DEMOGRAPHICS AND VOLATILE SOCIAL SECURITY WEALTH: POLITICAL RISKS OF BENEFIT RULE CHANGES IN GERMANY

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Abstract

In this paper we address the question how the generosity of the benefit rule of the German public pension system has changed during the past three decades and how this development can be explained by demographic changes. Firstly, we illustrate the political risk of benefit rule changes for individuals. We find that depending on the birth year and the considered scenario the relative losses vary between 30 and nearly 60 percent. Secondly, we estimate how demographic developments have triggered these changes in generosity. Our results suggest that future developments of the old-age dependency ratio have an influence on the determination of generosity.

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Keywords: social security wealth, demography, political economy, Germany.

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Contents

1 Introduction

During the past two decades economists and politicians have increasingly discussed how to sustain pay-as-you-go public pension schemes during the demographic transition that is currently taking place in the ageing societies of the developed world. As a result, one can notice a shift from mainly pay-as-you-go financed pension schemes towards systems with a stronger weight on funded components for the provision of retirement income. With this shift from an unfunded to a funded financing of the social security system, the question of risk aspects of the different schemes has moved into focus of the research agenda on social security. The risk components of old-age income can be broadly classified into three categories: demographic risks, productivity (and valuation) risks, and political risks. Here, we want to concentrate on the last type of risk: changes of the retirement benefits from the public pension program in Germany due to changes in the specification of the benefit formula. Specifically, we address two issues in this paper: Firstly, we calculate the "political riskiness" of the German public pension scheme. Secondly, we estimate how demographic developments have triggered the changes to the benefit formula.

By "political riskiness" we mean the risk that the generosity of a pay-as-you-go pension scheme varies due to legislative changes of the benefit formula. These alterations to the benefit rule obviously constitute a source of risk for the individuals life cycle resources. McHale (2001) has pointed out this source of risk for old-age income in a conference volume that actually focused on risk aspects of investment based social security reforms edited by Campbell and Feldstein (2001). In order to quantify this political risk, we construct a measure of the relative generosity of the benefit formula and track this measure for single cohorts over the time-span from 1970 to 2001. This measure is limited since it is constructed around the standard retiree (*Eckrentner*) who has paid 45 years of contributions on a gross salary that is equal to the average income of every year. While this constitutes a very unrealistic time-path of contribution payments, this is not such a serious restriction on our measure since the time path is not important in calculating the relative generosity of the benefit rule. Also we consider two alternative scenarios. In scenario two, which will be our benchmark, the retiree will always make use of the possibility to retire at the earliest date possible for the regular pension payment. The third scenario adds the assumption that the retiree has spent seven years in higher education and is making use of the early-retirement option. This will be the scenario with the highest volatility in relative generosity. Our measure is based on using the benefit formula as it is effective in a given year and assuming that it will not be amended from then on. Applying this principle, we calculate the gross social security wealth (SSW) in present value at the time of entering retirement for each year from 1970 until 2001. The relative generosity of the pension scheme is then defined as the fraction of SSW_t in each respective year t divided by the social security wealth that would have resulted if the laws concerning the benefit rule from 1970 were still effective. This measure of relative generosity will then show how the generosity of the German public pension scheme has increased or decreased over time. We apply this procedure to construct a time series of relative generosity for (a) single cohorts over time (RGC_{birth}) and (b) for individuals who are aged 45 and 62 in each year (RGT_{age}).

Our findings for the cohort born in 1950 are that – for the benchmark-case of early retirement – the relative generosity of the benefit formula, which is defined to be unity in 1970, will increase to 1.13 in 1972 and gradually decreases to 0.63 in 2001. In the scenario with seven years of higher education this deterioration of relative generosity amounts to 0.49 indicating that the generosity has been cut by 58 percent when comparing the current level of generosity to the zenith in 1972. For the cohorts born in 1940 and 1930, the losses in this third scenario between the highest level of generosity in 1972 and the lowest level in 2001 amount to approximately 53 and 42 percent, respectively.

The second aim of this paper is to provide an analysis on what drives the changes in the benefit formula. Specifically, we want to estimate a policy reaction function for the relative generosity of the German pension scheme. The main focus, when estimating this function, is how demographic developments trigger changes to the benefit formula. Similar questions have been posed by McHale (2001) and Razin et al. (2002). McHale (2001) comes to the conclusion that a relative increase in the old-age dependency ratio leads to a more than one-to-one relative increase in the share of old-age cash benefits to GDP. Razin et al. (2002) analyze the size of the entire welfare state and the labor tax rate and find that both the tax rate and the generosity of the transfer program measured in transfers per capita decrease with the dependency ratio.

Our study is more in the line of McHale since we concentrate only on the payments from the mandatory pension scheme (*Gesetzliche Rentenversicherung*). An important deviation from both other studies is that we are not estimating an actual time-series of transfer payments, but rather a measure of relative generosity (RGT_{age}) that we construct from the benefit rule as legislated during the time from 1970 until 2001. This allows us to include reforms that are only gradually phased in, and therefore are not included in actual data yet or are not visible in the data at the time the reform is made. Also, we do not only regress on current demographic changes, but we also test the influence of future demographic changes.

Our results suggest that not only the current but also the future level of the old-age dependency ratio has a significant influence on the current level of generosity. An increase of the current old-age dependency ratio tends to raise the generosity, while increases of the future old-age dependency ratio reduce generosity. Surprisingly, the elasticity of the generosity to demographic changes is larger in absolute terms for the future old-age dependency ratio than that elasticity for the current old-age dependency ratio. Furthermore, the result of a negative generosity-elasticity of the future old-age dependency ratio holds for both, the relative measure of generosity for the 45-year old (RGT_{45}) and the 62-year old (RGT_{62}). This contradicts the result of McHale (2001) that persons just entering retirement are protected from reductions in generosity. The contribution rate, on the other hand, is much less influenced by demographics than the relative generosity.

Finally, to put past changes into context of what might still be ahead of us, we apply the method of generational accounting to assess the sustainability of the social security system under the current valid legislation. We propose a new indicator for the measurement of sustainability that calculates the size of necessary changes when reforms are only possible in a piecemeal fashion. According to our results, reductions from the 2001-level of benefits will have to be in the range from 30 to over 40 percent under this ”soft transition”-scenario. Instead, if reductions were fully implemented straight away, the necessary cuts would amount to only roughly 20 percent.

We believe that this paper is interesting for an international audience[1] for at least two reasons: Firstly, the indicator of relative generosity that we develop is more suitable, as we believe, to empirically address the issue of political risks within social security than those that have been previously used. Secondly, we suppose that the non-protection from social security reform for people close to retirement is probably not a unique German feature. Therefore, our results could be an interesting new point of departure for models of political economy of social security.

The paper is organized as follows. Section 2 summarizes and categorizes all changes to the benefit rule of the German public pension scheme since 1957. In Section 3 we quantify these changes in terms of generosity of the pension system for specific cohorts and scenarios. The current demographic situation and past population projections are summarized in Section 4. In Section 5 we look at demographic developments and changes of the benefit rule. Specifically, we modify our indicator of relative generosity such that we are able to measure changes as a time series in Section 5.1. In Section 5.2 we use this data to estimate a policy function of changes to the generosity of the public pension scheme. To conclude this section, we turn the perspective from the past to the future, and we quantify the sustainability of social security under the current status quo. Section 6 concludes.

[1] The reader who is not interested in the German public pension scheme may want to skip Section 2, however.

2 A chronicle of the German benefit formula

2.1 The history of the German *Gesetzliche Rentenversicherung*

Germany has been the first country in the world to set up a public pension scheme. The first steps towards such a scheme were taken in 1889, when an insurance against disability was introduced for workers. The system rapidly expanded towards a regular pension scheme.[2] However, it wasn't until 1957 that the benefits from the pension scheme were indexed to the growth rate of labor income, and it took another twelve years until the pension scheme became a purely pay-as-you-go financed social security system.[3] These two features, pay-as-you-go financing and wage-indexed earnings related benefits, are the essential characteristics of what is often called a "Bismarckian" system of public pension provision that is predominant in continental Europe.

The pension system is financed via flat rate contributions on wage income until a certain income threshold is reached (*Beitragsbemessungsgrenze*). The contribution rate has varied between 14 percent (1957-1967) and 20.3 percent (1997-1999) and is currently at 19.5 percent. Next to the payroll contributions the state subsidizes the public pension scheme at a level that has been in the range between one fifth and one third of total expenditures. Recent legislation – the so called "green-tax-reform" – will most likely stabilize this level at about one third of total expenditures. This rather large tax-financed subsidy is commonly justified by the coverage of persons and/or pension entitlement that should and would not be covered in an actuarially fair insurance.

Benefit payments are categorized into three types of pensions: pensions due to age, pensions due to incapability to work, and pensions for dependent survivors. In each of these types of pensions there are still a number of different subclasses. We will cover some of those in the following subsections, and we give an overview of theses types in Table 6 in the Appendix. Major reforms of the benefit formula have taken place in the years 1957, 1972, 1989 (effective 1992), 1997 (planed to be effective in 1999) and 2001.

2.2 The benefit formula: A general description

In the remaining part of this paper, we focus only on the public pension system, the *GRV* – *Gesetzliche Rentenversicherung*, post 1957. Even more specifically, we concentrate

[2]For a chronicle of the German public pension scheme from 1889 to 1957 see Köhler (1990). The history of the first century of the public pension in Germany is extensively covered in the Festschrift edited by Ruland (1990) and in Kohl (1990). Helpful overviews of the German public pension system can be found in VDR (2002a), Steffen (2002a,b), and Börsch-Supan (1999).

[3]Next to the introduction of the benefit formula, the reform in 1957 also marked the begin of a unified pension scheme (*GRV*) under which the same laws apply to the pension systems of the workers (*ArV*) and the employees (*AnV*). The miners pension scheme (*KnV*) was integrated somewhat later. Today, about 90 percent of all employed workers are covered by the *GRV*.

on expenditures only, i.e. the benefit formula that is used to calculate the individual pension payments for the participants of the social security system. Here, we first describe the general structure of the benefit formula and we will then present a more detailed chronicle of changes to the benefit formula since 1957 in subsection 2.3.

Individual pension payments are calculated with the help of the benefit formula, which is basically comprised of three components. The three components are: i) the individual eligibility calculated by the years of contribution payments weighted by personal earnings relative to the average earnings in each respective year, ii) an adjustment factor that is dependent on the type of pension and possible deductions for early retirement, and iii) the indexation of the benefits. The first two of these components are dependent on an individuals employment history and choice on when to retire. The personal eligibility is also increased for years spent in education and child rearing.

Since the wage-indexed pension has been introduced in 1957, the general structure of the benefit formula has only been changed once under the so-called "Social Security Reform Act of 1992" (RRG92).[4] The formulas pre and post 1992 respectively are shown in Table 1.[5] As can be seen in row one of this table, both formulas fit into the classification of the three components given above.

There are three differences between the two formulas, nonetheless the structure remains the same. Firstly, the components Vj and $pVhs$ that relate years of coverage to relative earnings during time of service have been joint together into one variable EP. This step has only minor consequences since it mainly changes how credits for non-working years that nevertheless increase eligibility are valued (especially years spent in education). Secondly, an adjustment factor ZF is introduced in 1989 (but will only be applied after 2000) that reduces or increases benefits depending on the choice of the retirement-age (cf. Section 2.4). And thirdly, the combination of $St \cdot AB$ is being numerically transformed into values for RF and AR from a calculation that is based on annual values into monthly values. In 1992, where both formulas yield the identical benefit payments, the AR_{1992} was defined by $St \cdot AB_{1992}/12$ (see Table 1). The calculation of AR after 1992 is, however, fundamentally different from the calculation of AB until 1992 (see Table 8). At the same time the factor St was numerically transformed into a new factor RF. The respective values for the standard retiree are 1,5 percent for St until 1992 and unity for RF from 1992 onwards.[6] The relative difference between the different types of pensions remains the same for St and RF. Therefore, the two

[4] The rules on the single components have however changed numerous times. Specifically the indexation of the benefits has undergone three fundamental reforms and several minor changes. Compare Section 2.3 and Table 8 in the Appendix.

[5] The representation of the benefit formulas and their components in Tables 1 and 8 is based on Ruland (1989) and SVR (2001,2002).

[6] The values of the new adjustment factor (RF) for different types of pensions are given in Table 6 in the Appendix.

Table 1: Benefit formula for periods 1957-1992 and 1992-today
(numerical values are for the standard retiree)

year	**individual eligibility**			x	**adjustment factors** (depend. on retirement-age and pension-type)			x	**index-ation**	=	**benefits**	
1957 -1992	Vj	x	$pVhs$	x			St	x	AB	=	annual benefits	monthly benefits
1957	45	x	100%	x			1.5%	x	4281	=	2,890	241 DM
1992	45	x	100%	x			1.5%	x	33149	=	22,376	1,865 DM
RRG92	↓				new ↓		↘ $1.5\% \cdot 33149/12 = 41.44$		transformation ↘			
1992 -today	EP			x	ZF	x	RF	x	AR	=		monthly benefits
1992	45			x	1	x	1	x	41.44	=		1,865 DM
2002	45			x	1	x	1	x	25.86	=		1,164 €

with			
	Vj	years of coverage	Versicherungsjahre
	$pVhs$	personal earnings relative to average earnings	pers. Vomhundertsatz
	St	scaling of benefits depending on type of pension	Steigerungssatz
	AB	statistical measure of average earnings of employed during past years	allgemeine Bemessungsgrundlage
	EP	years of coverage scaled by average earnings	Entgeltpunkte
	ZF	adjustment factor for early retirement	Zugangsfaktor
	RF	adjustment factor depending on type of pension	Rentenartfaktor
	AR	statistical measure of value of entitlements	aktueller Rentenwert

factors serve exactly the same purpose.

In Table 1 we also show the numerical calculation of benefits for selective years. The numerical values represent the so called standard retiree (*Eckrentner*) who has 45 years of service with the further assumption that the standard retiree has always earned exactly the average income in every one of those 45 years during his working life. Also, it is assumed that the standard retiree enters retirement at the regular retirement age for pensions due to age at the age of 65. He[7] will therefore receive a pension due to age without any reductions or increases. The standard retiree will be the point of departure for the scenarios chosen in Sections 3 and 5.

[7]The usage of the male gender is intentionally and necessary because other rules apply for females.

2.3 The benefit formula from 1957 to 2001: A ”moving” history

As described earlier, 1957 marked the begin of the wage-indexation of the German public pension scheme. A dynamic component was introduced by adjusting pension payments annually to the mean growth rate of the gross average labor income of the past years.

Since then, the benefit formula or some of its components have undergone major changes in 1972 (early retirement), 1989 (net indexation, effective 1992), 1997 (demographic factor, effective 1999), and 2001 (modified gross indexation). We will first describe the major reforms chronologically and then touch on some further changes to specific categories of the pension formula. All changes are summarized in Table 2. Furthermore it is indicated whether the changes have increased (+) or decreased (−) the generosity of the benefit formula. The table is chronologically[8] organized according to the three major components described above: eligibility, adjustment factors[9], and indexation. Also we highlight which of these changes will be relevant for our three scenarios used for the analysis of relative generosity later.

In 1972 the generosity of the pensions was extensively increased by allowing early retirement for male individuals after reaching the age of 63 years if they have at least 35 years of coverage. This early retirement option was introduced without a compensating reduction of transfer payments.[10] The official term of the early retirement option is “pensions due to age for long-term contribution-payers” (*Altersrente für langjährige Versicherte*), which we will coin as “regular early retirement”. Along with this regular early retirement option a wide variety of further paths into early retirement were introduced. In our analysis of the relative generosity, we will nevertheless only consider the regular early retirement option. For completeness, Section 2.4 covers the different paths into retirement. Finally, the 1972 reform increased the generosity of the public pension system for low-income earners with the introduction of a minimum credit for one year of contribution payments. Individuals with an income that was below 75 percent of the average earnings were accredited an entitlement as if they had paid contributions on the threshold value of 75 percent (*Rente nach Mindesteinkommen*: MinE).

After the expansion of the generosity of the benefit formula with the reform of 1972, the generosity has steadily been reduced in the following decades. The only exemption from this general reduction of generosity is the introduction and expansion of benefit

[8]Because in sections 3 and 5 we are interested in the generosity of the benefit rule under the effective law at the different points in time, the chronological order depends on the time of legislation and not on the time of implementation.

[9]This column also includes further requirements for personal and general eligibility of the pension due to incapability to work and the survivor benefits.

[10]The pension payments were of course reduced because the retirees had two years less of contribution payments at retirement in comparison to the pre 1972 retiree, who worked (more or less) until 65 (see section 2.4).

Table 2: Changes to the generosity of the German benefit formula

time of legislation	time of implementation of changes	name of law	individual eligibility			type of pension / adjustment factors				indexation of pension			others:
			working years	credits for other activities		normal retirement	other pensions			date of adjustment	statistical calc. of adjustment	fundamental changes	health ins. contr.
				education	child-rearing		regular early retirement	incapability to work	survivors benefits				
			1	2	3	4	5	6	7	8	9	10	11
1957	**1957-**	**Rentenreform**	**Major reform of the public pension sxstem: Introduction of gross wage indexation (partially funded until 1968)**										
1972	**1972-**	**Rentenreform**	+ (MinE)*				+	+		+			
1977	1978-	20. RAG		-				-		-	-		
1978	1979-1981 1980-	21. RAG RVÄndG						+				- 4.5% and 4%	
1982	1983-1986	HBeglG								-	-		-
1983	1984-	HBeglG		-		+ (15→5)*		-	-		-		
1985	1986-	HEZG			+				+				
1989	**1992-2019**	**RRG '92**	- (MinE)*	-	+		-					- **net index**	
1996	1996-2001	WFG BeutrEntlG		-				-					
1997	**1999-2011**	**RRG '99**			+		+	-				- **demogr. comp.**	
1998	1999							+				+ non-applic. of demogr. comp.	
1999	2000	HSanG										- Inflation index.	
2000	2001							-					
2001	**2001-2011**	**AVmEG**			+				-			- **mod. gross index**	
Relevant for scenarios			**1,2,3**	**3**	**none**	**1,2,3**	**2.3**	**none**		**1,2,3**			**1,2,3**

* measures indicated in columns 1 and 4 are not relevant for all three scenarios

entitlements for rearing children.[11]

The next truly fundamental reform was legislated in 1989 and effective from 1992 onwards.[12] This reform changed the general form of the benefit formula (see Table 1), replaced the gross earnings indexation by a net earnings indexation (cf. Table 8), increased the minimum age (with a long transition period) for a number of paths into retirement (cf. Section 2.4), and introduced an adjustment factor for early retirement (ZF). In addition, the minimum earnings rule was abrogated and coverage for years spent in education severely reduced. The only enhancement of generosity of the RRG92 was an increase of entitlement for child-rearing (three years instead of one). As one can see, the RRG92 was the most comprehensive reform since the introduction of the indexed benefit formula. Even today, the long-term effects of this reform on the financial situation of the public pension scheme can hardly be captured in full detail.

In 1997, under the pension reform act of 1999 (RRG99), some paths into retirement

[11]Since the beginning of the 1980s politicians and scientists alike have stressed that the rules of the pension scheme do not do justice to the true nature of a pay-as-you-go financed pension scheme that is in fact a three-way-generational contract, in which the working generation is supporting both the old and the young, instead of just a two-way contract between the working population and the retirees. See Borchert (1981), Eekhoff (1985) and Sinn (1998).

[12]Some measures of this reform will not be effective before 2018, thirty years after legislation.

were abolished and the net-wage indexation was appended by a demographic factor (cf. Table 8). This demographic factor was supposed to take changes to longevity into account, but it was suspended before it came to application and was later replaced by an entirely new indexation of the benefits.

The pension reform of 2001 was, for the time being, the last reform of the German benefit formula. With this reform the indexation of benefits has again been changed fundamentally. The former net indexation (including the suspended demographic factor) is now replaced by a modified gross indexation. The dynamic factor AR is now determined by the growth of gross earnings and by changes in the deductions for the provision of old-age income. These deductions are defined much broader than before because they include employees and employers contributions to the GRV and in addition a fixed percentage to a facultative individual account for retirement benefits, the so-called *Riester-Pension*.[13]

Turning to the changes of specific parts of the benefit formula, we concentrate on those that will be of relevance for the scenarios based on the standard retiree that will be the center of interest in the proceeding sections.

<u>Education</u>

During 1957 and 1989 a maximum of 13 years of time spent for educational purposes after the age of 16 years were accredited to personal eligibility (column 2 in Table 2). In 1989 the maximum number of years were reduced to seven and in 1996 another reform reduced the maximum possible years to three.[14] Next to the reduction of the upper limit for the time spent in education, the valuation of educational years was also continuously decreased.[15] Finally, the age after which educational credits can be obtained was increased from 16 to 17 years of age in 1996.

<u>Early retirement</u>

The option for regular early retirement (column 5) was introduced in 1972. The pension reform act of 1992 has severely deteriorated the conditions under which future gener-

[13] Note, that we do not include the tax subsidies of the *Riester-Pension* when calculating our measure of generosity in Sections 3 and 5. The are two reasons for this: Firstly, the participation is not mandatory and secondly, strictly speaking, this tax subsidy is not part of the public pension program, i.e. the *Sozialgesetzbuch IV*. Also, if we included this subsidy of private savings program we would also have to consider other savings subsidies and tax breaks for employer's pension programs.

[14] The reductions of maximum eligible years of the RRG92 and in 1996 were only applied after a transition period until 2004 and 2001, respectively.

[15] The educational credits were evaluated at the personal average earnings ($pVhs$) until 1965. From 1966 until 1977 lump-sum credits were given depending on the kind of education. A year of university education was evaluated at approximately 200 percent p.a. From 1977 until 1983 all types of education were evaluated at 100 percent p.a. From 1983 onwards years spent in education after 1965 were evaluated at 90 percent. The RRG92 reduced the lump-sum credit to 0.75 EP.

ations could choose this option. Retiring one year earlier than the regular retirement age after the year 2000 reduces pensions by 3.6 percent.[16] In 1997 the minimum age for early retirement is reduced to 62 years. We evaluate this as an increase of generosity since the deduction of 3.6 percent is still not actuarially fair (cf. Section 2.4).

Indexation

The indexation of benefits has been changed numerous times during the past four decades. The fundamental changes have already been covered above. There are however other, on first sight minor, modifications that can have an influence on the generosity of the pension scheme. These can be classified into changes to the date of adjustment (column 8) and the way how the past average earnings are used to calculate the indexation of benefits (column 9). In 1972 the adjustment-date was moved from the 1st of January to the 1st of July. Whereas in 1978/79 the adjustment-date was moved back to the 1st of January and in 1983 again to the 1st of July, where it has stayed since (for the Old Laender). Changing the timing of adjustment increased the generosity of the social security program in 1972 because pensions were increased after six months instead of twelve. The other two times the new date of adjustment reduced the generosity because pensions were not adjusted for eighteen months. The formula to calculate the indexation from past average earnings has been changed numerous times (cf. Table 8). For example in 1983, the past earnings with a lag of up to five periods were used to calculate the dynamic component AB. One year later in 1984, the lag was reduced to two periods. Because the growth rate fluctuates quite significantly between years, changing the years that are considered in the formula at a given point in time can have quiet an influence. Such changes have occurred three times and have always led to a reduction of the adjustments of benefits in the respective year of change. An unique measure was taken in 1978, when instead of applying an adjustment formula that is conditional on economic development, the future increases of benefit payments were fixed to 4.5 percent in 1979 and 4 percent in both 1980 and 1981. Furthermore, the pensions for existing and new retirees are no longer being differentiated by a lagged pension adjustment for existing retirees. Because the calculation of pensions for new pensioners was aligned to the adjustment of transfers to existing pensioners this led to the only ever true reduction in benefit payments.[17]

Contributions to health insurance

Finally, there has been one change to the net-value of benefit payments that does not fit into any of the other categories. Starting from the 1st of July 1983, the retirees

[16]During the transition period between 2001 and 2006 the reductions are lower.

[17]The legislator tried to hide this fact, by designing a special time path of benefits for persons entering retirement in 1978.

were obliged to pay contributions to the mandatory health insurance (column 11). The contribution rate on gross pensions were continuously increased until 1987. Since that time the retirees are paying half of the total contributions rate and are therefore treated in the same manner as employees are.

2.4 Disability, incapability, unemployment and part-time work: One thousand and one ways to retire even earlier than early

The regular retirement age in Germany has always been and still is 65 years. Nevertheless the average retirement age has fluctuated within the interval between 58 and 62 years of age with the current value slightly underneath (above) 60 for men (for women). The reason for this is that there have always been different ways to enter retirement other then the pensions due to age, which is the "normal" retirement type. While the title of this subsection overstates the possibilities to enter retirement, there are currently seven and a half[18] different ways to enter retirement without even considering survivors benefits[19]. These different paths into retirement, with the respective earliest possible age of eligibility and the necessary conditions that have to be met, are displayed in Table 7 in the Appendix. A detailed discussion of these possibilities can be found in Arnds and Bonin (2002). Four of these seven paths have always existed. These are the regular pension, pension due to incapacity to work, pensions due to unemployment, and the benefits due to age for women. What we call the "regular early retirement", the pension due to age for long-term contribution-payers, has been introduced in 1972 along with the pension for severely handicapped persons. The possibility to enter retirement after part-time work only exists since the early nineties.

These numerous and generous paths into retirement have however been severely cut down during the course of the last decade. The pensions due to age after unemployment and part time work and the reduced retirement age for women have been abolished, and they will not be available anymore for cohorts entering retirement in the near to far future. There are however long transition periods under the protection of confidence. While the remaining paths into pension will offer more flexibility to retire early, i.e. the regular early retirement can be chosen at the age of 62 after 2012, this flexibility comes at the cost of reductions in benefits. The above mentioned ZF adjusts benefit payments by -3.6 (+6.0) percent per annum for each year of retiring earlier (later) than the regular retirement age.[20] Note that retiring early, e.g. at the age of 63 instead of 65, has

[18]We speak of seven and a half, since the pension due to incapacity to work actually has to be split up in at least two cases: full incapacity and half incapacity to work, or former BU and EU pensions.

[19]There are another five types of survivors benefits (cf. Table 6, where we have not included the so-called *Erziehungsrenten*; this is a very special case for divorced survivors raising children).

[20]The regular retirement age will be 63 for pensions due to incapability to work or disability and 65 otherwise.

three consequences on the financial transactions between the individual and the pension system. Firstly, the retiree is not paying contributions for these two years. Secondly, the retiree is receiving his pension for two more years, and thirdly, the payment of transfers is not only for a longer time-period but also at an earlier point in time. A fair insurance, that is an insurance that operates at zero profit under perfect competition, would take full account of all these deviations from the stream of contribution-benefit-payments of a "regular" retiree. However during the time span of 1973 until 2000, only the first of the three effects was considered in the benefit rule of the German public pension scheme. By legislation from 1989 the other effects (receiving transfers earlier and for a longer period) will be partially taken account for in the benefit rule from the year 2001 onwards. After 2006 benefits are reduced by 0.3 percent per month (or 3.6 percent p.a.) if pensions are paid before the 65th birthday. The first effect (not earning further entitlements) reduces benefits by roughly 2 percent to 2.5 percent p.a.[21] Retiring one year early therefore reduces the monthly pension by approximately six percent in comparison to the pension that one would obtain if one had retired at age 65. According to Börsch-Supan (1999) the non-distorting reduction equals about eight percent.[22]

To conclude this section, we illustrate how the different pension types have been made use of over time. In Figure 1 we depict how many percent of each male cohort have entered retirement via the different pension types.[23] The types are sorted by the degrees of freedom the retiree has in choosing his retirement. The top two pension types (disability and incapability) are pensions that are (at least formally) dependent on the medical condition of the retiree. The path over part-time work is mostly in accordance with the employee. That over unemployment to a lesser degree, but there is an indication that also unemployment is chosen very deliberately as a path into retirement.[24] Finally the two bottom types of pensions are those that mark the choices of entering retirement normally, that is without any conditions on things that are not completely in the control of the retiree.[25]

Figure 1 indicates that the pensions for severely handicapped persons have partially crowded out the pensions due to incapability to work, and the pension under regular early retirement have substantially reduced the share of people that start receiving

[21] In our benchmark case the reduction of benefits due to working one year less at the average income equals $\frac{1}{45} \approx 2.2$ percent.

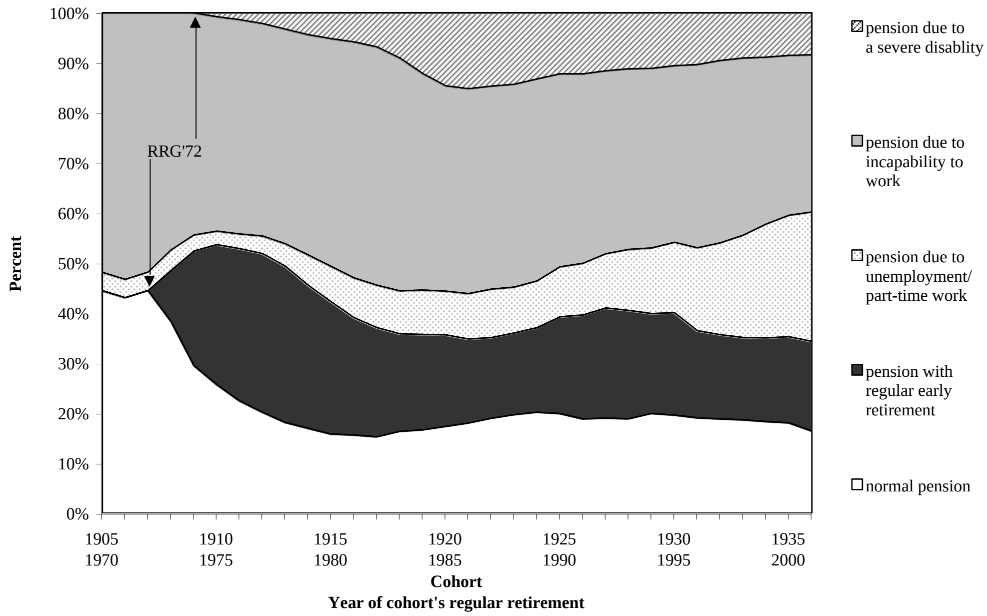
[22] For a more thorough, but outdated analysis see Börsch-Supan (1992). For an international perspective on early retirement and the incentives to retire early see Gruber and Wise (1999,2001).

[23] In Figure 5 in the Appendix we also show at what age the different types of pensions where entered in 2001.

[24] Many employees are entering unemployment at exactly that age that will give them unabridged unemployment benefits just until the age of being eligible for pensions.

[25] Most people who are retiring at the regular retirement age are not retiring earlier because they do not fulfill the requirement of 35 years of service.

Figure 1: Ways into retirement by cohort



Notes: Male retirees, without survivor benefits.
Source: VDR (2002a).

benefits at the regular retirement age for all cohorts entering retirement after 1972. Because of the generous rules for pensions after part-time work, the share of this type of pension has rapidly increased to over 20 percent reducing all other types of pensions.

In the following sections we will only concentrate on the generosity of the bottom two types of pensions. This is certainly a restriction since only about one third of all individuals are entering retirement via these two channels. We do however put up with this loss of generality for several reasons. First and most importantly, it is close to impossible to track all these different types of pensions into one consistent measure of generosity. Secondly, the qualitative changes to the generosity have followed a quite similar path for all types of pensions except for that of pensions after part-time work. This last exemption is therefore the most severe set-back to our approach. However, the pension after part-time work is as much a labor-market policy and a subvention of firms as it is a policy towards the aged.

3 The volatility of individual social security wealth: A cohort analysis of the generosity of the benefit rule

After having worked our way half-descent through the jungle of nearly 50 years of social security laws, we can finally begin to measure the generosity of the benefit rule over time. In order to do so, we first describe how we construct our measure of relative generosity of the benefit rule in Germany and will then proceed to apply this indicator to the three cohorts born in 1930, 1940, and 1950 for three different scenarios.

All three scenarios considered are based on the standard retiree. We further assume for all three scenarios that the person is male and single without children. The difference between the scenarios are in concern to whether the person is making use of the early retirement option (scenarios 2 and 3), and whether he has spent time in education (scenario 3). Scenario 1 is hence a standard retiree who has not spent time in education after the age of 16 and is retiring at 65. Scenario 2 differs to the first scenario in regard to the timing of retirement: independent of the size of the adjustment factor, the person will always choose to retire at the earliest age possible under the rules for regular early retirement.[26] Finally, under scenario 3 all assumptions of scenario 2 apply, and in addition the person under consideration has spent seven years in education after the age of sixteen. To ease notation, we will give names to the three scenarios: STAN, EARLY, and EARLY ED for scenarios 1 through 3 respectively. While all three scenarios are rather unrealistic, not all restrictions that result from these assumptions are a major set-back for our purposes. Because we are interested in the changes to the generosity of the benefit rule over time, the assumptions only become important when they are touched by changes to the benefit rule. In subsection 3.3 we discuss the restrictions of our approach.

Finally, before we commence with our analysis, it is helpful to stress what we are **not** trying to investigate with our measure of relative generosity. For now, we are neither interested in the sustainability of the public pension scheme, nor are we interested in questions of intergenerational distribution. Both of these questions have already been covered extensively: Numerous official and unofficial studies have presented projections of the social security contribution rate addressing issues of sustainability.[27] Schnabel (1998) calculates the rates of return of the public pension system for different cohorts, and he finds that the returns are continuously decreasing the later a cohort is born. Depending on the scenario under consideration, cohorts born after 1960 may actually be facing negative rates of return.[28] Finally, the method of generational accounting has addressed both questions, sustainabilty and intergenerational distribution, at the same time. Studies concerning the effects of most recent social security reform can be found in Bonin (2001b) and Borgmann et al. (2001). In Section 5.3 we apply the method of

[26] Choosing early retirement will of course reduce personal eligibility to 43 EP for the cohorts born in 1930 and 1940 and to 42 EP for the 1950-cohort.

[27] See Sinn and Thum (1999) for a survey of different contribution-rate-projections and the influence of different assumptions on these projections. Werding (2000) analyzes the influence of the RRG92, the RRG99, and a preliminary version of the 2001 reform on future contribution rates.

[28] Eitenmüller (1996) and Hain et al. (1997) conduct similar studies. In contrast to Schnabel they compute nominal rates of return.

generational accounting to assess the sustainability of the legal status quo of the social security system.

3.1 A measure of relative generosity

We construct a measure of relative generosity that is based on gross social security wealth (SSW).[29] The SSW, as defined in equation 1, is the sum over all benefit payments from the time of entering retirement until the expected age of death. We adjust the nominal payments with the consumer price index, and we discount them to a specific point in time. The SSW_t in a given year t is equal to the discounted sum of future real benefit payments conditional on the policy that is valid in period t. We also take account of transition periods and protection of trust rules by specifically applying the policy that will be valid in a future year i as specified under the laws in t. Note that all three components of the benefit formula described above are conditional on the policy in t and also the age of retirement may vary depending on the scenarios and the policy in t for the cohort under consideration.

For our analysis it is important that the value of SSW does not rise only due to moving one year closer to retirement. Therefore, we have to discount the stream of benefit payments to one specific age of the retiree instead of taking the present value at every point in time. A natural choice for this date would be the age of entering retirement. However, since the retirement-age varies between scenarios and cohorts, D^c will not always be identical to $R_i^{c,s}$. Instead, we choose one discounting-year for all scenarios of one cohort. The age that we discount to equals the earliest possible retirement age under the considered pension types and scenarios. Because the pension reform from 1997 allows the cohort born in 1950 to retire at the age of 62, we choose $D^{1950} = 1950 + 62 = 2012$. In order to guarantee the comparability between the three cohorts, we calculate the discounting date for all three cohorts by $D^c = c + 62$.

In order to calculate the SSW, we need to make assumptions on the future development of parameters that determine the pension payments. In detail, we assume that both the real growth rate and the rate of inflation after the year 2002 will be at one percent per annum, respectively. We discount all pension payments by three percent per annum. Further, we assume that the retirees share of health insurance contributions will be constant at 7.85 percent from 2003 onwards. Also, the quota of net-to-gross-earnings and the quota of net-to-gross-pensions (cf. Table 8) will remain constant after 2001 at 65.4 percent and 92.4 percent respectively. The remaining life-expectancy of the 65 year old is assumed to rise from 16 years in 2001 to 22 years in 2034. The projection of the contribution rate to the public pension system is taken

[29] The calculation of social security wealth has first been introduced by Feldstein (1974).

from Birg and Börsch-Supan (1999) according to which the contribution rate will rise to 24 percent.

$$SSW_t^{c,s} \equiv \sum_{i=D^c}^{c+65+L_{65}^c} \frac{B_i(EP_i^{c,s}, ADJ_i^{c,s}, V_i, R_i^{c,s} | P_t^i)}{CPI_i} \cdot \delta^{i-D^c} \qquad (1)$$

with	$SSW_t^{c,s}$	gross social security wealth at time t of cohort c under scenario s
	c	year of birth of a specific cohort
	s	scenario
	D^c	date to which benefits are discounted for cohort c
	L_{65}^c	remaining life-expectancy conditional on reaching age 65
	$B_i^{c,s}$	benefit payment in period i conditional on the effective policy at time t
	$EP_i^{c,s}$	years of coverage scaled by average earnings (determine benefit entitlement)
	$ADJ_i^{c,s}$	adjustment factor for different types of pensions or reductions for early retirement
	V_i	value of pension entitlement at date i (indexation)
	$R^{c,s}$	age of retirement of cohort c under scenario s
	P_t^i	policy of benefit payments as legislated at date t for benefit payments in year i
	CPI_i	consumer price index for year i
	δ	discount factor $= 1/(1+r)$, with $r =$ real interest rate

Since we are primarily interested in the *changes* to the benefit rule, the calculation of the SSW is only an intermediate step in calculating our measure of relative generosity. This measure is based on using the benefit formula as it is effective in a respective year and assuming that it will remain valid from then on. Applying this principle, we calculate the SSW at the time of entering retirement for each year from 1970 until 2002. The relative generosity of the pension scheme is then calculated by the fraction of SSW_t of each respective year t over the social security wealth that would have resulted if the laws concerning the benefit rule from 1970 still were effective.

$$RGC_t^{c,s} \equiv \frac{SSW_t^{c,s}}{SSW_{1970}^{c,s}} \qquad (2)$$

By constructing this cohort specific measure of relative generosity (RGC), we show how the generosity of the German public pension scheme has increased or decreased over time. By definition the value of RGC_{1970} equals one. The measure therefore shows by how many percent the generosity of the laws at every point in time t deviates from the generosity under the laws from 1970.

3.2 The impact of benefit rule changes on relative generosity for selective cohorts

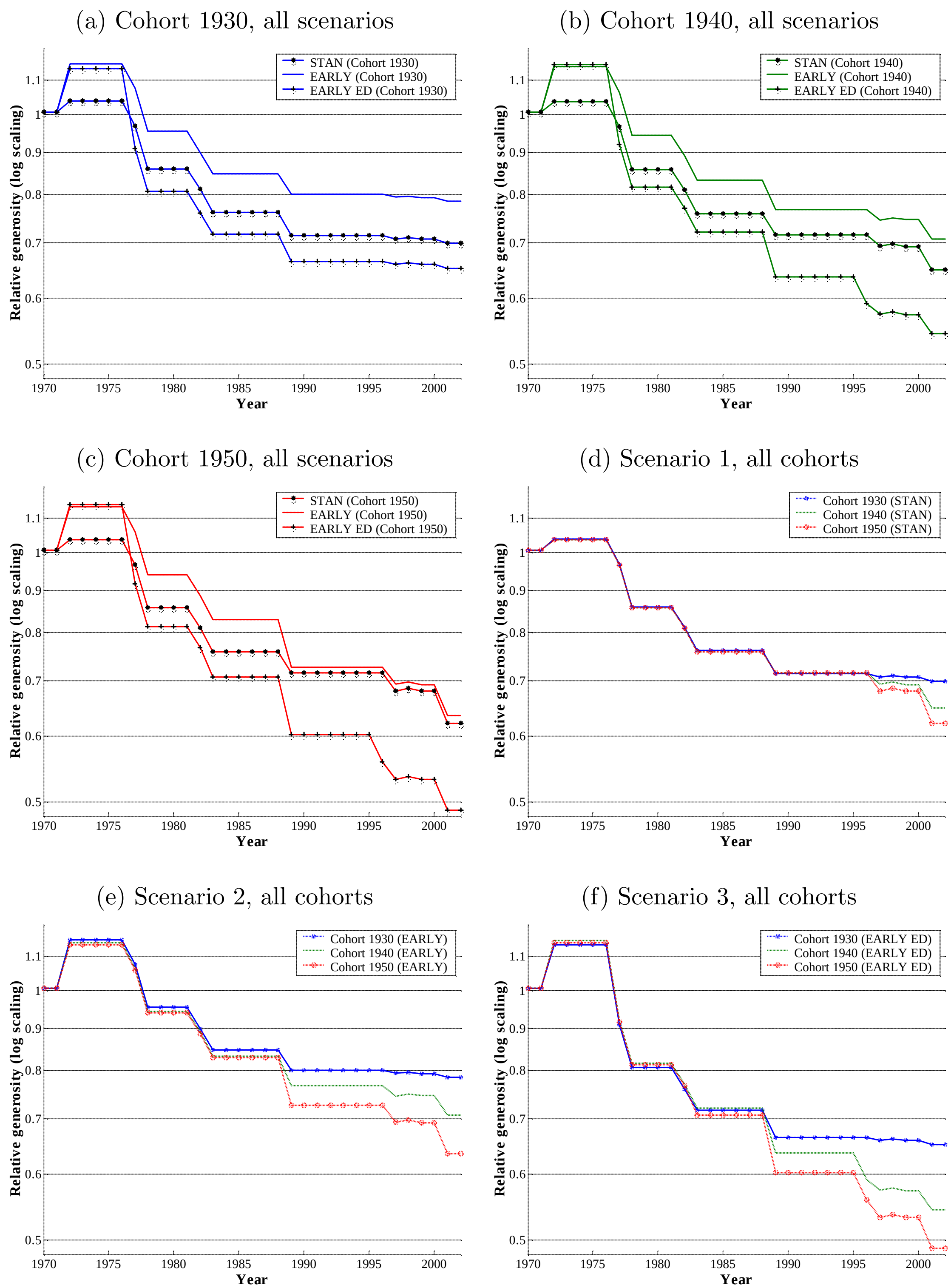
We calculate our measure of relative generosity for cohorts (RGC) given in equation 2 for the three cohorts c born in 1930, 1940, and 1950. For each cohort we consider the three earlier described scenarios s: the standard pensioner (STAN), the early retiring standard pensioner (EARLY), and the early retiring pensioner with education (EARLY ED). We display the results in Figure 2. Figures 2a)-c) show all three scenarios for each respective cohort. In Figures 2d)-f) we present a single scenario for all three cohorts in each respective sub-figure. We have chosen a logarithmic scaling of the vertical axis in order to illustrate the size of the relative changes between years at a later point in time.[30] As expected from the qualitative analysis of changes over time, summarized in Table 2, the generosity has increased in 1972 under all scenarios and for all cohorts, but has steadily fallen since. One can follow the impact of the different changes to generosity by comparing Figure 2 with Table 2. Changes of the generosity under scenario STAN are all due to alterations of the indexation of the benefits and due to the introduction of health care contributions (columns 8 through 11 in Table 2). The differences between the scenarios STAN and EARLY can also be traced by focusing on the changes listed in column 5 of Table 2: EARLY shows a sharp increase of generosity in 1972 with the introduction of the early retirement option. For cohorts 1930 and 1940 the relative generosity to STAN and EARLY will run in parallel paths after 1972 with EARLY being roughly 10 percentage points above STAN. For the cohort born in 1950, scenario EARLY will experience a sharp drop in generosity in 1989 when the adjustment factor ZF was introduced for future early retirees.[31] In scenario EARLY ED the changes to personal eligibility due to educational years reduce the relative generosity in additions to scenario EARLY significantly. This large drop in generosity is not surprising since personal entitlements due to education were reduced from 14 EP in 1970 to 2.25 EP today under scenario 3.[32]

[30]If we did not use a logarithmic scaling later reforms could not be compared well to the laws that were valid just before the last reform, because the changes are all in relation to the laws of 1970. The logarithmic scaling avoids this problem since the graphical representation is in line with the period-to-period change of the generosity.

[31]The 1997 increase of generosity, that allowed early retirement with deductions at 62 instead of 63, is not very large and can hardly be seen in Figure 2c).

[32]Actually, we put a cap on the maximum loss by assuming only seven years of education under scenario EARLY ED. The maximum amount of years that were accredited in 1970 was 13 years which led to an entitlement of 26 years of contribution payments at the average salary.

Figure 2: Relative generosity for cohorts 1930, 1940, and 1950 (*RGC*)



Source: Authors calculations.

In addition to Figure 2, we summarize the maximum and minimum levels of relative generosity in Table 3. Obviously, the losses and the volatility of relative generosity are largest for scenario EARLY ED. The standard retiree is the scenario with the lowest volatility in relative generosity, even though the level of relative generosity is higher under scenario EARLY. As can be seen from Table 3, the relative differences between the maximum values of relative generosity in year 1972 and the lowest values in year 2001 amount to losses that vary – depending on the considered scenario and cohort – between 32 and 57 percent. For the 1930 cohort the relative generosity has dropped from its highest level to its lowest level 33 percent under scenario 1 and 43 percent under scenario 3. Under scenario 2 the relative drop has only been 32 percent with a standard deviation for RGC^{1930} of 0.13. For the other two cohorts under consideration, the relative difference under scenario 2 amounts to a drop of relative generosity of 37 and 40 percent for cohorts 1940 and 1950 respectively. The highest reduction of generosity is that of cohort 1950 under scenario 3. The standard deviation in this case is over 20 percent.

It is noteworthy that the relative losses tend to vary more between scenarios for one cohort than between cohorts for one scenario. Also, in most cases the changes under scenario 1 touched the relative generosity quite equally for all cohorts. Only the two most recent major reforms of the dynamic component of the benefit formula discriminated between the different cohorts (see Figure 2d). In fact, this equal treatment of cohorts holds quite general for all changes to the indexation of the benefit formula. Reforms of the early retirement options, especially those of the RRG92, are on the other

Table 3: Difference between maximum and minimum values of relative generosity

		Cohort 1930	
	Scenario 1	Scenario 2	Scenario 3
Max	1.03	1.14	1.13
Min	0.69	0.78	0.61
Difference	32.7%	31.8%	45.7%
Standard deviation	12.8%	13.0%	18.0%
		Cohort 1940	
	Scenario 1	Scenario 2	Scenario 3
Max	1.03	1.14	1.14
Min	0.64	0.70	0.54
Difference	37.4%	38.2%	52.7%
Standard deviation	13.1%	14.3%	19.8%
		Cohort 1950	
	Scenario 1	Scenario 2	Scenario 3
Max	1.03	1.13	1.13
Min	0.62	0.63	0.48
Difference	40.0%	44.0%	57.3%
Standard deviation	13.3%	15.9%	21.1%

hand highly discriminating in their treatment of different cohorts.

Finally, it also comes as a surprise that among the changes to the indexation of the benefits, even seemingly minor changes to the statistical calculation of benefits may have quite a significant impact on relative generosity. This can be seen by the rather large reduction of relative generosity in 1977 and 1978 under scenario STAN.[33]

3.3 Discussion and caveats

Our analysis has shown that the relative generosity, and therefore the gross social security wealth, has been drastically reduced over the past three decades. From the way we have constructed our measure of relative generosity, political changes of the benefit formula are the only source of risk that we consider in our analysis of the German public pension scheme. Our results show, that the standard deviation of RGC under all considered scenarios and for all cohorts is well over 10 percent and that the gross social security wealth can be subject to losses between 30 and 57 percent over the life-cycle. We will now touch on some caveats of our approach:

i) Diamond (2002, p.46) has rightfully pointed out that "...it is not clear whether the possibility of further legislation should be viewed as a political risk or a political hedge. The possibility of adapting Social Security to changing economic and demographic circumstances makes it more valuable to society, not less valuable." Still we feel that our analysis is worthwhile for several reasons. Firstly, the magnitude of these changes is nevertheless interesting. Secondly, we are interested in whether the elderly are generally protected from social security reform or not. Finally, we also try to identify the influence of demographic developments on our measure of generosity (cf. Section 5).

ii) Our perspective is of course restrictive since we assume that individuals are foresighted enough to include their social security wealth in the calculation of their life-cycle resources, but are at the same naive enough to believe that the current law will still be valid for them. There is some evidence that individuals do have quite realistic expectations on future social security reform. According to a recent survey of opinion conducted by Boeri et al. (2001b), 75 percent of the German population are expecting that in the course of the next 10 years there will be a reform reducing significantly

[33] The 20. RAG of 1977 postponed the retirement adjustment, and it changed the calculation of the dynamic factor AB. The lion's share of the generosity-cut is due to the new calculation of the AR. Because the calculation moved away from a three-year moving average towards an autoregressive determination, a relation of the growth rates of 1974, 1975, and 1976 is a determinant in all future calculations of AB. Because of the unusual high nominal growth rates of average earnings in these three years, this will lead to a reduction of generosity of the benefit formula if the average growth rate during pension payment is less than 8.3 percent. In comparison, the average growth rate since 1977 has been 3.5 percent with even much lower values in the past decade.

the level of the public pension. On the other hand, the government tends to induce the believe amongst individuals that the current benefit formula will be valid at later times. For example, the most recent reform (AVmEG) obliges the administration of the pension scheme to provide information of personal eligibility for current contribution payers. This information is similar to our values of SSW since it will provide the working population with information on the prospective future size of benefit payments under current law.

iii) As stressed by Schnabel (1998) in his calculation of rates of return and touched upon by McHale (2001) in an appendix, the expected SSW of someone facing a certain expected remaining life-time may deviate from the SSW of someone with an uncertain remaining life-time. This is due to the result familiar from Jensen's inequality that the expectation of non-linear functions evaluated at the random variable is not equal to the function evaluated at the expectation of the random variable. McHale (2001) argues that for the calculation of SSW there will be both a downward bias because of the uncertainty of reaching retirement and an upward bias during pay-out if the interest rate is larger than the growth rate. The sign of the bias is therefore undetermined. Because our measure is a relative one that has this potential bias both in the nominator and denominator, it is highly unlikely that the simplification of using a certain life-time will have severe consequences. Only reforms that change the benefit payments with a non-uniform time-profile for a single cohort may lead to a potential bias.

iv) Because we are only looking at the gross social security, we do not need to consider the timing and size of contribution payments. The age-profile of earnings is not important because the German public pension system does not use a sub-sample of past earnings to calculate eligibility and because we are not analyzing the implicit rate of return of the contributions to the scheme. A calculation of the rates of return of the pension scheme would also have to consider the effects of each reform on the future development of the contribution rate.

v) Finally, there are restrictions due to the choice of the scenarios. By only considering standard retirement and regular early retirement, we neglect that there are a number of other paths into retirement and that they play a major role in the German pension system as presented in Section 2.4. Furthermore, we are only looking at the rules for male retirees. This is certainly a set-back, but we feel that creating even more scenarios will not yield significant different results because the general direction of changes is similar for the cases we have not considered as for those that we did consider. Nevertheless, two restrictions apply: contrary to the scenarios we are analyzing pensions after part-time work and individual eligibility due to time spent rearing children were both increased during the 1980s and 1990s. Not including entitlements for rearing children is, however, offset by the fact that women face even larger reductions in generosity then men do. This is because the cut-back in generosity under the early retirement option has been more severe for females. Also, we do not account for changes in the rules concerning the benefit payments to dependents.

4 Demographics and population projections

In this section we first draw a general picture of the demographic developments in Germany. We then touch upon past population projections, and we show how well these projections performed at forecasting the old-age dependency ratio. We will argue that since the late seventies the official population projections did a good job at predicting the old age dependency ratio at a range of roughly 15 years and that the influence of demographic developments on social security has found its way into the political debate since the mid-seventies. This is important for the analysis we conduct in Section 5, where we use future values of the old-age dependency ratio as a determinant for the generosity of the pension scheme.

4.1 Demographic developments of the past decades

In Germany, like in many other developed countries, a demographic transition towards an ageing population is currently taking place. Today the population pyramid, whose name originates from the silhouette of the graphical representation of the population structure, resembles much more the contour of a mushroom than that of a pyramid. The causes for this development can be identified in the extreme changes of the fertility rates and in the continuously increasing life expectancy. One way to measure the development of fertility rates is to keep track of the total fertility rate, which is the sum of age-specific fertility rates in relation to the number of women in child-bearing ages. A value slightly above two is needed for a constant population size. The total fertility rates in East and West Germany have undergone a sharp increase in the late fifties of the last century and stayed at a level around 2.5 for roughly ten years. The cohorts born during this time – generally referred to as the baby boomers – were immediately followed by cohort-sizes that were well below the level of reproduction. Since the beginning of the seventies the total fertility rate has stabilized at around 1.4 in West Germany, which is about 30 percent short of reproduction. Because of this immediate succession of very high and very low birth rates, one sometimes speaks of a ”baby-boom–baby-bust“ scenario.

At the same time the life expectancy has increased over the past century at an afore unknown speed. Except for the time span between 1960 and 1970, where the increases were quite moderate, life expectancy at birth has consistently increased every ten years by approximately three years. The remaining life expectancy conditional on reaching the age of 65 has also changed significantly over the years. Obviously this value is of great interest for matters concerning social security, since it is an indicator of the duration of benefit payments. This remaining life expectancy has risen by over 50 percent for men and nearly doubled for women. At the same time the probability of reaching the age of 65 has increased from 25 percent to 80 percent for men and from 30 percent to 90 percent for women.

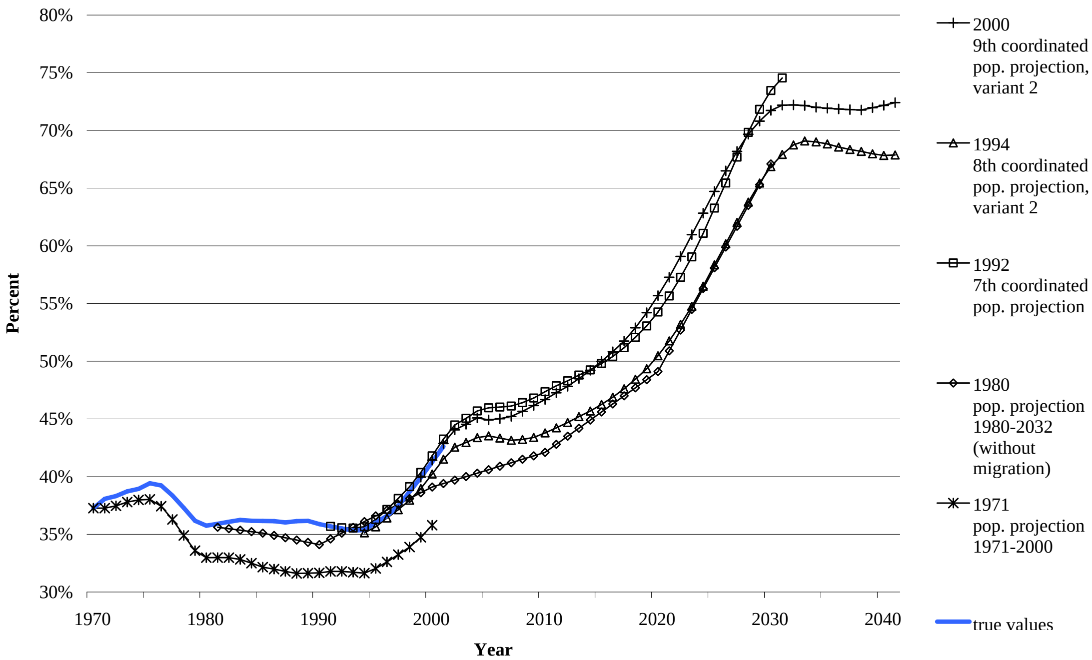
In order to combine the developments of the birth rate and longevity into one indicator, we choose the old-age dependency ratio defined as the proportion of the population that is 60 years and above in relation to the 20 to 59 year old population. This measure is especially instructive when addressing questions of pay-as-you-go public pension schemes, since it gives an illustration of how many (potential) retirees have to be supported by one person of the potential work force. The most recent official population projection forecasts roughly a doubling of this ratio within the next thirty years (see Figure 3 below).

4.2 On the precision of past population projections

Keeping track of the size and structure of a countries population by conducting a population census has been a common practice for over two millenniums. Using the data collected in such a census together with mathematical models to project future developments of the population is, compared to the over two thousand year long history of the census, a very recent undertaking. However, enough time has gone by since the introduction of the formal framework by Leslie (1945) that by now we have some official projections to look back upon and evaluate their performance at predicting future demographic developments. In Figure 3 we plot the old-age dependency ratio over time as predicted by various official population projections. In addition we include the true figures of the old-age dependency from 1970 through 2001. Inspection of this figure shows that only the 1970 projection was really of the mark. Apparently, the decelerated increase of life expectancy of the 1960s led to a misjudgement concerning the future rise of life expectancy. The rise in longevity was again underestimated in the projection of 1980, however not as severely as in 1970. Also, because birth rates were correctly assumed to stay at the low level of the seventies, the long-run values of the old-age dependency ratio correspond to those of the more recent projections. The 1992 projection shows how good a population projection can perform in the medium term.

From Figure 3 we conclude two things. Firstly, an idea of the extend of the population crises has been around since the late seventies and was officially documented with

Figure 3: Old-age dependency ratio 1970-2042: true values and projections



Notes: Old-age dependency ratio at the beginning of each year is defined as $\frac{60+}{20-59}$. Except for the 8th and 9th coordinated population projection the values are for the Old Laender.
Source: Statistisches Bundesamt (1971), BMI (1984), Sommer (1992,1994,2001) and Statistical Yearbook of Germany, several years.

the population projection of 1980. Secondly, at the medium term of 15 to 20 years, the past population projections were quite precise at predicting the level of the old-age dependency ratio. These findings are important for our paper since we will analyze whether political changes to the benefit formula can be explained by lead values of the old-age dependency ratio. In order to conduct this analysis, it is a prerequisite that these projections exist, that they forecasted a "demographic crisis", and that they are fairly precise at the medium term.

The implications of these projections have also found early access into the political debate on the future of the public pension scheme. Grohmann (1980) conducted a study for the federal ministry of labor and social security where he finds that projections with a horizon of 15 years ahead are useful for the analysis of the financial situation of the *GRV*. A federal institute for the research on demographics (*BiB*) was founded in 1973 as a think tank of the political implications of demographic changes. A report on the research conducted at the *BiB* during the first 25 years of its existence can be found in Höhn (1998). A comprehensive survey on the future of the public pension in an ageing society can be found in Eekhoff (1985).[34]

[34] surprisingly (or not), the different proposed measures to reform the public pension scheme have not much changed since then.

5 Demographic development and benefit rule changes

In this section we try to estimate what are the driving forces behind changes to the generosity of the public pension system. Specifically, we investigate how current and future values of the old-age dependency ratios can explain the changes to the prospective generosity of the pension scheme for a middle aged worker and the changes to the generosity for a person who is just about to enter retirement. This analysis is in the spirit of McHale (2001) and Razin et al. (2002). The former author analyzes how the fraction of old-age-expenditures to GDP can be explained by the old-age dependency ratio. A regression for the OECD countries yields the result that a relative increase of the old-age dependency ratio increases the share of old-age-expenditures to GDP by roughly 1.6. This elasticity is larger than unity and indicates that per-capita transfers to the old are actually increased during demographic transition.[35] McHale further gathers data on recent reforms in the G7 countries, and he comes to the conclusion that the currently old are protected from severe social security reforms. The middle aged are, however, subject to cuts in generosity. He formulates a model of political economy to explain this by introducing the fear of the middle aged that future generations might abolish the system altogether.[36]

Razin et al. (2002) take a broader look at the size of the welfare state and find that the dependency-ratio-elasticity of social transfers equals -7.5. They put forward a model that can explain a shrinking welfare state in an ageing economy if the median voter is not yet part of the old population. This is due to the increased fiscal "leakage" for the median voter in an ageing society. Because of the rising share of transfers that are paid to the elderly, the low-skilled median voter can turn from a net-beneficiary to a net-contributor during demographic transition, and he will then be in favor of reducing the welfare state.

Our analysis deviates form both of these studies for two reasons: Firstly, we are not estimating an actual time-series of transfer payments, but rather a measure of relative generosity that we construct from the laws of the benefit formula. This allows us to include reforms that are only gradually phased in, and that are therefore not included in actual data yet, or are not visible in the data at the time the reform is made. Secondly, we add the hypothesis that future values of the old-age dependency ratio may have an influence on the generosity of the pension system.

[35]The inclusion of country dummies reduces this elasticity to 0.2. Unfortunately, McHale does not comment much on this, even though this drastically changes his results. A value of 0.2 implies a severe cut-back of per-capita-transfers instead of an increase.

[36]For a recent survey of the political economy of social security see Galasso and Profeta (2002).

5.1 Time-series analysis of relative generosity

In order to conduct our analysis, we first need to modify the measure of relative generosity to be applicable over time. We do so by calculating the relative generosity over time (RGT) for persons of a specific age at each point in time. In particular, we calculate the gross social security wealth of a 45 and 62 year old under the applicable law in t. Again, we compare this value of SSW_t to the social security wealth of the respective cohorts under 1970 law in order to derive our measure of relative generosity.

$$RGT_t^{45} = \frac{SSW_t^{c=t-45,s=2}}{SSW_{1970}^{c=t-45,s=2}} \quad \text{and} \quad RGT_t^{62} = \frac{SSW_t^{c=t-62,s=2}}{SSW_{1970}^{c=t-62,s=2}} \tag{3}$$

In this section we are concentrating on scenario 2 only, i.e. the standard retiree without education who is retiring early. We do so because we want to keep the number of regressions to a limited amount. We choose scenario EARLY because we believe this is the most representative scenario for two reasons: not only do most people who meet the necessary requirements choose the early retirement option but also the time path of generosity for early retirement is quite similar to that of the pension due to occupational incapacity.

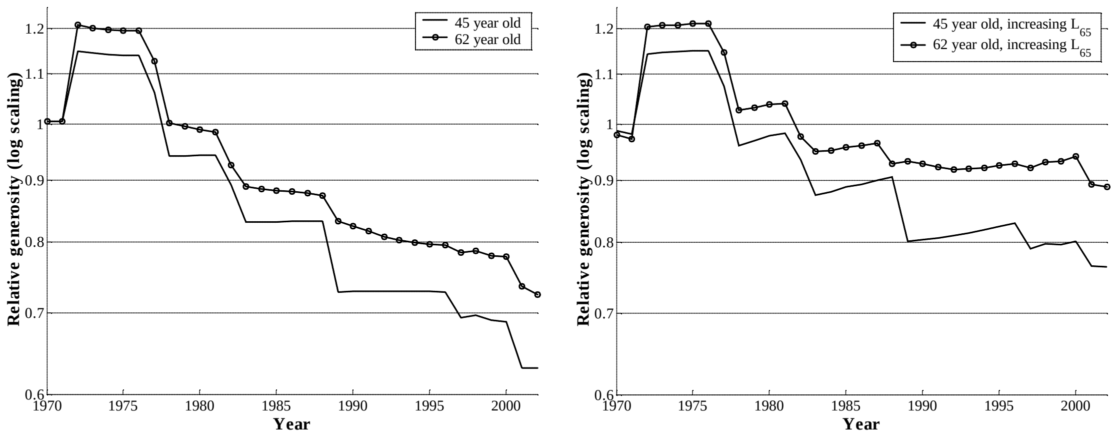
The time path of RGT^{45} and RGT^{62} is plotted in Figure 4. Because we are looking at 45 and 62 year old persons at every point in time, we are considering a different set of two generations in every year. This inclusion of many cohorts in one indicator raises the question of how we treat the rising remaining life-expectancy over time. For the regression of the policy function, we use a constant value for the remaining life-expectancy.[37] We proceed in this manner because we want the demographic variable to be an explaining variable and not be part of the explained variable. In Figure 4 we have, however, also included a sub-figure in which we illustrate the development of generosity if we take account of rising life-expectancy.

The time-path of RGT^{45} is almost identical to that of cohort 1950 under scenario 2 (cf. Figure 2c). The time path of RGT^{62} differs to that of RGT^{45} with respect to two features. Firstly, the increase of generosity in 1972 is larger for RGT^{62} because the average remaining life-expectancy we use for RGT^{62} is smaller than that for RGT^{45}. Therefore the relative increase of adding two more years of pension payments is larger. Secondly, the time path of RGT^{62} exhibits a more continuous course of changes in contrast to the discrete jumps in the time path of RGT^{45}. The explanation for this is that some measures are only implemented gradually. A good example is the intro-

[37] To be precise, for RGT^{62} we have taken the average remaining life-expectancy of the 65 year old male of all generations that are considered in this scenario. For RGT^{45} we proceed in the same way. The resulting figure is higher for RGT^{45} because the sample of cohorts used to calculate this average is born seventeen years later than in the case of RGT^{62}.

Figure 4: Relative generosity for the 45 and 62 year-old (RGT) from 1970 through 2002

(a) with constant life-expectancy (b) with increasing life-expectancy



Source: Author's calculations

duction of health care contribution payments for retirees in 1983. Because the cohorts entering retirement in 1984 and 1985 are also beneficiaries during years with a reduced contribution rate, they are not hit by the full extend of the reform. However, as one can see from Figure 4a) the entering retirees are by no means seriously protected from benefit rule changes.

5.2 Estimating a policy function of generosity: Does Germany have an implicit demographic factor?

In the above mentioned survey of opinion conducted by Boeri et al. (2001b) the majority of the interviewed Germans were in favor of opting out of the public pension scheme. At the same time there was a large consensus that the size of the welfare state should be maintained at the current level. A question that the survey does not address is the preference of the German citizens if they have to choose between either raising contributions in order to keep per-capita benefits constant or reducing per-capita benefits in order to keep the contribution rates constant.[38] But this is exactly the crucial question for social security during demographic transition. In sections 3 and 5.1 we have shown some evidence that the generosity of the pension scheme has been significantly reduced in the course of the past decades indicating that per-capita benefits are not being held at the constant level. We will now estimate the influence of demographic developments on this trend.

[38] Consulting the web-appendix of the survey shows that the questionnaire only gave a choice of a) reducing taxes and benefits, b) increasing taxes and benefits, or c) maintaining the current level of contributions (cf. Boeri et al. (2001a)).

We estimate a regression in which the dependent variable RGT^{45} is a function of the current old-age dependency ratio, of the 17-period forecast of the old-age dependency ratio,[39] and of further variables that are indicators of the short-run financial situation of the *GRV*. These are the federal subsidy to the pension scheme as a fraction of total expenditures, the average gross earnings of the labor income, and the reserves of the *GRV* measured in monthly expenditures (SSREV). All data are taken from VDR (2002a). We use a one period lead of the federal subsidy since the federal subsidy is usually determined beforehand by legislation. Note that we take the natural logarithm of the dependent and all independent variables. We estimate this function by least squares with an included AR(1) term. The AR(1) term is added because for some of the regressions we could not reject autocorrelation of the error terms. The same regressions are run on RGT^{62}. The results for the regressions are given in Table 4. We denote significance levels by asterisks, and we include the t-statistics in parentheses.

The results in table 4 show highly significant coefficients for both the current and the future dependency ratios under all models. This holds for all regression on RGT^{45} and on RGT^{62}. Of the other potential determinants added to the regression, only the federal subsidy can be found to have a significant (negative) influence on both measures of generosity. The average earnings also have a significant (positive) influence on the generosity to the 62 year old. However, none of the additional determinants changes the size or significance of the coefficients of OAD and $OAD(+17)$ in a fundamental way. The regressions show that a 10 percent increase of the current OAD is associated with a 6 to 7 percent increase of generosity to the middle aged. On the other hand, a future increase of the OAD has a more than one-to-one negative influence on RGT^{45}. The elasticity is smaller than -1.1 in all regressions. The general direction of this result is also valid for the generosity to the 62 year old. A rise in the current OAD is associated with an increase in generosity, but higher levels of future old-age dependency ratios are associated with an even larger reduction in generosity today. The coefficients of OAD are slightly higher in the regressions on RGT^{62} than those in the regressions on RGT^{45}. We also run the regressions on the contribution rate (not reported here). The only noteworthy result of this exercise is a modest positive influence of size 0.2 of the current OAD on the contribution rate.

The results of the regressions show that the medium to long term demographic development has a significant influence on how the legislator is adapting the generosity

[39] We use the true values of the old-age dependency ratio in the years 1970 through 2001 and the figures from the ninth coordinated population projection for the future value of the old-age dependency ratio. We use the true value instead of the forecast when this value is available for three reasons. First of all, we try to avoid discrete jumps in the dependency ratio. Secondly, it is hard to say at what time the official population projection was known to the policy maker. And finally, Figure 3 shows that the projections are not to far of the mark.

Table 4: Determinants of generosity RGT, least squares regression 1970 through 2001

	$\log(RGT_t^{45})$				
	(1)	(2)	(3)	(4)	(5)
log(OAD[a])	0.37*	0.59***	0.64***	0.67***	0.65***
	(1.75)	(3.01)	(3.13)	(3.22)	(3.13)
log(OAD(+17))	-1.33***	-1.17***	-1.28***	-1.28***	-1.27***
	(-17.15)	(-13.53)	(-6.98)	(-6.67)	(-6.86)
log(federal subsidy(+1))		-0.33***	-0.34***	-0.36***	-0.34***
		(-2.96)	(-3.05)	(-3.38)	(-2.97)
log(average earnings)			0.04	0.03	0.05
			(0.76)	(0.59)	(0.79)
log(SSREV[b])				-0.01	
				(-0.54)	
dummy for unification					-0.01
					(-0.22)
AR(1)	0.47**	0.38**	0.36*	0.32	0.34
	(2.41)	(2.05)	(1.77)	(1.42)	(1.70)
Constant	-0.93	-1.11	-1.61	-1.51	-1.62
Adjusted R^2	0.96	0.97	0.97	0.97	0.96
Durbin-Watson	1.78	1.82	1.81	1.81	1.81
F-Statistic	244.55	228.15	177.65	143.46	142.61

	$\log(RGT_t^{62})$				
	(1)	(2)	(3)	(4)	(5)
log(OAD)	0.47***	0.68***	0.89***	0.88***	0.89***
	(2.99)	(3.53)	(5.77)	(5.69)	(5.89)
log(OAD(+17))	-1.12***	-0.97***	-1.28***	-1.28***	-1.29***
	(15.12)	(-10.94)	(-9.27)	(-8.77)	(-9.12)
log(federal subsidy(+1))		-0.34**	-0.41***	-0.40***	-0.42***
		(-2.36)	(-3.14)	(-3.07)	(-3.21)
log(average earnings)			0.13***	0.14***	0.13**
			(2.98)	(3.05)	(2.62)
log(SSREV(-1))				0.00	
				(0.24)	
dummy for unification					0.01
					(0.56)
AR(1)	0.49*	0.48**	0.18	0.18	0.18
	(1.74)	(2.16)	(0.87)	(0.86)	(0.82)
Constant	-0.58	-0.79	-2.36	-2.39	-2.35
Adjusted R^2	0.95	0.97	0.97	0.97	0.97
Durbin-Watson	1.94	1.93	1.78	1.78	1.79
F-Statistic	215.45	230.45	212.58	170.63	172.06

t-statistics are in parentheses
significance is denoted by asterisks (*=10%, **=5%, ***=1%)

[a]Old-age dependency ratio: population 60+/ population(20-59).

[b]Reserves of the public pension scheme measured in monthly expenditures (*Schwankungsreserve*).

of the benefit rule. This indicates that the legislator is taking action today to encounter potential future financial problems of the pension scheme due to demographic crisis.

It seems that the German benefit rule is subject to an implicit demographic factor. An important result from our analysis is that future demographic developments are effecting the generosity for both future and current retirees. The findings of McHale (2001) that current old are protected from social security reform can not be confirmed by our data. On the other hand, without long term demographic pressure the classic theory of political economy of social security would apply: the positive coefficient on the current OAD indicates that the old will use their growing political power to increase the generosity of the pension scheme. To our knowledge none of the existing models of political economy of social security can explain the phenomenon that the current OAD has a positive influence on generosity while at the same time the $OAD(+17)$ has a negative influence on generosity. We see this as a point of departure for future research.

5.3 Future changes: What does it take to make the *GRV* sustainable?

From the projection of the future old-age dependency ratio depicted in Figure 3, it comes as no surprise that the current level of generosity of benefit payments is not sustainable.[40] Accordingly, the German government has put a task force in place – the so-called *Rürup Commission* – that is working out a proposal for yet another reform of the social security system.[41] In the following analysis, however, we will not consider these latest proposals. Instead, we now turn away from specific reforms, and we address the more general question of the magnitude of further changes that will be necessary to make the german public pension program sustainable. In order to put the past changes to the generosity of the benefit rule into context to the still to be expected changes, we compute the sustainability – or more precisely the sustainability gap – of the public pension scheme. We do this by applying the method of generational accounting (c.f. Auerbach et al (1991,1992,1994), Raffelhüschen (1999) and Bonin (2001a)) to the isolated sector of the public pension scheme.

Because the German public pension scheme is heavily financed by tax revenues from the government, it is difficult to conduct an isolated analysis of social security. The federal subsidy makes up roughly 28 percent of all expenditures in the baseyear 2000. Assumptions of how this federal subsidy will evolve over time will have an impact on the size of the sustainability gap. We counter this problem by looking at three

[40]Sustainability is defined as a state in which the current laws can be maintained *ad infinitum* without a further increase in the contribution rate or a decrease of transfers.

[41]This commission has suggested two measures: An increase of the statutory retirement age by two years to 67 over the next 30 years and a modification of the indexation of benefits that will take account of future demographic developments. The so called "sustainability factor" is similar, but not identical to the "demographic factor" of the RRG 1999. The now proposed addition to the indexation-formula will adjust the benefits depending on the development of the ratio of entitled retirees to contribution payers. This ratio is a participation-adjusted version of the old-age dependency ratio.

Table 5: Generational accounting for the German public pension scheme

Baseyear 2000; r=0.03; g=0.01; 9^{th} coordinated population projedtion

scenarios for federal subsidy	sustainability gap (% of GDP)	reducing benefits				
		immediate reduction	soft transition			
			0.99^{years}		$1-\frac{years}{100}$	
			years	reduction	years	reduction
A)[a]	96%	18%	42	34%	33	33%
B)[b]	133%	24%	42	34%	33	33%
C)[c]	110%	20%	30	26.0%	25	25%

[a]federal subsidy is a constant fraction of benefit payments
[b]federal subsidy is a constant fraction of contributions
[c]federal subsidy is financed via a constant value added tax rate

scenarios: A) the fraction of expenditures that is covered by the federal subsidy will remain constant at the level prevailing in 2000, B) the federal subsidy is a constant fraction of contribution payments, and finally C) we assume that the federal subsidy in the year 2000 was completely financed by a value added tax with a tax rate of roughly 7 percent and that this tax rate will be held constant.[42] Apart from computing the sustainability gap, it is common in the generational accounting literature to calculate indicators that show how taxes or transfers have to be adjusted in order to meet the intertemporal budget constraint. Here, we develop a new indicator that is more in line with the lesson we have learned from looking at the history of the benefit rule above: Reductions to the generosity of the benefit rule have been gradual but continuous. We implement this indicator of a "soft transition" by asking the following question: If benefits were reduced by one percent every year, how many times would this reduction have to occur in order to guarantee sustainability? The results of this exercise are given in Table 5.

The findings confirm that the *GRV* is currently not sustainable. Depending on the assumption concerning the future size of the federal subsidy, the sustainability gap ranges between 96 and 133 percent of GDP under current law. The sustainability gap is smaller under scenario A) than it is under scenario B) because under scenario A) the absolute size of the federal subsidy increases with the process of aging. In contrast, under scenario B) the federal subsidy behaves as the contribution receipts do. These tend to decrease because of the future decline in contribution payers. Scenario C) is

[42]Budget of the *GRV* for the year 2000 (figures in billion €): Contributions of the employed (141.8), contributions of the unemployed (8.2), pensions (191.6), contributions by the public pension scheme to health care and long term health insurance (15.8). The total of expenditures amounts to 207.4 billion € and receipts from contributions are 150.0 billion €. We assume that the federal subsidy is equal to the deficit of 57.4 billion €. See Krimmer and Raffelhüschen (2003) for more details and an analysis of the entire public sector with the help of generational accounting.

more or less neutral with respect to the demographic development.

Making the *GRV* sustainable at the current contribution rate would call for an immediate decrease in benefits for all generations in the region between 18 and 24 percent, again depending on the choice of scenario. Because the immediate reduction is not a realistic indicator, we also compute a "political feasible" path into sustainability. Under the "soft transition"-indicator benefits are decreased annually by one percent for all generations from the year 2001 onwards until the intertemporal budget constraint of the public pension program is fulfilled with equality. We look at two different scenarios: under the first (columns 4 and 5) benefits are always just 99 percent of the level of the previous year, i.e. in addition to the growth adjustment pensions are adjusted by $0.99^{year-2000}$.[43] Under the second scenario benefits are reduced annually by one percent of the level that prevailed in 2000, i.e. the adjustment factor is equal to $1 - \frac{year-2000}{100}$. As can be seen from columns 5 and 7 in Table 5, the percentage reduction under both scenarios is nearly the same. It is only the time span to reach this reduction that differs by quite a bit between these two different transition scenarios. Finally, we can see that there is quite a difference between the immediate reduction of benefits and the soft transition. Under scenario C) the slow reduction calls for a benefit reduction by 26 percent instead of 20 percent under the immediate reduction. The necessary reductions are even larger under scenarios A) and B) amounting to over 34 percent.[44] Sensitivity results for different values of the growth rate (not reported here) have shown that the "soft transition"-indicator is much less sensitive to changes of parameter values than the other, currently used, indicators are.

Summarizing, we have shown that under a politically realistic transition path a further continuous decrease of benefits that will, at the end of the transition, amount to a reduction of something between 26 and 34 percent is necessary to make the German public pension program sustainable. While the results from the generational accounting perspective are not really comparable to our measure of relative generosity, it seems that the reductions of the past 25 years – including the reform of 2001 – have taken us about halfway. Roughly, another 30 to 40 years of continuous bite-size reductions will be necessary to cope with the severe demographic transition Germany is undergoing right now.

[43]Because in this scenario we assume a real growth rate of one percent. This means that pension are constant in real terms. However, because this adjustment occurs in addition to all other already legislated reforms, a real reduction of benefits cannot be ruled out completely.

[44]Note that under scenario A) the federal subsidy is also decreased with the reduction of benefits while under scenarios B) and C) the federal subsidy remains constant.

6 Conclusion

In this paper we analyze the political volatility of social security wealth by constructing a measure of relative generosity of the benefit rule of the German public pension system. In order to do so, we first need to outline the social security reforms of the past 40 years. We have tried to put this chronicle of the benefit rule into an economic structure, and as a result we come up with a history of the benefit formula of the German public pension scheme from an economists point of view. We believe this to be a nice by-product of our analysis since a comparable history of the German *GRV* can only be found in fragments.

One of the two main issues, we address, is the uncertainty or ”political risk” of benefit payments. We show that changes to the generosity are not only very frequent, but are also of significant magnitude. When stressing the risk-aspects of alternative forms of old-age income provision, such as real investments, one should keep in mind that the pay-as-you-go financed pension system bears several significant risks itself. We have only pointed out one of those risks, namely the ”political risks”.

As the second main focus, we have tried to estimate a policy function that tries to explain legislative changes of the benefit rule by current and future demographic developments. Our findings are that a 17 year forward of the old-age dependency ratio has a significant negative influence on the pension scheme's generosity to both the middle aged and the elderly. Apparently, legislation steers towards medium-term sustainability of the system, and it is not blind to demographic development. Even though the demographic factor that was intended to be a part of the benefit formula under the RRG99 was never implemented, it seems as if German pensions have been subject to an implicit demographic factor for quite some time.

Furthermore, both section 3 and 5 do not show evidence that elderly people are protected from social security reform. On the contrary, the generosity for the elderly is also influenced by the future development of the old-age dependency ratio. This indicates that the burden of guaranteeing the medium-term sustainability of the system is also carried by the currently old. We believe this phenomenon to be a point of departure for future models of political economy of social security.

Finally, we derive the magnitude of future changes that are necessary in order to guarantee the long-term sustainability of the *GRV*. If the generosity is only reduced by annual bite-size steps, as it has been the case in the past, reductions will amount to roughly 30 percent of the current level. Instead, if measures were taken immediately a reduction of only 20 percent would be required.

A Appendix: Further information on the *GRV*

Table 6: Types of pensions and the respective adjustment factors

Type of pension	**adjustment factor (RF)**
Pension due to age (Rente wegen Alters)	1.0
Pension due to partially reduced capacity to work (Rente wegen teilweiser Erwerbsminderung)	0.5
Pension due to fully reduced capacity to work (Rente wegen voller Erwerbsminderung)	1.0
Survivor benefits for spouses under the age of 45 not raising children (limited to 2 years) (Rente wegen Todes: Kleine Witwen(r)renten)	0.25
Survivor benefits for spouses older than 45 or raising children (Rente wegen Todes: Große Witwen(r)renten)	0.55
Survivor benefits for children that have lost one parent (Rente wegen Todes: Halbwaisenrenten)	0.1
Survivor benefits for children that have lost both parent (Rente wegen Todes: Vollwaisenrenten)	0.2

Notes: Adjustment factors for pensions begining after 1.1.2001.
Source: Sozialgesetzbuch VI, 2. Kap., 2. Ab., 3. Unterab.: Rentenhöhe und Rentenanpassung § 6.

Table 7: Different paths of entering retirement and conditions that have to be met

		58	59	60	61	62	63	64	65	66	67
	3 years of covered work in the last 5 years, 5 years of coverage	*Benefits due to reduced capacity to work / occupational incapacity* (*Rente wegen verminderter Erwerbsfähigkeit*)								Benefits due to age (Regelaltersrente)	
	8 years of covered work in the last 10 years, 15 years of coverage	*unemployment*			*Benefits due to age after unemplyoment and old-age part-time employment* (*Altersrente nach Arbeitslosigkeit und Altersteilzeitarbeit*)						
	8 years of covered work in the last 10 years, 15 years of coverage		*old-age-part-time-employment* (*Altersteilzeitarbeit*)		*Benefits due to age after unemplyoment and old-age part-time employment* (*Altersrente nach Arbeitslosigkeit und Altersteilzeitarbeit*)						
	10 years of covered work after age 40, 15 years of coverage				*Benefits due to age for women* (*Altersrente für Frauen*)						
	35 years of coverage and severely handicapped (at least 50 percent)				*Benefits due to old age for severely handicapped persons* (*Altersrente für Schwerbehinderte*)						
Scenario 2 and 3	35 years of coverage						*Benefits due to age for long-term contribution-payers* (*Altersrente für langjährig Versicherte*)				
Scenario 1	5 years of coverage									Benefits due to age (Regelaltersrente)	

Source: Arnds and Bonin (2002).

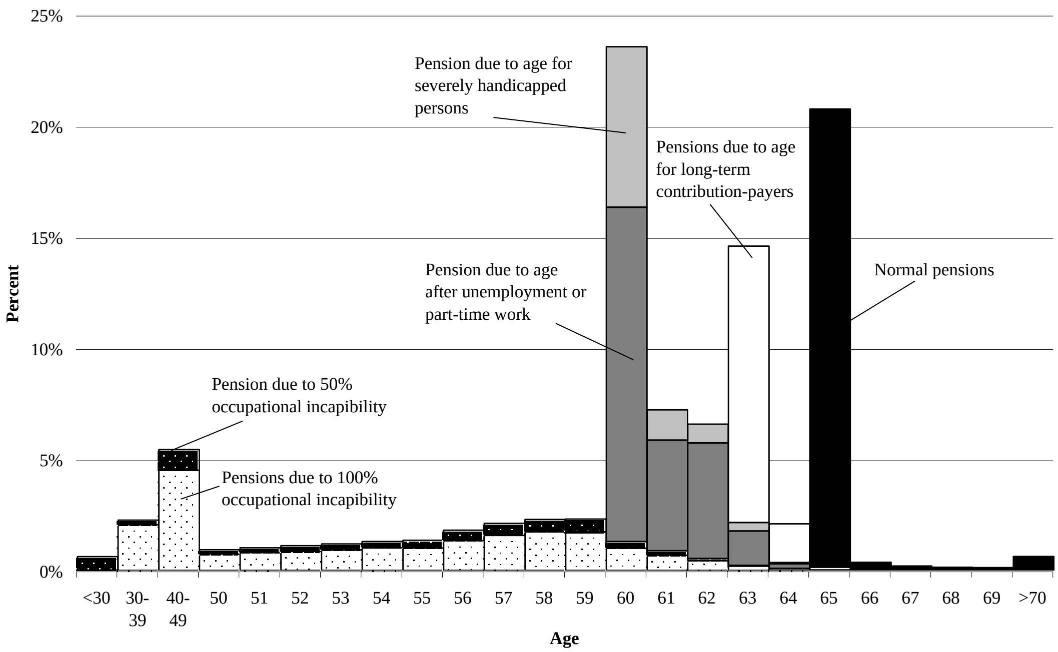
Table 8: The dynamic component of the benefit formula 1957-today

Year of legislation	Name of law / reform	Date of first adjustment:	Dynamic components of benefit formula: aB, aR, RAS
1957-1992	Annual benefits = Vj · pVhs · St · AB		
1957	Rentenreform 1957	01.01.1959	$AB_t = \frac{BE_{t-2}+BE_{t-3}+BE_{t-4}}{3}$ $RAS_t = \left[\left[\frac{AB_{t-1}}{AB_{t-2}}\right] - 1\right]$
1972	RRG 1972 15. RAG	01.07.1972 early adj.	$RAS_t = \left[\left[\frac{AB_t}{AB_{t-1}}\right] - 1\right]$
1977	20. RAG	01.01.1979 postponed adj. for old reitrees	$AB_t = AB_{t-1} \cdot \frac{BE_{t-1}+BE_{t-2}+BE_{t-3}}{BE_{t-2}+BE_{t-3}+BE_{t-4}}$
1978	21. RAG	01.01.1979	Equal adjustment of pensions of new and old pensioners. Therefore actual reduction of pensions for new retirees. $RAS_{1979} = 4,5\%, RAS_{1980} = 4\%, RAS_{1981} = 4\%$
1982	Rentenanpassungs-und Haushaltsbegleitgesetz 1983	01.07.1983 postponed adj.	$AB_t = AB_{t-1} \cdot \frac{BE_{t-2}+BE_{t-3}+BE_{t-4}}{BE_{t-3}+BE_{t-4}+BE_{t-5}}$
1983	Rentenanpassungs-und Haushaltsbegleitgesetz 1984	01.07.1984	$AB_t = AB_{t-1} \cdot \frac{BE_{t-1}}{BE_{t-2}}$
1992 - today	Monthly benefits = EP · ZF · RF · AR		
1989	RRG 1992	01.07.1992	$AR_t = AR_{t-1} \cdot \frac{BE_{t-1}}{BE_{t-2}} \frac{NQ_{t-1}}{NQ_{t-2}} \frac{RQ_{t-2}}{RQ_{t-1}}$
1997	RRG 1999	01.07.1999	$AR_t = AR_{t-1} \cdot \frac{BE_{t-1}}{BE_{t-2}} \frac{NQ_{t-1}}{NQ_{t-2}} \frac{RQ_{t-2}}{RQ_{t-1}} \cdot DF_t$ $DF_t = 1 + (\frac{L^{65}_{t-9}}{L^{65}_{t-8}-1}) \cdot 0.5$
1998	Gesetz zu Korrekturen in der Sozialversicherung und zur Sicherung der AN-Rechte	01.07.1999	Suspension of the demographic factor DF (for 1999 and 2000)
1999	Haushaltssanierungsgesetz	01.07.2000	$AR_t = AR_{t-1} \cdot \text{Inflation}_{t-1}$ (for 2000 and initially planned for 2001)
2001	Altersvermögens-ergänzungsgesetz	01.07.2001	$AR_t = AR_{t-1} \cdot \frac{BE_{t-1}}{BE_{t-2}} \frac{100\%-AVA_{t-1}-RVB_{t-1}}{100\%-AVA_{t-2}-RVB_{t-2}}$
		01.07.2011	$AR_t = AR_{t-1} \cdot \frac{BE_{t-1}}{BE_{t-2}} \frac{90\%-AVA_{2009}-RVB_{t-1}}{90\%-AVA_{2009}-RVB_{t-2}}$

with Vj, $pVhs$, St, AB, EP, ZF, RF, AR as in table 1, and

BE	average gross earnings of employees and workers	Bruttoentgelte
RAS	adjustment of benefits that are paid to retirees who are already retired	Rentenanpassungssatz
NQ	quota of net–to-gross-earnings (including employees share of contributions to all mandatory insurances)	Nettoquote
RQ	quota of net-to-gross-pensions	Rentennettoquote
DF	demographic factor	Demographischer Faktor
L^{65}_t	remaining life expectancy of 65 year old in year t	
AVA	Share of gross earnings for savings in individual accounts (4% in 2009)	Altersvorsorgeanteil
RVB	contributions to GRV (employers and employees share)	Beitragssatz GRV (AN+AG)

Figure 5: Age and path of entering retirement in 2001



Notes: Male retirees, without survivor benefits.
Source: VDR (2002b).

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