Aspects of Savings, Wealth, Portfolio Choice, and Inequality in the Life-Cycles of German Households

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Contents

Introduction

"In the early 1950s, Franco Modigliani and his student Richard Brumberg worked out a theory of spending based on the idea that people make intelligent choices about how much they want to spend at each age, limited only by the resources available over their lives. […] While there have been many challenges to the theory of consumption through the years, most recently from a coalition of psychologists and economists, the life-cycle hypothesis remains an essential part of economists' thinking. Without it, we would have much less to say about many important issues, such as the private and public provision of social security, the effects of the stock market on the economy, the effects of demographic change on national saving, the role of saving in economic growth, and the determinants of national wealth. […] These are among the grandest issues in economics, and our thinking about all of them has been fundamentally shaped by Modigliani's work. Indeed, his influence is so deep, and so automatic in economists' thinking that it is no longer easily documented. Life-cycle analysis is so much a part of our regular everyday toolkit, that we pay Modigliani the great compliment of not citing him."

Angus Deaton (2005) on the influence of
Modigliani and his life-cycle theory of consumption

Since the seminal work of Franco Modigliani and Richard Brumberg (1954), the life-cycle model has gained substantial importance in the thinking of both, macro- and microeconomists. Against the background of Keynesian thinking, the implications of the life-cycle model were first perceived as counterintuitive. The innovations of modeling household behavior in a dynamic setting, however, became soon the state-of-the-art. Subsequent seminal research, e.g. on dynamic portfolio choice (Samuelson, 1969; Merton, 1969, 1971, 1973), on the substitution between private and public old-age provision (Feldstein, 1976), and on the mechanics of aging economies (Auerbach and Kotlikoff, 1987), is hardly imaginable without the concept of life-cycle optimization. At the same time, the discrepancies between the implications of the basic model and the empirical evidence have triggered both, amendments to the basic model as well as severe criticism. The amendments account for a number of independent threads of research which all take the basic model as natural framework.

They concern the inclusion of risk and precautionary savings, of bequest motives, as well as complex utility functions which allow e.g. for loss aversion. Step by step, the life-cycle model has grown to incorporate a wide variety of human decision motives and interacting environmental factors. Its success in providing an intuitive framework for human economic behavior has only been surpassed by innovations from the field of economic psychology. The use of heuristics as well as context dependent decision processes are intuitive and even closer to actual human behavior than the life-cycle model will ever be. As they give up the corset of rational and optimizing choice, these models go clearly beyond the original framework of the classical life-cycle model. Consequently, economists sometimes seem unreconcilably opposed into supporters of the life-cycle model and those who consider it old-fashioned and incapable of reproducing certain empirical facts without major and sometimes complex extensions to the model. In fact, however, the two groups have rather been mutually stimulating. Remarkably, the life-cycle model has remained the point of reference for the majority of counterdraft models of human decision behavior.

Despite the impressive history and evolution of the life-cycle theory, many questions and puzzles in this field are not fully understood. The chapters of this dissertation all circle around empirical household behavior in a life-cycle context and touch both, substantive issues and methodological hurdles. The methodological questions range from the problems connected to the unavailability of longitudinal household data to the identification of general life-cycle profiles. Regarding the content, we focus largely on saving behavior and portfolio choice. The last chapter which is dedicated to inequality concerns additionally includes income, consumption and wealth.

Each of the following chapters is a self-contained paper with its own introduction and appendix and can be read independently. Apart from their common life-cycle background the papers share a common empirical database. Specifically, they all rely on the German Income and Expenditure Survey (EVS), from which we have six independent cross-sections available as scientific use files. The data spans the time between 1978 and 2003 and provides us with detailed information on income, consumption, savings and wealth on behalf of private households. Furthermore, the size of each dataset is sufficiently large at 40'-60'000 households to allow for a wide range of empirical applications. The cross-sectional nature of the data as well as conceptual issues related to the sampling process present serious challenges to any empirical work. We discuss these issues with a focus on the application for life-cycle analyses in a technical chapter which is appended at the end of this dissertation.

In the remainder of this introduction, we give a short overview over the objectives and results of the four substantive and the final technical chapter.

The first chapter of this dissertation investigates life-cycle saving behavior with a special focus on the elderly. The basic life-cycle model implies that households should dissave after retirement. The empirical evidence for a variety of countries, among them Germany, documents however that the vast majority of households continues to save after retirement. The amendments to the basic life-cycle model of uncertain life expectancy, of health related expenditure risks or of a bequest motive have helped to reconcile the implications of the theoretical model with the empirical evidence. The empirical evidence, however, must be put into question as well. The reason to doubt the empirical findings lies in the use of synthetic panels. Where true panel data is unavailable or provides only an insufficient panel dimension for life-cycle analyses, it is common practice to rely on repeated cross-sectional data. The repeated cross-sections are used to follow groups of households from a common birth cohort over their life-cycle. The key issue about this procedure lies in the fact that we cannot directly control for selection effects that may change the composition of cohorts as they age. Previous studies, e.g. by Shorrocks (1980) and Attanasio and Hoynes (2000), have found strong effects of differential mortality in the life-cycle wealth trajectories of elderly households estimated from synthetic panels. They conclude that the degree of dissaving in retirement is underestimated. Von Gaudecker and Scholz (2006) and Reil-Held (2000) have shown that differential mortality with respect to income and socioeconomic status matters also for the case of Germany. It is hitherto unclear, whether these selection effects can also be found in the EVS and whether they carry over to the estimated life-cycle trajectories of savings and wealth. We therefore have to put a question mark on the stunningly high old-age saving rates in Germany – often referred to as the "German saving puzzle" (Börsch-Supan et al., 1999).

To scan the EVS cohort data for selection effects like differential mortality or differential sampling success, we exploit a characteristic of the German public pension system which covers roughly 90 percent of the retired population. Specifically, each individual accumulates so called earnings points over her life-cycle which are later used to determine the actual public pension payments. At retirement, the earnings points provide a summary variable for the earnings history and thus also a good proxy for permanent income. As job-market re-entry is rare in Germany, the individual earnings points will usually remain constant after retirement. To assess the prevalence of selection effects in the EVS we therefore control for changes to the distribution of earnings points over the life-cycle of cohorts. As a matter of fact, we find changes to the distribution of earnings points as the cohorts grow older. They turn out substantial for females and smaller, but still noticeable, for men.

In a second step, we device re-weighting procedures to restore the initial distribution of earnings points over all age-groups of a retired cohort to correct for a possible bias in the corresponding life-

cycle savings and wealth trajectories. By employing a time-invariant individual characteristic, we avoid estimating and applying wealth dependent survival probabilities, as it is done e.g. by Attanasio and Hoynes (2000). Their questionable but necessary assumptions call for alternative approaches to validate their results. Contrary to the results of most previous studies (e.g. Attanasio and Hoynes, 2000; Jianakoplos et al., 1989; Shorrocks, 1980), we do not find evidence for a synthetic panel bias in our data. In fact, the life-cycle trajectories for savings turn out to experience similar numbers of upward and downward corrections. For wealth, we find barely any cases where the level of dissaving would be underestimated in an uncorrected synthetic panel.

Overall, our results eliminate differential mortality as a possible explanation for the German savings puzzle. On the other hand, joined with the evidence provided in the technical appendix, the first chapter supports the EVS as a sufficiently good basis for a wide range of life-cycle analyses.

Chapter two leaves the basic investigation of the data behind to focus on a first applied life-cycle analysis. Looking at the historical trends in household portfolio choice, we aim to understand the underlying life-cycle effects and the role of cohort-differences. For the assessment of life-cycle effects, we need to elicit life-cycle patterns of asset allocation. These in turn, can be used to compare the predictions of theoretical models of portfolio choice with actual household behavior.

In a first step, we look at five broad financial asset categories and contrast the trends in portfolio shares and participation rates estimated from the EVS household data with the results of aggregate statistics. We then look at the underlying meta-trends in the investment behavior of different cohorts. We find for instance that households from all age-groups have participated in the trend towards stronger investments in securities. At the same time, we also find distinct differences across cohorts. In fact, younger cohorts show a higher propensity to invest in securities than their predecessors. Cohort differences can also be found for life-insurance policies and saving accounts who have both lost part of their previous popularity, although among different age-groups. We are surprised to also find some reductions in the popularity of life-insurance products between cohorts at young age. We return to the investigation of the possible reasons in the third chapter.

The second objective of the paper is to compare empirical evidence for life-cycle asset allocation with the predictions of theoretical models. We therefore aim to elicit general life-cycle trajectories of portfolio choice from the synthetic cohorts. As the actual life-cycle patterns differ across cohorts, the estimation of one general life-cycle pattern is a non-trivial task. Given that we observe each cohort only in a certain age-window, there is no other way to arrive at a full life-cycle profile than to rely on the joint information of all cohorts. As the drivers behind cohort heterogeneity – be they different

preferences, expectations, initial endowments, or differences in the institutional environment – clearly outnumber the cohorts we observe in each age-group, it is virtually impossible to parameterize these factors for the estimation of a stylized life-cycle profile. Instead, simplifying assumptions about the nature of cohort differences are necessary. A number of different procedures has been proposed and discussed in the literature (Deaton and Paxson, 1994; Brugiavini and Weber, 2001; Ameriks and Zeldes, 2001), the key issue being the collinearity of age-, cohort- and time-effects in a linear specification. Identification can easily be achieved by excluding either cohort- or time-effects but in some cases neither may be justified. As our cohort analysis of portfolio choice suggests that time- and cohort-effects may be important, we rely on the Deaton-Paxson methodology which restricts time-effects to be orthogonal to a possible linear trend.

The resulting life-cycle profiles look mostly plausible and in line with the savings motives we would tend to associate most with the respective assets. However, the results also highlight the problems connected to the estimation of a general life-cycle trajectory based on the behavior of different cohorts. A crucial aspect is the assumption that time- and cohort-effects only shift an unchanging general life-cycle pattern. As many trends will affect only part of the life-cycle profile or alter it in different directions at different points of the life-cycle, the above assumption is often to be considered unrealistic and may ultimately lead to biased age-profiles. Whenever we are uncertain about the true nature of time-and cohort-effects we should thus rely on the raw results of the cohort analysis. Furthermore, it conveys substantially more information about the changing nature of life-cycle profiles.

In chapter three, we set aside the analysis of life-cycle profiles and look instead at the drivers of household saving behavior. From our previous comparison of the age-pattern of cohorts' saving behavior and asset allocation with the implications of theoretical models only a broad judgment of the ingredients of theoretical models is possible. We therefore revert to regression analysis to understand the drivers behind German households' investment choices. We focus on the demand for life-insurance products which have the capacity to satisfy a wide range of saving motives. Retirement savings and tax advantages are probably the most named arguments for investing in a life-insurance policy. Additionally, the provision for the family in case of an early death of the main earner or a bequest motive may play a role. Finally, also the wish to acquire a piece of real estate may be a reason to sign a life-insurance contract. Given that life-insurance plays an exceptional role in German households' portfolios, we can expect to gain important insights not only about the demand for life-insurance but also about Germans' saving motives in general.

The chapter stands in the tradition of an earlier working paper by Walliser and Winter (1999) who suggest a theoretical model that allows for variation in the replacement rate of the public pension system, in the tax advantage connected to life-insurance products compared to other assets, and in the strength of a bequest motive. Building on the predictions of their model we add to their empirical approach in several dimensions. First, we include additional cross-sections of the EVS to obtain additional variation through changes in the tax system. This allows us to separate income and tax effects. Second, we generate detailed measures to quantify the tax advantages connected to investments in life-insurance products. Third, we include additional measures to identify households with higher need for additional private old-age provision and proxies for a motive to provide for the family against unfortunate events. Finally, we estimate a two stage model in which we separate the investment decision from the size of the investment.

For part of the question whether households respond to tax incentives in their savings and investment decision, our results are split. The tax exemption for interest earned in a long-run life-insurance contract turns out a distinct motive for investing in life-insurance products. The possibility to deduct contributions from taxable income, however, turns out ineffective. Although our evidence is mixed for the two types of tax incentives, our results clearly differ from those of Jappelli and Pistaferri (2001) who find no changes in Italian households' investment behavior after a rigid cutback in tax incentives. Among the other saving motives, we find overall supportive evidence for the old-age saving motive. We further conclude that the wish to provide for ones dependents is associated with higher investments in life-insurance products with a term-life component.

From our results, we expect the reduction in the generosity of the public pension scheme and the recent reform of the tax incentive scheme to result in significant shifts on the German life-insurance market. Especially annuity insurance products must be expected to profit at the disadvantage of whole life insurance products.

The fourth chapter is dedicated to the analysis of inequality in a life-cycle context. Overall, the reasons for rising inequality are still not well understood, and hitherto the public and political debate has given little thought about natural trends in inequality which may in part be caused by demographic change or by skill-biased technological change. The subject, however, is not only of interest for political and sociological concerns, but also for applied quantitative macroeconomists. They have become more and more interested in inequality, as today's quantitative models incorporate increasing dimensions of heterogeneity. For the calibration of the models, internationally comparable stylized facts about income, consumption and wealth inequality are required which are

hitherto unavailable. Empirical evidence about life-cycle inequality is especially important given the predominance of OLG models for the simulation of aging economies.

Part of the research for this chapter has therefore been motivated by an international infrastructure project which aims to fill this gap of empirical evidence. We start by documenting the trends in inequality for the last 25 years in Germany. Disposable income and consumption exhibit little inequality growth, whereas wealth inequality has seen a significant increase. We then decompose these trends and illustrate the influence of the German Reunification and the trend towards smaller households. Finally, we investigate the evolution of in inequality over the life-cycle of cohorts. As we have shown in chapter two, the assumptions underlying the estimation of a general age-profile may have crucial influence on the results. We therefore employ two different approaches and arrive at ambiguous results for income and wealth. Only for consumption, we find a clear upward trend in inequality over age.

In the last part of the chapter, we further investigate the drivers behind wealth inequality. It turns out that active savings account for the lion's share of wealth growth in Germany. Passive savings, by contrast, have mostly caused wealth reductions. The reasons are the conservative asset allocation of financial wealth, as well as the poor performance of real estate wealth. The German housing market has generated only small positive nominal returns which were neither sufficient to compensate for inflation, let alone for the interest payments on the mortgages. Overall, the predominance of active savings for wealth growth implies a strong interdependence between the distributions of wealth and income. Accordingly, we observe a clear income gradient in projected wealth growth. While households in the top income decile have been able to increase their wealth by a compound annual real growth rate of almost 5 percent, those at the bottom of the income distribution have suffered small wealth losses. These results, however, have no direct implications on wealth mobility, given that households do not remain in the same income group over their life-cycle.

Following these four chapters, a technical paper concludes this dissertation. It documents all imputation and harmonization work which was involved in the preparation of the EVS data for the above empirical analyses. These steps are necessary, as the EVS surveys are carried out with a focus on providing information for the construction of consumption baskets and the calculation of subsistence levels. The comparability of items across surveys has thus been of secondary importance. There are two important contributions of this paper: First, we suggest a new procedure to impute the EVS wealth data. Previous work has mostly involved some kind of mean imputation which has been – at least in part – also been applied by the imputations carried out by the Federal Statistical Office.

As this procedure is neither suited to preserve the true interdependencies between various economic variables nor to preserve the variation within the imputed variables, we rely instead on regression based imputation. We augment our approach by adding a random component which takes the form of cold-deck or hot-deck error sampling. Second, we discuss and analyze the possible influence of structural changes to the EVS sample on life-cycle analyses. Specifically, these are the switch from an annual to a quarterly household diary and the changing sampling threshold with respect to income. The latter can be expected to cause only minor disturbances and only for selected life-cycle analyses. The effects connected to the switch in the household diary are much harder to assess. We should expect the distribution of annual variables constructed from quarterly data to exceed that of regular annual data. A substantiated assessment would require outside information on the cross-quarter correlations of household incomes and expenditures. Distributional analyses based on the EVS should thus be careful in the interpretation of changes observed between 1993 and 1998.

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Chapter 1

Are Germans really not dissaving at old age or are we just not seeing it?

I. Introduction

Life-cycle saving behavior has attracted a large deal of attention since the fundamental work by Modigliani and Ando (1957). Despite the various extensions to the classical life-cycle model that have been suggested to reconcile empirical evidence with the theoretical predictions of the life-cycle model, an astonishing number of aspects in household saving behavior remains opaque. Especially the saving behavior of elderly households is still not well understood. Specifically, it has been shown for a number of countries that households continue to save also after retirement. Examples are Brugiavini and Padula (2001), Börsch-Supan et al. (2001), and Takayama and Kitamura (1994) who present such results for Italy, Germany and Japan respectively.

Economists have proposed several extensions to the theoretical life-cycle model to motivate the observed household behavior. The most influential additions concern uncertainty. In retirement, the important sources of uncertainty concern the life-expectancy (Yaari, 1965) and the evolution of individual health (Palumbo, 1999). Both aspects may induce precautionary savings and thereby lead to higher saving rates. But also the influence of a possible bequest motive – be it altruistic or egoistic – has been suggested.[1] Independent of these extensions of the life-cycle theory, also deviations from optimal life-cycle behavior have been proposed. Börsch-Supan and Stahl (1991) justify the low level of elderly dissaving by the deteriorating health status of the elderly which may prevent them from spending more of their income. However, none of the above contributions is suited to explain why the elderly in countries with a tightly woven public safety net are among those with the highest saving rates after retirement.

In this paper, we approach the disparities between theory and empirical evidence from the opposite direction and analyze the reliability of the empirical evidence on high old-age saving rates which the above extensions of the life-cycle model aim to match. In fact, the empirical evidence about life-cycle savings and wealth trajectories for a remarkable number of countries relies on synthetic panels constructed from repeated cross-sectional data. The possible bias induced by the use of synthetic panels has first been discussed by Shorrocks (1975) and more recently by Jianakoplos et al. (1989) and Attanasio and Hoynes (2000). They all conclude that dissaving among the elderly is underestimated in synthetic panel data, as the poor face higher mortality rates. That is, each cohort is observed with a more and more selective sample as it ages. Apart from considerations of differential mortality, also differential sampling may play a role. Jianakoplos et al. (1989) argue that sample attrition is higher among richer households. However, also conceptual aspects of the sampling process may produce an increasingly selective sample.

[1] For an overview over the literature on bequest motives see Jürges (2001).

Among the elderly, the conventional exclusion of the institutionalized population can be expected to play an important and hitherto underestimated role. Despite the existing social insurance schemes, we have to expect them to be among the strongest dissavers given the costs involved in long term care.

As mentioned above, all of the above previous studies find a strong inverse wealth gradient in mortality and conclude that the use of synthetic panels leads to upward biased age-trajectories in wealth. To the extent, that their correction procedure relies on estimating wealth-dependent survival probabilities it depends on strong assumptions. Attanasio and Hoynes (2000) for instance rely on the assumption of a time-invariant ranking of households in the wealth distribution. Heterogeneity in subjective life expectancies, in inter-vivos transfers, as well as in the importance of private retirement funds relative to public annuities are important reasons to question such assumptions and look for alternative procedures to validate previous evidence.

We therefore suggest a different procedure of employing a proxy for permanent income to correct for possible selection effects in the life-cycle trajectories of cohorts. To do so, we exploit a characteristic of the German pension system. Specifically, the pension entitlements of each individual depend on a time-invariant factor of so called "earnings points" and a known flexible component, the monthly pension payment per earnings point. After the retirement of a cohort and in a constant sample, the distribution of public pensions therefore only changes according to the legal rule which determines the value of an earnings point and the distribution of earnings points should be time-invariant. All changes to the distribution of earnings points must therefore stem from selection effects. Given that roughly 90 percent of the German population are covered by the public pension system, we can assess the importance of selection effects for a broad population. Furthermore, the use of earnings points provides us with an almost ideal measure of lifetime resources, as they essentially summarize the earnings history of each individual. While we give up the direct link between survival and wealth, we are above all able to proceed without strong and questionable assumptions.

Apart from our conceptual innovation, the use of German data allows us to join two strings of literature. Reil-Held (2000) and von Gaudecker and Scholz (2006) have shown that differential mortality with respect to income also matters in an economy with a reputedly tightly woven social security net.[2] A yet unanswered question is to what extent these effects carry over to savings and wealth and how much of the German savings puzzle (Börsch-Supan et al., 2001) can be explained by differential mortality. We fill this gap and assess the influence of possible selection effects in

[2] The analysis by Reil-Held (2000) is based on the GSOEP, while von Gaudecker and Scholz (2006) employ administrative records from the public pension fund, which we also employ in part of our analysis.

synthetic cohorts on the estimated life-cycle trajectories of saving rates and wealth. To do so, we employ data from the German Income and Expenditure Survey (EVS) based on which Börsch-Supan et al. (2001) have originally established the German savings puzzle.

Our findings with respect to the prevalence of differential mortality in individual pension entitlements are broadly in line with those of von Gaudecker and Scholz (2006). Especially among females we observe a decreasing share of individuals without a public pension over the life-cycles of cohorts. But also among pension receivers, selection effects play an increasing role as the cohorts grow older. Correcting the life-cycle trajectories of saving rates and wealth, however, we do not arrive at higher rates of dissaving. These results contradict the findings of Attanasio and Hoynes (2000). Furthermore, we can conclude that the German old-age savings puzzle cannot be explained by the use of a synthetic panel.

The paper is structured as follows. We start out in section two with a short summary of the German savings puzzle and present updated life-cycle trajectories by adding the most recent data to the previous analyses. Section three shortly describes the EVS data with a focus on selection issues and the concept of earnings points. We then present evidence for selection effects in the distribution of earnings points over the life-cycle of cohorts based on the EVS and evaluate the EVS sample in a comparison to administrative records from the German public pension fund. In section four, we then turn to the correction of life-cycle trajectories in saving rates and wealth and assess the importance of a possible synthetic panel bias. We summarize our results and discuss possible issues in section five.

II. The German Savings Puzzle

The Germans' high median and average saving rates at old age have made researchers wonder for more than a decade, what might be the reasons for this odd behavior. The rather generous public pension system may explain why the observed age-trajectories of savings and wealth are rather flat compared to the United States or the Netherlands (Börsch-Supan, 2002). Before the recent pension reforms, there was no need for large private savings in order to be well provided for old age. But also other institutional factors are unlikely to explain much of the German savings puzzle. Sommer (2002) compares a variety of possible institutional cross-country differences like the generosity of the public health insurance. Palumbo (1999) proposed the risk of high out-of pocket health expenditures as a possible reason against dissaving at old age. It turns out that the German public health insurance is rather generous by international standards so that the resulting precautionary savings should play only a minor role in explaining the German savings puzzle. Apart from these institutional considerations, health limitations as suggested by Börsch-Supan and Stahl (1991) as well as a strong bequest motive are candidate explanations for high saving rates among the elderly. However, there is no obvious reason why these factors should play an especially strong role in Germany. To our knowledge, Schnabel (1999) is the only paper which presents a German particularity to explain the German savings puzzle. He claims that the unexpectedly high growth rates of public pensions in the 1970s and 1980s had left households with much higher levels of retirement income than they had prepared for. Nevertheless, the high saving rates among elderly German households are still not satisfyingly understood. The same applies to similar evidence e.g. for Italy and Japan.[3] In the subsequent sections of this paper we therefore investigate the influence of the use of repeated cross-sectional data. We start, however, by updating the existing evidence from Börsch-Supan et al. (2001).

The life-cycle saving and wealth pattern updated

Employing a cohort analysis based on a synthetic panel, the initial step is the definition of a cohort. For our analysis we employ six cross-sections of the German Income and Expenditure Survey (EVS) from the years 1978 through 2003. We define cohorts by grouping households from five adjacent years of birth. The age and year of birth of a household are defined by the

[3] Different explanations have been suggested for the high saving rates among elderly Italians – specifically the importance of multi-generational households.

according figures of the household head, who in turn is defined to be the oldest male in the household. In the absence of male household members, we choose the oldest female.[4] To ensure a maximum of homogeneity of cohorts over time, we restrict our sample to West German households and exclude households with a foreign household head.[5] For each cohort, we present age-trajectories of total savings, saving rates, total net wealth and annualized wealth changes.

Measuring savings

Technically, savings can be measured in three ways: the sum of savings flows to and from certain asset categories, the difference between income and consumption, and changes in the level of wealth. The first two measures capture only active savings. The third also includes passive savings through appreciation or depreciation of asset values over time as well as through wealth transfers. In the EVS, income and consumption as well as contributions and withdrawals from the different wealth accounts are questioned by means of a household diary. Given that the diary includes essentially all incoming and outgoing payments, the Federal Statistical Office uses the available information to cross-validate the two sides of the household budget. Consequently, we obtain closely comparable results for both measures of active savings, as previously documented e.g. by (Börsch-Supan, 1999). For the results on active savings below, we rely on savings calculated as the sum of savings flows. Contrary to the first two savings measures, the difference in wealth levels also includes passive savings through appreciation or depreciation of asset values over time, as well as wealth transfers. Especially at old age, the importance of wealth transfers may be non-negligible. Thus, we may add important insights by looking additionally at this more comprehensive measure of savings.

Active savings

Median active savings show the expected hump over the life-cycle (see figure 1). Maximum savings are achieved between age 40 and 55. Towards retirement, savings drop considerably. However, median savings remain clearly positive throughout retirement. Specifically, the median household aged 65 and above saves between 350 € and 1500 €. Based on average savings we obtain quite similar results with slightly higher savings at all ages.

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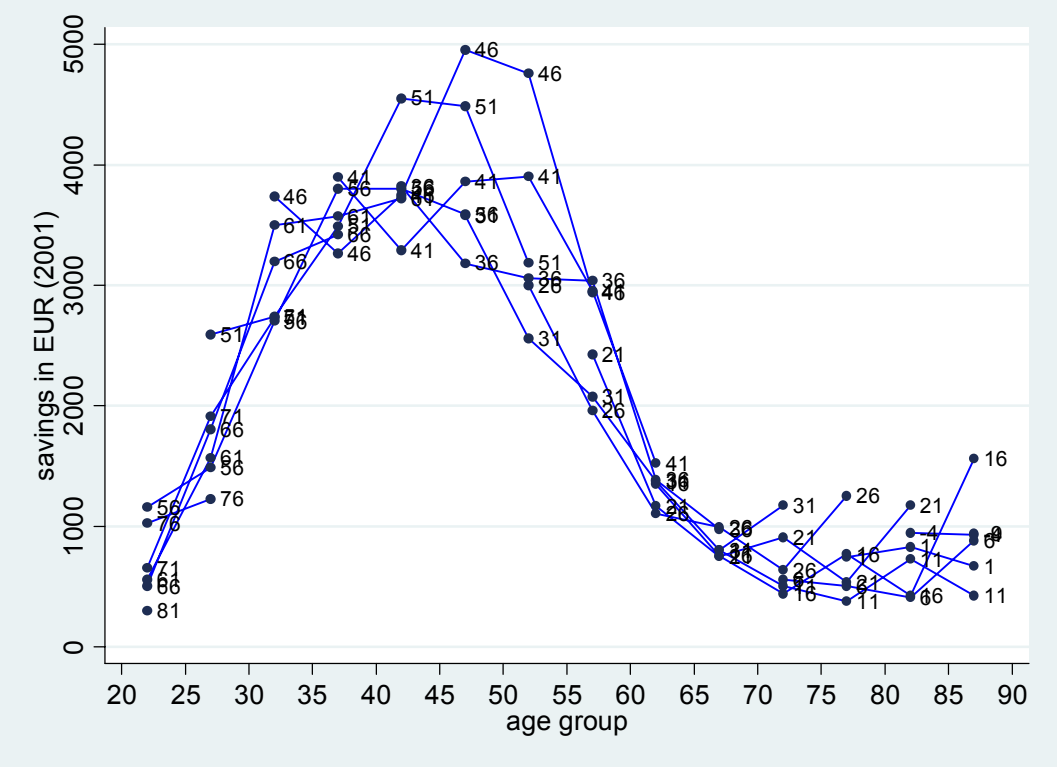
[4] This deviates from the EVS definition where the main earner is considered the household head. We choose this definition to ensure that we would attribute a household to the same birth cohort if he was part of the sample in several cross-sections and remained intact.

[5] Foreign households as well as households from the former GDR were first included in the EVS in 1993.

Figure 1: Median household savings of West-German cohorts (in Euros (2001))

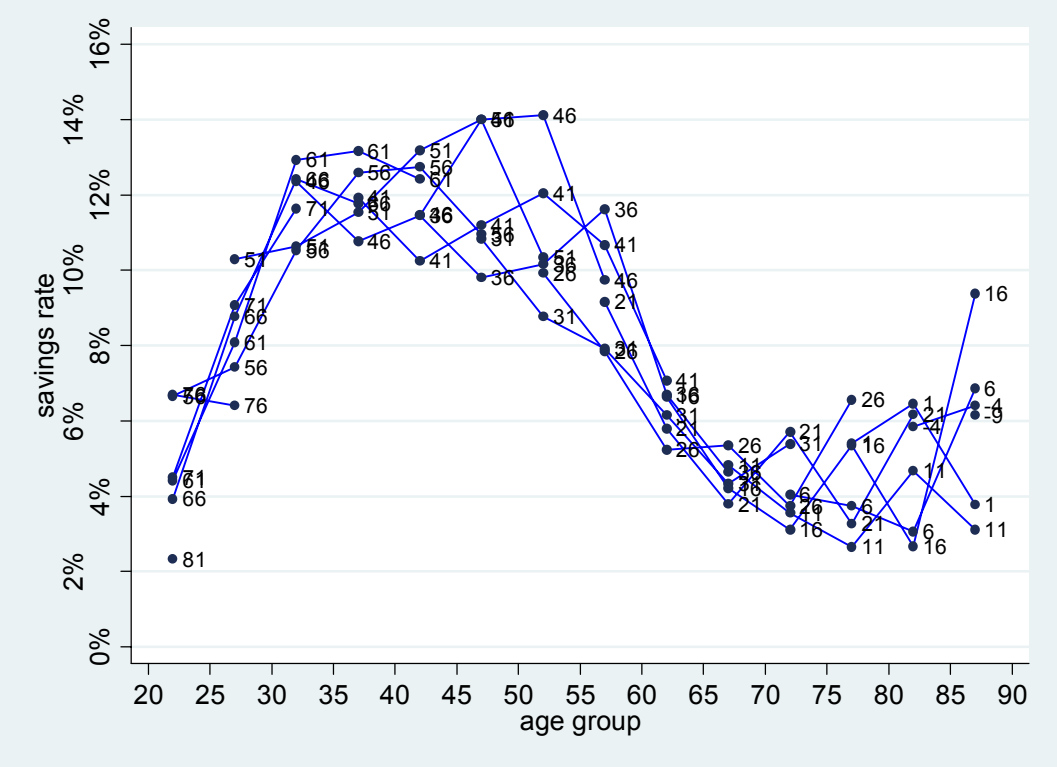


Source: Own calculations based on the EVS 1978-2003, weighted results; Note: the labels denote the birth cohorts. "46", for instance, refers to households headed by an individual born between 1944 and 1948.

Saving rates

To relate the above results for absolute savings to the available household resources, we next look at savings rates. Figure 2 displays the evolution of median savings rates, calculated as the net sum of savings flows divided by the net disposable household income. It turns out that the bulk of median saving rates in retirement lies between 2 and 7 percent. Again only few observations lie outside this band. To assess the prevalence of actual dissaving, we additionally looked at the share of households with negative savings rates. Pooling across cohorts we found roughly 28 percent of households in the age-group 65-74 to be dissaving compared to only 21 percent among pre-retirement households. However, the share of dissavers declines again among higher age-groups: Among households aged 75 and above, we found only 23.5 percent with negative saving rates. Overall, the results for active saving confirm previous evidence that only a minority of Germans is dissaving in retirement.

Figure 2: Median savings rates of West-German cohorts



Source: Own calculations based on the EVS 1978-2003, weighted results

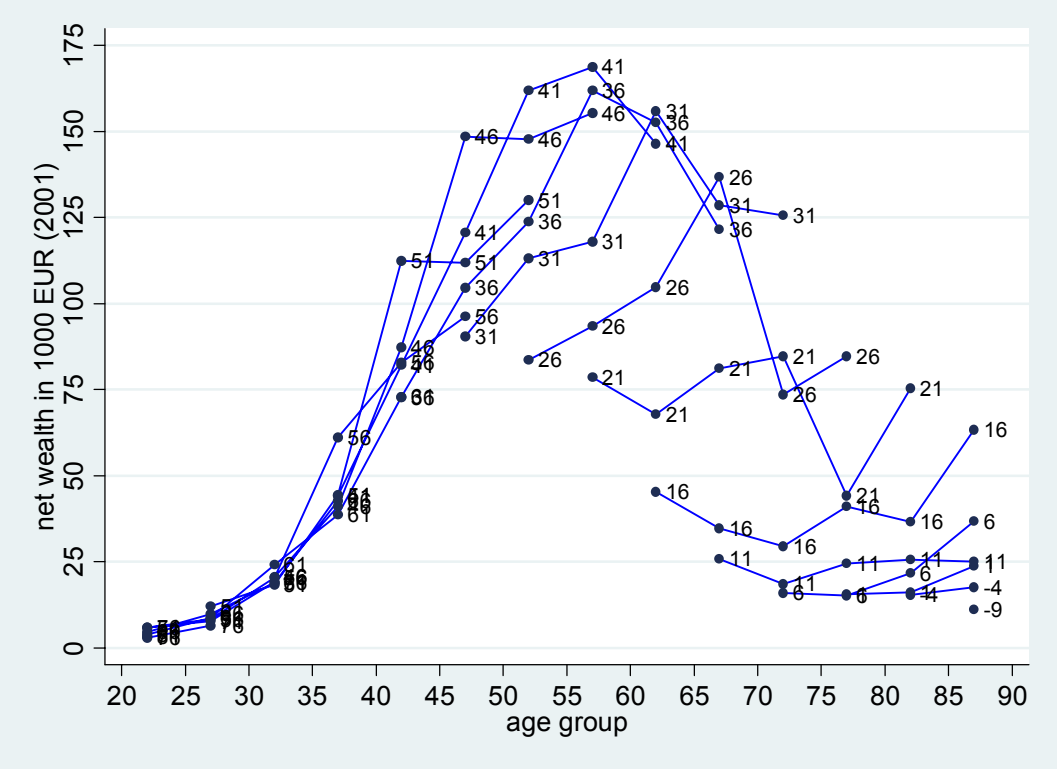
Wealth levels and wealth changes

As mentioned above, there may be more factors determining the levels of wealth than just active savings. First, there are changes in assets prices which may change the households' wealth without additions or withdrawals being made. Sommer (2008) shows, however, that among elderly German households, essentially only the top income decile has profited from such passive savings. All other households are barely affected by passive savings after retirement. The main reasons are the poor performance of real estate wealth and the conservative asset allocation on behalf of German households. Second, wealth transfers may play a role among elderly households. Even if the elderly do not dissave for the sake of their own consumption, they may deplete their stock of wealth by donating money or housing wealth to their children. If wealth is traded for the support of their children, this is quite closely comparable to dissaving for consumption purposes. However, wealth transfers between two cross-sections will occur largely unobserved given the five year intervals of the EVS data. Comparing the results for active savings with actual wealth changes, we therefore cannot distinguish wealth transfers and appreciation effects. Nevertheless, changes in median wealth levels and in the distribution of wealth within a cohort over time may supplement our understanding of the savings behaviour of the elderly. Put

differently, the resulting wealth changes provide us with a roundup of savings, transfers received and made, as well as valuation changes which happened between two surveys.

Figures 3 and 4 depict the evolution of median net total household wealth of cohorts over their life-cycles. While figure 3 is focused at the median levels, figure 4 looks directly at the first differences. That is, it represents total savings and includes all kinds of wealth accumulation or decumulation. We have annualized the changes, so that e.g. the data point of an age-group 65-69 can be interpreted as the average annual change in the median net wealth position of this cohort between age 60-64 and age 65-69.

Figure 3: Median net wealth of West-German cohorts (in 1000 € (2001))



Source: Own calculations based on the EVS 1978-2003, weighted results

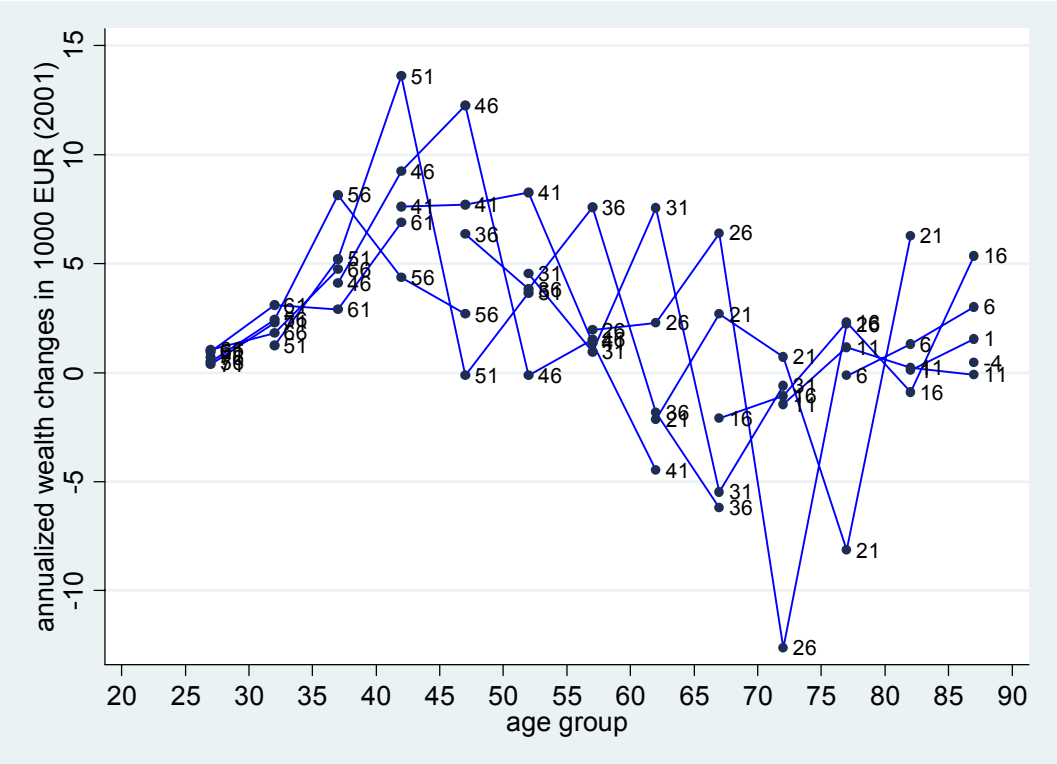
Wealth levels increase throughout most of the working life. We then observe reductions in median wealth levels between the age-groups 60-64 and 70-74. As we have learned from the evolution of net savings, these drops are unlikely to be related to dissaving. We cannot fully rule out actual dissaving since we observe households' sales and purchases of assets only over a short time span and not over the entire five years.[6] As valuation changes should affect all age-groups

[6] The diary was kept for a full year between 1978 and 1993. Since 1998, each household fills in the diary only for three consecutive months.

and cohorts in a similar way, it seems much more likely that inter vivos transfers explain the observed drops in median wealth levels. As the cohorts age further, we barely find any further reductions in median wealth levels. Somewhat surprisingly, the drops in median wealth levels are not matched in the corresponding averages, which we do not display here for brevity. This indicates that the observed wealth reductions do not apply for the entire distribution.

The age-trajectories of wealth changes turn out to be dominated by strong fluctuations which take the appearance of time-effects. Specifically, most cohorts have experienced their strongest wealth growth between 1988 and 1993. Over the subsequent years until 1998 most cohorts have seen little if any wealth growth. Despite the strong fluctuations, the positive wealth changes before age 60 and the substantial drops in the median wealth between age 60 and age 75 remain clearly visible.

Figure 4: Annualized differences in median net wealth (in 1000 € (2001))



Source: Own calculations based on the EVS 1978-2003, weighted results

The saving puzzle re-visited

Overall, we still find strong evidence for the German Savings Puzzle. Median active savings are strictly positive for all age-groups after retirement. Also the share of dissavers increases only slightly over the pre-retirement levels. Inspecting a more comprehensive measure of savings the changes in median wealth levels turn out to look much more in line with the life-cycle hypothesis.

We find drops in median wealth levels for roughly ten years into retirement which are most likely to be attributed to inter-vivos transfers. Last, there is an upswing in median wealth levels of cohorts reaching age 75 and above. If these results are reliable, they would be in line with the hypotheses raised by Börsch-Supan and Stahl (1991) of the elderly facing consumption constraints for reasons of bad health, but also with precautionary savings connected to health related consumption risks as suggested by Palumbo (1999). Before caring about a possible distinction between the two theories, the above evidence is to be tested for possible selection effects, which is what we turn to in the subsequent sections of this paper.

III. German savings and wealth data and the importance of selection effects

Having looked at the plain evidence based on which the German savings puzzle was established, we now take a closer look at the underlying sample. As we have mentioned before, Germany is still lacking a longitudinal data source which would be suited for life-cycle topics.[7] Consequently, all life-cycle analyses have relied on a synthetic panel based on the German Income and Expenditure Survey (EVS). The available cross-sections reach back until 1978 and contain between 40'000 and 60'000 households each.[8] The large sample size and the rather long history with 6 data points between 1978 and 2003 allow an investigation of age-trajectories of synthetic cohorts up to high ages.

In the following, we shortly describe the general selection effects implied by the sampling process of the EVS before we investigate effects of differential mortality and finally turn to an actual evaluation of the EVS sample based on administrative data. For a more detailed description of the data, see Sommer (2008a).

III.1 *The EVS sample*

The EVS is supposed to be representative for the German population with an exception of the institutionalized. Additionally, the Federal Statistical Office applies an upper income threshold above which households are not included in the sample. The latter can be expected to have little effects on the estimation of saving profiles among retired households (see Sommer, 2005, 2008a). While the exclusion of the institutionalized is typical for household surveys, there is good reason to believe that it will lead to an overestimation of savings among the oldest.

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[7] The only other data set with a sufficiently long time series to permit life-cycle analyses is the GSOEP. Unfortunately, the savings question only refers to precautionary savings and essentially rules out negative savings by the way savings are questioned. A first attempt to question wealth was made in 1988 which caused substantial attrition. In the following, wealth was not questioned again until 2002 and 2007. However, also the 2002 data contains a number of problems. Most importantly, assets below 2500 € per category are not questioned. Among the other panel surveys, SAVE and SHARE both contain a substantial section on savings and wealth. Their panel dimension is still too short for life-cycle analyses though.

[8] The first EVS was conducted in 1962/63. However, only the cross-sections 1978-2003 are available as scientific use files.

Non-sampling of top income households

We first look at the sampling threshold with respect to income. Specifically, households with a net monthly income of above 17'000-18'000 Euros were excluded from the individual cross-sections. Merz (2003) has shown for the EVS 1993, that roughly 1 percent of German households are not sampled due to the threshold. He finds further, that also below the sampling threshold, high income households are somewhat underrepresented in the EVS. The harm done by the sampling threshold seems minor given that also surveys without such restrictions have issues to sample households with higher incomes. In fact, the GSOEP contains only a handful of households with incomes above the EVS sampling threshold even after the addition of a high-income sample.[9] The additional jumps in the sampling threshold over time can be expected to be harmless for our analysis of the savings behavior of the elderly.[10] In fact, the marginal households are largely headed by a 40- to 55-year old, given the large household size and the high income levels at this age-group.

Exclusion of the institutionalized

The exclusion of the institutionalized may have similar effects like differential mortality. Households moving into a nursing home drop out of the sample just like households in which the last member dies. Table 1 illustrates the importance of institutionalization among the oldest old in Germany. Any survey excluding this population subgroup will hence miss up to a sixth of the population aged 85-90 – the oldest age-group we investigate in our analysis.

The risk of institutionalization is higher among low income households, as shown by Börsch-Supan (1989). This turns the remaining population into a selective sample. Yet we can only speculate about the actual savings behavior of the institutionalized given that most surveys tend to exclude them from the beginning. Given the costs of living in a nursing home we would expect the institutionalized households to save little or even dissave. Under this assumption the wealth and savings profiles estimated from a synthetic panel will be upward biased for the oldest old.

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[9] Sommer (2008a) finds between zero and 4 observations in the GSOEP of 1988, 1993 and 1998 with an income above the EVS threshold. In 2003, the income of 18 GSOEP households exceeds the EVS sampling threshold.

[10] We nevertheless apply the correction suggested by Sommer (2008a).

Table 1: Institutionalization by age-group

age	in need of care	institutionalized	institutionalized (in % of age-group)
65 - 70	121'110	26'478	0.6%
70 - 75	181'528	41'483	1.1%
75 - 80	284'699	79'418	2.8%
80 - 85	338'610	109'580	6.4%
85 - 90	391'296	150'878	15.2%
90 - 95	259'390	112'813	26.6%
95 and above	69'318	34'943	27.7%
total	2'039'780	604'365	0.7%

Source: Pflegestatistik 2001

III.2 *Evidence for differential mortality in the EVS synthetic panel*

In the case of a true panel it is usually quite easy to evaluate the presence of differential mortality: Households can be followed over time and we thereby observe changes in the household composition – be it through the birth of children, the moving in or out of individual household members or their death. If a household leaves the panel altogether, survey agencies make efforts to learn about the reasons – be it death or the just the unwillingness to participate again.

In a synthetic panel, none of this is possible. If households participate in several cross-sections, their observations cannot be linked over time. However, there are ways to deduce the presence of selection effects like differential mortality. Specifically, we investigate the evolution of time invariant household characteristics. In the absence of differential mortality in the population, we would expect to observe no changes to the distribution of time invariant household characteristics over the life-cycle of a cohort. A typical example is the distribution of educational attainments, which should be stable from a certain age. If we observe changes to the distribution of such variables in our sample, we take this as evidence for selection processes like differential mortality, differential institutionalization or differential sampling success. In the following, we uniformly denote all of the above selection effects as differential mortality as they have comparable effects and there is no way we could distinguish between them in a synthetic panel.

Choice of identifying variables

The key to finding evidence in favor or against differential mortality in a synthetic panel are time-invariant household characteristics, as outlined above. These variables should additionally be closely related to the drivers of differential mortality. Only then can we expect a good indicator for selection effects which is then also applicable for a later correction. That is, we essentially search for proxies of permanent income.

In an analysis focused on the retired population, educational achievements are clearly a candidate variable. Given that education is usually completed decades before retirement, the share of individuals with different degrees should be constant throughout retirement. Unfortunately, the EVS data contains information on the individuals' education only in 1993.[11]

We therefore exploit a characteristic of the German public pension system. Specifically, public pensions y^P depend on the earnings points EP an individual has accumulated over his life-cycle and the value of an earnings point PV (see equation 1).[12] The earnings points may be adjusted in the case of early retirement but the scaling factor AF will apply through all years after retirement.

$$y_{it}^{P} = EP_i \cdot AF_i \cdot PV_t \qquad (1)$$

It is important to understand that only the value of earnings points PV will be changing over time once an individual has retired while the actual number of earnings points will remain constant. Legal retirement age used to be at age 65 or below between 1978 and 2003. Job market participation beyond age 65 is close to zero in Germany and job-market re-entry is quite unusual after retirement. Hence the distribution of earnings points should be constant for each cohort once it has fully entered retirement unless there is differential mortality or other issues connected to the sampling process. Also the data-situation is quite favorable, given that the EVS contains information on the individuals' income by source, among them public pension payments.[13] Given that the value of earnings points is known for each year and common for all retirees, we can calculate the individuals' earnings points. To be precise, we calculate effective earnings points

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[11] Instead, the EVS 1993 through 2003 contains information on the job education. However, for retirees this information is largely unavailable.

[12] Earnings points are accumulated annually depending the individuals' contributions to the pension system. Also for child raising times earnings points are credited. For a description of the public pension system see Börsch-Supan and Wilke (2003).

[13] Dependant's pensions are recorded separately.

EEP, which we define as the product of actual earnings points times the adjustment factor (see equation 2).

$$EEP_i \equiv EP_i \cdot AF_i = \frac{y_{it}^P}{PV_t} \tag{2}$$

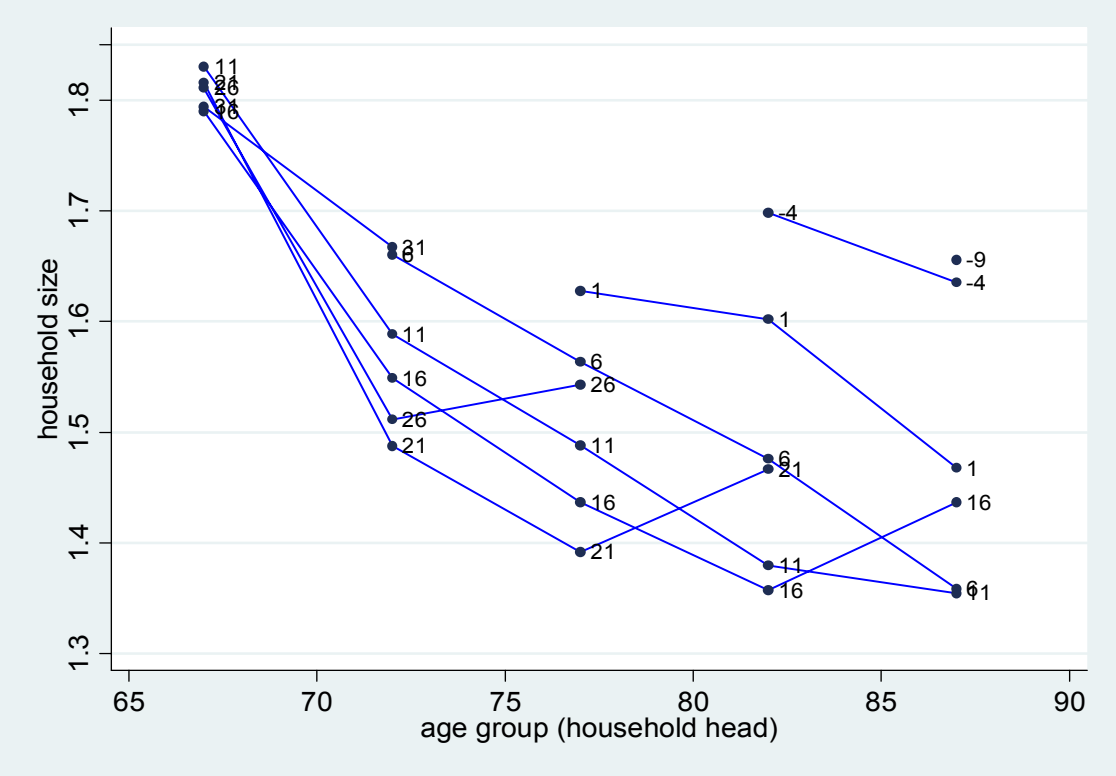
The main downside of using an estimate of the earnings points from the public pension system is that it cannot be calculated for the entire population. However, roughly 90% of today's population aged 65 and above are covered by the public pension system. The sample is certainly not representative for the German population given that a large share of self-employed individuals is not covered. Yet learning something about 90% of the retired population seems to be an important step towards understanding the savings behavior of German retirees in general. Furthermore, public pension income is the main source of income in retirement and the earnings points essentially summarize the earnings history of employees. For individuals who have only worked in dependent employment we therefore obtain an excellent measure for permanent income. Only for individuals who spent part of their working life in self-employment or as a civil servant, the earnings points derived from a public pension yield misleading results. In fact, a number of individuals with extremely low earnings points have indeed rather high permanent incomes. This will be the case for if they left the public pension system early in their life-cycles towards the civil service or into self-employment, as argued already by von Gaudecker and Scholz (2006).

Household size and household headship

Our first approach to look for selection effects is focused on the household level. Mortality rates are non-negligible among the age-groups we consider and cause substantial changes to the households' size and composition. Figure 5 illustrates how the average household size changes over the cohorts' lifecycles. Over the first 10 years into retirement, the average household shrinks from about 1.8 persons to between 1.4 and 1.6 persons. The decline in household sizes is more pronounced among younger cohorts.

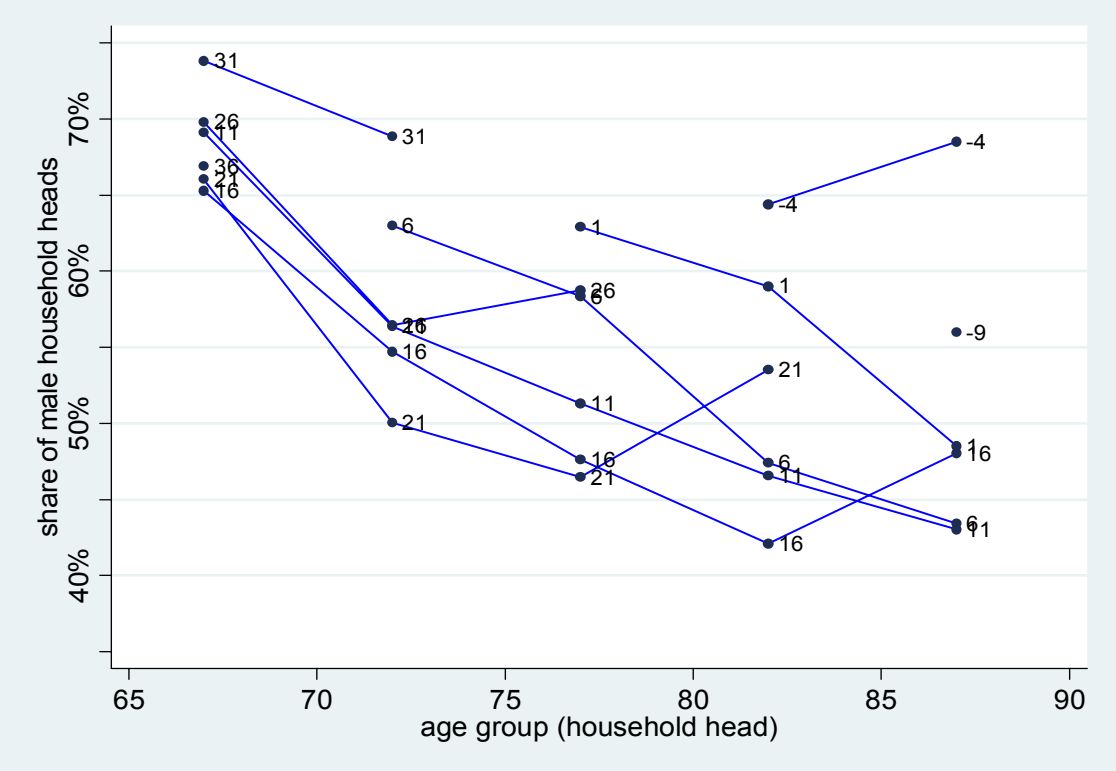
More important are the changes in household headship though. The differences between male and female survival probabilities lead to a decline in the share of male household heads (see figure 6). Given the substantial amount of switching in household headship we are well advised not to focus on the distribution of the household heads' earnings points for our analysis.

Figure 5: Average household size by age of household head



Source: Own calculations based on the EVS 1978-2003, weighted results

Figure 6: Share of male household heads by age of household head



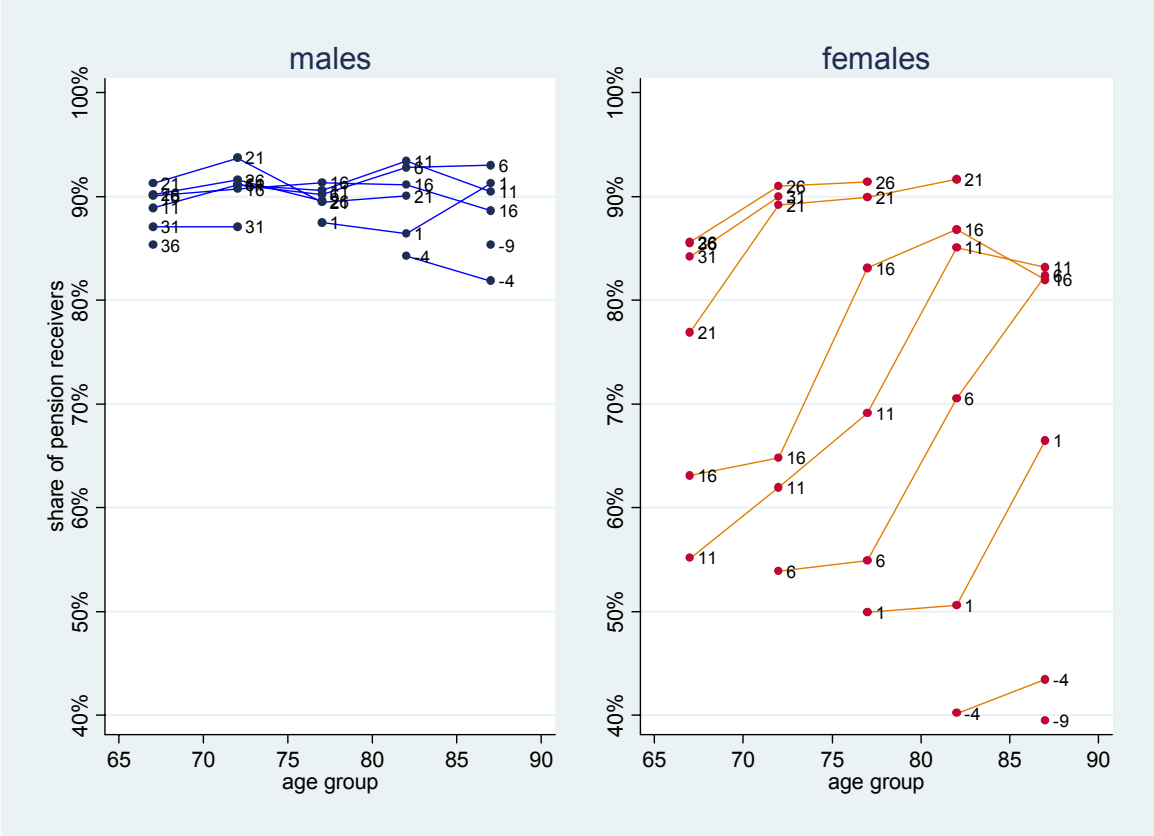
Source: Own calculations based on the EVS 1978-2003, weighted results

In the following we therefore switch from a household perspective to an individual perspective and distinguish between the male and the female population. Note, that the administrative data we use below to examine the quality of the EVS sample also considers only individuals. Despite these strong arguments to switch to an individual perspective, we should keep in mind that the link between individual earnings points and differential mortality may be weakened if resources are pooled e.g. in couple households.

Public pension status and earnings points

As described above, almost 90% of today's elderly population receive a public pension. The share of pensioners among males has been roughly constant at this high level over the last decades. At the same time, own pension entitlement among females has seen strong growth rates (see figure 7). While only 55 to 65 percent of the females aged 65-69 received a public pension in the years 1978-1983, this share had increased to the level of males by the year 1998, i.e. within only 15 years.

Figure 7: Share of individuals receiving a public pension by gender



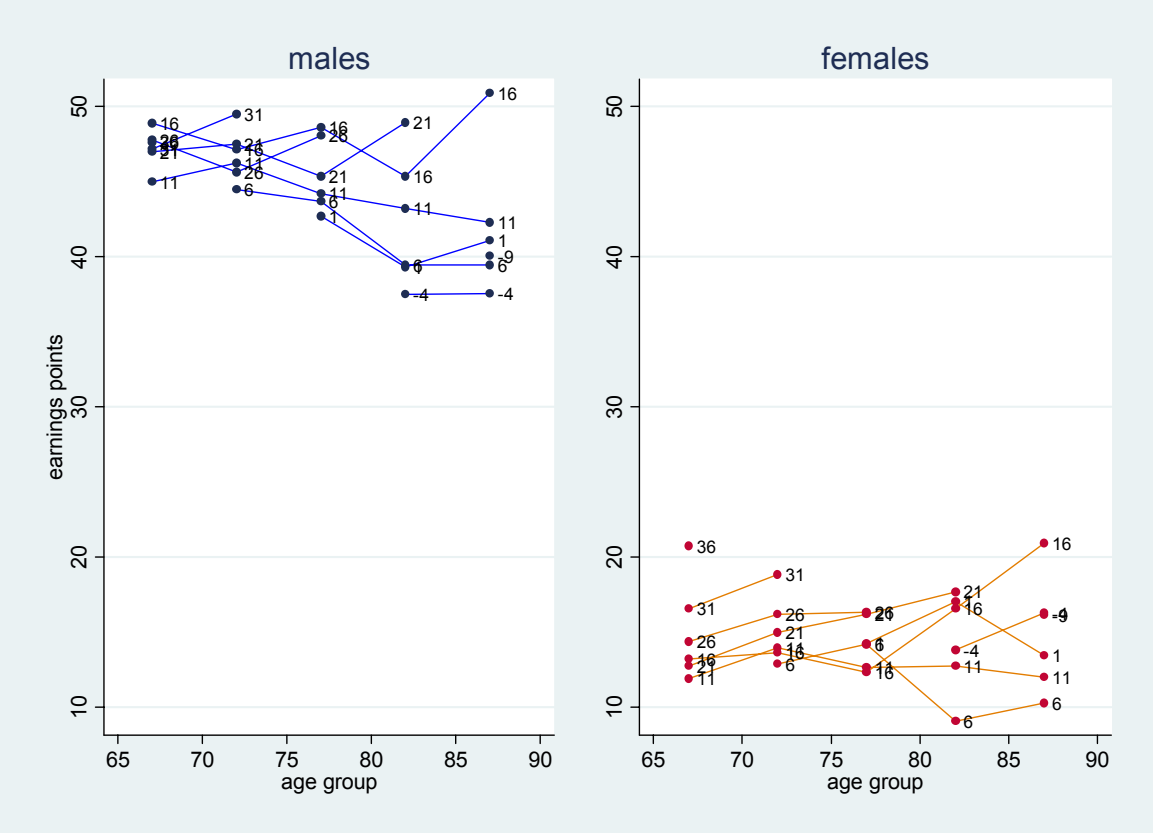
Source: Own calculations based on the EVS 1978-2003, weighted results

Note: pension payments only based on the individuals own claims, i.e. dependant's pensions are not included

Apart from the gender gap and the evolution of females' own pension entitlement over time we also observe strong age-effects within the female cohorts. Look at females born between 1909 and 1918: Where the share of pension receivers should remain constant once these cohorts have fully entered retirement, we observe this share to rise steeply by almost 20 percentage points. Given that the above results are based on individuals and split by gender, we can be rather sure, that some selection issues are at play among the elderly – especially for females.

Inspecting the subgroup of pension receivers further, we look at the distribution of earnings points within cohorts as they age. Figure 8 gives us a first impression by looking at the development of median earnings points. First, we observe a strong gap in median earnings points between males and females. While males pensioners have accumulated 45-50 earnings points at the median, female pension entitlements are based on only 20-30 earnings points at the median. Again, the youngest female cohorts seem to be somewhat better off. Each cohort enters retirement with higher median earnings points than its predecessor. The subsequent evolution of median earnings points indicates that also here, selection effects play a certain role, although they seem smaller than what we observed for the participation question above. For males, the age-trajectories exhibit some ups and downs in the median earnings points with no clear trend.

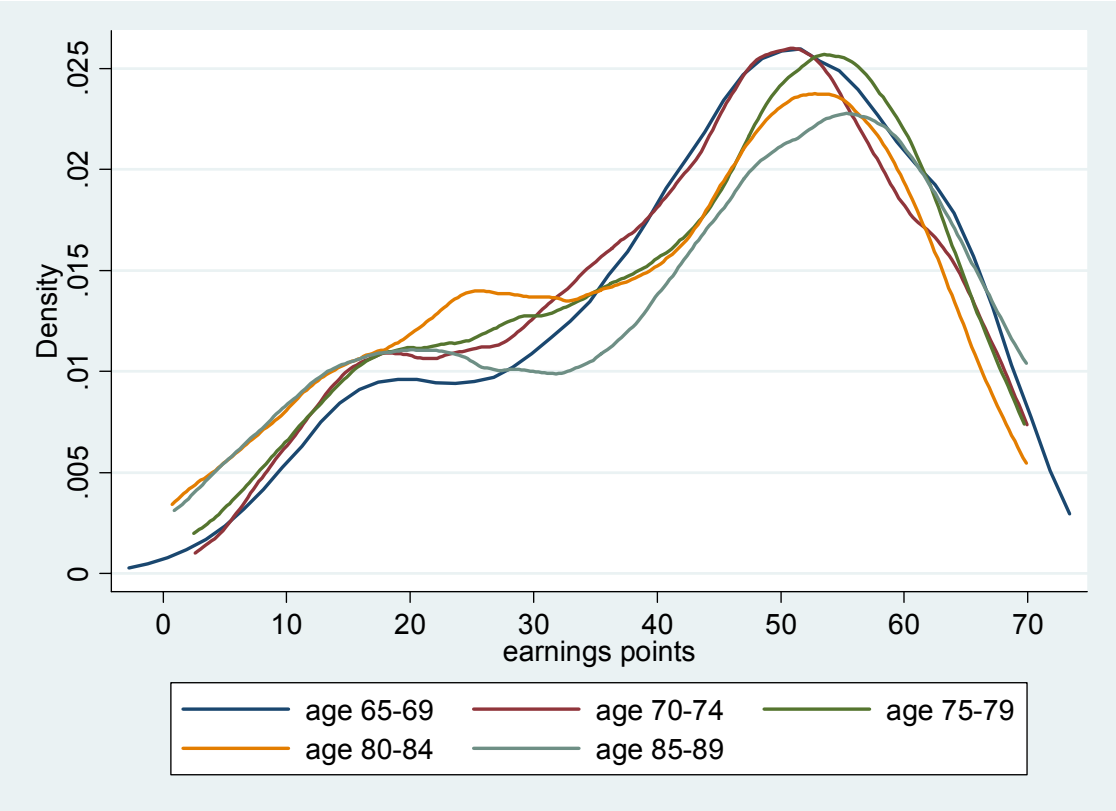
Figure 8: Age-trajectories of median earnings points by gender



Source: Own calculations based on the EVS 1978-2003, weighted results

Being aware that the median of a distribution is a tentatively insensitive measure for changes in the distribution of a variable, we dig deeper and look at the actual distribution of earnings points in selected cohorts over time. Figures 9 and 10 depict kernel density plots of the distributions of earnings points of the male and the female cohort born between 1914 and 1918 as they evolve in the EVS samples 1978 through 2003. The changes in the distribution of males' earnings points over the years show little clear direction (figure 9). Overall, the distribution is slightly flattened over age. The peak density at the upper end of the distribution is lowered and shifted further to the right, whereas the share of individuals at the bottom end of the distribution increases slightly over time.

Figure 9: Changes in the distribution of earnings points among males born 1914-1918



Source: Own calculations based on the EVS 1978-2003, weighted results

These results are in line with a finding by Gaudecker and Scholz (2006), who argue further, that the bottom end of the distribution of earnings points is quite heterogeneous. Table 2 supports their suggestion that a considerable number of civil servants are found there. In fact, we find as much as 48.2 percent of the males with a small public pension entitlement to also receive a civil servant's pension. Among all males with up to 18 earnings points civil servants pensions are on average five times as high as public pensions. The prevalence of civil servants declines strongly among males with higher public pensions though. Generally, the same argument can be made

also for individuals who left the public pension system into self-employment and therefore accrued only a small number of earnings points in the public pension system.

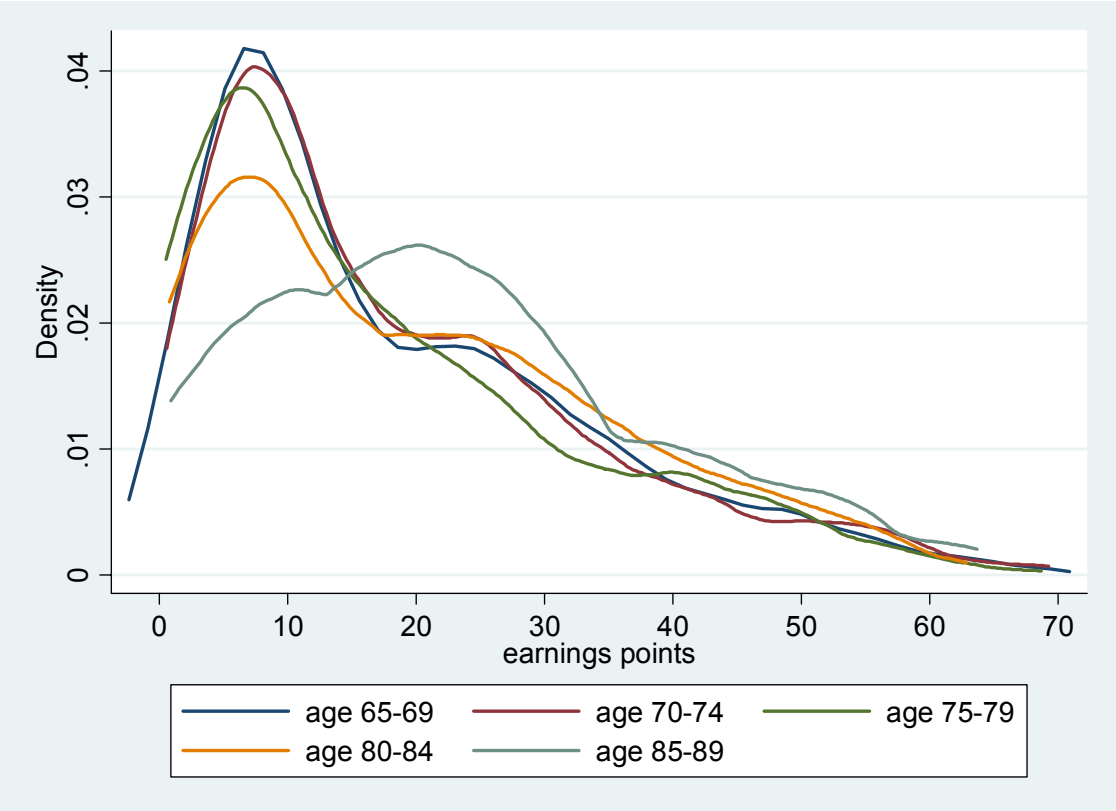
Table 2: Prevalence of civil servants among male public pension receivers

	0	0< EP < 18	18 ≤ EP < 36	36 ≤ EP < 48	48 ≤ EP < 60	EP ≥ 60
share of males w/ civil servants' pension	73.4%	48.2%	13.6%	2.0%	1.5%	1.6%
average ratio of civil servants' pension and public pension						
all males	∞	5.65	0.44	0.03	0.01	0.01
male civil servants	∞	11.71	3.20	1.59	0.92	0.88

Source: own calculations, weighted results; Note: pooled results for all years, all age-groups above age 65

For part of the earnings point distribution among females we find more clear-cut evidence in favor of a changing sample (see figure 10). It is the bottom part of the distribution which catches the eye first: we find the share of females with less than 13 earnings points to decline steadily as the cohort ages. The reverse pattern can be found for females with 40 to 55 earnings points. Part of the reason why the selection effects appear so much clearer may be the considerably smaller effects of additional civil servants' pensions, as illustrated in table 3.

Figure 10: Changes in the distribution of earnings points among females born 1914-1918



Source: Own calculations based on the EVS 1978-2003, weighted results

Table 3: Prevalence of civil servants among female public pension receivers

	0	0< EP < 6	6 ≤ EP < 12	12 ≤ EP < 20	20 ≤ EP < 28	EP ≥ 28
share of females w/ civil servants' pension	5.6%	0.7%	1.2%	2.2%	0.9%	1.1%
average ratio of civil servants' pension and public pension						
all females	∞	0.23	0.10	0.10	0.03	0.01
female civil servants	∞	33.10	8.33	4.29	3.26	1.21

Source: own calculations, weighted results; Note: pooled results for all years, all age-groups above age 65

Overall, the above evidence suggests, that selection effects play a stronger role among females than among males. First of all, the share of females without a public pension declines strongly over the life-cycle of cohorts. Furthermore, also the share of females with rather low public pensions declines. We might have expected the evidence for differential mortality among low income females to be vague given that the socioeconomic status of the household is often be dominated by the male's income. However, it is among males that we find no clear evidence for the importance of selection effects. The main reason may indeed be the significant share of individuals with additional civil servant's pensions and of previously self-employed among alleged low income males. Looking at the share of individuals with a public pension over the life-cycle of cohorts, we did not find major fluctuations though.

III.3 *Evaluating the EVS sample based on administrative data*

Having established some stylized facts about the importance of selection effects throughout the retirement of cohorts, we last compare the EVS sample of public pensioners to administrative sources. We restrict our comparison to the age-group 65-69, i.e. the first age-group of each cohort entering retirement. We abstain from a more comprehensive comparison because our ultimate focus is on the correction of life-cycle savings and wealth trajectories. To mimic the characteristics of a panel based life-cycle analysis, we will ultimately aim to keep the distribution of time invariant characteristics constant over the remaining life-cycle of each cohort. Hence, knowing the true distribution of earnings points at the starting age of each cohort is fully sufficient for our purpose.

The administrative reference sample

For the evaluation of the EVS sample of young retirees we rely on pension records provided by the German pension fund. The fund is the administration authority for the pay-as-you-go system and maintains records on all individuals who receive a public pension. Our scientific use file contains a 1 percent sample of all pension recipients for the years 1993 through 2003. It contains males and females without information on possible family links. Most importantly it provides information on the individuals' total earnings points.

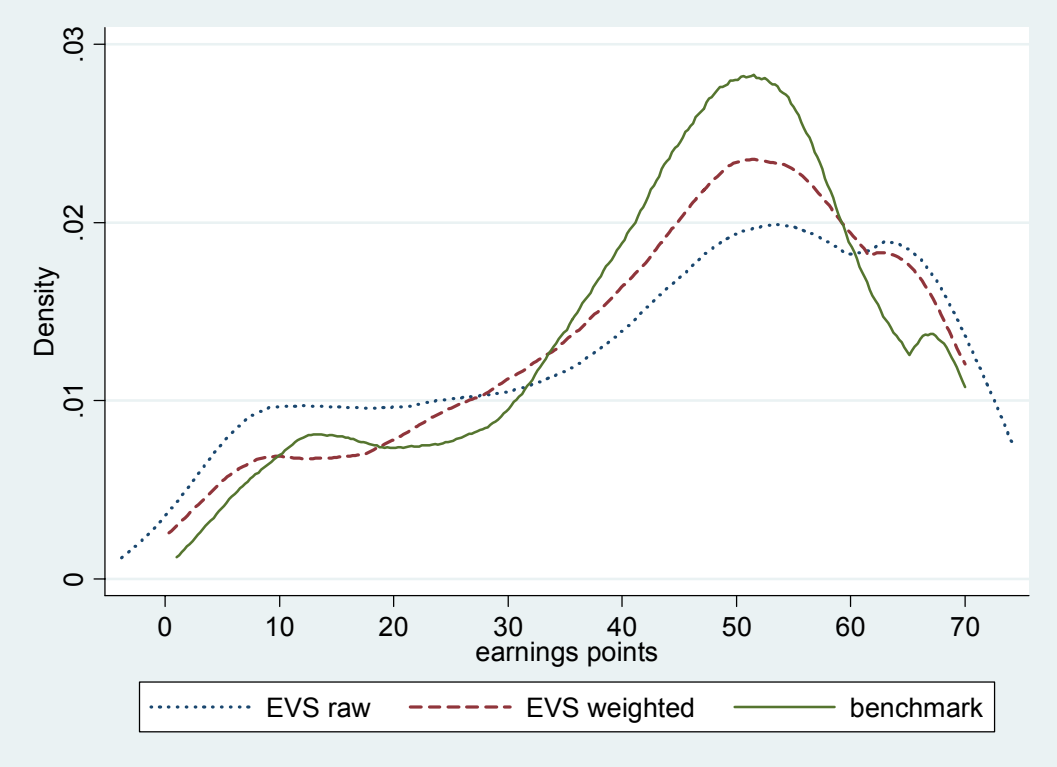
Of the full sample we keep only individuals from West Germany and disregard East Germans and individuals living abroad, as we also exclude these groups from our cohort analysis. Further, we restrict the sample to individuals receiving an old-age pension and disregard e.g. pensions for reduced earnings capacity. The remaining samples for 1993, 1998 and 2003 have a size of about 80'000 to 104'000 individuals. Restricting the sample further to individuals aged 65-69 the pension fund data still contains roughly 27'000 to 34'000 individuals, of which 52.5 to 56.6 percent are female. The huge sample size is therefore well suited for distributional analyses. The corresponding EVS samples are considerably smaller but still sufficiently large at sample sizes that range between 3'300 and 3'900 individuals.

Evaluating the initial EVS sample

Given that the administrative data reaches back only until 1993, we essentially have only six cohorts which we observe at their entry to retirement, three male and three female cohorts. We restrict the presentation of the results of our comparison between the EVS and the administrative data to the cohort entering retirement in 1993. We skip the findings for the subsequent years for brevity as the structural differences between the two datasets remain constant across the years.

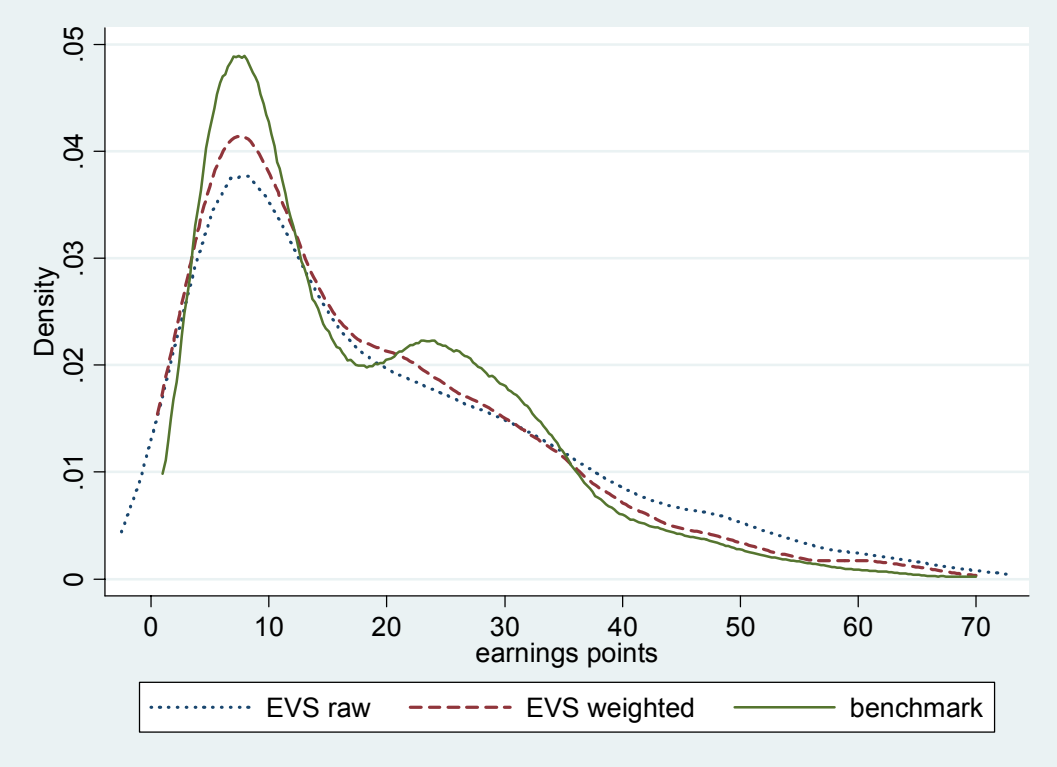
We start with the distribution of earnings points among West German male old-age pension receivers aged 65-69. The dotted line in figure 8 describes the unweighted EVS sample, the solid line the benchmark from the pension fund data. Overall, the raw distribution of earnings points is too flat in the EVS. Males with a low public pension entitlement as well as males with earnings points near the top-coding level of 70 earnings points are over-represented in the EVS. Instead, there is a deficit of retirees with an upper middle pension entitlement of between 35 and 55 earnings points. The weights provided with the EVS data, however, help considerably to narrow the gap between the survey data and the benchmark.

Figure 8: Comparing the distribution of earnings points among males aged 65-69 (1993)



Source: Own calculations based on the EVS 1993 and administrative pension fund data

Figure 9: Comparing the distribution of earnings points among females aged 65-69 (1993)



Source: Own calculations based on the EVS 1993 and administrative pension fund data

Also for the case of female retirees applying the EVS weights helps a lot to receive a distribution of earnings points which is rather closely comparable to the benchmark (see figure 9). Despite the improvements achieved by the weighting, especially females with low pension entitlements remain underrepresented in the EVS.

To account for the remaining divergence of the distribution of earnings points in the early retirement years of a cohort from the benchmark, we will proceed in two steps for the subsequent estimation of adjusted life-cycle trajectories. Specifically, we first apply a re-weighting of the initial distribution in the EVS to reduce the discrepancies between the survey data and the administrative data further. In a second step, we will then adjust the survey weights of each cohort such that the initial distribution of earnings points is kept constant.

IV. Selection effects in the age-trajectories of wealth and savings

As outlined above, our ultimate goal is to purge the age-trajectories in saving rates and wealth of different thinkable selection effects. It has been shown by Reil-Held (2000) and von Gaudecker and Scholz (2005) that differential mortality with respect to the socioeconomic status and retirement income play a certain role also for the case of Germany. Additionally, any survey where participation is voluntary will face issues of differential response. Among the elderly, additional factors may play a role – among them especially health and the exclusion of the institutionalized population. In the following, we first describe our procedures for the estimation of corrected age-trajectories. We then turn to the actual results and discuss remaining issues.

IV.1 *Conceptual considerations for estimating corrected age-trajectories*

Ideally, we would investigate the savings behavior of households, as they can be considered a decision unit. Correspondingly, all major surveys collect savings and wealth data at the household level. Given that savings decisions of couples should differ from that of singles (see Hurd, 1999), a separate analysis for different household types would be desirable.

Nevertheless, we deviate from the traditional household context in our cohort analysis and instead focus on individuals. We have broached the reasons above already: First and foremost, the required time invariant characteristics are only constant at the individual level and not in a household context. This issue prevails no matter if we focus on characteristics of the entire household or of the household head: Total earnings points of a household for instance will change if a retired household member dies. Focusing on the characteristics of the household head, especially the death of household heads will lead to disturbances. The different survival probabilities of males and females lead to a considerable number of switches in the household headship as indicated above by the declining share of male household heads over the life-cycle of a cohort. Any changes in the household headship will entail changes in the level of pension entitlements and thus destroy the concept of time invariant characteristics.

Apart from these conceptual considerations, it is furthermore impossible to link individuals from the same household in the pension fund data. The administrative data contains some information on the marital status of the individuals, but the according information is missing for roughly 30 percent of the sample and it is impossible to distinguish unmarried and widowed individuals. A

direct evaluation of the household data from the EVS based on the administrative data is therefore impossible. Furthermore, also a comparative analysis of the saving trajectories of single and couple households is impossible if we want to involve the administrative data. We therefore add several analyses where we omit the adaptation of the EVS sample to the administrative benchmark. Contrasting the results from the estimations with and without involving the pension fund data we are able to disentangle the effects of the EVS sampling quality from the selection effects connected to the use of synthetic panel data.

Savings behavior of individuals

While there are good reasons to switch our analysis to the individual level, this leaves us with the question how we should break down household savings and wealth data to the individual level. A variety of concepts have been suggested how individual optimization may translate into household choices. In fact, if a household consists of several individuals, we may observe the outcome of independent individual optimization behavior, or of joint optimization. Among joint optimization processes, cooperative and non-cooperative decision processes may play a role. Important theoretical derivations for these cases have been proposed by Hurd (1999), Browning (2000) and Lundberg and Ward-Batts (2000).

The empirical evidence on the importance of the different possible decision processes is mixed. Without much empirical guidance, there is no way we could assign the individual household members a certain amount of savings and wealth, other than by making assumptions. It is important to understand that the actual assumptions will ultimately be of secondary importance. That is, because our correction procedures rely on re-weighting while the individual savings and wealth data thereby remains unaltered.

For part of savings, we take a quite simple approach and assume equal saving rates for all household members.[14] For part of wealth, the choice of sensible assumptions is considerably harder. It helps to deliberate over the question, what happens to the level of household wealth in the case of death of individual household members. Let's assume that the death of an individual as such does not imply significant savings or dissavings. Any change in the level of wealth of the household then depends on wealth transfers. If the wealth of the deceased is bequeathed to the surviving spouse we should consider household levels of wealth also for the individual. The other extreme case is that all wealth of the deceased spouse is transferred from the household, e.g. to the children. To keep such effects out of the saving behavior of the surviving spouse, we would

[14] In absolute terms this means that each individual contributes to household savings according to her income share.

need information about the individual shares of wealth owned by each spouse. As the data provides information about wealth holdings only at the household level, we decided to assign each individual the household levels of wealth.[15]

IV.2 *The re-weighting procedures*

We apply three different re-weighting schemes which aim to disentangle the different possible selection effects. Based on each set of weights, we calculate life-cycle trajectories of saving rates, wealth holdings, and the share of dissavers for males and females. All re-weighting schemes can be expressed by a general formula. Equation (3) below illustrates our procedures for the case of saving rates:

$$\overline{sr_{ca}} = \sum_{i=1}^{N_{ca}} \left(sr_i^{HH} \cdot \tilde{\omega}_i \right), \qquad \text{where} \quad \tilde{\omega}_i = \omega_i \cdot CF_k^{ca} \tag{3}$$

Specifically, for each cohort *c* at the age *a*, we calculate the weighted average over the N_{ca} individuals in this group. The weights are adjusted with a correction factor *CF* which is common for all observations in a certain range of earnings points ("EPs") from the same cohort at a certain age. The correction factor re-scales the weights in each of the *k* EP-bands such that the adjusted population weight in each cohort-age-EP-band cell $w_k^{c,a}$ equals the population weight of a target population $\varphi_k^{c,T}$. The correction factor can therefore be written as:

$$CF_k^{ca} = \frac{\varphi_k^{c,T}}{w_k^{c,a}}, \qquad \text{where} \qquad w_k^{c,a} \equiv \frac{\sum_{i \in k} \omega_i^{c,a}}{\sum \omega_i^{c,a}} \tag{4}$$

As the re-weighting schemes differ only in the choice of the target population, it is only the different $\varphi_k^{c,T}$ that we report in the below description of the three correction procedures.

Before turning to the description of the different target populations, a few words about the EP-bands seem appropriate. The EP-bands are chosen such that they each contain a sufficient

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[15] An alternative assumption would we to split the household wealth evenly among spouses as e.g. under joint marital property regime. We can only speculate that for the cohorts under investigation joint property is in fact the predominant regime.

Our procedure of attributing each household member the entire household wealth, wealth transfers to the children connected to the death of one spouse are then observed like any other wealth transfer from the household.

number of observations to allow a reliable adjustment of the EVS distribution of earnings points to the benchmark. For both genders, we decided for six bands, but with different cutoff points.[16] Additionally, there is the group of individuals without a public pension, i.e. with zero EPs.

The baseline age-trajectories

For the baseline life-cycle trajectories we apply the traditional EVS weights. Compared to the usual life-cycle trajectories, we only divert in looking at the individual level and by calculating the age-profiles separately for men and women.

Correction I: adjusting for a selective EVS sample

The first correction procedure is aimed at the quality of the EVS sample. We adjust the weights such that the EP distribution from the EVS matches that of the administrative records at all age-groups. That is, we do not correct for a possible bias induced by differential mortality. For the initial age-groups, we have illustrated in the previous section that the EP-distribution elicited from the EVS matches the administrative benchmark rather well. This first correction shows to what extent the remaining discrepancies between the EVS and the GRV-sample have effects on the estimated saving rates and wealth levels.[17] The differences in life-cycle trajectories between the benchmark and this first correction can therefore be interpreted as the selection bias of the EVS sample. Equations (5) define the according correction factor:

$$CF_k^I = \frac{\varphi_k^{c,a}}{w_k^{c,a}}, \qquad \text{for } k \neq 0 \qquad \text{where } \varphi_k^{c,a} = \frac{n_{k,GRV}^{c,a}}{n_{GRV}^{c,a}} \qquad (5)$$

and $$CF_0^I = 1 \qquad \text{for } k=0$$

The target shares for each cohort-age-EP-band cell are obtained from the corresponding cell in the GRV data. An exception is the share of individuals without a public pension which we leave unadjusted.

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[16] A table describing the gender-specific clusters is contained in the appendix.

[17] The abbreviation "GRV" is derived from the German term "Gesetzliche Rentenversicherung" for the public pension fund.

Correction II: mimicking a panel and adjusting the EVS sample

Our second correction can be expected to produce the closest approximation to panel based life-cycle trajectories. Equations (6) describe that we adjust the EVS weights such that they restore the initial EP-distribution of each cohorts to its characteristics at age 65-69. We calculate the target share of individuals without a public pension based on the EVS age-group 65-69 of each cohort. The relative size of the EP-bands is drawn from the equivalent distribution at age 65-69 of the same cohort in the GRV data.

$$CF_k^{II} = \frac{\varphi_k^{c,65}}{w_k^{c,a}}, \qquad \text{for } k \neq 0 \qquad \text{where } \varphi_k^{c,65} = \frac{n_{k,GRV}^{c,65}}{n_{GRV}^{c,65}} \qquad (6)$$

and $$CF_0^{II} = \frac{w_k^{c,65}}{w_k^{c,a}} \qquad \text{for } k=0 \qquad \text{where } w_0^{c,65} = \frac{\sum_{EP=0} \omega_{i,EVS}^{c,65}}{\sum \omega_{i,EVS}^{c,65}}$$

We thereby keep the EP-distribution artificially constant as the cohorts age. At the same time we adjust for a possible selection bias at the initial age of each cohort. Hence, we achieve the most comprehensive correction of life-cycle profiles which is possible based on the joint information from the EVS and the GRV data.

The differences between the second and the first correction approach can be interpreted as the *"synthetic panel effect"*. It comprises all kinds of selectivity other than a bias in the initial EVS sample at age 65-69. Most importantly, they will comprise differential mortality and differential sampling success. An exception is the question of institutionalization, which we will come back to in the discussion of our results.

Unfortunately, our preferred correction procedure is limited with respect to the oldest age-groups due to the short time span covered by the administrative data. Given that the first observations reach back to 1993, this is also the time at which we observe the oldest cohorts at age 65-69. The remaining EVS surveys from 1998 and 2003 provide us with a ten year age-trajectory for this cohort. In other words, the age-trajectories which are anchored to the GRV data at the age-group 65-69 only reach age 75-79. Correcting the age-profiles of the oldest old is impossible with this procedure.

Correction III: mimicking a panel without initial adjustments

To investigate selection effects among the oldest age-groups further we disregard any possible selection effects in the EVS age-group 65-69 and only adjust the subsequent observations of each

cohort to the initial distribution in the EVS. We have shown in the previous section that the EVS weights allow a rather close approximation to the distribution of earnings points that we find in the GRV data.

$$CF_k^{III} = \frac{w_k^{c,65}}{w_k^{c,a}}, \qquad \text{where} \quad w_k^{c,65} = \frac{\sum_{i \in k} \omega_{i,EVS}^{c,65}}{\sum \omega_{i,EVS}^{c,65}} \tag{7}$$

Equation (7) illustrates that we impose the share of individuals without a public pension as well as the distribution of earnings points at the beginning of retirement on all subsequent age-groups of each cohort.

The life-cycle trajectories estimated based on this third approach should be compared to the baseline trajectories as they start from the same initial distribution at age 65-69. The difference can again be interpreted as *"synthetic panel effect"* except that we do not apply a correction to initial distribution. The difference between the results of the second and the third correction procedure are limited to the scaling effect of the different initial distributions that the subsequent age-groups are adjusted to.

IV.3 *Evidence for synthetic cohort effects and initial sample effects*

Turning to the actual results from the above correction schemes, we present selected results of the male and female life-cycle trajectories in saving rates, net financial wealth, net total wealth and the share of dissavers. Each graph contains the four trajectories described above, denoted as baseline, GRV - synthetic panel (C1), GRV - pseudo panel (C2), and EVS - pseudo panel (C3).

To forestall the most important findings: neither the remaining selectivity of the EVS sample nor the synthetic panel effects are suited to solve the puzzle about high old-age saving rates. In fact, the correction turns out to take both directions, sometimes even within a single age-trajectory. Overall, we find an almost equal number of cases where the age-trajectories are upward and downward adjusted.

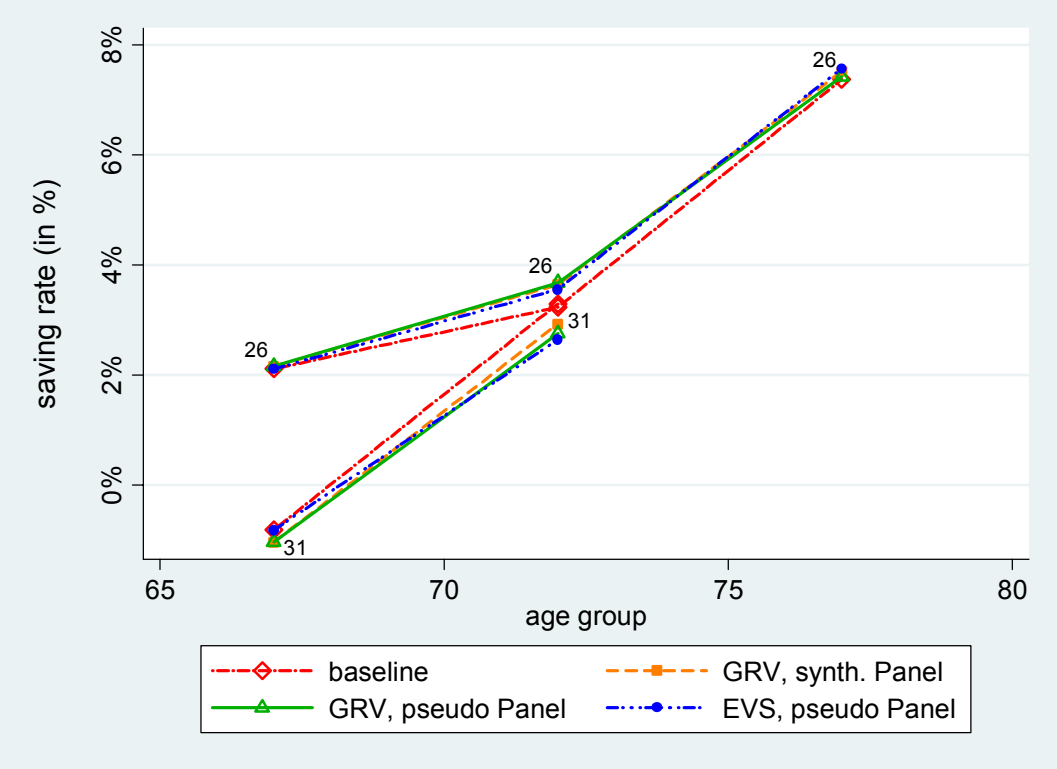
We start by comparing the results of all three correction approaches to the baseline age-trajectories. As two of the correction procedures involve the GRV-data, our analysis is limited to two cohorts. Figures 10-12 are focused on male individuals born between 1924 and 1933 that we observe in their initial years after retirement. The baseline results and the EVS based pseudo panel always start from an equal point at age 65-69. The same applies to the two age-trajectories where our correction involves an adjustment to the initial distribution drawn from the GRV data.

Saving rates

For saving rates, figure 10 illustrates, that the slight differences in the distribution of earnings points between the EVS and the GRV at age 65-69 implies almost no shifts in the initial saving rates when we correct for them. That is, we find no EVS-sample-effect for saving rates.

The second important comparison relates the age-trajectories estimated from the traditional synthetic panel to the adjusted age-trajectories which mimic the constant population in a panel analysis. Already for the two cohorts depicted in figure 10, we observe that the adjustment may take both directions. Quantitatively, none of the corrections exceeds 0.6 percentage points, the majority being considerably lower. That is, at least until age 75-79, we find no significant evidence for a synthetic panel effect on saving rates.

Figure 10: Life-cycle trajectories of saving rates, males



Source: Own calculations based on EVS and RV data

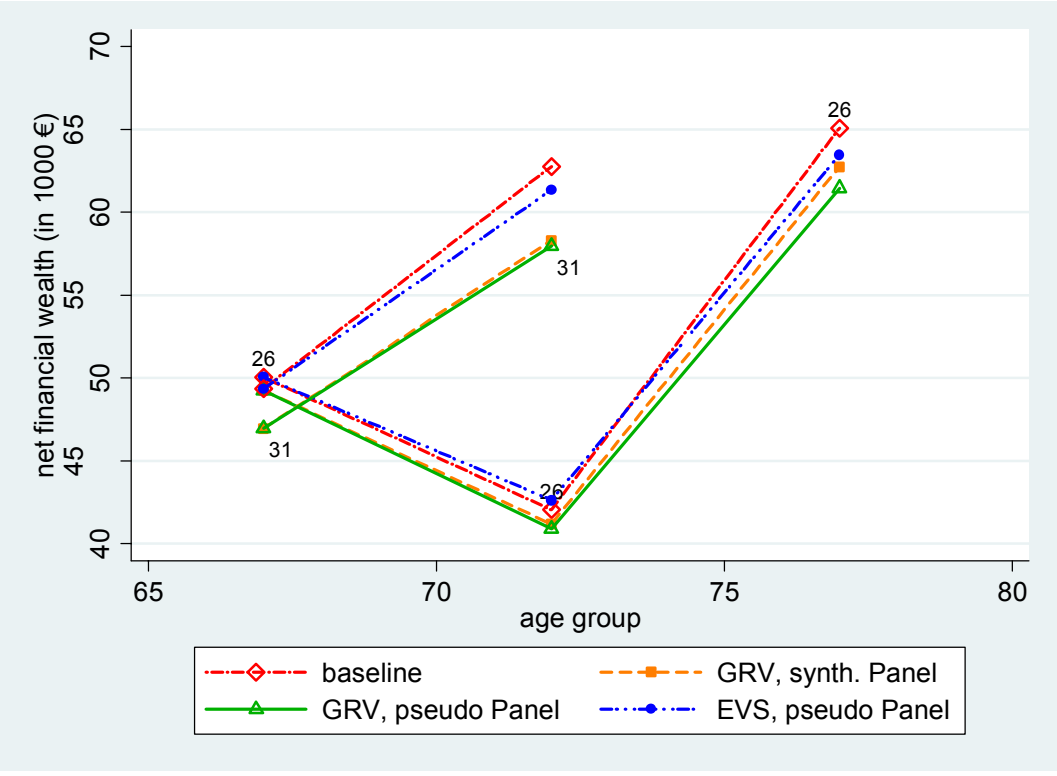
Net financial and net total wealth

Figures 11 and 12 show the equivalent corrections for net financial and net total wealth. The first evident result is that the deviations of the initial EVS sample from the GRV benchmark at age 65-69 play a more important role when it comes to estimating wealth levels than above in the context of saving rates. In fact, the EVS tends to overestimate the level of wealth held by males

aged 65-69.[18] We can only speculate about the reasons why there are significant corrections for wealth and not for savings. Certainly, wealth is a stock variable and whereas savings are based on annual flows. Wealth can therefore be expected to be more closely connected to structural factors which determine health and mortality as well as the willingness to participate in a survey. Furthermore, the more skewed wealth distribution brings more leverage to the reweighting process.

Following the age-trajectories of wealth as the cohorts age, we find also some differences in the slopes. In fact, the corrected age-profiles have smaller slopes than the benchmark, although only by a small margin. That is, in a synthetic panel we tend to underestimate the degree of wealth decumulation. It turns out that this finding is reverted if we look at females. This latter finding comes with some surprise given that we had found clear evidence for differential mortality among females. If the poor drop out from the sample with higher probability, we would expect our re-weighting to lead to a downward correction of the life-cycle trajectories and not vice versa. A possible explanation is the unclear connection between individual income and household resources. The subsequent distinction of singles and non-singles may shed some light on the underlying reasons of this surprising finding.

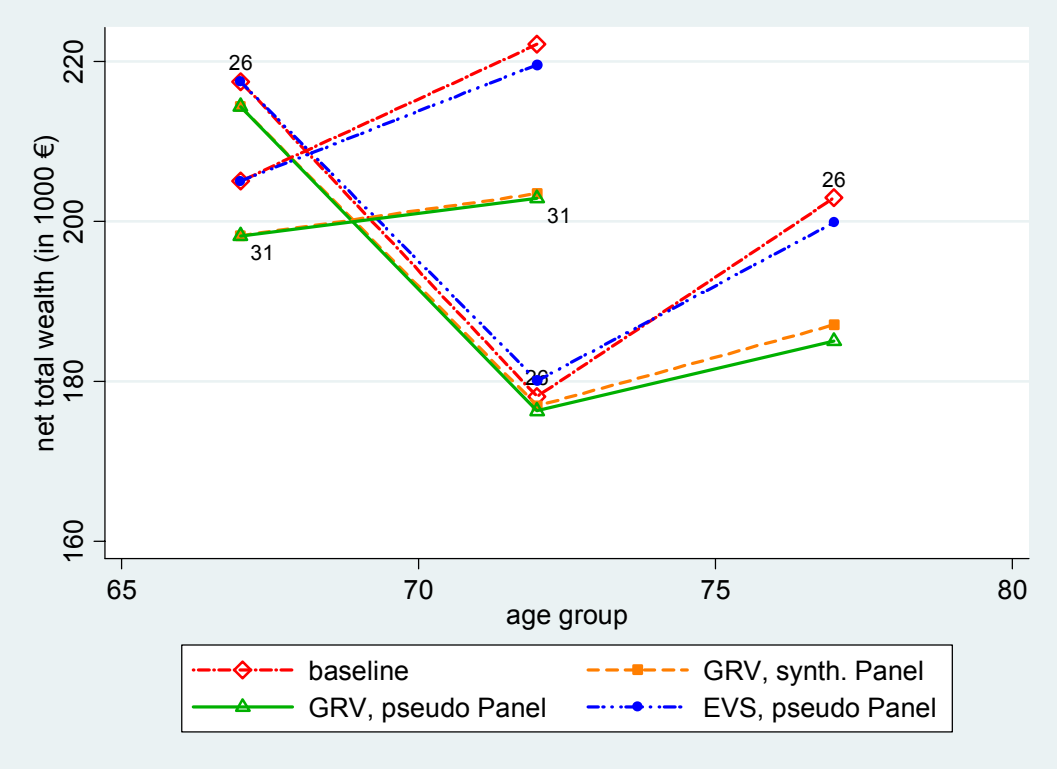
Figure 11: Life-cycle trajectories of financial wealth holdings, males



Source: Own calculations based on EVS and RV data

[18] The equivalent differences among females are much smaller (see the figures in the Appendix).

Figure 12: Life-cycle trajectories of total wealth holdings, males



Source: Own calculations based on EVS and RV data

Interim summary

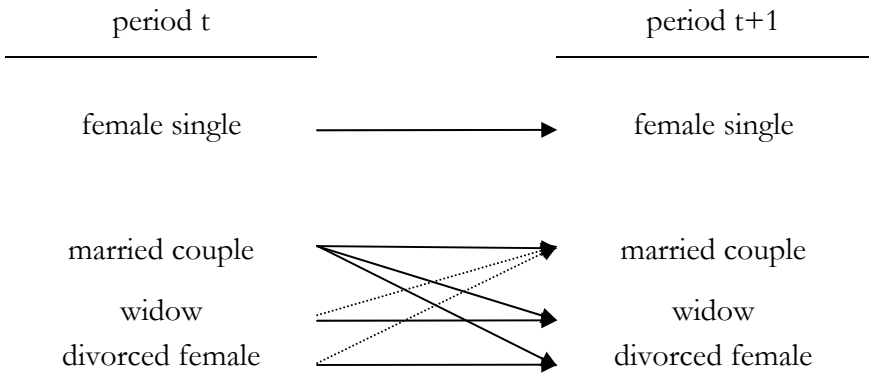
From the above, we conclude that selection effects cannot explain the high German saving rates and the limited evidence for declining wealth levels.[19] Where our corrections yield lower age-trajectories for males, we find the opposite fore females. However, we have ignored the oldest age groups so far. If differential mortality affects the survivors' distribution of savings and wealth only after age 80, the above corrected age-profiles simply stop too early. In the following we therefore focus on correcting for selection effects within the EVS framework and omit the adjustment to the GRV benchmark at the initial age of each cohort. The above results yield a mixed picture about the damage of skipping the adjustment to the benchmark. In fact, the initial correction has barely any effects for savings. For wealth, however, the initial correction seems to have a non-negligible effect, although with different sign for males and females. Overall, there is little we can do about these concerns if we want to extend the life-cycle trajectories to the oldest old.

[19] The share of dissavers turns out to be essentially unaffected by our corrections. We omit the corresponding figure for brevity.

IV.4 *Life-cycle trajectories of singles and non-singles*

We try to make the best of being limited to the EVS data and split our sample with respect to singles and couples, whom we would expect to save differently (see Hurd, 1999). Given that death, divorce, and marriage may imply changes in the family status of individuals, a few additional conceptual considerations seem necessary. In fact, individuals may switch between unmarried/single, divorced, married, and widowed between two points in time. To sustain cohorts with a time-consistent EP-distribution, we split the sample into singles that have never been married on the one side, and couples, as well as divorced and widowed individuals on the other side (see table 4). Marriages and divorces are rare among the elderly but all we have to rule out is marriages of singles to ensure the homogeneity of cohorts over time.

Table 4: Transition paths in the family status of elderly individuals



The subsequent procedure for the calculation of the age-trajectories remains exactly the same. The only change compared to the previous procedure is the refinement of the cells which now include the distinction of never-married individuals and individuals who have married at some point in their life. Conceptually, we would have preferred to further distinguish couples from widows and divorcées, as their saving decisions must be expected to differ. Based on a synthetic panel this is, however, not feasible.

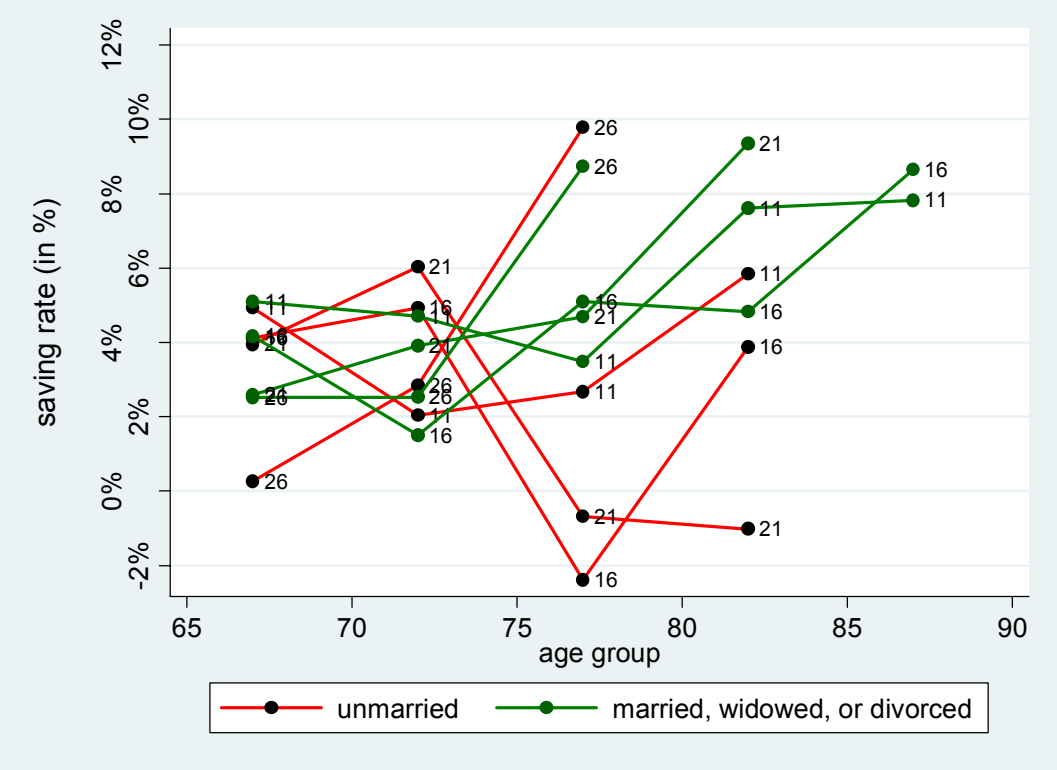
The EVS sample contains roughly 1'800 to 3'200 female individuals with marriage background – couples, divorcées or widows – between age 65 and 69 for each cohort. We start with a similar number of males, given the predominance of couples over widows and divorcées in this age-group. The samples of unmarried women between age 65 and 69 are considerably smaller and count only 150 to 250 individuals per cohort. The corresponding samples of unmarried males start with only 25 to 50 individuals. Given that the cohorts shrink by more than 50 percent by the time they reach age 75-79 we quickly run into small sample problems. This is especially the case, as we split each cohort into earnings point bands for the re-weighting procedure. We therefore

abstain from correcting the age-trajectories of unmarried males as it would involve applying unreasonably large weights to tiny cells. Instead, we focus on single and non-single women. We first compare the corrected life-cycle trajectories of singles and non-singles and revert to the importance of correcting for a possible synthetic panel bias towards the end of this section.

Saving rates

While the saving rates of single and non-single females are rather similar among young retirees, the saving behavior of the two groups gets more and more dissimilar in older age-groups (see Figure 13). Above age 70, the age-trajectories of non-single females are slightly upward trending. Furthermore, they remain within close distance from each other. For single females, we observe lower average saving rates, especially beyond age 75, where two out of four cohorts dip into negative average savings. At the same time, we face larger dispersion between the age-trajectories of singles, which may in part be caused by the declining sample size.

Figure 13: Age-profiles for saving rates of single and non-single women

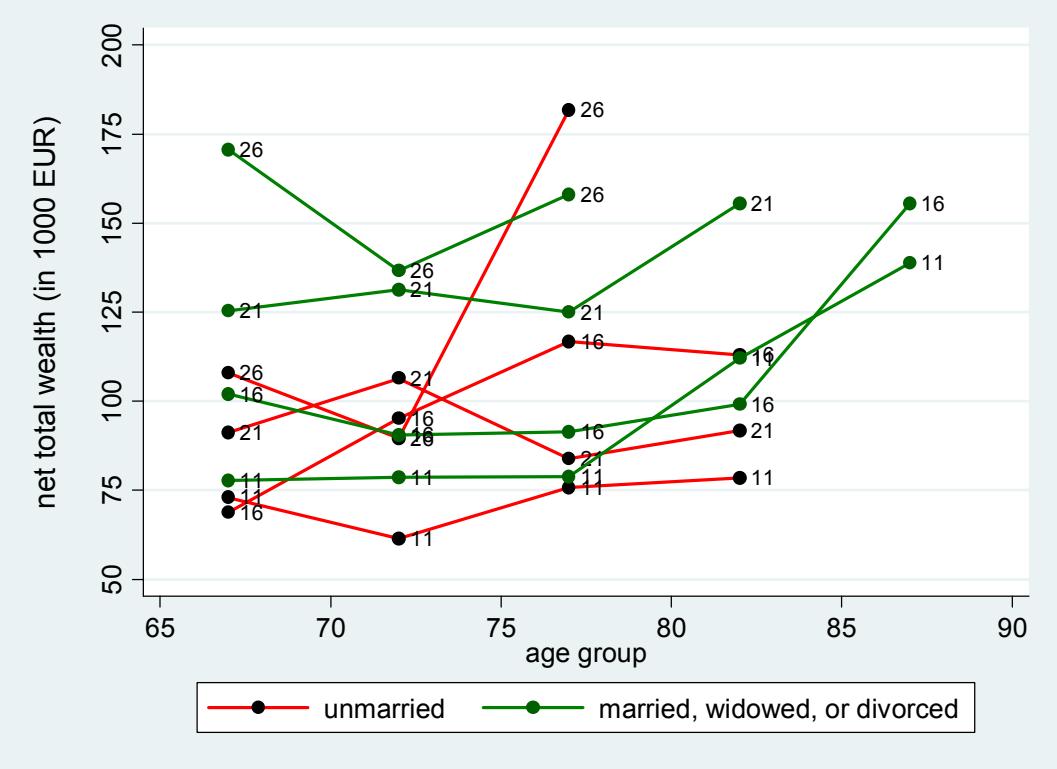


Source: Own calculations based on EVS 1978-2003, weighted. Note: for the cohorts 1911 and 1916 the single age-groups 85-89 were dropped as the sample size dropped to 20 or less observations.

Wealth

We find slightly lower levels of net total wealth for unmarried females at age 65-69 compared to their married or previously married counterparts (see figure 14). Given that we look at household levels this comes with little surprise, as the wealth accumulation of couples may be founded on two incomes. However, we find no significant wealth deculumation for single or non-single females. For married females the corrected wealth trajectories imply further increases, especially for the age-groups 80 and above. The result of no wealth reductions prevails if we focus on financial wealth. However, there are barely any differences between single and non-single females with respect to the level of financial wealth. That is, the additional wealth of married females is largely invested in real estate wealth.

Figure 14: Age-profiles for total net wealth of single and non-single women



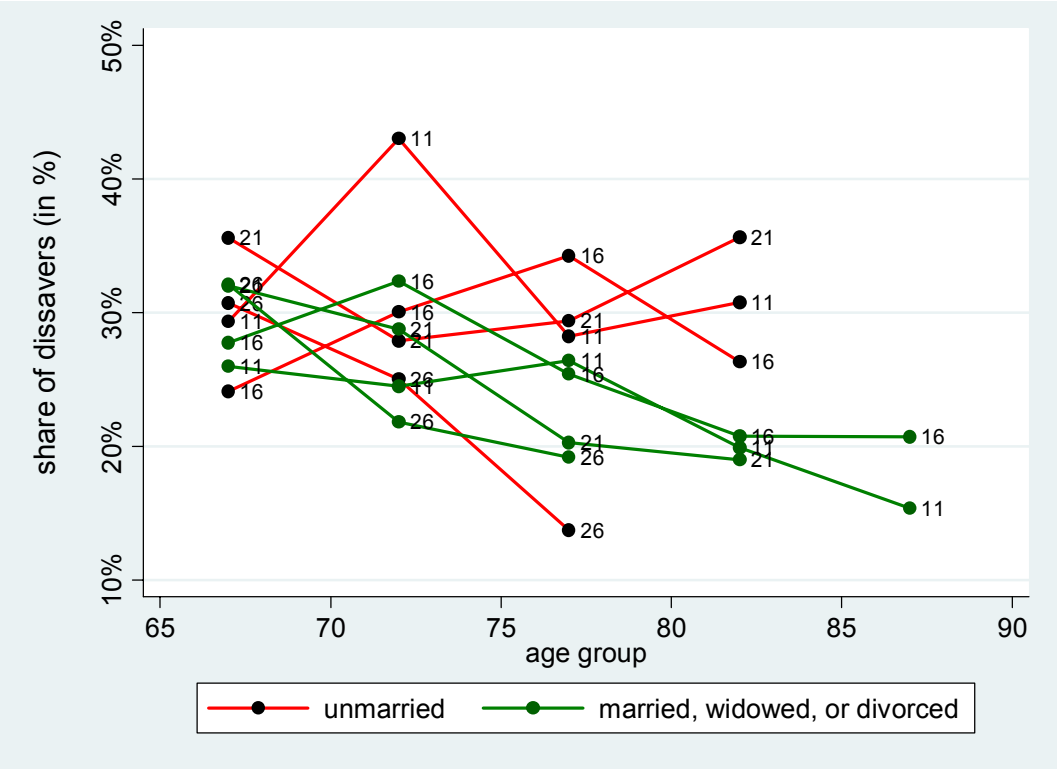
Source: Own calculations based on EVS 1978-2003, weighted. Note: for the cohorts 1911 and 1916 the single age-groups 85-89 were dropped as the sample size dropped to 20 or less observations.

Share of dissavers

The share of dissavers among single and non-single women starts out at roughly similar levels of 25-35 percent at age 65-69 (see figure 15). Among married, divorced or widowed women, this

share gradually declines over the subsequent age-groups and reaches 20 percent or less for the age-groups 80 and above. Overall, the share of dissavers among singles remains roughly constant at all ages generating an increasing gap between singles and non-singles among the older age-groups. Also the corrected age-profiles imply, however, that the majority of individuals do not dissave at any age beyond retirement.

Figure 15: Age-profiles for total net wealth of single and non-single women



Source: Own calculations based on EVS 1978-2003, weighted. Note: for the cohorts 1911 and 1916 the single age-groups 85-89 were dropped as the sample size dropped to 20 or less observations.

The synthetic panel effect

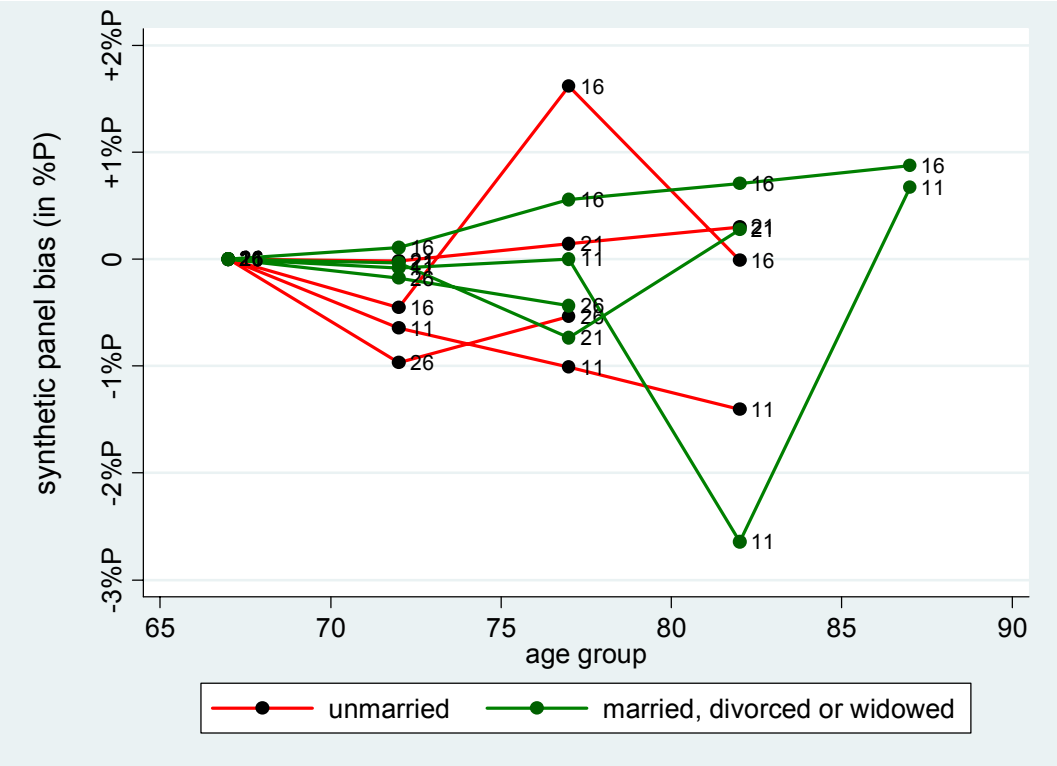
While the above results were focused on the comparison of corrected life-cycle trajectories of singles and non-singles, we now revert to the effects of using data from a synthetic panel instead of (emulated) true panel data. We present age-trajectories of the synthetic panel bias, calculated as the differences between the uncorrected and the corrected age-profiles. As the correction concerns the EP-distribution of older retirement age-groups to the respective initial distribution of the same cohort, the bias is by construction zero at age 65-69.

Figures 16 and 17 present the bias – i.e. the counterpiece to our correction – in saving rates and total net wealth. Above, we had found upward biases for males and downward biases for females.

Looking now at more cohorts and life-cycle trajectories which are extended to the oldest age-groups, the results turn out even more inconclusive. Specifically, we observe both, upward and downward biases, for some cases even within one cohort. Comparing the bias between single and non-single females, we find no distinct differences.

Most interesting is therefore the size of the bias: For saving rates, the bias ranges between +1 and -1 percentage points with only few outliers. For the age-groups 65-75 – where the uncorrected saving rates were smallest and closest to zero – the bias is zero or negative. That is, the correction goes in the direction of slightly higher saving rates. Looking at the older age-groups the absolute size of the bias is slightly increasing. Contrary to Attanasio and Hoynes (2000), we do not find clear evidence for an upward synthetic panel bias in saving rates caused by differential mortality or other selection effects.

Figure 16: Synthetic panel bias in the age-trajectories of female saving rates

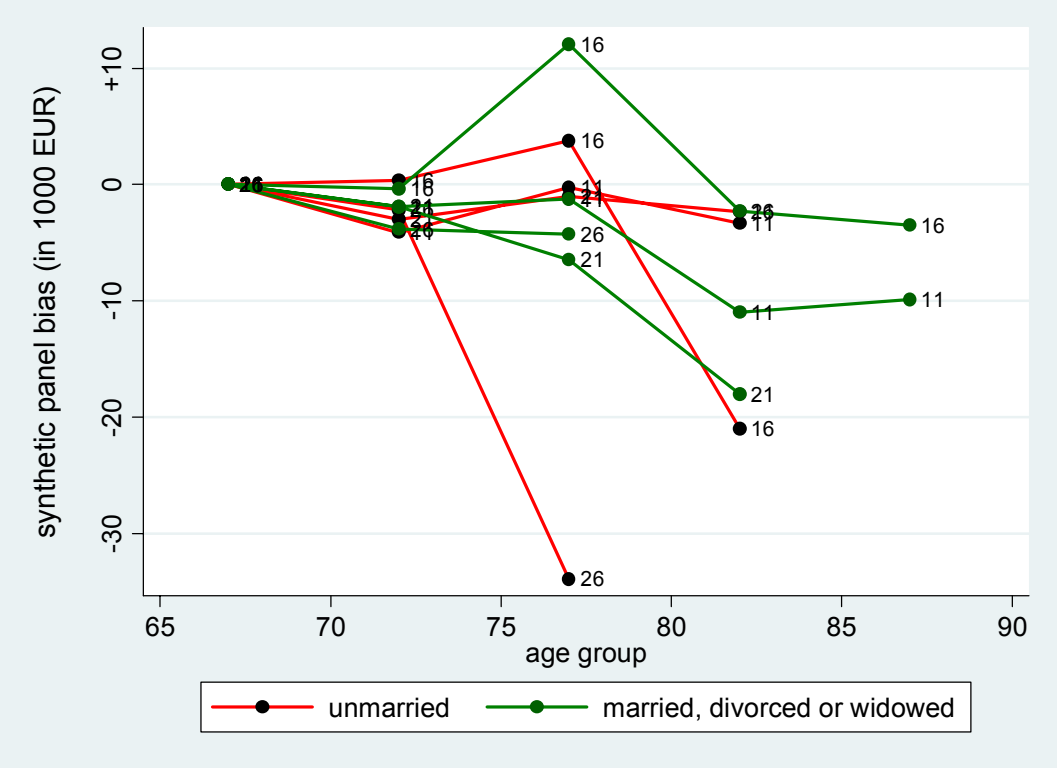


Source: Own calculations based on EVS 1978-2003, weighted

For net wealth, the number of cases with a downward bias slightly outweighs the cases pointing in the opposite direction (see figure 17). Again, our estimations imply that there is no evidence for an underestimation of old-age wealth decumulation. Put differently, the selection effects which we have observed especially for the female EP-distribution do not carry over to an upward bias in wealth levels. Overall, we find the bias in life-cycle wealth trajectories to range largely

between +5'000 Euros and -10'000 Euros. In relative terms, this amounts to deviations of +6 to -18 percent. Larger deviations are the exception.

Figure 17: Synthetic panel bias in the age-trajectories of female total net wealth



Source: Own calculations based on EVS 1978-2003, weighted

Last, looking at the share of dissavers among females, we find a similar number of cases with negative bias as with positive bias. The size of the bias ranges largely between +3 and -3 percentage points and never exceeds 5 percentage points.[20] As for the above cases of saving rates and wealth, the selection effects in the female EP distribution do not carry over to savings in a way that would help us explain part of the German old-age savings puzzle.

[20] The corresponding figure can be found in the appendix.

V. Conclusion

The goal of this paper was to evaluate the quality of life-cycle saving pattern among the elderly which are estimated based on synthetic panel data. For many important economies, there is no representative panel survey available which contains information on savings and wealth so that economists have to rely on repeated cross-sectional data which they use to construct synthetic panels. In contrast to actual panel data, however, we have only limited possibilities to control for selection effects in a synthetic panel. Examples are differential mortality or differential sampling success which may both change the composition of a cohort as it ages. If the drivers of these selection effects are correlated with savings and wealth, we should be concerned about the reliability of life-cycle trajectories which are estimated from a synthetic panel. Previous analyses, have found a positive synthetic panel bias in the life-cycle trajectories of wealth (see e.g. Attanasio and Hoynes (2000) or Jianakoplos et al. (1989)). As they rely on the estimation of wealth dependent mortality rates, strong assumptions are necessary to deal with the endogeneity problems.

We therefore suggest a different approach which relies on time invariant individual characteristics. We exploit a characteristic of the German public pension system which allows us to validate the quality of the survey data by means of administrative records. Specifically, each individual accrues earnings points over her life-cycle which remain constant throughout retirement and are thus predestined to help us control for possible selection effects and – if present – correct for them. Furthermore, for the sample of roughly 90 percent of the retired population the earnings points provide an excellent proxy for permanent income.

We start by analyzing the prevalence of selection effects for the case of the German Income and Expenditure Survey (EVS) which has traditionally been used for life-cycle analyses of saving behavior in Germany. Germany is thus a prime candidate for a case, where high saving rates among the elderly coincide with the use of synthetic panels for the estimation of life-cycle saving pattern. We are not aware of a previous analysis which would assess the importance of selection effects as a possible explanation of the German (old-age) savings puzzle.[21]

Our results imply, that the distribution of earnings points in the EVS sample of retirees matches the administrative benchmark quite well once the sample weights are applied. The sample does, however, change over age. In fact, the share of females without a public pension declines strongly throughout retirement. Furthermore, also among females with a public pension, those with low

[21] The German savings puzzle was documented previously e.g. by Börsch-Supan et al. (2001)

pension entitlements tend to drop out from the sample more frequently. For males, the evidence for selectivity effects are much less distinct, which may in part be explained by alternative income sources like civil servants' pensions. Overall, we find evidence for selection effects in the EVS which are broadly in line with previous findings by Reil-Held (2000) and von Gaudecker and Scholz (2006) which are based on other German data sources.

In a second step, we re-weight the EVS sample such that the distribution of earnings points remains constant for each cohort throughout retirement. The corrected age-profiles aim to mimic the results based on panel. Vice versa, we denote the differences between the corrected and uncorrected age-profiles by "synthetic panel bias". It turns out that the bias may take both directions, especially for average saving rates and the share of dissavers. Despite finding the expected selection effects in the distribution of earnings points, they do not carry over to biased life-cycle trajectories of mean savings. For wealth, we find a certain overweight of cases with a downward synthetic panel bias – which is at odds with what we would expect in the presence of differential mortality or similar other selection effects. Furthermore, this is in contrast to the typical results in this literature (see e.g. Attanasio and Hoynes (2000) and Jianakoplos et al. (1989)). Splitting the sample into singles and non-singles to account for the expected differences in saving behavior, the estimated corrected life-cycle trajectories indicate some differences, but overall the results for the synthetic panel bias remain the same.

An open issue remains the non-sampling of the institutionalized which we would expect to dissave. Especially if the elderly continue to save for the case of institutionalization, the finding of positive saving rates among those who remain in the sample is exactly what would we expect. Institutionalization would then simultaneously imply negative savings and the exclusion from the sample. A major task for future research is thence to complete the picture of old-age savings behavior by gathering evidence of the savings behavior of the institutionalized.

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Appendix

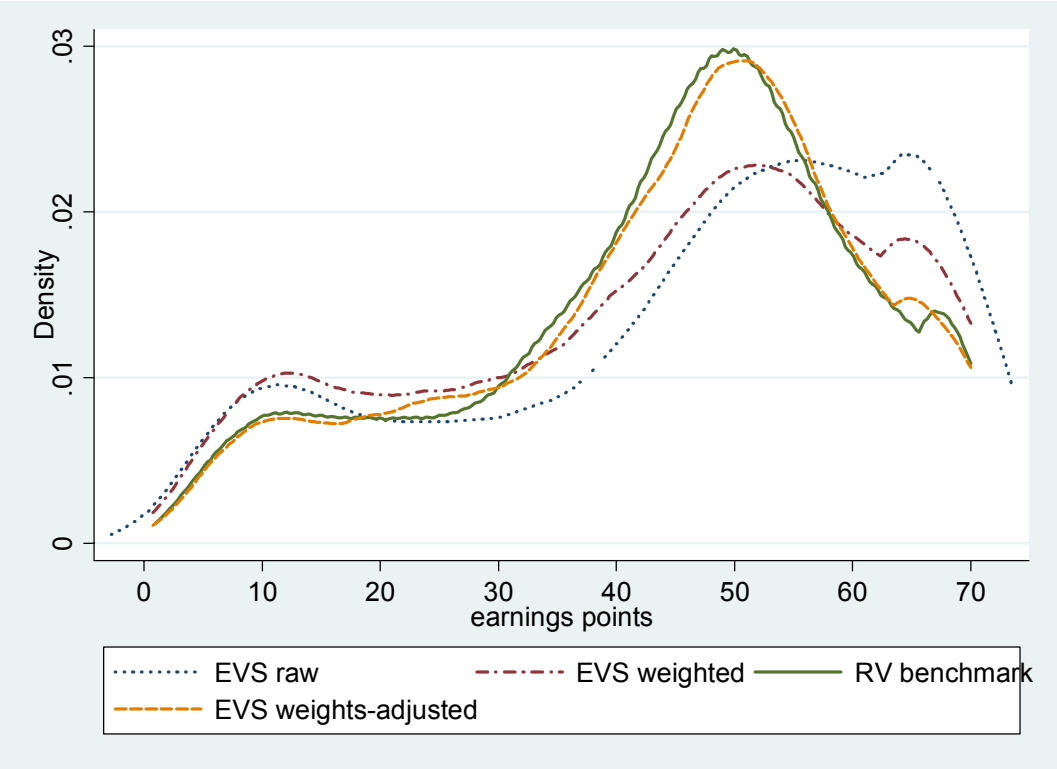
Table A-1 describes the bands of earnings points used in the re-weighting process. Figures A-1 and A-2 show how the EVS distribution of earnings points is adjusted by means of this re-weighting process.

Figures A-3 and A-4 present the results for the different correction procedures for females, where section four contained the equivalent graphs for males. Finally, figure A-5 presents the synthetic panel bias in the share of single and non-single dissavers. All graphs have been moved from the main text for brevity.

Table A-1: EP-Bands employed for the re-weighting procedure

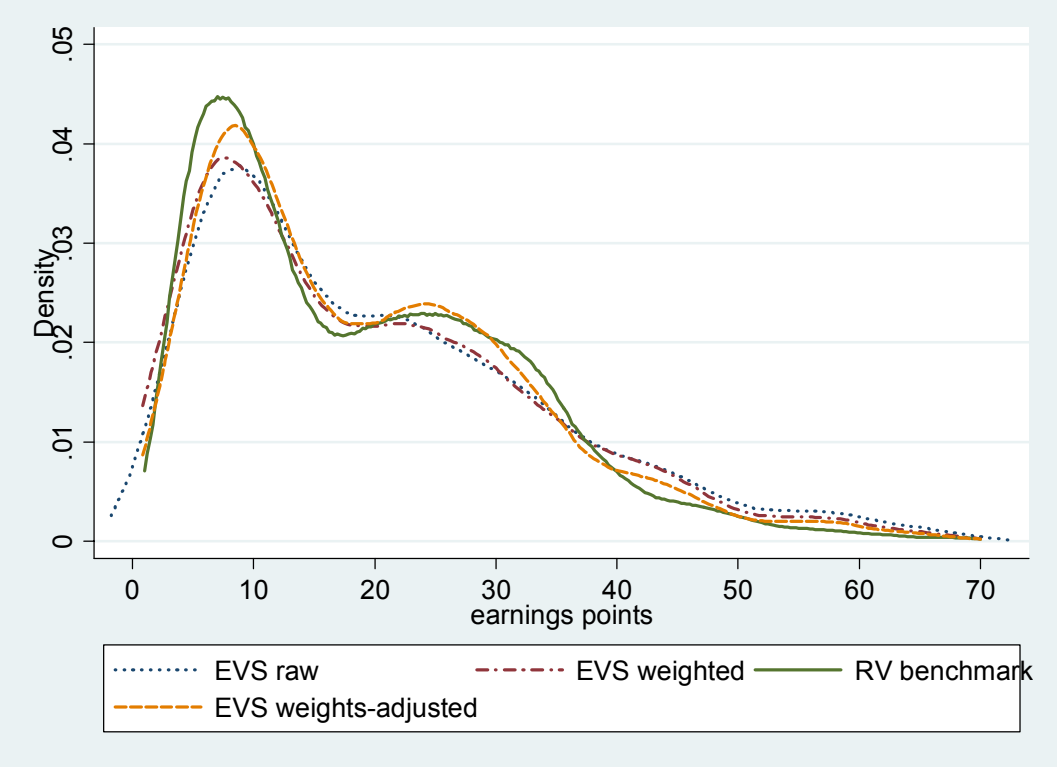
k	male	female
1	0< EP < 18	0< EP < 4
2	18 ≤ EP < 36	4 ≤ EP < 10
3	36 ≤ EP < 44	10 ≤ EP < 16
4	44 ≤ EP < 54	16 ≤ EP < 22
5	54 ≤ EP < 62	22 ≤ EP < 35
6	EP ≥ 62	EP ≥ 35

Figure A-1: EP-distribution among males aged 65-69 in 1998 in the EVS and the RV-data



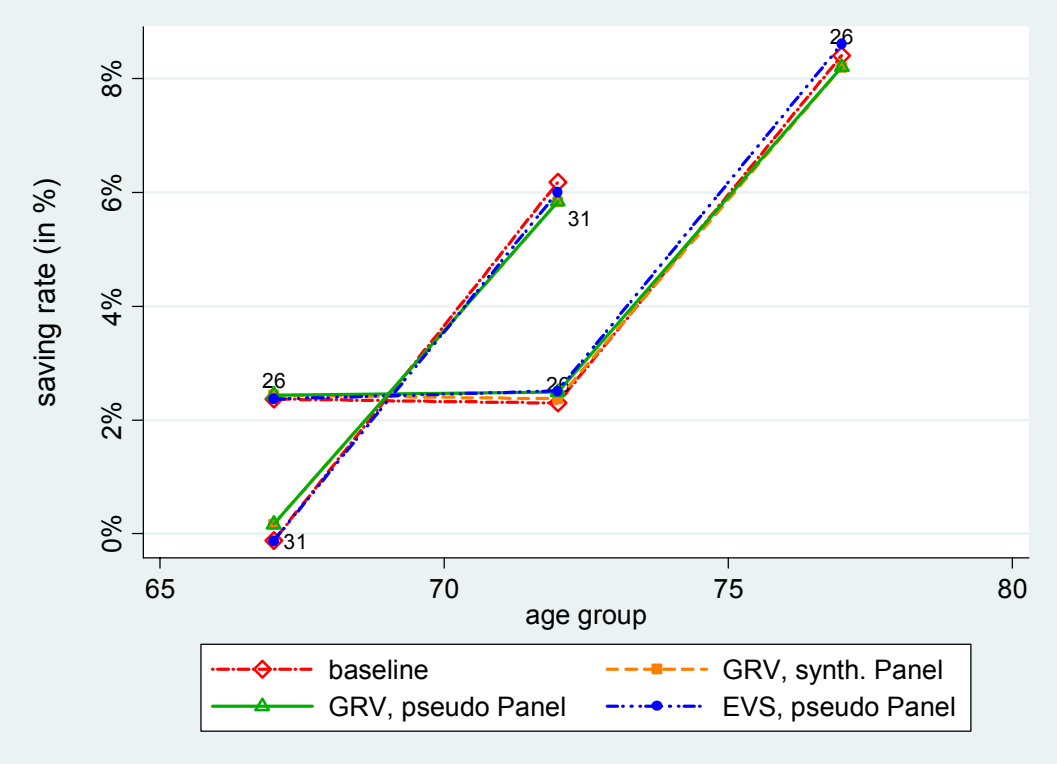
Source: Own calculations based on EVS and RV data

Figure A-2: EP-distribution among males aged 65-69 in 1998 in the EVS and the RV-data



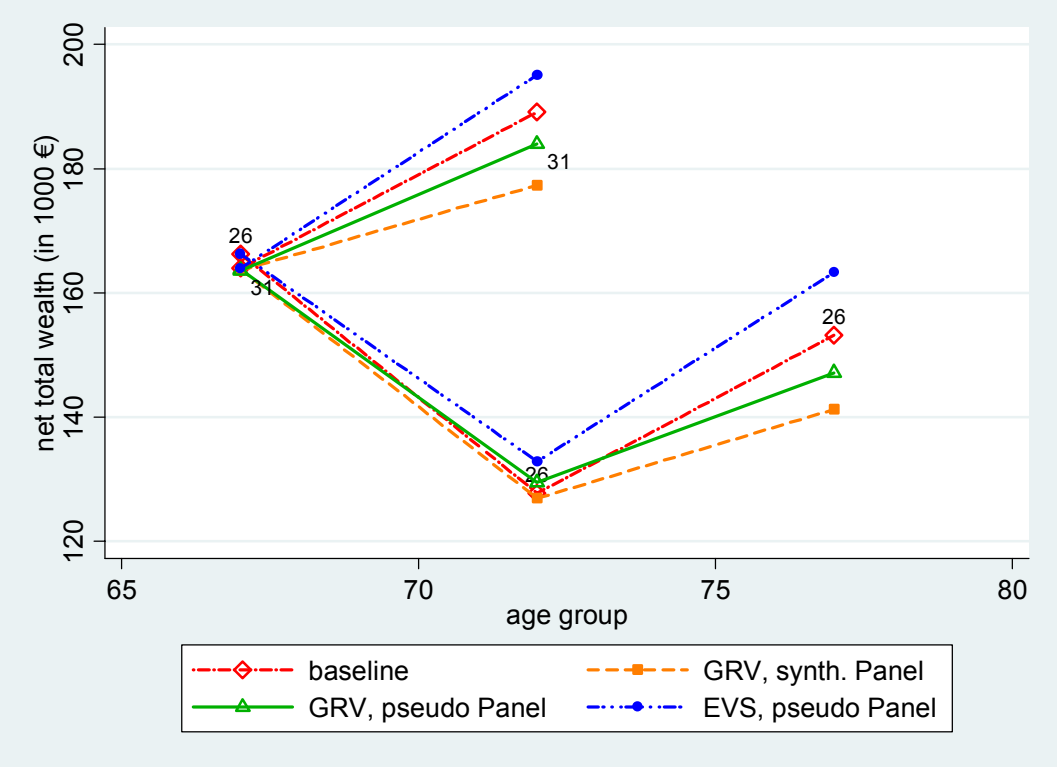
Source: Own calculations based on EVS and RV data

Figure A-3: Life-cycle trajectories of saving rates, females



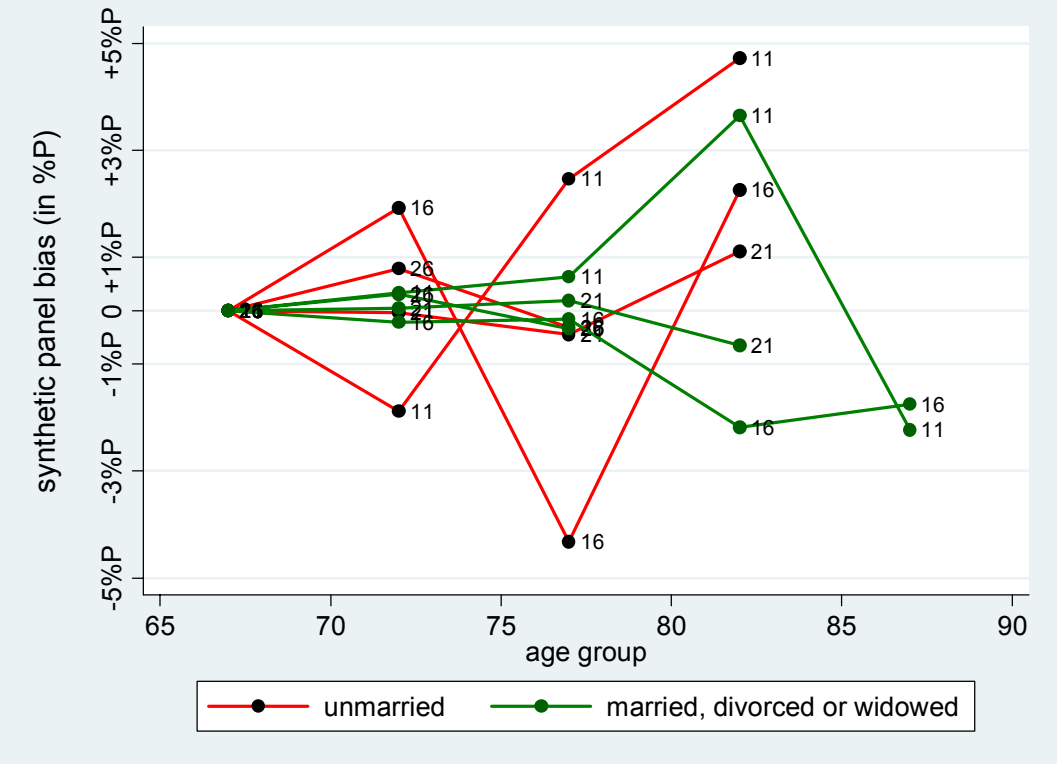
Source: Own calculations based on EVS and RV data

Figure A-4: Life-cycle trajectories of total wealth holdings, females



Source: Own calculations based on EVS and RV data

Figure A-5: Synthetic panel bias in the age-trajectories of the share of female dissavers



Source: Own calculations based on EVS 1978-2003, weighted

Chapter 2

Trends in German households' portfolio behavior – assessing the importance of age- and cohort-effects

I. Introduction

Germans' investment behavior – like that of several European neighbors – is frequently considered outdated compared to the asset allocation in Anglo-American countries. In fact, saving accounts, building society saving contracts, and life-insurance policies have attracted a considerable share of private wealth in Germany. In the early 1980s, they accounted for more than 75 percent of Germans' financial assets. Since then, a lot has changed, and Germans' investment behavior has followed the path of Anglo-American countries towards higher investments in securities and mutual funds. While it seems that Germany and other European countries are just lagging behind, it is uncertain at what pace the convergence may continue and how much assimilation we should eventually expect.

Overall, a considerable number of factors influence the investment behavior of private households. They can broadly be classified into accessible alternatives, institutional environment, demographic factors, and preferences. Stocks for instance have become accessible to a much larger community through the introduction of mutual funds and the reduction of transaction and information costs. Next, tax reforms may imply changes to the after-tax returns of certain assets and thereby alter the optimal asset allocation. A recent example in Germany is the reform of the favorable tax treatment towards certain life-insurance products. Furthermore, we observe structural changes in the population. Specifically, there is an ongoing growth of single households and of households with two earners but no kids. There are direct implications for income risk sharing, and subsequently also the optimal asset allocation of a household will be affected. Finally, preferences may change. It remains an open question whether preferences can change over the life-cycle. It is a common perception, however, that the younger (post-war) generations are less risk averse than the generation of their parents and grandparents. These and other factors are possible drivers behind the historical trends in household portfolios. Accordingly, differences in the environment or in preferences across countries may be reasons why we should not be surprised to find certain differences in households' investment behavior to remain.

But why should we care about the future trends in household portfolios in the first place? The obvious benefit for the players on the financial markets is the possibility to focus their product development and their sales efforts on the most promising products. However, there may also be important macroeconomic implications. Shifts in the desired portfolio allocation of the household sector may ultimately imply shifts in the market returns. Imagine an aging economy where households' demand for risky assets declines. Unless there is a counterbalancing demand shift on the international capital markets we should expect an increasing risk premium. In a next

step, enterprises will have an incentive to shift their financing and lower their equity ratio. While a changing asset allocation on behalf of private households may thus have far-reaching consequences, predicting the future trends is far from trivial.

Of the driving forces mentioned above some are easy to predict. Especially population aging is pretty straightforward to foresee. Also part of the political changes to the environment in which households are making their investment choices have been decided long in advance. A large number of factors, however, are essentially unpredictable and others must be considered unknown. Demographic changes and the known long run changes to the environment are thus the key factors which we can rely on to assess the chances of an ongoing assimilation in international portfolios.

The first large-scale general equilibrium models to incorporate demographic transition as well as changes to the public pension system are the OLG models by Brooks (2002) and Börsch-Supan et al. (2003). A crucial ingredient to these models is choice of an appropriate utility function and the assumptions with respect to risky income and asset returns. The discussion about the optimal specification of a life-cycle portfolio model has occupied economists since the seminal initial works of Merton (1969) and Samuelson (1969). An overview over the most important extensions to the basic model and their respective implications to the optimal life-cycle portfolio allocation is given by Campbell and Viceira (2002). The actual choice of the portfolio model in an OLG framework, however, is characterized by the trade off between computational complexity and a decent match of the empirical benchmark.

A comparatively simple alternative approach is therefore to project the future asset allocation of private households based only on the observed (historical) outcomes of household decision making. Specifically, a simple shift share analysis based on the empirical evidence on life-cycle portfolio choice may do a decent job in capturing the first order effects of demographic change. A crucial assumption is that the estimated life-cycle pattern will remain unchanged over time. Only in part can changes to the life-cycle pattern induced by the changing environment be accounted for – specifically by making assumptions about future time- and cohort-effects.

Evidently, both above approaches rely on the identification of general life-cycle profiles of asset allocation. Over the past decades, a substantial literature has provided empirical evidence on life-cycle portfolio choice and thereby incited many innovations to theoretical life-cycle portfolio models. However, many of the early empirical studies were based on cross-sectional data (see e.g. Yoo, 1994; Guiso et al., 2002; Haliassos et al., 2001). As their cross-sectional setting makes it impossible to control for confounding time- and cohort-effects, the resulting age-profiles may be

biased. To disentangle age-, time- and cohort-effects based on panel or synthetic panel data, identifying assumptions are inevitable to avoid multicollinearity.

The first study on household portfolios to use synthetic cohorts to account for possible confounding cohort effects is Poterba and Samwick (2001). They provide evidence for a number of financial assets in the portfolios of American households based on the Survey of Consumer Finances (SCF). A subsequent study by Ameriks and Zeldes (2004) is focused entirely on equity ownership and the portfolio share of financial wealth invested in equity. The results turn out quite sensitive to the choice of the identifying assumptions – a finding which has received remarkably little attention against the background of their respective core results. The sensitivity of the results with respect to the identifying assumptions is closely connected to the question under what circumstances the commonly used procedures to estimate general life-cycle profiles are suited to yield sensible results. To highlight the limitations of the pursuit of a general life-cycle profile is part of the goal of this paper.

The first and overall purpose of this paper, however, is to help us understand the historical trends in German household portfolios and to provide empirical evidence for the typical life-cycle investment behavior in Germany. Most of the existing literature has been focused on the United States or has relied on cross-sectional data for the estimation of age-profiles. As we have argued above, this ignores possible distorting effects, especially of differences across cohorts. We therefore start with a plain cohort analysis of participation rates in the five most important asset categories and the respective portfolio shares. We discuss the broad age-pattern and pay special attention to cohort differences and year-effects. In a second step, we aim to elicit a general life-cycle profile by means of the Deaton-Paxson decomposition which allows for both, time- and cohort-effects. We are able to draw some conclusions about the plausibility of different theoretical life-cycle portfolio models. At the same time, we highlight the conditions under which the procedures of eliciting a general life-cycle profile are promising or just futile.

The paper is structured as follows: In section two, we describe the data from the Financial Accounts and from the German Income and Expenditure Survey and discuss issues connected to the different data sets. Section three documents the historical trends in aggregate German household portfolios based on both above data sets. We then exploit the household data further to investigate the structural changes underlying these trends in section four. At the core of this section are the cohort analyses of participation rates and portfolio shares and the subsequent Deaton-Paxson decomposition. Section five concludes.

II. Data

We make use of two datasets: First, the Financial Accounts statistics published annually by the Deutsche Bundesbank covering aggregate wealth holdings by sector and type of wealth. The data is available back until 1960 and splits into two sub-datasets before and after the German reunification. Second, we exploit the wealth section of the German Income and Expenditure Survey (EVS). This cross-sectional survey has been carried out by the Federal Statistical Office at five-year intervals since 1962/63. Our subsequent analyses are based on micro data from the years 1988, 1993, 1998 and 2003. Additionally, we use age-specific averages from the years 1978 and 1983, which are drawn from a previous study by Börsch-Supan and Eymann (2000).

II.1 *Financial Accounts*

The Financial Accounts data is compiled annually by the Deutsche Bundesbank. It contains information on sectoral wealth holdings, liabilities and savings but none about participation rates. The household sector unfortunately includes private non-profit organizations, like the churches and trade unions. For Western Germany the data has been published from 1960 though 1992, disaggregated into 9 categories of financial wealth. With new asset categories like mutual funds becoming more and more important in the late 1980s the classification scheme was changed. Hence, time series on 13 – not fully comparable – asset categories are available for the reunified Germany since 1991. The latest data stems from 2007.

The data is constructed using the monthly banking statistics, as well as the quarterly reports on wealth in insurance companies. These are augmented by capital markets statistics, depot statistics and balance of payments statistics, all statistics that are originally collected for other purposes than the Financial Accounts. The household sector is largely calculated as the residual from the entire private sector and the corporate sector. The household wealth data is therefore affected by the data quality for the corporate sector, especially valuation practices in corporate balance sheets. The Bundesbank corrects for secret reserves though, which are quite prevalent under German accounting standards. The main concern therefore seems to be the inclusion of private non-profit organizations in the household sector. Given that both, the banking statistics as well as the depot statistics carry more information on wealth allocation within the sector, Lang (1997) makes an effort to separate private non-profit organizations. We extended his work to include the most recent data. Securities that are not registered with banks turn out to be the main issue.

Counting only registered wealth holdings[1], the private non-profit organizations (NPOs) account for roughly 4-5 percent of total financial wealth in the private household sector as defined by the Bundesbank. This share varies across asset categories from essentially zero (life-insurance) to as much as 14-16 percent (savings deposits). Directly held stocks (2-3 percent) play a much smaller role for the private NPOs than investment certificates (8-10 percent). This seems plausible given that many NPOs have their funds managed in special closed mutual funds. Building society saving contracts – just as life-insurance contracts – are held almost exclusively by private households. For a comparison of wealth holdings from survey data with these aggregate statistics, the varying importance of private NPOs across asset categories must be kept in mind.

II.2 *The German Income and Expenditure Survey (EVS)*

We use the German Income and Expenditure Survey as micro level database despite its lack of a longitudinal dimension. The available panel datasets suffer from different defects. The GSOEP includes wealth holdings only in the 2002 and 2007 waves. For 2002, the data has a few additional deficits: In fact, the individual asset categories are bottom coded and some assets cannot be distinguished at all.[2] There is very little information on financial wealth for the earlier years of the GSOEP. The SAVE panel only covers a rather short time span so far. Furthermore, its rather small sample size is unsuitable for a detailed breakdown by age, especially if we want to investigate asset classes with small participation rates.

We therefore use the detailed information on financial wealth in the EVS cross-sections to construct a synthetic panel, which allows us to track birth cohorts over time instead of individuals or households. Generally, information on savings and wealth in the EVS is recorded at the household level. Hence, households are attributed to birth cohorts according to the age of the household head. Schnabel (1999), Börsch-Supan et al. (2002) and Sommer (2002) have previously applied this procedure to the EVS data to account for cohort effects in saving behavior. The six available EVS cross-sections between 1978 and 2003 each contain between 40'000 and 60'000 households. The large number of observations even in the oldest age-groups allows an analysis of saving and wealth pattern among even among the very old. To achieve comparability of cohorts over time, we restrict the sample to Western Germany. Apart from these pleasant features of the

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[1] I.e. assuming that all financial wealth which is not registered by public statistics is held by others than the NPOs – most likely the private households.

[2] Wealth in life-insurance contracts and in building society saving contracts are questioned as a combined asset class in 2002.

EVS data, there are also several issues to the EVS data. They can broadly be summarized in three categories: concerns of comparability and measurement, concerns of sample selection, and last but not least coverage.

II.2.1 Comparability of asset categories and measurement issues

The questions concerning wealth exhibit certain differences over the cross-sections of the EVS. First, the questioning and measurement of wealth in life-insurance contracts has changed considerably over time: For the years 1993 through 2003 the dataset contains the cash value of insurance contracts. Yet until 1988 only information on the insurance sum is available. The cross-sections 1978-88 provide information neither on the inception date nor on the contribution history. Hence, there is no reasonable way to directly estimate the cash value of those contracts. For 1993, both, the insurance sum as well as the cash value are contained in the dataset. Schnabel (1999) estimated age-specific ratios of the cash value to the insurance sum from the 1993 cross-section. Based on these relations, he was able to impute cash values for the previous cross-sections.[3] We use the age-group specific average wealth holdings in life-insurance contracts from Schnabel's estimations for our analysis.[4]

The second issue for our analysis lies in the changing level of detail of the EVS wealth questionnaire. In fact, in most EVS cross-sections some types of assets are grouped together. Unfortunately, some assets were regrouped into different categories over time. We therefore only use the broad asset categories "saving accounts", "life-insurance", "building society saving contracts", and "securities" for our analysis, although the individual cross-sections offer more detailed insights into household portfolios.

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[3] Schnabel (1999) also deals with the switch from categorical data (1978-88) to exact values in the subsequent years. Again he uses information from the 1993 cross-section to impute the mean values for the different classes.

[4] The more recent imputations by Sommer (2008b) employ regression based imputation and aim to restore the dispersion of the imputed data by adding a random term. The analyses of this paper were carried out before the EVS 1978 and 83 became available as scientific use files and therefore rely on the results of Schnabel (1999). The main difference between the two approaches is certainly the dispersion of the imputed wealth data. Given that the analyses of this paper are focused on age-specific averages, we are confident that the results are not too sensitive with respect to the chosen imputation procedure.

II.2.2 Sample selection

While the EVS is supposed to be a representative sample of the German population, there are a couple of noteworthy exceptions. In fact, households with a monthly income above a certain threshold as well as the institutionalized population are excluded. The exclusion of the tentatively poor institutionalized and of high-income households is the main reason why the EVS data cannot be expected to add up to national accounting figures.

Exclusion of the institutionalized

Exclusion of the institutionalized is serious among the very old. While only 0.7 percent of the population in need of care is living in nursing homes, this percentage increases strongly over age from 0.6 percent among the age-group 65-70 to 6.4 percent among those aged 80-85. More than 25 percent of the population above age 90 lives in nursing homes (see table 1).

Table 1: Share of Institutionalized by Age-Group

age	in need of care	institutionalized	institutionalized (in % of age-group)
65 - 70	121'110	26'478	0.6%
70 - 75	181'528	41'483	1.1%
75 - 80	284'699	79'418	2.8%
80 - 85	338'610	109'580	6.4%
85 - 90	391'296	150'878	15.2%
90 - 95	259'390	112'813	26.6%
95 and above	69'318	34'943	27.7%
total	2'039'780	604'365	0.7%

Source: Pflegestatistik 2001

The elderly in institutions are likely to be rather poor so that the old will on average look wealthier than they actually are. Börsch-Supan et al. (1998) find EVS-based poverty rates to be much lower than those reported in administrative sources. Specifically, the number of poor elderly widows in the EVS is lower than indicated by social assistance figures. With the rising importance of institutionalization over age, the remaining sample of a cohort may become more and more selective. Sommer (2008) takes a distinct focus on the importance of differential mortality for the estimation of age-trajectories from the EVS. He finds distinct selection effects

in the distribution of pension incomes, especially for females. However, correcting the age-trajectories of savings and wealth for these selectivity effects he finds no clear evidence for biased life-cycle trajectories – unlike e.g. Attanasio and Hoynes (2000) for the United States.

Obviously, the findings by Sommer (2008) cannot fully rule out a bias in the life-cycle trajectories of portfolio allocation. Even if the probability of institutionalization or mortality has little connection to pension incomes, savings and wealth, it may well be correlated with the households' portfolio allocation. In fact, we would expect households to adjust their portfolios according to their expectations about their individual risks of institutionalization and mortality. Unfortunately, there is no way to control for the selection of households into nursing homes within the EVS framework.

The sampling threshold with respect to net household income

The EVS sample is restricted to households below a certain income. The threshold was introduced due to difficulties in gathering a sufficiently large sample of extremely high income households to allow reliable analyses of these top income households. While the Federal Statistical Office has frequently been criticized for applying the threshold, it turns out that the other large German household survey – the GSOEP – has not been very successful in sampling households with an income above the EVS threshold. Only since the addition of the high income sample to the GSOEP, we find a handful of households above this threshold (see Sommer, 2008b).

More important for life-cycle analyses is the fact that households from different age-groups face a different probability of being cut-off. In fact, households with high incomes and several earners have the highest chances to exceed the threshold which refers to monthly net household income.[5] Thus, the resulting life-cycle trajectories may be biased. The issue is aggravated by the fact that the threshold has been altered repeatedly over the years. The threshold, however, is not adapted according to price or income growth but chosen arbitrarily (see table 2). Possible corrections have been suggested by Hauser (2006) and Sommer (2008b) but require micro-data for all years.

[5] The appendix contains a small simulation to assess the different probability of households to exceed an income threshold.

Table 2: Sampling threshold (monthly net HH income) in the EVS

year	thresholds (current EUR)	CPI (West, 2000 = 100)	threshold (EUR, 2000)	"relative threshold" (1993=100)
1968	5'113	36.1	14'152	71.3
1973	7'669	45.3	16'947	85.4
1978	10'226	56.9	17'965	90.5
1983	12'782	72.2	17'713	89.2
1988	12'782	76.5	16'711	84.2
1993	17'895	90.1	19'854	100.0
1998	17'895	97.9	18'271	92.0
2003	18'000	104.5	17'225	86.8

Note: CPI available for West-Germany available only though 1999, 2003 data estimated using inflation rates for Germany (total)

Sources: EVS, Statistisches Bundesamt, own calculations

There are a number of reasons why our analysis might not be too badly affected: First of all, we look at wealth and not at income. Furthermore, we mainly look at broad asset categories and take averages over age-bands of five-year width. The exclusion of marginal households should therefore have only minor impact on the estimated averages. Second, average portfolio shares are less sensitive to the exclusion of extreme values than absolute averages of a single asset category. And finally, participation rates will essentially be unaffected in a sufficiently large sample.

II.2.3 Coverage

The collection of wealth data in a household survey is a difficult task. Answering the questions thoroughly, a household will usually have to look up information from a number of sources – specifically the account statements of various accounts. Even if the questions are answered to the best of one's recollection, valuation changes as well as the detail of items may have considerable effects on the declared wealth levels (see Juster et al., 1999). Furthermore, households may deliberately make inaccurate or false statements, as they consider their wealth holdings a delicate topic. As a consequence of the above issues, household surveys tend to capture household wealth only incompletely. To the extent that the data quality differs across asset categories, the survey data will result in biased portfolio shares. For the EVS 1978-88, Lang (1997) has assessed the coverage of the wealth data in a comparison with aggregate figures from the National Accounts.

He finds the coverage rates[6] to vary considerably across asset classes: For 1983, they range from 92.7 percent for building society saving contracts to 27.2 percent for time deposits (see table A-1 in the appendix). Furthermore, Lang (1997) observes a decline in coverage rates for almost all asset categories over time. In fact, total coverage dropped between 1978 and 1988 from 49 percent to 39 percent.

So far, differential coverage will lead to biased portfolio shares. Time trends, as well as the slopes and patterns of life-cycle trajectories will, however, be unaffected unless the coverage of different asset categories takes a different evolution over time. The results of Lang (1997) indicate some differential shifts in coverage across asset categories between 1978 and 1988 – a period where the wealth questionnaire of the EVS remained largely unchanged. The changes to the questionnaire in the subsequent surveys may have caused additional shifts. Obviously, these shifts in coverage rates imply biased life-cycle trajectories. We could attempt to correct the levels by rescaling the portfolio shares to the levels reported in the National Accounts. As our focus is on the slopes of the life-cycle trajectories and the National Accounts data on private households is of arguable quality, we abstain from such a correction. For part of the biased slopes we assume that all cohorts are affected equally. Under this condition, the bias takes the form of time-effects and can thus be corrected for.[7] We implicitly apply this assumption in section four, where we use the econometric specification suggested by Deaton and Paxson (1994) to purge the life-cycle trajectories of confounding time- and cohort-effects.

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[6] Calculated as the wealth accounted for in the EVS relative to the National Accounts.

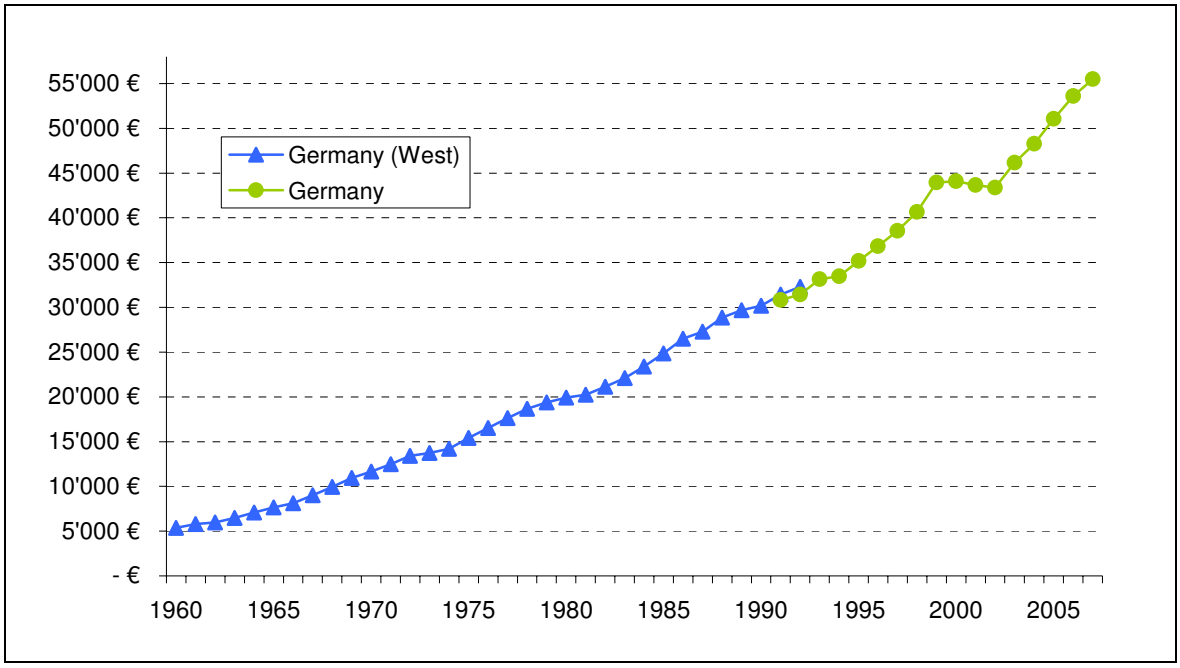
[7] A severe complication would be variation in coverage across cohorts or age-groups. There is no way to control for differential coverage across age-groups, however, as the National Accounts data does not provide a breakdown by age.

III. Macro trends

III.1. Financial wealth growth

Despite the reputedly conservative asset allocation of German households, financial wealth has grown impressively since 1960, even in real terms (see figure 1). With the German reunification, per capita financial wealth of German households took a small drop, as the average wealth level in the eastern states was about 14 percent below the contemporaneous level in West Germany.

Figure 1: Per capita gross financial wealth, 1960-2001 (in EUR, 2000)



Source: Financial Accounts, own calculations

Growth rates have been somewhat cyclical over the entire time span covered by the Financial Accounts. Yet it was a first when per capita financial wealth declined in 2001 and 2002 as a result of the stock market downturn. Stock market wealth already declined by 8.7% in 2000 but savings and appreciation of other wealth components compensated for it.[8] In 2000 and 2001, per capita wealth in stocks declined by almost 30 percent from 5846 Euros to 4135 Euros, in part, however, also due to sales. Since 2003, wealth holdings have been back on their previous growth path.

[8] The components of wealth growth in Germany are assessed in more detail by Sommer (2008a).

III.2 *Trends in the portfolio allocation (Financial Accounts)*

The above figures highlight the importance of changes in stock market prices on overall wealth holdings. The effects are quite impressive given that directly held stocks only account for about 10 percent of household wealth in Germany. Looking at portfolio shares, the changes are obviously even larger.

Table 3 (for West Germany) and table 4 (for the reunified Germany after 1991) give an overview of the changes in asset allocation since the 1960s. One of the most prominent trends has been the rising importance of life-insurance investments. Since 1960, the share of wealth held in life-insurance policies has doubled from 12.3 percent to 25.2 percent in 2002. The fact that total financial wealth rose by more than 700 percent throughout that period underlines the importance life-insurance has gained. Given that one of the key motives to holding life-insurance is old-age provision, the rising portfolio share is in line with what we would expect in an aging economy where more and more people are saving for their retirement. We should note though, that also the tax treatment towards life-insurance policies used to be quite favorable until recently.

Table 3: Asset allocation, Germany (West), 1960-1992

	1960	1965	1970	1975	1980	1985	1990	1992
investment with banks	45.7%	50.5%	52.4%	54.5%	52.4%	46.1%	43.1%	40.6%
thereof:								
cash and checking	14.3%	12.8%	10.6%	9.4%	8.6%	7.0%	7.7%	8.0%
time deposits	1.2%	1.1%	1.8%	2.1%	4.8%	5.0%	6.7%	8.0%
saving certificates	-	-	0.9%	2.9%	5.8%	6.5%	6.1%	5.3%
saving deposits	30.2%	36.6%	39.1%	40.1%	33.2%	27.6%	22.6%	19.4%
building society saving contracts	5.4%	6.9%	7.6%	7.8%	7.3%	5.5%	4.1%	3.7%
investment /w insurance companies	12.3%	13.3%	13.3%	13.1%	14.5%	16.3%	18.6%	18.6%
fixed interest securities	3.3%	6.7%	7.7%	9.1%	11.5%	15.0%	16.7%	20.9%
stocks	24.2%	13.7%	11.3%	7.3%	4.8%	7.0%	6.4%	5.2%
other outstanding money [9]	9.1%	8.9%	7.8%	8.2%	9.5%	10.0%	11.1%	11.1%
total	100%	100%	100%	100%	100%	100%	100%	100%

Source: Financial Accounts, own calculations

[9] Subsumes money market funds and occupational pension claims. Pension claims account for about 80 percent of the category.

Building society saving contracts increased their importance in private households' portfolios from 5.4 percent in 1960 to 7.8 percent in 1975. Their rise coincides with times when housing construction was a major political concern and savings in building society saving contracts were strongly subsidized. Per capita wealth in building society saving contracts stayed essentially constant between 1975 and 1990. As a consequence, their portfolio share dropped back to below 4 percent. After 1991, building society saving contracts are not shown separately in the National Accounts. Instead, they are accounted as saving deposits until 1998 and as time deposits thereafter.

Table 4: Asset allocation, Germany, 1991-2007

	1991	1994	1997	2000	2002	2004	2006	2007
investment with banks	45.8%	43.5%	40.9%	35.2%	37.6%	36.4%	34.8%	35.5%
cash and checking	8.9%	9.4%	9.6%	9.7%	12.1%	13.6%	13.9%	14.2%
time deposits	10.0%	8.7%	5.0%	7.2%	7.4%	6.0%	6.1%	7.2%
saving certificates	4.7%	3.4%	3.1%	2.2%	2.1%	1.8%	1.6%	2.0%
saving deposits	22.2%	22.0%	23.2%	16.1%	15.9%	15.0%	13.1%	12.1%
investment /w insurance companies	18.8%	19.7%	21.9%	23.4%	25.2%	25.0%	25.1%	25.5%
fixed interest securities	13.4%	11.9%	7.9%	6.4%	7.4%	8.1%	8.2%	7.2%
stocks	6.5%	6.8%	10.1%	12.7%	5.7%	6.9%	8.3%	8.6%
other shares	3.9%	4.2%	4.0%	3.8%	4.6%	4.6%	5.1%	4.5%
mutual funds	4.1%	6.9%	8.2%	11.6%	11.9%	11.6%	11.7%	11.9%
other outstanding money	7.4%	7.0%	6.9%	6.8%	7.6%	7.3%	6.8%	6.7%
total	100%	100%	100%	100%	100%	100%	100%	100%

Source: Financial Accounts, own calculations

Overall, life-insurance and building society saving contracts have a differentiated standing in household portfolios, given their unique features. Most of the remaining assets are more exposed to substitution effects and have thus lost or gained substantially over the years. Saving deposits, for instance, have lost a lot of their former importance, first in favor of time deposits and saving certificates, later in favor of fixed interest securities and mutual funds. The overall decline of investments with banks has come to a halt at the beginning of the new century.

Mutual funds have gained substantial popularity since the early 1990s following several financial market promotion acts.[10] In fact, this relatively young asset class has eased the access to and the fungibility of a wide range of different assets and provides easy diversification to private investors. Consequently, mutual funds have replaced wealth that had previously been invested in many different asset categories. Money market funds are close substitutes for saving deposits or time deposits. Saving certificates may be replaced by other fixed income funds. Last but not least, indirect investment in stocks and real estate through mutual funds may replace the respective direct investments.

Looking at households' investments in the stock market, a few more figures catch the eye. In fact, between 1960 and 1990, per capita stock market wealth remained flat in real terms letting its portfolio share plunge. While this aggregate figure would be in line with the assumption of constant absolute risk aversion, the micro data provides contrary evidence, as the rich invest a higher share of their wealth in risky assets. Hence, it seems much more likely, that entry and transaction costs are part of the explanation. For small investors, another issue may have been the high costs of diversification. Once these costs decreased with the spreading of the internet and the introduction of mutual funds, both direct and indirect investment in the stock market saw an unpreceded boom. In fact, stocks and mutual funds doubled their combined portfolio share in the 1990s. For directly held stocks, valuation effects have been the key factor behind rising portfolio share. Net saving flows into directly held stocks increased slowly at first. The share of savings going into stocks only rose from 1.3 percent between 1960 and 1992 to 1.8 percent between 1991 and 1999. Only in 1999 and 2000 private households invested roughly 12 percent of their savings in stocks, most of which was undone in 2001 when net sales of stocks accounted for 90 percent of the amount invested in the two previous years. Households have shifted a substantial part of the revenues from these sales into cash.

Mutual funds attracted 12 times as much net inflow as directly held stocks between 1991 and 2001 and kept a stable share of private household portfolios also throughout the stock market baisse. Overall, these figures provide a strong argument for the importance of entry costs and especially diversification costs.

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[10] Börsch-Supan and Eymann (2000) give an overview over the legislation and institutional changes promoting the development of the financial markets in post-war Germany.

III.3 *Trends in participation rates and portfolio shares (EVS)*

As we have noted above, the Financial Accounts do not provide information on the share of households holding wealth in certain asset categories. We accordingly rely on the Income and Expenditure Survey (EVS) for this question. As the EVS data additionally provides information on actual wealth holdings, we can compare the evidence from the Financial Accounts with that from the household survey data. Both sources have their deficits: The Financial Accounts data on the household sector is largely generated as a residual and thus relies heavily on the quality of the data from the other sectors. Furthermore, the private non-profit organizations are included and non-trivial to disentangle. The EVS must be expected to suffer from the usual issues of household surveys – differential response and problems of accurate knowledge. Even willingly inaccurate answers may occur in the sensitive wealth part of a survey.

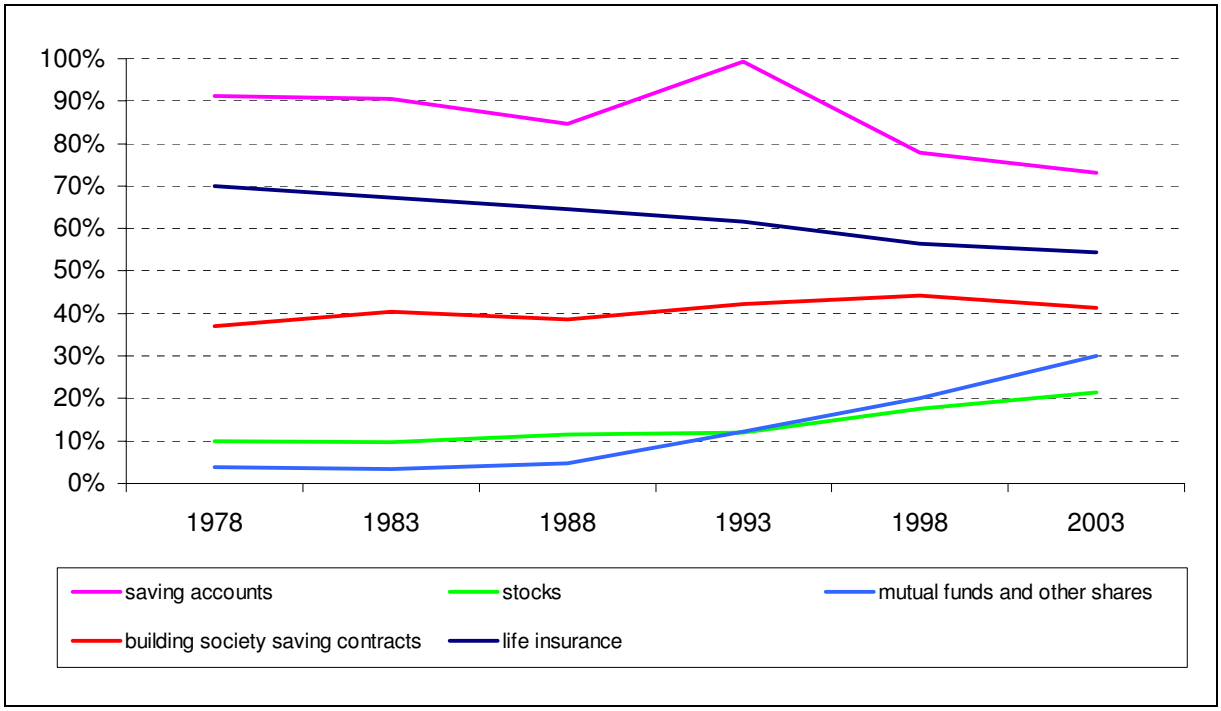
Hence, none of the two data sets can be considered the benchmark and we take the two data sources as an opportunity to cross-check our results. Overall, we find the broad trends in the Financial Accounts data supported by the EVS household data. The levels of the portfolio shares, however, exhibit some disparities. Stocks are an example, where the differences seem rather obvious and likely connected to two main reasons: First, stock market wealth is highly concentrated among a small number of families which are obviously not sampled in the EVS. And second, German accounting standards permit undisclosed reserves in corporate balances. While the Financial Accounts will thus overestimate the stock market wealth of the household sector, the EVS will most certainly underestimate private stock market wealth.

Figures 2 and 3 display the trends in participation rates and portfolio shares respectively. For both cases we restrict our analysis to West German households to avoid the structural break of the German Reunification.

Looking first at saving accounts, we observe a steady decline in the probability to hold wealth in saving accounts (see figure 2), which is matched by a contemporaneous decline in the portfolio share (see figure 3). Note that the 1993 data includes checking accounts for this category, which is responsible for the jump in participation rates.

Also the declining portfolio share of building society saving contracts is supported by the survey data. Like in the National accounts data, the portfolio share was almost halved over the last 20 years. Notably, this trend is not matched by a decline in participation rates. In the late seventies, about 37 percent of the population had savings at a building society. This share rose to about 44 percent in 1998 and somewhat dropped back in 2003. The stagnation in average wealth holdings in this asset category is likely related to the capped subsidization of the contracts.

Figure 2: Participation rates in selected asset categories (West Germany)



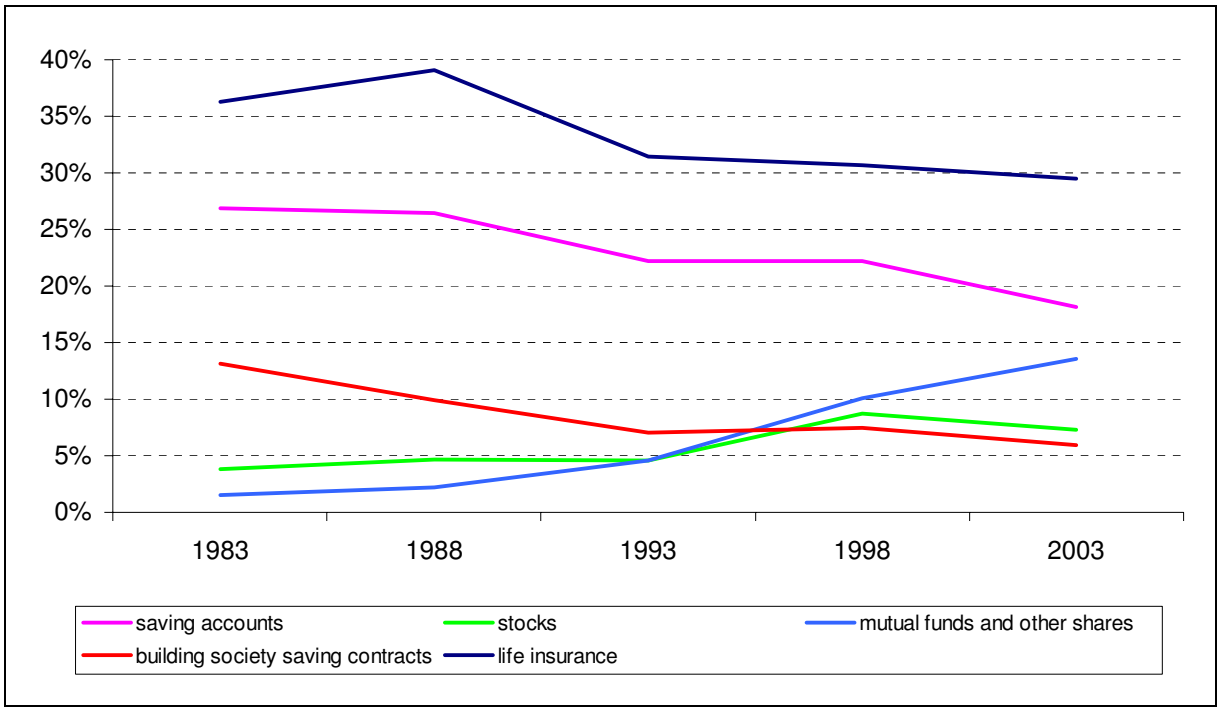
Source: Eymann and Börsch-Supan (2000), EVS, own calculations

The rise of stocks and mutual funds, especially in the 1990s, is clearly reflected in the EVS data. Participation in both asset categories rose continually from 1988 through 2003. For part of stocks, the market turndown of the years 2001-2003 already shows in the portfolio shares. Participation rates in 2003 where still higher than five years before though. Between 1978 and 1998, we observe a rising participation in stocks but a much smaller rise in conditional portfolio shares (the average portfolio share invested in stocks by those who actually hold stocks). Between 1998 and 2003, the conditional portfolio share dropped from 22 percent to roughly 16 percent, which is lower than in any other year. Aggregate statistics imply that not only the drop in valuation but also actual sales have contributed to this decline. Comparing the evolution of conditional and unconditional portfolio shares, we conclude, that the new investors entering the market in the 1990s were rather small investors compared to those who already held stocks before. While some investors sold part of their stocks during the downturn, only few of them quit the market.

At the same time we observe an ongoing rise in the popularity of mutual funds – again in line with the figures from aggregate statistics. In contrast to (direct) investments in stocks, mutual funds have only recently started to play a role in household portfolios. This short history is just the more impressive. Participation rates rose from 4.7 percent in 1988 to about 20 percent in 1998 and 30 percent in 2003. Conditional portfolio shares also rose substantially over this time

span and leveled off at roughly 25 percent in 1998 and 2003. Where the drops in stock prices should have led to declining prices of mutual fund on stocks, other factors have obviously compensated for these losses. First, mutual funds on fixed interest securities have performed quite well over these years due to the decline in interest rates. And second, aggregate flow statistics indicate that net inflows into mutual funds have remained positive throughout the market downturn.

Figure 3: Portfolio shares in selected asset categories[11] (West Germany)



Source: Eymann and Börsch-Supan (2000), EVS, own calculations

Last, there is life-insurance: Participation in life-insurance dropped back from 70 percent to 55 percent between 1978 and 2003. The portfolio share remained more stable. It dropped from a high of 35-40 percent in the 1980s to roughly 30 percent throughout the 1990s. Remember that the trend in the Financial Accounts took the opposite direction. However, the portfolio shares estimated from the two sources have assimilated to a large extent. Overall, both sources show that wealth in life-insurance contracts remains the dominant asset in private households' portfolios next to saving accounts.

[11] For 1993 the category saving accounts includes checking accounts.

IV. Trends at the age- and cohort-level

Breaking down the aggregate trends in households' investment behavior may tell us more about the underlying reasons and thereby also about the prospects of further change. In fact, if households from all age-groups have participated in the trends towards higher investments in securities this would support our hypothesis that reduced entry, transaction and information costs have promoted these trends. Weather this trend is to continue will then depend on the question whether households have already fully adjusted or if new changes to the environment will produce additional shifts.

IV.1 *Trends and differences in age-groups*

It turns out that the rise of investments in securities and the reduced popularity of savings accounts are similarly prominent across all age-groups (see figures 4 and 5). Also the time patterns look almost identical.

Comparing 2003 to 1978, the share of households holding wealth in saving accounts has declined by roughly 15 percent in all age-groups.[12] This finding prevails also for the entire group of safe assets - saving passbooks, life-insurance or building society saving contracts. Whereas in 1978, 95 percent of all households held at least one of the above assets, this share dropped below 90 percent in 1998. At the same time, more and more people held assets in securities. The participation rate rose from only 25 percent in 1978 to more than 50 percent in 1993 and has remained roughly stable in subsequent years. The largest jump falls in the era of the First Financial Markets Development Act which abolished stock exchange value taxes and promoted the introduction of mutual funds.[13] In fact, participation rates soared by almost 20 percentage points between 1988 and 1993.

The speed of change in the participation rates in securities had essentially already excluded demographic factors as the underlying reason. The similarity of participation rates across age-groups further strengthens the insight that population ageing cannot be the source. Furthermore, the uniformity of the time pattern suggest that the trends are indeed likely to be connected to the introduction of new investment possibilities and the reduction in transaction and diversification costs.

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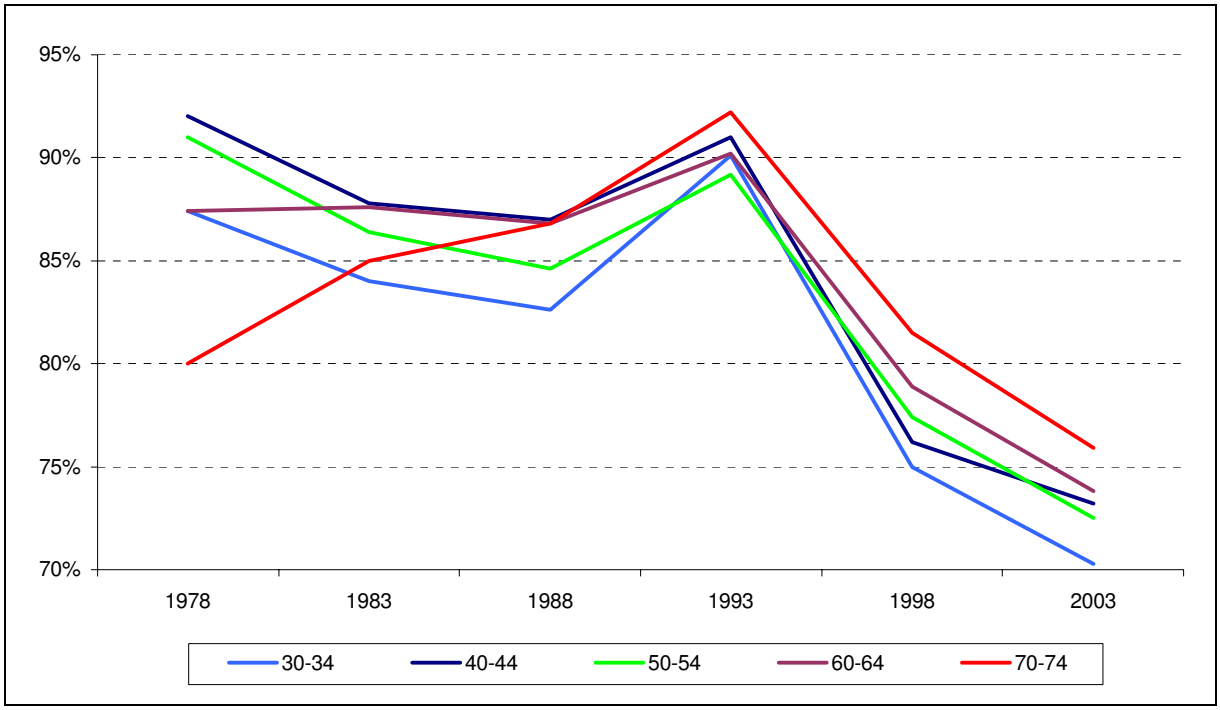
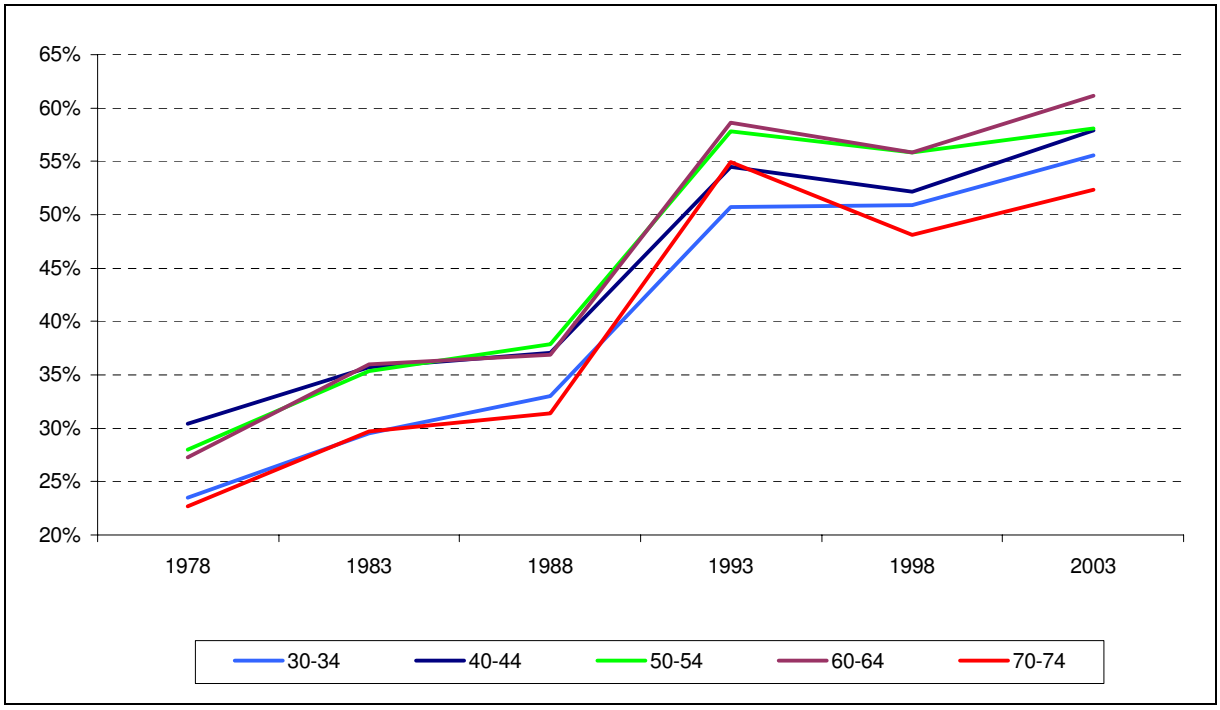
[12] The peak in participation in savings in 1993 is again to be explained by the inclusion of checking accounts.

Figure 4: Participation rate in savings passbooks by age-group



Source: EVS, own calculations

Figure 5: Participation rate in (all) securities by age-group

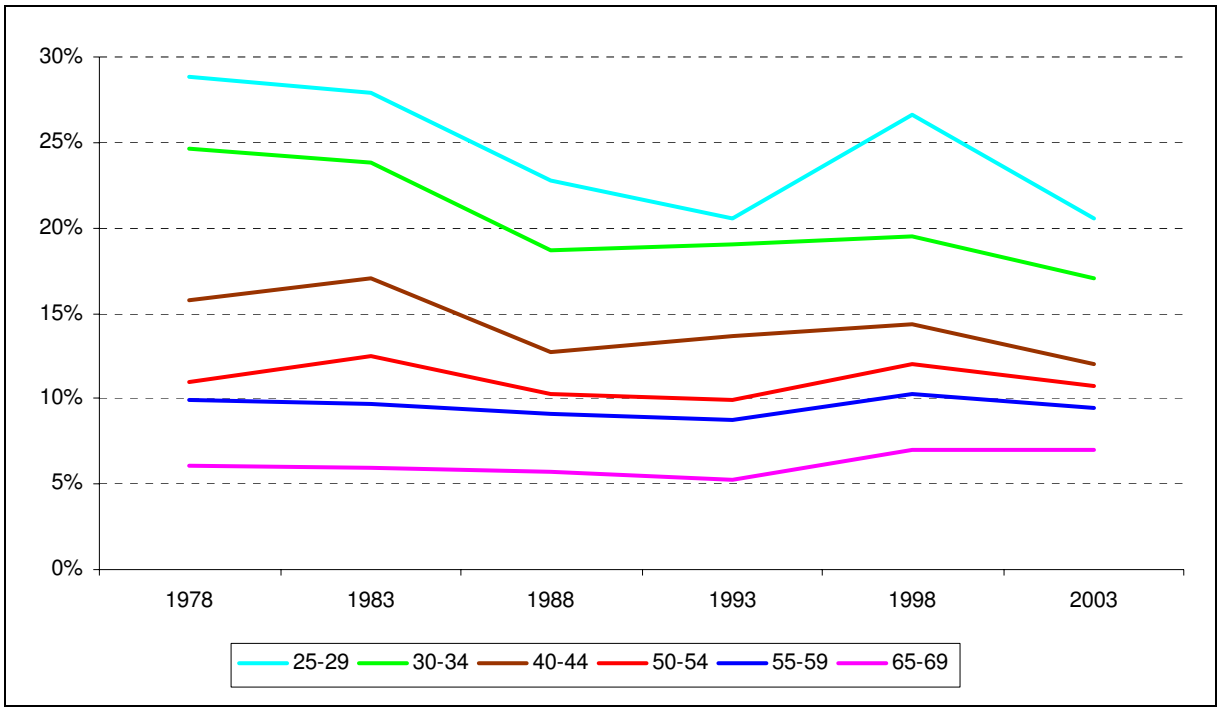


Source: EVS, own calculations

[13] The law was enacted in 1990.

The overall picture for portfolio shares looks similar with respect to the uniformity of the time trends across age-groups. At the same time, we find quite strong and stable level differences across age-groups indicating that population aging may affect portfolio shares in the future:
Building society saving contracts, for instance, constitute a considerable share of gross financial wealth among the young (see figure 6). Their importance among older age-groups has been much lower for the older age-groups in all years. As the population ages, also the share of aggregate wealth invested in building society saving contracts must be expected to shrink.

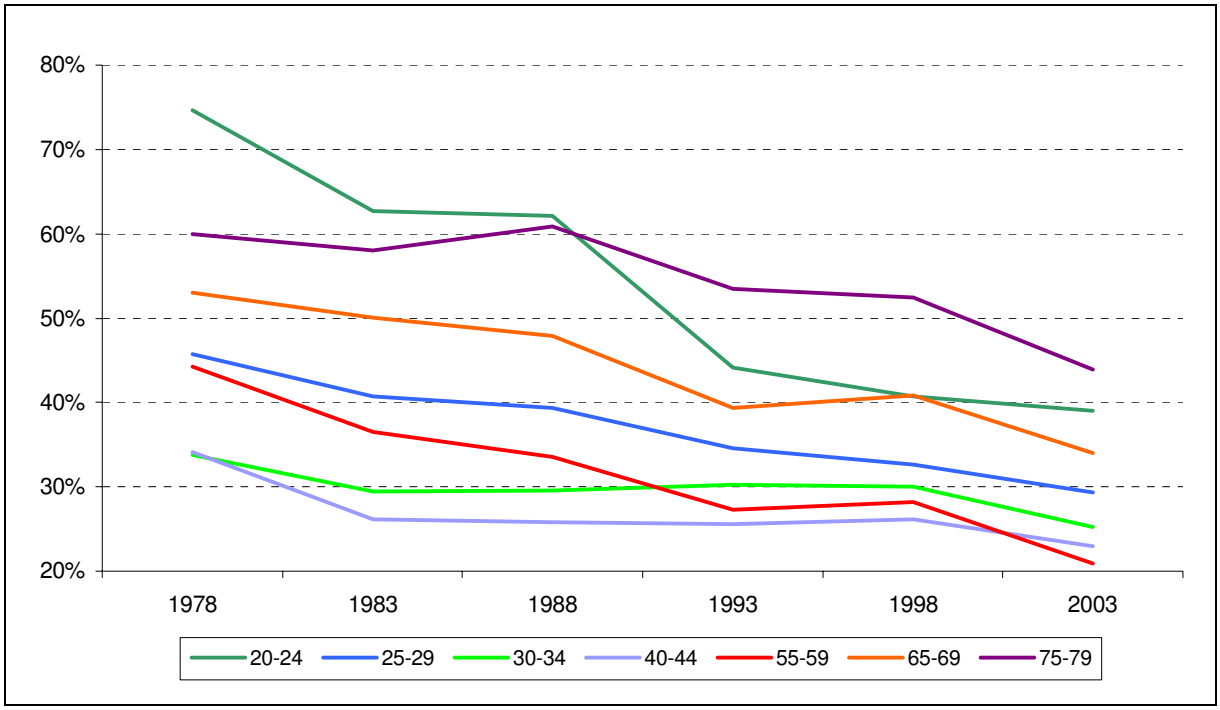
Figure 6: Portfolio share invested in building society saving by age-group



Source: EVS, own calculations

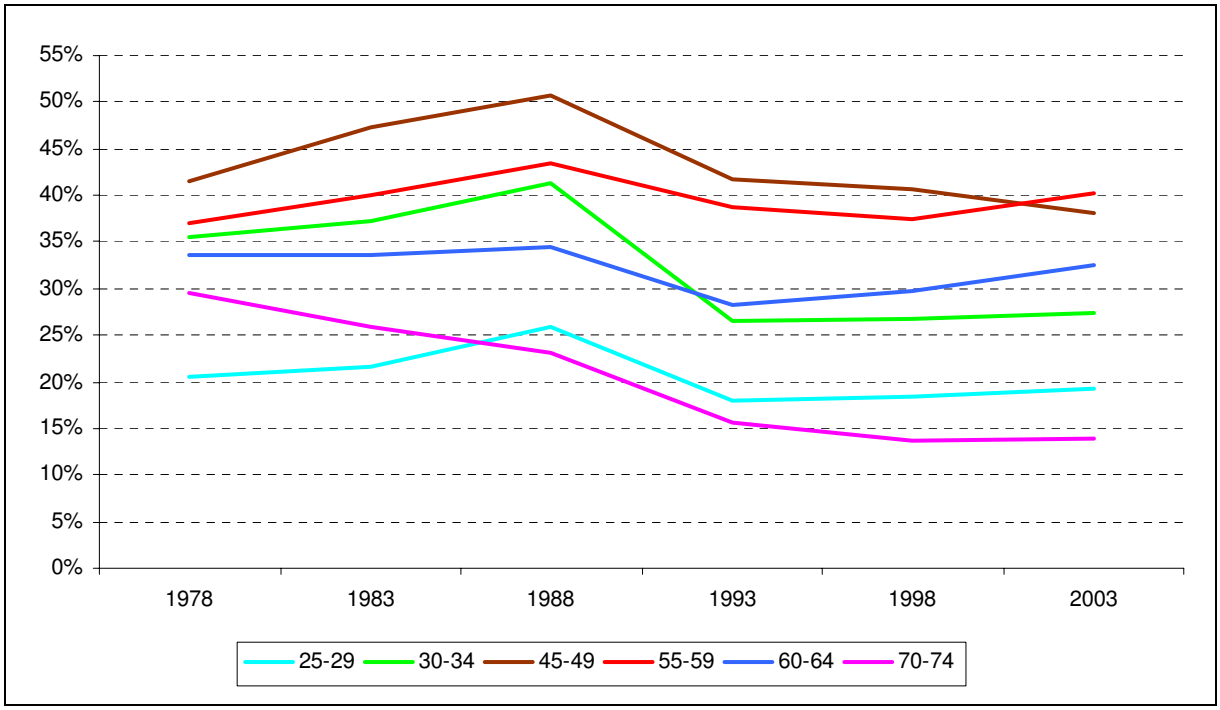
Saving passbooks display a similarly clear picture of level differences across age-groups (see figure 7). At young age a lot of money is allocated to these safe and fungible assets. The portfolio share is considerably lower for the middle-aged households, increases for those approaching retirement and peaks for the elderly. Over the years, the portfolio shares have declined for all age-groups, but especially so among the youngest households.

Figure 7: Portfolio share invested in saving accounts by age-group



Source: EVS, own calculations

Figure 8: Portfolio share invested in life-insurance contracts by age-group



Source: EVS, own calculations

The picture is exactly reversed for life-insurance wealth (see figure 8). The portfolio share held in life-insurance policies starts at about 20 percent for those aged 25-29. Portfolio shares have been

highest for the age-groups 45-60. Around age 60, a substantial share of contracts becomes due, reducing the average wealth holdings and portfolio shares of those age-groups. For the first time, the time patterns look remarkably different across age-groups. Especially for the oldest age-groups, we observe a continuous downward trend in the portfolio share invested in life-insurance products. For most other age-groups we observe a flat or somewhat hump shaped time-trend. Overall, we should be careful interpreting these historical trends given their lack of a common pattern. We will try to shed some more light on these stunningly heterogeneous patterns based on the different perspective provided by the subsequent cohort analysis.

IV.2 *Facts and figures at the cohort level*

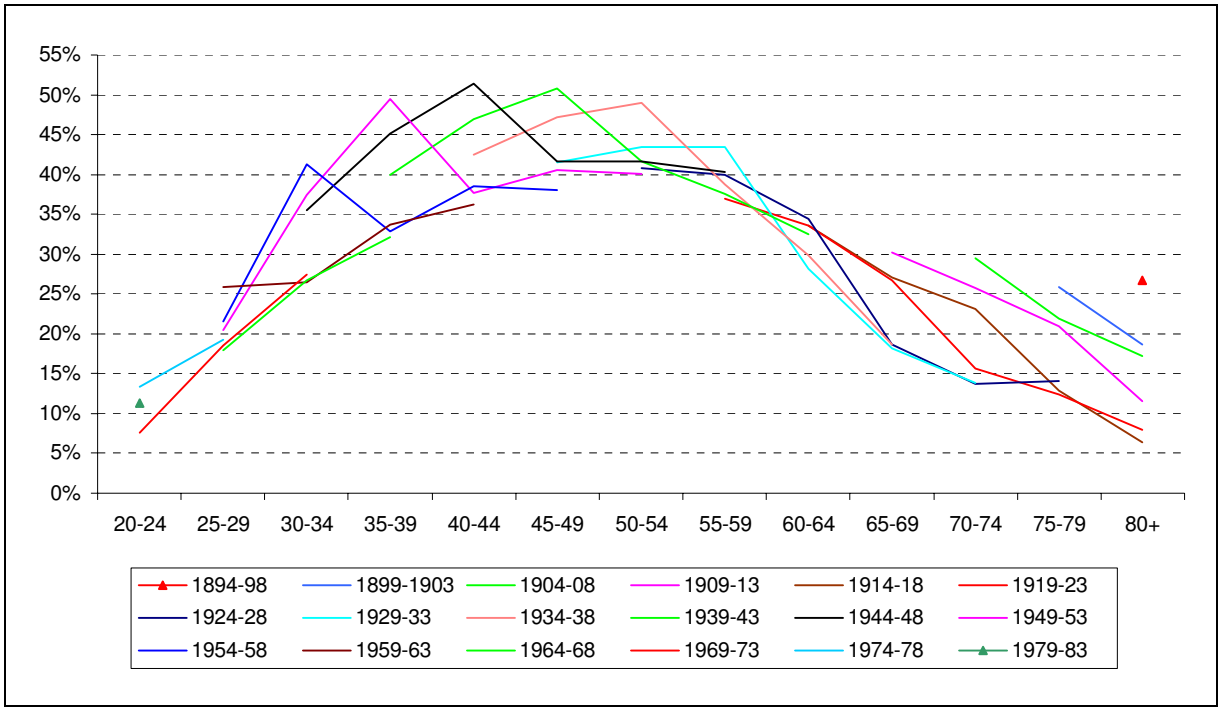
Comparing the changes in participation rates and portfolio shares across cohorts over time we find the pictures to be confounded by age-effects, as different cohorts are observed at quite different stages of their life-cycle. We therefore plot the cohorts over age to compare the different cohorts' behavior at equal stages in their lives. At the same time, these graphs give a first idea of the typical age profile and how it has been changing over the past 25 years. Yet again – following the observations of a specific cohort as it ages we cannot distinguish true age-effects and time-effects – at least not without some identifying assumption. In the following, we present evidence for a selection of assets and highlight life-cycle, cohort- and time-pattern either in portfolio shares or in participation rates. In the last part of this chapter, we revert to the issue of disentangling age-, time- and cohort-effects.

Life-insurance

Looking at figure 9, we easily observe the hump shape in the households' portfolio share invested in life-insurance contracts. The portfolio share peaks somewhat before retirement, as other wealth categories exhibit stronger growth at that age. For the early years – 1978-1988 – the younger cohorts' profile lies above their older counterparts. Moving from 1988 to 1993, we observe a slump in portfolio shares, especially for the young cohorts. This is largely due to the rise of stocks and mutual funds in the 1990s. There is an equivalent kink in the portfolio share of securities – just in the opposite direction. The portfolio shares then stabilized at this lower level in the years 1998 and 2003. The kink over time is also visible for the older cohorts but a lot less pronounced. Instead there are strong cohort differences at old age: younger cohorts hold less of their wealth in life-insurance contracts than their predecessors. While those born around 1900

held roughly 25 percent of their wealth in life-insurance when they reached age 75-80, today's old only hold about 10 percent of their wealth in life-insurance.

Figure 9: Age-profiles of portfolio shares invested in life-insurance by cohort



Source: EVS, own calculations

Partly, this may have been caused by the decreasing popularity of death benefit insurances among the old. The 2003 cross-section provides disaggregated data on the types of life-insurance (see table 5). Roughly 6.5 percent of the population held death benefit insurance. However, among the population aged 50 and below this share is only 1.7 percent. Between age 50 and 65, the share rises to 7.3 percent and averages 15.4 percent for those aged 65 and above. Wealth in death benefit insurance as a share of total life-insurance wealth is 1.1, 5.5 and 38.6 percent for the above subsamples.

Table 5: Death benefit insurance by age (2003)

	age			
	<50	50-65	>65	all
ownership rate				
all life-insurance	60.2%	63.9%	34.4%	58.2%
death benefit insurance	1.7%	7.3%	15.4%	6.5%
portfolio share				
all life-insurance / gross fin. wealth	31.6%	37.5%	14.4%	28.6%
death benefit insurance / total life-insurance	1.1%	5.5%	38.6%	8.3%

Source: EVS (2003), own calculations

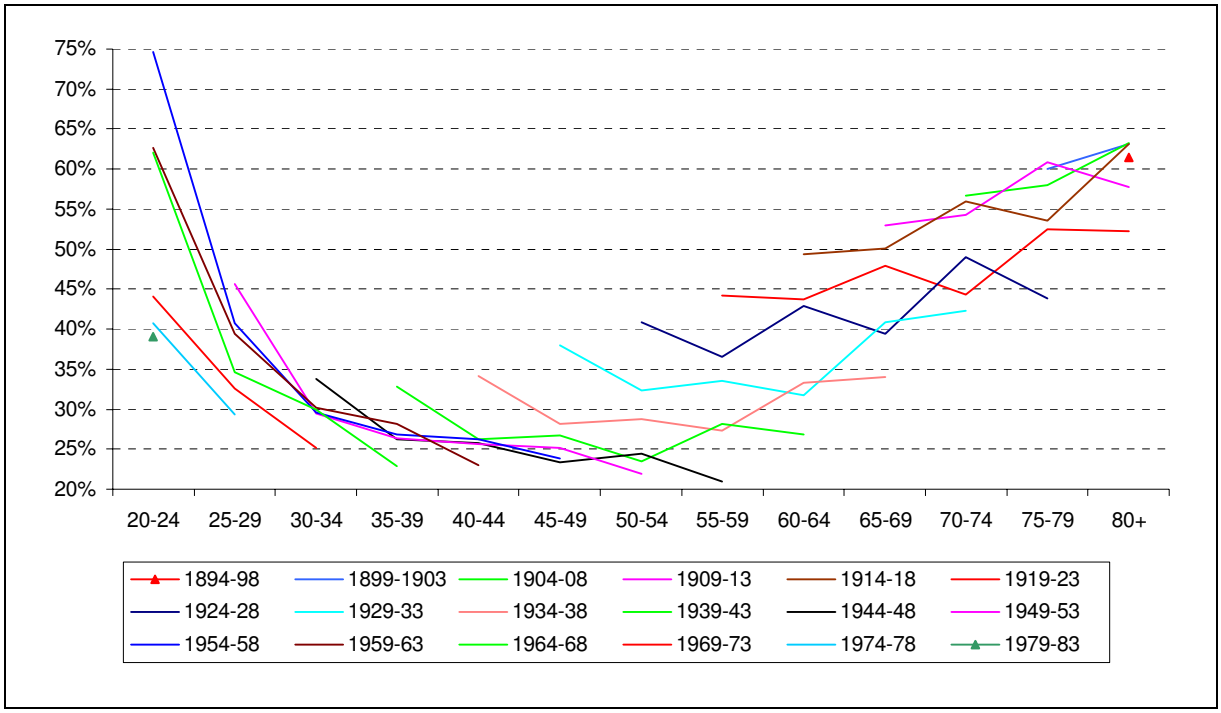
Generally, the portfolio share invested in life-insurance is the only one that exhibits a clear hump over the life-cycle. This is what we would expect for the asset category, which is most important for an individual's old age-provision. There are a few technical aspects to be kept in mind about wealth in life-insurance contracts though. First, there are two ways to buy life-insurance: by regular payments over a certain time span or by a lump sum payment. Second, there are three different ways they can be paid out: as a lump sum, as an annuity, or as a combination of both. Life-insurance products can hence be used in different ways as a mean for old-age provision. We just sketch three short examples and illustrate their implications for what we observe in the data:
A person that saves regularly until retirement and then chooses a life-long annuity will show up in the data holding life-insurance until retirement and none thereafter. A person that saves in other assets to buy a pure annuity at retirement will never show up as an investor in life-insurance products in our data, although she uses life-insurance to insure against longevity risk or premature dissaving for other reasons. Last, a person that saves in life-insurance products using a shortened contribution period and then chooses a lump-sum payout to consume out of the cash received: She will only show up in the data holding wealth in life-insurance for a quite short time span. We should keep in mind that many of these contracts with a shortened contribution phase and an intended lump-sum payout are not intended for old age provision but aim to best exploit the available tax favors.
There are two main consequences for our analysis: we would expect a product being used in connection with the retirement saving motive to show persistent participation rates into old age. With life-insurance being paid out as a lump sum or as an annuity, participation rates drop back clearly after age 60. A similar argument applies to portfolio shares. We would expect a continuous decline of portfolio shares for a financial asset being purely intended for old-age provision. For the reasons mentioned above the observed portfolio shares in life-insurance drop back quite quickly around retirement.

Savings passbooks

The portfolio share invested in savings passbooks (figure 10) is u-shaped over age. Comparing the distances across cohorts at a specific age – which is equivalent to figures 4-7 – the decline of wealth invested in savings passbooks has been strongest for households in their twenties. As much as 75 percent of financial wealth was held this way by the young in 1978. For the same age-group, the share declined to about 40 percent in 1998 and 2003. Cohort differences are comparatively small among the age-groups 35 through 50 and among the elderly. The intermediate age-groups 50 through 70 exhibit considerable cohort differences. The increasing

life-expectancy might explain why today's old have postponed the reallocation of their financial wealth into safe and fungible assets like saving passbooks.

Figure 10: Age-profiles of portfolio shares invested in savings passbooks by cohort



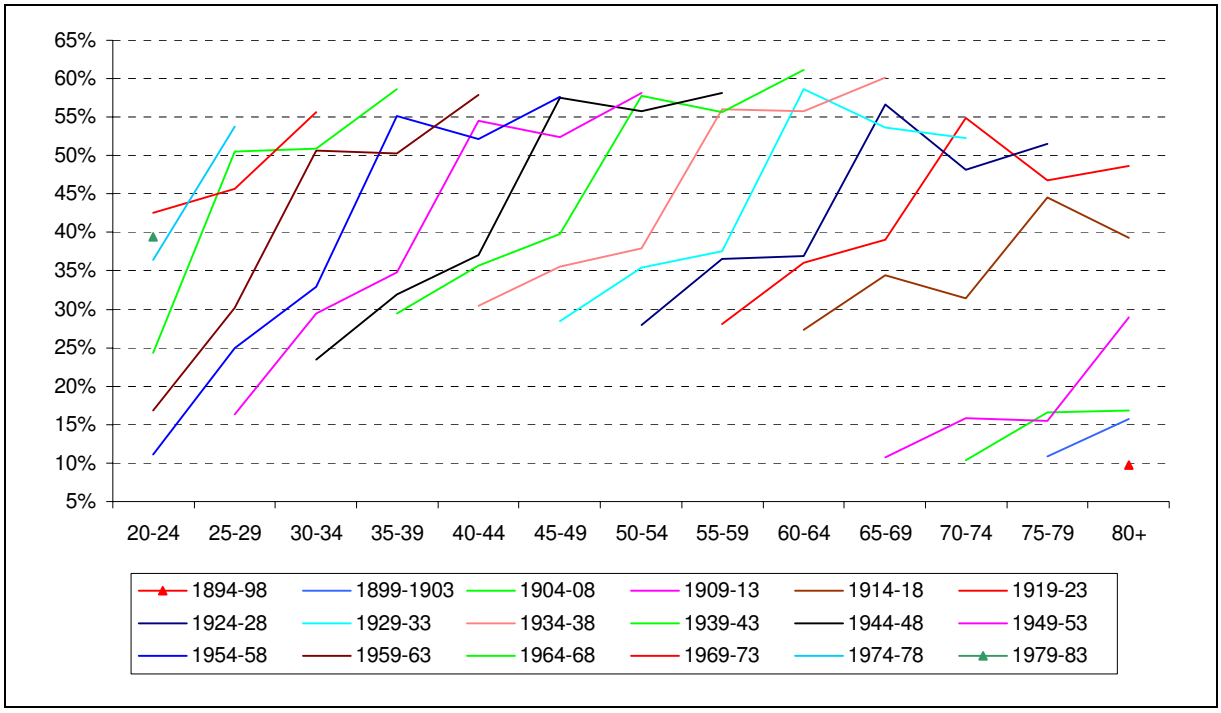
Source: EVS, own calculations

Securities

Figure 11 gives an example how strong trends look like in a plot of cohorts over age. Almost all cohorts show a common development over time: basically, their participation rates in securities rise from 1978 through 1993 and level off thereafter. It seems quite obvious, however, that following a cohort as it ages we capture a mixture of age- and time-effects. Certain differences in the slopes of the trajectories between age-groups indicate that a slightly hump shaped life-cycle profile may be mingled with the dominant time-pattern. In fact, the patterns for the oldest cohorts are less steep than what observe for the younger cohorts.

On top of the common trends, we observe the younger cohorts' profiles to lie above the profile of their predecessor cohort in almost all cases, indicating additional cohort-effects. The differences are especially large among the old: about 20 percent more of today's old hold securities compared to previous generations.

Figure 11: Age-profiles of participation rates in (all) securities by cohort



Source: EVS, own calculations

IV.3 *The Deaton-Paxson decomposition*

Connecting the observations on a certain birth cohort in a graph over age may give the impression that we are observing age-effects. However, even if we ignore the differences in the age-trajectories across cohorts and look at individual cohorts, the supposed age-pattern may be confounded by time-effects. The age-profile will e.g. look steeper if positive time-effects add to the true age-effects. Essentially, the slope of the true age-profile may even have the opposite sign of what the graph suggests. While the experienced economist may quickly come up with an interpretation of the observed pattern, each interpretation will rely on implicit structural assumptions, as age-, time-, and cohort-effects are by definition linearly dependent.

We therefore add another perspective on how much investment behaviors change over age, and how much cohorts differ in their investment attitudes by employing the Deaton-Paxson decomposition. We start by motivating the inclusion of all three possible effects and then turn to the assumptions used by Deaton and Paxson (1994) in the identification of the different effects. Along the way, we discuss the key issues in the overall pursuit of stylized age-profiles.

IV.3.1 General considerations

To be able to distinguish age-, cohort- and time-effects any approach has to impose additional structure. Two structural assumptions are usually made: first and often not explicitly discussed, it is assumed that there is an age-profile, which is common to all cohorts. Second, cohort- and time-effects are typically limited to parameters, which change the common age-profile along one dimension.

Yet, considering different possible changes to the public pension system and their theoretical implications on the optimal age trajectories, it is obvious that cohorts might well differ in more than just one dimension. Let us assume for instance, that the legal retirement age is being postponed. We would then expect wealth accumulation to take a slower pace to a lower level at retirement, as time in retirement is shortened and thereby also the necessary financial resources for the time after retirement. At all ages until retirement, the implicit (safe) investment from wage earnings will account for a larger share of total wealth while the share of financial assets will be smaller. Hence we would expect the portfolio share of risky assets to be higher at all ages until retirement for cohorts expecting a later retirement age.[14]

A second example is the reduction of the replacement rates in the public pension system. Cohorts will aim to compensate by accumulating larger amounts of wealth. Hence there will be differences in the relative size of the implicit save investments from the pension payments. Specifically, the younger cohorts are facing a less generous public pension system and will depend more on their private savings. We would therefore expect them to choose a less risky asset allocation for their financial wealth.

Now let us translate the above argument to investments in life-insurance, which offer a close substitute to public pensions. If the retirement age is postponed, we would expect the portfolio share of life-insurance to start declining at later age. Following a reduction in the replacement rate from the public pension system, we would expect the portfolio share of life-insurance to increase, especially for the working-age years. Both examples highlight that restricting cohort effects to change a common age-profile along only one dimension is certainly a questionable assumption.

If we nevertheless aim to estimate stylized life-cycle profiles we have to deal with the collinearity of age-, cohort- and time-effects. In fact, given the age and the year of birth of a certain observation, we can always calculate the year of observation and vice versa. To ensure identification in a decomposition of age-, cohort- and time-effects we therefore have to either

[14] Obviously, the argument is reversed if work income is to be considered an implicit risky asset.

apply restrictions to some of the effects or achieve identification through the choice of the functional form.

We are in a comfortable situation if we can rule out time- or cohort-effects, e.g. if we are confident to operate in a stable environment. In the case of portfolio choice, however, there is good reason to assume that all three effects might be important. Age-effects are suggested by various theoretical models as well as by financial intermediaries' recommendations. Cohort-effects will matter e.g. if generations differ in their risk-aversion, rate of time preference or – if the utility function is not of CRRA form – in their initial endowments. As argued above, also changes to the social security scheme may induce cohort-effects. In fact, the 2004 reform of the German pension system introduced different replacement rates for future cohorts. Finally, also time-effects must be expected to play a role: First, there are valuation date effects. The portfolio shares will vary with the fluctuation of asset prices unless households continually reoptimize their asset allocation. Second, changes to the questionnaire – e.g. with respect to the level of detail with which certain assets are questioned – may induce differences in coverage over the years. Finally, also the introduction and the abolishment of investment restrictions will typically affect all households at the same time.

IV.3.2 The Deaton-Paxson approach

We have argued above, that all three – age-, time-, and cohort-effects – should matter in the context of life-cycle portfolio-choice. Equation (1) describes the general problem:

$$y = \beta + A\alpha + C\gamma + Y\psi + u \qquad (1)$$

A, C, and Y are matrices of age, cohort, and year dummies respectively. Let A_i (i=1…N) denote the age-dummies, C_j (j=1…M) the dummies for the birth-cohorts, and Y_t (t=1…T) the dummies for the years of observation. The common age-profile is defined by the sequence of coefficients α. The levels of the age trajectories differ across cohorts according to the γ's. Finally, the time-effects may shift all cohorts at their respective ages by the year-specific parameters ψ.

Deaton and Paxson (1994) suggest treating time-effects as orthogonal deviations from a possible linear trend. We can think of this as a business-cycle effect, caused e.g. by valuation date effects in wealth holdings. A second assumption is necessary, however, to ensure identification. Specifically, Deaton and Paxson assume that the time-effects add up to zero. The identifying

restrictions can be substituted into the regression equation such that T-2 year-dummies are included in the regression, which take the following form:

$$\textit{for } t=3,\ldots T: \qquad Y_{ijt}^{\ *} = Y_{ijt} - \left[(t-1)Y_{ij2} - (t-2)Y_{ij1}\right]. \tag{2}$$

The year-effects can easily be backed out from the estimated coefficients in the transformed equation and the implied restrictions. Additionally, Deaton and Paxson include N-1 age and M-1 cohort dummies in the regression. The left-out age- and cohort-dummies act as references categories. The age- and cohort-effects therefore describe changes relative to these reference categories.

Although we generally adopt the fundamentals of the procedure proposed by Deaton and Paxson, we make some minor modifications: To obtain age-profiles that also have some meaning in terms of their levels we choose not to drop one age-dummy from the estimation but include all age-dummies and drop the constant instead. We further add the restriction that not only the year effects have to add up to zero but also the cohort effects. The cohort-dummies are therefore replaced according to equation (3):

$$\textit{for } j=2,\ldots M: \qquad C_{ijt}^{\ *} = C_{ijt} - C_{i1t} \tag{3}$$

Again, the cohort-effects can be backed out from the estimated coefficients and the applied restriction. The resulting cohort-effects can be interpreted as differences relative to the average cohort. Also the estimated coefficients of the age-dummies get a different interpretation: they now display the predicted life-cycle pattern for the average cohort in an average year. Summarizing, we estimate:

$$y_{ijt} = \sum_{i=1}^{N} \alpha_i A_{ijt} + \sum_{j=2}^{M} \gamma_j C_{ijt}^{*} + \sum_{t=3}^{T} \psi_t Y_{ijt}^{*} + u_{ijt}, \tag{4}$$

where C* and Y* are the transformed dummies.

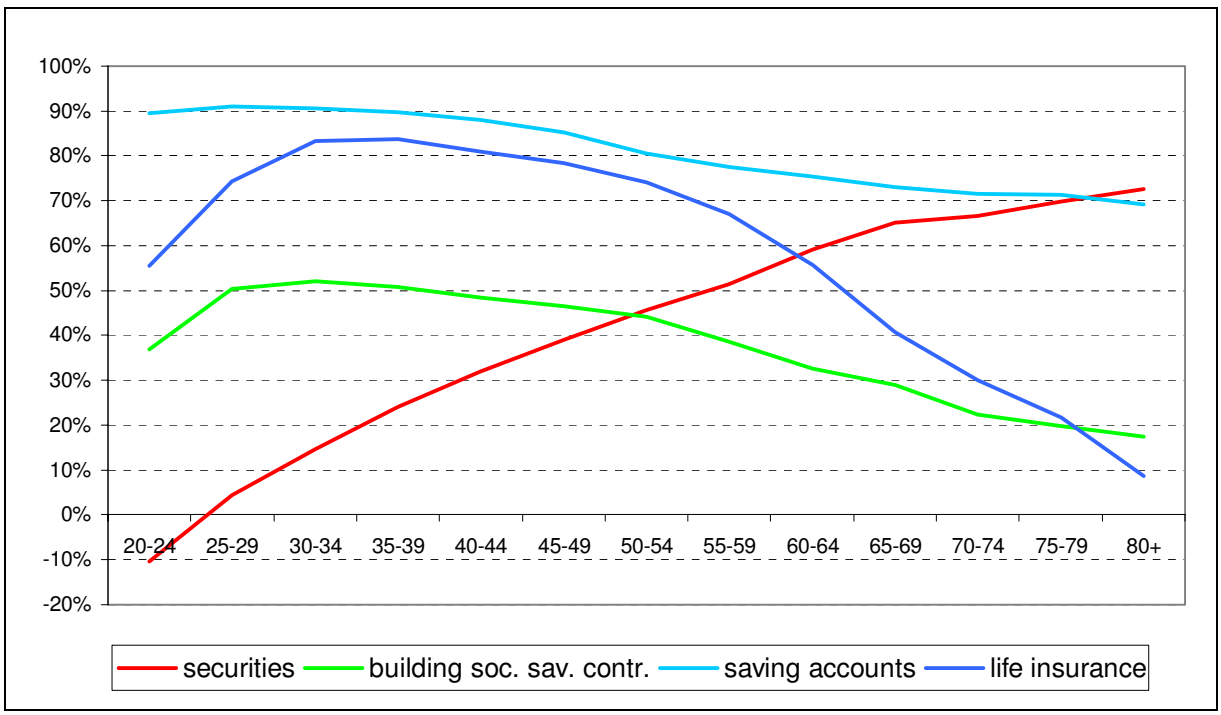
IV.3.3 Decomposition results

Treating the estimated year-effects as correction of business-cycle-, questionnaire- or deregulation-effects we subsequently focus on the estimated age- and cohort-effects. The results for the time-effects are reported in the appendix though (figures A-1, A-2). Before turning to the actual results, a few further notes seem necessary: Although the age-profiles are depicted for the average cohort, they still only imply relative changes over the life-cycle. While the percentage levels should be in a reasonable order of magnitude, the actual slopes of the profile can only be interpreted as relative differences in the participation rate or in the portfolio share across age-groups. In fact – negative numbers as well as numbers beyond 100 percent are technically possible.

Participation rates

Looking at the age- and cohort-effects in participation rates for saving accounts (figures 12 and 13), we see the previous results (see figure 4) supported: While there are little changes in the participation rate over the life-cycle, we observe a clear trend over cohorts. The oldest cohorts (born before 1928) are rather homogeneous, but all subsequent cohorts are less and less likely to hold saving accounts.

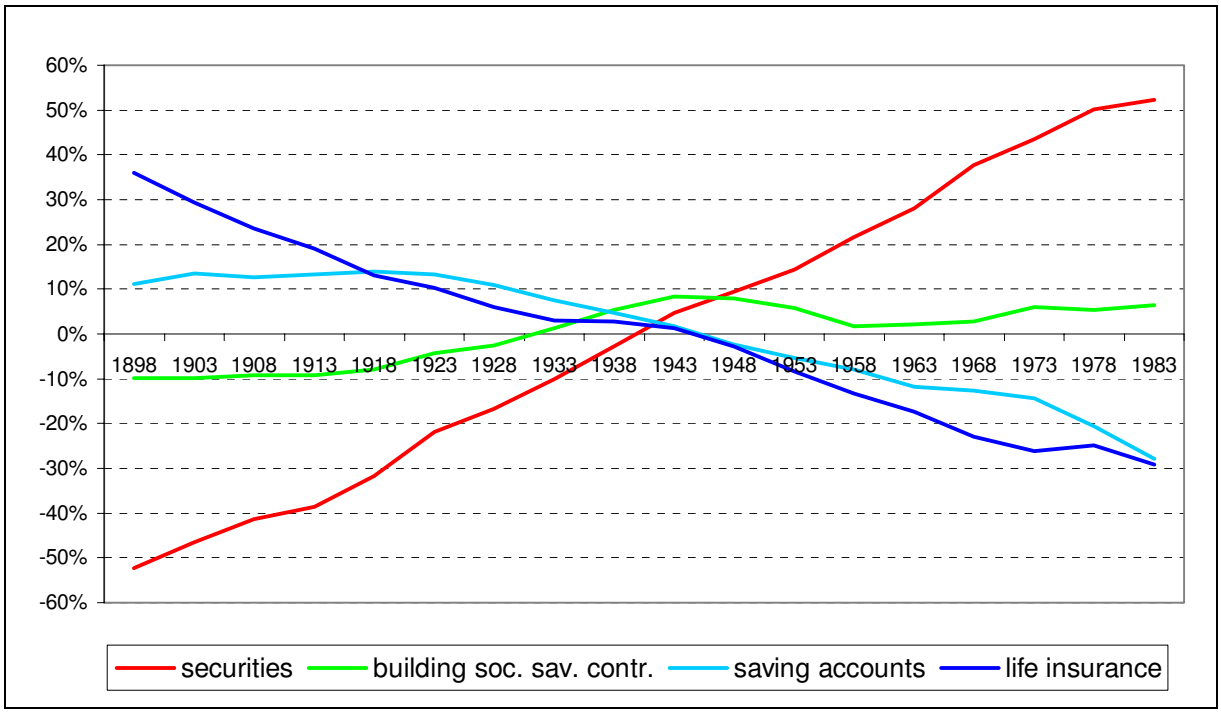
Figure 12: Age-effects in participation rates (relative scale)



Source: EVS, own calculations

For building society saving contracts we observe a similar trend in the opposite direction. The oldest cohorts have a lower probability of holding building society saving contracts. The ownership rates increase steadily for the cohorts born between 1920 and 1940 and remain flat for the younger cohorts. The life-cycle profile for building society saving contracts is hump-shaped but flatter than the corresponding trajectory for life-insurance contracts.

Figure 13: Cohort-effects in participation rates (relative scale)



Source: EVS, own calculations

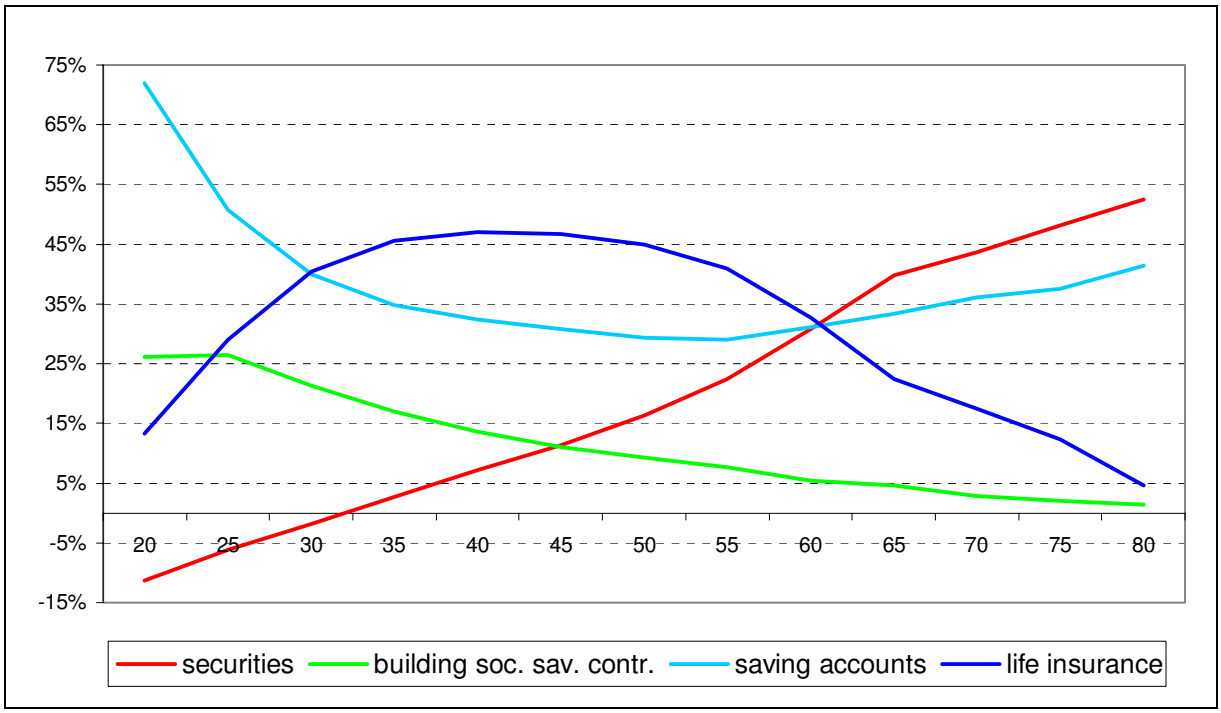
The age-profile for life-insurance indicates that the likelihood of holding life-insurance increases until about age 35. For the subsequent age-groups, we observe a slow decline. Around age 60, participation rates start dropping back more sharply, when an increasing share of contracts becomes due. Looking at the cohort-effects we observe a clear downward trend over the generations, which only slowed down for the very youngest cohorts. Obviously our decomposition picks up two trends at separate parts of the age-distribution. As the oldest cohorts are observed largely at old age, the downward trend for these cohorts corresponds to the declining importance of death benefit insurance. The further decline of the cohort-effects for the young cohorts is obviously "caused" at the other end of the age distribution where the young cohorts are observed. The cohort-graph thus gives a summary of two declining trends, which happened at different times and at different parts of the age-profile. We will discuss this issue below in some further detail.

Finally, the decomposition yields strong age- and cohort-trends for the participation in securities. Between age 20 and age 80, the results imply an increase in ownership rates by 80 percentage points. At the same time the analysis implies a differential of close to 100 percentage points between the youngest cohorts and the cohort of their grandparents. Again, these results are not to be taken seriously given the obvious issues induced by the assumptions underlying the decomposition.

Portfolio shares

Before we discuss the conceptual issues of the decomposition, we have a look at the results for portfolio shares (figures 14 and 15): For securities and life-insurance, we find quite similar results for portfolio shares as above for the participation rates. In fact, the age- and cohort-effects for the portfolio share invested in securities are strongly upward sloping. The increase is slightly smaller than for the participation rate but still in an unrealistic order of magnitude.

Figure 14: Age-effects in portfolio shares (relative scale)

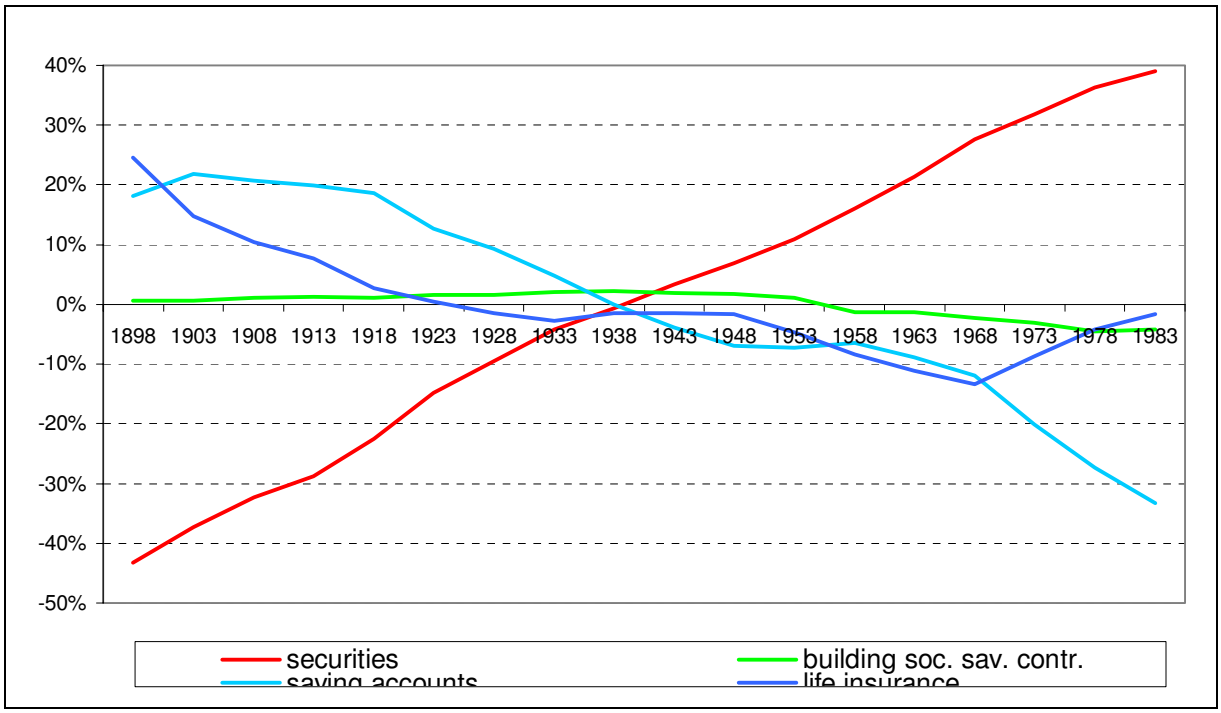


Source: EVS, own calculations

The portfolio share in life-insurance exhibits a hump shaped age-profile. The similarity of results compared to the participation rates above comes with little surprise. As we have explained above, both payout options for life-insurance – be it as an annuity or in a lump-sum payment – imply

that the household is no longer considered an owner of life-insurance wealth after the payout. The decline in portfolio shares across cohorts turns out somewhat smaller compared to what we observed for participation rates, and the recovery for the youngest generation is more discernible. For the remaining asset classes – building society saving contracts and saving accounts – the results of the decomposition look much more reasonable. In fact, the estimated age-profiles match our first impression from the pure descriptives. Saving accounts make for a relatively high portfolio share at young ages. Their importance is reduced strongly until age 40, bottoms out at around age 55 and increases steadily until old age. The importance of building society saving contracts is highest at young age and starts to diminish early in the life-cycle when other financial assets gain more and more importance in private households' portfolios.

Figure 15: Cohort-effects in portfolio shares (relative scale)



Source: EVS, own calculations

IV.3.4 Issues in the decomposition of age-, time-, and cohort-effects

The concerns about the identification of a general life-cycle pattern from repeated cross-sectional data are certainly justified. In fact, year-effects may imply shifts in the portfolio choice of households that have nothing to do with the contemporaneous aging of the cohort. Thus it is

quite natural that we would like to purge the age-trajectories from these fluctuations and shifts we usually denote as time-effects.

There is, however, a second source of adversity – specifically, the short time horizon over which we typically observe households or cohorts in panel or synthetic panel data. We therefore have to rely on the various bits of information we can gather from each cohort about rather small age-windows. Essentially all decomposition approaches estimate a general life-cycle profile by stringing together the average slopes of the cohorts' age-trajectories over the sequence of age-groups. That is, we ultimately interpret a life-cycle profile consisting of the behavior of three generations. From the youngest cohorts we adopt the behavior early in the life-cycle. To this initial phase of the life-cycle we then add the observed behavior of their parents and grandparents for the middle and later phases of the life-cycle.

Let us illustrate the possible drawbacks of this procedure using the above example of securities. At almost all stages of the life-cycle we have been facing increasing participation rates. The young cohorts at young age as well as the old cohorts at old age provide information that the participation rates are increasing over age. Over the limited time span for which we observe each cohort, there was no sign that this trend would eventually level off. At the same time, there are technical limits to this rise in participation rates. The old could not have increased their participation rate in securities if they had increased them already at young age as today's young generation did. Vice versa, today's young simply cannot keep up their growth of ownership rates over several more decades as they will reach retirement already with a much higher participation rate than the generation of their grandparents. The assumption of a common general life-cycle profile does not allow for changes though.

So far, the choice of possible structural assumptions for the identification of age-, time-, and cohort-effects has received considerable attention in the literature. In many cases, however, we should question the value of estimating stylized life-cycle profiles, especially if we have reason to believe that life-cycle behavior as such is in flux. Frequently, it will be advisable to stick with the raw age-trajectories of cohorts. On the one hand, they certainly provide a less clear impression of life-cycle behavior. On the other hand, they convey considerably more information, especially on the changing nature of life-cycle behavior. Furthermore, we may induce new bias in our attempt to purge the age-profiles of time- and cohort-effects.

V. Conclusion

We start out from a comparison of aggregate trends in German households' asset allocation focusing on participation rates and portfolio shares derived from micro data and from the National Accounts. We find the broad trends supported by both data sources: safe investments with banks, especially saving accounts have played an important role in private household portfolios and still do so. However, their portfolio share has been on a continuous and strong decline until recently. Only the bear market years made sure that this trend came to a standstill in 2002. At the same time, life-insurance has gained substantial importance since the 1960s. The rise of life-insurance has been slowed with the increasing popularity of stocks and mutual funds in the 1990s. While the participation in life-insurance products has dropped back in the last years, especially mutual funds have seen a strong and steady growth. Their popularity continued through the stock market downturn in 2001-03. In fact, mutual funds could still generate saving inflows while direct investments in stocks lost some of their previous importance. We find that despite the considerable divestments in the bear market years only few investors quit the stock market entirely.

In a second step, we investigate these historical trends in more details by looking at the underlying developments at the age- and cohort-level. We find that the rising importance of securities as well as the declining share of saving accounts can be found among almost all age-groups. Only the elderly participated in these changes to a lesser extent. For life-insurance we observe a declining importance among the old and among the very young. The reasons, however, are likely quite different. For the old, death benefit insurance has lost most of its previous importance. For the young, the declining guaranteed interest rates as well as the less favorable tax treatment of whole life-insurance may have been the main reasons. Furthermore, the later marriage and childbirth may be reasons to postpone investments in life-insurance contracts. Somewhat surprisingly, the reductions in the generosity of the public pension system have not triggered additional investments in this close substitute. Maybe the 2003 data is just too close to the enactment of the reforms. Analyses of the SAVE indicate data that households are indeed more and more aware of the need for additional private old age provision and have started to adjust accordingly in recent years (see Börsch-Supan et al., 2007).

Our findings allow some conclusions about the plausibility of theoretical models of life-cycle portfolio choice and the sources of the observed trends in household portfolios. First, the allocation of financial wealth clearly changes over the life-cycle. Second, the share of safe and

fungible assets like saving accounts takes a u-shaped life-cycle path. It is highest among the youngest age-groups and declines until age 55. This finding is in line with theoretical models which include risky income streams and borrowing constraints. Assuming that labor income can be treated like an implicit risky asset, households would correctly choose a low risk allocation of financial wealth when this implicit risky investment – the present discounted value of future work income – is largest. For the second part of the life-cycle we observe a revival of safe and fungible saving accounts. The prime candidates to explain the changing investment behavior are again risk factors, especially risks of high expenditures on health and long term care.

Third, we find a strong increase in the popularity of securities among essentially all age-groups and cohorts. Most of the surge has happened in the first half of the 1990s, when several financial market development acts were passed. Furthermore, information and transaction costs were reduced with the spreading of modern information technologies. The coincidence of these institutional changes with behavioral changes which we observe essentially for the entire population suggests that restrictions to household optimization were abolished or at least softened. So far, this does not explain, however, why German households do not reduce their exposure to market fluctuations after retirement. As the persistent asset allocation is matched by continuously high old age saving rates (see Börsch-Supan et al, 2002 and Sommer, 2008), it seems obvious to think of a strong bequest motive as suggested by Abel (2002). At the same time, the time-effects of easier market access may just have concealed a different age-effect.

Forth and last: Investments in life-insurance are rather hard to reconcile with the predictions of theoretical portfolio choice models. In fact, life-insurance is often perceived as a safe investment although the insurance companies invest part of their portfolio in risky assets. That is, a comprehensive portfolio model should account for the asset allocation within a typical life-insurance contract. Even if households consider this in the allocation of their remaining financial wealth, life-insurance contracts additionally incorporate a variety of features which are untypical to other assets. Specifically, there is the insurance against longevity risks and frequently also a term life-insurance. A detailed investigation of the determinants of the demand for life-insurance is beyond the scope of this paper though.

The last part of the paper is dedicated to the issues around the identification of stylized life-cycle profiles. We use the decomposition approach suggested by Deaton and Paxson (1994) to highlight the general problems connected to the estimation of a common life-cycle pattern. The source of trouble is the fact that the estimation draws bits of information from the age-trajectories of several generations. If changes to the institutional environment lead to differences in the life-cycle behavior across cohorts, the estimation of a common life-cycle pattern will likely

yield biased results. The attempts to purge an age-profile from confounding cohort- and time-effects and to condense the information contained in a full cohort analysis should thus be carried out with much diligence taking into account the changing nature of life-cycle behavior.

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Appendix

Effects of the sampling threshold on life-cycle trajectories

The age of households – or strictly speaking of the household heads – with a net monthly household income above 33000 DM in 1998 – the threshold being 35000 DM – ranges from 32 to 52. The 99th income percentile exceeds 20000 DM for all age-groups between 48 and 57. Dropping those households in the 1998 cross-section whose income exceeded the indexed 1988 threshold left average stock market wealth unchanged for 60 out of 66 age-groups. Affected were the ages 32 and 45-49 with changes in average stock market wealth for an individual age-group between (-0.5) to (-9.9) percent.

Comparing the wealth levels from the EVS with the Financial Accounts

Table A-1: Coverage rates in the EVS 1978-1988

	1978			1983			1988		
type of asset	FA	EVS	EVS coverage rate	FA	EVS	EVS coverage rate	FA	EVS	EVS coverage rate
saving deposits	459.1	216.3	47.1%	545.8	229.9	42.1%	699.6	273.7	39.1%
building society saving contracts	93.5	86.7	92.7%	122.8	112	91.2%	118	102.2	86.6%
time deposits	36.8	n.a.	n.a.	125.7	34.1	27.1%	144.3	37.4	25.9%
securities	240.4	103.4	43.0%	441.9	163.9	37.1%	646.4	211.2	32.7%
saving bonds	59.9	n.a.	n.a.	128.5	47.4	36.9%	164.5	72.1	43.8%
bank bonds	48	n.a.	n.a.	128.5	40.1	31.2%	104.3	29.7	28.5%
government bonds	46.6	n.a.	n.a.	69.1	26.9	38.9%	75.6	24.5	32.4%
stocks	55	n.a.	n.a.	71.2	32.3	45.4%	134.5	48.7	36.2%
mutual funds	24	n.a.	n.a.	31.8	8.4	26.4%	73.3	17.3	23.6%
other securities	6.9	n.a.	n.a.	12.8	8.8	68.8%	94.2	18.9	20.1%
life-insurance									
other claims		n.a.	n.a.		n.a.	n.a.		n.a.	n.a.
private pension funds		n.a.	n.a.		n.a.	n.a.		n.a.	n.a.
other claims		n.a.	n.a.		n.a.	n.a.		n.a.	n.a.
gross financial wealth	829.8	406.4	49.0%	1236.2	539.9	43.7%	1608.3	626.9	39.0%

Source: Lang (1997), absolute numbers in billion DM

Time-effects from the Deaton-Paxson decomposition

Figure A-1: Time-effects in participation rates (relative scale)

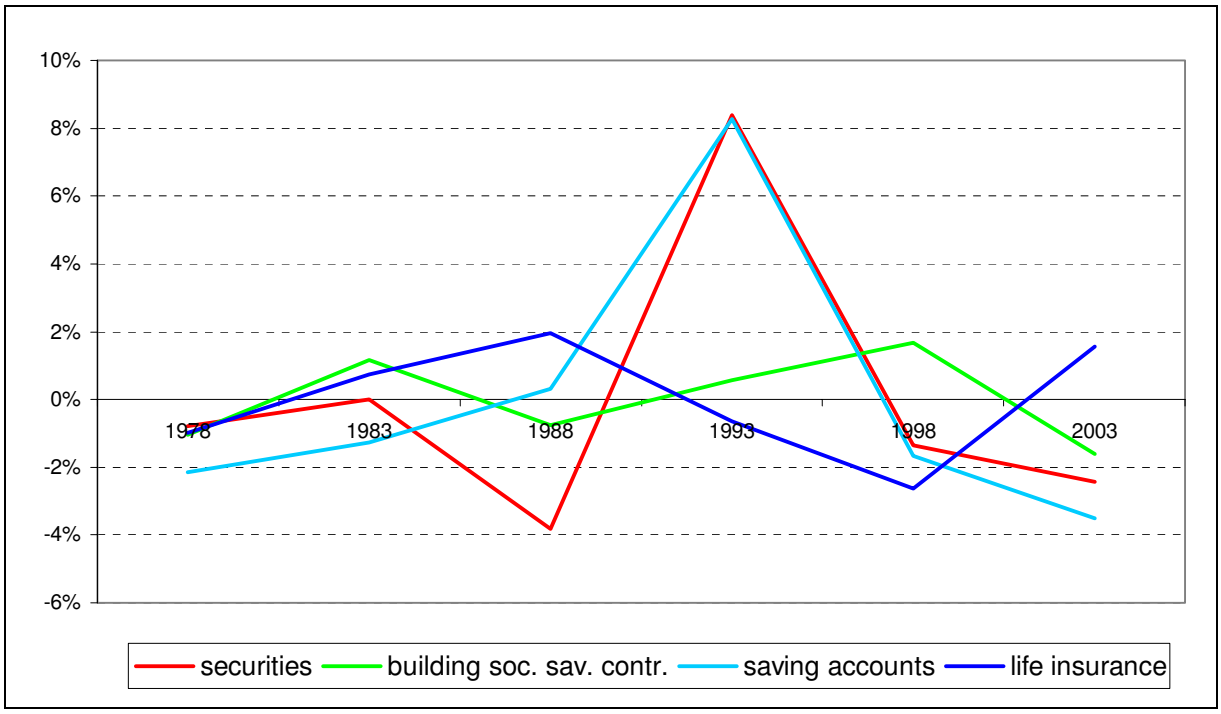
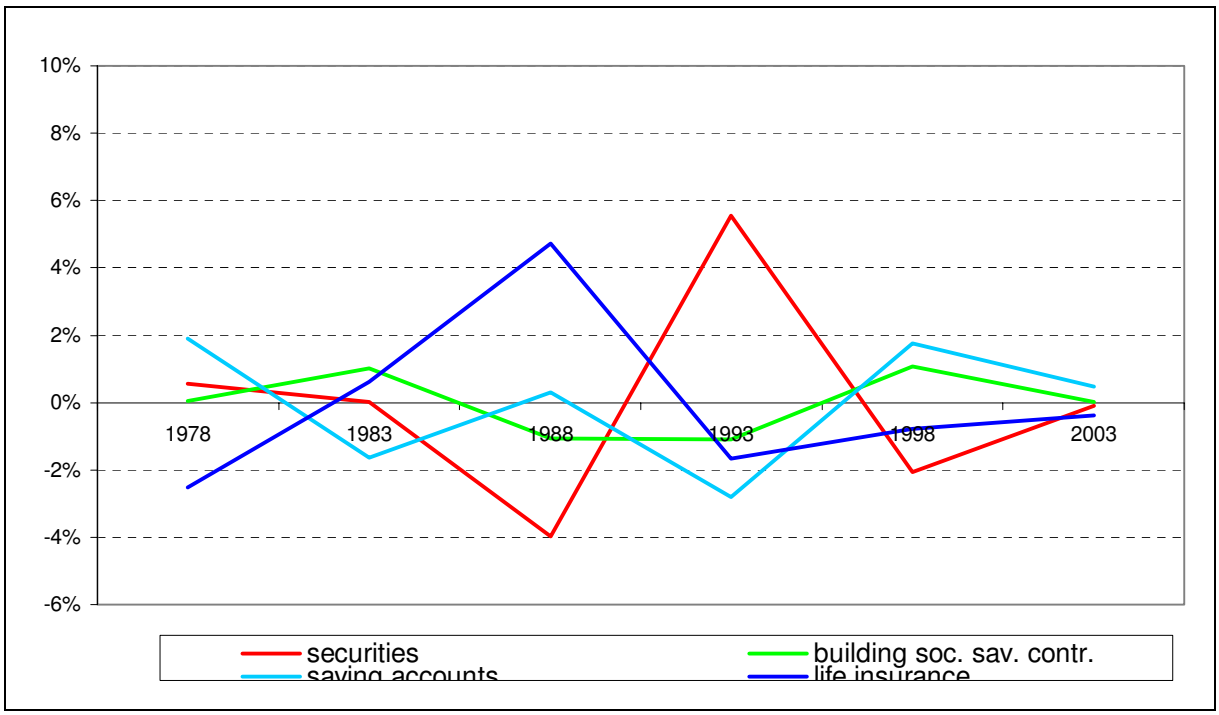


Figure A-2: Time-effects in portfolio shares (relative scale)



Chapter 3

Savings motives and the effectiveness of tax incentives – an analysis based on the demand for life-insurance in Germany

I. Introduction

Life insurance traditionally plays an important role in Germans' private savings. Roughly 60 percent of all German households held some kind of life insurance in 2003. Its popularity might seem somewhat unusual from an international perspective. Yet life insurance products in Germany have some key characteristics, which are not common to life insurance in many other countries. The combination of characteristics also makes the German insurance market an interesting field for research on savings behavior and savings motives: old age provision, tax favors, protection of one's family against income risks, bequest motives and the wish to acquire a piece of real estate may induce people to invest in some kind of life insurance. We exploit the remarkable aspects of the German insurance market in order to test, which of these determinants actually drive the demand for life insurance and shed some light on the importance of different savings motives.

As of today, most Germans would probably think of a life insurance policy as a means of private old age provision. But there is more to it: Annuity insurance and whole life insurance contracts in Germany essentially combine the insurance against longevity risk with a highly tax favored savings plan. Hence, pure tax savings motives as well as the need for additional old age provision in the face of the declining generosity of the public pension system may drive the demand for life insurance. Further, life insurance contracts can aim at the insurance of the owner's family against an early death of the main earner or serve a bequest motive. Last, also the possibility to use life insurance contracts as collateral to home loans adds to the popularity of annuity and whole life insurance contracts. Some term life insurance is frequently required for a successful application for a home loan.

Our paper contributes mainly to two threads of research: The importance of tax incentives for household savings and portfolio choice and the relevance of savings motives in savings decisions. But also the demand for life insurance itself has attracted some attention in the past. Given that life insurance products have such extraordinary relevance for German households our dataset seems well suited to add some insights.

A substantial literature has discussed the importance of tax incentives and after-tax returns on portfolio choice. The first paper to empirically document the importance of taxation on portfolio choice has been Feldstein (1976). Later, the favorable tax treatment of IRAs and 401(k) plans in the United States triggered a scientific debate on whether or not the tax incentives created additional savings or just crowded out other forms of savings. The literature is summarized by Poterba, Venti and Wise (1996) as well as Engen, Gale and Scholz (1996). While this literature

remains somewhat undecided on whether or not tax incentives are suited to create additional savings it largely agrees that tax incentives shift households' investment decisions in the expected direction. Jappelli and Pistaferri (2001) analyze the effects of a change in the tax treatment towards life insurance products in Italy. Unlike the American studies they do not find evidence for a reaction in household portfolio behavior.

Also the question whether or not bequest motives play a role for private households' savings decisions has received a great deal of attention: The majority of analyses test implications of a bequest motive on consumption or on the demand for term life insurance and private pensions. Bernheim (1991) focuses on the demand for life insurance, while Hurd (1987, 1989) analyzes total savings. Both make use of the Longitudinal Retirement History Survey. Lacking data on surrender values, Bernheim focuses on insurance sums. He concludes that households would not choose to annuitize their entire wealth even in the presence of perfect insurance markets. Bernheim argues further that a large segment of the population behaves according to what the presence of a bequest motive would imply. His findings are at odds with the conclusions of Hurd (1987), who investigated the rate of asset decumulation of elderly households. Hurd's estimates show no significant differences in the degree of dissaving between households with and without children. While the childless have less reason to save in order to leave a bequest, the weaker family insurance may call for a stronger precautionary savings motive, offsetting the smaller bequest motive. In a subsequent analysis Hurd (1989) used a parametrized model of consumption and saving. He estimates the marginal utility from bequests to be close to zero. The most recent contribution to this literature stems from Kopczuk and Lupton (2005). They relax Hurd's distinction between households with and without children and estimate the existence of a bequest motive using a switching regression. They find the bequest motive to be prominent among all households, no matter whether they have children or not. For a significant share of households, the bequest motive is also estimated to be economically significant. Yet, all these studies suffer from the impossibility to distinguish an operative bequest motive from other savings motives – e.g. a precautionary savings motive. Some studies therefore exploit survey data containing direct questions on the intention of leaving a bequest. Alessie et al. (1999) find only insignificant effects of intended bequests on savings for the Netherlands. But also the sign of the estimated effect is not robust across the years. Also Kazarozian (1997) finds no evidence for a bequest motive. His estimates for the United States have a consistently positive sign but none of them is significant. Laitner and Juster (1996) make use of the TIAA-CREF survey and find households with a bequest motive to have significantly higher wealth levels at age 65. At the same time, they find a large amount of heterogeneity among these households and point out that other household characteristics seem to be more important than the existence of a bequest motive.

Furthermore, the sample of TIAA-CREF annuitants is known to be not representative for the US population and consisting of rather high educated and well off persons. Juerges (2001) compares subjective and objective indicators for the importance of a bequest motive in Germany. Like Hurd (1987) he finds the presence of children to be of minor importance for the heterogeneity in wealth holdings, whereas differences in declared bequest intentions are associated with significant shifts in wealth holdings. Similarly, Schunk (2007) finds that there is a significant bequest motive for older households, even when he controls for the presence of a precautionary motive. While the evidence for a bequest motive remains at best ambiguous, it still remains unclear, whether egoistic or altruistic aspects are causing people to plan to leave a bequest.

Last but not least there is a considerable literature which has focused on specific aspects in the demand of life insurance. Gandolfi and Miners (1996) argue, that there might be differences in the determinants of the demand for life insurance between husbands and wives and find support for their hypotheses. Chen, Wong and Lee (2001) describe the historical trends in the demand for life insurance in the U.S. They find differences in the historical sales between women and men and argue that labor force participation might be an important determinant. Like in Germany, they find a reduction in life insurance purchases over the last years, which is especially prominent among the young. They speculate the higher share of single households and the trend towards later marriages and later childbirth to be the main causes.

Given that we observe a considerable amount of change on the German insurance market we aim to exploit our results to also shed some light on the past – and possible future – trends. Recent changes in the tax legislation and the pension reforms are likely to affect demand in the short and medium run. Over a longer horizon also sociological developments are likely to play a role: Between the 1970s and today we have observed trends to later household formation, later childbirth and higher female labor force participation which are likely to continue over the next decades.

The paper is structured as follows: We start out in section two with an overview over the German market for life insurance products and illustrate the relative importance of the various products with recent data. Further, we describe in detail the subsidization scheme. Section three discusses the theoretical foundations of the demand for life insurance and derives hypotheses about the effects of various savings motives on the demand for life insurance. In the fourth section we describe the data we use for the empirical part, the results of which are presented in the following section. We begin the fifth section with a description of the historical developments and some basic regressions of ownership decisions for the various life insurance products. Bernheim (1991) presented strong evidence, that different processes are driving the ownership

decision and the decision, how much to invest in life insurance. We therefore also employ a two stage model for the households' demand for life insurance. Section six concludes.

II. Life insurance in Germany

The high popularity of life insurance products in German households' portfolios has – at least in part – an historical background: Capital accumulation on behalf of private households was one of the main political objectives in Germany after the Second World War. To promote this, public economic policy widely employed tax incentives. Hence, life insurance contracts have been designed to meet the requirements for the favorable tax treatment. Apart from a rather attractive combination of reasonably high returns and low levels of risks, these tax advantages will certainly have contributed to the high popularity of savings in life insurance products in Germany. With the stock market boom in the late 1990s the popularity of life insurance products has suffered, but wealth in life insurance products remains to be one of the most important components of German households' financial assets. In 2003, roughly 60 percent of all German households held at least one life insurance contract and wealth in life insurance products accounted for as much 27.5 percent of total financial wealth.

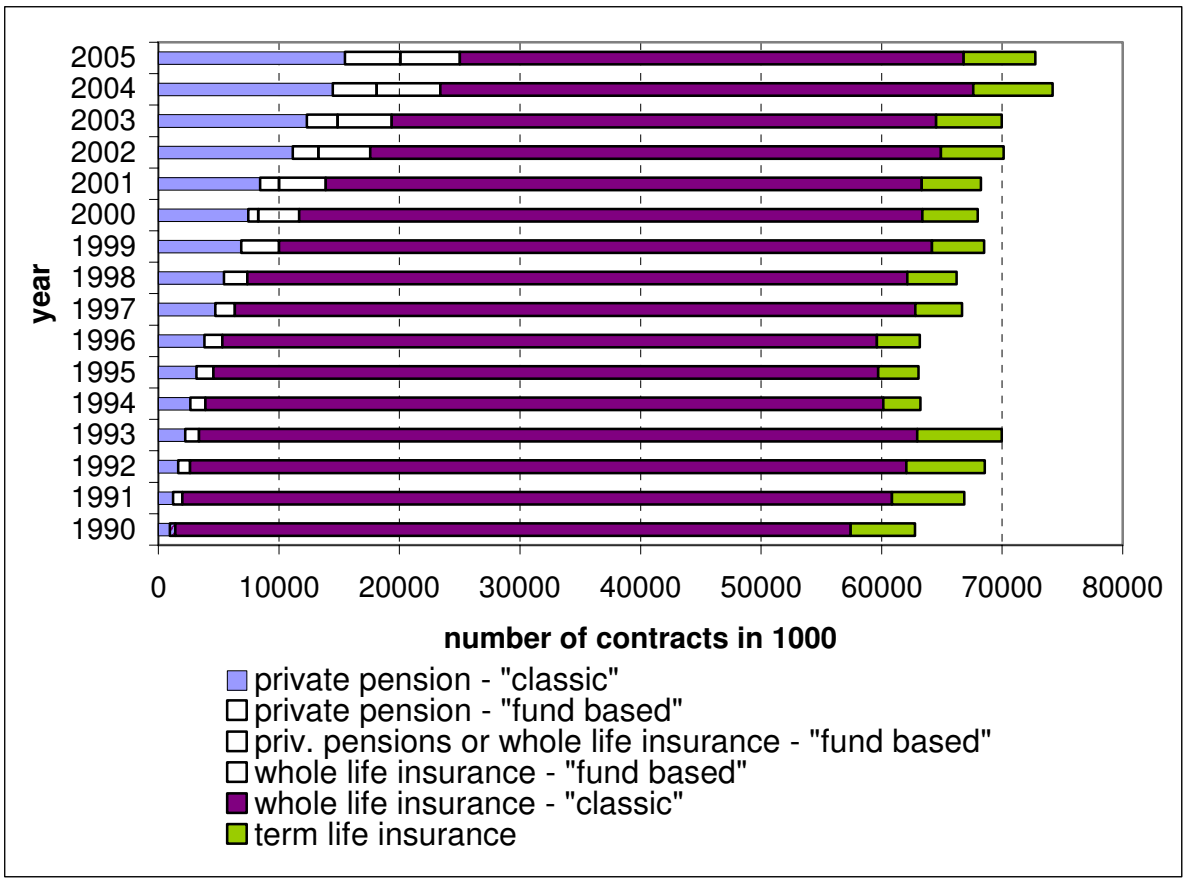
II.1 *Market overview*

The German market for life insurance products spans term life insurance, as well as whole life insurance and private pensions. The first is distinct from the two others, as it does not involve capital accumulation. We still consider it in our analysis, as term life insurance can be employed to insure the family against income risks connected to the death of the main earner. Comparing whole life insurance and private pension contracts the two products should be quite dissimilar from a theoretical point of view. Yet the way they are offered on the German market, they differ only in a few aspects. Essentially, they both combine an insurance against longevity risk with a highly tax favored savings plan. The main difference is that whole life insurance contracts include a term life component whereas private annuities do not.

Additionally, we distinguish between so called "classical" and "fund based" contracts. Whole life insurance as well as private pensions are offered in either specification. In a "classical" insurance contract, the insured person is guaranteed a minimum annual return. The insured further participate in excess returns of the insurance company. The key characteristic of the "fund based" contracts is that the insured person essentially bears the risk of return. Additionally, the classical and fund based contracts differ with respect to their tax treatment, which we will discuss later.

Figure 1 illustrates the relative importance of the above products on the German insurance market since 1990. Mere fifteen years ago, essentially only term life insurance and classical whole life insurance contracts played a role. Since then, two major trends have changed the structure of the market. First, fund based insurance contracts have experienced a considerable growth. Second, the popularity of private pensions has increased considerably. These changes have happened at an impressive pace and are even more striking when we look at the number of newly signed policies. In fact, private pension contracts account for at least 50 percent of total new contracts since the year 2001.[1]

Figure 1: Number of life insurance contracts by type of product (in 1000)



Source: Gesamtverband der Versicherungswirtschaft

[1] excluding pure term life insurance

II.2 *Market structure and investor characteristics*

These above aggregate figures already give us a broad impression of the importance of life insurance products in German households' portfolios. The total of roughly 70 million contracts relates to a population of 82 million people in 39 million households, a lot of which hold several insurance contracts.

The 2003 Income and Expenditure Survey (EVS) allows us to inspect the structure of life insurance ownership and portfolio shares of the different products in more detail. Whole life insurance contracts turn out to be part of financial wealth in every second German household (see table 1). The EVS additionally allows us to distinguish certain special types of whole life insurance: Specifically there are death benefit insurances, apprenticeship insurances, and trousseau insurances. They differ rather little from regular whole life insurance contracts and the conditions for the favorable tax treatment are identical. Further, they all share the characteristic that their respective payout is linked to specific events. However, these special types of whole life insurance have lost most of their previous importance: In 2003, trousseau insurance and apprenticeship insurance were held by only 1-2 percent of all households. 6.4 percent owned a death benefit insurance contract.[2]

Table 1: Ownership rates and wealth in life insurance contracts by type of life insurance (2003)

		wealth		portfolio share	
	ownership rate	average	cond. average	average	cond.
term life insurance	12.7%	-	-	-	-
whole life insurance	51.5%	9'940	19'308	24.6%	37.2%
"regular"	46.9%	9'517	20'286	23.6%	38.1%
"apprenticeship"	1.7%	88	5'207	0.2%	10.3%
"death benefit"	6.4%	266	4'172	0.7%	8.7%
"trousseau"	1.1%	67	6'250	0.2%	11.7%
private pension insurance	13.3%	1'134	8'511	2.8%	15.9%

Source: EVS (2003), own calculations. Note: all results are weighted and in Euros (2001); the conditional figures refer to the group of households holding wealth in the respective type of insurance.

Looking at the surrender values of life insurance contracts, we find them to make up for a substantial share of total household financial wealth.[3] The conditional wealth levels and conditional portfolio shares illustrate the substantial importance of life insurance wealth for those

[2] The appendix contains a small analysis of the historical developments in the ownership of death benefit insurance, apprenticeship insurance and trousseau insurance.

[3] Average financial wealth in 2003 accumulated to 40327 Euros.

households who actually had some money invested in the various kinds of policies. Note that also private pensions account for an important share of financial wealth for their owners, but still play only a minor role in the aggregate portfolio of all German households.

Next, we aim to know more about the characteristics of life insurance owners: We find them on average to be richer than their counterparts without any life insurance. This gap is tiny between households with and without term life insurance but huge if we distinguish by the ownership of capital accumulating insurance products. This finding prevails if we restrict our view to financial wealth other than wealth in life insurance contracts.

Table 2 presents some further stylized facts: Life insurance products are more popular among married couples, households with children and households with a self-employed household head.

Table 2: Life insurance ownership and household characteristics

	term life insurance	whole life insurance	private pension insurance
Household Type			
single	5.5%	35.2%	9.6%
couple	10.1%	53.5%	9.4%
single + cohabitants	13.9%	50.9%	18.4%
couple + cohabitants	25.5%	73.6%	20.2%
Marital Status			
married	17.7%	63.5%	14.7%
not married	7.7%	39.3%	11.9%
Children			
no children	7.9%	43.8%	10.3%
1 children	17.8%	61.7%	19.0%
2 and more children	26.1%	70.3%	19.4%
Work Status			
self-employed	19.1%	69.2%	26.7%
civil servants	19.5%	68.5%	15.6%
employees	18.8%	62.6%	19.4%
Income[4]			
1st quintile	4.7%	34.9%	4.9%
2nd quintile	12.3%	48.8%	18.1%
3rd quintile	18.1%	63.4%	19.6%
4th quintile	21.4%	70.3%	20.1%
5th quintile	24.6%	76.0%	21.9%
All	**12.7%**	**51.5%**	**13.3%**

Source: EVS (2003), own calculations, weighted results

[4] Income is total household income from work. To avoid strong age- and retirement-effects in the income distribution, the sample is restricted to households with a household head aged 65 and below.

We further find a strong income gradient, which is especially steep between the first and the third income quintile. While this might hint at some possible motives to purchase life insurance, we leave this aside for the moment and return to the matter in the context of multivariate regressions.

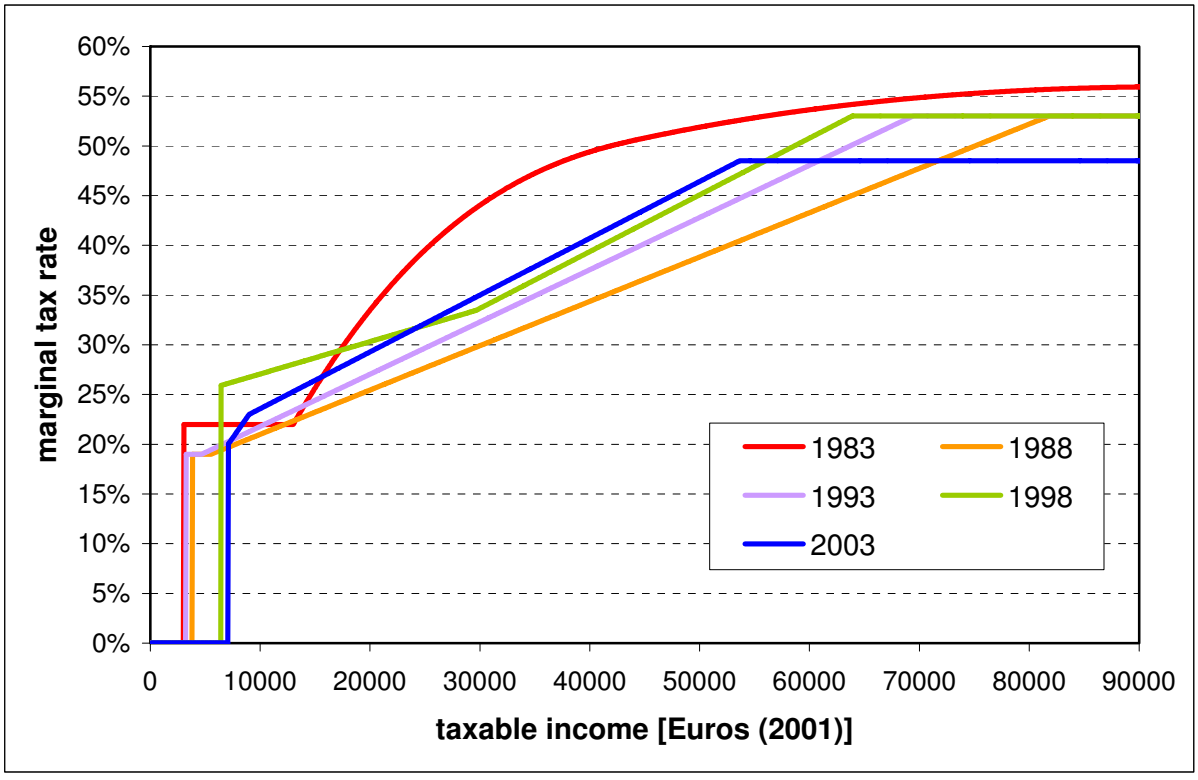
II.3 *Taxation and life insurance products*

We now turn to one of the key sales arguments for life insurance products: their favorable tax treatment. We first describe the German income tax scheme as the basis to which the tax favors are applied and then turn to the actual privileges and the conditions under which they are granted.

The German personal income tax scheme

The German income tax scheme is characterized by its progressive tax rate. A number of tax reforms have touched the amount of tax allowance and the actual tax rates (see figure 2).

Figure 2: Marginal tax rates between 1983-2003



Source: Own calculations based on German tax laws; Note: Tax rates for a single person with no children

Note that the level of tax allowance also depends on the number of children and that certain types of transfer income remain untaxed or are subject to reduced tax rates. Further, different and independent amounts of tax allowance apply to different kinds of income.[5] Last, there is a splitting option for married couples which taxes each spouse on half the total of their combined incomes. Hence, there is a certain level of variability in household tax rates for a given level of income. This is crucial to our target of separating income- and taxation-effects, which we will further discuss later.

Capital income is subject to general income taxation and hence taxed at the individual tax rate. That is, Germany does not have a flat tax rate which applies to all capital income like some other European countries. There is an independent tax allowance for interest and dividend payments. Realized capital gains are taxed only if they exceed a tax exemption limit. Unrealized capital gains remain untaxed. The same applies to realized capital gains after a certain holding period.[6]

Tax favors towards life insurance products

German tax laws provide two kinds of tax subsidization towards life insurance contracts. First, expenditures for various kinds of insurance – and among them life insurance policies – can be deducted from taxable income. Second, interest income earned in a life insurance contract remains untaxed. These two ways of subsidization can be claimed simultaneously but are subject to certain conditions. If the conditions are not met, interest payments within an insurance contract will be treated just like any other capital income: The share of interest income will be taxed at the personal interest rate with every payment from the contract. In the case of a lump sum payment, the entire accumulated interest is taxed in the year of the payout.

Tax-deductibility of expenditures

All types of private life insurance and private pensions have to fulfill certain conditions to qualify for tax deductibility: First, there have to be regular contributions, i.e. no lump sum contributions are allowed. Second, payments from the contract are not allowed within 12 years after the

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[5] The German tax system differentiates e.g. between income from employment, from self-employment, from financial assets, and rental income. For most of them, a certain tax allowance applies and advertising costs like costs for commuting may – at least partly – be deducted. The resulting subtotals are then added up to calculate the assessment basis to which the main tax allowance is applied.

[6] A fundamental reform of the taxation of financial assets has been enacted for 2009 but has no effects on the data we analyze in this paper.

inception date. Expenditures for private term life insurance are deductible without such condition. Contributions to mutual fund based insurance contracts cannot be deducted.

Two aspects make deductibility a rather complex topic though. First, not only contributions to life insurance contracts are deductible but so are other expenditures. The core set of expenditures relates to some kind of insurance. Second, the deductibility is capped, which is why we have to bother in the first place. Let us assume that certain deductible expenditures are inevitable for the household or decided upon before it comes to the question whether or not to buy life insurance. Then the deductibility cap may already be reached without further expenditures. Most important among the inevitable tax deductible expenditures are the employees' contributions to the social security system as well as to private health insurance.[7] Apart from insurance premia, also expenditures for tax consultants, premia for private liability insurance or car liability insurance etc. are deductible.

Deductibility cap and lump sum deduction

The deductibility of expenditures is capped in a rather complex way. For each year and all tax payers, there is a general upper cap. In 2003, this cap was 5069 Euros for singles and 10138 for couples who are jointly assessed. Yet these amounts essentially only apply to individuals who earn income solely from self-employment. The reason is that employers' contributions to social security remain untaxed for the employee, so that the deductibility of additional expenditures is lowered accordingly. At a gross income from employment of roughly 19500 (39000) Euros, the cap reaches its minimum at 2001 (4002) Euros for singles (couples) (see figure 3).

At the same time, German tax authorities apply a lump sum deduction of 20 percent of the taxpayer's income from employment up to certain limits. This takes into account that all employees pay roughly 20 percent of their incomes as social security contributions. Hence, the lump sum deduction rises with a taxpayer's income while the deductibility cap is reduced. As a consequence, for employees with an income of about 17500 (35000) Euros, the lump sum deduction equals the upper limit for deductions (see figure 3).

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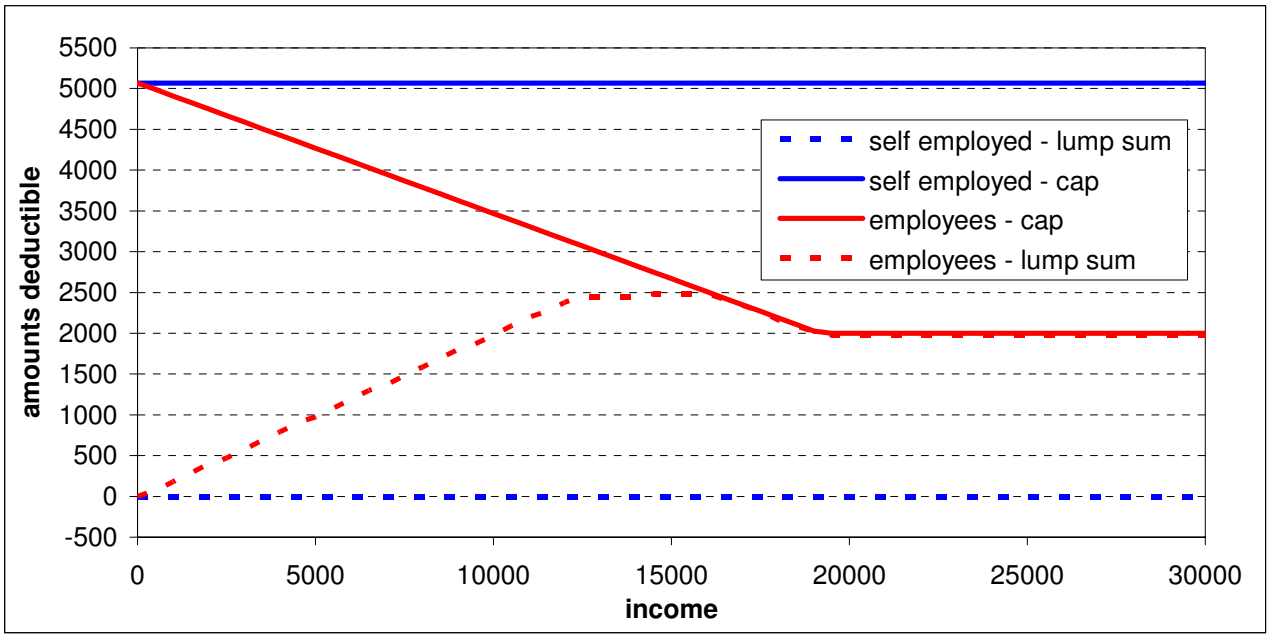
[7] The social security system includes the public pension system, public health insurance, public unemployment insurance, as well as long term care insurance. The self employed can freely choose to contribute to the social security system. For employees, the contribution is generally compulsory. Only employees with earnings above a certain income threshold can opt out of the public health insurance and buy private insurance instead. The membership in a public or private long term care insurance is always linked to the equivalent status in health insurance.

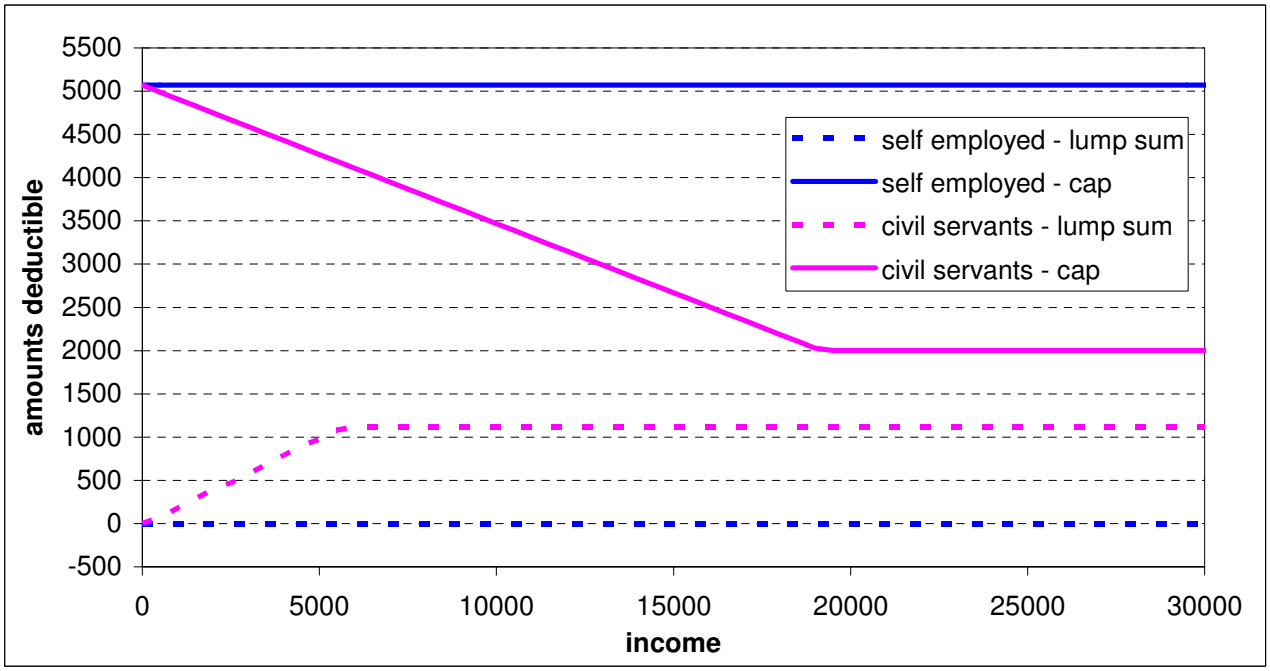
Figure 3: Lump sum deduction and deductibility caps for employees (2003)



Source: Own calculations based on Germans tax laws

For civil servants, the deductibility cap is the same as for all other employees but the lump sum deduction is lower (see figure 4). Therefore, civil servants can always enjoy at least some tax advantage from additional tax deductible expenditures – independent of their income.

Figure 4: Lump sum deduction and deductibility cap for civil servants (2003)



Source: Own calculations based on Germans tax laws

Deductible expenditures and utilization of the deductibility cap

So far, we have described the theoretical framework for the deductibility of certain expenditures. In the following, we now investigate, how different expenditures matter for civil servants, self-employed and employees, and how these different employment groups make use of the possible deductions. To keep things comparable we restrict the respective samples to single households. Individuals are assigned to the respective occupational groups depending on their main source of income. We categorize the different expenditures in what we consider inevitable expenditures and expenditures on life insurance premia. For the inevitable expenditures, we use two different definitions – a rather tight one and a second, which we call "extended definition".[8]

We first add up the inevitable expenditures and present subtotals for the tight and the extended definition. We then calculate the corresponding deduction from taxable income. Additionally, we indicate the share of households which reaches the deductibility cap at each subtotal and the average excess expenditures – i.e. expenditures above the amount needed for maximum tax savings. After investigating the situation without life-insurance investments, we combine the inevitable expenditures and the contributions to life-insurance policies and repeat the above calculations. Table 3 displays the respective calculations for the subsamples of civil servants, self-employed and employees.

Section I of table 3 shows that over 83 percent of the employees already reach the deductibility cap declaring only their inevitable – and largely compulsory – expenditures. The equivalent shares among civil servants and self-employed are 37.6 percent and 28.3 percent respectively. Looking at the extended definition of inevitable expenditures, the overall picture does not change much (see section II). We should note though that occupational pension funds play an important role for some groups of self-employed, e.g. lawyers.

Looking at the third section of table 3, we find average contributions to life insurance contracts by the self-employed (2266 €) to be considerably higher than for the other two groups (704 € among civil servants and 575 € among employees). Looking at the ratios of additional tax deductions to additional expenditures from life insurance premia, we find them to reach only 6.5 percent among civil servants and self-employed and an even lower 2.5 percent among employees. Hence, at least on average, the tax subsidy on life insurance premia amounts to less than 3 percent of the expenditures. Looking at these numbers, tax deductibility seems rather unlikely to be an important argument for purchasing life insurance – at least for the majority of the population.

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[8] For a detailed overview over the expenditures included in the two definitions see the appendix.

Table 3: Utilization of the deductibility of contribution by type of occupation

	civil servants		self-employed		employee	
age	38.7		45.9		39.4	
labor income	31'000 €		27'355 €		28'545 €	
ownership rate (any kind of life insurance)	62.2%		63.7%		55.8%	
observations	723		373		3836	
I. "inevitable" expenditures						
public pension system	- €		1'186 €		2'678 €	
public unempl. insurance	- €		5 €		893 €	
public health insurance	- €		163 €		1'578 €	
voluntary publ. health insur.	147 €		1'184 €		278 €	
private health insurance	1'651 €		1'542 €		210 €	
additional priv. health insur.	260 €		356 €		125 €	
publ. long term care insur.	19 €		147 €		231 €	
private long term care insur.	161 €		167 €		15 €	
car liability insurance	342 €		432 €		309 €	
	2'580 €		5'181 €		6'316 €	
deduction (I.)		1'700.5 €		3'717.2 €		2'063.0 €
share of households at the deduction cap (I.)		**37.6%**		**28.3%**		**83.4%**
excess expenditures (I.)		489.8 €		1'214.5 €		3'673.1 €
II. "inevitable" expenditures (extended definition)						
occupational pension funds	7 €		110 €		53 €	
civil servants pension funds	5 €		5 €		103 €	
voluntary public pension system	19 €		482 €		14 €	
	31 €		597 €		170 €	
	2'611 €		5'778 €		6'486 €	
deduction (II.)		1'707.7 €		3'863.0 €		2'065.4 €
share of households at the deduction cap (II.)		38.1%		33.1%		83.5%
excess expenditures (II.)		509.7 €		1'632.4 €		3'839.8 €
III. total expenditures incl. life insurance premia						
life insurance premia	704 €		2'266 €		575 €	
	3'314 €		8'044 €		7'060 €	
total deduction (III.)		1'754.0 €		4'010.6 €		2'078.9 €
excess expenditures (III.)		1'037.6 €		3'529.1 €		4'388.5 €
max. possible deduction		**2'238.5 €**		**5'029.2 €**		**2'315.2 €**

Source: Own calculations based on the EVS (2003), weighted results

Table 4 suggests further, that it might rather be a question of financial means whether or not people decide to save in life insurance. We split the above samples depending on whether households reached the deductibility cap based on their "inevitable" expenditures or not. We find households at or above the cap to be more likely to invest in life insurance and to hold more wealth in life insurance contracts. For civil servants the differences are both highly significant. Among the self-employed, the difference in ownership rates is not significant but the conditional wealth holdings are again significant at the 1% level. Among employees, the difference in conditional wealth levels is not significant, but the difference in ownership rates is[9]. Comparing the financial means of the two groups, we find the households at or above the deductibility cap to earn significantly more income and to have higher saving rates. To rule out that households below the deductibility cap just save in different products we calculated the saving rates without savings in life insurance contracts and found our results to be robust.

Table 4: Life insurance ownership and wealth by opportunity of further deductions

	civil servants		self-employed		employees	
	at or above the cap	below the cap	at or above the cap	below the cap	at or above the cap	below the cap
observations	317	406	116	257	3395	441
	723		373		3836	
life insurance ownership	68.6%	58.3% (0.006***)	70.0%	61.2% (0.113)	59.3%	38.1% (0.000***)
wealth in life insurance (cond.)	19'263 €	10'363 € (0.000***)	50'614 €	24'398 € (0.000***)	11'579 €	9'566 € (0.138)
income from work	39'201 €	26'052 €	44'838 €	20'466 €	32'387 €	9'259 €
median saving rate (w/o life insurance)	11.1%	7.8%	10.3%	3.4%	7.7%	0.0%

*Source: Own calculations based on the EVS 2003, weighted results. Note: p-Values in brackets for tests of equality in ownerships rates and cond. wealth levels. *** denotes significance at the 1% level*

Tax free interest

Additionally to the tax deductibility of insurance premia all capital gains and interest earnings within the contract remain untaxed if contributions are made regularly and the first payments from the contract lie at least twelve years after the inception date. In contrast to the deductibility

[9] Using the extended definition of inevitable expenditures does not change our results. Only the difference in ownership rates among the self-employed turns significant (p=0.06).

of contributions no cap applies to this tax favor and mutual fund based insurance contracts enjoy the same tax favor as "classical" insurance contracts.

From the above tables 2 and 4 we know that households with life insurance products receive higher incomes from work. Given the progressive German tax scheme we can expect these households to also face higher marginal tax rates. While we might take this match of high tax advantages with high actual investments as a first piece of evidence for the importance of this second tax favor, there is also reason to be careful. The fact that income and tax rates are positively correlated may lead us to the false conclusion that we are observing actual tax-effects. We therefore abstain for such speculations and revert to microeconometric analyses for a more thorough inspection of the importance of tax advantages for German life insurance buyers.

III. Theoretical considerations

Several authors have proposed models for the demand of life insurance products and derived testable hypotheses. Some of these models are motivated indirectly – i.e. their ultimate focus is not on the demand for life insurance but on some other phenomenon. Yet there is a lot to be learned from these models: They all cover specific aspects to the demand for life insurance and thus matter for our rather comprehensive analysis.

III.1 *General relevance of the demand for life insurance products*

First, we are interested in the determinants of the demand for life insurance as such. Life insurance wealth plays an outstanding role in German households' portfolios and it seems important to reach a better understanding of the factors influencing this vast market. Furthermore, the life insurance industry is an important employer and used to be a core element of the highly interwoven corporate sector in Germany. Hence, all political reforms affecting the market environment tend to trigger an intense debate, which also calls for a sound understanding of the actual mechanisms behind private households' decisions and possible reactions to such reforms. The reduction in tax advantages towards whole life insurance products is a recent example. Among the literature touching the demand for life insurance products, two analyses take a similar original interest in the demand for life insurance products: Jappelli and Pistaferri (2001) focus on a change in the tax treatment towards life insurance products which bears a strong resemblance to the recent German reform. They exploit this natural experiment to estimate the effects of tax incentives on the demand for life insurance products as they are suggested by theoretical models of portfolio choice. Walliser and Winter (1999) focus on the German insurance market and propose a small theoretical model, which incorporates some important characteristics of this market. We adopt some of the hypotheses developed in these two papers and extend them in some dimensions.

III.2 *Savings motives*

Apart from this general interest, our second focus is on the identification of the savings motives at work in connection to the demand for life insurance. The coexistence of several savings motives is also the main reason why we do not adopt the very basic hypotheses suggested in the literature, e.g. by Yaari (1965) and Bernheim (1991). One such basic hypothesis derived from a

very simple model is, that nobody should hold term life insurance and annuity products at the same time. A considerable share of households still holds both – a puzzle which has been established for several countries which is also supported by our data.[10] Note that the above hypothesis is based on a model where term life insurance products and private annuities are bought to arrive at an optimal level of annuitized pension wealth. Now it is important to know that the typical German annuity insurance product can always be paid out in a lump sum. Hence, purchasing a private annuity and term life insurance is not necessarily a contradiction to this basic hypothesis. Furthermore, other savings motives are not included in this rather parsimonious model but might cause a simultaneous demand for term life insurance and private pensions. What we learn from this example is that although a variety of testable hypotheses can be derived from theoretical models, it is important to keep in mind the contextual market environment.

In the following, we go through the list of possible savings motives and refer to hypotheses suggested in the literature as they connect to the demand for life insurance products. We make adaptations where necessary and add aspects, which have not been discussed in the literature, where they naturally arise in the context of the German market.

Old age provision

First and foremost life insurance has been promoted as a means of private old age provision. Feldstein (1974) suggested that private and public old age provision should be substitutes. Once a household receives less than his desired replacement rate from public pensions, his private savings will fill the gap. Savings in life insurance contracts can be paid out as an annuity and are therefore a close substitute to social security wealth. We therefore expect the probability of life insurance ownership to rise and more savings to go into life insurance products the higher the need for additional private old age provision is.

Unfortunately, there is no generally available data source for Germany providing information on social security wealth and wealth in life insurance contracts. The income and expenditure survey (EVS) which we base our analysis on, is the only data source in Germany which contains a sufficiently detailed level of information on household savings and wealth. While we describe our data in more detail later, it is important to know at this point, that the EVS has no longitudinal dimension and also does not provide an earnings history, which would allow the calculation of a proxy for social security wealth. We therefore rely on different proxies for private old age provision needs:

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[10] 2.73 percent of all households hold both, annuity insurance and term life insurance. 21.4 percent of households who have a term life insurance also have annuity insurance.

First, replacement rates in the public pension system differ across households for a number of reasons. The self-employed are typically not covered by the public pension system. That is, their replacement rate is essentially zero and the need for additional private old age provision will tend to be high. Civil servants are covered by a separate public pension scheme which differs from the employees' scheme in a few minor aspects. We therefore compare the self-employed to employees and civil servants and expect the self-employed to be considerably more likely to hold life insurance policies and to accumulate more life insurance wealth.

Second, there is a certain degree of variation in replacement rates within the group of employees. As contributions to the public pension system are capped, the pension claims also rise only up to the corresponding income level. Figure 5 illustrates how many earnings points a person receives for a given gross annual income. Without the assessment ceiling pensions would be a linear function of pre retirement income. Given that contributions and earnings points are independent of the income above the ceiling (61200 € in 2003), the actual replacement rate of individuals with a higher income declines with income.

Figure 5: Effects of the assessment ceiling on the public retirement income of high income households

Source: Own calculations

If people save to achieve a certain target replacement rate, they will need additional private savings. Accordingly we expect households with an income above the contribution ceiling to be more likely to invest in life insurance products and accumulate more life insurance wealth. At the same time it is questionable, how large this effect will be. Only few individuals will receive incomes considerably above the contribution ceiling for an extended number of years. Figure 5 shows the annual annuity which would have to be bought for one year of income above the assessment ceiling if the individual meant to make up for the reduced public replacement rate.

Bequest motives and insurance for the family

The second savings motive which is often mentioned in connection with the purchase of life insurance products is the bequest motive. Talking about a bequest motive, we do not distinguish an actual bequest motive from a motive to insure the family against the early death of an earner. Given that the EVS does not contain a question on planned bequests we employ several proxies for a possible bequest motive. Like Hurd (1987, 1989) we employ the presence of children. Generally, all accumulated wealth can be bequeathed and serve as an insurance for the family. Term life insurance can provide an additional coverage at rather low expenses. The term life component also makes a whole life insurance more suitable for the task at hand than for example stock market wealth or wealth in an annuity insurance. We thus start with the hypothesis, that the existence and the number of children will increase the probability of purchasing a policy with some term life component. Apart from the pure existence and number of children, the age of the children may matter. Consider the stream of child related expenditures up to the age at which a child could provide for herself. The present value of these expenditures will typically decrease with the child's age. Hence, we further conjecture, that families with young children are more likely to purchase a policy which includes term life insurance than families with near-grownup children.

Bernheim (1991) suggests that also the intra-household allocation of assets may matter for the demand for term life insurance. He argues that if the survival-contingent incomes of the two partners differ substantially it may make sense to purchase term life insurance to reduce this imbalance. Insuring the death of the spouse with the higher income will leave the other spouse with the insurance sum. We are not aware of an empirical analysis which tests the corresponding hypothesis: We expect the probability of some sort of term life insurance in a household to be higher the more the income flows of the spouses differ.

Home loan motive

Third and last, the intention of buying or building a house of one's own will often trigger demand for life insurance products. First, banks frequently require a household to have some kind of term life insurance to get the credit in the first place. And second, it is not uncommon to pick the lump sum payout option and use the life insurance savings to buy back the outstanding mortgage. We conjecture that home owners with outstanding credit will be more likely to have some term life insurance.

III.3 *Tax incentives*

Some households would probably name the possibility to save taxes as an independent savings motive. The importance of the favorable tax treatment as a sales argument for life insurance products would suggest ranking the tax savings motive second behind the need for private old age provision if not even first. Nevertheless, we separate the aspect of tax incentives from the original savings motives. The reason is that tax incentives affect the characteristics of an asset rather than determining the preferences of the investor.

Taxfree interest

Strictly speaking, tax incentives change the after tax return of an asset. Note that while the pre tax returns are equal for all investors, after tax returns may vary substantially depending on the person's individual tax rate. In most standard theoretical models of portfolio choice the optimal asset allocation depends on the expected returns of the available assets, their risk and their cross-correlations.[11] Apart from the asset allocation, also the consumption-savings decision may be affected – the reason is the income effect connected to the return of the selected portfolio.[12] Yet under standard assumptions concerning the form of the utility function all these models imply, that the portfolio share invested in life insurance products should rise in the level of tax incentives.

Walliser and Winter (1999) tailor a stylized model of portfolio choice to the German case and explicitly model the tax advantage for life insurance products. They allow households to invest in

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[11] The capital asset pricing literature goes back to Markovitz (1952). First dynamic asset pricing models were suggested by Merton (1969, 1971, 1973) and Samuelson (1969).

[12] Campbell (2002) gives a nice overview over the literature which integrates life-cycle consumption decisions with portfolio choice.

life insurance and bonds. Their numerical simulations imply that the tax favors for life insurance contracts are a key determinant of the demand, especially early in the life cycle.

We follow their hypotheses and expect households with higher tax rates to invest more in life insurance contracts, as the difference in after tax returns between life insurance products and other assets increases with the households' tax burden. We further expect the probability to hold life insurance products to increase in the household's tax rate. Simple portfolio choice models imply that essentially all available assets will be part of the optimal portfolio. Indivisibilities or market entry costs may prevent some people from investing in all assets though. Hence, the probability to actually invest in a certain asset increases in those factors that increase the optimal amount invested in a world without such restrictions. Thus we can conjecture that households facing higher tax rates will also be more likely to invest in life insurance contracts. Note that the above argument also holds for possible other determinants of the demand for life insurance products, especially the savings motives discussed above.

At this point a note on the importance of income seems necessary. Looking only at the portfolio choice, there is no consensus, whether income should play a role. Campbell and Viceira (2002) give an overview over the circumstances under which portfolio choice should depend on the level of income. Apart from these theoretical considerations it has repeatedly been argued that the co-movement of income and tax rates will always prevent us from distinguishing the two in an empirical analysis. The basic argument is that the effective tax rate will always be a (nonlinear) function of income. We are confident, that the situation is not all that bad in our case as we have outlined in the previous section.

Tax deductibility of contributions

The effects of the deductibility of contributions to life insurance contracts have been ignored by earlier studies although the two ways of favorable tax treatment are conceptually independent and different groups of households may benefit most from the one or other advantage. We have described in detail, why there may be substantial variation in the amount by which households will profit from the deductibility of contributions. Following the above logic we expect households with a higher tax advantage to be more likely to invest in life insurance products. We further hypothesize them to invest more and thence accumulate larger amounts of wealth.

IV. Data

We make use of six cross-sections of the German Income and Expenditure Survey (EVS). The most recent data stems from 2003, the oldest from 1978. The data was collected in 5-year intervals and originally aimed at the calculation of consumption baskets. Hence, the Federal Statistical Office never bothered to add a longitudinal dimension to the survey although a considerable number of households is known to have participated repeatedly. The data includes sociodemographic and economic information both at the individual and at the household level. To a large extent the data is fully imputed but given the cross-sectional nature, some harmonization is necessary.[13] Each dataset contains between 40.000 and 60.000 households, which allows us to analyze population subsamples. The sample size and the rather long time span between 1978 and 2003 also allow us to investigate age trajectories of synthetic cohorts up to high ages. Aside from the extensive sociodemographic information, the EVS data contains detailed information on the household members' income by sources and taxes paid. Further, there is detailed data on the households' expenditures, be it for consumption goods, for insurance premia, for the purchase of assets or for the repayment of debt. Last, there is a section on household wealth.

A few issues are to be mentioned when using the EVS data. While the sample is designed to be representative for the German population, the institutionalized as well as households with extremely high incomes are excluded from the sample. For 2003, this sampling threshold was a net monthly household income of 18.000 €.[14] Furthermore, foreigners are included in the sample only since 1993. Apart from these sample restrictions, we should note, that the EVS is carried our as a quota sample. The sample is aimed to include 0.2% of the population in each quota cell. The quotas are generated based on a number of household characteristics, including household type, income and social status of the household head. The quotas are known to be reached with differential success though. While the quotas for civil servants are reached rather well, the quotas

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[13] Unfortunately, little of the imputation procedures employed by the Federal Statistical Office is documented. Especially for the cross-sections 1978-88, the imputation of conditional means is not unusual.

[14] Sommer (2008) discusses the possible effects of the income threshold on life cycle trajectories of synthetic cohorts. Contrary to common criticism, the sampling threshold does not lead to substantial losses at the top of the income distribution compared to a random sample. It turns out that only the new sample of rich households which has been added to the GSOEP in 2002 has been able to question a handful of households above the EVS sampling threshold. In fact, both German surveys miss a considerable part of the German income distribution as shown by Merz (2003) for the EVS and by Sommer (2008a) by comparison of the GSOEP with the EVS.

for farmers and unemployed households have turned out to be difficult to reach. To compensate for the differential success to fill the quotas the federal statistical office provides weights. While the choice of a quota sample seems problematic experiments to switch to a random sample have turned out to generate even lower response rates from certain population subgroups. Instead, several measures have been taken to compensate for the issues of a quota sample. Especially the non sampling issues were reduced by assigning the interviewers the households to be questioned.[15]

Life insurance in the EVS

The EVS 1993 through 2003 contain data on wealth holdings in life insurance contracts - specifically the surrender value. For 2003, we can distinguish between various types of life insurance products. For the years 1978 through 1993 the questionnaire only contains the insurance sum. Given that we have information on the surrender values and the insurance sums in 1993, we exploited this information to impute the surrender values for the years 1978-1988 using regression based imputation.[16] Further, we know about the households' expenditures on life insurance premia, as well as pension payments and lump sum payouts received from private life insurance contracts. For our empirical analysis we focus on four variables: life insurance ownership, premium payments for life insurance contracts, wealth in life insurance contracts, and the portfolio share of financial wealth invested in life insurance products.

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[15] For a detailed methodological description of the EVS see Statistisches Bundesamt (2005).

[16] The imputation employed for this paper is closely comparable to that described in Sommer (2008a).

V. Empirical results

In the section describing the German market for life insurance products, we have pointed out important trends which have evolved over the last decade and which coincide with two recent developments: First, there have been substantial cutbacks in tax favors towards whole life insurance contracts. At the same time private pensions continue to be strongly tax favored. Second, private old age provision has gained additional importance after several reductions in the public pension system. Given these changes in the market environment these trends seem only reasonable reactions on behalf of private households. The most drastic reforms, however, date from 2002/03 (the "Riester Reform") through 2005 (the "Rürup Reform"). Given that the latest EVS data stems from 2003, we can not expect to see behavioral reactions to these reforms in our data. We will therefore start with a more in depth inspection of past trends in the demand for life insurance – specifically at the cohort level – and then turn to regressions to better understand the importance of the various motives for an investment in life insurance products. Understanding the determinants of the demand in the past may help us assess the future perspectives on this market in the face of a further changing market environment.

V.1 *Historical developments at the cohort level*

Before turning to the actual results, a few notes should be made: We use all six cross-sections but exclude East German households to keep the cohorts as homogeneous as possible over time.[17] Furthermore the households' age has to be defined. We follow the common procedure of assigning each household the age of its household head. Defining the household head to be the oldest male in the household and the oldest female in a household with no male members we deviate from the traditional EVS definition.[18] Our definition ensures that intact households will always be attributed to the same birth cohort if it is sampled in consecutive surveys. Note that

[17] The EVS contains East German households starting in 1993. Unfortunately, we only know the actual place of residence of a household and have no information about their place of residence before the reunification. Hence, migration will bring in some heterogeneity but including the East German sample must be expected to cause unequally larger disturbances.

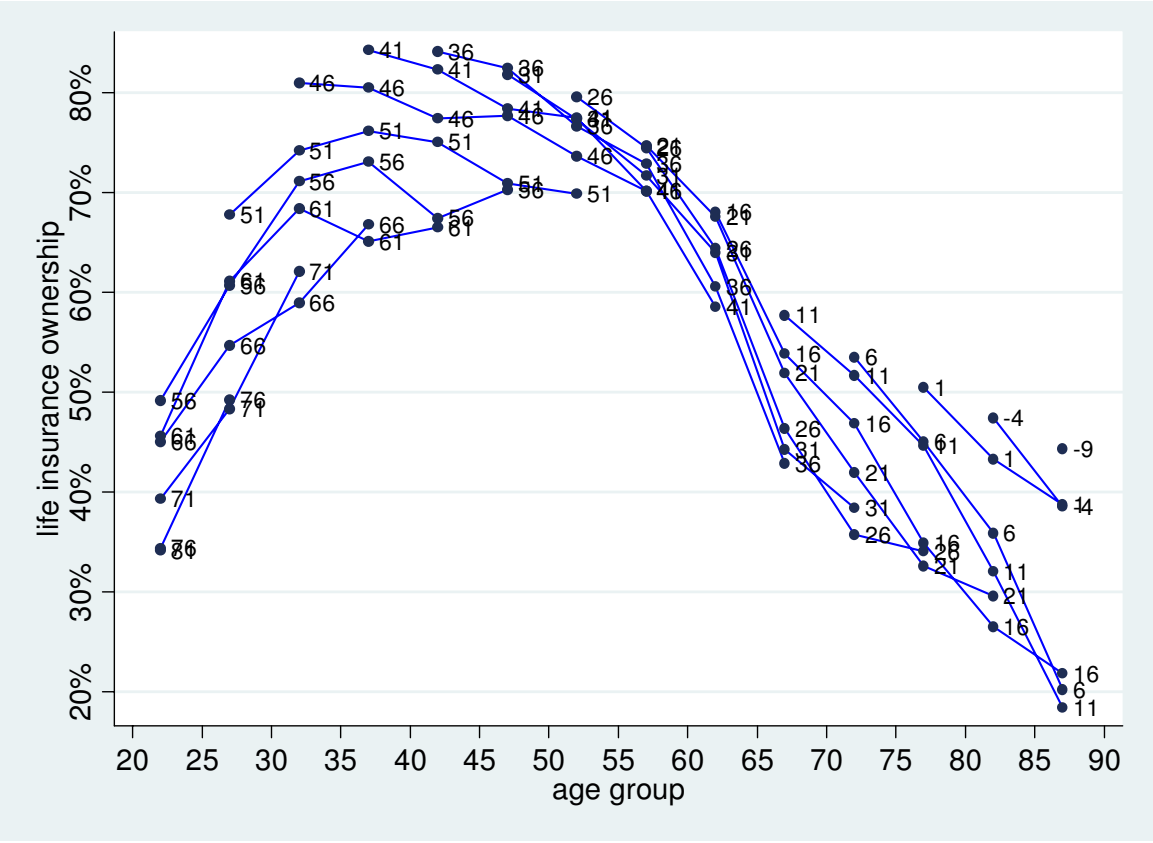
[18] The EVS defines the household head to be the main earner. Based on this definition, the household head may switch between two years because of changes in the composition of the household income, e.g. following the retirement of the previous household head.

throughout the following cohort analysis we do not present confidence bands for our estimates. A short discussion of the accuracy of our estimates can be found in the appendix.

Ownership rates of life-insurance

We start our cohort analysis with the first decision connected to any investment: whether or not to invest in the first place. Looking at the age trajectories of the synthetic cohorts, our first observation is the clear hump shape in ownership rates over the life cycle. 35 to 50 percent of the households own a life insurance contract between age 20 and 24. Between age 35 and age 55 we observe cohorts with as much as 80 percent life insurance owners. Around age 60 the share drops steeply and declines continually towards 20 to 40 percent after age 80 (see figure 6).

Figure 6: Age-trajectories in life insurance ownership by cohort (West Germany)[19]



Source: Own calculations based on the EVS 1978-2003, weighted results

[19] Households who indicate ownership or give a positive value for the insurance sum are considered life insurance owners. Birth cohorts are highlighted in the graph with tags. Each label indicates the middle year of birth of a five-year birth cohort. That is, following the dots labelled "66" we observe the age trajectory of the households whose heads were born between 1964 and 1968.

What strikes us at the second look are the differences between cohorts at certain ages. First, among the elderly, life insurance ownership is much less popular today than it was until the late 1980s. Part of the reason is likely the much lower popularity of death benefit insurance contracts.[20] But also the reduction of composite households at these age-groups may be a reason. With less young cohabitating children the likelihood of a life insurance owner in the household is obviously reduced.

Second, we observe substantial shifts in life insurance ownership between young cohorts up to age 45. Chen, Wong and Lee (2001) report similar drops for young cohorts in the United States. They speculate later marriage, household formation and childbirth to play a key role. Following their argument, we would expect the age-profiles of the young cohorts to be steeper. Indeed, we find that the differences between cohorts tend to grow smaller towards age 50 in the German data which is in line with what we would expect under the above hypothesis.

Wealth in life insurance contracts

Comparing the cohort graphs for wealth holdings with the ownership rates above, a few disparities catch the eye. At young age, the lower ownership rates we observed for young cohorts are not matched by lower wealth levels (see figure 7). Towards age 45, the wealth levels of today's generations are rising more quickly compared to their predecessors. The gap is widening until age 55 before it collapses in the following 10 years. That is, there are barely any differences in average wealth holdings across generations around age 70. Only among the oldest old, we observe a steep drop in average wealth holdings across cohorts that broadly matches the discrepancies in ownership rates.

However, there is more to be learned from the combined trends in ownership rates and average wealth holdings. Obviously, the young generation of life-insurance owners holds higher levels of wealth in life-insurance contracts during all of their working life. At the same time, the size of the gap in average life-insurance wealth between cohorts seems to be largely driven by trends in ownership rates. In fact, average wealth levels diverge especially between age 40 and age 60 as the ownership rates of the young generation are catching up with the ownership rates of the preceding cohorts. A similar logic applies to the oldest old: Here, the participation rates have dropped back considerably across cohorts, which is mimicked by reductions in average wealth levels. Again, the drop in average wealth levels can be largely attributed to the drop in ownership rates.

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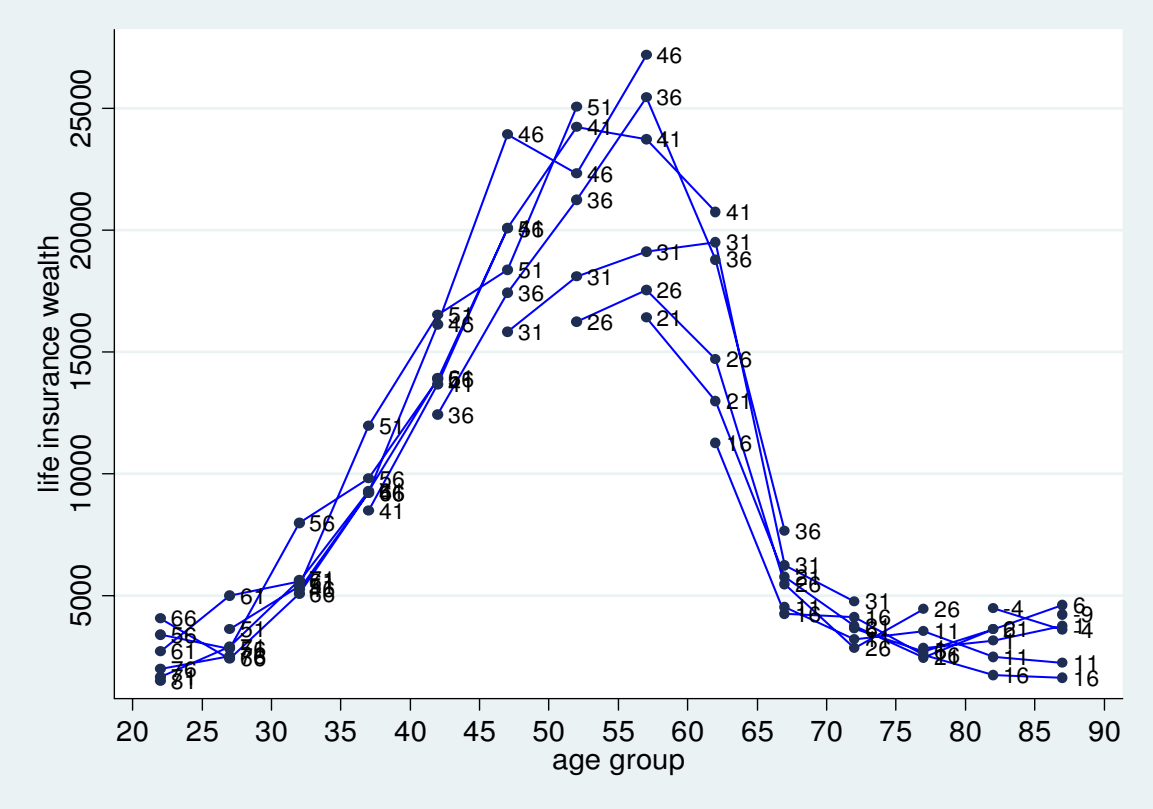
[20] For an illustration of the developments in ownership rates of death benefit insurance, apprenticeship insurance and trousseau insurance see the appendix.

Figure 7: Age-trajectories of wealth in life insurance contracts by cohort (West Germany)



Source: Own calculations based on the EVS 1978-2003, weighted results

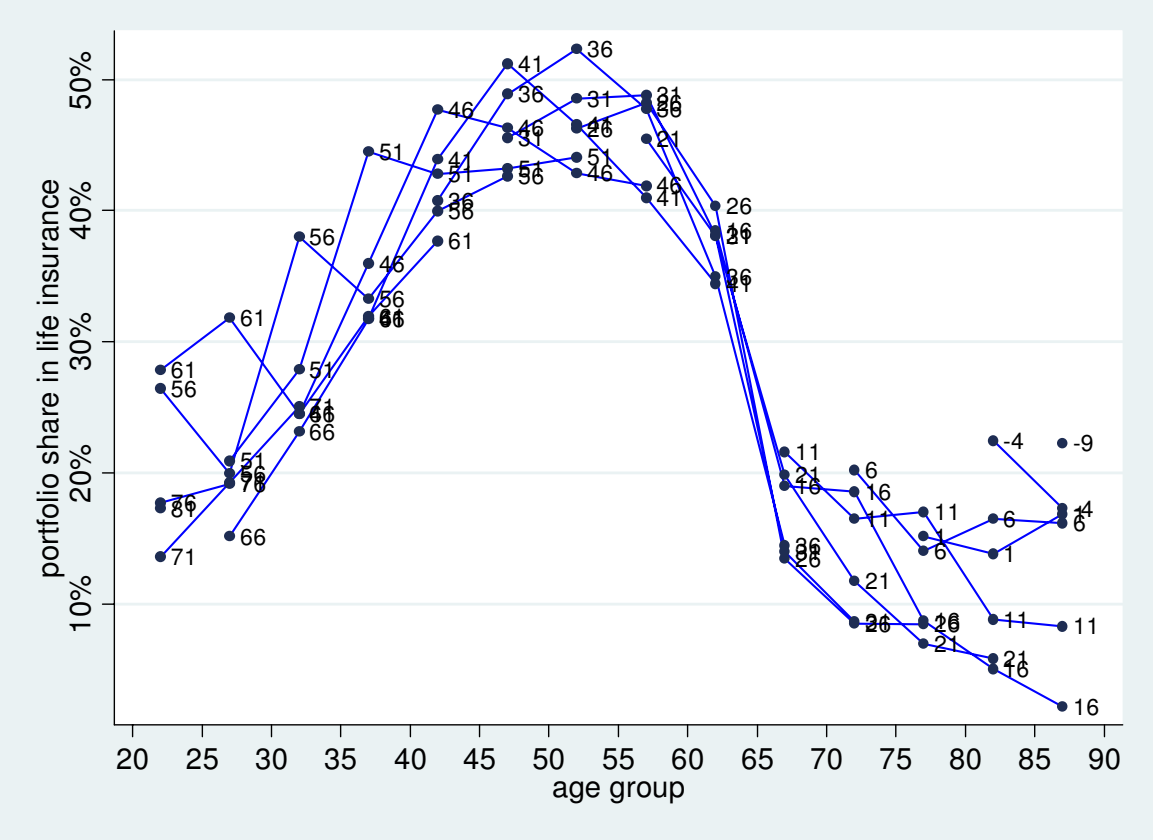
So far, we have neglected the influence of a skewed distribution on the estimated averages. As a matter of fact, the evolution of ownership rates is much less sensitive to trends at the top of the wealth distribution than actual wealth measures. Thus, part of the above trends in average wealth holdings may be driven by trends at the top of the wealth distribution. To this point, we know little about changes in wealth inequality over the life-cycle and across cohorts. Sommer (2008) sheds some light on this question but focuses on total wealth holdings rather than individual asset classes.

Portfolio shares in life insurance contracts

Looking at the share of financial wealth invested in life insurance, we again find huge changes among the old (see figure 8). In 1978, the average household with a head aged 65 and above held 25 to 35 percent of its financial wealth in some kind of life insurance product. 20 years later, this share had dropped to below 10 percent. The displacement of life insurance contracts through other kinds of financial wealth shows clearly also among other age-groups. Yet up to age 60 the development over the last decades has been an up and down. Until 1988, the younger cohorts

show higher portfolio shares invested in life insurance than their predecessors. With the growing importance of stocks and mutual funds in the 1990s the portfolio share invested in life insurance has dropped back behind the levels of the preceding cohorts.[21]

Figure 8: Age trajectories in portfolio shares[22] of life insurance contracts by cohort (West Germany)



Source: Own calculations based on the EVS 1978-2003, weighted results

Contributions to life insurance contracts

To conclude this overview, we look at the age-trajectories of contributions to life insurance contracts (see figure 9). The age-profile is clearly hump shaped for all cohorts. We observe little cohort differences among the youngest and the oldest age groups. Yet in the middle of the life-cycle, we find younger cohorts to save significantly more than the previous generation at the same age 20 years before. Given that ownership rates among the young and among the very old have dropped considerably, the conditional contributions to life insurance contracts must have increased for all age-groups.

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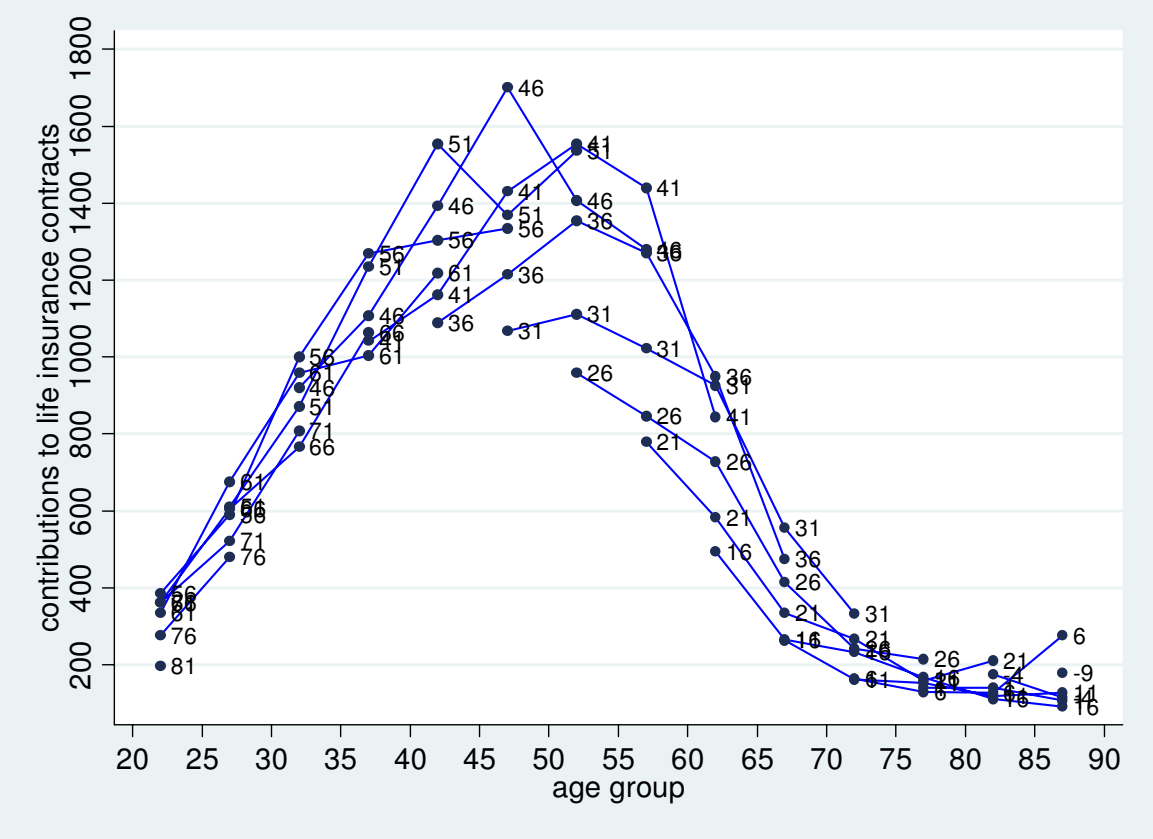
[21] For a more detailed analysis of asset accumulation and portfolio choice over the life cycle, see Sommer (2005).

[22] The portfolio shares are calculated as the average wealth in life insurance contracts divided by the average financial wealth holdings of each cohort at a certain age.

Figure 9: Age trajectories in contributions to life insurance contracts by cohort (West Germany)



Source: Own calculations based on the EVS 1978-2003, weighted results

V.2 *Regression analysis*

From the above we have gained some insight on the importance of life insurance products over the life-cycle. Our cohort analysis also allows us to track back some of the aggregate trends to its underlying meta-trends in the savings behavior of different generations. To actually relate the observed savings behavior to the underlying savings motives and to assess the effectiveness of tax incentives, we now turn to the microeconometric analysis.

Life insurance ownership

We start out with an indicator variable for wealth in life insurance contracts. We do not distinguish between the different kinds of capital accumulating policies and estimate probit regressions based on the pooled sample (1978 – 2003). Table 5 presents three specifications which aim to test the hypotheses derived in section 3. Note that all coefficients reported are average marginal effects. Most of the control variables are left out from the table.[23] Our control variables include dummies for the years of observation, the age of all household members, net wealth and net income. We experimented with a number of specifications with respect to the chosen functional form to test the sensitivity of our results and the core results remained essentially unchanged.[24]

Column (1) presents our basic specification: First, we find households with children to be more likely to hold wealth in life insurance. Yet throughout all specifications we tried, we observe the probability of life insurance ownership to be non-increasing with the number of children. Households with three or more children are not significantly more likely to hold life insurance than households without children. A married household head also increases the probability of life insurance wealth in the household. Hence, these first results are broadly in line with our hypotheses connected to the presence of a bequest motive or the desire to insure the family.

Turning to the retirement savings motive, we find one of our hypotheses supported. The self-employed turn out to be more likely to invest in life insurance products, whereas civil servants are slightly less likely. Our results concerning the self-employed remain consistent throughout all analyses and have the expected sign. Looking at households with work income above the contribution ceiling, we find their income above the ceiling to increase the probability of life insurance ownership as expected[25]. Yet the basic level effect has a negative sign and the overall probability contribution of the joint effect for incomes above the contribution ceiling is at first

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[23] The complete results are available from the author upon request.

[24] A description of the variables used in the specifications but unreported in the results is included in the appendix.

[25] Note that we converted the income above the contribution ceiling in millions of Euros

negative. Further, the results are quite sensitive to the specification of the income term among our control variables. We restricted the sample to working age employees but did not receive evidence in support of our hypothesis. In other words – there is no convincing evidence that employee households above the contribution ceiling invest in life insurance to offset their lower replacement rate from the public pension system. Higher income households might just be happy with a lower replacement rate as the absolute level of public retirement income is not reduced. Yet while it is easy to come up with a possible explanation, we have to concede that our regression analysis cannot help us answer this question.

Looking next at the importance of home loans for the ownership of life insurance wealth we find a positive effect for the presence of a loan. The estimated coefficient is not significant in all specifications though. Instead, the ratio of outstanding mortgage to gross housing wealth turns out to be an important predictor of life insurance ownership. The higher the share of debt on housing wealth, the more likely is the household to hold wealth in life insurance products. Note that we do not distinguish different types of life insurance products at this point. Hence, we will pay more attention to the matter of home loans later.

Finally, we inspect the importance of tax motives for the probability to invest in life insurance: As expected we find the households' average tax rate to be a positive and consistently significant predictor for life insurance ownership. Note that this finding is robust to the chosen specification with respect to income and wealth.

The second specification adds to the question whether couples with highly unequal contributions to household income are more likely to hold wealth in life insurance products. Again, we employ the pooled sample but restrict the sample to couple households with at least one work income. We choose a reference group of households with rather equal contributions to household income from the two partners (distributions lying between 40/60 and 60/40). Moving towards a more unequal composition of household income we find the probability of life insurance ownership to increase. The effect is at first insignificant but turns significant at the 1 percent level for households in which one partner contributes only 10 to 25 percent to the household income. Yet the size of the effect of income inequality becomes smaller for households where one partner contributes no income or only a tiny share of less than 10 percent. We consider our results weak evidence in favor of an additional insurance motive among couples with high income risk.

Table 5: Probit-Regression - life insurance ownership

	life insurance ownership		
	(1)	(2)	(3)
HoH male (D)	0.006	0.016	0.006
	(2.32)*	(3.56)**	(1.77)
unmarried, 1 child	0.052		0.059
	(11.05)**		(8.59)**
unmarried, 2 children	0.035		0.038
	(5.12)**		(3.93)**
unmarried, 3+ children	0.003		0.009
	(0.25)		(0.54)
married, no children	0.091		-0.088
	(23.68)**		(4.92)**
married, 1 child	0.098	-0.008	-0.079
	(22.07)**	(2.51)*	(4.25)**
married, 2 children	0.124	0.013	-0.071
	(26.14)**	(3.67)**	(3.86)**
married, 3+ children	0.103	-0.005	-0.088
	(19.05)**	(1.16)	(4.55)**
HoH self-employed (D)	0.083	0.020	0.094
	(20.34)**	(4.72)**	(14.91)**
HoH civil servant (D)	-0.019	-0.021	0.020
	(6.52)**	(7.12)**	(4.27)**
above contr. cap (D)	-0.010	-0.008	-0.048
	(2.18)*	(1.79)	(6.60)**
income above the contr. cap (in MEUR)	0.286	0.340	0.590
	(1.37)	(2.18)*	(2.21)**
mortgage (D)	0.014	0.001	0.018
	(4.40)**	(0.01)	(3.68)**
debt share (real wealth)	0.053	0.055	0.039
	(8.93)**	(8.94)**	(4.28)**
average tax rate	0.300	0.088	0.233
	(8.51)**	(3.85)**	(7.19)**
smaller inc. Share 25-40%		0.005	
		(1.18)	
smaller inc. Share 10-25%		0.015	
		(3.22)**	
smaller inc. Share <10%		0.007	
		(1.80)	
deductibility cap reached			0.046
			(10.22)**
possible further tax savings			-0.038
			(3.95)**
Observations	267282	157175	116523
Pseudo R^2	0.1198	0.0501	0.1183

Note: The t-statistics in brackets are calculated using heteroskedasticity consistent estimators.
** denotes significance at the 5 percent level, ** at the 1 percent level*

The third column inspects the importance of the tax deductibility of contributions. Looking only at households for which we can calculate the tax advantage we exclude composite households

from the sample. We also drop households from the sample if there are children who earn enough money to be liable to pay taxes.[26] Our results are opposite to what economic theory would suggest. Households who have some room under the deducibility cap should be more likely to invest in life insurance products. Yet they are significantly less likely to do so. Also the level of possible tax savings from life insurance purchases does not yield the expected results. The more tax savings a household could receive from an investment in life insurance products, the less likely we find him to own life insurance. The results are robust to the choice of our two possible definitions of inevitable expenditures.

Ownership by type of life insurance product

Given that we would expect savings motives to be differently connected to the different types of life insurance products, we now turn to separate analyses of the demand for whole life insurance, private pensions, and term life insurance contracts. Table 6 displays the results of our basic specification applied to these three types of insurance products. Given that we can only distinguish whole life insurance and private pension contracts in the 2003 cross section of the EVS the sample is restricted accordingly.

We first look at the influence of children and marital status: While the results look comparable for whole life insurance and term life insurance contracts, the results for private pensions look quite different. Children in the household increase the probability of holding term and whole life insurance, while the effect on private pensions is mixed and largely insignificant. Comparing the influence of the number of children we find the demand for whole life insurance to be reduced once a family has three or more children. At the same time, the probability of holding term life insurance is continually rising in the number of kids. We take this as evidence that a bequest motive and insurance for the children induce demand for insurance products with a term life component. Further, there seems to be a substitution between whole life insurance and term life insurance depending on the number of children which might be related to the available financial resources.

Next, we find a stable and positive effect of marital status on the demand for whole life insurance. The estimated effect is largely independent of the existence and number of children. The effect of marriage on the demand for term life insurance is mixed and only significantly positive if no children are present. Last, private pensions seem to be less popular among married households. Like in the case of whole life insurance, this effect changes only little depending on

[26] The appendix includes a detailed overview over the samples employed for the different specifications.

the existence and number of children in the household. The term life component being the main difference between whole life insurance and private pensions one might consider these results evidence in favor of a bequest/insurance motive. It remains an open question, however, why pure term life insurance does not benefit accordingly.

Table 6: Probit regressions for life insurance ownership by type (2003)

	ownership of …		
	whole life insurance	private pensions	term life insurance
HoH male (D)	-0.002	-0.010	0.002
	(0.37)	(2.37)*	(0.46)
unmarried, 1 child	0.035	0.014	0.041
	(3.38)**	(1.72)	(4.20)**
unmarried, 2 children	0.037	-0.009	0.079
	(2.55)**	(0.83)	(5.81)**
unmarried, 3+ children	-0.048	0.005	0.091
	(1.99)*	(0.31)	(4.15)**
married, no children	0.022	-0.017	0.027
	(2.39)*	(2.59)**	(3.58)**
married, 1 child	0.041	-0.014	0.050
	(3.77)**	(1.88)	(5.69)**
married, 2 children	0.051	-0.029	0.075
	(4.57)**	(4.25)**	(8.07)**
married, 3+ children	0.029	-0.038	0.072
	(2.27)**	(5.21)**	(6.82)**
HoH self-employed (D)	0.068	0.071	0.022
	(6.41)**	(8.10)**	(2.72)**
HoH civil servant (D)	0.015	-0.028	0.007
	(1.88)	(5.31)**	(1.31)
above contr. cap (D)	-0.039	-0.012	-0.010
	(2.68)**	(1.32)	(1.10)
income above the contr. cap (in MEUR)	0.461	0.051	0.022
	(1.27)	(0.22)	(0.10)
mortgage (D)	0.025	-0.025	0.059
	(3.23)**	(4.57)**	(10.10)**
debt share (real wealth)	0.043	-0.002	0.052
	(3.37)**	(0.25)	(6.09)**
average tax rate	0.264	0.125	0.106
	(4.20)**	(5.38)**	(3.89)**
Observations	42680	42680	42680
Pseudo R^2	0.1098	0.0724	0.1058

Note: The t-statistics in brackets are calculated using heteroskedasticity consistent estimators.
** denotes significance at the 5 percent level, ** at the 1 percent level*

We next turn to the influence of a possible old age savings motive. Given that term life insurance does not include capital accumulation, we would expect our proxies for the old age provision needs to have no effect on them at all. We find households with a self-employed household head to be significantly more likely to hold all kinds of life insurance. In support of the above

hypothesis the effect of self-employment on the probability of term life insurance ownership is a lot smaller.[27] The effect of a civil servant household head also differs across products. While those products with a term life component tend to be more spread among civil servants, private pensions are significantly less popular among them. For households with an income above the contribution ceiling our evidence is again mixed. Overall, our results show little support for our theoretical considerations: Where the effect of income above the contribution ceiling has the expected sign, it remains statistically and economically largely insignificant. Additionally, the level effect of being at or above the contribution ceiling is negative (though mostly insignificant) for all three products.

Returning to the influence of housing debt, we find strong evidence in favor of our hypotheses: Households with outstanding mortgages turn out more likely to own term and whole life insurance contracts. Both products include a term life component – which is frequently required to receive a home loan in Germany. Furthermore, the probability of holding whole life insurance and term life insurance increases in the share of debt on the household's real wealth. Somewhat striking is our finding that households with a home loan are less likely to hold wealth in a private pension contract. Given that whole life insurance contracts and private pensions are quite similar products except for their term life component, households with a home loan might just pick the two-in-one package among the otherwise close substitutes. Another reason might be that households perceive their home as a substitute for additional old age provision and therefore reduce their additional savings in a private pension contract. This finding is in line with Schunk (2007) who investigates to what extent different forms of savings are competing with each other. However, the above logic makes sense only if there is a closer link between the old-age savings motive and private pensions than with whole life-insurance contracts.

Finally, we consider the effects of tax incentives and find our hypotheses supported for all types of life insurance products. As for the pooled sample, we find the average tax rate to be one of the most important predictors for life insurance ownership. The effect is stronger by an order of magnitude for whole life insurance products; hence our results support the often raised claim that especially whole life insurance owed much of its popularity to its favorable tax treatment.

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[27] A possible explanation for the positive coefficient may be the fact that the self-employed do not have dependent's insurance unless they are voluntarily insured in the public pension system. Hence the self-employed dummy may capture not only the need for additional private old-age provision.

Wealth in life insurance policies

What we have investigated so far is only the question of whether or not a household decides on the purchase of a life insurance product or not. To gain further insight, we look at how much households invest and – resulting from this – how much wealth they accumulate in insurance products. We first look at wealth levels invested in whole life insurance products and private pensions. Given that we can only distinguish the two types of products in the 2003 cross-section of the EVS, we again restrict the sample accordingly. We employ a Heckman model to allow for selection effects. For part of the exclusion restrictions we pick the age-variables, the time-effects and the dummy for households above the contribution cap. Although wealth and contributions can be expected to vary with age, we expect both to be captured by income and wealth effects. For part of the dummy for households above the contribution cap theory suggests that there should be no level effect in wealth holdings or contributions for households above the cap. Instead, wealth and contributions should gradually increase in income above the cap.

Table 7 contrasts the estimation results for wealth in whole life insurance and wealth in private pensions. We find married couples without children to hold significantly more wealth in insurance products. At the same time, households with children hold lower levels of wealth in both products. The differences are significant for almost all types of families when considering whole life insurance. Significance is mixed for wealth in private pensions. Given that we are controlling for differences in total net wealth and income, it seems obvious that households with children simply spend their money differently – be it on consumption goods or on other types of investments. Hence our results clearly reject the hypothesis that households with children should save more in life insurance products to provide insurance against the early death of an earner. The same hypothesis is supported in the case of married couples with no children.

We next turn to households' old age savings motive. As expected, we find households with a self-employed household head to accumulate significantly more wealth in both types of products. The effect is some 20 percent larger for whole life insurance products, but for both types of insurance the effect is statistically highly significant and of vast economic significance. Controlling for income and wealth, the average household with a self-employed head accumulates 10.000 Euros more in private pensions and 12.000 Euros in whole life insurance products. Looking at the additional savings from income above the contribution ceiling, we find the expected sign for wealth in whole life insurance and the opposite sign for private pensions. Both effects are insignificant though.

Table 7: Heckman selection models for wealth in different types of life insurance (2003)

	wealth in whole life insurance	selection	wealth in private pensions	selection
HoH male (D)	-499	-0.005	-37	-0.044
	(0.90)	(0.29)	(0.06)	(2.29)*
unmarried, 1 child	-1'394	0.087	-635	0.063
	(1.51)	(2.99)**	(0.75)	(1.90)
unmarried, 2 children	-2'990	0.123	-2'337	-0.042
	(2.22)*	(2.96)**	(2.20)*	(0.86)
unmarried, 3+ children	1'908	-0.146	-1'497	0.021
	(1.05)	(2.05)*	(1.11)	(0.29)
married, no children	2'212	0.075	1'929	-0.071
	(2.82)**	(2.54)*	(1.94)	(2.22)*
married, 1 child	-1'431	0.116	-1'244	-0.056
	(1.38)	(3.68)**	(1.21)	(1.65)
married, 2 children	-2'976	0.156	-2'848	-0.134
	(2.92)**	(4.82)**	(2.50)*	(4.08)**
married, 3+ children	-4'516	0.080	-3'607	-0.184
	(4.04)**	(2.24)*	(3.03)**	(4.92)**
HoH self-employed (D)	11'953	0.245	9'815	0.286
	(8.00)**	(7.60)**	(5.96)**	(8.51)**
HoH civil servant (D)	-936	0.026	-3'265	-0.135
	(1.23)	(1.05)	(5.17)**	(5.24)**
above contr. Cap (D)		-0.137		-0.059
		(3.66)**		(1.38)
contr. Cap * inc (in MEUR)	45'718	1.491	-32'382	0.227
	(1.29)	(1.37)	(1.02)	(0.21)
mortgage (D)	-5'389	0.050	-5'954	-0.120
	(6.30)**	(2.26)*	(5.10)**	(4.32)**
debt share (real wealth)	13'371	0.136	7'814	-0.011
	(9.28)**	(3.68)**	(4.32)**	(0.23)
average tax rate	-4'367	1.029	10'345	0.546
	(1.13)	(8.18)**	(3.30)**	(5.49)**
mill's				
lambda	-23'789		13'270	
	(11.24)**		(6.30)**	
rho	-0.67		0.58	
Observations	42'680	42'680	42'680	42'680

*Note: The variance-covariance matrix was estimated using nonparametric bootstrap estimation using 200 repetitions. * denotes significance at the 5 percent level, ** at the 1 percent level.*

We move on to the connection of life insurance wealth with housing debt and find households with an outstanding mortgage to hold less wealth in life insurance products. At the same time, the level of wealth clearly increases in the ratio of home loans to housing wealth. We have pointed out before that many households will need to provide some kind of term life insurance to get a home loan approved. Private pensions do not include such term life component and this is mirrored in our results. Households with an outstanding mortgage are less likely to hold private pensions and their probability to hold private pensions also does not increase with the share of debt on the home. At the same time a higher share of debt always requires additional loan

securities. Both, wealth in private pensions as well as wealth in whole life insurance contracts, can serve this purpose. The positive coefficients for the share of debt for both types of insurance support these theoretical considerations.

Last we turn to the effects of the tax rate the household is facing. While the Heckman model confirms our previous results that the probability of accumulating wealth in life insurance products increases in the household's tax rate, we are somewhat surprised by the result, that only private pension wealth increases significantly for higher tax rates. For whole life insurance wealth the estimated coefficient is negative although not significant.

Contributions to life insurance products

Any wealth variable will comprise a history of savings and investment decisions and be influenced by the returns on capital. Also, today's sociodemographic characteristics and economic variables can only proxy the corresponding history of variables which have determined the investment decisions along the way. We therefore turn to contemporaneous investment behavior knowing that also contractual commitments of the past may play a role in the observed contributions to life insurance contracts.

Table 8 presents the results of selection models estimated for the contributions to term life insurance as well as to capital accumulating life insurance products, i.e. private pensions and the various types of whole life insurance policies. Looking first at the contributions to term life insurance contracts, we find only few of the reported variables to have significant impact. There are striking differences for households with a self-employed household head and households with a civil servant head. The first spend significantly more on term life insurance products while the latter spend significantly less. Considering that families with a self-employed head are often much more dependent on their main earner and civil servants profit from dependant's pensions this finding is clearly in line with a motive to insure the family against the death of the main earner.

Somewhat surprising is the result that contributions tend to be lower for households with a home loan. Contributions rise with the share of debt on the home but this effect is not statistically significant. Last, households facing higher tax rates tend to spend more money on term life insurance policies.

Turning to our results for the contributions to whole life insurance and private pension policies we should note that the samples for the two regressions displayed in table 8 are not the same. The sample for the second regression is restricted to households where we could calculate the possible tax savings from contributions to life insurance products – i.e. composite households and households with children who are paying income taxes are excluded.

Table 8: Heckman selection models for contributions to different types of life insurance (2003)

	contributions to term life insurance	selection	contributions to cap. acc. life insurance	selection
HoH male (D)	6.6	0.009	137.9	-0.028
	(0.19)	(0.48)	(1.51)	(1.56)
unmarried, 1 child	-167.1	0.177	-281.4	0.073
	(1.99)*	(4.44)**	(2.39)*	(1.93)
unmarried, 2 children	-129.8	0.321	357.6	0.05
	(1.14)	(6.03)**	-0.51	(0.98)
unmarried, 3+ children	-97.2	0.362	-627.8	0.176
	(0.61)	(4.69)**	(3.62)**	(2.23)*
married, no children	67.0	0.119	-388.1	-0.073
	(0.82)	(3.49)**	(2.15)*	(0.02)
married, 1 child	-48.7	0.214	-452.0	-0.017
	(0.51)	(5.95)**	(2.38)*	(0.00)
married, 2 children	-46.8	0.310	-403.9	-0.019
	(0.41)	(8.16)**	(1.81)	(0.01)
married, 3+ children	-34.0	0.296	-532.5	-0.048
	(0.28)	(7.15)**	(2.55)*	(0.01)
HoH self-employed (D)	844.2	0.095	1'955.1	0.168
	(5.58)**	(2.76)**	(6.38)**	(4.85)**
HoH civil servant (D)	-118.8	0.032	-311.9	0.052
	(2.57)*	(1.21)	(4.94)**	(2.09)*
above contr. Cap (D)		-0.047		-0.123
		(1.08)		(3.02)**
income above the contr. cap (in MEUR)	-3'152.4	0.086	13'889.3	1.549
	(1.10)	(0.08)	(2.22)*	(1.54)
mortgage (D)	-168.2	0.261	-746.4	0.118
	(2.12)*	(10.11)**	(5.40)**	(5.03)**
debt share (real wealth)	152.6	0.236	1'175.9	-0.032
	(1.54)	(5.91)**	(5.72)**	(0.89)
average tax rate	1'271.0	0.480	1'040.6	0.451
	(2.60)**	(3.38)**	(1.34)	(3.11)**
possible further tax savings (in TEUR)			-545.1	-0.051
			(2.09)*	(0.67)
deductibility cap reached				0.146
				(6.07)**
mill's				
lambda	390.1		-1464.6	
	(1.66)		(5.85)**	
rho	0.26		-0.34	
Observations	42'680	42'680	37'247	37'247

*Note: The variance-covariance matrix was estimated using nonparametric bootstrap estimation using 200 repetitions. * denotes significance at the 5 percent level, ** at the 1 percent level.*

Again, our results for the contributions made by the different family types are mixed: with one exception – unmarried households with 2 children – the estimated coefficients have a negative sign and the effects are statistically significant. While we would have expected that married households and households with children put more money into capital accumulating life

insurance products, the opposite is the case: Controlling for income and wealth, single households without children contribute significantly more.

Looking at those groups of households who we would expect to save more in life insurance products for their lower replacement rates in the public pension system, we find our hypotheses supported: First, the self-employed save significantly more in insurance products. Each year, the average household with a self-employed head pays almost 2000 Euros more in insurance premia compared to an employee's household. Also, among employees, we find our hypothesis supported, that households above the contribution ceiling to the public pension system contribute more as their income rises. The estimated positive contribution out of additional income is statistically significant, yet economically these contributions are negligible: on average, only 1.4 cents out of every additional Euro are going into life insurance savings. Civil servants pay smaller contributions compared to other employees. Again, the effect is statistically significant.

Looking at households with a home loan we find the results for contributions to be in line with the previous results for wealth levels. Households with outstanding mortgages contribute less, but their contributions rise in the share of debt on their housing property.

Finally, we inspect the influences of tax incentives. First, we find households with higher tax rates to save more in life insurance contracts. The coefficient – though economically significant – turns out to be statistically insignificant. Second, our results suggest, that the possibility to deduct contributions from taxable income is no incentive to contribute to a life insurance policy. The estimated coefficient has the opposite sign from what theory would predict and it is statistically significant.

Portfolio shares

Some of our theoretical considerations concern the portfolio share invested in life insurance products rather than wealth levels or contributions. Especially the effects of tax free interest earnings should affect portfolio choice. We conjectured that households with higher tax rates should invest a larger share of their portfolio in life insurance products as the difference in after tax returns compared to other assets rises in the actual tax rate.

We use a two-stage Heckman approach as we did for the analysis of wealth holdings and contributions. Otherwise the samples and specifications employed are the same as for the pure ownership decision. Table 8 below presents three specifications: The first column contains the basic model which we augment by our measures for income inequality in the second column. The third column is directed at the influence of the tax deductibility of contributions.

Table 9: Heckman selection models for the portfolio share invested in life insurance (pooled sample)

	(1)		(2)		(3)	
	portfolio share	selection	portfolio share	selection	portfolio share	selection
HoH male (D)	-0.012	0.010	-0.023	0.054	0.000	0.019
	(5.09)**	(1.22)	(5.94)**	(3.61)**	(0.14)	(1.74)
unmarried, 1 child	0.006	0.167			0.007	0.183
	(1.01)	(10.91)**			(0.71)	(8.23)**
unmarried, 2 children	0.031	0.114			0.017	0.117
	(3.97)**	(5.23)**			(1.32)	(3.76)**
unmarried, 3+ children	0.064	0.018			0.065	0.027
	(5.41)**	(0.56)			(3.04)**	(0.55)
married, no children	-0.021	0.225			-0.055	-0.057
	(3.84)**	(18.27)**			(5.50)**	(1.91)
married, 1 child	-0.019	0.254	-0.009	-0.026	-0.062	-0.030
	(3.13)**	(17.38)**	(3.54)**	(2.36)*	(5.25)**	(0.94)
married, 2 children	-0.017	0.334	-0.009	0.044	-0.055	-0.009
	(2.69)**	(22.12)**	(2.81)**	(3.59)**	(4.53)**	(0.28)
married, 3+ children	0.012	0.276	0.019	-0.016	-0.034	-0.056
	(1.77)	(15.60)**	(5.38)**	(1.17)	(2.68)**	(1.59)
HoH self-employed (D)	0.124	0.252	0.126	0.195	0.102	0.300
	(32.63)**	(19.28)**	(33.00)**	(12.67)**	(15.71)**	(14.57)**
HoH civil servant (D)	-0.028	-0.051	-0.031	-0.110	-0.019	0.062
	(11.66)**	(6.28)**	(13.01)**	(10.98)**	(4.84)**	(4.35)**
above contr. Cap (D)		-0.023		-0.026		-0.144
		(1.86)		(1.48)		(6.65)**
income above the contrib. cap (in MEUR)	1.302	0.788	0.852	1.113	0.972	1.758
	(7.39)**	(1.38)	(7.01)**	(2.09)*	(4.20)**	(2.31)*
mortgage (D)	0.083	0.046	0.076	0.001	0.069	0.053
	(31.26)**	(5.36)**	(30.74)**	(0.12)	(17.21)**	(3.53)**
debt share (real wealth)	-0.058	0.178	-0.056	0.208	-0.025	0.117
	(12.55)**	(10.60)**	(11.29)**	(10.45)**	(3.37)**	(4.21)**
average tax rate	-0.125	0.984	0.007	0.442	-0.172	0.697
	(4.92)**	(10.65)**	(0.31)	(4.55)**	(4.34)**	(6.96)**
smaller inc. Share 25-40%			0.004	0.016		
			(1.15)	(1.18)		
smaller inc. Share 10-25%			0.009	0.049		
			(2.47)*	(3.03)**		
smaller inc. Share <10%			0.013	0.024		
			(4.46)**	(1.75)		
deductibility cap reached						0.139
						(10.07)**
possible further tax savings					-0.021	-0.117
					(1.54)	(3.49)**
mill's						
lambda	-0.216		-0.229		-0.303	
	(22.75)**		(13.56)**		(21.00)**	
rho	-0.667		-0.740		-0.842	
Observations	267282	267282	157175	157175	116523	116523

*Note: The variance-covariance matrix was estimated using nonparametric bootstrap estimation using 200 repetitions. * denotes significance at the 5 percent level, ** at the 1 percent level.*

Looking first at the effects of the tax rate on households' investment behavior, we find the expected positive effect for the selection equation. This essentially only confirms our previous results. For part of the portfolio allocation, we find a negative effect of tax rates on the portfolio share invested in life insurance wealth. The effect turns out to be statistically significant except for the second specification which is focused on married couples and the effects of intra-household income inequality. Other tax favored assets might just be even more important for these households. Capital gains in stocks also remain untaxed if a certain holding period is fulfilled – to give just one example. Note that this result is robust to the exclusion of any wealth and income related variables from the regression!

The third specification concludes our analysis of tax favors towards life insurance products. As before, the deductibility of contributions turns out to be an ineffective device for the promotion of life insurance products. Overall, our hypotheses based on considerations of optimal portfolio theory are all rejected by our analysis.

VI. Conclusion

Starting from a thorough description of the German life insurance market, we have highlighted the possible usability of savings in life insurance products for different savings motives. Furthermore, we have explained the scheme of tax favors towards life insurance products and outlined its effects from a perspective of portfolio theory.

Depending on the degree to which households behave according to these theoretical considerations, we can draw some conclusions about the relevance of the various savings motives for German households and evaluate the efficiency of the existing tax incentives. At the same time, our insights about the determinants of life insurance demand in the past shed light on the possible consequences of the recent changes to the market environment. First and foremost, these changes concern the tax treatment of life insurance products. But also sociodemographic changes like the postponement of marriage and parenthood may affect the market. Finally, the recent pension reforms have increased the need for additional private old age provision for German households.

The need for additional private old age provision has become the main sales argument for life insurance products in recent years. Given that all capital accumulating life insurance products in Germany can be chosen to be paid out as an annuity, they are an important candidate to substitute for the reduced public pensions. Lacking data on households' public pension claims we rely on groups of households with reduced or no coverage from the public pension system to identify the need for additional private old age provision. We consistently find the self-employed – most of whom are not covered by the German public pension system – to save more in life insurance products and accumulate higher wealth levels. Apart from the self-employed, also employees with an income above the contribution ceiling will face reduced replacement rates. Our empirical evidence for the demand of this group is at best mixed. The effects of excess income on the effective replacement rate may be just too small to induce behavioral responses, especially if households receive such high incomes only for a small number of years. Otherwise, our results would imply that these households are either just fine with their lower replacement rates from the public pension system or save differently for their retirement.

The second group of savings motives we investigate concerns the insurance of the family or a bequest motive. We consider the insurance against the loss of an earner and the intention to leave a bequest – be it altruistic or not – to be equivalent for our purpose and do not make attempts to distinguish them. Our focus is on three variables: The presence and number of children, marital status, and the distribution of incomes within among couples. In support of our hypotheses, we

find married households and households with children to be more likely to hold whole life insurance and especially term life insurance. Especially the term life component seems to be an important aspect for the insurance of the family. Pure wealth accumulation as a way to provide for the family turns out to be much less of an argument though. Controlling for income and wealth, the average contributions of married households and households with children are estimated to be lower than for unmarried households without children. Further, the estimated wealth levels are lower in most cases where children are present. With respect to income inequality within a couple Bernheim (1991) had conjectured that a large differential in survival contingent incomes should increase the demand for life-insurance. Our results provide some support for Bernheim's hypothesis. Specifically, life insurance products are more popular among households with some income inequality. The estimated effect is diminishing for households with an extreme inequality of earnings though. These results hold for life insurance ownership as well as for the portfolio share is invested in life insurance products.

Third and last among the savings motives, we inspect the effects of home-ownership and mortgage debt on the demand for life insurance products. We find households with a home loan to be more likely to hold some sort of life insurance with a term life component – i.e. whole life insurance or pure term life insurance contracts. Yet contributions to life insurance products and the corresponding wealth levels are lower in households with small outstanding mortgages. With an increasing share of debt on a home the level of wealth in life insurance contracts strongly increases though. This may reflect that households have already used some life insurance wealth to pay off part of their debt. An alternative explanation is that only a higher level of life insurance wealth allows households to take up an increased credit line. We would need longitudinal data to further investigate this question. The demand for private pensions in the presence of mortgages looks quite different: In fact, real estate debt reduces the probability to hold wealth in private pensions. If households consider their home a kind of old age provision we would expect private pensions to suffer most – exactly what we observe in the data.

Assessing the effectiveness of the tax incentives, we have to differentiate between the two kinds of tax favors life insurance products enjoy in Germany. On the one hand, we find households to ignore the possibility to deduct contributions to life insurance products from taxable income. Instead, households with higher possible tax savings are less likely to invest in life insurance products and contribute less. On the other hand, there is the tax exemption for capital gains and interest earned within a life insurance contract. Theory predicts that households facing higher tax rates profit more from the tax advantage and should therefore contribute more to life insurance contracts and accumulate more wealth. We find these predictions supported by our data. An exception is the portfolio share invested in life insurance products. The portfolio share turns out

to decrease in the households' tax rate. One might speculate that households favor other tax favored assets. A more solid answer to this question would require a complete portfolio choice model which is beyond the scope of this paper.

Generally, all of our inference on the importance of different possible savings motives is indirect – a limitation shared by the majority of the existing literature – and strictly speaking it is limited to life insurance wealth. The immense importance of life insurance wealth in Germans' financial portfolio should allow some generalization of our results though. Our findings support Feldstein's (1976) predictions that households substitute between private wealth accumulation and public pension claims. An open question arising from our results concerns the old age savings of high income households. It remains unclear whether they just save differently or whether they are satisfied with the reduced replacement rates they receive from the public pension system. Germans also behave according to a bequest motive when it comes to the demand for term life insurance. At the same time our evidence concerning the accumulation of additional wealth is at best mixed like the existing literature on this aspect.

Apart from our original interest in households' savings motives and the resulting investment choices our analysis delivers some helpful insights about the future developments on the market for life insurance products: First, as the need for additional private old age provision seems to be an important factor in the demand for life insurance products, we can expect both – whole life insurance and private pensions – to benefit from the recent pension reforms. Second, also some of the changes in tax treatment towards life insurance products can be expected to have a strong impact. Given that only contracts with a distinct orientation towards old age provision – specifically in the form of a compulsory annuity payout scheme – continue to receive the favorable tax treatment, we can expect to see the shift in market shares from whole life insurance products to private pensions to continue. At the same time the deductibility of contributions to life insurance contracts has shown to be irrelevant for the investment decision – at least in the current form. Hence, changes to the deductibility rules should not harm the sales of the life insurance industry. Third and last, the recent changes to the promotion of private real estate formation may have second order effects on the demand for life insurance. The size of these effects will largely depend on the first order effects – i.e. changes in the demand for real estate and changes in the financing of possible purchases. Overall, private pensions can be expected to gain from the above changes while the cumulative effect on whole life insurance products is undecided.

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Appendix

Variables and definitions

children — The EVS contains information only about the number of children in the household. We augment this measure by imputing children, whenever the amounts of child benefit allowance, maternity benefits or education benefits imply a larger number of children. While we are far from measuring the true number of children, we expect to arrive at a reasonable measure of children which are still financially dependent on their parents.

marital status — Throughout our analysis we consider a household head married whenever he is indicated to be married, no matter if the couple is living together or apart.

job status — Each person is attributed to the groups of employees, civil servants, or self-employed depending on her main source of income.

inevitable expenditures

The *tight definition* includes all compulsory contributions to the public pension system and to the other branches of the social security system (public health and long term care insurance). Further, insurance premia for private health insurance, private long term care insurance and car liability insurance are included.

The *extended definition* contains all above expenditures. It is distinct from the *tight definition* as payments to occupational pension funds, civil servants pension funds and voluntary contributions to the public pension system are added.

Control variables in the regressions

For reasons of clarity, the regression results presented in section V.2 are shortened with respect to the following control variables:

west (D) — Dummy: 1 if the household lives in the states of the former FRG

wealth — household net wealth (second degree polynomial)

inc — household net disposable income (third degree polynomial)

n_agegrp(*a*) — number of household members aged *a* to *a*+4; $a \in [20, 25, \ldots, 75]$

Samples descriptions

Starting from a total of 267'434 observations in the pooled (1978-2003) sample, we exclude 148 households with extreme outliers of total net wealth and of the ratio of debt to assets.

regression	years	exclusions	sample size
Tables 5(1) , 9(1)	1978-2003	-none-	267282
Tables 5(2) , 9(2)	1978-2003	married couples only, possibly with children	157175
Tables 5(3) , 9(3)	1993-2003	singles or couples, possibly with children, unless the children are liable to taxation - no composite households	116523
Tables 6, 7	2003	-none-	42680
Table 8 (1)	2003	-none-	42680
Table 8 (2)	2003	singles or couples, possibly with children, unless the children are liable to taxation - no composite households	37247

Death benefit insurance, apprenticeship insurance and trousseau insurance

There are a number of special types of whole life insurance, the importance of which has strongly declined. Specifically, the EVS distinguishes death benefit insurance, apprenticeship insurance and trousseau insurance in the years 1988, 1993 and 2003. For the years 1988 and 1993, the data contains a question about the types of life insurance held in the household. For 2003, the separate amounts of wealth in the above categories allow us to infer ownership equivalently. Apart from the distinct age-pattern in ownership rates we also observe strong time effects. Death benefit insurance used to be rather popular among the elderly (see figure A-1). In 1988, as much as 30-35% of households headed by a 65+ year old owned at least one death benefit insurance contract. Within 15 years, ownership rates among the same age groups had declined by more than 15 percentage points. The absolute drops in ownership rates for apprenticeship insurance (figure A-2) and trousseau insurance (figure A-3) are smaller as their popularity has been lower to begin with. Both were held by 6-8% of the households aged 30 to 45 in 1988. Ownership rates had dropped to 2-3% in these age groups by the year 2003.

Figure A-1: Ownership rates in death benefit insurance by cohort (West Germany)

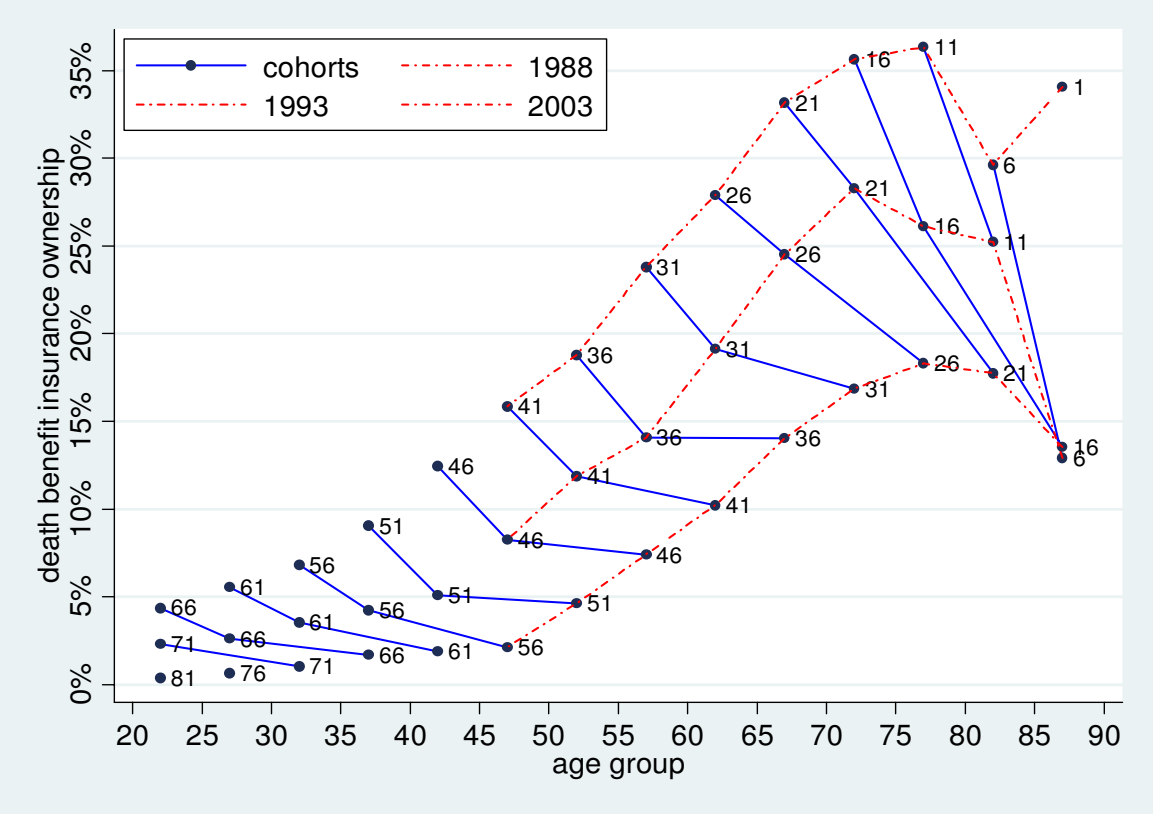
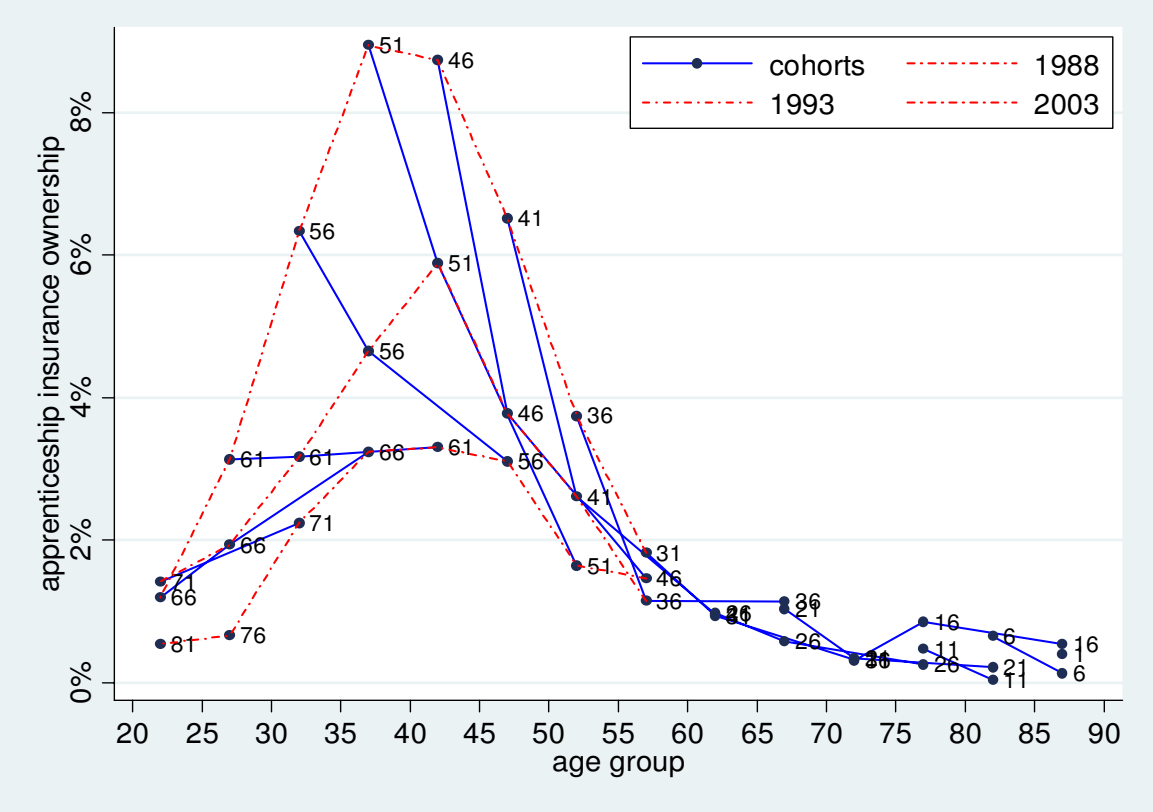
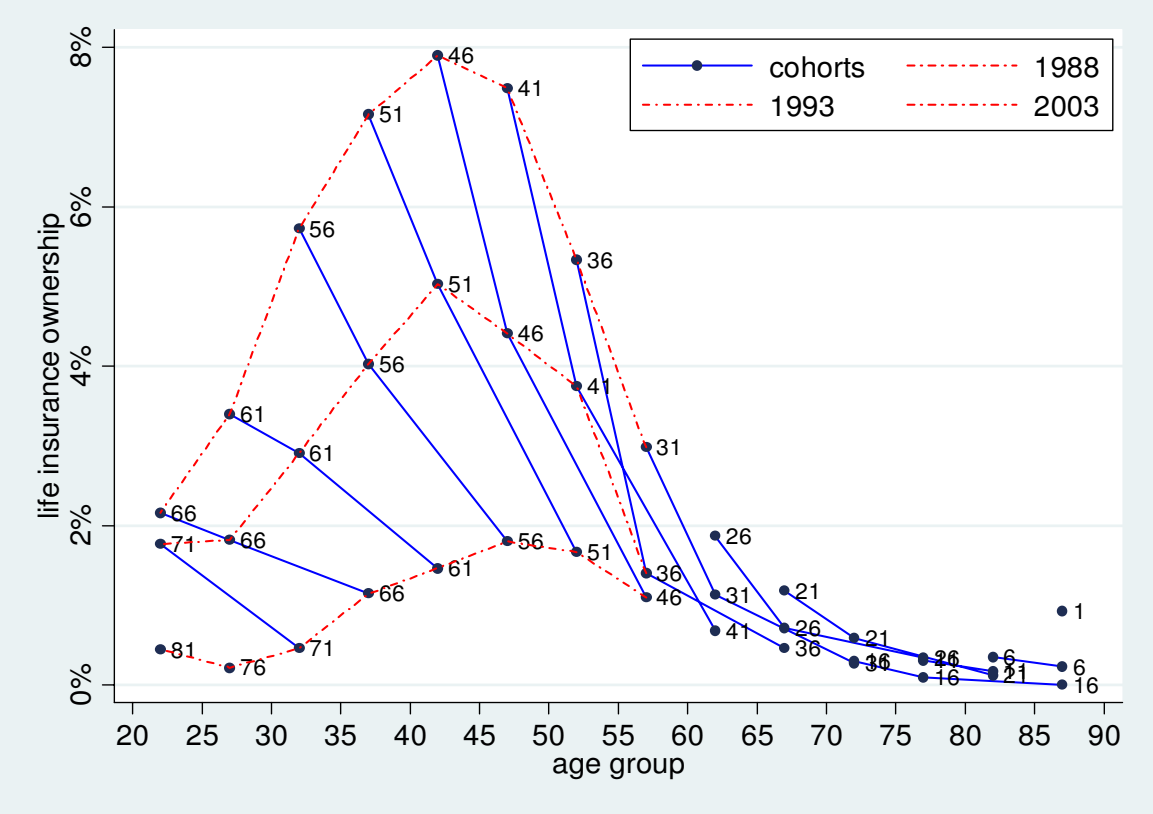


Figure A-2: Ownership rates in apprenticeship insurance by cohort (West Germany)



Source: EVS, own calculations, weighted results

Figure A-3: Ownership rates in trousseau insurance by cohort (West Germany)

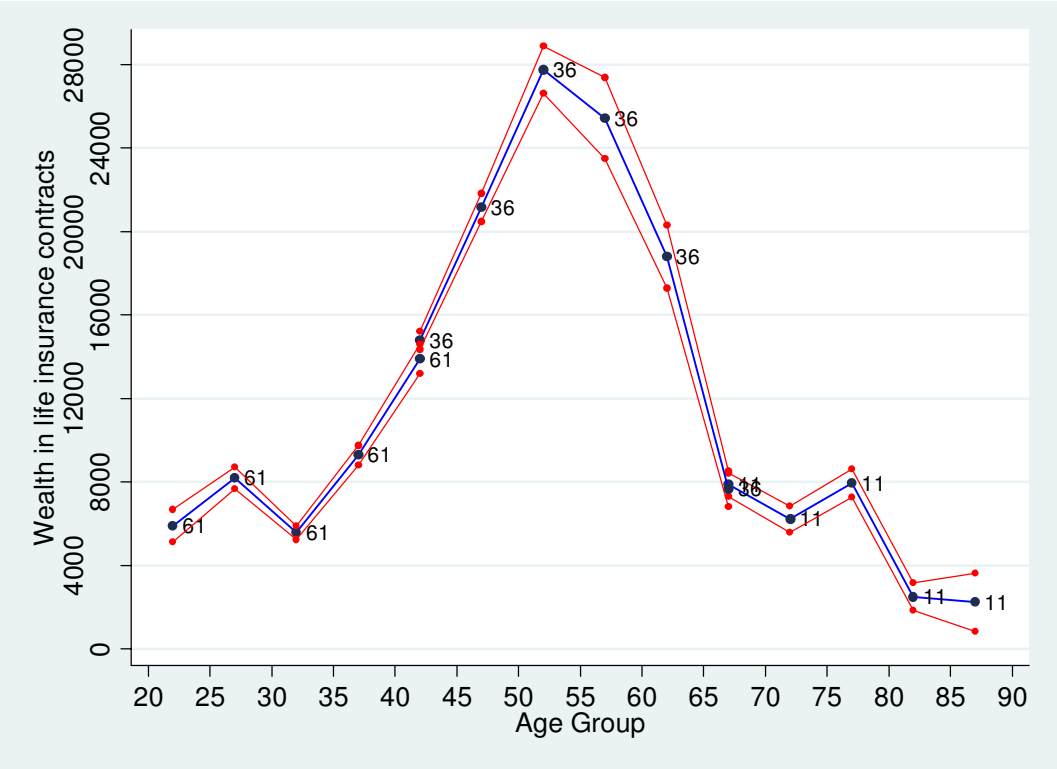


Source: EVS, own calculations, weighted results

Age-trajectories and confidence bands

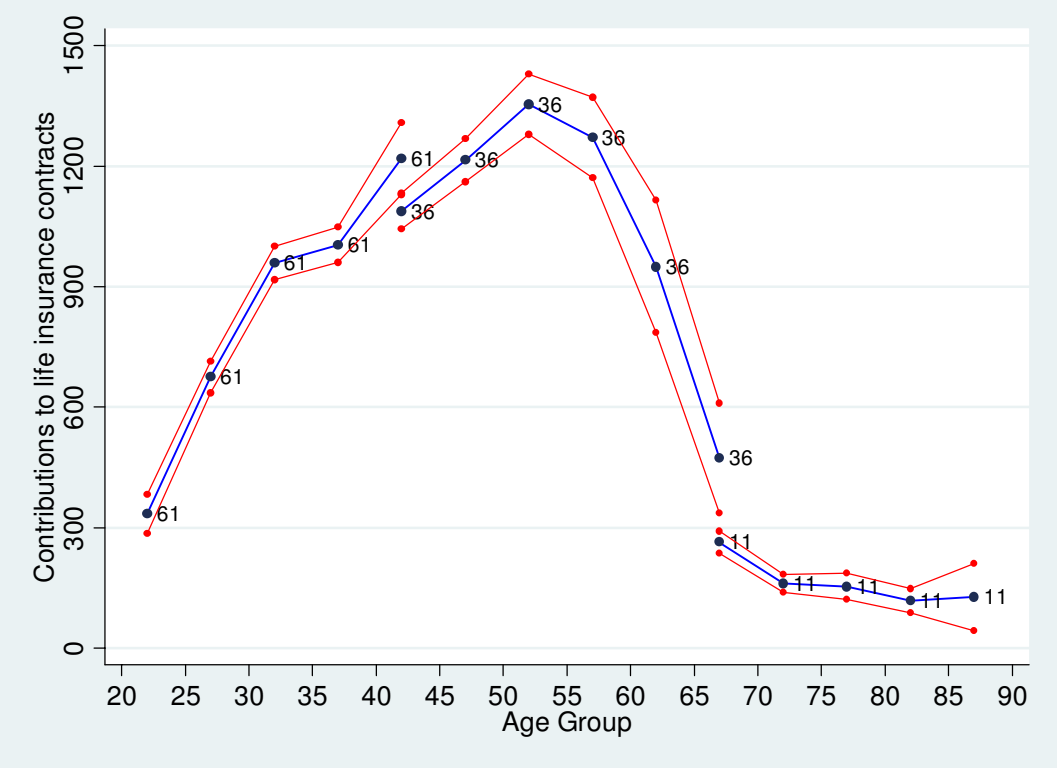
An often raised question concerns the accuracy of the estimated age trajectories – especially at old age. Figures A-4 and A-5 depict the average wealth levels and average contributions of selected cohorts over time. Each graph shows the estimated average (blue) and the 95% confidence interval around the estimated averages (red). The confidence bands get wider for the oldest age-group – households with a household head aged 85 to 89. Note that this age-group still contains between 200 and 300 observations for each cohort we observe up to such a high age.

Figure A-4: Cohort wealth trajectories with confidence bands



Source: EVS, own calculations, all values in 2001 Euros, weighted results

Figure A-5: Cohort trajectories in contributions with confidence bands



Source: EVS, own calculations, all values in 2001 Euros, weighted results

Chapter 4

Understanding the trends in income, consumption and wealth inequality and how important are life-cycle effects?

I. Introduction

The term *inequality* seems to have a purely negative connotation when we look at the public debate about rising inequality. Especially in continental Europe, there is a vigorous public and political debate about the need and possible ways to mitigate the effects which are largely ascribed to globalization. This debate is only to a minor degree based on scientific results despite that fact that there is a substantial literature on inequality that reaches back into the 1960s. However, the sources of rising inequality are still not very well understood. Further, natural components in the observed trends, which may e.g. be induced by changes in the population structure, by the globalization, or by skill-biased technological change have received rather little attention so far.

At the same time macroeconomists have been largely ignorant to the matter of inequality in the past. Incorporating heterogeneity into their quantitative models has only recently become possible with the availability of sufficiently powerful computers. With the grown opportunities to refine the quantitative models there is a growing need for empirical benchmarks for the calibration of these models.

The purpose of this paper is twofold. First, we document the trends in income, consumption and wealth inequality in Germany over the past 25 years. While this has been done in the past e.g. by Becker and Hauser (2003), the goal of our work in collaboration with a large community of international researchers is to provide results for a variety of countries based on common definitions.[1] We thereby aim to provide an empirical benchmark for future macroeconomic models. Given the popularity of OLG models for capturing the characteristics of aging economies, we put a special focus on the analysis of inequality in a life-cycle context.

Understanding the sources of rising inequality, however, seems especially important also for the assessment of the need for political action against rising inequality. We therefore compare the trends in inequality from the raw data to the remaining inequality after filtering out structural

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[1] The results documented in this paper are closely comparable to our work for the joint project "cross-sectional facts for macroeconomists (CFM)". The project, initiated by Dirk Krüger, Fabrizio Perri, Luigi Pistaferri, and Gianluca Violante includes empirical work from 10 countries. In collaboration with Nicola Fuchs-Schündeln and Dirk Krüger we provide the German contribution to the project. The chapters four and five of this paper contain the EVS analyses which we also provide for the CFM-project, but without the sample restriction applied in the CFM project. Specifically, we restrict the sample for the CFM-project to households headed by a 25 to 60 year old. Accordingly, also the life-cycle analyses focus only this age-band. For our analysis, we extend the focus over all age-groups. Section six of this paper provides an independent analysis, which is not part of the CFM-project and based on joint interests with Tilman Eichstädt.

changes in the population structure. Procedurally, we employ a variance decomposition to obtain trends in residual inequality. Similar exercises have been carried out e.g. by Schwarze (1996) who uses a Theil decomposition to assess the effects of the German reunification on the national trends in income inequality.

While a considerable literature has investigated possible drivers behind income inequality, deeper analyses of the backgrounds to wealth inequality are rare. Among the few exceptions are the analyses by Hendricks (2007) and Scholz (2003). Hendricks estimates discount rates from life-cycle wealth data and uses the estimated preference parameters to predict wealth inequality. He finds differences in discount rate heterogeneity to significantly improve the predictions of wealth inequality from life-cycle models except for the top of the wealth distribution. Overall, his results support the view that life-cycle savings can account for a large part of wealth inequality. Therefore, demographic changes may be among the drivers of wealth inequality. We concur with Scholz (2003) who argues that looking at changes in the cross-sectional distribution of wealth, we are unable to understand the evolution of household wealth and thus receive an inaccurate view on the evolution of wealth inequality. While Scholz focuses on a comparison of the wealth accumulation of the baby boom generation with their parents, our goal is a more general one. We aim to present a stylized pattern of wealth accumulation in a life-cycle context and assess the relative importance of active and passive savings as well as inheritances at different parts of the income distribution and different ages.

The paper is organized as follows. We start out in section two with conceptual considerations about economic inequality and deduce the variables and definitions employed in the subsequent analyses. Section three shortly describes the data we use for our analysis. Section four presents the aggregate trends in the levels of income, consumption and wealth and the respective trends in inequality. We then turn to the decomposition of inequality in section five. We start with a cross-sectional perspective on the parts of inequality connected to observable household characteristics before we then turn to the life-cycle effects in inequality which. Section six is dedicated to our analysis of the different drivers behind wealth accumulation in a life-cycle context. Section seven concludes.

II. Conceptual considerations about inequality

Focusing on economic measures of wellbeing we certainly disregard a variety of dimensions which might be important for comprehensive assessment of differential wellbeing in a society. Important examples are the value of health and of social networks. While the contribution of such non-financial factors to individual welfare is non-trivial to quantify, also the right measurement of economic inequality has received considerable attention the literature. Income, consumption and wealth have all been employed and depending on the research question at hand the choice of different variables is only well-founded.

We aim to provide a rather general survey of differential wellbeing in a life-cycle context and therefore present evidence on all three measures. Furthermore, all three could be employed for the evaluation of macroeconomic models. Before turning to the actual analyses, we shortly discuss the significance of income, consumption and wealth inequality with respect to individual welfare and introduce the data we use.

II.1 *Income*

The link between income and wellbeing is an indirect one. Given that economists usually consider wellbeing a synonym for utility and utility to be derived from consumption and leisure, income does not seem the measure of choice. At the same time income is rather easy to measure and can be interpreted as a measure of immediate consumption opportunities. The obvious income measure is therefore *disposable (post-government) income*, which we define as the sum of gross work and asset income plus private and public transfers net of taxes and contributions to the social security system. For an assessment of the redistributive effects of the government sector it might further be interesting to compare pre- and post-government income, as it is done by Schwarze (1996). In the literature, also analyses focusing on certain income components have received some attention. Especially research questions with respect to the labor market have investigated the distribution of gross work income and wages. Recent example for the case of Germany are Becker (2006) and Gernandt and Pfeiffer (2006). Both lines of research are beyond the purpose of this paper.[2]

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[2] In Fuchs-Schündeln et al. (2008) we focus on the working age population and provide comparative analyses of inequality in pre- and post-government income as well as work income and wages.

II.2 *Consumption*

As mentioned above, income is not necessarily a good measure of actual wellbeing. Consumption smoothing over the life-cycle as first suggested by Modigliani and Brumberg (1954) as well as home production (Gronau, 1976) blur the link between income and consumption utility. Although consumption is much more directly linked to individual wellbeing, measuring inequality in consumption is not suited to thoroughly solve the problems. First, the issues around unaccounted utility from home production persist. Second, theory suggests that utility is not linear in consumption expenditures and may further depend on leisure. Third, consumption expenditures need not coincide with derived utility. This is especially the case for durable goods like cars or furniture. While it would conceptually be possible to distribute consumption utility of durable goods over their life-time, this is rarely done in practise. One of the main reasons is that most surveys lack information on the value of durable goods in the household.[3] Further, household expenditures for durables tend to occur irregularly and infrequently. As a consequence, the usual time frame over which household consumption is recorded is too short to receive a comprehensive picture of durable consumption.[4] For an assessment of consumption inequality it is therefore common practise to focus on non-durable consumption and we follow this approach.[5]

II.3 *Wealth*

Thinking about inequality in utility, analyses of wealth inequality seem out of place at the first thought. To the extent that wealth is ultimately used for consumption purposes, we should care about consumption inequality at the time of usage rather than about wealth itself. Given that we cannot measure future consumption, wealth may serve as a good proxy. Especially in the context of private old age provision, utility from wealth can be quantified, e.g. by converting projected net wealth at retirement into a lifelong annuity. An exact quantification would then depend largely on assumptions about certain probabilities, most importantly survival and changes to the household composition. In the subsequent analysis we assume that wealth will eventually be used

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[3] This also applies to the available household data in Germany and in our case the data from the German Income and Expenditure Survey (EVS). Specifically, the EVS contains only information on the number of selected durables, like cars, dishwashers, etc., but none about their value.

[4] For a discussion of the possible effects of the switch from an annual household diary to quarterly data in the EVS between 1993 and 1998 on consumption inequality see Sommer (2008).

[5] The construction of a harmonized definition of non-durable consumption in the EVS is documented in Sommer (2008).

for consumption in an unaltered household context.[6] Furthermore we abstract from survival probabilities and thereby implicitly aim at the expected present discounted value of future consumption derived from a fair annuity. It is unclear, however, whether all wealth will actually be employed for retirement consumption or if it will be handed on – unused – to the next generation. As reverse mortgages remain to be rarely used to convert housing wealth into additional income, this argument seems especially applicable for real estate wealth. To account for the questionable use of housing wealth in this context, we present results for inequality in *net financial wealth* and *net total wealth*.

Based on the above procedure, we largely disregard utility which wealth may provide by its plain existence. In fact, wealth may facilitate access to the credit market and thereby generate opportunities. Furthermore, – through the above credit channel or by itself – wealth may facilitate consumption smoothing and thereby lead to higher lifetime utility.[7] In practise, it is quite difficult to quantify the utility from these functions of wealth. We would have to make assumptions about the magnitude and the incidence of income fluctuations. Furthermore, different kinds of wealth are differently suitable to fill the various functions. Real estate wealth, for instance, is highly valued as a collateral for credit, yet it provides essentially no bufferstock function against income fluctuations. There is, however, a third channel through which wealth may provide utility. Specifically, wealth may take the form of consumer durables like in the case of an owner occupied dwelling. In this case, we measure the derived utility by including the rental value of the residence in income and consumption.

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[6] An alternative assumption would be that only the adult household members will ultimately use the existing wealth for retirement consumption. This would imply the application of an equivalence scale which disregards children in the household. At the same time, financial support of the children, e.g. for their education, and inter-vivos transfers may be good reasons not to neglect the presence of children in the household.

[7] The importance of wealth for consumption smoothing has been assessed by Carrol and Samwick (1998) who estimate the share of wealth accumulated for this purpose to attain up to 46 percent of total wealth.

III. Data

Inequality analyses foremost require a sufficiently large dataset. Whereas means can reasonably well be estimated from a rather smaller sample, being interested also in the dispersion and the tails of a distribution implies much higher demands on the dataset. For our purpose of analyzing inequality in a life-cycle context, we would ideally employ a long series of panel data covering income, consumption and wealth. This would not only allow us to separate age- and cohort-effects but even provide the ground for mobility analyses.

Only two German data sets fulfill the requirements with respect to a sufficient sample size and a sufficient time series. A comparison of the German Socioeconomic Panel (GSOEP) and the German Income and Expenditure Survey (EVS) which have both been used for a variety of inequality analyses is provided by Becker et al. (2002). The German Socioeconomic Panel (GSOEP) reaches back to 1984 and offers a sample size of up to 12'000 households. Furthermore a high-income sample has been added in 2003 which enhances analyses with respect to the rich. Fuchs-Schündeln et al. (2008) employ the GSOEP for an analysis of income and wage inequality. Unfortunately, wealth has only become part of the questionnaire in recent years and consumption is untapped by the GSOEP.[8]

We therefore rely on the German Income and Expenditure Survey (EVS), which covers income, consumption and wealth even at slightly more detail. The sample size of roughly 40'000-60'000 households per year has predestined the German Income and Expenditure Survey (EVS) for inequality analyses already in the past (see e.g. Hauser and Stein (2001), Hauser (2003), Becker and Hauser (2003)). The main downside of the EVS is certainly that it consists of independent cross-sections rather than a panel. Of the EVS cross-sections, which started in 1962/63, we employ the available scientific use files from the years 1978 through 2003 for our analysis. The survey was implemented at five year intervals so that we have six cross-sections available. Comparability of the surveys over time has been a secondary concern for the Federal Statistical Office behind adding recent developments in consumption and income and improving the survey conceptually. A large deal of the implied issues can be dealt with by imputation and harmonization procedures which are documented in Sommer (2008). Sommer also discusses the effects of two important structural problems in the EVS: Specifically, the Federal Statistical

[8] Among the other German surveys especially the SAVE survey stands out with a comprehensive questionnaire on savings and wealth. Its sample size of roughly 2000 households and the still short panel dimension of 5 years between 2001 and 2007 are unsuitable for our purposes though.

Office applies a sampling threshold which has been shown to limit the ability of the EVS to capture the top income households (Merz, 2003). It seems questionable though to what extent other German surveys are more successful in capturing the very top of the income distribution.[9] To compensate for the differences in the default thresholds over time, we apply an indexation to the threshold and disregard observations above the most constraining threshold which was applied in 1988. Overall, this leads to dropping 53 observations out of a total 267'434 in all six cross-sections.[10] The second important structural change concerns the household diary which is employed for the collection of income and consumption data. To reduce the time and effort on behalf of the participating households, the diary was switched from an annual to a quarterly one between 1993 and 1998. We can expect the distributions of income and consumption to be affected by these changes. However, the dimensions of the consequences are hard to quantify and will likely differ strongly by the variable under scrutiny. Unfortunately, little can be done to correct for the possible bias in the distribution of projected annual measures.[11] Instead, comparative analyses of the pre-1998 data with the more recent data should involve careful interpretation.

[9] Sommer (2008) shows that the GSOEP contains only a handful of households above this threshold even after the inclusion of the GSOEP-high-income sample. This indicates that there is simply not much hope of learning more about the very top of the German income distribution from the existing data.

[10] A comparison of our correction procedure to a procedure proposed by Hauser (2006) is provided in Sommer (2008). In that paper, we also address the effects of the two correction procedures on the distribution of selected variables.

[11] We discuss the direction and size of the expected bias in Sommer (2008)

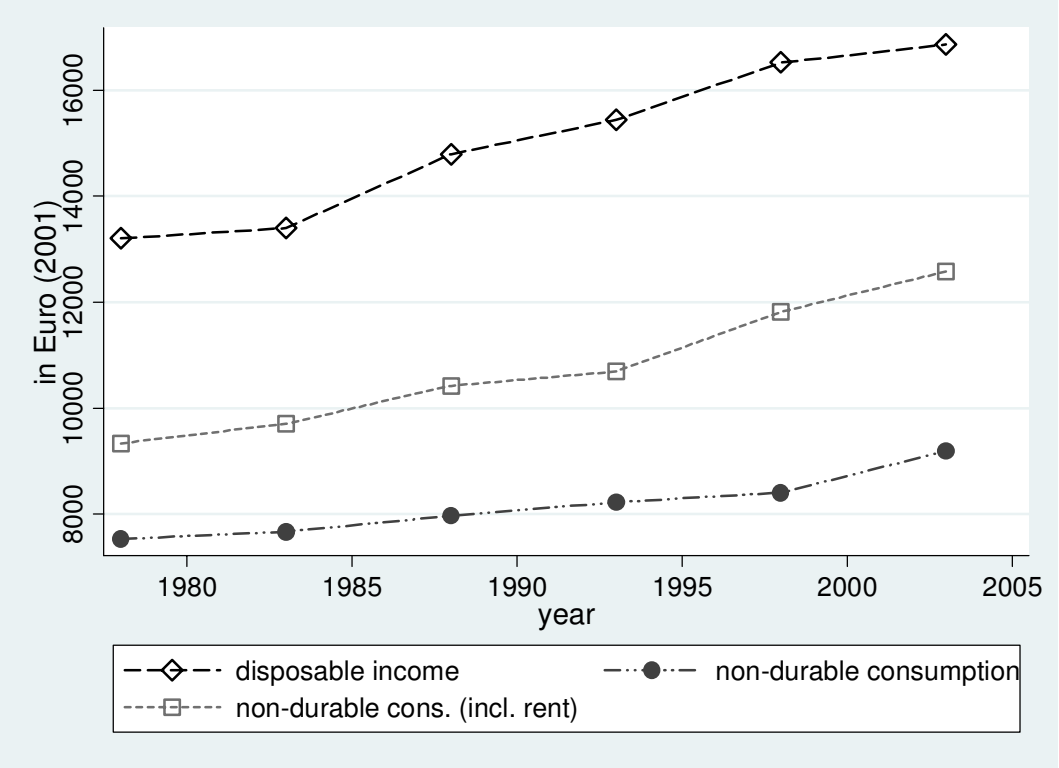
IV. Trends in inequality in Germany

Before we turn to the actual investigation of the determinants of inequality and with a special focus on inequality over the life-cycle we document the trends in the levels of income, consumption and wealth and describe the evolution of their dispersion over the last decades.

IV.1 *Trends in household income, consumption and wealth*

Income and consumption in Germany have grown at a slow but steady pace over most of the last 25 years. Based on the EVS data we estimate a compound annual growth rate of per capita non-durable consumption of 1.2 or 0.8 percent in real terms, depending on whether we include housing expenditures in non-durable consumption or not.[12] Average disposable income per capita has grown at a similar rate of roughly 1 percent per year (see figure 1).

Figure 1: Trends in average per capita income and non-durable consumption

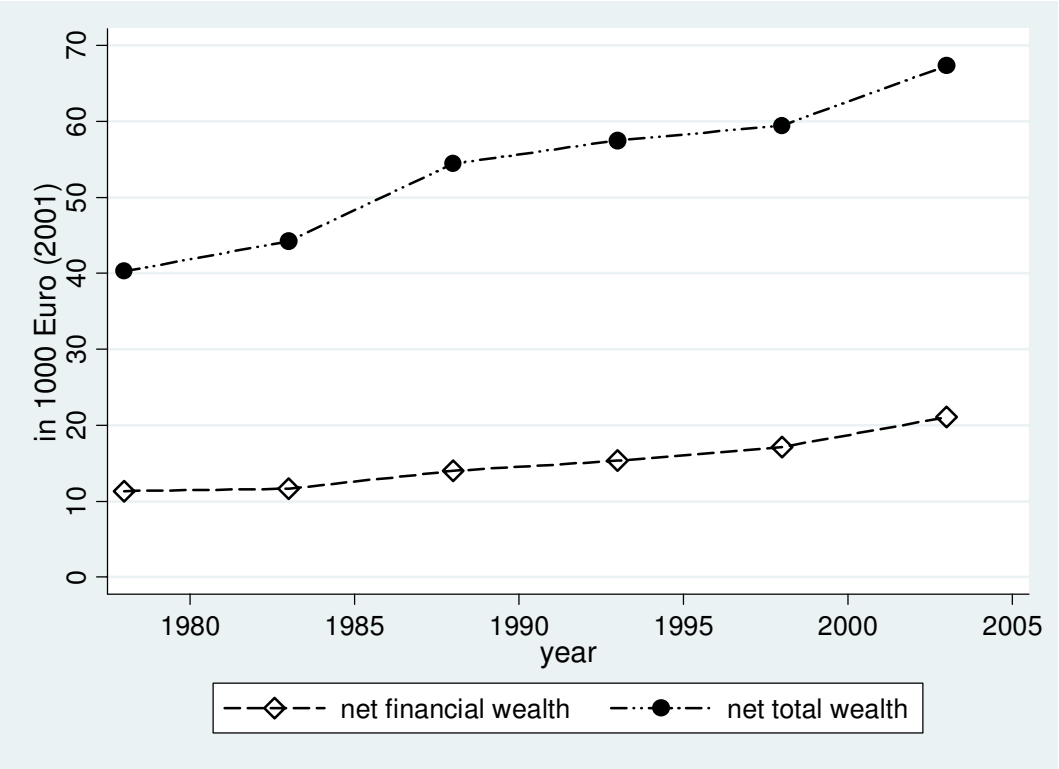


Source: own calculations based on the EVS 1978-2003

[12] The definition of housing expenditures also includes hypothetical rent of owner occupiers. A full description of the expenditures included in our definition of non-durable consumption is given in Sommer (2008).

Figure 2 displays how average per capita net financial and net total wealth have evolved over the last decades. The growth in financial wealth appears much less impressive at first sight, but starting from much lower levels financial wealth has actually seen higher compound annual growth rates. Specifically, financial wealth has grown by an average 2.5 percent per year, whereas total wealth has grown by only 2.07 percent, indicating the somewhat lower growth rates of net real wealth. As a consequence, the share of wealth in financial assets has grown by about 3 percentage points to roughly 31 percent in 2003.

Figure 2: Trends in per capita net wealth



Source: own calculations based on the EVS 1978-2003

Overall, income, consumption, and wealth have all seen rather slow growth over the last decades, especially in comparison with international figures.[13] Note, that looking at household levels rather than per capita figures, the above growth rates are reduced further as the average household size in Germany has declined over the last decades from about 2.5 individuals per household in 1978 to 2.1 in 2003.

[13] The OECD (2008) provides comparative time series for household income and consumption. For wealth, we draw our information from the other country chapters of the project "cross-sectional facts for macroeconomists".

IV.2 *Trends in inequality*

While the previous section has documented that the historical growth rates in Germany are far from impressive, the rather generous public safety net has traditionally a reputation of achieving more favorable results with respect to inequality. Given that our results are based on data until 2003, we expect little if any effects of the recent reforms to the social security system on the below trends in inequality.

Before turning to the actual trends in inequality we need to make a choice how to measure inequality. Inequality not being a technical term there are different conceptions of what it takes for a distribution to become more equal or unequal. A large variety of inequality measures has been suggested in the literature, each of them with different characteristics when it comes to capturing different aspects of inequality.[14] For our analysis we focus on the Gini coefficient and the variance of the logarithmized variables of interest. We are aware that other inequality measures are more sensitive e.g. towards inequality at the bottom of a distribution which may especially be a matter of public concern. We nevertheless employ the Gini for its traditional use in the literature and the variance as it is rather intuitive and straightforward to decompose.

For all inequality analyses, we refer to what is commonly denoted as equivalized income, consumption and wealth.[15] Using household figures, individuals in households with several income earners would be attributed proportionally higher levels of welfare than individuals in households with just one earner. The other extreme would be the use of per-capita data, which disregards returns to scale in consumption. While the first approach will lead to an overestimation of individual wellbeing in all households but single households, the second would equivalently cause an underestimation. The use of equivalence scales therefore aims to integrate the concept of individual utility and consumption in a context where individuals may draw utility from public goods within the household. A variety of adjustment scales have been proposed in the literature. We rely on the OECD equivalence scale which is widely accepted in the literature.[16] Given that we employ a pseudo-individual measure based on household data, we have to adjust the household weights accordingly. Specifically, we multiply the weight of a household by the

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[14] For an overview over the most common inequality measures see e.g. Coudouel et al. (2002)

[15] The equivalization of wealth data is highly debated in the literature and depends strongly on the assumptions of the use of wealth. As noted in the previous section, we rely on the assumption that wealth is ultimately used for consumption purposes in an unaltered household context. Alternative adjustments e.g. by the number of adult household members implicitly assume that children in the household will not draw utility from the existing stock of wealth.

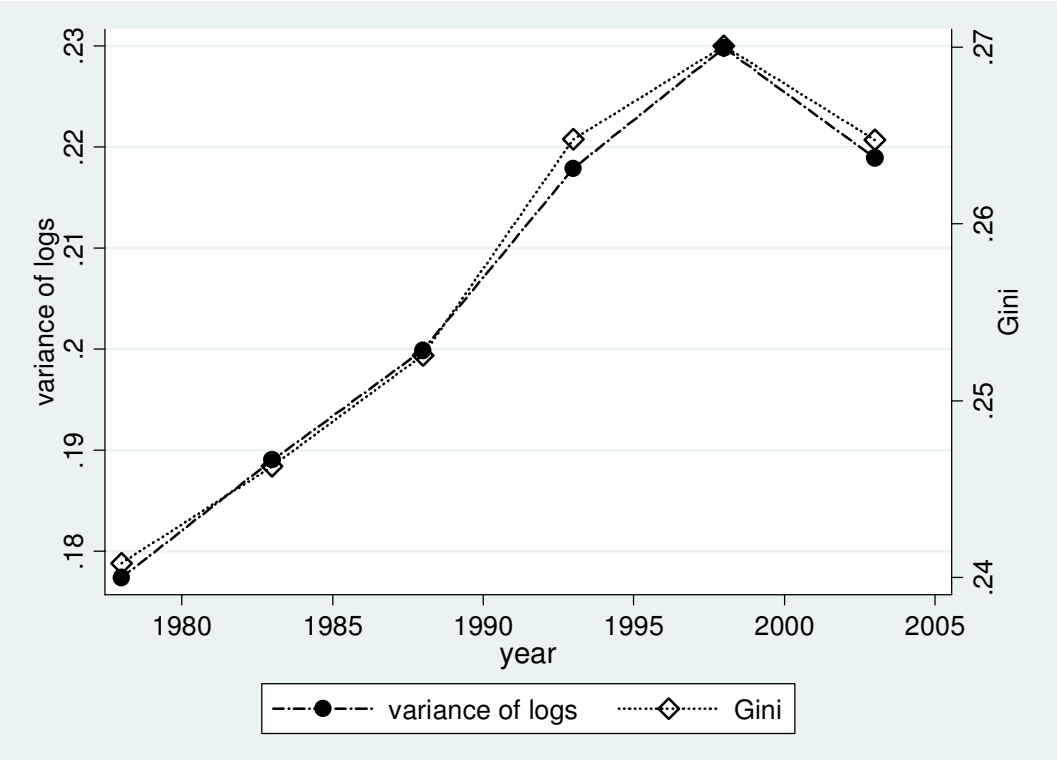
[16] The OECD equivalence scale attributes a value of 1 to the first household member. For each additional adult and underage household member in the household 0.7 and 0.5 are added respectively.

number of its members to ensure that individuals receive equal weight independent of the size of the household they live in.

Income inequality

No matter whether we measure income inequality by the variance of log income or by the Gini coefficient, we find a clear increase in inequality between the late 1970s and the late 1990s (see figure 3). Between 1998 and 2003, both measures indicate a drop in income inequality back to the level of 1993. Two structural breaks are to be kept in mind. The 1993 data is the first to include also East German households. The changes in inequality within the western and eastern states as well as between the two formerly separated economies have first been investigated by Schwarze (1996) for the years 1990-92. He finds a strong growth in income inequality in the eastern states which is overcompensated by a general catching up of the East with the West. It turns out that the increase in income inequality in the East has continued through the rest of the 1990s as we document in Fuchs-Schündeln et al. (2008). Our analyses based on the GSOEP support the finding from the EVS that the increase in disposable income inequality for the unified country has come to a halt.

Figure 3: Trends in income inequality, Gini coefficient and variance of log income



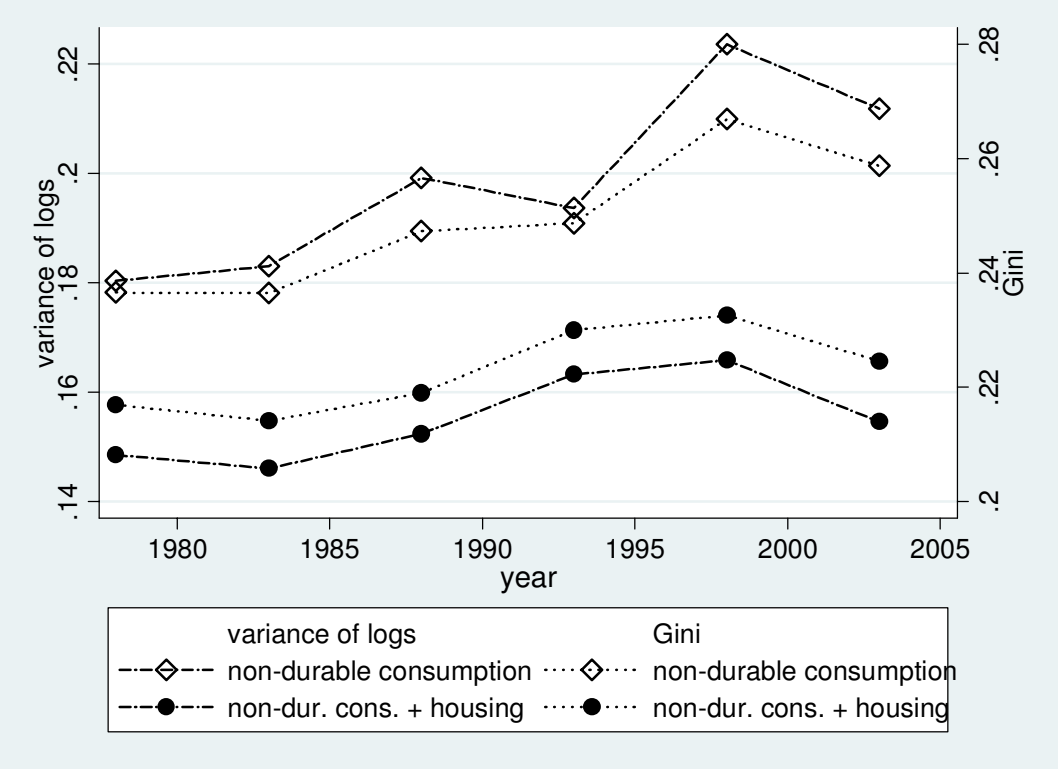
Source: own calculations based on the EVS 1978-2003

Furthermore there is the switch from annual to quarterly income data in the EVS between 1993 and 1998. It may explain part of the jump in inequality between 1993 and 1998 which seems somewhat larger than what Fuchs-Schündeln et al. (2008) find based on the GSOEP. Their work differs from ours in two aspects: While they focus on the working age-population, we impose no restrictions with respect to age. Further, they employ traditional household weights, where we adjust the weights according to the household size. It turns out that the trends in inequality are quite similar. The level of inequality reported by Fuchs-Schündeln et al. is consistently higher though. Specifically, they report a variance of log disposable income which is about 0.1 higher, roughly 0.03 of which can be attributed to the use of different weights.

Consumption inequality

Like for income inequality, our two inequality measures yield comparable results. Starting in 1978, we find the degree of non-durable consumption inequality in the same order of magnitude as for income (see figure 4). At the same time, the increase over time turns out to be slightly smaller, especially when we exclude housing expenditures from our definition of non-durable consumption. Looking first at non-durables including housing, consumption inequality has been essentially constant throughout the pre-unification phase. For 1993 and 1998 we observe a small increase in inequality before inequality level recede almost to their pre-unification levels in 2003. Excluding expenditures for housing in our definition of non-durable consumption the trend in inequality roughly follows what we observe for disposable income although the consumption trend is more irregular between 1978 and 1998. We observe a first increase in inequality in the late 1980s and a second one for 1998. The drop in inequality between 1998 and 2003 is consistently found for both consumption definitions and matches our findings for disposable income.

Figure 4: Trends in consumption inequality, Gini coefficient and variance of log consumption



Source: own calculations based on the EVS 1978-2003

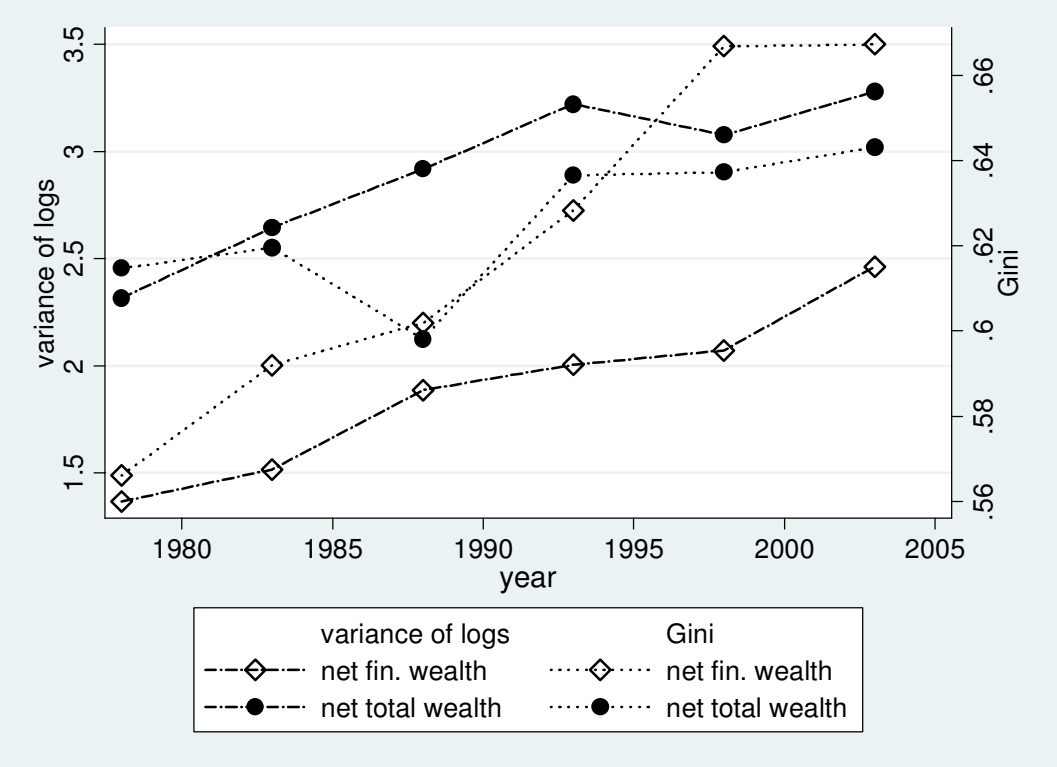
Wealth inequality[17]

Inequality in total net wealth has distinctly increased between 1978 and 1993 and leveled off in subsequent years. The increase in the Gini between 1978 and 1993 amounts to roughly 4 percentage points. Again, the results differ only slightly looking at the two different inequality measures. An exception is the slump in the Gini coefficient for the year 1988 which is unmatched by the variance of log wealth (see figure 5).

Inequality in net financial wealth has seen an even steeper increase, especially in the Gini, which has increased by almost 10 percentage points between 1978 and 1998 and has only leveled off between 1998 and 2003. The increase in inequality measured by the variance of log wealth has been somewhat more moderate. Here, the trend towards higher inequality has not come to a halt though.

[17] Note, that real estate wealth and wealth in life insurance contracts are fully imputed for the years 1978 through 1988 based on structural information drawn from the 1993 cross-section. The imputation procedures have been carefully chosen to avoid the transmission of undesired distributional characteristics from the 1993 cross-section to the earlier years. Nevertheless, comparisons of distributional characteristics over time should keep this in mind. A full documentation of the imputation procedures is given in Sommer (2008).

Figure 5: Trends in net wealth inequality, Gini coefficient and variance of log wealth



Source: own calculations based on the EVS 1978-2003

Overall we find a much stronger increase in inequality for wealth than for income and consumption. Given that income and wealth are positively correlated, this comes with little surprise, as the existing income inequality is transmitted to wealth through savings. The stronger inequality growth in financial wealth coincides with higher growth rates as we have presented in the first part of this section. We postpone the question to what extent income, savings and wealth appreciation are the drivers behind rising wealth inequality to section six.

V. Decomposing the trends in inequality

Having looked at the aggregate trends in inequality, we now aim to get a deeper understanding of the sources of inequality. We are especially interested in inequality connected to observable household characteristics, as the results can directly be transferred to the introduction of heterogeneous households in macroeconomic models.

Today's standard of modeling economies with a changing demography is to employ an OLG model. The prime characteristic of these models is their setup of the household sector. Rather than using one representative household, they include heterogeneity of households in age. A set of representative households born in different years optimizes over their respective life-cycles. Consequently, differences in the population age-structure are one of the key household characteristics for our decomposition of aggregate inequality. Further examples are differences in household types and heterogeneity in human capital endowments. That differences in human capital endowments can account for a large part of variation in lifetime utility has been shown by Hugget et al. (2006, 2007) as well as by Keane and Wolpin (1997). Ludwig et al. (2007) are an example where such differences in human capital endowment are included into an OLG framework. The empirical benchmarks for the calibration or the evaluation of such models should therefore include the above dimensions of household heterogeneity. For our below analysis of inequality in Germany, we additionally include a distinction of households from the Eastern and the Western states. This is inevitable as since 1990 the population consists of two quite heterogeneous parts which have assimilated over time but hitherto remain somewhat different.

While all of the above household characteristics may be related to inequality, few if any of them can be influenced by political action. Furthermore, to the extent that natural changes in these characteristics are responsible for rising inequality there should be little reason for concern. Possible examples are the trend towards smaller households, especially single households, the German Reunification and the transition of the East German economy, as well as population aging. Where the public and political debate about rising inequality is founded on scientific results little thought is given to such natural trends and differences in inequality. We therefore also aim to strengthen these aspects with new scientific results. An example where public policy will induce rising inequality concerns the recent pension reforms. As the level of public pensions is reduced and replaced accordingly by private savings, wealth inequality will inevitably increase. It is important to understand that this will be case even if the ultimate distribution of retirement incomes remains unchanged.

Before vivifying the above questions with empirical results, it is helpful to think conceptually about the mechanisms in inequality trends. We show using the example of a variance decomposition that the above changes to the population structure are only one dimension of the possible drivers behind changing inequality. In fact, the total variance in period t, σ_t^2, can be written as the weighted sum of the variances within the k population subgroups plus a term driven by the differences between the subgroups' means and the overall population mean μ_t (see equation (1)).

$$\sigma_t^2 = \sum_k \left(\varphi_{kt} \cdot \sigma_{kt}^2\right) + \sum_k \left(\varphi_{kt} \mu_{kt}^2\right) - \mu_t^2 \qquad (1)$$

where

$$\mu_t = \frac{1}{N} \sum_{i=1}^{N} x_{it}$$

$$\mu_{kt} = \frac{1}{N_{kt}} \sum_{j=1}^{N_k} x_{jt}$$

$$\varphi_{kt} \equiv \frac{N_{kt}}{N_t}$$

$$\sigma_{kt}^2 = \frac{1}{N_{kt}} \sum_{i \in k}^{N_{kt}} \left(x_{it} - \bar{x}_{kt}\right)^2$$

Hence, three components may induce changes to the aggregate level of inequality: First, there may be changes in the means of population subgroups. A classic example is the catching up of the East German economy over the last decades. Second, the level of inequality within population subgroups may change over time. With the rise in inequality within a population subgroup, this carries forward also to the aggregate. Also this second component has played an important role for inequality levels of post-unification Germany. Specifically, inequality in income and consumption has been on the rise in the eastern parts of Germany in the aftermath of the reunification. Third, shifts in the population share of the individual subgroups affect aggregate inequality. The change in a group's weight operates through both of the above channels. If a relatively unequal population subgroup gains weight, also aggregate inequality will increase. Similarly, inequality will rise if subgroups with a group specific average far from the population average gain weight. Equation (2) describes the above formally.

$$\Delta\sigma_t^2 = \sum_k \left(\varphi_{kt} \cdot \left(\Delta\mu_k^2 - \Delta\mu^2\right)\right) + \sum_k \left(\varphi_{kt} \cdot \Delta\sigma_k^2\right) + \sum_k \left(\Delta\varphi_k \cdot \sigma_{kt+1}^2\right) + \sum_k \left(\Delta\varphi_k \cdot \left(\mu_{kt+1}^2 - \mu_{t+1}^2\right)\right) \quad (2)$$

In the following, we present selected results on the drivers behind aggregate inequality. We start with a regression based analysis of the cross-sectional variance in income, consumption and wealth. By construction, we thereby focus on the variance explained by differences in the explanatory variables – in our case key household characteristics. Where applicable, we complement the discussion of the results by facts about the changes in inequality within the respective population subgroups. In the second part of this section, we address the changes in inequality over the life-cycle.

V.1 *The importance of sociodemographics for cross-sectional inequality*

To get a first impression of the influence of heterogeneity across households on inequality we analyse, what part of the cross-sectional variance in income, consumption and wealth can be explained by differences between observable household characteristics. To do so, we specify a simple regression model for log income, consumption and wealth. Explanatory variables are the household composition, the age, gender and job education of the household head, as well as the place of residence in the East or in the West. As we include the household composition in the decomposition, we revert to household level data, i.e. we do not apply an equivalization to the data.

Figures 6-9 display what parts of the cross-sectional variance in log disposable household income, log consumption, and log wealth can be explained by the observable household characteristics mentioned above. We add the residual variance as a point of reference. For a comparison of the decompositions of the early cross-sections (1978-88) and the later cross-sections two important changes are to be kept in mind:

First, there is the addition of the Eastern German population in 1993. The regional dummy will only capture the added variance from the differences in means between the two subsamples. As Schwarze (1996) and Fuchs-Schündeln et al. (2008) show, differences in inequality within the respective parts of the country play an important role for the evolution of inequality at the national level though. We will discuss the effects of the reunification further in the context of the actual results.

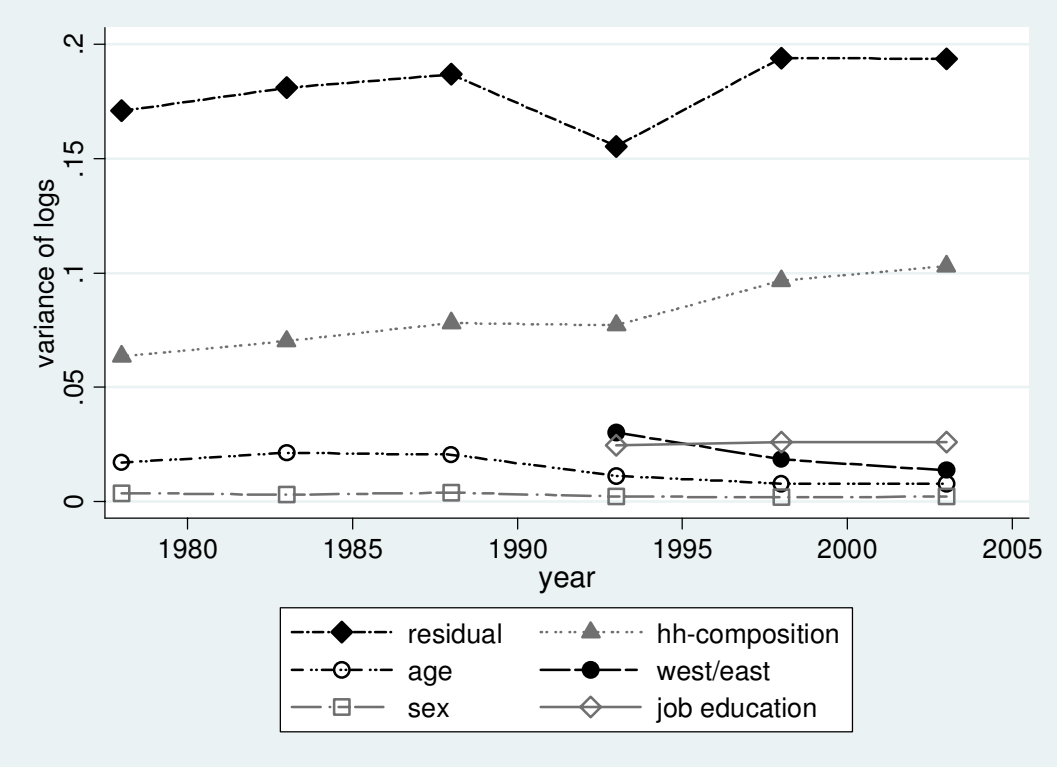
Second, educational attainment is missing in the analysis of the pre-unification years for availability reasons. Thus for the years 1978 to 1988, the dispersion caused by differences in education will be subsumed in the explained variance of correlated variables and in the residual variance. Although the addition of education complicates the comparability of results over time, we decided to add education where possible, as the addition of heterogeneity in education has become a standard extension of macroeconomic models.

Decomposition of income inequality

Among the household characteristics included in the decomposition, only differences in the household composition account for a considerable part of the variance in log disposable income (see figure 6). Evidently, the variance connected to differences in the household composition increases over time. It turns out that this is largely caused by the proliferation of households at the extremes of the income distribution. The key reason is the trend towards single households. The incomes of single households have seen above average growth rates between 1978 and 2003 but remain at the bottom of the income distribution. At the same time, the share of single households in the population has increased by roughly one third from 27.7 percent in 1978 to 38.8 percent in 2003. The increased number of single households has therefore over-compensated the inequality reducing effects of favorable income growth among single households.

Noteworthy are also the regional dummy and the educational attainment of the household head. Both explain about a third of the variance explained by differences in the household type. While the explanatory power of education is fairly constant over time, the importance of the East/West distinction decreases considerably, indicating that the gap between disposable incomes in East and West Germany has shrunk. The effects of different levels of inequality within the respective regions are apparent in the slump in the residual variance in 1993. At that time, the level of inequality within the East was still substantially smaller than in the West, causing a drop in inequality at the national level.

Figure 6: Decomposition of the variance of log disposable household income



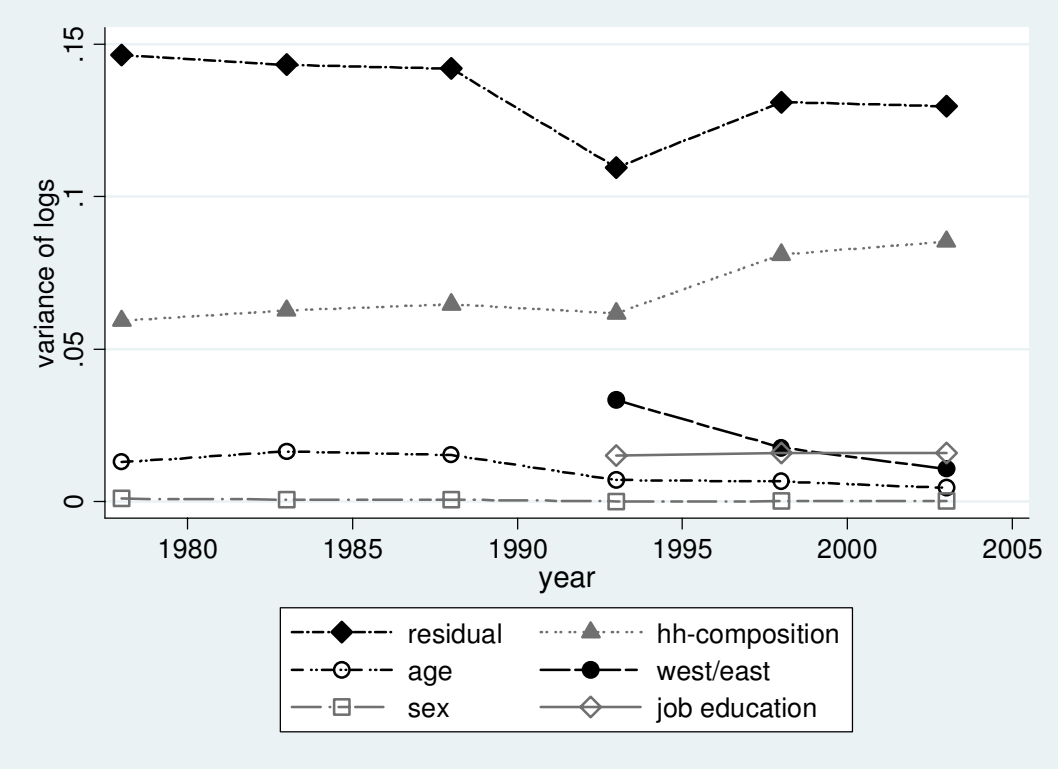
Source: own calculations based on the EVS 1978-2003

Decomposition of consumption inequality

The pictures for income and consumption inequality look quite alike (see figure 7). The main difference is the smaller and decreasing residual variance in consumption where we had observed a slight increase in the residual variance for income.

Like for income, differences in the household composition explain a great deal of consumption inequality. Education has a constant explanatory power in a similar order of magnitude as for income. However, there is little direct reason why education should matter as much for consumption as it does for income. An exception might be a higher willingness of higher educated households to invest in further education, quality food and health. Yet it seems much more likely, that differences in income related to different educational attainments carry over to consumption possibilities and ultimately to expenditures. The same argument can be transferred to our regional distinction. In fact, the variance connected to the differences in consumption and income between the East and the West has more than halved between 1993 and 2003. We omit the corresponding graph for our alternative definition of non-durable consumption for brevity as the results show no remarkable differences.

Figure 7: Decomposition of the variance of log non-durable consumption (incl. housing)

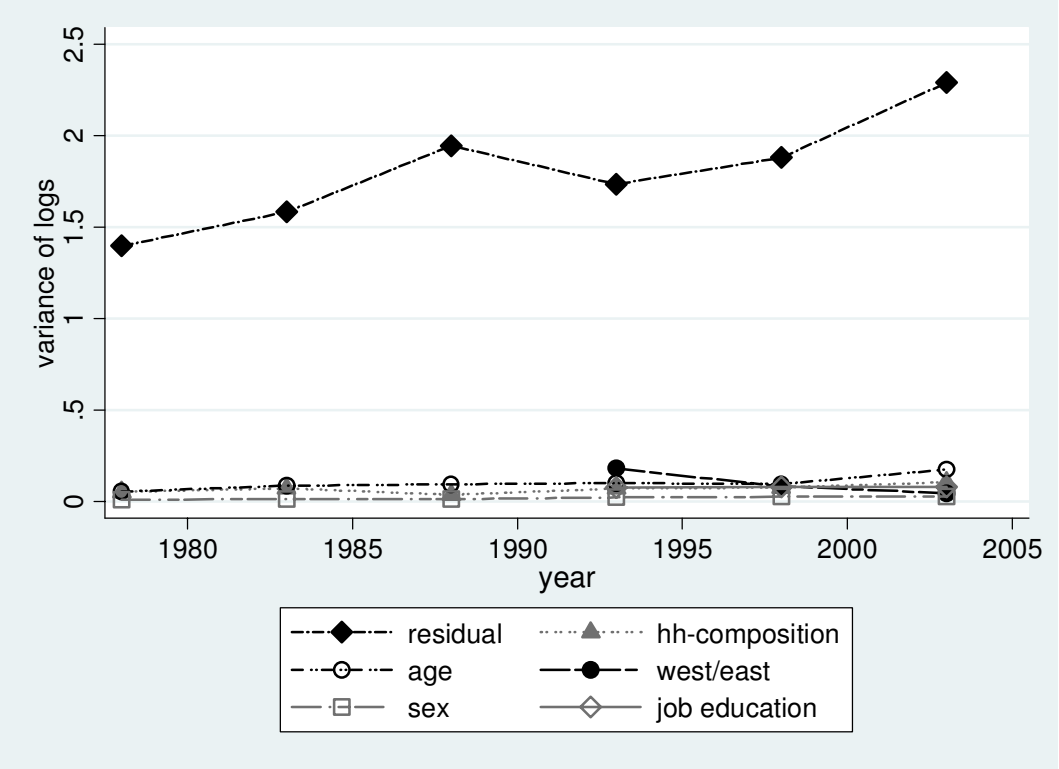


Source: own calculations based on the EVS 1978-2003

Decomposition of wealth inequality

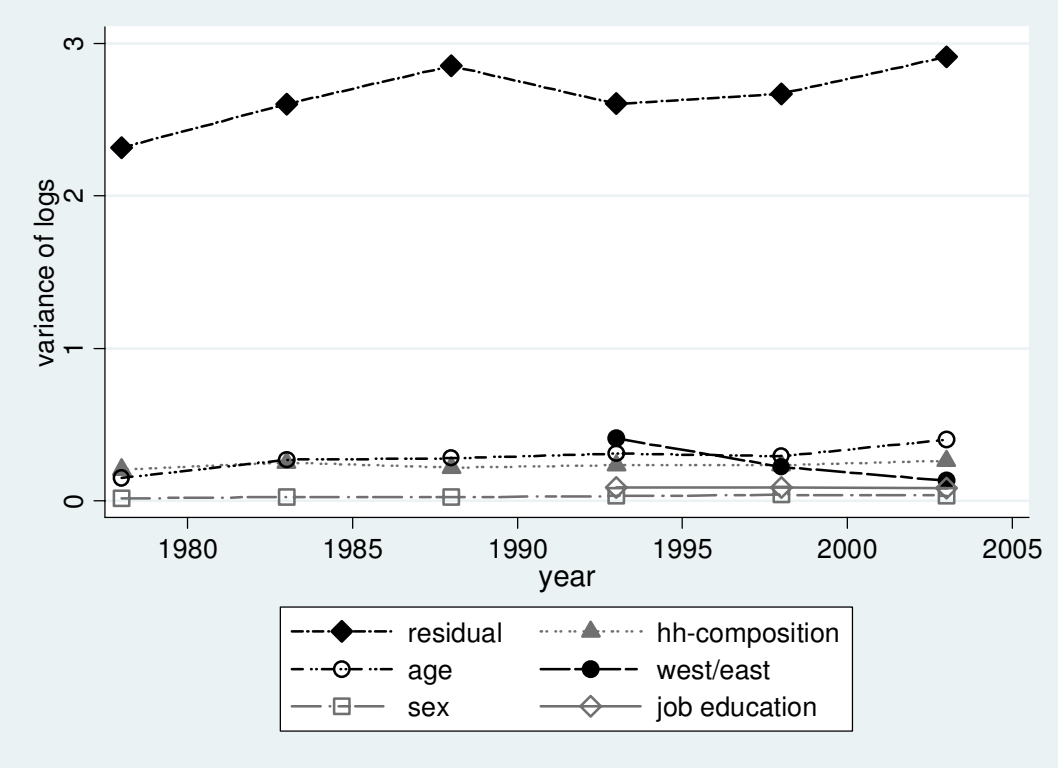
Last, we turn to the question what part of the wealth dispersion can be explained by observable differences between households. Figure 8 strikingly illustrates, that none of the household characteristics employed in the decomposition accounts for a relevant part of financial wealth inequality. Among the tightly cramped lines at the bottom of the graph, only age and the East/West distinction catch the eye. Concretely, a small but increasing part of the variance is connected to the age-structure of the population. At the same time, the differences in wealth holdings between West and East have declined over time, as observed previously for income and consumption. Also for net total wealth, the observed household characteristics explain rather little of the overall dispersion (see figure 9). Again, the East/West dummy explains a certain but diminishing part of the variance in total wealth, age a similar, though slightly increasing amount. The remarkable difference comparing the variance in net financial and net total wealth concerns the role of differences in household composition. Only for total wealth, variation in wealth levels across household types plays a role. The reason is differential home ownership across household types: In fact, only about 26 percent among households with one adult own real estate, but 54 and 72 percent of the households with two and three adults respectively.

Figure 8: Decomposition of the variance of log net financial wealth



Source: own calculations based on the EVS 1978-2003

Figure 9: Decomposition of the variance of log net total wealth



Source: own calculations based on the EVS 1978-2003

V.2 *Evolution of inequality over the life-cycle*

Overall, the above cross-sectional decompositions of inequality in income, consumption and wealth have revealed a number of important coherences. A substantial part of the dispersion in income and consumption is connected to different household types, which highlights the necessity to employ an equivalence scale in the assessment of inequality. Further, looking at the national trends in inequality in Germany, it is important to account for the German reunification. While the effects of the reunification are rather well understood, much less is known about the effects of a changing population age-structure.

In the introduction of this section, we have proposed a general structure for the factors behind changes in inequality. We now apply these to the context of an aging society using the example of income inequality. The transfer to consumption and wealth inequality is straightforward.

First, there are differences in average income across age-groups which we typically think of as the life-cycle income profile. It exhibits a hump shape with a steep increase over the first decades in the work force. Around age 50, average income levels off before it declines for the following age-groups due to rising unemployment rates and early retirement. Income levels drop considerably between age 60 and 65, as the cohort gradually goes into retirement. Thereafter, average income is essentially flat for the oldest age-groups. If the life-cycle income profile grew steeper with larger distances of the average income of certain age-groups to the overall average, this would ceteris paribus increase the overall level of inequality. However, the results from the cross-sectional decomposition above indicate that differences between age-groups play only a minor role for the overall level of income inequality.

Second, the level of inequality within the individual age-groups may increase. Thinkable reasons would be a rising dispersion in market wages or hours worked. Given that we are looking at post-government income also the government sector may play a role. Examples would be changes in the income tax scheme or in the payment of government transfers.

Third and last, the population age-structure may change and thereby shift weight to or from age-groups with extremely low or extremely high income levels. In the same manner, population weight may be shifted from rather unequal age-groups to more equal ones and vice versa. If fact, the retirement of the baby-boom generation will shift weight away from the highest income age-groups. Whether inequality among the working age-population is higher or lower compared to the first post-retirement age-groups is to be determined in the subsequent analysis. Unless the inequality age-profile is flat, gradual effects on the distribution of incomes and consumption can be expected as more and more baby-boomers retire.

In the following, we focus on differences in inequality between age-groups to assess the possible effects of changes to the population age structure on aggregate inequality. To elicit an age-profile

in inequality from our synthetic panel data, we have to take a stand with respect to time- and cohort effects.[18] We alternatively assume time- and cohort-effects to be zero and compare the resulting age-profiles.

Specifically, we estimate for both inequality measures *I* an OLS regression including age-group dummies *A* based on the age of the household head and year dummies *Y*, as described in equation (3). The alternative cohort-specification includes cohort dummies C instead of the age-dummies, as described in equation (4).

$$I_{at} = \alpha + \sum_{a} \beta_a \cdot A_{at} + \sum_{t \neq 1} \tau_t \cdot Y_{at} + \varepsilon_{at} \tag{3}$$

$$I_{at} = \alpha + \sum_{a} \tilde{\beta}_a \cdot A_{at} + \sum_{c \neq 1} \gamma_c \cdot C_{at} + \varepsilon_{at} \tag{4}$$

The resulting life-cycle profile of inequality is then computed as follows:

$$\hat{I}_a^T = \alpha + \bar{\tau} + \sum_{a} \beta_a \cdot A_{at} \qquad \text{and} \qquad \hat{I}_a^C = \alpha + \bar{\gamma} + \sum_{a} \tilde{\beta}_a \cdot A_{at}$$

The inclusion of the average year- and cohort-effect implies that the levels of our results can be interpreted as the age-profile for an average year and an average cohort respectively.

Age-profiles in income inequality

The results for income turn out to be rather sensitive with respect to the chosen specification (see figure 10). At the same time, the two inequality measures yield closely comparable results. Based on the time-effects specification we find a relatively flat age-profile. Inequality is smallest for the youngest age-groups. What follows is a two-step increase in income inequality towards the age-group 30-34 and then again between age 50 and age 64. In between, the level of inequality remains flat or decreases slightly. Inequality peaks for the age-group 60-64 and declines in the following 10 years. The remainder of the age-profile is flat again. If we think of a baby-boom generation moving through this stylized life-cycle, we can expect aggregate inequality to increase as the baby-boom generation moves through their last years in the labor force and to revert to its previous level as the baby-boomers reach age 70 and above.

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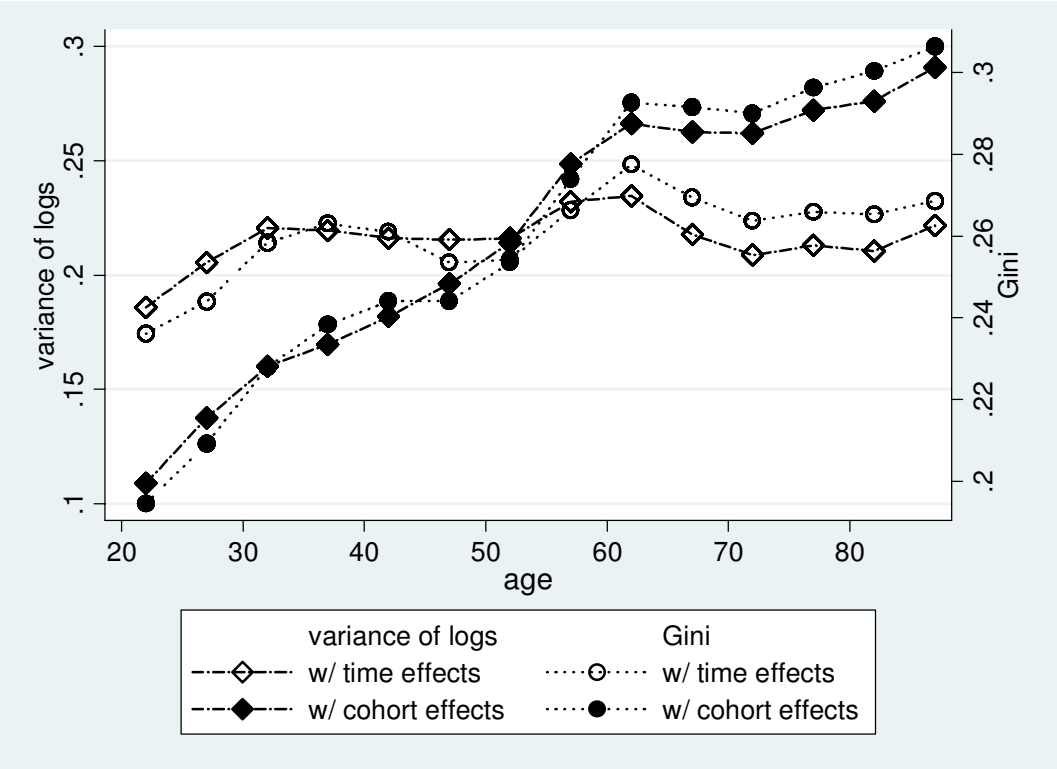
[18] By construction, age-, time-, and cohort-effects are perfectly collinear in a linear specification. Identification therefore relies on assumptions or the functional form of the specification (see Deaton and Paxson (1994), Brugiavini and Weber (2001), or Ameriks and Zeldes (2001))

The age-profile estimated from the cohort-specification looks similar in its swings over the life-cycle, but tilted by about 25° to be strongly upward sloping. The clearly different life-cycle path of inequality derived from the cohort-specification gives reason to investigate the underlying raw data in more detail. It turns out that the major shifts in income inequality have affected essentially only the working age population.[19] Much of the results may therefore be driven by the assumptions implicit to the regression model. Specifically, the specification implies that time- and cohort-effects cause parallel shifts to an otherwise unaffected age-profile. The raw data suggests that neither assumption is justified for all age-groups. While a closer look at the raw data is probably the best way to understand the historical trends in inequality, the complex evolution makes things somewhat more difficult for macroeconomic modeling. In fact, income inequality over the life-cycle used to be much steeper in the past and has flattened out in recent years. Such structural changes throughout the historical data used for the calibration pose a challenge for projections.

Figure 10: Age-effects in equivalized post-government income inequality



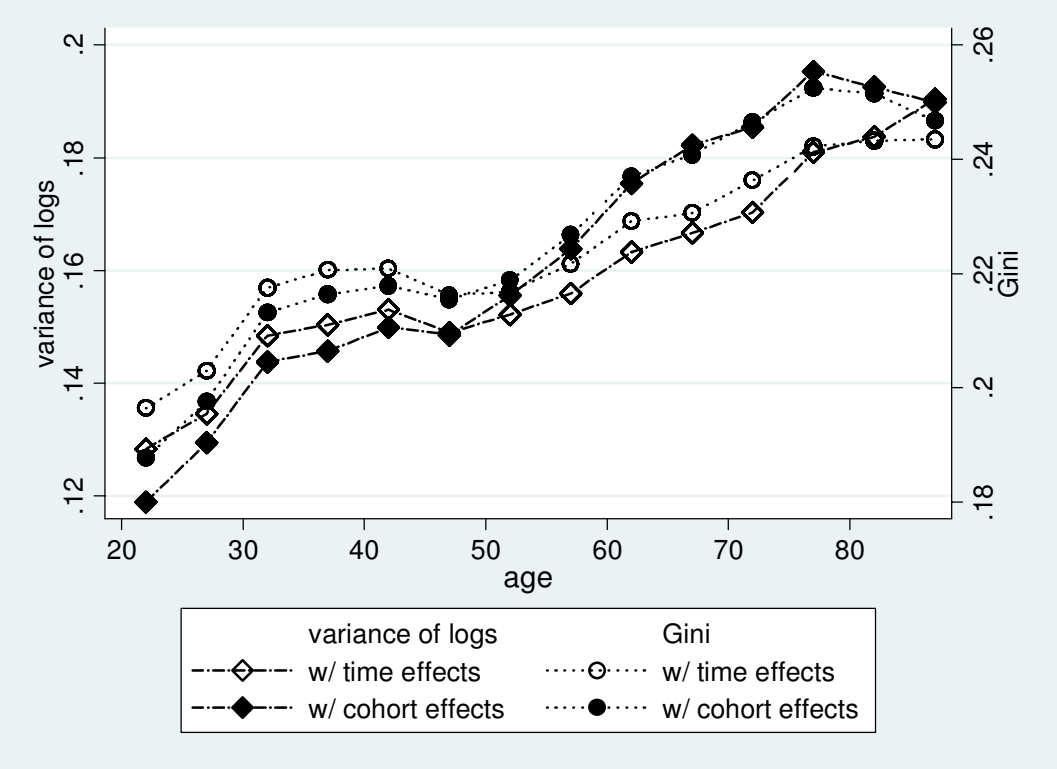
Source: own calculations based on the EVS 1978-2003

[19] The appendix contains a cohort-graph of the raw inequality data.

Age-profiles in consumption inequality[20]

Consumption inequality does not exhibit the issues we observe for income inequality. Not only the different inequality measures but also the different specifications yield quite similar age-effects. We find a continuously increasing level of inequality over the life-cycle (see figure 11). The age-trajectories are flat only between age 30 and 50 and then again beyond age 75. For part of inequality trends in an aging society, the upward slope of the age-profile suggests that consumption inequality will continuously increase over time as the population weight shifts towards older age-groups. However, this effect is attenuated by the age-profile in consumption levels. Specifically, average consumption levels after retirement are much closer to the population mean than the consumption levels of those age-groups immediately before retirement.

Figure 11: Age-effects in equivalized non-durable consumption inequality



Source: own calculations based on the EVS 1978-2003

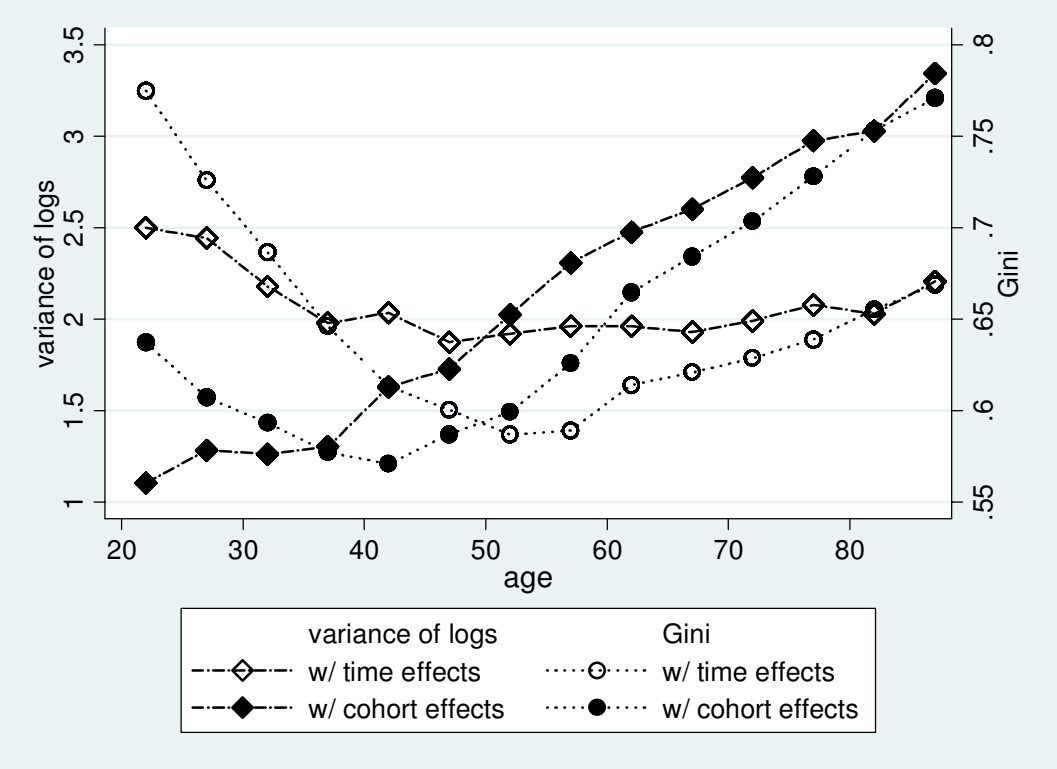
[20] We only present results based on non-durable consumption including housing expenditures for brevity. The results from our alternative definition show only minor deviations.

Age-profiles in wealth inequality

Figures 12 and 13 present the results on life-cycle inequality in net financial wealth and net total wealth respectively. Much more than for the case of income inequality, the results based on different specifications and inequality measures yield different results.

Employing the cohort specification, we find a strongly upward sloping age-profile for both wealth measures based on the variance. Looking at the results for the Gini coefficient, the general life-cycle pattern resembles a u-shape. For financial wealth, inequality bottoms out around age 40 and the upward slope over the remaining life-cycle clearly dominates the downward slope among the early age-groups. For total wealth, the pattern is shifted and tilted to the right. Inequality levels decline until age 55 and increase only slightly thereafter.

Figure 12: Age-effects in equivalized net financial wealth



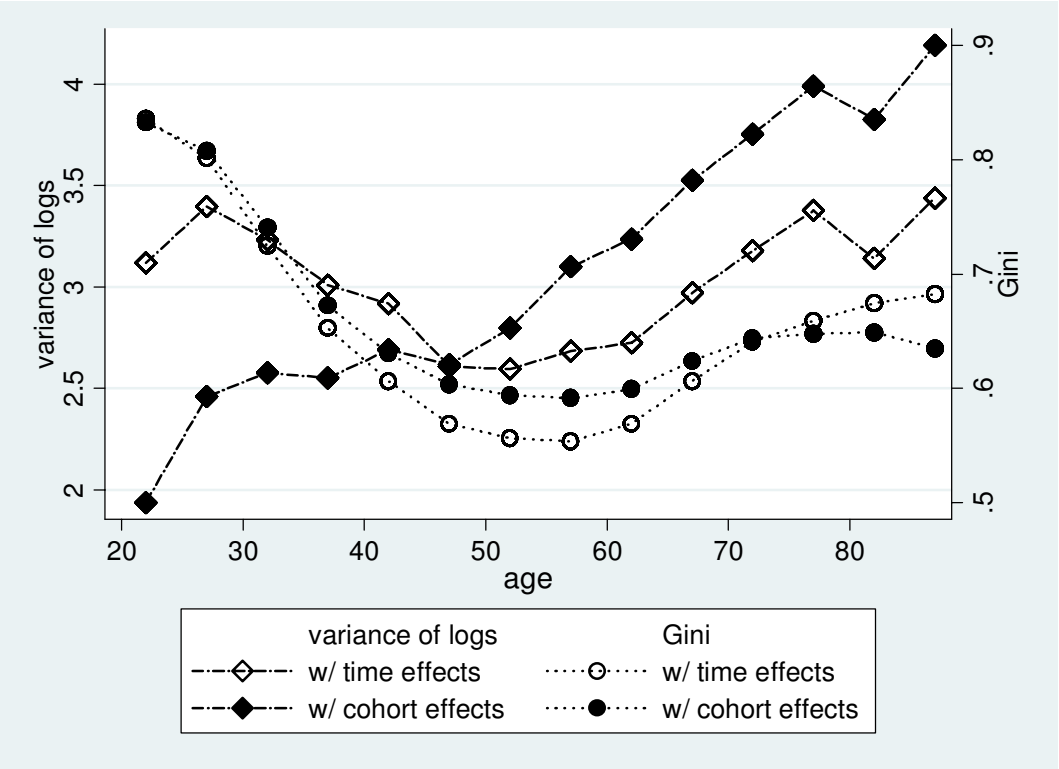
Source: own calculations based on the EVS 1978-2003

Looking at the results based on the time-effects specification we find the above age-profiles to be clockwise rotated. However, there is a considerable amount of variation in the degree of rotation to the age-profiles.

Overall, the results for life-cycle wealth inequality are strikingly ambiguous. Especially surprising are the differences between the two inequality measures. The raw data exhibits a u-shaped cross-

sectional age-profile for both measures.[21] At the same time, the different slopes over the life-cycle of cohorts shed some doubt that wealth inequality actually takes a u-shaped path over the life-cycle. In fact, the age-trajectories of individual cohorts based on the Gini are mostly flat or downward sloping, whereas the variance trajectories are remarkably upward sloping. Furthermore, the raw data suggests only minor differences between cohorts based on the Gini. Based on the variances of log wealth, we find the individual cohort trajectories much further apart.

Figure 13: Age-effects in equivalized net total wealth



Source: own calculations based on the EVS 1978-2003

The different sensitivity of the two inequality measures with respect to extreme values may help us resolve the puzzle and add further insights. The variance being more sensitive to outliers we suggest that wealth inequality is rather stable across cohorts and over age with an exception of extreme values. At the same time, the number of extremely wealthy households increases over the life-cycle. Further, younger cohorts tend to contain more extremely wealthy households than the generation of their parents did at the same age.

[21] A cohort-graph of the raw data is presented in the Appendix.

VI. Relating the expansion of wealth inequality over the life-cycle to savings, asset allocation and inheritances

We have documented in the previous sections, that wealth is much more unequally distributed than income and consumption. In addition, wealth inequality has increased over the last decades. Conceptually, both findings are rather unsurprising, as wealth is a stock variable. Changes to the existing stock of wealth are first of all driven by savings and appreciation. Savings in turn depend on income, which is highly correlated with wealth. Given that in Germany even among retired households only one in four is actually dissaving, savings can be expected to have largely dispersing effects on the wealth distribution. The same applies to appreciation effects. As long as real returns are positive, the effects of asset appreciation on wealth inequality should also be dispersing – at least in absolute terms. Hence, mainly inter-vivos transfers seem suited for wealth decumulation. However it is arguable, whether the intergenerational transmission of wealth through inter-vivos transfers and bequests has had equalizing effects on the wealth distribution in the past. Kohli et al. (2005) compare the actual wealth distribution with a counterfactual where they eliminate received wealth transfers. They find a slightly higher level of inequality in the case without transfers. Westerheide (2004) investigates the propensity to consume out of received transfers and finds it to be higher among the rich. Consequently, they both tend to attribute wealth transfers an equalizing effect. At the same time, they both document a strong income and wealth gradient in received wealth transfers. While poor households have profited more in relative terms, the absolute differences in transfers received remain large.

Overall, all the above factors lead to a relatively small level of mobility within the wealth distribution – especially compared to income – as shown by Jianakoplos and Menchik (1997).[22] While there is a certain literature assessing the connections between life-cycle savings and wealth inequality (e.g. Pudney (1993), Hendricks (2002)), we are not aware of a more comprehensive analysis of the drivers behind wealth inequality in a life-cycle context. In the following, we aim to fill this gap based on a parsimonious model of wealth accumulation which we apply to the German EVS data.

[22] Other analyses investigate wealth mobility as such (e.g. Edlund and Kopczuk (2007), Steckel and Krishnan (1997)).

VI.1 *A parsimonius model of wealth accumulation*

Changes in wealth holdings over time can be classified into savings, appreciation and wealth transfers. In a household context, also the formation and the dissolution of households will play a role. Given that a well founded analysis of household formation effects on wealth holdings should be based on panel data, we defer this question for future research.

We think of wealth accumulation as presented in equation (5):

$$a_{t+1} = a_t \cdot (1 + r_t) + s_t + t_t \tag{5}$$

Wealth in period t+1 consists of wealth in period t which has appreciated by the real rate of return *r*. Further, savings *s* and net transfers *t* received in period t are added. This equation of motion can be rewritten and expanded as follows:

$$\Delta a_t = a_{t+1} - a_t = a_t \cdot \underbrace{\left(\sum_k \varphi_{kt} r_{kt} \right)}_{r_t} + sq_t \cdot y_t + \underbrace{t_t^R - t_t^G}_{t_t} \tag{6}$$

Thus, wealth growth consists of three components: First, there is the appreciation effect, which depends on the real returns r of the *k* individual assets and their portfolio shares φ_k. This first component of wealth growth is often denoted as passive savings. Second, there is the effect of active savings, i.e. the value of net asset purchases, net contributions to insurance contracts and savings accounts, as well as net repayments of debt. This can also be expressed as the net savings rate sq multiplied by the contemporary disposable income y, which illustrates the influence of the income distribution on the wealth distribution. Last, there are net transfers which can be split into received transfers t^R and given transfers t^G. In practice, these transfers can take the form of inter-vivos transfers or inheritances.

VI.2 *Estimating stylized life-cycle profiles of wealth accumulation*

The above general considerations can easily be applied to a life-cycle context. In panel data we would follow the savings and the portfolio choice of households over time. Thus, starting from

initial wealth holdings we could add the observed active savings and the known net transfers. Further, we could estimate the expected appreciation effects from the known portfolio allocation. Given that we only have repeated cross-sectional data available, we revert to using groups of households sharing the year of birth of their household head for the construction of a synthetic panel. The household level data is replaced accordingly by cohort averages of wealth, savings, and portfolio shares, as we observe them at different ages over time. We define cohorts such that households from adjacent years of birth are grouped together. To provide insights into the different mechanisms of wealth accumulation among households with high and with low savings capacity, we further stratify the cohorts by their position in equivalized income distribution of the cohort. Put differently, we ultimately follow the wealth holdings, the savings and investment behavior of the top, upper middle, lower middle and the bottom of the income distribution of each birth cohort over their pseudo life-cycles.

To actually interpret the life-cycle wealth growth trajectories of the cohorts defined as above, we have to insure that cohorts remain homogeneous over time as far as possible. First of all, we therefore exclude the East German sample and focus only on West German households. Furthermore, households should ideally be attributed to the same cohorts in case they are sampled several times over the years. The assumption that households remain in the same birth cohort may not do too much harm. A household will only be attributed to a different birth cohort if there is a change in the household head. Given that we define the household head to be the oldest male, such a switch in household headship will essentially only occur if the household head leaves the household or dies.[23] The second assumption is a much more problematic one. While the relative income position of households within a cohort tends to relatively stable between age 35 and age 55, income mobility plays a more important role in the phase of job market entry and exit. We therefore carefully interpret our results and discuss the direction of the effects of income mobility.

For the actual projection of wealth accumulation we proceed as follows: For each birth cohort and each year, we split the distribution of equivalized household disposable incomes in four parts. The top income decile, the 7^{th}-9^{th} income decile ("upper middle"), the 4^{th}-6^{th} income decile ("lower middle") and the bottom three income deciles. In the following, we denote these fragments of the income distribution as *quartiles*. For each quartile y of each birth cohort c at a given age a we estimate the growth in wealth per adult capita over the following five years. We

[23] In the absence of male household members we choose the oldest female to be the household head.

choose a per adult capita measure to minimize the distorting effects of changes to the household composition.[24]

For the actual estimation of the wealth growth through asset appreciation, we apply the observed average portfolio allocation to the initial average level of wealth (see equation 7). For the real returns of the individual asset classes, we deliberately decided against year-specific returns. The fluctuations in nominal returns and inflation rates over time have been comparatively large. Furthermore, we are foremost interested in the conceptual differences of wealth growth at different ages and for households at different positions in the income distribution. Therefore, incorporating the historical fluctuations in real returns seemed detrimental. We generally apply equal asset returns for all income quartiles and age-groups, although differences in financial literacy and restrictions in access to certain assets would imply an income gradient in asset returns. The main reason is that we have no means to quantify the suspected differential returns. An exception is housing wealth, where we estimate the differential growth rates for the income quartiles from the EVS data.[25]

$$\Delta a^{A}_{cya} = \left(\left(1 + \sum_{k} \bar{\varphi}_{cyak} \bar{r}_{yk} \right)^{5} - 1 \right) \cdot \bar{a}_{cya} \qquad (7)$$

In the results below, we break down the appreciation effects further into real wealth, financial wealth and debt.

To estimate the wealth growth through active savings we project the average annual savings $\bar{s}_{cya}$ of each cohort-age-quartile cell to the next five years (see equation 8). We thereby assume constant savings over the unobserved following four years. Given the short horizon of the projection of only five years, the inaccuracy induced by this assumption can be expected to be small for the vast majority of age-groups. Given that over five years, the new savings already earn interest, the projected five-year savings have to be augmented accordingly. For simplicity we assume that the new savings are allocated like the existing stock of wealth and therefore apply the

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[24] Using plain household levels, our results would be strongly affected by household formation and dissolution. Employing an equivalence scale which includes the children in the household, equivalent savings would depend on the birth or the moving out of children over the life-cycle of their parents. Only in the case of death of an adult where the remaining adult member inherits the stock of wealth using per adult capita measures can be expected to have distorting effects on the life cycle wealth path.

[25] The returns used for the projection are tabulated in the appendix, which also contains a description of our procedures of estimating the differences in housing price growth across income quartiles.

same rate of return. Furthermore, we include the additional appreciation of savings in active savings although these wealth gains should conceptually be counted as passive savings.

$$\Delta a^{S}_{cya} = \bar{s}_{cya} \cdot \sum_{t=1}^{5} \left(1 + \bar{r}_{cya}\right)^{t-1} \quad \text{, where} \qquad \bar{r}_{cya} = \sum_{k} \bar{\varphi}_{cyak} \cdot \bar{r}_{yk} \tag{8}$$

Last, there are average net transfers received. If possible we would proceed equivalently to the case of savings and project the known net transfers from the years of observation to the following four years for which we have no data as described by equation (9).

$$\Delta a^{T}_{cya} = \left(\bar{t}^{R}_{cya} - \bar{t}^{G}_{cya}\right) \cdot \sum_{t=1}^{5} \left(1 + \bar{r}_{cya}\right)^{t-1} \tag{9}$$

Unfortunately, we cannot distinguish bequests and gifts from support payments and other income streams between households in all years. Thus, we initially restrict our core model to the effects of active and passive savings. Total wealth growth of the cohort-quartiles over the following five is therefore calculated by

$$\Delta a_{cya} = \Delta a^{A}_{cya} + \Delta a^{S}_{cya} \tag{10}$$

To get as close as possible to a comprehensive picture of the drivers behind wealth growth, we add a cross-sectional breakdown of received inheritances based on the EVS 2003. While this implies that we disregard possible cohort effects in inheritances it is simply the closest we can get given the available data.

VI.3 *Results for a broadly based cohort*

Before turning to the stylized age-profiles, we have a look at the raw results for a single broadly based cohort. The purpose is twofold: first, looking at the raw projections, we avoid the effects of the assumptions involved in the extraction of age-effects. Second, we deliberately choose a wide cohort for this exercise which includes households from 15 adjacent years of birth. Thereby we aim to convey the best-possible impression of how the German population has accumulated wealth over the last decades without entirely giving up the life-cycle context.

To do so, we focus on a cohort which we can observe over most of their working life, i.e. the period where we would expect little intention to dissave and little changes to the household

composition through mortality. Specifically, we choose households headed by in individual born between 1944 and 1958. We follow these households from 1983 when they are 25 to 39 years old until 2003. By then, we observe the same cohort at an age between 45 and 59.

We employ two measures for the contribution of the individual pathways of wealth accumulation. First, we use absolute wealth growth as derived above. This allows a comparison of the orders of magnitude across income quartiles. To relate the absolute wealth growth to the respective initial wealth, we additionally calculate growth rates. Specifically, we relate the absolute growth by the individual components *i* over the following *t* years to total initial wealth for each cohort-quartile-age cell. Finally, we annualize the growth rates and report compound annual growth rates contributed by the individual drivers.

$$CAGR^{i}_{cya} = \left(\left(1 + \Delta a^{i}_{cya} / a_{cya} \right)^{1/t} - 1 \right) * 100 \qquad (11)$$

The key finding from our analysis is certainly, that wealth growth in Germany over the past 20 years was mainly driven by savings whereas passive savings have actually been negative (see table 1). Counting all wealth drivers together, households at the top of the income distribution achieved an average annual wealth growth of 4.8 percent in real terms. Also the middle quartiles were able to improve their wealth position, although at substantially lower rates of 2 and 1 percent per year respectively. If a household was stuck at the bottom of the income distribution we project an average annual wealth loss of 1.8 percent per year. The composition of these numbers turns out to be driven by high savings, a conservative allocation of financial assets, and negative returns on real estate wealth.

The effects of active savings

Over a time span of twenty years, household from all parts of the income distribution have increased their wealth by means of active savings. This applies even to households at the bottom of the income distribution. Negative savings early in the life-cycle and when part of the cohort was already approaching retirement are overcompensated in those years where essentially the entire cohort was in their core working age. Looking at the higher income quartiles we find a clear income gradient in the contribution of savings to absolute as well as relative wealth growth. In fact, households that remained at the top, the upper middle, the lower middle and the bottom of the income distribution over this time, would have increased their wealth by 5.2, 3.1, 2.3 and 0.8 percent per year.

Table 1: Wealth growth by source at different positions in the income distribution (in EUR 2001)

	wealth growth					
initial wealth in 1983	1983-88	1988-93	1993-98	1998-2003	total growth 1983-2003	20-year CAGR
18'758 €	*Income deciles I-III*					
active savings	-886 €	2'473 €	3'096 €	-369 €	4'314 €	0.8%
passive savings	-1'974 €	-2'786 €	-3'462 €	-3'150 €	-11'372 €	-3.7%
inheritances	4 €	13 €	15 €	87 €	118 €	0.0%
total wealth growth	-2'856 €	-301 €	-351 €	-3'432 €	-6'940 €	-1.8%
46'670 €	*Income deciles IV-VI*					
active savings	5'150 €	8'544 €	11'736 €	10'533 €	35'963 €	2.3%
passive savings	-5'136 €	-6'084 €	-5'839 €	-5'719 €	-22'778 €	-2.6%
inheritances	31 €	21 €	17 €	62 €	131 €	0.0%
total wealth growth	45 €	2'481 €	5'914 €	4'876 €	13'316 €	1.0%
66'953 €	*Income deciles VII-IX*					
active savings	11'613 €	18'449 €	22'487 €	23'592 €	76'142 €	3.1%
passive savings	-7'857 €	-8'807 €	-8'543 €	-7'820 €	-33'027 €	-2.7%
inheritances	209 €	164 €	338 €	410 €	1'122 €	0.1%
total wealth growth	3'966 €	9'806 €	14'282 €	16'182 €	44'236 €	2.0%
95'220 €	*Income decile X*					
active savings	36'916 €	56'139 €	72'408 €	76'449 €	241'911 €	5.2%
passive savings	-12'089 €	-11'313 €	-9'355 €	-12'524 €	-45'282 €	-2.5%
inheritances	1'865 €	2'745 €	5'303 €	6'724 €	16'638 €	0.6%
total wealth growth	26'691 €	47'571 €	68'356 €	70'649 €	213'267 €	4.8%

Source: own calculations based on the EVS 1983-2003; Note: inheritances estimated based on cross-sectional data from the EVS 2003, all numbers calculated in real terms.

The effects of passive savings

In contrast to active savings, which plays the expected role for wealth accumulation, passive savings have in fact been dissavings in Germany. One of the reasons is the low return on real estate wealth which does not even match the inflation rate. In real terms, housing wealth has depreciated by an average annual rate of between 0.5 and 1.7 percent (see table 2). High income households' homes have seen a somewhat more favorable price development, leading to a small income gradient in real wealth depreciation.

Additional to the unfavorable housing market, credit costs have depressed the total return on assets for all income groups. The effect is especially strong at the top and at the bottom of the income distribution. The reasons, however, are different. The poor suffer especially from high rates of debit interest, as they hold more of their debt in expensive consumer credits. For the rich, the large effects of debt are due to a higher leverage of their real estate wealth.

Table 2: Compound annual real growth rates by wealth category (1983-2003, in %)

	Income Decile			
	I-III	IV-VI	VII-IX	X
financial wealth	1.1%	0.7%	0.7%	1.0%
housing wealth	-1.7%	-1.1%	-0.8%	-0.5%
debt	-3.2%	-2.3%	-2.8%	-4.1%

Source: own calculations based on the EVS 1983-2003

Only for financial wealth there have been positive real rates of return over the last decades. Somewhat surprisingly, we do not find the expected clear income gradient. In fact, the bottom as well as the top income quartiles have outperformed the middle class. Overall, the real returns on financial wealth as well as the differences across income groups are quite small. First of all, the asset allocation is rather uniform across the income distribution. The largest differences can be observed for direct stockholding. While the bottom income quartile held a maximum of 5.5 percent of its wealth in stocks in 1998, the same share has never exceeded 10 percent for the top income decile. The fact, that asset allocation in Germany has remained rather conservative is certainly the main reason for the overall poor performance of financial wealth.

The effects of inheritances

For the assessment of the importance of wealth transfers we rely solely on cross-sectional information about inheritances from the EVS 2003. There is also information on other transfers from private households, be we cannot distinguish alimony and other income transfers from wealth transfers. The same applies to inter-vivos transfers to other households.

The averages reported in table 1 tell only part of the story: comparing average inheritances to the wealth levels of a cohort, they seem almost negligible. Only the top income decile can be expected to receive substantial amounts of wealth. Over 20 years, inheritances augment initial wealth of the top income quartile by roughly 17 percent. Already the third quartile gains less than 2 percent of its initial average wealth by means of inheritances. While the unconditional means look rather disappointing especially for the lower half of the income distribution, Kohli et al. (2005) has shown that for those households receiving an inheritance, their relative impact on previous wealth holdings may be quite considerable.

VI.4 *Age-profiles in wealth accumulation by source*

To elicit age-profiles from our repeated synthetic panel data we have to take a stand with respect to time and cohort effects. As commonly known, age-, time- and cohort-effects are by

construction perfectly collinear. Therefore, structural assumptions are inevitable. In the following, we derive the age-effects under the assumption that there are no cohort-effects, i.e., we only include time-effects in the regression. We chose time-effects over cohort effects as we expect them to play a role for both key input variables – savings and portfolio choice. Specifically, savings have experienced some fluctuations over time. For portfolio choice, we observe quite similar trends towards more securities over time for essentially all cohorts.[26] One might argue, that also cohort-effects seem to play a certain role for portfolio choice but hitherto this is much less the case for savings.

Age-profiles for the contribution of active savings

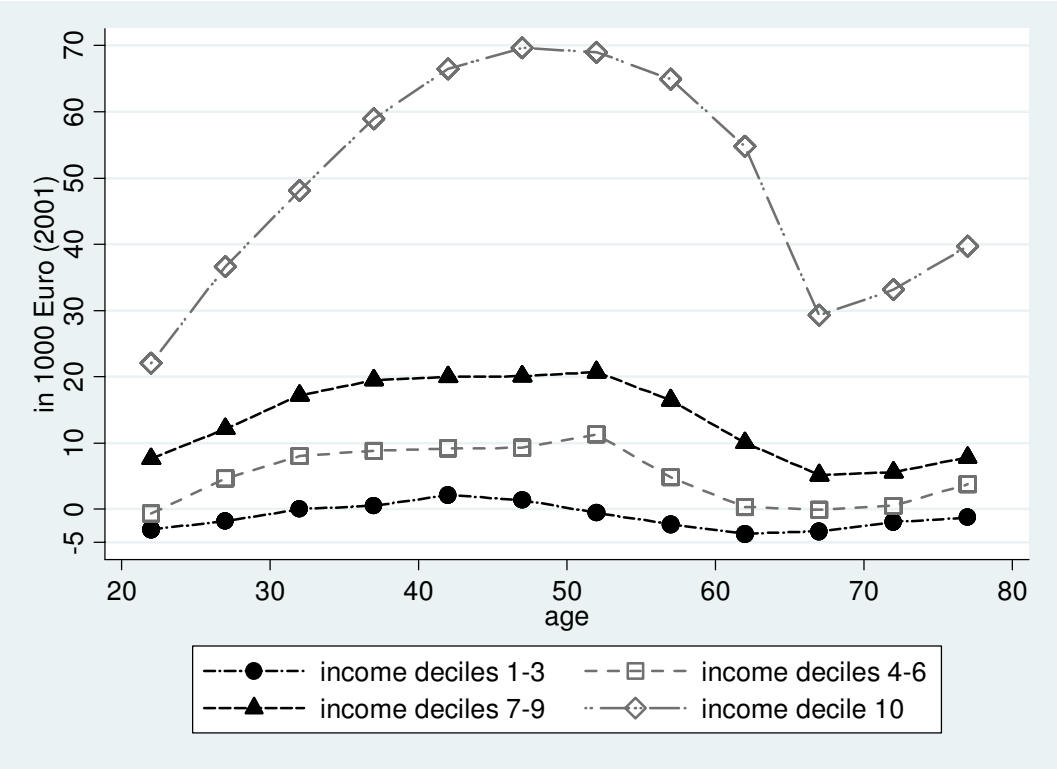
Figure 14 depicts the age-effects in absolute wealth growth through active savings over the following five years. Wealth growth through active savings has the expected hump shape for essentially all income deciles. Savings increase over the first half of the life-cycle. Peak savings are reached at age 40-44 for the bottom income decile, and around age 50 for the higher income classes. Savings drop steeply around retirement age and reach a local minimum between age 60 and 70. For the subsequent age-groups, savings increase once more. The most likely reasons for this late increase in savings are health limitations which prevent households to consume more (Börsch-Supan and Stahl, 1991), increased precautionary savings for the case of high health and long-term care expenditures (Palumbo, 1999), as well as the non-sampling of institutionalized households which can be expected to be among the strongest dissavers. The effects of differential mortality within the existing sample have been assessed by Sommer (2008a) and have been found to be small. Overall, it is evident that especially the rich do not consume the wealth they have accumulated over the life-cycle in retirement.

Looking at the levels of new wealth accumulated through active savings, we find them to be negligible for the bottom income deciles of essentially all age-groups. At certain ages, these households have negative saving rates and are thus predicted to reduce their stock of wealth. Over the entire life-cycle we estimate an average 5yr savings effect of -1150 €, i.e. a wealth loss of 230 € per year. The differences compared to the broadly based cohort which we have analyzed above are caused by negative savings among the youngest age-group and the age-groups 50 and above. Households who remain in the lower middle income quartile over their life-cycle can be expected to accumulate close to 5'000 € by means of savings over a time span of five years. The neighboring upper middle attains about double the amounts through most of the life-cycle. The

[26] For a detailed disaggregation of the trends in household portfolios see Sommer (2005).

gap between the second and the third income quartile widens only among the youngest age-groups and around retirement. On average, the third income quartile attains real wealth gains over five years of 13'120 € just through savings. The saving levels of the top income decile are of a different order of magnitude: their five-year savings never fall below 20'000 Euros and average out at 47'900 Euros over the entire life-cycle.

Figure 14: Age-effects for 5-year wealth growth by means of active savings



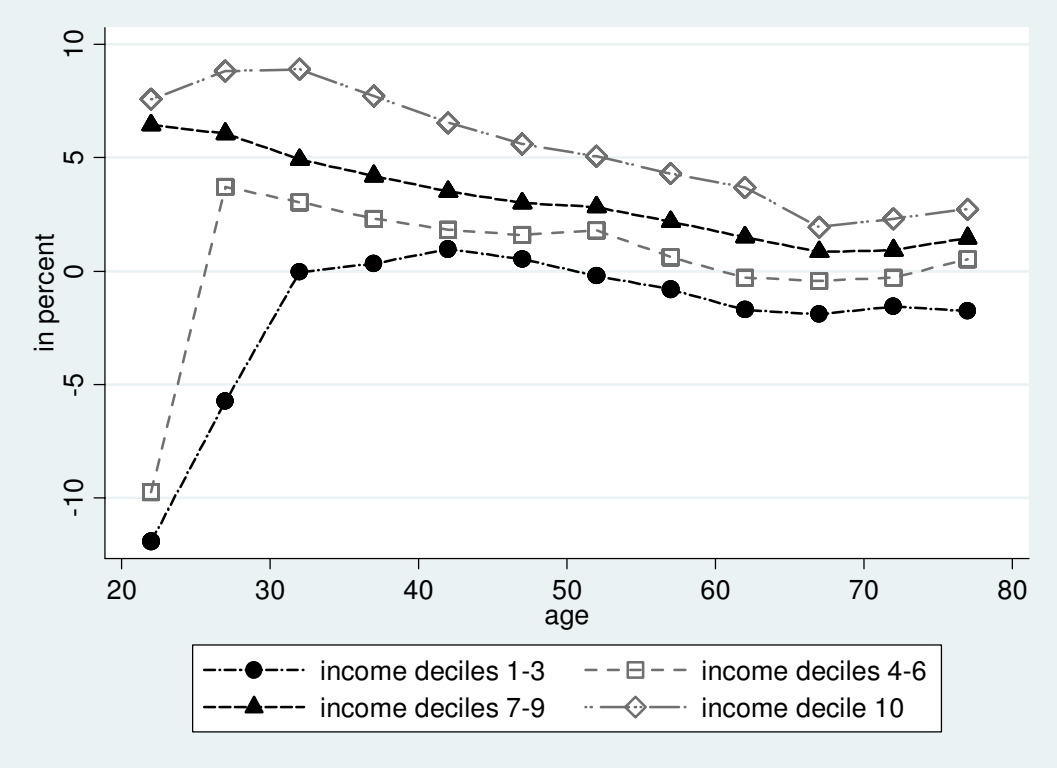
Source: own calculations based on the EVS 1983-2003

To put the above absolute figures in the context of different wealth holdings over the life-cycle and across income deciles, we now convert the above absolute wealth growth into growth rates. The growth rates always relate to the initial wealth of an income quartile at a certain age. To give an example: In real terms, the top income decile of the age-group 50-54 is projected to experience an increase in total net wealth by means of savings of 5 percent per year over the following five years based on their initial wealth at age 50-54 (figure 15).

The first feature of projected growth rates to catch the eye is certainly the clear income gradient. In all age-groups, households from higher income deciles are able to increase their wealth at a higher pace. The second finding from figure 15 is the trend towards lower growth rates as age increases. Again, this comes with little surprise, as the annual savings flows become smaller and smaller compared to the increasing stock of wealth which is accumulated over the life-cycle. Last,

we observe substantial wealth decumulation through dissavings for the bottom half of the income distribution among the youngest age-groups. The suspicion of borrowing against higher future income levels is supported by the income and consumption data of these cohorts.

Figure 15: Age-effects for contributed growth rate through active savings



Source: own calculations based on the EVS 1983-2003

Generally, having in mind the life-cycle savings patterns in Germany, our results for active savings contain no big surprises. The key findings are certainly that the bottom 30 percent of the income distribution are unable to accumulate wealth through savings, as also documented by Börsch-Supan et al. (2006) based on the SAVE survey. Furthermore, we find the expected clear income gradient in wealth accumulation through active savings.

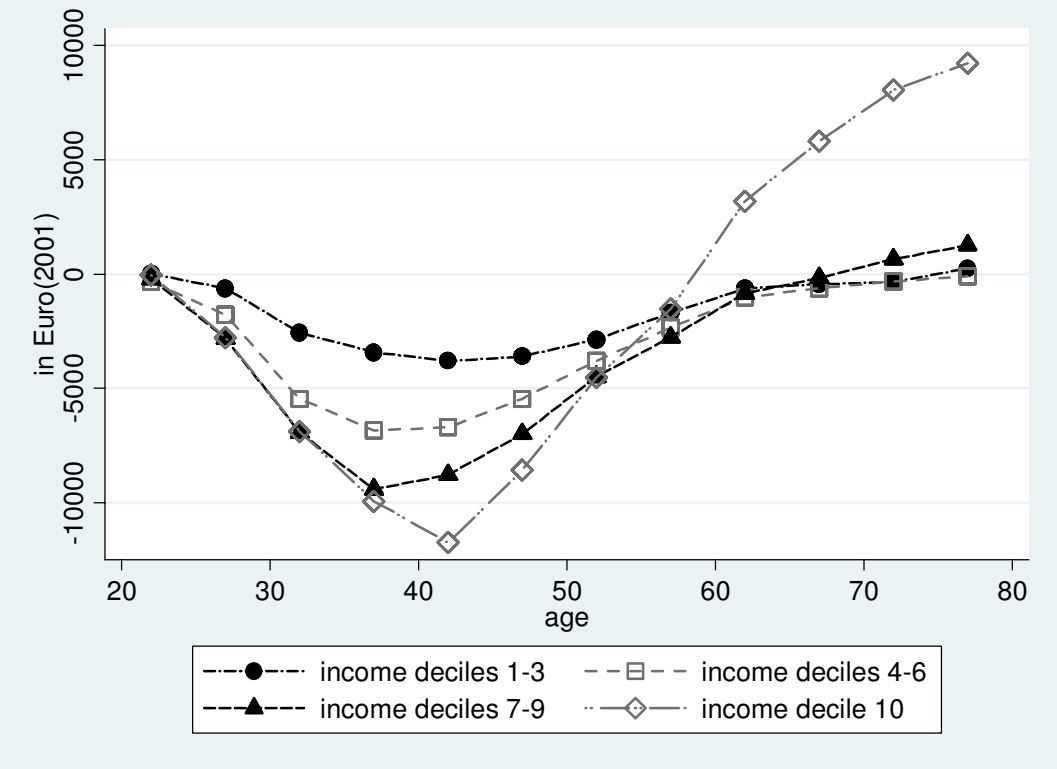
Age-profiles for the contribution of passive savings

Our analyses for passive savings yield essentially three key findings. First and foremost, we find considerable depreciation effects between ages 20 and 55. Essentially only the top income households are able to profit from passive savings, and only beyond retirement age. Second, the performance of poor households' portfolios is better than one might expect. Over the entire life-cycle, their returns on total wealth are level with the portfolios of middle income households. Especially at young age, their portfolios even outperform the middle class. Third and last, we find

a clear income gradient for the performance of financial wealth for the age-groups 35 and above and a reversed income gradient for the younger age-groups.

We first look in some more detail at the u-shaped age-profile of projected passive savings. Throughout the entire working life, we observe only wealth depreciation which peaks in absolute terms around age 40 (see figure 16) and somewhat earlier at age 30-35 when looking at growth rates (see figure 17). The key to understanding the negative and u-shaped age-profile are mortgages. That is, depreciation effects play an increasing role among those age-groups with large numbers of credit-financed home owners. As the outstanding debt is repaid towards retirement, the depreciation effects decline correspondingly. In fact, wealth losses become negligible around age 60 and remain so for the remainder of the life-cycle.

Figure 16: Age-effects for wealth growth by passive savings

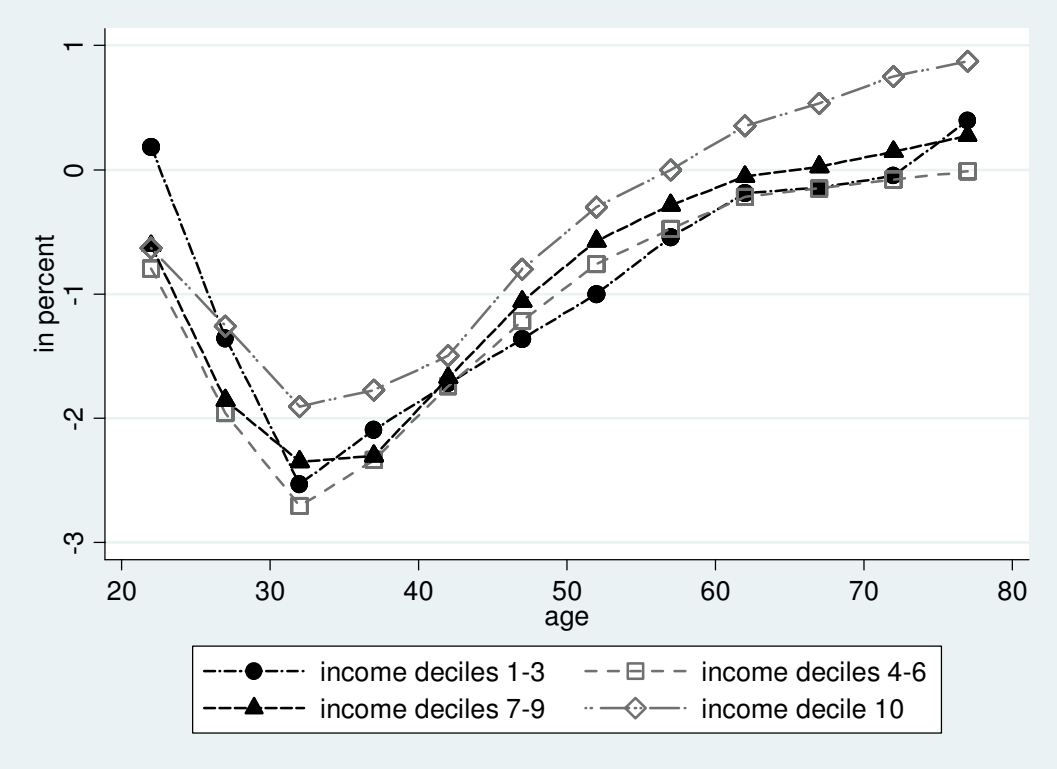


Source: own calculations based on the EVS 1983-2003

Next, there are the low overall returns from passive savings. We have already highlighted the reasons above in the context of the wide cohort. Apart from the debt effects, the poor portfolio performance of households' investments is largely due to a conservative allocation of financial assets as well as the negative real returns on housing wealth. It turns out, that the differences across quartiles are rather low throughout the entire life-cycle. The margin between the highest and the lowest projected returns ranges from 0.3 to 0.9 percentage points. For most age-groups,

the top income decile also attains the highest return on assets. The third and the second quartile follow in the expected order at a certain distance. The main surprise in returns from passive savings concerns the performance of low income households' portfolios. Over all age-groups, they never have the worst projected performance. Furthermore, the bottom income quartile outperforms the middle income quartiles for a considerable number of age-groups. Before coming back to the surprisingly good performance of the portfolios of young low income households, we focus on passive savings from financial wealth. This seems especially worthwhile given the overall predominance of credit-financed homes for the above results.

Figure 17: Age-effects for contributed growth rate through passive savings



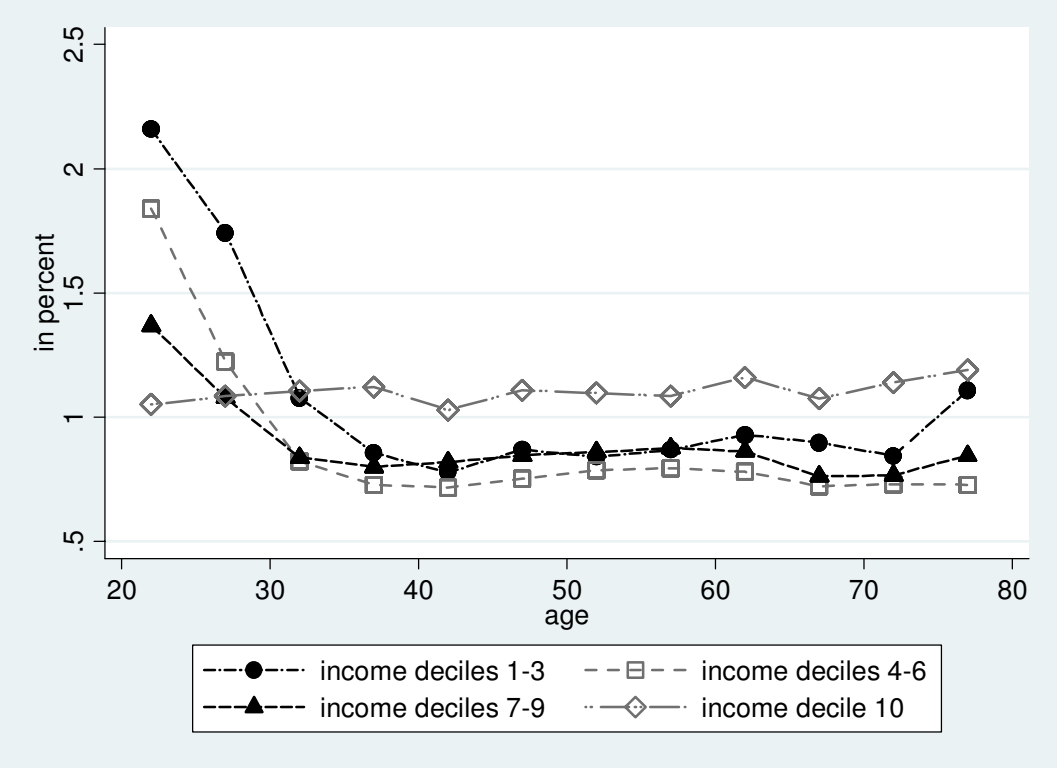
Source: own calculations based on the EVS 1983-2003

Age-profiles for the contribution of passive savings from financial wealth

The estimated age-pattern for projected growth rates in financial wealth are depicted in figure 18. Financial wealth contributes positive wealth growth for all ages and income groups. The actual real rates of return vary between 0.7 and 2.2 percent. The life-cycle pattern is essentially split in two parts. Among households below age 30, we observe an inverse income gradient and the dispersion across income quartiles is comparatively large at a margin of 120 basis points. Furthermore, it is here that we observe the highest returns. For the later age-groups, we observe

essentially flat life-cycle profiles. Real returns are highest for the top income decile at roughly 1.1-1.2 percent per year. The lower income groups attain a real return between 0.7 and 0.9 percent. The reasons for these low portfolio returns are the ongoing popularity of safe assets like savings accounts and building society savings contracts among German households.[27]

Figure 18: Age-effects for contributed growth rate through financial wealth appreciation



Source: own calculations based on the EVS 1983-2003

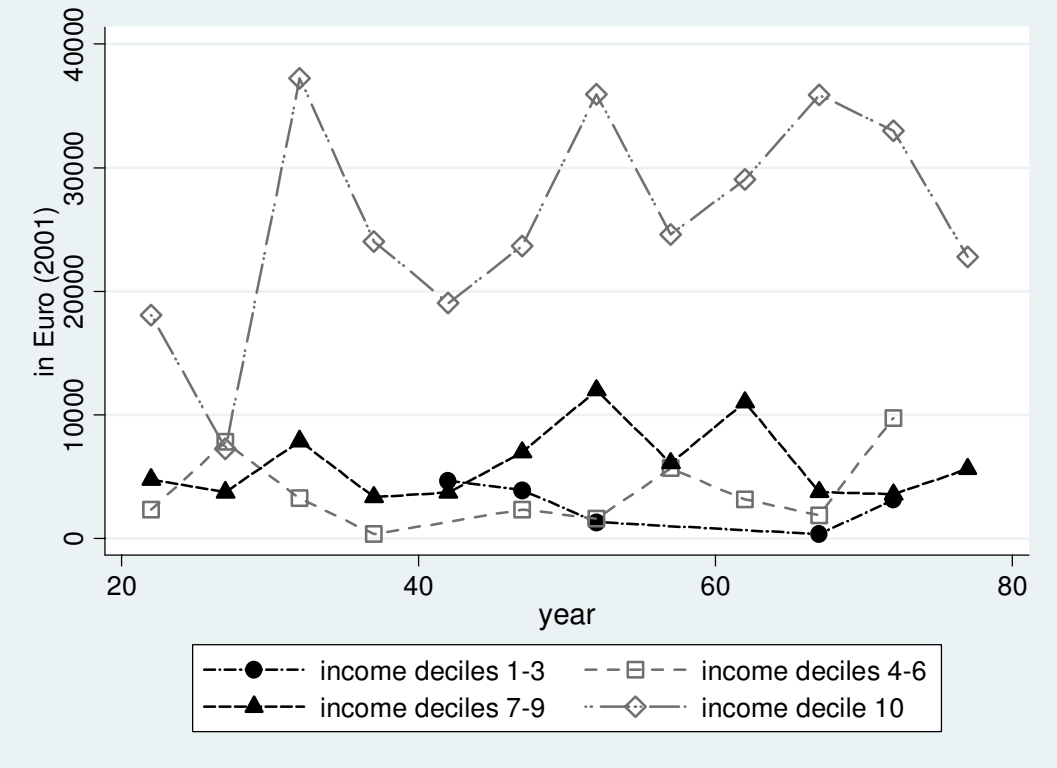
Let us come back to the remarkably good performance of the lower income quartiles among the young. One might speculate that the favorable asset allocation is driven by student households which expect high income growth in the future and therefore reduce their investment in safe but low return assets in favor of securities. Furthermore, we would expect these households to have good knowledge about financial markets and therefore choose a more attractive long run portfolio allocation. Looking at the distribution of educational attainments across income groups supports the above speculation. For a solid understanding of the investment behavior of young low income households we would require panel data though.

[27] For a more detailed description of trends in German household portfolios see Sommer (2005).

Cross-sectional age-profiles for the contribution of inheritances

As mentioned above, it is impossible in most EVS cross-sections to distinguish wealth transfers from income transfers like e.g. alimony payments. Fortunately, the EVS 2003 allows us to separate inheritances from other transfers. In the following, we present results for a cross-sectional distribution of received inheritances over age. Specifically, figure 19 depicts the averages of actual inheritances by income quartiles. The immense fluctuations indicate the difficulties involved in the measurement of such extremely rare events.[28] Although the differences between the bottom income deciles are not significant for the majority of age-groups, the results suggest a certain income gradient in received inheritances.

Figure 19: Cross-sectional age-profile for average inheritances by income quartile



Source: own calculations based on the EVS 2003

We abstain from interpreting the age-pattern given the small number of observations at the bottom of the income distribution and the high degree of noise in the data. Table 3 therefore discards the context of age and focuses on the absolute and relative importance of inheritances for the different income quartiles at all ages. We find higher income households to expect substantially higher inheritances than households at the bottom of the income distribution. The

[28] We dropped one extreme case for the bottom income quartile for the estimation.

stronger income gradient for the unconditional averages compared to the average actual inheritances implies that the rich are also considerably more likely to receive an inheritance in the first place.

Table 3: Absolute and relative impact of bequests on wealth holdings by income quartile

	income decile			
	1-3	4-6	7-9	10
average annual (uncond.) bequests				
levels	1.90 €	8.94 €	67.22 €	945.52 €
average implied wealth growth	0.03%	0.03%	0.17%	0.74%
average annual actual bequests				
levels	2'927 €	3'065 €	6'551 €	27'097 €
average implied wealth growth	51.4%	10.6%	17.1%	21.5%

Source: own calculations based on the EVS 2003

Putting these numbers in relation to wealth holdings, we arrive at similar results as Kohli et al. (2005) and Westerheide (2004). Specifically, the actual incidence of inheritances has a much stronger impact on recipients at the bottom of the income distribution than for their richer counterparts. In fact, inheritances boost total wealth among households from the bottom income quartile by an average of 51.4 percent. The corresponding effects for the next higher income classes range only between 10.6 and 21.5 percent.

Issues and limitations of the above analysis

In the absence of panel data, any life-cycle analysis will be based on less-than-ideal solutions like a synthetic panel. Especially the assumption that cohorts remain homogeneous over time is a questionable one. Above, we have already discussed the possible effects of changes to the household head and of differential mortality which we consider a minor concern for our analysis. However, the interpretation of the above results becomes delicate through our stratification of cohorts by income. Specifically, connecting the projections of equal income quartiles over age for a life-cycle interpretation is dangerous given the degree of mobility in the income distribution. That is, a considerable number of households will switch between different income quartiles over their life-cycle. An example are university graduates, who tend to enter the labor market several years later than the remaining population. Thus, these households will start from a rather low relative income position. Their subsequent life-cycle earnings path is steeper so that they will move up the income distribution. A similar case can be made for the job market exit. E.g. self-employed households who do not receive a public pension may drop from an above average income level to rather low post-retirement incomes. Thus, our results can only be interpreted as

short run projections of average wealth growth of households at a certain age and a certain income position. If we nevertheless follow income quartiles over age, we will tend to underestimate wealth accumulation of households starting at the bottom of the income distribution and overestimate wealth accumulation at the top.

The second important limitation of our analysis is connected to the assumptions involved in the projections. As our use of common average real returns is aimed at the estimation of stylized life-cycle pattern of wealth accumulation, these projections are unqualified to replicate the actual year-to-year changes in wealth levels. Furthermore, we ignore important aspects of inequality within and between income quartiles. In fact, we most certainly underestimate the dispersion between income quartiles as we ignore a possible income gradient in asset returns due to different credit conditions and differences in financial literacy.

Overall, our results certainly depend strongly on a small number of factors: The high saving rates which we observe for German households at all age-groups, their rather conservative asset allocation and the poor returns especially on housing wealth over the past decades. Consequently, the relative importance of active and passive savings can only be generalized to countries with similar characteristics. Vice versa, we would expect quite different results e.g. for the United States where real estate prices have evolved more favorably, where stocks are highly popular in household portfolios, and where saving rates are considerably lower. However, the case of Germany nicely illustrates the precarious wealth shrinkage in the case of leveraged real estate ownership with low or real estate returns. Only the high saving rates of German households have ultimately allowed a growth of net total wealth over the past decades.

VII. Conclusion

In this paper, we document the trends in inequality for Germany over the past twenty five years based on data from the German Income and Expenditure Survey (EVS). First of all, the results are prepared to provide a benchmark for future macroeconomic modeling which increasingly incorporates various forms of heterogeneity on behalf of the household sector. Against the background of demographic change, OLG models play a particularly important role in macroeconomic modeling. Thus, we take a great interest in the trends in inequality over the life-cycle to provide these models with benchmarks for the calibration of life-cycle behavior. At the same time, our results can be employed to assess the prospects for inequality in an aging society.

Like in most important economies, income, consumption and wealth inequality have been on the rise in Germany over the past decades. For international standards the growth in inequality has been comparatively moderate in Germany, but so have been the growth rates in the corresponding levels.

Consumption inequality has been almost constant over the last decades. Important drivers of inequality have been the trend towards smaller households and the reunification. Correcting for household size and other observable household characteristics, the residual level of inequality has even declined slightly. Over the life-cycle we find a clear upward trend in consumption inequality. The prospects for consumption inequality are therefore dependent on two countervailing factors. The retirement of the baby boom generation will shift a large cohort away from the high pre-retirement consumption levels. At the same time, consumption inequality within this important cohort can be expected to increase in upcoming years.

For income inequality, we observe a distinct upward trend in inequality which has only leveled off between 1998 and 2003. The connections between income and consumption inequality seem to be sufficiently close to generate almost identical trends in the parts of inequality which can be explained by household characteristics. The main difference compared to income is the increasing rather than decreasing level of unexplained income dispersion. Looking at the results for income inequality over the life-cycle we find them to be somewhat sensitive to the chosen econometric specification. Only two aspects emerge pretty clearly: before age 30 and between age 50 and 60, income inequality rises more strongly than for the remainder of the life-cycle. Furthermore the raw data suggests rather strong positive cohort effects between the cohorts born in 1930 and 1950. We observe them in the middle of their life-cycles, where the individual age trajectories in income inequality have shifted pretty strongly towards higher levels of inequality.

Our results for wealth inequality differ considerably depending on whether we focus on financial wealth or total wealth. It turns out that financial wealth inequality has grown double as fast as

inequality in total wealth. Once again, a favorable development of inequality coincides with low growth rates – in this case for real estate wealth. Compared to income and consumption inequality, household characteristics can explain only a tiny part of the cross-sectional variation in wealth inequality. Looking at the life-cycle pattern of wealth inequality, the results once again depend strongly on the inequality measure and the econometric specification we choose. A closer look at the raw data confirms the different results but hints also at a possible explanation. Specifically, we find rather flat age-profiles and only little cohort differences based on the Gini coefficient, which is not very sensitive towards changes at the extremes of the distribution. The variance is much more sensitive to changes in the tails of the distribution and exhibits stronger cohort differences and upward sloping age-trajectories. This indicates that most of the grown inequality has happened at the extremes of the wealth distribution.

We conclude this paper by supplementing the above life-cycle effects in inequality with a more detailed analysis of the drivers behind life-cycle wealth accumulation in Germany. To do so, we simulate wealth growth of households at different age-groups and with different positions in the income distribution by projecting their wealth growth based on active savings and their portfolio choice derived from our synthetic panel data. To arrive at stylized pattern of wealth accumulation, we apply average real returns to the observe portfolio allocation. In a second step, we elicit age-trajectories based on a simple regression.

For active savings, we observe a strong income gradient. Except for the bottom income quartile which is largely unable to save, all households receive their strongest wealth growth through active savings. Total passive savings turn out to be dissavings over the entire working age and for all income groups. The reason are mortgages which are taken up with the purchase of a home and only paid back slowly towards retirement age. The actual real returns on housing wealth have been negative in Germany over the past decades. Given the large share of total wealth invested in the privately owned home the positive returns on financial wealth do not suffice to compensate the negative effects from leveraged real estate wealth. Overall, the real returns on financial wealth are rather poor and range between 1.3 percent for the top income decile and 0.7 percent for the lower income groups. The underlying reason is the asset allocation of German households which still holds fast to saving accounts and is cautious with respect to a higher exposure to the stock market.

For inheritances we unfortunately only have cross-sectional data available. Based on the EVS 2003 we show that the probability of receiving a bequest as well as the absolute amounts of wealth received increase strongly in income. The actual incidence of an inheritance has a much stronger impact on wealth growth for low income households though. These results are in line with the findings of Kohli et al. (2005) and Westerheide (2004). Yet over all households, the

importance of average inheritances for wealth growth turns out to be small. Only for the top income decile, the impact of inheritances is noticeable also for average wealth growth.

Overall, our results on the relative importance of savings, portfolio returns and inheritances for wealth growth are certainly specific to the case of Germany. Especially for countries with lower saving rates and a less conservative asset allocation like most Anglo-American countries, we would expect quite different results. However, the unfortunate German case of negative real returns on real estate accentuates the risks involved in leveraged investments. Only the high saving rates have ultimately led to a growing stock of household wealth in Germany over the past decades.

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Appendix I - graphs

Figure A-1: Cohort analysis for the evolution of inequality in post-government income

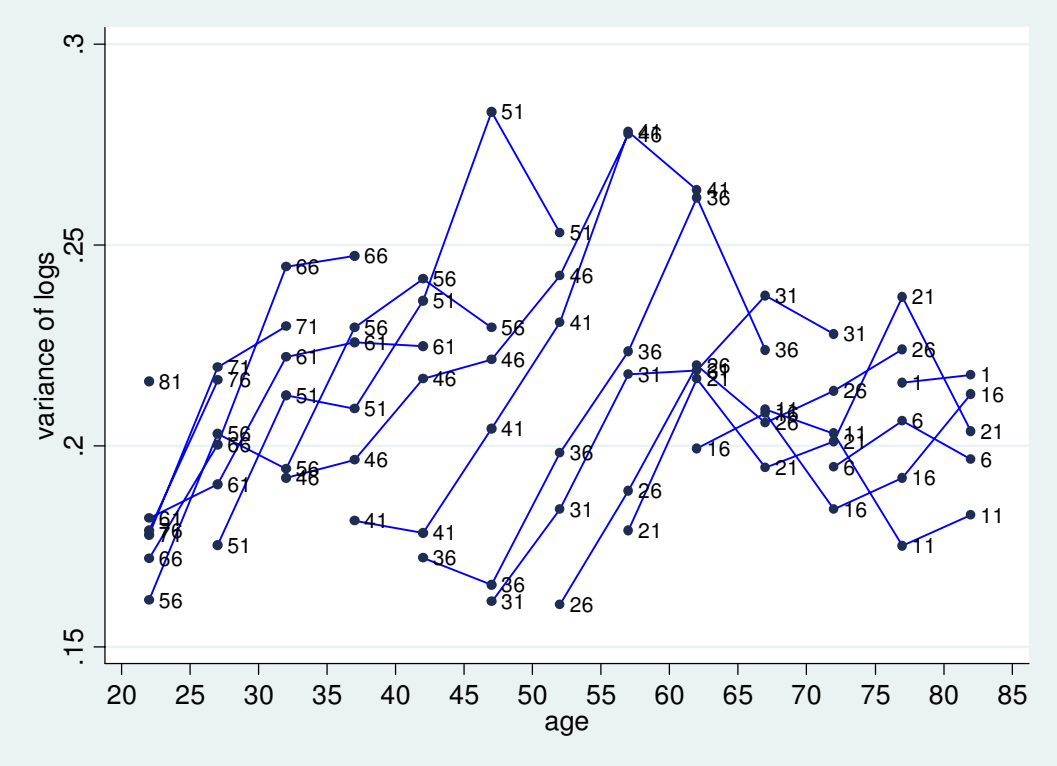


Figure A-2: Cohort analysis for the evolution of inequality in non-durable consumption

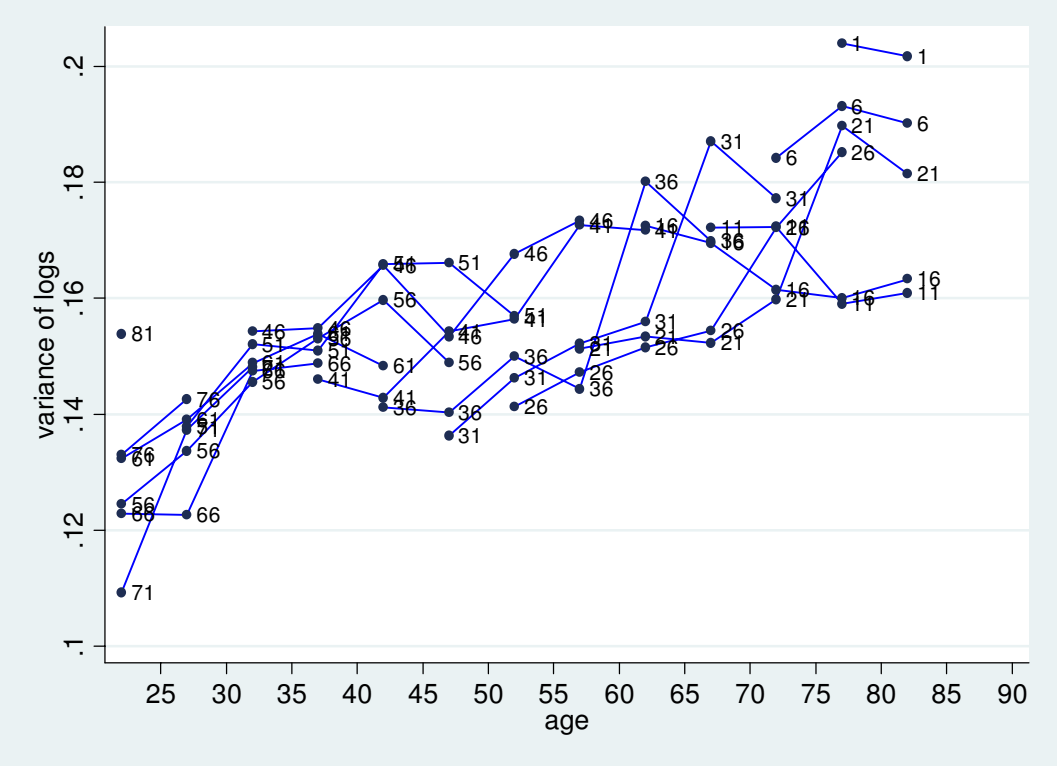


Figure A-3a: Cohort analysis for the evolution of inequality in total net wealth

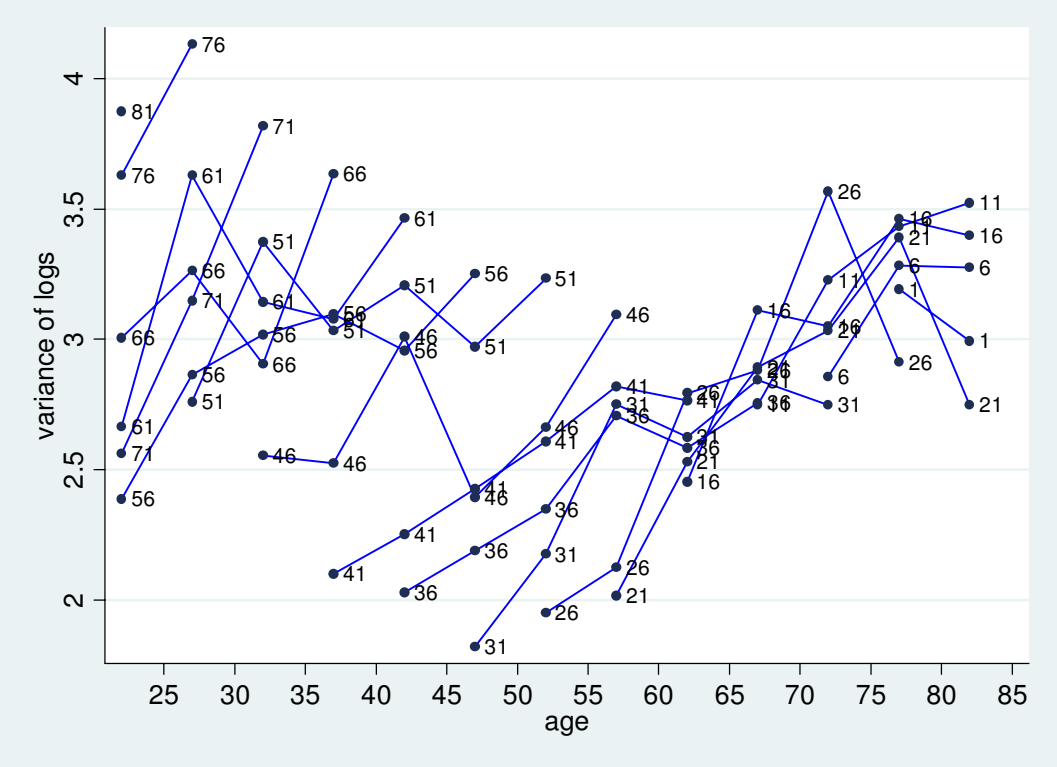
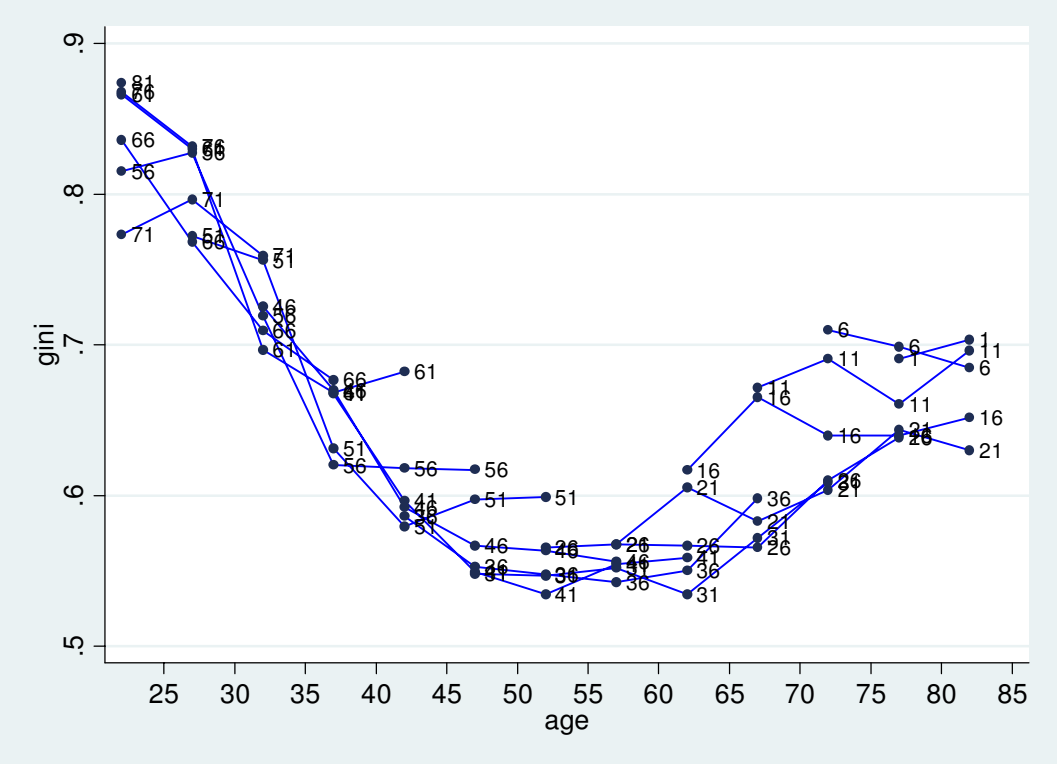


Figure A-3b: Cohort analysis for the evolution of inequality in total net wealth



Appendix II – assumptions and methodology

In the following, we shortly describe the assumptions used for the projection of passive savings in section VI. We first tabulate the nominal rates of return and the inflation rates employed and then turn to the estimation of differential real estate returns by income quartiles.

Nominal returns and inflation rates

Table A-1 documents the nominal returns and inflation rates underlying our wealth growth projection in section six. We assume constant returns and interest rates for all cohorts at all ages. Only for real estate, we differentiate between returns in the different income deciles.

Table A-1: Assumptions for nominal returns and inflation

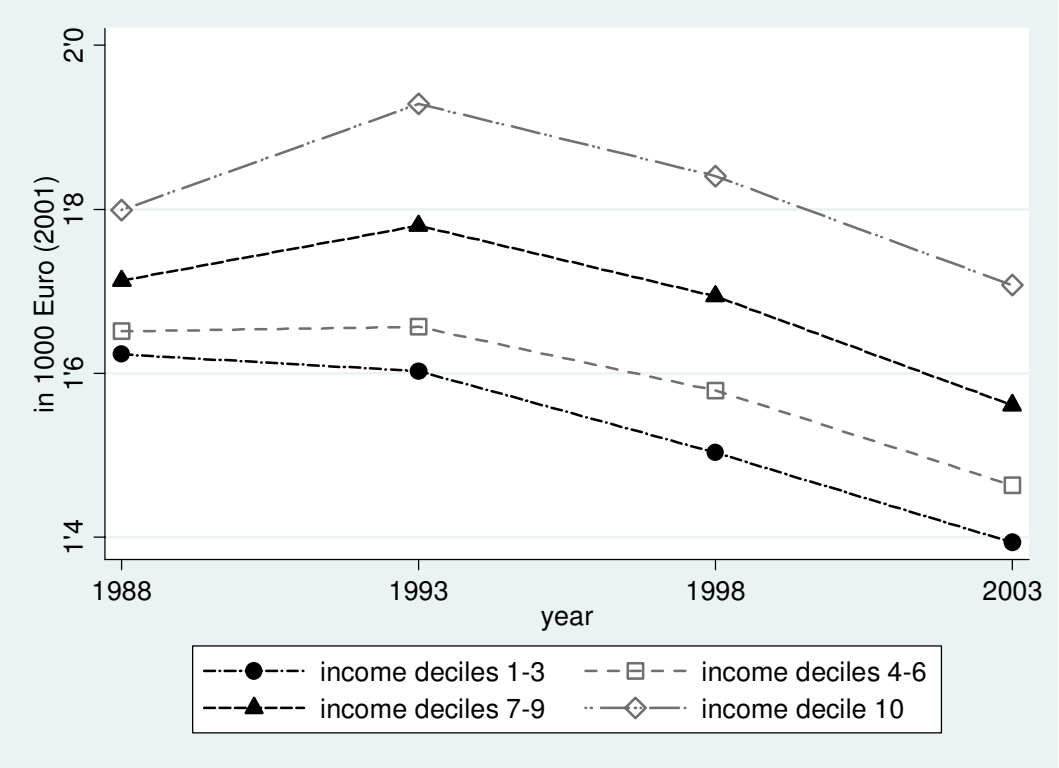
	income decile			
	1-3	4-6	7-9	10
financial wealth				
saving accounts	3%			
building society saving contracts	3%			
stocks	8.30%			
other securities	5.95%			
life insurance	5%			
real estate	0.87%	1.08%	1.27%	1.54%
debt				
consumer credit, installment credit	11.57%			
mortgages	7.04%			
inflation	1.90%			

Sources: MGI, Statistisches Bundesamt, own calculations

Estimating the rate of return on real estate for different income groups

The EVS contains data on the market value of real estate wealth as well as detailed information on the primary residence. To avoid mixing price and quantity effects, we estimate prices per square meter based on the sample of households which owns only one piece of real estate. The compound annual nominal growth rates are then generated based on the median square meter prices of real estate in the respective income groups between 1988 and 2003. Figure A-4 graphically illustrates the actual development of the square meter prices used for the above calculations in Euros (2001).

Figure A-4: Development of median square meter prices (in real terms)



Source: own calculations based on the EVS 1988-2003

Chapter 5:

Imputation and harmonization of income, consumption, savings and wealth data from the German Income and Expenditure Survey

I. Introduction

The German Income and Expenditure Survey (EVS) has been the data basis to an extended literature on inequality and life-cycle analyses. The size and the richness of the individual cross-sectional datasets with respect to income, consumption and wealth as well as its long tradition since the early 1960s have put the EVS into an exclusive position. Other datasets like the GSOEP have expanded their attention to wealth only recently or have started quite recently altogether (e.g. SAVE and SHARE). All these datasets will strongly improve the data situation in Germany with respect to savings and wealth. The GSOEP comes as a well established panel dataset and includes rich information on the households' income and work history. The SAVE survey is focused on questions related to savings and investment behavior and adds an important dimension by including sociological and psychological questions. Last, SHARE focuses on the growing elderly population, includes information on health and social networks and allows an international comparison as the survey is implemented in 15 countries. While the future looks much brighter for research related to savings and wealth in Germany, much of today's research still relies on the EVS.

Key to successful analyses of longitudinal analyses of levels and distributions of any variable is the homogeneity of the variable over time. The homogeneity of a variable may be harmed in many ways, some of them subtle. The framing and the phrasing of a question may cause changes in households' responses just as the interview mode. The effects are often hard to assess and even more difficult to correct for. Another obvious issue is changes to the questionnaire, some of which are inevitable, as new products arise and ought to be incorporated in a comprehensive survey. In this case, harmonized definitions can often be restored by simple recombination of variables into newly defined variables. Apart from such harmonization work, in the presence of missing data also imputations are necessary, before the data is ready for the actual analyses.

Given that the EVS was originally intended for the construction of consumption baskets and the calculation of subsistence levels, comparability of variables, definitions and methodology was not the key criterion in the design of the individual cross-sectional surveys. Harmonization is therefore a key preparatory step to any work involving data from multiple years. But also missing data plays a role in the wealth section of the EVS. While the Federal Statistical Office has a tradition of providing fully imputed scientific use files, some key variables were not part of the questionnaire in the early years. Specifically, housing wealth and wealth in life insurance policies were not questioned until 1993. In recent years, the Federal Statistical Office has changed its approach towards wealth imputation. Thus also the two most recent surveys, 1998 and 2003,

contain missing wealth data. The necessary imputations of the 1998 and 2003 data have been carried out by Ammermüller et al. (2005). Their procedure mimics earlier imputations by the Federal Statistical office, but disregards the earlier cross-sections which are available as scientific use files. Further, none of these previous imputations is well documented nor is the imputed data flagged. Last, these procedures are knows to involve mean imputation which is dissatisfactory from a methodological point of view. We therefore suggest a regression based imputation approach which includes the addition of a stochastic component to preserve the dispersion of the imputed variables.

Overall, our work aims to generate fully imputed data sets for the EVS years 1978 through 2003 and provide comparable definitions on income, consumption, savings and wealth. Further, we investigate the influence of selected structural changes to the EVS. Specifically, we shed some light on the effects of the often criticized sampling threshold with respect to household income and the switch from an annual diary to quarterly ones between 1993 and 1998.

The paper is structured as follows. Section 2 describes the missing variables in the different cross-sections of the EVS and our imputation procedures. Section 3 discusses our decisions on the way to generate harmonized definitions of household income, consumption, savings and wealth. Section 4 investigates the effects of above mentioned conceptual changes on comparability over time.

II. Imputation

Missing information is essentially only a problem in the wealth section of the EVS. Where household have refused or were unable to answer questions in the other sections, the data has been fully cleaned and imputed by the Federal Statistical Office. None of the imputation procedures is well documented though.

Missing wealth data in the early EVS cross-sections – 1978 through 1988 – originates from voids in the questionnaire. Specifically, neither a sufficient question on wealth in life insurance contracts nor on real estate wealth is included. We are able to fill this gap using available covariates which are closely connected to the value of life insurance wealth and real estate wealth respectively. In recent years, the Federal Statistical Office abstained from imputing the wealth data. Specifically for the years 1998 and 2003, the user is provided with unimputed data. Filter questions on wealth ownership are included which allow us to apply a two-stage imputation procedure. The main difference between our imputation approaches for the early and the two most recent cross-sections is the data from which we gather the outside information for the imputation process. The imputation of the years 1998 and 2003 is based on contemporary information from complete observations. Given that certain wealth categories were not questioned in the years 1978 through 1988 we are missing information for all households in these years. We resolve this issue by drawing the necessary information from the neighboring 1993 cross-section.

Previous imputations of the early cross-sections have been made by Börsch-Supan et al. (1999), who employ an age-dependent ratio of surrender values to insurance sums to impute life insurance wealth. Similarly, they use average ratios of ratable values and market values to impute housing wealth. Both ratios are drawn from the 1993 cross-section. Ammermüller et al. (2005) focus on the imputation of the 1998 and 2003 cross-sections. Their procedure mimics earlier imputations by the Federal Statistical office, and involves the use of conditional means for cells of similar households. Thus, both procedures are limited in their ability to preserve the dispersion of the imputed variables and their correlation structure with other covariates. We therefore rely on regression based imputation methods which we adapt accordingly given the different conceptual problems at hand in the different years.

II.1 *Imputation of the early cross-sections (1978-1988)*

The 1993 cross-section was the first to contain surrender values for life insurance contracts and market values for real estate property. Fortunately, the data from 1978 through 1993 shares a considerable amount of additional information on life insurance contracts and real estate. We exploit the connections between these variables and the actual wealth measures in the year 1993 to impute the older data.

Yet the use of outside information from a different year may entail some problems. Clearly, any imputation will impose the relations between the variables used in the imputation process from the outside data on the data to be imputed. Hence in our case, the imputed data from 1978 through 1988 will inherit the characteristics of the joint distribution of the variables involved in the imputation process from the 1993 cross-section. The imputation should therefore rely on structural coherences which are largely time-invariant. If this can be successfully implemented, then changes in the distributions of the imputed variables (e.g. housing wealth) between 1978 through 1993 will legitimately be driven by changes in the joint distribution of the variables involved in the imputation process (e.g. living space, ratable values, and characteristics of the building). Given that we cannot check the underlying assumptions of our imputation procedure, possible limitations are to be kept in mind when analyzing trends in the distribution of wealth data between 1978 and 1993.

II.1.1 Wealth in life insurance contracts

There are several ways in which the value of a life insurance policy could be measured. If we are interested in the actual value of the accumulated wealth, we should calculate the present value of the expected payouts from the contract – assuming that no further contributions would be made. There are two reasons why we might want to deviate from this measure. First, the wealth resulting from the above concept will not be available to its owner. The insurance company will only offer a lower surrender value.[1] And second, the above measure will depend strongly on the assumptions about future access returns generated by the insurance company, which are credited to the contract.[2] But also for reasons of availability of the desired information, most surveys question the surrender value of life insurance contracts which is part of the annual reports sent out by the insurance companies.

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[1] Taking out a credit to be paid back with the payments from the insurance contract the owner will also not be able to access the full present value. The reasons are credit costs, disagios, and the spread in interest rates.

[2] According to German laws 90 percent of the insurance companies' profits have to be handed on to their customers' contracts.

The surrender value was part of the EVS questionnaire in the years 1993 through 2003. The earlier cross-sections 1978 through 1988 questioned only the insurance sum. Fortunately, the 1993 cross-section contains the surrender value and the insurance sum, as well as a large number of covariates allowing us to impute the missing information on the surrender values in the older cross-sections.

Regression based imputation

We estimate an OLS model for the surrender value of life insurance policies *(sv)* in 1993 (1) and use the regression results for the imputation of the years 1978 through 1988 (2).

Our core explanatory variables *(X)* include the contributions made and the insurance sum. The latter is available as a categorical variable in the years to be imputed and as a continuous variable in 1993. For the estimation we translate the cutoff points of the brackets into 1993 values and mimic the equivalent brackets in the 1993 data. The brackets differ between the cross-sections 1978 through 1988.[3] This and the applied indexation yield slightly different regressions for the imputation of the three years with missing data. Otherwise, we use identical procedures for the imputation.

$$sv_{i,1993} = f\left(X_{i,1993}, A_{i,1993}\right) + u_{i,1993} \tag{1}$$

$$\hat{sv}_{i,t} = f\left(\beta_{1993}, X_{it}, A_{it}\right), \qquad t = 1978,1983,1988 \tag{2}$$

While the insurance sum tells us something about the ultimate volume of the insurance contract the contemporary contributions are an indicator for the savings that go into the contract and may – in relation to the insurance sum – be an indicator for the time span over which contributions are made. Specifically, observing a contract with small annual contributions relative to the insurance sum we can expect it to receive payments over many years, maybe even several decades. Vice versa for a contract with relatively large annual contributions. Yet without further knowledge about the inception date and the contribution history it will be quite difficult to assess how much wealth has been accumulated in the contract. Hence we include the age of the household members *(A)* to proxy for the contribution history. As we cannot attribute life insurance wealth to a specific household member, we try to capture the household composition

[3] Table A-1 in the Appendix gives an overview over the changes in the categories which carry over to slightly different regressions in the imputation process.

by including count-variables for the number of adult household members in age-groups of 5-year width and a dummy specification for the number of children. The sample size of the EVS cross-sections (between 40'000 and 60'000 households, among them roughly 50 percent holding wealth in life insurance contracts[4]) allows us to include interactions of our age-group counts with the core explanatory variables and among these variables.

We deliberately exclude other sociodemographic and socioeconomic variables from the regression to minimize the effects of induced connections from the 1993 data. The main reason is that we are ultimately interested in the analysis of wealth, savings and investment behavior throughout the life-cycle. Including information on other wealth categories, income, marital and parental status we were able to increase the predictive power of our model only marginally. At the same time, the inclusion of variables like income may generate artifacts in the distribution of the imputed data. We give an example for this potential issue in the description of the imputation procedures around real estate wealth. With respect to the inclusion of age variables we decided in favor of an inclusion, as the theoretical connection between age and accumulated wealth in life insurance contracts turned out to be statistically important.[5]

Stratified cold-deck error sampling

All regression based imputation procedures will underestimate the true amount of variation in the missing variables unless measures are taken to compensate accordingly. Given the non-normal distribution and the heteroskedasticity of the error terms resulting from our estimation, we use a procedure, which can be described as cold-deck error sampling. Specifically, we draw from the distribution of error terms $u_{i,1993}$ resulting from our estimation based on 1993 data and add them to the predicted values $\hat{sv}_{i,t}$ of the missing 1978-1988 data.

In a first step, we keep only estimation errors within two standard deviations of the mean standard errors conditional on age to avoid draws of extreme outliers. This reduces the error sample by roughly 4 percent. Next, we draw from the errors using clustering to account for the complex structure of the error terms. The clusters are defined as a matrix of age-groups and the

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[4] For a detailed analysis on the prevalence of life insurance products in German households' portfolios see Sommer (2007).

[5] The explained share of the variation in life insurance wealth decreased from 52.1 percent to 51.2 percent when dropping information on income, marital and parental status and other assets. This share declines to roughly 34 percent if the age-structure of the household is dropped from the model.

categories of insurance sums described above.[6] Clusters containing only a small number of observations are merged with neighboring clusters.[7] From this procedure, we arrive at a final number of roughly 100-150 clusters for the actual imputation.[8] Last, we re-draw errors from the same distribution when encountering errors outside the 95% confidence interval of the distribution of residuals in each age-group. This step becomes necessary, as some clusters are merged across age-groups.

II.1.2 Housing Wealth

Two different questions concerning housing wealth have been included in the EVS over the years. The first concerns the ratable value, which was questioned between 1978 and 1993. The main advantage of this value is that it is rather easily available to the household and a reliable figure, as it is used for the calculation of property taxes and hence not subject to subjective judgement. Unfortunately, the ratable value typically falls substantially below the market value although it is strongly correlated.[9] For a good estimate of the actual value of a household's real estate wealth we are better off in the EVS cross-sections since 1993, which incorporate questions on the actual market value. Being aware that this measure will contain a much larger measurement error it is still our preferred measure.[10] Given the overlap in the questionnaires with respect to market and ratable values in the 1993 cross-section, we proceed much like in the case of life insurance wealth and exploit the variance covariance-structure in 1993 to impute the market values in the previous cross-sections using regression based imputation.

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[6] The age-groups are defined with 5-year width and based on the age of the household head. Head of household is the main earner.

[7] We strived to reach a minimum cluster size of 40-50 observations per cluster. Further, we try to merge only clusters with a comparable distribution of errors. For clusters involving small insurance sums, we mostly merged equal age-groups with the neighboring insurance sum category. Among retired households we also merged across age-groups – especially among clusters with high insurance sums.

[8] Table A-2 in the Appendix gives an overview over the sample sizes and the number of clusters involved in the imputation process.

[9] The coefficient of correlation is roughly 65 percent in the 1993 cross-section which holds information on both, market and ratable values. On average, the ratable value made for 12 percent of the market value in the same year.

[10] Benitez-Silva et al. (2008) show e.g., that households tend to overestimate the value of their homes by 5-10 percent comparing them to actual sales data.

Regression based imputation

We estimate an OLS model for the market value of the household's real estate wealth based on the sample of property owners. We rely exclusively on information about the property and especially on the characteristics of the owner occupied home. In contrast to the case of wealth in life insurance contracts, the inclusion of information about the household composition, its age-structure and the household members' income seemed to hurt rather than help our purpose. To give an example: Assume that young households which are still in the workforce and earn larger incomes are part of cohorts which live in larger homes compared to their parents' generation throughout their lifecycle. The inclusion of income variables – a positive and significant predictor of real estate wealth – will then pick up these cohort effects. The imputation of housing wealth in previous cross-sections would then imply higher levels of housing wealth for the older cohorts in their pre-retirement years. While the gains from including income and household composition variables in the imputation process seem small, there is reason to believe that the inclusion of such variables would induce artificial connections in the data.[11]

The set of variables used in the imputation process includes the ratable value and the rental income of the property. The latter includes actual rental income as well as imputed rent for owner occupiers. Further, we include information on the size, the type and the age of the building, the city size and the heating system. Again, we take a uniform approach for the imputation of the years 1978, 1983 and 1988 and make minor adjustments depending on the harmonized definitions which can be established in 1993 and the individual year to be imputed.[12] Like in the case of life insurance wealth we exploit the size of the dataset to include various interactions of the above variables.

Last, we correct our predicted values for a distinctive feature of ratable values. Specifically, for all buildings – independent of their year of construction – the ratable value denotes the hypothetical value of the building in the year 1964. Hence, our imputations will reproduce the relations between the market values and the deflated hypothetical values of this base year. Given that this relation has been inflated over time, we apply a correction factor to our results based on the rent price index.

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[11] The share of explained variation in the 1993 real estate market values decreased from 53 to 51 percent when skipping all the information related to the household members from the regression used for the imputation of the 1978 data. The corresponding figures for the years 1983 and 1988 differ from the above by less than 2 percentage points.

[12] The appendix contains an overview over the information about the building used for the imputation (table A-2).

Cold-deck error sampling

To restore the dispersion of the imputed data to a realistic level we draw from the distribution of errors generated in the regressions based on the 1993 data and add these error terms to our predicted values in the previous years. We refrain from using clusters as the errors show little if any signs of heteroskedasticity with respect to the age of the building or its ratable value. Hence, we only truncate the error sample at two standard deviations above and below zero. Similar to the case of life insurance wealth, roughly 4 percent of the observations from the error sample are lost because of this procedure.[13] In a second step, we redraw from the errors if the imputed market value was negative or resulted in an unrealistic ratio of the ratable value to the market value.[14]

[13] Table A-4 in the Appendix gives an overview over the sample sizes involved in the imputation process.

[14] We used the ratios between ratable values and market values in the 1993 cross-section as a reference and chose a maximum ratio of 0.5 to be realistic.

II.2 *Imputation of the cross-sections 1998 and 2003*

As mentioned above, the Federal Statistical Office has abandoned the provision of fully imputed data in recent years. The incomplete data concerns only wealth but essentially all asset categories. For the years 1998 and 2003, the data contains filter questions on ownership. In 2003, this is the case for each asset and debt category. In 1998, the filter questions are less detailed – specifically, all financial assets are questioned in one filter question. Further, the 1998 questionnaire allowed households to answer the filter question with yes without indicating an actual amount of wealth. For 2003, we can further distinguish households which refused to answer the filter question. We impute both cross-sections using a similar approach: We start by checking the filter questions for consistency and make corrections where necessary.[15] Next, we impute the filter question where households refused to answer. From this, we define the samples which are to receive actual wealth imputations by asset category. We employ regression based imputations on both stages, i.e. for the imputation of the ownership question and the imputation of actual wealth levels.

II.2.1 Imputation of the ownership question

In 2003, between 0.5 and 2 percent of the households refused to indicate whether or not they held certain assets. An exception is mortgages, where almost 30 percent of households did not answer the filter question (see table 1). The vast majority of these households does not own a home, thus they may just have considered the question inapplicable.

We use a probit model to estimate the probability of households to hold certain assets or owe certain kinds of debt. Eymann (2000) has shown for the case of Germany, that unobserved factors like financial knowledge are important determinants of asset ownership. This generates correlations between the ownership of the various assets. We also observe these correlations in our data and therefore mutually include the ownership of other assets or debt in the imputation process. As the imputations become interdependent, we implement an iterative imputation process. Each iteration, all ownership variables are imputed successively, ordered by the number of missings in each asset category. Households are considered owners or non-owners if the predicted probabilities exceed or fall below 50 percent respectively. A round of iterations is completed as soon as the imputed ownerships remain unchanged for all households and asset categories.

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[15] Specifically, 64 households (~ 0.15 percent of all households) indicated to hold zero housing wealth, but declared receiving rental payments, contributing to maintenance reserve funds, owing mortgages etc.

The first round of iterations includes ownership dummies for all other assets. It eliminates 82.5 percent of all missing data points. The remaining belong to observations with multiple missings. Round by round we drop more ownership variables from the imputation model until all ownership variables are fully imputed. Last, we rerun the full specification with all ownership variables to allow the structure of multiple ownerships to be conveyed also to those observations with multiple missings, which had been imputed using the restricted model.[16]

Table 1: Effects of the imputation on asset and debt ownership (EVS 2003)

		real estate	building soc. savings contracts	other assets with banks	saving accounts	securities	mort-gages	con-sumer credit
ownership								
without imputation	yes	25623	21101	18335	32928	20081	15397	6904
	no	16922	21286	23541	9383	22337	14688	35475
	dont know / refuse	135	357	868	433	326	12659	365
	recodes	64	-	-	-	-	-	-
	% miss.	0.5%	0.8%	2.0%	1.0%	0.8%	29.6%	0.9%
	total	42744	42744	42744	42744	42744	42744	42744
with imputation	yes	25734	21196	18530	33342	20144	16033	6904
	no	17010	21548	24214	9402	22600	26711	35840
growth of owner-HHs								
		0.4%	0.5%	1.1%	1.3%	0.3%	4.1%	0.0%
ownership rates								
before imputation		50.07	43.2%	38.8%	75.3%	40.2%	41.3%	15.1%
imputed obs.		45.55	17.8%	16.8%	93.9%	13.9%	3.6%	0.0%
after imputation		50.05	43.0%	38.3%	75.6%	40.0%	28.0%	14.9%

Source: Own calculations based on EVS 2003

The resulting ownership rates for the fully imputed data change only marginally compared to the raw data (see the bottom part of table 1). The obvious reason is the small overall number of refusals. A clear exception is the ownership rate of mortgages. As mentioned above, the vast majority of refusing households does not own a home. The share of households owing mortgages drops correspondingly from 41.3 percent in the raw data to 28 percent in the imputed data. Despite the small overall effect of the imputation on estimated ownership rates, we observe

[16] For 2003, this last round causes a total of 21 changes counting all six categories together. For the entire imputation, 24 iterations were necessary.

substantial differences in the estimated ownership rates of the denier households compared to the remaining sample. Somewhat surprisingly at first, the differences take different directions for the individual asset categories.

Investigating the characteristics of the denier households, we find them to be older and earn lower incomes than the remaining sample (see table 2). Further, the share of household heads with no educational attainment is considerably higher among the deniers. The facts that saving accounts play a more important role in the portfolios of older cohorts and at the bottom of the income distribution suggest that the diverging effects of the imputation on ownership rates is no reason for concern.

Table 2: Characteristics of households with missing wealth observations

	real estate	building soc. savings contracts	other assets with banks	saving accounts	securities	mort-gages	con-sumer credit
age of household head							
missing	56.6	58.0	55.4	53.5	59.0	49.1	57.9
non-missing	51.4	51.4	51.4	51.4	51.4	52.7	51.4
post government income							
missing	22'601 €	22'794 €	24'882 €	23'573 €	23'756 €	23'561 €	24'131 €
non-missing	29'550 €	29'580 €	29'623 €	29'586 €	29'562 €	32'729 €	29'564 €
share of household heads without educational attainment							
missing	12.7%	12.2%	11.3%	14.4%	11.6%	7.9%	10.2%
non-missing	6.2%	6.2%	6.1%	6.2%	6.2%	5.4%	6.2%

Source: Own calculations based on EVS 2003

II.2.2 Imputation of wealth holdings

With the ownership question imputed we turn to the missings in actual wealth holdings and find the share of missings in the 1998 and the 2003 cross-section to range between 0.1 and 2.6 percent of all observations. For the imputation, we take separate approaches for housing wealth and all other kinds of assets and debt. For both cases, we employ OLS regressions among households which have been identified as owners and use hot-deck error sampling to restore the dispersion of the imputed data.

Housing wealth

For *housing wealth* we applied the established imputation procedure of the early cross-sections 1978-88. We base our regressions upon the contemporary information on the coherences between the market values, rental incomes, rateable values, building characteristics, and several interactions between the aforesaid variables.[17] Among the building characteristics are the size and age of the primary residence as well as its location – proxied by city size and states. Obviously, this approach has its limits for households owning several pieces of real estate and renters who own property. At the same time, the non-responding households tend to have lower incomes and are thus rather unlikely to own multiple pieces of property.

Financial wealth

Given the near log-normal distribution of wealth holdings, we convert all measures of wealth and debt involved in the estimation into logs. For the prediction of actual wealth and debt levels we employ the correction factor suggested by Bakersville (1972) to compensate for the antilog-bias.[18] We successively impute the individual asset and debt classes, starting with those asset classes with the least missings. Like in the case of ownerships, we mutually include actual asset and debt holdings in all categories in the regression model. Again, the imputations become interdependent and we iterate over the identical regression and imputation steps until convergence.[19] To overcome the problem of multiple missings, we first exclude individual asset categories from the regressions. For the next round of iterative imputations, we generate intermediate subtotals of total debt and gross wealth which we include in the regression instead of the individual asset holdings. This allows us to generate a preliminarily imputed dataset. Last, we use these preliminary asset and debt holdings to rerun the initial imputation model. Thereby, we allow the complex interdependencies of the asset allocation to be conveyed also to those observations with multiple missings, which had been imputed using the restricted models.

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[17] For 1341 observations also the rateable value is missing. For these cases, we apply the same imputation algorithm and exclude the according variable and its interactions.

[18] Beauchamp and Olson (1973) have shown that the procedure proposed by Bakersville (1972) still does not eliminate the full bias but concede that the bias is small unless the variance is quite large. We carried out some comparative checks with an unbiased estimator. We found the differences to be comparatively small and thus decided for the more parsimonious calculations.

[19] We define convergence as achieved if for all asset categories the sum of absolute changes from the previous to the actual iteration is less than one 0.1 percent of the mean asset holdings in this category. The entire imputation took roughly 100 iteration steps.

The imputation procedure for the 1998 cross-section differs slightly from the 2003 procedure. This is due to the fact that in 1998, the filter question only allows us to identify households that indicated holding some kind of financial wealth without filling in amounts. Unlike in 2003, a more detailed breakdown of refusals by asset category is not possible. For 1998, we therefore impute wealth only at a rather general level. Specifically, we use the categories *gross financial wealth, life insurance wealth, and consumer credits.*[20] *Mortgages* turn out to be fully imputed in 1998 just as *life insurance wealth* in 2003.

Hot-deck error sampling

For all kinds of assets and debt, we draw from the distribution of errors generated in the regressions and add these error terms to the predicted values of the imputed observations. Contrary to the procedure described above for the imputation of the years 1978-88, we use a hot-deck procedure as we are also using contemporary information for our imputations. The procedure itself is quite alike though: We truncate the error sample at two standard deviations above and below zero. If the final imputed values turn out negative, we redraw individual errors until we arrive at positive values.

Effects of the imputation on net household wealth

For 2003, the imputation raises average net household wealth by 5.6 percent (see table 3). The largest increase is in real estate wealth, which increases by roughly 7'500 Euros or 6.9 percent. Also mortgages are heavily underestimated in the unimputed data. Here, the increase amounts to almost 5 percent. Overall, the imputation leaves households with higher levels of net real wealth. The imputation effects are substantially lower for all components of financial wealth at a weighted average of 1.6 percent. Average outstanding debt in consumer credits is largely unaffected by the imputation.

As mentioned above, the 1998 cross-section required a slightly adapted imputation approach, as no breakdown of unreported financial wealth into asset classes is available. Table 4 gives an overview over the effects of the imputation on average wealth holdings for the year 1998. Life insurance wealth increases by 4.3 percent, other financial wealth by 1.1 percent. This leads to an overall jump in gross financial wealth of 2 percent. On the liabilities side, the raw data underestimates average consumer credits by 6.4 percent. Real estate and mortgages contain no

[20] For 2003, the category *gross-financial wealth* is broken down further into four subcategories which we employ directly in the imputation process. The other categories are equally used in both years.

missings in 1998, so that net total wealth is rather little affected by the imputation compared to 2003.

Table 3: Effects of the imputation on average wealth and debt levels (2003)

	before imputation	after imputation	% change
real estate	110'533 €	118'116 €	+ 6.9%
+ gross financial wealth	40'578 €	41'210 €	+ 1.6%
saving accounts	7'758 €	7'947 €	+ 2.4%
building society savings contracts	2'543 €	2'646 €	+ 4.1%
other assets with banks	8'275 €	8'493 €	+ 2.6%
securities	10'652 €	10'774 €	+ 1.1%
life insurance	11'350 €	11'350 €	n.a.
= gross total wealth	151'112€	159'326 €	+ 5.4%
- total debt	25'422 €	26'622 €	+ 4.7%
mortgages	24'212 €	25'401 €	+ 4.9%
consumer credit	1'210 €	1'221 €	+ 0.9%
= net total wealth	125'690 €	132'704 €	+ 5.6%

Source: own calculations based on EVS 2003
Note: weighted results in EUR 2003

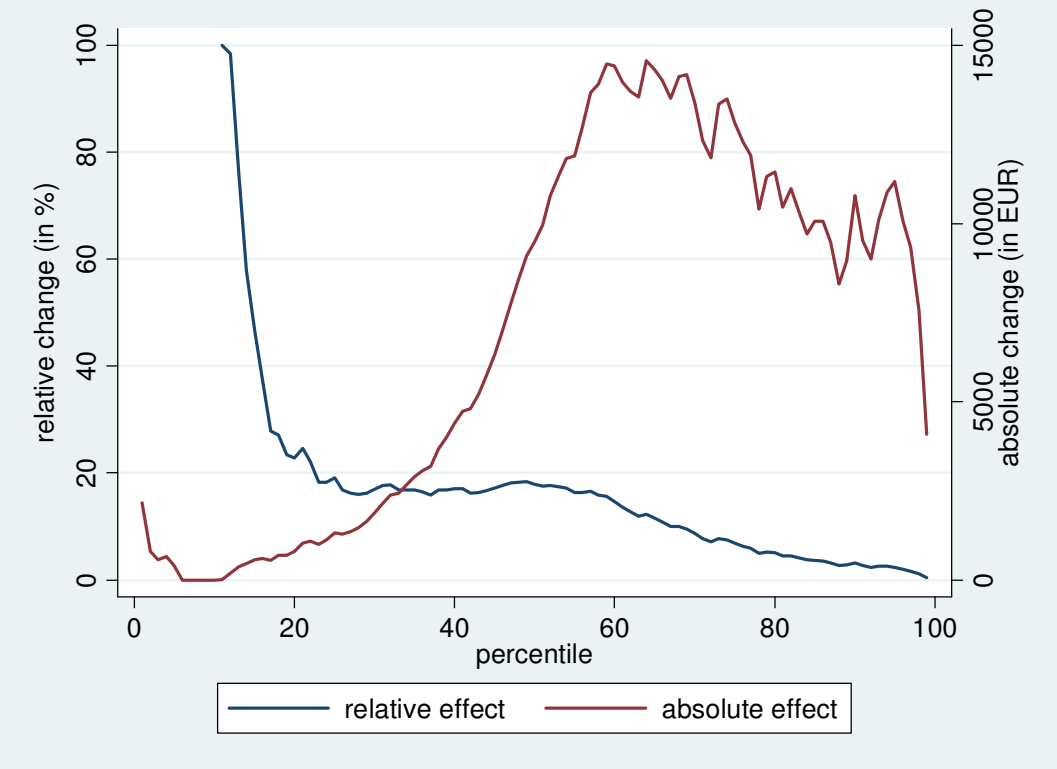
Table 4: Effects of the imputation on average wealth and debt levels (1998)

	before imputation	after imputation	% change
real estate	100'980 €	100'980 €	n.a.
+ gross financial wealth	31'852 €	32'496 €	+ 2.0%
life insurance	9'439 €	9'846 €	+ 4.3%
other financial assets	22'413 €	22'649 €	+ 1.1%
= gross total wealth	132'832 €	133'475 €	+ 0.5%
- total debt	19'877 €	19'962 €	+ 0.4%
mortgages	18'570 €	18'570 €	n.a.
consumer credit	1'308 €	1'392 €	+ 6.4%
= net total wealth	112'955 €	113'514 €	+ 0.5%

Source: own calculations based on EVS 1998
Note: weighted results in EUR 1998

Obviously, the effects of the imputation on household wealth holdings are more complex than describable by just the changes in mean wealth levels. Figure 1 gives some more insights: Displayed are the absolute and relative changes in net wealth percentiles caused by the imputation. In absolute terms, the imputation has the strongest impact on the upper half of the distribution – the 43rd to the 98th percentile are all shifted by at least 5000 Euros. In relative terms, the importance of the imputation is just reversed. The bottom 10 percent of the distribution have zero or negative wealth. Imputation accounts for 25 to 100 percent of the shift of the following 10 percentiles. From the 20th up to the 60th percentile, the imputation had a rather uniform effect on the distribution. Without imputation the wealth levels of this part of the wealth distribution would be approximately 20 percent lower. The relative importance of the imputation steadily declines towards the top end of the distribution.

Figure 1: Effects of the imputation on the distribution of net total wealth (2003)



Source: Own calculations based on the EVS 2003

Note: relative change is defined as the difference between post- and pre-imputation wealth levels as a share of post-imputation wealth.

Comparative evaluation of the imputation

Comparing the results of our imputations to the work of Ammermüller et al. (2005) we find only little differences for 1998 as regards the sample means. Also for 2003, our results are broadly in line with their work.

Like us, Ammermüller et al. use separate imputation approaches for housing wealth and financial wealth. They propose two different imputation schemes for the imputation of financial wealth: In the first scheme only those observations are imputed where the presence of assets in a certain category is known and the actual value is unknown. The alternative scheme also imputes those observations where the filter question also remained unanswered. Remember that we use a two-stage approach, in the first stage of which the filter question is imputed. Thus, our results can be expected to end up between the two approaches suggested by Ammermüller et al., which proves to be true: Their two schemes increase gross financial wealth in 2003 by 1 and 4.1 percent respectively compared to 1.6 percent in our imputations.

For part of real wealth, Ammermüller et al. applied three different imputation schemes. The first only imputes those observations where ratable values are available. The actual imputation applies a scaling factor to deduce the market values from ratable values. The second approach also deals with those households who are known to hold housing wealth but did not indicate ratable values. For the additional households, Ammermüller et al. apply mean imputation for groups of similar households in similar buildings. Those households who did not answer the filter question on real estate ownership remain unimputed also in this second approach. Only the third approach deals with these cases where the actual ownership is uncertain. Instead of imputing the ownership question, they estimate average real wealth holdings based on a reduced dataset. They drop the uncertain cases and a random selection of households which are known to hold no real estate. They choose the number of dropped non-owners such that the share of real estate owners in the sample remains. Their underlying assumption is that the share of real estate owners and the distribution of real estate wealth is the same among households who answered the filter question and those who did not. We estimate the share of real estate owners to differ only slightly in the two samples – 45 percent among the refusers, 50 percent among the remaining households. Our estimated wealth levels differ substantially though, just as expected by Ammermüller et al. in their discussion of the different approaches. Specifically, the average imputed wealth level of the owners among the households refusing to answer the filter question is 45% lower than the average real estate wealth among all other real estate owning households. The average post-imputation gross real wealth estimated by Ammermüller et al. reaches 112'438 € and 119'494 € using the first and the second approach respectively. Our result of an average real estate wealth of 118'116 € is the same order of magnitude but slightly lower than one might expect given that the

second approach by Ammermüller et al. still leaves roughly 200 observations unimputed. We suspect at least part of the stronger wealth growth in their imputation to be caused by their choice of mean imputation. We find imputed real estate wealth to be roughly 20 percent lower than wealth reported by the households. This is matched by a 23 percent lower average level of post-government income.[21]

Overall, we find our results with respect to average post-imputation wealth levels to be largely in line with this earlier work – despite the different methodological approaches. As the EVS data is quite frequently also employed for distributional analyses, the procedures of these previous imputations seem unsatisfactory though. Especially the use of mean imputation and the lack of a stochastic component in the imputation process will lead to a reduced level of dispersion in household wealth holdings. Further, only a regression based imputation approach will be able to preserve the connections between wealth holdings and other socioeconomic variables, which is a necessary basis for subsequent multivariate analyses.

[21]Note that income is not part of the regressions involved in our imputation of real wealth, as we have illustrated above.

III. Harmonization of EVS data

As we have mentioned before, Germany is still lacking a longitudinal data source which would be suited for life-cycle considerations of income, wealth, savings and consumption.[22] The use of a synthetic panel based on the German income and expenditure survey (EVS) causes some complications but also the EVS sample itself is not free of conceptual issues. In the following, we will focus on issues which arise because of changes to the questionnaire before we turn to conceptual issues in section 4. The changes concern the level of detail at which asset, income, and consumption categories are questioned. We observe both, an increasing and a decreasing level of detail for different variables over time. Furthermore, the household diary was switched from an annual to a quarterly time frame. In the following we provide comparable definitions which can be applied to all available cross-sections of the EVS.

III.1 *Income*

Although the EVS was originally intended for the construction of consumption baskets, the level of detail at which income is questioned is enormous. The data allows us to distinguish household income by source and by person. Incomes from a number of sources, which are difficult to attribute to a single person, tend to be questioned for the entire household. Examples are asset income or child benefits. Where income is available at the individual level, up to six persons in each household are questioned. If more people live in the household, there is no income data available for these further individuals. The share of households with more than six adult members was 0.01 percent over the years 1978-2003 though. In absolute numbers we are talking about 30 households out of a total 267'434 in the pooled sample.

Where possible we start by harmonizing the individual level income data. To arrive at harmonized definitions we group income categories to the smallest common summary category and adjust quarterly and annual measures. We will come back to the issues connected to the switch from annual to quarterly data between 1993 and 1998.

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[22] The GSOEP provides a well established database for analyses of income dynamics. In 2002 and 2007, a wealth questionnaire was added. The savings questions are insufficient though and consumption is not questioned in the GSOEP. The other longitudinal datasets like SHARE and SAVE also contain no or only little consumption data. Further, their panel dimension is rather short so far. SHARE is additionally focused on the elderly and therefore only suited for a restricted area of life-cycle and inequality analyses.

Once the individual variables are harmonized we generate aggregate variables in two dimensions: subtotals and totals by person and household incomes by income categories. The subtotals are generated for the following income categories, for each of which we describe the key definitions and harmonization decisions made:[23]

Income from dependent employment

Our core definition of employment income includes all regular payments from the main occupation and possible secondary jobs as well as irregular payments. The latter include Christmas bonuses and other bonuses, settlement payments, employer co-payments to private and voluntary public health insurance as well as employers' contributions to employees' savings schemes. As non-cash income components can only be separated from other income for the years 1998 and 2003, we also include these payments in kind in our definition of income.[24] But there are also important conceptual reasons to do so. First, any income related analysis cannot ignore payments in kind as they may substitute for pecuniary payments. Excluding the monetary value of payments in kind would lead to an underestimation of wages in a labor market analysis or underestimate financial opportunities and the economic wellbeing of the household in an inequality context. Second, induced by the household budget, also analyses of consumption and savings are affected if payments in kind are disregarded. They generate consumption utility and are therefore correctly comprised in household consumption in the EVS. The difference between income and consumption being savings payments in kind have to be equally treated as part of household consumption and income. Otherwise, the reception of payments in kind instead of pecuniary payments would per se change household savings.

Income from self-employment

Whereas theoretical considerations would suggest splitting income from self-employment into work income and asset income depending on the degree to which the self-employed work is capital intensive, this distinction is rarely implemented in practice.[25] We follow the EVS definition

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[23] For a more detailed overview over possible harmonized definitions in the EVS, see the appendix.

[24] In 2003, only 0.68 percent (weighted) of the households indicated having received incomes in kind for dependent work. For these households, such incomes in kind account on average for roughly 3 percent of their dependent work income.

[25] Assumptions about the production technology would have to be made and information on the capital stock involved is necessary. Like in most other household surveys, no such information is available in the EVS framework.

and consider all income from various kinds of self-employment in this category. They include farm income, service-, trade- and industrial-business income as well as income from work in private practice, e.g. of lawyers and doctors. Note, that we also include private withdrawals from the business in our definition of income from self-employment. While we would conceptually consider private withdrawals equivalent to a sale of assets such distinction is rendered impossible by the construction of variables within the EVS. Specifically, only the 2003 cross-section allows us to separate withdrawals and other income from self-employment. Income from partial or full sales of private businesses can be distinguished in all years and is not included in the above definition.

Public transfers

The notion of public transfers contains a large number of quite heterogeneous payments. We therefore define the following harmonized subcategories: public pensions, health related public transfers, unemployment related public transfers, public support transfers, and a residual category of other public transfers.

Public pensions include payments from the public pension system, pensions for civil servants and veterans' pensions. All three include both, pensions from own employment history as well as survivors pensions. Further, we also subsume foreign pensions and pensions paid by the public accident insurance into this category.

Health related public transfers comprise civil servants' health assistance, regular and irregular payments from the public health insurance, sickness benefits, maternity benefits, as well as subsidies from the public pension scheme to voluntary public or private health and long term care insurance. Also payments from the long term care insurance are included.

We define unemployment related public transfers to include all kinds of unemployment benefits and payments intended to support reentry into the job-market, as well as old age part-time payments.

The public support payments include child benefits and child raising benefits, social welfare, housing benefits, payments from European social funds, and advance payments for alimony.

Finally, we generate a residual category of other and unclassified public transfers. It includes apprenticeship grants, home owners' benefits and compensations for damage and losses during and immediately after the Second World War.[26] But also selected income categories are included which we would want to assign to one of the above categories if they were not grouped together

[26] The German term is "Lastenausgleichsrenten".

in a way which prevents us from doing so. Generally, all of the above subcategories should be available and comparable across years except for some minor inevitable discrepancies.

Private transfers and private pensions

Our definition of private transfers refers to all kinds of non-government payments received without involving a defined work-effort. Hence alimony payments, gifts, inheritances, strike support payments from unions, as well as support from churches and other charitable institutions are included. We also subsume payments from private insurance contracts in this category. Excluded are only payments from private life-insurance contracts and any pension payments for which we generate an independent subtotal.

Although Germans' pension income still largely relies on public pensions, there is a variety of private and occupational pension schemes which are included in this last income category. Specifically, it comprises pensions from private insurance contracts, as well as a number of employment related pensions which differ in the extent to which they are based on employers' or employees' contributions. First, there are occupational pensions for certain groups of self-employed, e.g. for lawyers, doctors and farmers. Second, there are occupational pensions from medium- and large-sized firms. Last, there are additional private pensions for employees in the civil service.

Note that we deviate from previous work in that we include private pensions in private pension income. Conceptually, we treat the start of a private pension as lump-sum dissaving of life insurance wealth which is then turned into an annuity. The resulting stream of private pension payments is then considered as income. Our main reasons not to split the annuity income into dissavings and asset income as suggested by Börsch-Supan et al. are the following:[27] First, the individual has no longer access to the underlying wealth once it is turned into an annuity and neither a surrender value (which does not exist in the payout phase) nor a present discounted value of the future pension payments shows up on the household balance sheet. Hence, treating part of the annuity as dissaving would not result in a corresponding reduction in household wealth. And second, given the lack of detailed information about the underlying insurance contract, any estimation splitting the annuity into asset income and dissaving seems rather at hoc.

Note further, that the definitions of the two above categories – private transfers and private pensions – cannot be entirely harmonized across years. The sum of the two categories is consistently defined across years though.

[27] Börsch-Supan et al. (1999) split annuity incomes into dissavings (2/3) and asset income (1/3).

Asset income

The EVS allows a separation of several categories of asset income except for 1978. Specifically, we can distinguish interest payments, dividends and income from other kinds of shares. The sum of these three categories defines our notion of gross financial asset income. Adding rental income we arrive at gross total asset income. Analogous to the case of non-cash income we treat imputed rent from owner occupied housing as part of income and consumption. We further define net total asset income by deducting interest payments for outstanding mortgages. An analogous treatment of interest payments for consumer credits is not straightforward as the EVS questionnaire summarizes credit repayments and interest payments in one question. At the same time, it seems questionable whether households would be able to distinguish the two, as most consumer credits are installment plans with constant monthly rates where interest rates tend to be published only for advertisement purposes. We treat the installment payments entirely as savings. While this might cause inconsistencies with the wealth questionnaire, which asks about outstanding consumer credits, we expect households to fill in the sum of remaining payments in the case of installment plans as argued above.

Deductions from income

The deductions from income can be broadly split into tax payments and contributions to the social security system. Taxes include income tax, as well as the connected church tax and "solidarity tax". The latter was introduced following the German reunification and was officially intended to finance the unification costs. Further, there are wealth taxes, estate and gift taxes, and other taxes like car, dog, fishing and hunting taxes. Conceptually, we would consider wealth, gift, and estate taxes deductions from income, whereas car, dog, fishing and hunting taxes should be treated as consumption expenditures. Unfortunately, we can only distinguish wealth taxes from the other taxes.[28] Hence, we treat all these taxes as deductions from income. Further, we include the taxes imposed on landlords who received tax favors for engaging in the construction of social housing but rent out to non-eligible renters. Last, we calculate net tax payments by deducting tax refunds.

The second group of deductions concerns all compulsory contributions to the public health insurance, the public pension system, the public unemployment insurance and the public long term care insurance. A debatable question is whether to include voluntary contributions to the

[28] The procedures of wealth taxation were judged unjust in 1995. Since 1997 then the taxation of wealth was suspended.

social security system – e.g. by self-employed individuals – in the deductions or not. While they are free to contribute to the public pension system or to save privately – e.g. in a life insurance contract – we decided to include these voluntary contributions nevertheless. There are several reasons to do so: First, both payments go to the government sector and should hence be treated equally for the calculation of "post government income". Second, consider the alternatives: If the voluntary contributions are not considered deductions from income, they either have to be treated as savings or as consumption. Treating them as savings would imply the accumulation of some kind of capital. In the case of voluntary contributions to the public pension system we might consider the accrued pension claims social security wealth. Again it seems unreasonable not to treat compulsory and voluntary contributions alike. Treating them as consumption would imply that two otherwise equal households – one contributing compulsorily and the other voluntarily – would differ in their consumption expenditures causing misleading results on actual consumption inequality. Last, we will not be able to distinguish payments from the system to the individual depending on whether she is compulsory or voluntarily insured. That is, even if we treated payments to the system differently, payments from the system would have to be treated equally.

Market income

We define market income to be the sum of gross incomes from employment. I.e. we include all kinds of income from dependent work as well as from self-employment. Neither taxes nor contributions to the social security system are deducted. To ensure comparability of incomes from self-employment and dependent employment, also employers' contributions to the social security system should be included. While this procedure is also recommended by the Canberra Group (2001), it has often not been carried out – largely for reasons of the work involved. Only recently, the Sachverständigenrat (2007) ignored employers' contributions to the social security system and we follow their approach. Generally, the concept of market incomes is especially suited for any analysis focused on wages.

Pre-government income[29]

Adding private transfers, private pensions and asset income to the above definition of market income, we arrive at pre-government income. This notion can be considered the hypothetical situation without a government sector (and without behavioral reactions).

Post-government income

Pre-government income and post-government income differ by the amount of taxes and social security contributions paid as well as tax refunds and any kind of public transfers. The comparison of pre- vs. post-government income allows us to estimate the net contribution of private households to the financing of the public sector. At the individual level, the same comparison illustrates the amount of redistribution.

III.2 *Wealth*

Also the asset questionnaire of the EVS has seen some changes. Surprisingly, most of the changes have not been caused by the introduction of new products. Instead, a few asset categories have been grouped together in 1993 reducing the level of detail at which we can generate harmonized definitions which are applicable for all years. For any analysis based on these harmonized definitions it should be kept in mind that an increasing level of detail at which households are questioned about their assets has been shown to increase the amount of wealth reported (see Juster, Smith and Stafford (1999)).

Financial Wealth

We define gross financial wealth as the sum of assets held with banks, in building society saving contracts, and in securities. Assets held with banks mostly include saving accounts, saving certificates, and term deposits. The securities include stocks, government and commercial bonds, as well as mutual funds. Note that also mutual funds on housing assets are included. Further, we add the surrender value of life insurance wealth. The EVS cross-sections 1998 and 2003 additionally include privately lent out money, and for 1993 we have additional information on

[29] Note that for the project "Cross-sectional facts for Macroeconomists", we deviate from the definitions of pre- and post-government income in that we exclude real estate income in both cases.

checking account balances.[30] We include neither in our definition of financial wealth for reasons of comparability. For a comprehensive measure of financial wealth we are also lacking cash holdings, which the EVS like most other surveys has never questioned. Deducting outstanding consumer credits we arrive at our definition of net financial wealth.

Real Wealth

A comprehensive definition of real wealth would include housing and business equity, as well as valuables and durable goods. For reasons of data availability we restrict our definition of real wealth to housing equity. Especially the lack of business equity will have effects on evaluations of wealth inequality as it likely accounts for a large share of private wealth among business owners. Unfortunately, the EVS only included questions on business wealth in the year 1983 and referred to fiscal values instead of market values. For part of valuables some data is available on purchases and sales. We also know about the existence and number of certain durable goods, e.g. cars, fridges or dishwashers but no information about their value is included.
As mentioned above, we therefore define gross real wealth to be the market value of all pieces of real estate owned by the household. To arrive at net real wealth, we deduct the amount of outstanding mortgages.

III.3 *Consumption*

The level of detail at which the EVS questions consumption expenditures is enormous. Additionally, the Federal Statistical Office provides thematic subtotals, namely expenditures for food, apparel, rent, energy, furniture and household appliances, health and body care, traffic and communications, education and leisure, and a few rather mixed categories. A number of expenditures have been grouped in different categories over time so that the more detailed consumption categories turn out quite helpful for the construction of harmonized definitions. Regrouping the above categories provided by the Federal Statistical Office, we define harmonized variables and calculate subtotals for non-durable and durable consumption.

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[30] In 1993, the average balance on up to five checking accounts owned by the household was 1402 EUR (2001) in the Western and 2224 EUR (2001) in the Eastern states. Adding this to our above definition of household gross financial wealth would generate increases of 3.8% in the West and of 17.3% in the East. 2% of West Germans and 1% of East Germans indicated not having a checking account.
Including privately lent out money to the definition of gross financial wealth would imply increases of about 1.6-1.8% which neither differ much between West and East nor between 1998 and 2003. In absolute terms privately lent out money accounts for an average 531 and 735 EUR (2001) in 1998 and 2003 respectively.

Like for the case of income a general note is necessary concerning the treatment of free consumption. The early cross-sections of the EVS included free consumption in the respective expenditure categories and simultaneously included such incomes in kind in the definition of income. We follow this procedure for the later years although a distinction of actual consumption expenditures and free consumption is possible to an increasing extent. Apart from the objective to generate definitions which are consistent over time any analysis which refers to utility and not exclusively to expenditures should include free consumption.

Durable and non-durable consumption

We generate the following thematic consumption categories, which can immediately be attributed to durable or non-durable consumption: *Food, clothes, energy, health, bodycare, travel, communication, education, rent,* and *household services* all count exclusively as non-durable consumption. *Furniture* and *real estate maintenance* are the only consumption categories which are considered durable consumption only. The categories *leisure*, *vehicles* and the residual category *miscellaneous* are mixed categories which have to be split into durable and non-durable sub-categories.

Among the non-durable consumption categories *food* includes both, expenditures for food at home and for food away. *Clothes* include purchases of apparel and shoes whereas dry-cleaning, repairs and alternations of clothes are part of *household services*. In the latter, also expenditures for household articles and housekeeping are included. *Energy* includes all expenditures for heating and electricity. Fees for doctors, dentists, nurses and other medical services, as well as expenditures for pharmaceuticals and health related equipment constitute the *health* category. *Bodycare* is a rather small category which comprises expenditures for hairdressers as well as for equipment and items associated with bodycare. *Travel* includes expenditures for holidays as well as for business travel. All expenditures for telecom, internet and postal services are part of *communication*. Note that telephone and computer equipment are not included. The popular bundling of phones and telecom services in recent years may blur the intended separation though. Unfortunately, a different approach is hampered by the definitions of electronic devices in the EVS. *Education* includes student fees, as well as fees for extracurricular courses and coaching. Further, we also count expenditures for child care, kinder gardens, books and writing material as education. Last, there is one of the most important regular expenditures of private

households – housing. We define r*ent* to comprise both, actual rental payments of tenants and hypothetical rent for owner occupied housing, and deduct income from sublease.[31]

As explained above, *furniture* is one of only two pure durable expenditure categories: It includes typical furniture like beds and closets but also all kinds of electronic household equipment, carpets, collections of any kind and work of art. *Maintenance of real estate* includes payment for repair material and services involved in the preservation of a house or apartment. We decided against the alternative of treating such expenditures as savings. The main reason is that they are not intended to increase the value of a piece of real estate. They might still oppose depreciation but we do not impute depreciation which would decrease the value of real estate either. We consider all wealth changes between periods valuation changes unless they involve purchases or sales. The fact that the maintenance expenditures generate utility which reaches clearly beyond the time of expenditures turns them into durable goods.

The remaining categories *leisure*, *vehicles*, and *miscellaneous* are part durable and part non-durable. Where possible we split the categories accordingly. In case of doubt or indivisibilities we include the expenditures into durable consumption as a clean measure of non-durable consumption seemed more important to us. First, daily consumption utility is largely connected to non-durable consumption expenditures. Durables like dishwashers and washing-machines certainly contribute considerably to household utility yet the utility flow is much less connected to the actual expenditures which are usually irregular or one-time expenditures. The same reason makes durable consumption a complex concept. On the one hand, the single expenditures tend to be larger and less frequent, and the purchase decision is most often a more conscious and thought through than with most non-durable goods. Hence, the reliability of the actual answers is likely to be better with durables than with non-durables. At the same time, the distribution of expenditures which happen at a frequency larger than the questioning period will appear more unequal than they truly are. We will come back to this issue in the discussion of conceptual changes in the EVS.

Vehicles can be split into actual purchases of vehicles, repairs and services. We attribute repairs and services to non-durable consumption and purchases to durable consumption. *Leisure* comprises expenditures for photo, TV and HiFi equipment, and computers which are all included in durable consumption. Further, other leisure related equipment (e.g. sports and camping gear) is added. Non-durable leisure expenditures comprise all repairs of the above items,

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[31] Our procedure is aimed at calculating a measure of consumption which is linked to actual consumption utility. Thus, we deduct rent for sublet rooms as the household does not enjoy the utility from these rooms.

pet food, television fees as well as tickets for all kinds of entertainment. Unfortunately, we also had to include dishes and gardening tools for reasons of varying non-separabilities in different years. The residual category *Miscellaneous* contains a variety of highly mixed and often non-separable expenditures. Examples are expenditures related to lawsuits, but also funeral costs, donations, and purchases of personal items like purses, watches, and jewelry. We attribute only expenditures for financial services and insurance premia to non-durable consumption.

III.4 *Savings*

Conceptually, there are three ways of measuring savings: First, we can deduct consumption from disposable income. Unless we treat inter-household transfers separately, the difference should be savings. Second, we can add up all additions and withdrawals from the individual wealth accouts and we should yield the same result. Both definitions can be used in the EVS framework and have been shown to yield comparable results (Börsch-Supan et al. (1999)).[32] The third possible definition is based on wealth changes. Given the cross-sectional nature of the EVS we cannot identify households which have participated repeatedly. What remains possible is to estimate wealth changes of synthetic cohorts. Conceptually this third definition differs from the previous two in that it includes passive savings, i.e. appreciation or depreciation of the stock of wealth. A comparison of the resulting savings estimates from is further complicated by two aspects: First, the samples of a cohort drawn at two points in time may be affected by a number of selection effects. Reil-Held (2000) and Gaudecker and Scholz (2006) have shown that differential mortality with respect to income plays a role among elderly Germans. Given the correlation between income and wealth it seems likely that mean wealth levels of cohorts will increase over time just because of higher survival rates among the rich. Apart from such changes in the population, also differential success in the sampling of cohorts over time may be an issue if they are not compensated by sample weights. The second issue concerns the time intervals between observations. We observe income, consumption and payments to and from the individual wealth accounts over one year or one quarter. Yet wealth is measured only at five year intervals. While we may estimate 5-year savings by a projection of our annual measures, such procedure will remain crude as we cannot account very well for irregular incidents like inter-household inter-vivos transfers and bequests. Further, effects of household formation and separation cannot be controlled for in a cross-sectional framework. The unusual and innovative procedure in the

[32] The income, savings and consumption data are for cross-validation such that major inconsistencies would most likely be eliminated in the data cleaning process carried out by the Federal Statistical Office.

GSOEP of questioning personal wealth holdings rather than household wealth may allow some deeper insights into wealth changes related by household formation.[33]

Savings in financial assets

We define gross financial savings as the sum of payments going into the individual savings categories. Deducting the withdrawals and sales in the same asset categories, we arrive at net financial savings. The breakdown of financial savings by category is non-trivial given the repeated changes in the questionnaire. We can consistently distinguish savings in savings-accounts, building society saving contracts, securities and other assets held with banks, as well as life insurance contracts.

Savings in real assets

Conceptually, savings in real assets should comprise real estate, business wealth and valuables like gold. All three are captured in the EVS and we include them in our definition of real savings, despite the fact that we do not have corresponding wealth categories. The reason is that certain asset reallocations – e.g. a purchase of gold which is financed by a sale of stocks – would otherwise have an effect on total savings. Obviously, there are good reasons to proceed differently as well: in the above example, our definitions would imply zero savings but a reduction in wealth holdings, as we do not observe gold as a wealth category. Thus, depending on the analysis at hand, a different definition may be the preferred choice.

Savings in debt

It is unclear, whether all debt should be considered negative financial wealth. Given that the takeout of mortgages is usually linked to the purchase of a piece of real estate, we add net repayments of mortgage debt to real savings and include net repayments of financial debt in financial savings. Any different approach should be matched by an equivalent classification of real and financial wealth.

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[33] The 2002 wave of the GSOEP was the first to include wealth questions since 1988. While the 1988 wave questioned wealth at the household level, the 2002 wave introduced these questions for the individual household members. In 2007 individuals have again been questioned about their individual wealth holdings. With the availability of the data it will be possible to track wealth effects of household formation and separation.

IV. Conceptual changes in the questionnaire and ways to deal with the resulting issues

Given the cross-sectional nature of the EVS and its original purpose – the construction of consumption baskets – comparability over time has never been among the first concerns in the sample design process.[34] At the same time, the Federal Statistical Office has actively worked on improving the survey along several lines.

In the following we discuss two important structural changes which may affect the comparability of data based on different cross-sections: The switch from annual to quarterly household diaries between 1993 and 1998, and the changes to the sampling threshold based on net monthly household income. A number of further changes have been implemented or attempted over the years, which are beyond the scope of this paper though.

IV.1 *Switching from annual to quarterly household diaries*

All income and consumption variables for the years 1998 and 2003 are quarterly data. For the years 1993 and before, the data contains monthly and annual values. For the case of income, the vast majority of income categories is provided as annual data. The conversion of monthly and quarterly data into annual data seems trivial at first. Yet differences in the samples, as well fluctuations of payments at the aggregate and at the individual level across quarters may cause trouble for the correct estimation of various moments and hamper the comparability of results based on different cross-sections of the EVS. In the following we discuss the importance of the possible issues mentioned above with a special focus to employing a simple quadrupling approach for the quarterly data.

The quarterly samples

For part of sample means, just multiplying each income and consumption variable should indeed yield reliable results, if the samples are conceptually equivalent and equally sized. Under these circumstances, we can e.g. substitute

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[34] Upon request, the Federal Statistical Office provides synoptical tables about the comparable questions in the different years.

$$\mathrm{E}[x] = \mathrm{E}\left[\sum_{t=1}^{4} x_t\right] = \sum_{t=1}^{4} \mathrm{E}[x_t] = \sum_{t=1}^{4} \frac{1}{N_t} \sum_{n_t=1}^{N_t} x_{n_t t} \cong \frac{1}{N} \sum_{n=1}^{N} 4 \cdot x_n$$

Note, that it is not necessary, that consumption levels are the same across quarters!

The Federal Statistical Office aims to field comparable subsamples each quarter. Table 5 illustrates that the efforts have led to satisfactory results considering the distribution of employment statuses of household heads. A comparison with respect to gender, industry of employment, job education, and region yields similar results. E.g. mean household public pension income in the third quarter exceeded the first quarter's income by 2.2 percent. Actual pensions were raised on July 1st 2003 by 1.04 and 1.19 percent in the West and in the East respectively. From the above, we conclude that the quarterly samples are sufficiently similar for our purposes.

Table 5: Comparison of samples across quarters – employment status of household head

	quarter				Total
	1	2	3	4	
farmer	86	78	73	70	307
in %	*0.83*	*0.69*	*0.69*	*0.67*	*0.72*
self-employed	506	529	460	459	1'954
in %	*4.86*	*4.66*	*4.36*	*4.4*	*4.57*
civil servant	1'039	1'124	1'065	1'087	4'315
in %	*9.98*	*9.89*	*10.1*	*10.42*	*10.09*
employee	3'859	4'272	4'022	3'965	16'118
in %	*37.06*	*37.6*	*38.16*	*38.03*	*37.71*
worker	1'274	1'368	1'280	1'308	5'230
in %	*12.23*	*12.04*	*12.14*	*12.54*	*12.24*
unemployed	530	587	491	453	2'061
in %	*5.09*	*5.17*	*4.66*	*4.34*	*4.82*
retiree	2'279	2'481	2'348	2'298	9'406
in %	*21.88*	*21.84*	*22.27*	*22.04*	*22.01*
pensioner	495	558	499	512	2'064
in %	*4.75*	*4.91*	*4.73*	*4.91*	*4.83*
student	177	189	144	135	645
in %	*1.7*	*1.66*	*1.37*	*1.29*	*1.51*
other non-working	169	176	159	140	644
in %	*1.62*	*1.55*	*1.51*	*1.34*	*1.51*
Total	10'414	11'362	10'541	10'427	42'744

Source: EVS 2003, unweighted

Unfortunately, the sample sizes turn out slightly different. The sample questioned in the second quarter is about 8-9 percent larger than the samples from the other quarters. The sample weights do not adjust for this imbalance. Thus, estimating the annual averages by quadrupling the quarterly values from each subsample we will overweight the second quarter. For all payments which fluctuate throughout the year, we will thus arrive at biased estimates for the means.

Fluctuations and the estimation of means and variances

Whether or not the existing differences across quarterly samples play a role strongly depends on the fluctuations in income and consumption measures across quarters. It is important to understand, that aggregate and individual fluctuations have different effects and the typical frequency of payments plays an important role. In the following we focus on the estimation of means and variances. We show that a simple quadrupling approach yields good results for the estimation of means. At the same time, little can be done to verify variance estimates within the EVS framework. Outside information might help to implement a correction procedure though.

Aggregate vs. individual fluctuations

Aggregate and individual fluctuations across quarters are conceptually independent. Aggregate payments may rise and fall over time while individual payments are perfectly correlated over time. The other way round, aggregate payments may be constant independent of the correlation of individual payments over time. In reality, most aggregates fluctuate over time and most quarterly payments will be positively correlated at the individual level. Fortunately, aggregate fluctuations only matter for the estimation of means and individual fluctuations matter only for the estimation of the variance.

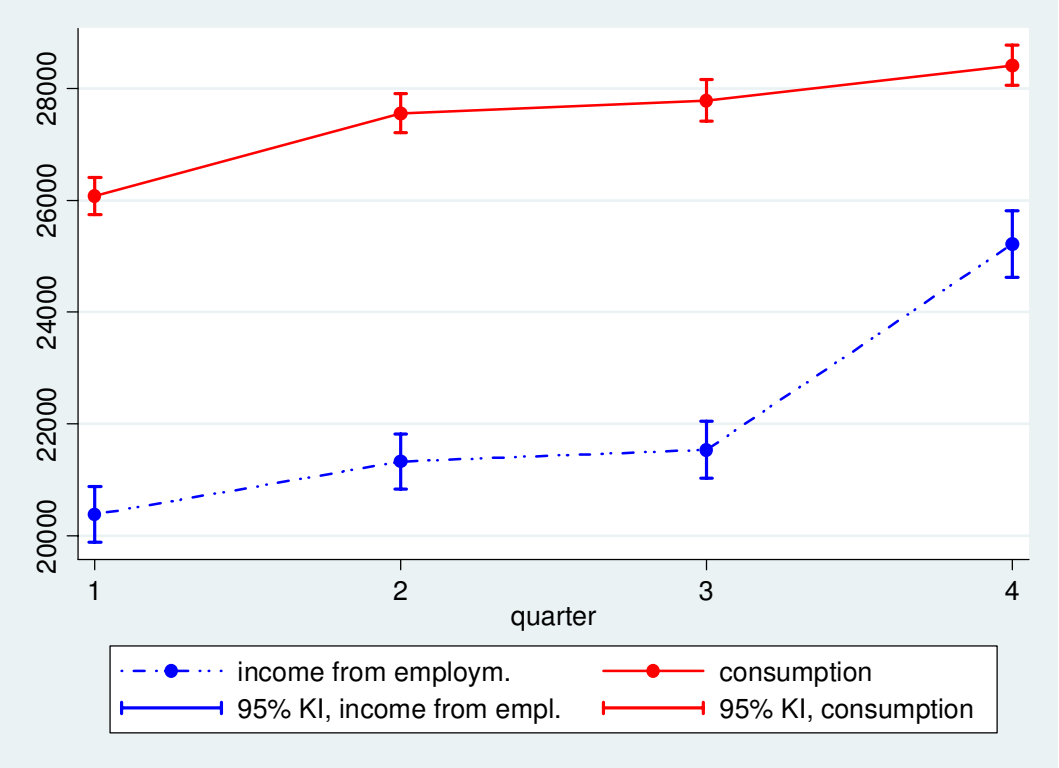
Aggregate fluctuations

We have argued above that in the presence of varying sample sizes across quarters we will estimate biased means from quadrupled quarterly measures if there are strong fluctuations. It turns out that not only averages of specific consumption or income categories fluctuate throughout the year. Even comprehensive measures like total consumption exhibit significant differences between quarters.

Figures 2 and 3 illustrate projected annual measures based on observations from the different quarters. The significantly higher income from dependent work among household questioned in the fourth quarter comes with no surprise: The obvious reasons are End-of-Year and Christmas bonuses. Somewhat more surprising is the fact that consumption expenditures in the first quarter are significantly lower than consumption in the remaining quarters.

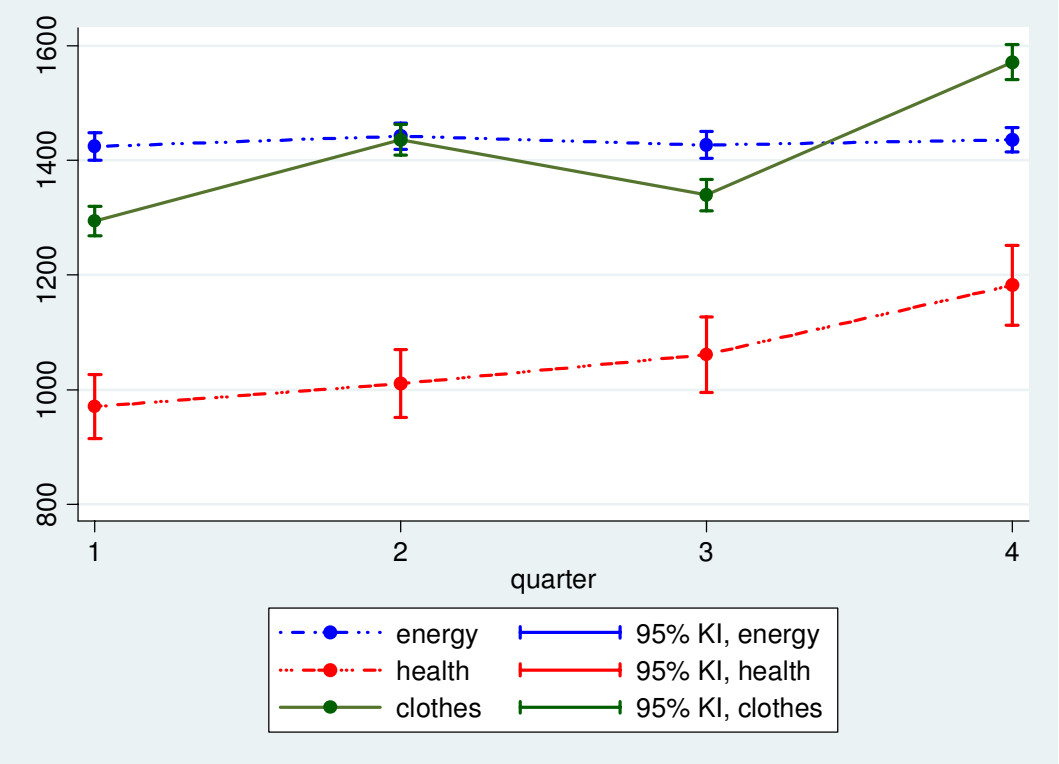
Figure 3 shows exemplarily, that the individual components of total consumption may fluctuate more strongly and quite differently from the aggregate. While average expenditures for energy are essentially stable throughout the year, we find expenditures for clothes and health to be much more cyclical.

Figure 2: Average projected annual income and consumption by quarter of observation



Source: own calculations based on the EVS 2003, projected quarterly measures in EUR, weighted

Figure 3: Average projected annual consumption expenditures by quarter of observation



Source: own calculations based on the EVS 2003, projected quarterly measures in EUR, weighted

No matter how striking the aggregate fluctuations in some income and expenditures categories are – the resulting bias in estimated sample means remains small. We calculated averages over quadrupled quarterly values instead of correctly summing up the quarterly averages: the estimated annual means differed by 0.8 and 3.6 per mille for income from dependent work and expenditures for travel respectively. Thus, the simple approach of quadrupling the quarterly values does little harm to the estimation of most sample averages.

Individual fluctuations

Independent of aggregate fluctuations, there may be fluctuations over time at the individual level. For illustration imagine two households who spend equal amounts on food on an annual basis. Their expenditures are made by daily turns such that there are a maximum of day-to-day fluctuation in individual expenditures and a maximum of daily variance in expenditures across households. Once we increase the observation time the fluctuations over time and between households decrease. Thus, in contrast to sample means, the estimated distribution of variables will change depending on the time span we look at. In our case, the comparison of the distributions of income and consumption over time is far from trivial given the switch from annual to quarterly household books between 1993 and 1998.

Let us focus on the estimation of variances: For a correct projection of the quarterly distribution to an annual one we need information on the individual fluctuations over time. The below formula illustrates, that for the case of variances little is needed to correctly estimate the variance of annual payments from quarterly data.

$$Var\left[x_{i1}+x_{i2}+x_{i3}+x_{i4}\right]=\sum_{t=1}^{4}\left(Var\left[x_{it}\right]+\sum_{q\neq t}Cov\left[x_{it},x_{iq}\right]\right)=\sum_{t=1}^{4}\sum_{q=1}^{4}\rho_{tq}\cdot\sqrt{Var\left(x_{it}\right)\cdot Var\left(x_{iq}\right)}$$

The quarterly variances are easily available. Yet we observe households in the EVS 1998 and 2003 only for one quarter each. Hence, there is no way to estimate the correlations of payments over time.

Only a few possible solutions come to mind: First, we may refer to external sources like the CEX to estimate between quarter correlations for individual consumption and income categories. The key assumption using such external information is the comparability of individual fluctuations across countries. Second, we may use ad-hoc assumptions. Calculating the variances from quadrupled quarterly data is equivalent to the assumption of perfect correlation of expenditures

across quarters. While ad-hoc assumptions are generally a quite unsatisfying approach it may yield reasonable results with respect to a wide variety of consumption and income categories. Specifically, expenditures for rent, energy, and food, as well as regular income from dependent employment and pension incomes will vary only little over time. Rent, energy and food account for roughly 68 percent of non-durable consumption. Regular incomes from dependent work account for 78.6 percent of total gross work income and income from public pensions accumulate to almost 68 percent of total public transfers.[35] Thus, for the majority of income and consumption, a cross-quarter correlation of payments near unity may be a reasonable assumption. For other expenditures like travel, vehicles, clothes and health the correlations may be significantly lower though. The same applies to income from self-employment and bonus payments from dependent work. Overall, ad hoc assumptions might not do all too poorly. For an evaluation and possible fine tuning of the assumptions we crucially rely on outside information.[36]

Infrequent payments

If payments occur less frequent than necessary to be captured within the given time span of the diary, noteworthy additional issues arise. Shrinking the observation time from a year to a quarter, some households will correctly report zero payments for a quarter although payments would be observed within a longer time horizon. Generally this issue is well known in the context of consumption inequality and the main reason to investigate non-durable consumption rather than total consumption. Durable goods tend to be purchased infrequently and will thus less often be registered if the observation time is shortened. Other examples are car taxes and car insurance premia, Christmas bonuses, donations and lump sum payments from insurance contracts.

Based on the three-month diary in 1998 and 2003 we will underestimate the share of households receiving or making payments, which happen at larger intervals. The bias will be smaller if the diary is kept over a longer time span, like in 1993 and before. At the same time, the use of quadrupled quarterly values will still yield the correct average annual payments. Yet the

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[35] Included are only civil servants pensions and pensions from the public pensions system. E.g. veterans' pensions and pensions from the public accident insurance are not included.

[36] Apart from the above two approaches, we can try to back out the average between quarter correlation of payments from the EVS data. If we assume constancy of the variance of payments over time, we can exploit the known annual variance from the 1993 data and the quarterly variances from the 1998 or 2003 data. Given that there are six cross-quarter correlations for each equation, we can only estimate the average correlation coefficient though.

conditional distribution of payments cannot be estimated unless the frequency of payments and thus the probability of a positive observation are known.

Looking only at the amount of average seasonal variation, we are likely to underestimate the true amount of individual variation over the course of the year. Generally, there are several possible ways of dealing with the resulting issues which are especially important for distributional analyses. We decided against imputation procedures and suggest running extensive sensitivity and validation checks. The main reason to avoid the effort of imputation is the lack of individual level information on the cross-quarter correlations. We observe each household only in one quarter each and therefore depend on outside information about the correlation structure. Any imputation could therefore be based only on the aggregate fluctuations and would thus be unable to restitute the true individual level correlation structure.

Sensitivity and validation checks are certainly a less elegant and somewhat less satisfying solution. Yet they can be easily applied and adjusted for the individual question at hand. E.g. investigating changes in inequality over time, we can compare changes in inequality of income categories which are known to be time invariant or to be subject to little fluctuations. Unless strong differences in the trends in inequality are present between fluctuating or one-time income categories on the one hand and regular and stable income categories on the other hand, restricting the focus in such way will allow us to compare the income and consumption data based on different time spans.

IV.2 *Changes to the sampling threshold*

Representativity for a certain population is typically one of the first objectives of a survey. This applies also to the EVS as its original purposes have been the construction of consumption baskets and the calculation of subsistence levels. While the description of the EVS claims its representativity for the German population, a number of limitations have been investigated in the literature (see e.g. Merz (2003)). In fact, the EVS sample does not include the institutionalized population, foreigners have only been included in the sample since 1993, and top income households are not sampled. The exclusion of the institutionalized is a typical procedure in most surveys and applies to all EVS cross-sections. Thus, it does not induce comparability issues. The inclusion of foreigners in 1993 is to be kept in mind for comparative analyses just like the inclusion of the population from the Eastern states. The changes to the sampling threshold with respect to income cause much more complex issues. Specifically, households with a net monthly income above this threshold are not included in the sample. Given that the changes do not follow a specific logic, different shares of the upper tail of the income distribution are likely cut

off. Estimates about the size of the population above the thresholds rely on tax statistics or national accounts data.

Merz (2003) employs income tax statistics and finds roughly 37'000 out of roughly 38 million households to be missing in the EVS 1993 due to the sampling threshold. He stresses further though, that high income households below the threshold are additionally underrepresented.

Given the general criticism towards the sampling threshold we also compared the restricted EVS sample to the (technically unrestricted) random sample of the GSOEP. We find only a few households in the GSOEP with net household incomes above the EVS threshold (see table 6). Only after the inclusion of the high-income sample into the GSOEP the number of households above the EVS threshold increases to 18 out of roughly 12'000 in 2003. Overall, these results cast some doubt on the chances to sample a sufficiently large number of high income households which would allow reliable statistical inference about the top of the income distribution.

Table 6: Sampling threshold and effects of different adjustment schemes

year	obser-vations	threshold		threshold as % of weighted median	thresholds (in EUR (2001)) applied by…		observations dropped applying an adjustment procedure		GSOEP obser-vations above the EVS threshold
		EUR	EUR (2001)		RDA	IND	RDA	IND	
1978	46'941	10'226	18'322	810%	18'165	17'043	5	10	n.a.
1983	43'614	12'782	18'065	859%	16'887	17'043	5	5	n.a.
1988	44'185	12'782	**17'043**	**803%**	17'043	17'043	0	0	4
1993	40'230	17'895	20'249	963%	16'892	17'043	24	23	0
1998	49'720	17'895	18'634	920%	16'274	17'043	28	13	1
2003	42'744	18'000	17'567	842%	16'763	17'043	2	2	18

Source: EVS, GSOEP, own calculations

Notes: "RDA" (relative distributional adjustment) labels the procedure proposed by Hauser (2003), "IND" our alternative approach of applying an indexed threshold.

Apart from the general criticism with respect to the application of a sampling threshold and the desire to learn more about the upper tails of the distributions of income and wealth, any comparative analysis will have to deal with the jumps in the sampling threshold. As the actual share of households missing in the EVS is unknown, it is impossible to focus on a fixed percentile range of the income distribution to achieve comparable samples over time. Therefore, we must rely on procedures defining a comparable distribution: Hauser (2006) suggests using a

common cutoff threshold which is defined from within the actual distribution. Specifically, he suggests defining the common threshold relative to the median. Alternatively, we have applied an indexation to the threshold. In both cases, all EVS samples are cut off at the lowest threshold which was in place between 1978 and 2003. The latter procedure caps a possible divergence of the income distribution by choosing an upper limit which is constant in real terms. Hauser's procedure is somewhat less constraining at first sight. Yet a runaway top in the presence of rather time invariant median would also be softened. Further, the reference to the median depends on the truncated distribution. Thus, the changing original thresholds will still affect the adjusted threshold. Overall, both procedures are certainly limited, as the missing part of the true distribution remains unknown.

Let us turn to the actual effects of the adjustment procedures, which are summarized in table 6. Both procedures identify the 1988 threshold as the most constraining one. Overall, only few observations have to be dropped to achieve pseudo-equal sampling thresholds. Further, the two approaches yield similar results with respect to their influence on estimated income and wealth levels.[37]

We conclude that the often criticized sampling threshold is unlikely to truncate the sample significantly compared to the established random sample of the GSOEP. Reliable analyses of the top income households remain a difficult task, especially in the context of a voluntary survey. Oversamling of the rich is essentially the only solution. For part of the discretionary jumps in the EVS threshold, a correction is highly recommendable, especially when focusing on highly skewed variables like stock market wealth.

[37] Table A-5 in the appendix illustrates the effects of the adjustment of the sampling threshold on estimated sample means.

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Appendix

Table A-1: Categories of insurance sums in different years (in DM)

category	year			
	1978	1983	1988	1993
1	<3.000	<3.000	<3.000	continous data
2	3.000 - 5.000	3.000 - 5.000	3.000 - 5.000	
3	5.000 - 7.000	5.000 - 7.000	5.000 - 7500	
4	7.000 - 1.0000	7.000 - 1.0000	7500 - 1.0000	
5	1.0000 - 15.000	1.0000 - 15.000	1.0000 - 15.000	
6	15.000 - 20.000	15.000 - 20.000	15.000 - 20.000	
7	20.000 - 30.000	20.000 - 30.000	20.000 - 30.000	
8	30.000 - 50.000	30.000 - 50.000	30.000 - 50.000	
9	50.000 - 75.000	50.000 - 60.000	50.000 - 60.000	
10	>75.000	60.000 - 80.000	60.000 - 80.000	
11		80.000 - 100.000	80.000 - 100.000	
12		>100.000	100.000 - 200.000	
13			>200.000	

Note: Individually harmonized definitions are used for the imputation of the different years.

Table A-2: Samples and clusters involved in the cold-deck error sampling as part of the imputation of life insurance wealth in 1978-88

	year		
	1978	1983	1988
total clusters	140	168	182
merged	39	34	36
clusters used for error sampling	101	134	146
total obs. to be imputed	34830	31921	31716
errors (based on 1993 regression)	21254	21254	21254
dropped as outlier errors	819	844	932
errors used for cold-deck sampling	20435	20410	20322

Table A-3: Information about the building included in the imputation process

variable	year			
	1978	1983	1988	1993
year of construction	<1919	<1919	<1919	<1919
	1919-1948	1919-1948	1919-1948	1919-1948
	1949-1960	1949-1960	1949-1960	1949-1960
	1961-1971	1961-1970	1961-1970	1961-1970
	1972+	1971+	1971-1977	1971-1977
	-		1978+	1978-1987
	-	-	-	1988+
type of building (# of units)	1	1	1	1
	2+	2	2	2
		3+	3+	3+
	other	other	other	other
heating system	-	-	district	district
	central	central	central	central
	appartment	appartment	appartment	appartment
	oven	oven	oven	oven
city size	<100000	<20000	<20000	<5000
				5000-20000
	>100000	>20000	>20000	20000-100000
				100000-500000
				>500000

Note: Individually harmonized definitions are used for the imputation of the different years.

Table A-4: Samples involved in the cold-deck error sampling - real estate wealth

	year		
	1978	1983	1988
total obs. to be imputed	22665	23117	24872
errors (based on 1993 regression)	12068	15842	17140
dropped as outlier errors	517	633	670
errors used for cold-deck sampling	11551	15209	16470

Ehrenwörtliche Erklärung

Hiermit erkläre ich ehrenwörtlich, dass ich diese Dissertationsschrift selbstständig angefertigt habe und mich anderer als der in ihr angegebenen Hilfsmittel nicht bedient habe. Entlehnungen aus anderen Schriften sind ausdrücklich als solche gekennzeichnet und mit Quellenangaben versehen.

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