of real 1% and 2% per year. Moreover, the difference between the optimistic and the pessimistic scenario is relatively small, as displayed in Table 25. With a variation of interest and wage growth rate results thus do not change qualitatively.

Table 22 – Filling the Gap – Household Level

	Obs.		*Pension gap in euros*	*Life-long annuity in euros*	*Residual in euros*	*% of gap that can be filled*	*% of households that cannot fill the gap*
				2003			
Single HH	181	Mean	97.06	208.30	111.24	172.73%	56.90%
		Median	75.94	35.26	-18.84	43.47%	
		Std. error	5.61	71.54	70.18	30.40%	
Couple HH	721	Mean	181.58	659.50	477.91	414.10%	35.95%
		Median	162.68	277.99	134.10	202.64%	
		Std. error	4.35	64.48	63.70	39.38%	
				2007			
Single HH	180	Mean	116.31	352.69	236.38	279.08%	57.77%
		Median	82.14	29.70	-17.39	54.26%	
		Std. error	8.02	60.69	57.71	41.01%	
Couple HH	451	Mean	228.95	1493.87	1264.91	696.52%	35.22%
		Median	196.97	418.66	226.93	251.55%	
		Std. error	7.63	264.44	263.35	102.28%	

Computations are based on accumulated net financial wealth plus savings at retirement entry and subjective life expectancy.

Source: Author's computations based on SAVE RR 2003 and 2007 cross-sections, reduced as described in section 2. Median values, ppp-adjusted in constant 2003 euros and weighted according to age and income.

Table 23 – Percentage of Gap Filled Under Varying Capital Market Rate of Returns

		Subj. LE	*Subj. LE + 3 yrs*	*Subj. LE + 5 yrs.*	*Subj. LE + 10 yrs.*	*Dynamic LE*
				2007		
2.00%	Mean	777.26%	523.84%	445.22%	328.41%	456.50%
	Median	205.32%	163.72%	143.99%	108.01%	131.73%
	Std. error	84.38%	48.52%	40.56%	29.69%	47.10%
	% of individuals that cannot fill the gap	39.06%	41.60%	43.84%	48.01%	45.37%
2.80%	Mean	807.42%	554.78%	476.34%	359.66%	487.56%
	Median	216.13%	175.52%	155.65%	117.63%	143.09%
	Std. error	86.26%	51.19%	43.39%	32.69%	49.51%
	% of individuals that cannot fill the gap	38.35%	41.30%	42.12%	46.49%	43.95%
3.50%	Mean	834.57%	582.84%	504.68%	388.47%	515.87%
	Median	227.56%	186.91%	164.21%	125.32%	152.26%
	Std. error	88.00%	53.67%	46.02%	35.50%	51.79%
	% of individuals that cannot fill the gap	37.84%	40.79%	42.01%	44.86%	43.03%

Source: Author's computations based on SAVE RR 2007 cross-section, reduced as described in section 2. Median values, ppp-adjusted in constant 2003 euros and weighted according to age and income.

Table 24 – Percentage of Gap Filled Under Varying Wage Growth

		Subj. LE	*Subj. LE + 3 yrs*	*Subj. LE + 5 yrs.*	*Subj. LE + 10 yrs.*	*Dynamic LE*
				2007		
1.00%	Mean	828.31%	569.98%	489.63%	369.96%	500.97%
	Median	219.32%	177.79%	157.48%	119.53%	144.67%
	Std. error	87.45%	51.92%	44.02%	33.18%	50.11%
	% of individuals that cannot fill the gap	38.14%	40.99%	41.91%	45.98%	43.54%
1.50%	Mean	807.42%	554.78%	476.34%	359.66%	487.56%
	Median	216.13%	175.52%	155.65%	117.63%	143.09%
	Std. error	86.26%	51.19%	43.39%	32.69%	49.51%
	% of individuals that cannot fill the gap	38.35%	41.30%	42.12%	46.49%	43.95%
2.00%	Mean	786.71%	539.84%	463.36%	349.70%	474.54%
	Median	209.07%	171.53%	151.61%	115.25%	137.78%
	Std. error	84.99%	50.34%	42.65%	32.13%	48.82%
	% of individuals that cannot fill the gap	38.35%	41.40%	42.72%	46.89%	44.35%

Source: Author's computations based on SAVE RR 2007 cross-section, reduced as described in section 2. Median values, ppp-adjusted in constant 2003 euros and weighted according to age and income.

Table 25 – Percentage of Gap Filled Under Extreme Economic Settings

		Subj. LE	*Subj. LE + 3 yrs*	*Subj. LE + 5 yrs.*	*Subj. LE + 10 yrs.*	*Dynamic LE*
				2007		
g=1% and r = 2.0%	Mean	797.20%	538.07%	457.54%	337.75%	468.94%
	Median	208.36%	167.08%	146.00%	110.03%	136.12%
	Std. error	85.55%	49.21%	41.15%	30.14%	47.66%
	% of individuals that cannot fill the gap	38.55%	41.20%	43.13%	47.91%	44.55%
g=2% and r = 3.5	Mean	813.06%	567.08%	490.88%	377.68%	502.03%
	Median	219.03%	182.72%	161.79%	122.71%	145.18%
	Std. error	86.17%	52.78%	45.24%	34.90%	51.06%
	% of individuals that cannot fill the gap	38.25%	41.09%	42.11%	45.57%	43.54%

Source: Author's computations based on SAVE RR 2007 cross-section, reduced as described in section 2. Median values, ppp-adjusted in constant 2003 euros and weighted according to age and income.

8. Conclusion

This paper has shown to what extent individuals and households are prepared to fill the upcoming public pension gap with private old age income, assuming that they will continue to save as they do now. In particular I analyzed how the latest reform in 2007 has changed the situation since 2003 when this question was evaluated for the first time[35] and how individuals have responded to these further changes up to now. In order to do this, computations were conducted (1) on the basis of the SAVE RR 2003 sample and the state of the German public pension system after the 2004 reform as well as (2) on the basis of the SAVE RR 2007 sample and the current state after the latest pension reform in 2007.

It turns out that the pension gap in fact has increased for the RR 2007 compared to the RR 2003 sample. While public pension levels (for the standard pensioner) under the 2007 reform turn out higher than after the 2004 reform, these higher levels can only be achieved by pensioners who adjust their retirement entry behavior such that they record the same amount of (adjusted) earnings points as before. It was shown that even though individuals in SAVE did adjust their retirement age expectations between the 2003 and 2007 waves, these adjustments were not sufficient enough in order to prevent the gap from widening.

Still, on average individuals in both 2003 and in 2007 saved enough to close the gap. Based on subjective life expectancy, the annuity out of net financial wealth plus savings is five times higher than the gap for the 2003 sample and eight times higher for the 2007 sample. The resources of the median individual cover the gap roughly twice in the 2003 as well as 2007 sample. However, around 38% of individuals in both samples cannot fill the gap. If the more realistic dynamic life expectancy measure is used for the projections almost half of the individuals can no longer close the gap. In terms of *adequacy* of retirement income these are clearly far too many.

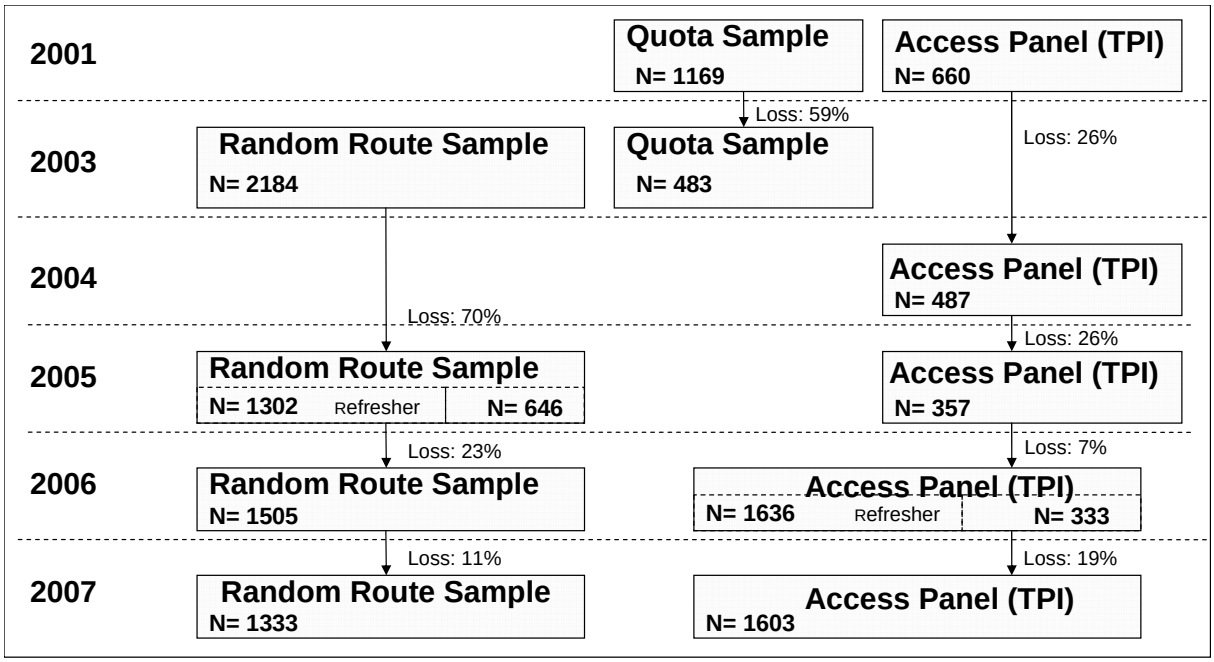
However, it has been stressed before that the analysis in this paper is to be regarded as a thought experiment rather than a realistic projection. If individuals choose to retire later than they currently expect and/or save more than they currently do, the share of individuals not being able to fill the gap will eventually decrease. As it was shown, trends towards a later retirement and higher savings can already partly be perceived in the data.

Thus, supplementary old age income will be crucial for most individuals. On a household level, it becomes even more crucial as single households on average have higher non-coverage rates than the mean and median individual. The public discussions of reforms at least seem to have increased peoples' awareness of the future challenges. The majority of current workers still seems to underestimate the gap in future public pensions, though. As mentioned at the beginning of the paper expected replacement rates have on average increased since 2003 but in fact are projected to decrease – despite a higher expected retirement age. The political task must be to help individuals to form realistic expectations about their future retirement income and to take the necessary decisions on how to close the pension gap. *Transparency* regarding the size of future pension benefits thus also here is of increasing importance.

[35] See Börsch-Supan, Essig, and Wilke (2005).

A. Structure and Selected Variables of the SAVE Waves 2001 to 2007

Figure 7 – Structure of the SAVE data



Source: Mannheim Research Institute for the Economics of Aging (MEA).

Table 26 – Selected Variables for Individuals and Households in SAVE

	Description	*SAVE Variables*	*2001*	*2003*	*2004*	*2005*	*2006*	*2007*	*Indiv*	*HH*
Sample			TPI –	– RR	TPI –	TPI RR	TPI RR	TPI RR		
HH characteristics	Gender	f06s	X	X	X	X	X	X	X	–
	Age	f07o, f11o	X	X	X	X	X	X	X	–
	Single/Couple HH	f10s	X	X	X	X	X	X	X	–
	School education	f20s1,2	X	X	X	X	X	X	X	–
	Prof. education	f21s1,2	X	X	X	X	X	X	X	–
	Employment status	fs23s1,2;f24s1,2	X	X	X	X	X	X	X	–
	Pensioner	f23s1,2; f60s, f61s	X	X	X	X	X	X	X	–
Income + Savings	Annual savings	f45o	X	X	X	X	X	X	–	X
	Monthly net income	f54o	X	X	X	–	X	X	–	X
		f54o1,2	–	–	–	X	–	–	X	–
		f55o1	–	–	–	–	X	X	X	–
Wealth	Financial wealth	f73eo1,2,3,4,5,6,9,10	X	X	X	X	X	X	–	X
		f73eo11	–	–	–	X	X	X	–	X
		f73eo13,14	–	–	–	–	–	X	–	X
	Housing wealth	f68o, f70o	X	X	X	X	X	X	–	X
	Business wealth	f82o	X	X	X	X	X	X	–	X
	Other wealth	f84o	X	X	X	X	X	X	–	X
	Debt	f78o1,2,3,4,5	X	X	X	X	X	X	–	X
Retirement	Expect. ret. age	f62o, f63o	X	X	X	X	X	X	X	–
Life expectancy	Avg. LE men	f90o1	–	–	X	X	X	X		
	Avg. LE women	f90o2	–	–	X	X	X	X		
	Subj. LE men	f90o1;f91o1,2;f92o1,2	–	–	X	X	X	X	X	–
	Subj. LE women	f90o2;f91o1,2;f92o1,2	–	–	X	X	X	X	X	–

Source: Author's compilation.

B. Regression Results

Table 27 – Imputing Income Shares from the RR 2007 Sample

		Respondent			*Partner*		
		Coefficient		*P value*	*Coefficient*		*P value*
East Germany	(d)	5.381	**	-2.664			
Household size		-0.0734		-0.856			
Age / 10		-0.792		-7.172			
(Age / 10)^2		0.116		-0.637			
Age difference between partners		-2.026		-1.864			
Sex: Female	(d)	-11.81	***	-3.357			
Children	(d)	1.661		-3.776			
Household net income/10,000		17.93		-19.28			
(Household net income/10,000)^2		-16.45		-13.14			
No or lowest school degree	(d)	-0.0451		-2.622	3.316		-2.44
High-school degree or university education	(d)	10.75	***	-3.262	1.509		-3.59
No professional education	(d)	0.421		-3.518	1.432		-2.931
In part-time employment	(d)	17.33	***	-3.833	-17.94	***	-4.666
In marginal part-time employment	(d)	8.525	**	-3.898	1.696		-4.396
Worker	(d)	-4.312		-2.938	1.784		-2.686
Job: Civil servant	(d)	8.162	**	-3.334	-11.07	***	-4.45
Job: Freelancer	(d)	-22.14	**	-8.869	21.16	**	-9.946
Job: Self-employed	(d)	-0.941		-3.191	-4.831		-6.939
Pensioner	(d)	-11.53	**	-4.052	17.43	***	-4.321
Housewife	(d)	-30.14	***	-3.842	34.66	***	-4.641
Unemployed	(d)	-28.44	***	-4.844	27.48	***	-4.038
Bad health status today	(d)	0.79		-0.492			
Content with work		-0.279		-0.474			
Financial decision maker	(d)	3.18		-2.902			
Constant		44.18	**	-21.33			
Observations		451					
R^2		0.617					

(d) Dummy variable.
Significant at: * 10%, ** 5%, *** 1%.
Source: Author's computations based on SAVE RR 2007 cross-section, reduced as described in section 2.

Table 28 – Imputing Subjective Life Expectancy from the RR 2007 Sample

		Respondent			*Partner*			
		Coefficient		*P value*	*Coefficient*		*P value*	
East Germany	(d)	-0.602		-0.691	-0.989		-0.644	H
Household size		-0.444		-0.319	-0.38		-0.309	H
Age / 10		-8.769	***	-2.295	-3.838	**	-1.834	
(Age / 10)^2		0.982	***	-0.201	0.406	**	-0.165	
Age difference between partners		0.341		-0.468	0.731		-0.534	H
Sex: Female	(d)	3.021	***	-0.881	5.429	***	-0.763	
Children	(d)	2.458		-1.033	0.449		-0.956	H
Household net income/10,000		6.306		-4.71	8.456	**	-3.957	H
(Household net income/10,000)^2		-3.621		-3.214	-5.977	**	-2.564	H
No or lowest school degree	(d)	0.982		-0.619	-0.452		-0.651	
High-school degree or university education	(d)	0.078		-0.956	0.761		-0.833	
No professional education	(d)	-0.801		-1.392	-0.727		-0.904	
University education	(d)	0.0956		-0.998	-0.285		-0.862	
In part-time employment	(d)	1.727		-1.077	-3.087	***	-1.109	
In marginal part-time employment	(d)	1.542		-1.145	-1.386		-1.043	
Worker	(d)	-1.303		-0.801	0.396		-0.677	
Pensioner	(d)	-1.217		-1.037	-0.785		-1.049	
Housewife	(d)	-1.083		-1.139	1.492		-1.005	
Unemployed	(d)	-1.848		-1.229	3.047	***	-0.895	
Job: Civil servant	(d)	-0.4		-1.328	1.595		-1.26	
Job: Freelancer	(d)	-2.883	*	-1.668	-0.235		-1.993	
Job: Self-employed	(d)	-0.805		-0.865	0.668		-2.249	
Smoker	(d)	-1.177	*	-0.694				
Former smoker	(d)	-0.764		-0.633				
Bad health status today	(d)	0.101		-0.164				
Positive expectations regarding future health	(d)	0.434	**	-0.207	0.0482		-0.128	
Readiness to assume health risks		-0.0618		-0.108				
Self appraisal: Optimist		0.0748		-0.169	0.245	*	-0.143	R
Self appraisal: Pessimist		0.00168		-0.132	-0.0171		-0.118	R
Self appraisal: Unstressed		-0.00591		-0.141	0.093		-0.129	R
Content with work		0.0397		-0.132	0.281		-0.714	R
Content with lifestyle		-0.376	**	-0.169	-0.751		-0.777	R
Live less long owing to: Illness	(d)	-6.225	***	-1.135	-2.479	**	-1.25	
Live less long owing to: Life circumstances	(d)	-7.046	***	-1.766	-4.022	**	-1.516	
Live less long owing to: Early death of family member	(d)	-3.319	**	-1.507	-3.688	**	-1.566	
Live less long owing to: Other reasons	(d)	-2.478		-1.747	-7.321	***	-1.84	
Live longer owing to: Health status	(d)	0.545		-1.503	0.665		-1.411	
Live longer owing to: Life circumstances	(d)	3.958	***	-1.343	3.953	***	-1.401	
Live longer owing to: Longevity of family members	(d)	6.920	***	-1.628	4.609	***	-1.024	
Live longer owing to: Other reasons	(d)	9.405	***	-3.383	4.327		-5.886	
Constant		93.14	***	-7.333	81.94	***	-5.735	
Number of observations		451			451			
R^2		0.539			0.487			

(d) Dummy variable, H Household value,
R Respondent value.
Significant at: * 10%, ** 5%, *** 1%

Source: Author's computations based on SAVE RR 2007 cross-section, reduced as described in section 2.

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