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Rates of Return of the German Pay-As-You-Go Pension System

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Working Paper

Abstract

Due to population aging, contribution rates of the mandatory German pay-as-you-go pension system are expected to increase dramatically during the next decades. This paper estimates the impact on the expected returns of contributions for different cohorts. I show that rates of return for younger cohorts will be between zero and one percent, depending on the demographic and economic scenarios; for some demographic groups they become negative. The implicit tax rates reach levels of up to 80 percent of contributions for the youngest cohorts. If decreasing returns reduce incentives for labor supply and system participation, the whole system may become unsustainable. Indeed, I find empirical evidence for a recent decline of voluntary contributions and for a substitution away from taxable employment.

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1 Introduction

Compared to many other OECD countries, population aging is particularly dramatic in Germany. The fertility rates have dropped rapidly from 2.5 during the baby boom to about 1.3 thereafter. Additionally to the fertility crisis, life expectancy has increased at a rate of about 1.5 years per decade. With the decline in average retirement age to 60 years, the average duration of pensions has increased by sixty percent from 10 years in 1960 to 16 years in 1996. Thus, aging already puts considerable pressure on the German pay-as-you-go (PAYG) pension system, long before the fertility crisis unfolds: in the year 1995 only 24.3 million West-German workers (including unemployed) contributed for the pensions of 11.5 million pensioners and over 4 million widows in the public pay-as-you-go pension system - an old-age dependency ratio of about 60 percent (VDR 1997). The old-age dependency ratio is expected to exceed 100 percent by the year 2040 when the baby-boom generations are retired.

The net replacement rate of old age pensions has increased from some 60 percent in the sixties to 72 percent by the end of the seventies and has stayed at this level since then. This is substantially higher than the corresponding U.S. net replacement rate of about 53 percent (Casmir 1989). As a consequence of program generosity and demographic shifts, public pensions in 1997 made up for more than 12 percent of GNP and contribution rates reached 20.3 percent of the wage bill in 1997. Since 1992, the pension levels have been adjusted annually, so as to keep the net replacement rate fixed[1]. This amounts to a net wage indexation of net pensions. Due to the net wage indexation, productivity gains do not slow down the rise in contribution rates. Holding the replacement rates constant, the most optimistic forecasts yield a contribution rate of 27 percent in the year 2040. Even with a reduction of the net replacement rate from 70 percent to 64 percent (as in the 1999 pension reform) the contribution rates will reach a level of 24 percent in the optimistic scenario, and about 32 percent in status quo projections.

Population aging will not only drive up contribution rates. It will also reduce the implicit rates of return of a pay-as-you-go pension system. A well-known theoretical result for a constant rate of population and productivity growth is that the rate of return of the pay-as-you-go system is the sum of both growth rates. A projected shrinking of the German population of 1 percent per year with a 1 percent per capita economic growth would thus result in a steady state return of zero. However, this result may not be very informative for several reasons. (1) The population is not shrinking at a constant rate; (2) improvements of life-expectancy may change the profitability of the system; (3) different cohorts are affected

[1] Before 1992 the indexation was to gross wages.

quite differently by population aging and changes in legislation; and (4) due to individual heterogeneity the returns vary widely *within* cohorts.

Hence, the aim of this paper is to derive empirical estimates of the returns of the German public pension system for different birth cohorts and demographic groups. There is some recent literature on this topic. In two papers Eitenmüller (1996) and Hain, Eitenmüller and Barth (1997) compute *nominal* rates of return for several cohorts based on the 1992 legislation. The advisory board of the department of economic affairs (Wissenschaftlicher Beirat des BMWi 1998) and very recently Frerich (1998) have presented estimates of returns based on the 1999 reform. My paper extends the recent literature in several respects. The estimates of the returns of the German PAYG pension system are in *real* terms and are based on the current social security legislation (*Rentenreformgesetz 1999*). In order to assess the effects of the assumptions on the rates of return, I consider three different demographic and economic scenarios. Finally, I compute *expected* pension wealth as the expected present discounted value of lifetime contributions and benefits. The literature so far has simply calculated the value of pensions as a function of life expectancy of a representative agent. One can show, however, that this leads to an upward bias of the rates of return by 0.5 percentage points.[2]

My estimation of expected present discounted values and of rates of returns takes into account the risks of longevity, disability, and surviving spouses. The (real) expected values have several important interpretations. First, from the point of view of an optimizing individual, the expected values can be interpreted as the *ex ante return* on investment in an uncertain environment for an individual of a given type (e.g. male/female; married/single; cohort). Second, from a macroeconomic perspective, the expected values are the *correctly aggregated* average values of all individuals of the same type. The aggregation over all groups within a given cohort using the population weights of the specific groups gives the average value of the pension system for a whole cohort. Third, the expected values are *life-cycle* values and thus, a measure of intergenerational redistribution within that branch of the fiscal system.

I show that the real rates of return are quickly deteriorating for younger cohorts in all scenarios. The average return for the cohort born in the year 1930 is estimated to be about 3 percent. The average rates of return for the cohort born in the year 1980 are projected to be between zero and one percent, depending on the demographic and economic projections. This intergenerational difference is mainly due to demographic changes and only to a lesser degree induced by the reform of 1992, which treats the older cohorts more favorably than the younger

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[2] This reflects the well-known fact that a non-linear function of the expected value of a random variable does not equal the expected value of this function. This is also closely related to the aggregation problem.

ones. The rates of return differ widely across demographic groups: as a rule, females get a higher return than males due to a higher life expectancy, and married persons are better off than singles due to survivor benefits.[3] As a consequence, the rates of return for single males in the youngest cohorts are clearly negative in all scenarios.

These findings raise the question of incentives for participation in the pension system and for labor supply, since contributions to the pension systems may be increasingly perceived as taxes. The implicit tax for the youngest cohorts will rise to two-thirds of the pension contributions, which translates into a tax rate of 18 percent of the gross wage bill ????. Tax evasion may eventually destroy the basis of the system. Indeed, this seems to happen already: persons who have discretion over their program participation have reduced their contributions. I present strong evidence for a dramatic decline of voluntary contributions. Moreover there is mounting evidence for a recent substitution away from taxable employment towards other types of employment.

The paper is organized as follows: The next section describes the set-up for the estimation of expected presented discounted values of pensions. Section 3 presents the different scenarios together with the resulting dependency ratios and contribution rates. Section 4 reports the results on pension wealth, rates of return and implicit tax rates. Section 4 provides empirical evidence on behavioral reactions and section 5 concludes.

2 The Basic Set-up

The Expected Present Discounted Value Function

The rates of return are estimated for cohorts born between 1930 and 1980. Within each cohort, I differentiate by gender, marital status, earnings, mortality risk, entry to and exit from the labor force. Each type of worker faces the uncertainty of the date of death (or the risk of longevity) and the risk of disability prior to . The *expected* present discounted value function of contributions and pension is in general:

$$PDV_S(r) = \sum_{t=R}^{\infty} \mathrm{E}_S\left(YPEN_t(aR_t, R)\right)\cdot \delta^{t-s} - \sum_{t=s}^{R-1} c_t \cdot E_S\left(YLAB_t\right)\cdot\delta^{t-s}$$

[3] In a related paper Börsch-Supan and Schnabel (1997) consider the *intra*-generational effects of the public pension system, namely the incentives to retire early. In another paper (Schnabel 1997), I study the effects of a transition to a partially funded system, which amounts to switching to a policy that holds the contribution rate fixed as opposed to the 1992 legislation, which fixes the net contribution rate. The 1999 reform can be

PDV	expected present discounted value of pension wealth
s	planning age
E_s	expectation formed at age *s*
R	retirement age
$YLAB_t$	labor income at age *t*
$YPEN_t$	pension benefits at age t for retirement age R
c_t	contribution rate at age *t* (where age = year – cohort)
aR_t	pension per average annual earning (Aktueller Rentenwert)
δ	discount factor = 1/(1+*r*), with r = real interest rate.

Setting this function equal to zero and solving for the interest rate yields the rate of return for a specific demographic group. The present discounted value depends on several macro and micro variables, which have to be determined over the whole life-cycle. The contributions depend on the (aggregate) contribution rate c_t and on the (individual) earnings $YLAB_t$. The pension income $YPEN_t$ depends on the individual life-time earnings, on the aggregate level of pensions (aktueller Rentenwert, aR_t), and on other specific features of the pension system. The individual retirement age *R* is an important determinant of pension benefits and is made explicit in the above formula.

Due to survival and disability risks the contributions and pensions on the individual level are *state contingent*. That is, for each type of worker all state contingent time paths of contributions and pensions have to be computed over the whole life-cycle. Then, the expected values of contributions and benefits are calculated with respect to the random variables date of death and disability using the probabilities for survival, for joint survival and for disability. The expectation is formed conditional on the agent's planning age *s*, which is chosen to be the entry to the labor force. In general, the expectation depends on the cohort and gender specific survival probabilities and on the probabilities of disability. The discounted sum over these expected values is the present discounted value function. Finally, setting the present discounted value function to zero and solving for the interest rate yields the rate of return for a given demographic group.

Longevity, Disability and Survivor Benefits

In order to illustrate the computation of rates of return, the following formula gives a simple, stripped down version of the present discounted value of the pension system for a single person, neglecting survivor benefits and disability benefits:

considered a mix of both, since it lowers the net replacement rate, but not to the extent of holding the contribution rate constant.

$$PDV_s(r) = \sum_{t=R}^{\infty} YPEN_t(R) \cdot a(t \mid s) \cdot \delta^{t-s} \; - \; \sum_{t=s}^{R-1} c_t \cdot YLAB_t \cdot a(t|s) \cdot \delta^{t-s}$$

a(t|s) survival probability (probability to survive at least until age *t* given age s*)*

In this simplified case only the uncertainty about the date of death enters the expected value. The pension system would only provide funds for old-age retirement and would insure against the risk of longevity. The detailed formulas for the full-fledged computation of expected values are more complicated, since they have to deal with a multitude of state contingent paths. Thus, they are relegated to a separate appendix, which is available upon request. In the following paragraphs I indicate the method of integrating disability and survivor benefits.

In the case of *disability* the worker is eligible for disability pension benefits, which depend on the whole earnings history prior to disability. In order to calculate the expected value of disability benefits, one path of disability benefits is calculated for *each* possible age prior to old-age retirement, in which disability can occur. Then, for each age until the maximum age 115, the expected benefit is calculated. Moreover, the calculation of the expected value of contributions has to take into account that contributions are suspended after disability retirement. Thus, the contributions have to be weighted by the joint probability of staying alive and staying in the labor force.

For married workers the expected value of *survivor benefits* has to be considered. It is convenient to distinguish survivor benefits that apply when a working spouse dies *before* retirement from survivor benefits that apply when spouse dies *after* retirement. In the first case the computation is similar to that in the case of disability: For each possible year of death prior to retirement the whole path of survivor benefits has to be calculated. Then, the expected values are computed using the joint probabilities for husbands and wives. If the spouse dies after retirement the pension claims of the survivor are based on the pension of the deceased spouse. The survivor benefits have to be weighted by the joint probability of the death of the wage earner *and* the survival of spouse.

The survival risks are estimated from the life tables of the Bureau of the Census and are adjusted for the increasing longevity, depending on the specific demographic scenario. The disability risks are estimated from the empirical distribution of retirement entries. This overstates the true risk of disability, since disability retirement has been used as a substitute for early retirement and as a device for lowering the official unemployment rate. In the case of the medium and the conservative scenario, the risks of disability retirement stay constant over time. In the case of the optimistic scenario, the *individual* disability risks are adjusted to the decreasing *aggregate* level of disability, which is one of the main features of this scenario.

If the present discounted values were independent of the old-age retirement age R, the pension system would be actuarily fair in the sense, that it would not bias the timing of retirement. As a by-product, it is easy to show that (assuming a discount rate of four percent) there are still incentives for early retirement (see also Börsch-Supan and Schnabel 1997).

As the simulations will show, the *rates of return* do not depend heavily on the timing of retirement. Note, that this is not a contradiction to the former statement. First, since the rate of return is calculated over the whole life-cycle, the effect of a change that affects only a few years is small. On the other hand, the retirement decision is a marginal decision which takes into account the trade-off of staying in the labor force against leaving next year. Second, if the rate of return of the PAYG-system is, say, zero percent, the impact of an additional year in the labor force may raise the (total) return, even though it is not profitable at the margin.

The calculation of the present discounted value function requires several building blocks. First, the demographic projections are performed up to the year 2100 using a detailed simulation model for East- and West-Germany. The structure and size of the population feeds into a macroeconomic simulation model which generates employment, exit from the labor force and pensioners by age group for each calendar year. The simulation is also done for East and West. The output of the macro simulation determines the aggregate budget constraint of the PAYG-pension system. This, in turn, is required for the recursive calculation of the contribution rates c_t and the aggregate levels of pensions (aR_t) for each year.[4] Based on these macroeconomic key variables, the contributions and pensions are determined on the individual level.

The Individual Paths of Contributions and Pension Benefits

For varying ages of entry to the labor force the real earnings profiles are calculated taking into account the upper social security threshold (*Beitragsbemessungsgrenze*). In years before 1997 I can use the historic data on average earnings from the administrative records. For earnings after the year 1996 I assume an average growth rate of gross wages. For each cohort, an average wage earner is defined as a person, who earns an average *life-time* wage. If an average earner works for, say, 40 years he or she will accumulate 40 average contribution years (*Entgeltpunkte*).

However, this typical wage earner has a life-cycle wage profile and thus wages early in life are lower than average and wages late in life are higher than average. The life-cycle earnings profile for each cohort are based on results of Fitzenberger et al. (1997). The life-

[4] This calculation considers the demographic factors of the 1999 reform and the increase in the federal subsidy. Details on this topic can be found in Frerich 1998.

cycle profile induces a positive sloped wage path for each cohort. Other things equal, the present discounted value depends on the time structure of earnings: The later the contributions the higher will be the return. Additionally, macroeconomic growth is reflected in the growth of the economy-wide average wage of a given year. As a consequence, the wage of a given cohort displays a life-cycle profile which is superimposed by a macroeconomic growth profile.[5] Heterogeneity of the labor force within a birth cohort can be accommodated by shifting the wage profile by a factor of proportionality.[6]

For a worker of the oldest cohort the earnings history starts in 1950 when he or she has reached the age of 20; alternative simulations use age 25 as age of entry to the labor force. In 1990, the workers of the oldest cohort have reached the age of 60, the average retirement age in the medium and the status quo scenario. At this point it is important to ensure that the assumptions on the *micro* level (e.g. expected retirement age, life-expectancies) match the assumptions on the *macro* level, which were used in the calculation of the aggregate budget constraint and the contribution rates. In the simulations of present discounted values I assume an expected retirement age of 60 in the status quo and in the medium scenario, which matches the average retirement age on the macro level. Since in the case of the optimistic scenario the average retirement age eventually increases to 62.8, the retirement probabilities on the micro level have to be adjusted accordingly. For life-expectancies similar adjustments are made.

Based on the earnings profiles of each group, the (contingent) profiles of pension benefits are calculated for all feasible ages of old-age retirement and of disability retirement, taking into account the cohort and age-specific discount factors that apply according to the institutional rules.

The Institutional Frame

I use the rules of the most recent reforms to compute the benefits and contributions for different members of each cohort. The basis for the computations is the pension reform of 1999. The reform of 1992 introduced the net wage adjustment of pension benefits and discount factors for early and postponed retirement. The discount factors for early retirement will be phased in gradually. This scheme has been modified by several small reforms. In my

[5] Technically, the wage growth of each cohort over time is the sum of the life-cycle wage growth and the macroeconomic wage growth.

[6] Since the elements of redistribution in the public pensions system *within* generations are very weak, the position in the earnings distribution has no large effect on the individual returns, except for persons with very low earnings (Rente nach Mindesteinkommen). In this paper I consider only pensions that are related to contributions.

computations, I assume that the discount factors for early retirement will fully apply in the year 2002 for men and 2005 for women and that both are treated in the same way (that is, that men and women can retire at the age of 60 when accepting a discount of 18%). I also assume that in the future, the same discounts will also apply to disability retirement, since this will be the only way to prevent workers from using disability as a substitute for old-age retirement.

In a recent law (Wachstums- und Stabilitätsgesetz 1997) the federal subsidy has been raised in order to keep the contribution rate at 20.3 percent – at the expense of a one percentage point increase in the value added tax. Given the current rules, the federal subsidy will eventually make up for 24 percent of the PAYG-pension budget. I assume that the federal subsidy will offset the intragenerational redistribution of the pension system in the future. Finally, the 1999 reform (among other things) has introduced a „demographic factor", which limits the growth of pensions. As a result the net replacement rate will be gradually reduced to 64 percent.[7]

3 The Demographic and Macroeconomic Scenarios

The Assumptions of the Scenarios

The calculation of the path of contributions and pension benefits for a given cohort requires the contribution rates and the value of the pension claims over the life-cycle of each cohort. For the time before 1997, I can use the historical data. From the year 1997 on these values have to be projected. I use three different scenarios that differ with respect to the assumptions on demographic and economic trends. The key assumptions of the scenarios are displayed in table 1.

The first scenario extrapolates the current demographic trends and the economic structure of the year 1994. It is thus termed *status quo scenario*. In this projection, the fertility stays constant at the level of 1.346 children per woman, the net immigration is declining from the extraordinarily high levels of the early nineties to 100.000 in 2020, and life-expectancy rises steadily until the year 2040. The age-specific employment rates and the mean retirement age are held constant over time. Note that using the employment structure of the year 1994 is by no means pessimistic, since employment has fallen considerably since then. Reaching the level of 1994 during the next decade would be a success.

[7] The previous version of this paper was based on the 1992 legislation. The qualitative results for rates of returns were similar. However, the projected contribution rates differ.

The second scenario termed *medium scenario* only differs from the first one in the demographic trends. Immigration is much higher and the rise in the life-expectancy much slower than in the previous scenario.

The third scenario additionally changes the assumptions on employment and retirement. The age specific employment rates are assumed to rise by 20 percent and the average retirement age rises by almost three years. This is termed the *optimistic scenario*.

Table 1: Key Assumptions of Different Scenarios

	Year	Status-Quo	Medium	Optimistic
Birth rate	all years	1,346	1,415	1,415
Net immigration	2000	150	396.000	396.000
	2020	100	248.000	248.000
	2040	100	225.000	225.000
Life-expectancy	2000	19,4 / 23,8	19,4 / 23,8	19,4 / 23,8
conditional on age 60	2020	21,0 / 25,6	20,1 / 25,1	20,1 / 25,1
(males / females)	2040	22,4 / 27,0	20,5 / 25,6	20,5 / 25,6
Age-specific labor	2000	as 1994	as 1994	Increase of up to
force participation	2020	dto	dto	20% compared to
	2040	dto	dto	1994
Average retirement	2000	60,0	60,0	60,0
age	2020	60,0	60,0	61,4
	2040	60,0	60,0	62,8

All projections share the assumption that the Eastern states will catch-up to Western levels by the year 2010. This means that life expectancies, birth rates, per capita income, and employment are assumed to reach the levels of the West-German states.

Another important variable is the growth rate of the real per capita wages (*Durchschnittliches Bruttoarbeitsentgelt*). This growth rate has been on average 1.17 percent over the period of 1975 to 1996, and 0.84 percent from 1980 to 1996. Note that the years 1975 and 1980 mark the recessions after the first and second oil shock. It is also worth mentioning that the average growth rate of real per capita GNP has been 1.95 percent since 1975. The compound effect is dramatic: while wages have risen by only 28 percent, GDP per capita has risen by 50 percent.

Below I present the results for a real wage growth of one percent, which seems to be a reasonable assumption given the historical experience. It is often argued that wage growth will increase due to a relative shortage of labor in the course of population aging. However, capital is mobile and there is nothing like a worldwide shortage of labor. Thus, international competition will tend to bid down German wages. Anyway, the mechanism of the PAYG-system makes it very easy to calculate the effect of higher wage growth on contribution rates and rates of return: (i) higher wage growth does not change the contribution rates at all and (ii) increases the return one-to-one. This is also confirmed in my simulations.

Dependency Ratios and Contribution Rates for Different Scenarios

The consequences of the demographic assumptions are reflected in the fraction of elderly displayed in figure 1. In the status quo scenario the fraction of the population aged 65 and above doubles and reaches 32 percent by the year 2040. In the medium and in the optimistic scenario the share of elderly reaches 28 percent.

Figure 2 displays how the three scenarios translate into effective dependency ratios. The pensioner ratio (number of pensioners per hundred workers) increases in the same way as the fraction of elderly in both scenarios that hold the employment rates constant. In the status quo scenario 100 workers have to support almost 120 pensioners and in the medium scenario 100 workers pay for 98. Since the optimistic scenario assumes strong increases in labor market participation the rise in the dependency ratio is mitigated considerably and reaches only 78 pensioners per 100 workers.

The projections of the contribution rates are displayed in figure 3. In the status quo scenario the peak of contribution rates will be reached between the years 2040 and 2050 with values above 30 percent. In the optimistic scenario the contribution rates will reach a level of 24 percent around the year 2035.

It should be stressed that the projections are static, since they do not allow for endogenous labor supply reactions. Rising contribution rates may reduce the incentives to participate in the pensions system. A shrinking labor supply might further increase the contribution rates compared to the profiles shown in figure 3.

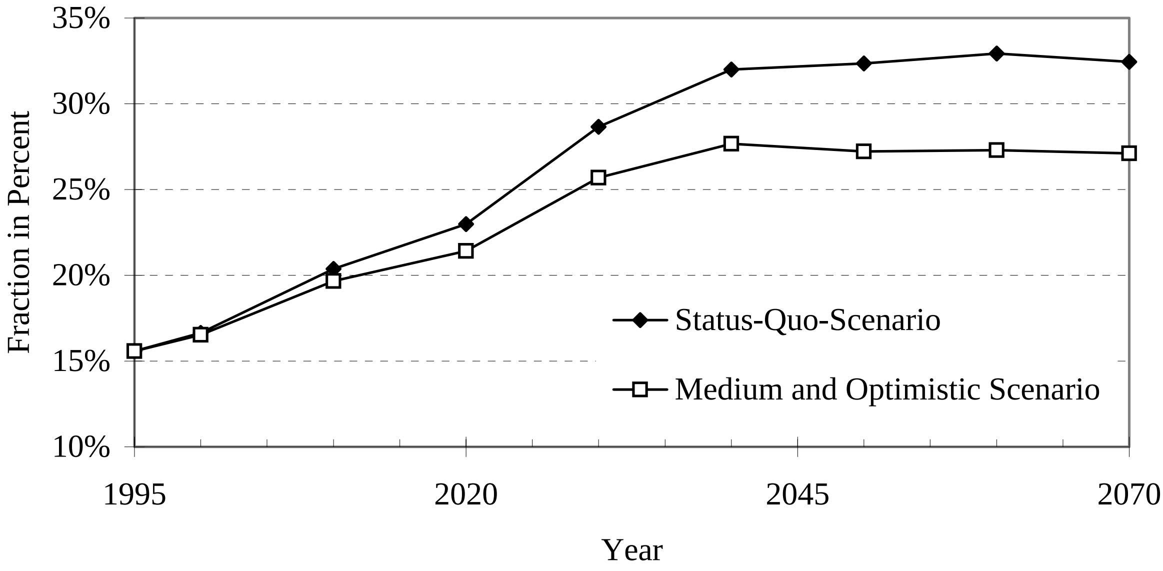

Figure 1: Projections of the Fraction of Elderly Persons. Persons 65 and older as percentage of total population.

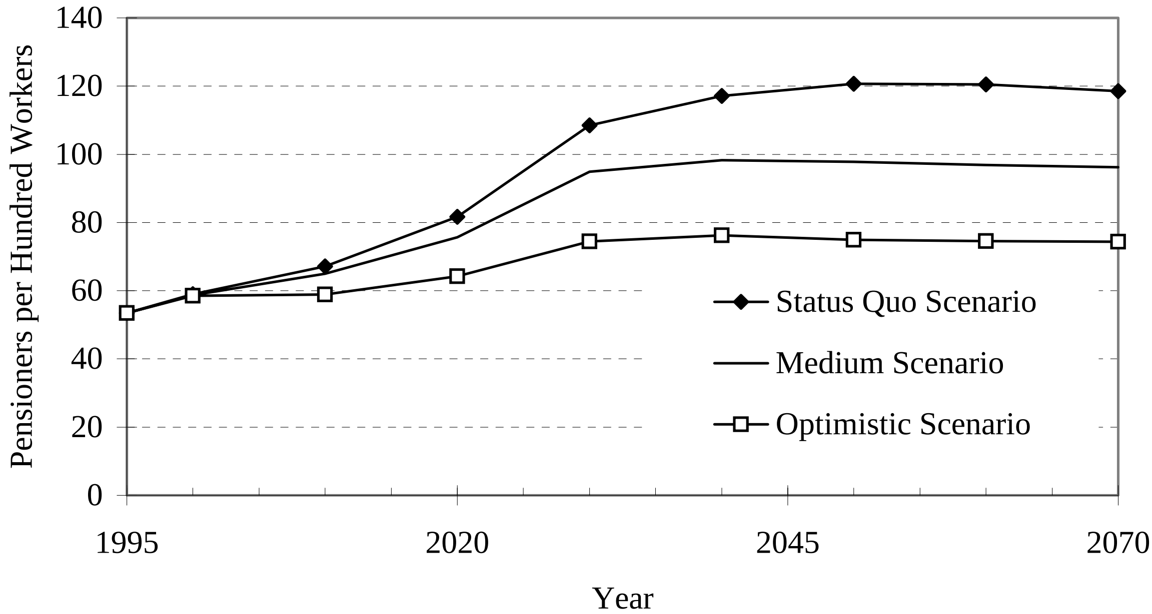

Figure 2: Projections of Dependency Ratios. Pensioners per hundred workers 1995-2070.

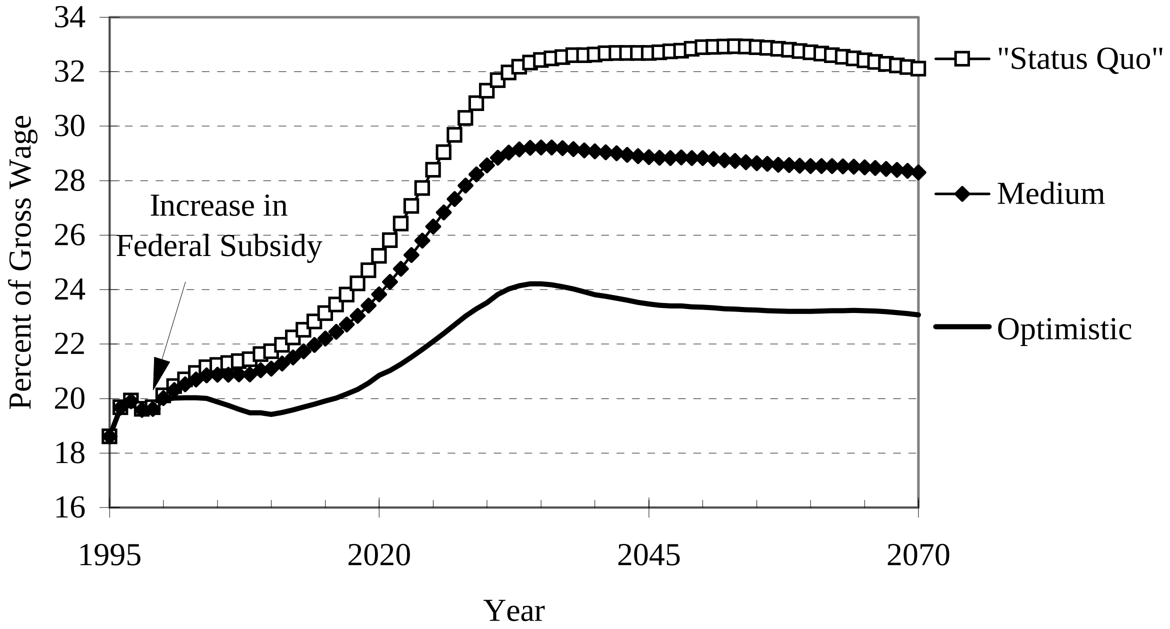

Figure 3: Projections of Contribution Rates of the PAYG-pension system.

4 The Returns for Cohorts 1930 to 1980

I report returns for cohorts born between 1930 and 1980. The 1930 and 1935 cohorts are currently at the beginning of retirement; the average males in these cohorts have already retired in the years between 1990 and 1995 and are expected to receive pensions until the years 2008/2013, long before the population aging process reaches its peak. At the other extreme is the youngest cohort, born in 1980, which is about to start working and will have to carry the burden of the social security system for the next 45 years before retiring around the year 2045. These small cohorts will have to finance the pensions of the baby-boom generations of the 1950s and 1960s. For each cohort several demographic groups are considered.

First, I present the results on the cohorts 1930 and 1935, which are almost unaffected by the demographic and economic assumptions. I contrast the results of four different groups: married males and females, and single males and females. Second, I present the intergenerational differences in rates of returns, focussing on the group of married males. I contrast the results for the three different scenarios. Finally, I estimate the implicit tax rates assuming a specific discount rate.

Cross-sectional Results

Married persons constitute the vast majority of retirees: about 85 percent of persons of age 60 are married. Due to survivor benefits, the expected value of social security pensions for this group is much higher than for single persons (see figure 4). On average, a wife is three years younger than her husband[8] and will outlive her husband by about 8 years. Thus, in the case of a married male, the expected time span of his widow receiving survivor benefits is 8 years. The expected value of this survivor benefit adds to the value of a married male's pension claims. As a consequence, for a married male the rate of return is one and a half percentage point higher than the rate of return for a single male. For married males born in 1930 the rate of return of contributions to the pension system is well above three percent. Even for single males in this cohort the rate of return is above two percent as is shown in figure 4.

The expected value of survivor benefits for a surviving husband is low due to the much higher life-expectancy of his wife. Thus, only little is added to the net value of the pension claims of a female worker in case she is married. As a consequence, the returns for married and single females differ only by about 0.3 percentage points: For females born 1930 the returns are 3.3 percent and 3 percent, respectively. However, the rate of return for a single woman is about one percentage point higher than the return for a single man. Again this is due to the higher life-expectancy of women.

The real return of 3.5 percent seems to be quite a good deal from the perspective of older cohorts. However, this relatively high return is due to the increasing generosity of the pension system over the last decades which is unsustainable in a steady state. Moreover, this cohort made only low contributions during working life, since the age structure used to be very favorable. Finally, the growth rate of the German economy was exceptionally high in the post war period until 1970. Thus the historical return of 3 percent is unsustainable in a steady state – even with a constant population.

Although the older cohorts have faced favorable conditions, even a real return of 3 percent does not seem very attractive compared to historical, long run returns in the capital markets. In the stock market real returns have exceeded 5 percent in the long run during the last 40 years – even excluding the recent years. For investors who started saving in stocks in the year 1955 and withdraw their assets in 1992 the real return of equities has been above 5 percent. For investors who started in 1965 the return of stocks has been 8 percent. Even the investment in German government bonds yielded returns of more than 3 percent.

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[8] I have estimated the average age differences using the 1985 and the 1996 waves of the German Socio-Economic Panel controlling for age and cohort effects.

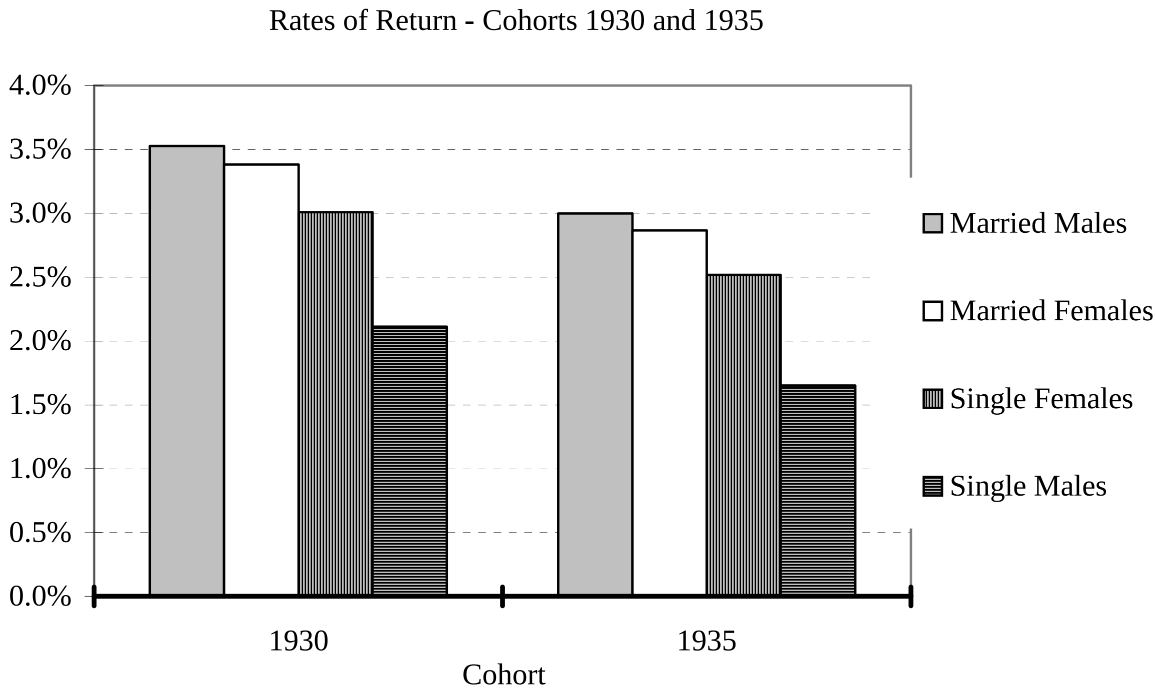


Figure 4: Rates of Return - Cross-sectional Results
Notes: Growth rates of real gross earnings equal to 1 percent after 1996.

Longitudinal Results

In this section I focus on *intergenerational* aspects. I illustrate the results choosing the group of married male workers who earn the highest returns. This can be done without loss of generality, since the differences in returns *between* demographic groups stay constant across cohorts. Also, married males constitute the largest group of insured workers. The results for other groups over time can be found in the appendix.

For married males the projected rates of return are displayed in figure 5 for cohorts born 1930 to 1980. While married members of the older generations earn returns of 3 percent or more, the returns for the youngest cohorts are much lower. The returns decline sharply in each scenario.

In the status quo scenario, the rates of return stay only slightly above zero for married males in the youngest cohort. However, also in the optimistic scenario the returns for married males decline to a level of only 1.1 percent. As can be seen from the appendix, in all scenarios the rates of return turn negative for single males born 1980.

Aggregation over demographic groups within cohorts leads to an average return of 0.9 percent for the youngest cohort in the optimistic scenario. In the status quo scenario the average for the cohort is virtually zero.

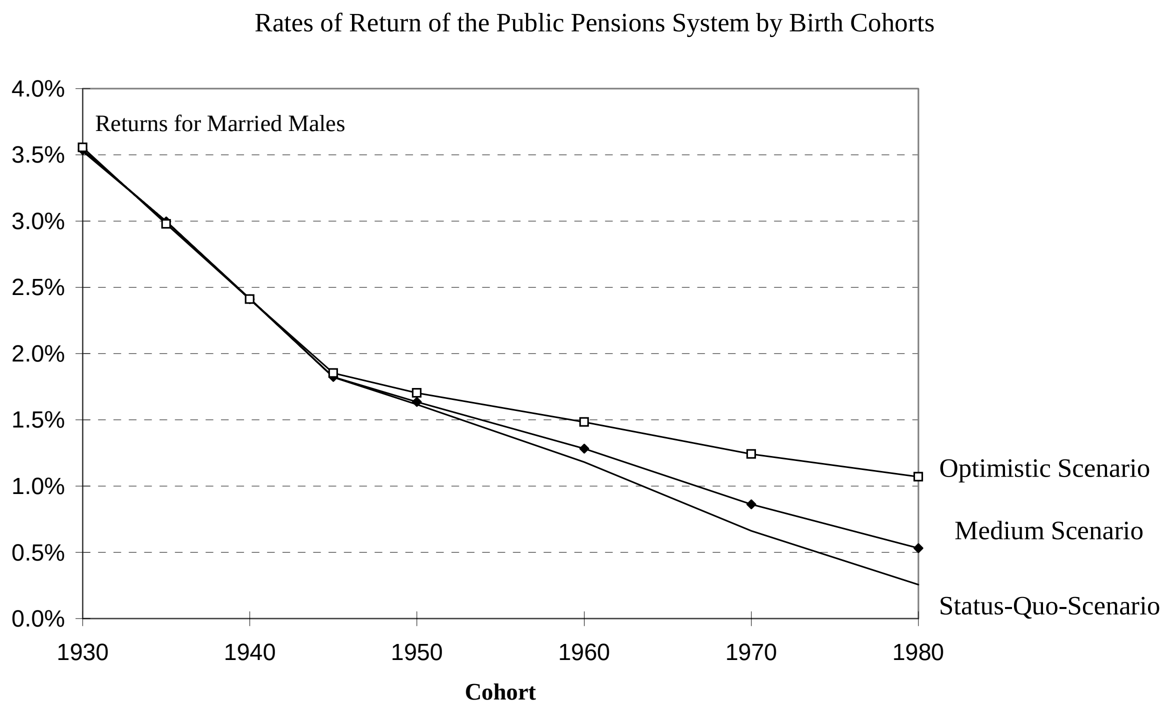


Figure 5: Rates of Return - Intergenerational Results.
Notes: Growth rates of real gross earnings equal to 1 percent after 1996.

Implicit Tax Rates

The following figure 6 displays the expected discounted values of contributions and benefits for married males of cohorts 1930 to 1980. The numbers are based on the medium scenario and assume a real interest rate of 4 percent All values are measured in constant prices of 1995 and are discounted to the age of retirement. The discounted values of pension benefits shown in figure 6 are equal to the real value of pension wealth at the beginning of retirement. The discounted value of the *contributions* can be interpreted as the capital stock that would be available at the time of retirement, had the contributions been invested in the capital market at a rate of 4 percent. For all cohorts the *net* discounted value (i.e. the difference of benefits and contributions) is negative given a real interest rate of four percent. From the point of view of the 1980-cohort, investing in the PAYG-system will accumulate to a loss of 800,000 DM (in constant prices of 1995) compared to an alternative investment at four percent.

The ratio of the discounted values of pension benefits to contributions has a simple and compelling interpretation: this ratio is the fraction of the contributions that would have been required to build up the same level of pensions in a funded system. One minus this ratio can be interpreted as the fraction of contributions that constitute an *implicit tax*. For the cohort of

1980 this means that the same benefit level as in the PAYG-system could have been obtained in a funded system by investing only one third of the contributions. If the interest rate were 5 percent, only 20 percent of the PAYG-contributions were required to yield the same benefit level in a fully funded system. The corresponding contribution to a funded system would be 5 percent of the wage bill instead of 20 to 30 percent in the PAYG-system.

The implicit taxes are shown in table 2 for two cohorts based on the medium scenario. The table first shows the implicit tax as a fraction of the contributions of a cohort. 38.9 percent of the 1940 cohort's contribution can be considered as taxes; for the cohort 1980 the tax is almost two third of contributions. Since the contribution rates will rise during the next decades it is more informative to look at the tax rates as a percentage of the gross wage bill for different values of the contribution rate. At a *moderate* contribution rate of 25 percent the implicit tax rate levied on the gross wage will reach 16.5 percent for the youngest cohort. Note that this implicit tax does not include the federal subsidy which is financed out of general tax revenues. Given a subsidy rate of around 24 percent (according to the current law) the tax levied on the youngest generation will be even higher.

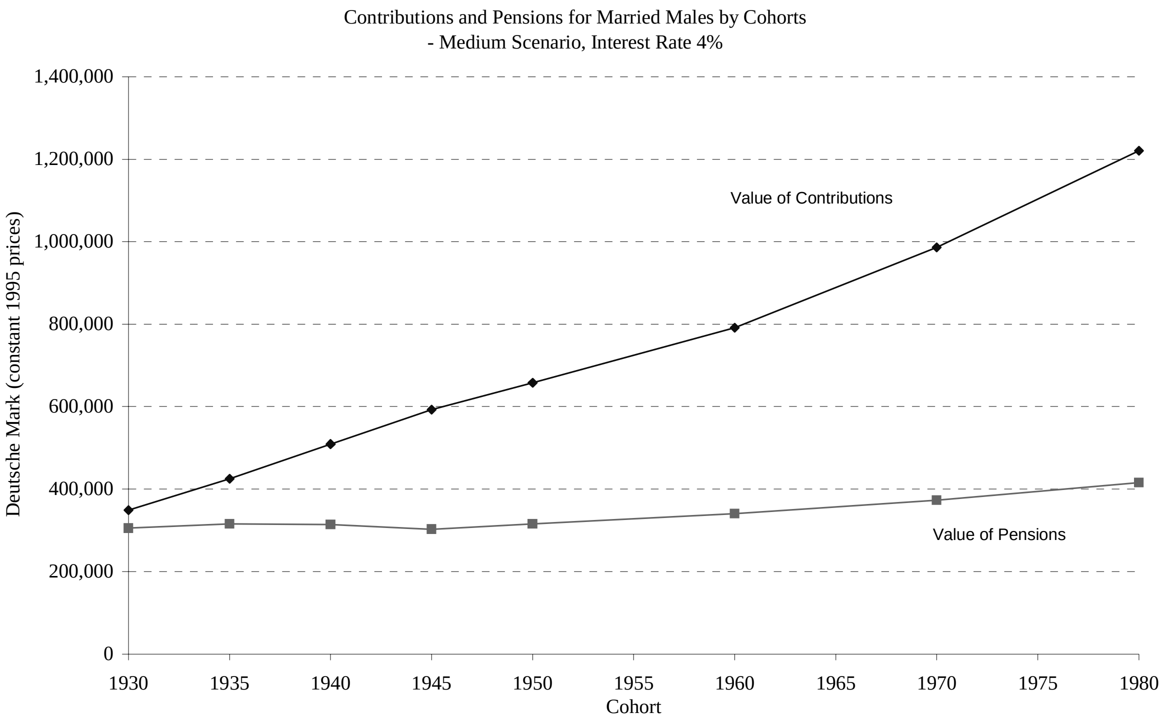


Figure 6: Expected Present discounted Values of Pensions and Contributions

Table 2: Implicit Tax Rates

Cohort	Tax as fraction of contributions	Tax rate as percentage of the wage at a contribution rate of			
		15%	20%	25%	30%
1940	38.3%	5.7%	7.7%	8.5%	n/a.
1980	65.9%	n/a.	13.2%	16.5%	19.8%

Notes: Calculations of taxes are based on the medium scenario for married males.

5 Economic Consequences of Deteriorating Returns

With decreasing real returns, the incentives to participate in the PAYG-system are vanishing for the younger cohorts. The implicit tax rates show how dramatic the development may become. It is important for the analysis of fiscal policies to know how relevant these incentives are for the behavior of economic agents. Two main questions are: (1) Do economic agents realize that returns deteriorate, and (2) if they do, how will they adjust labor supply? In order to address these questions, I examine the structure of voluntary contributions and present some macroeconomic evidence on employment.

There is some direct empirical evidence for reactions of economic agents. I infer this from the behavior of those persons who voluntarily participate in the public pension system (usually self-employed), and who have discretion over the amount of contributions. Voluntarily insured persons make up for 3.8 percent of contributors. The contributions of this group have dropped dramatically during the ten years from 1985 to 1995: the fraction of West-German males who contributed more than the minimum amount has halved within 10 years from 38 to 77 percent (see figure 7). The same is true for women. In the eastern part of Germany the evidence is even clearer: almost all voluntary contributions are at the minimum level. For West Germany, this minimum level is the contribution rate times the social security lower threshold, which is about one seventh of the average earnings. In addition to the decline in average contributions the number of voluntarily insured persons has declined considerably. This behavior may reflect the agents' changing perception of the profitability of the pension system.[9]

Why should self-employed persons pay the minimum contribution in the public pension system at all? The main argument is eligibility for disability insurance, which requires

[9] Individuals can assess the profitability of their own contributions by consulting a service of the local administration („Rentenberater“).

a permanent history of contributions prior to disability and a minimum number of service years. Also, males need at least 35 years of contributions to retire early.[10]

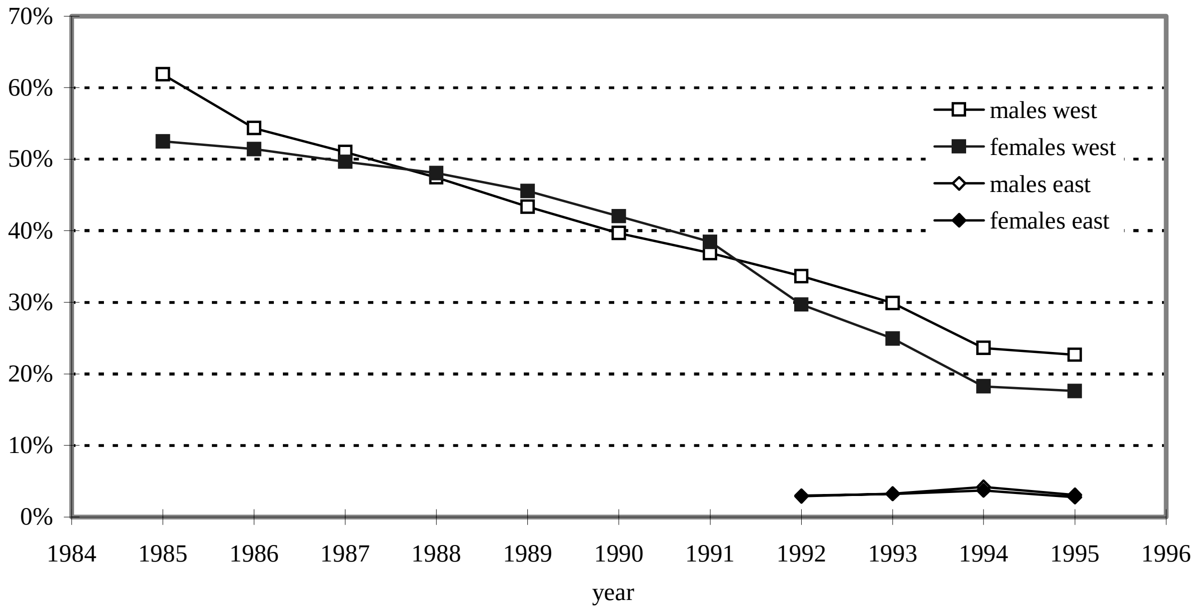


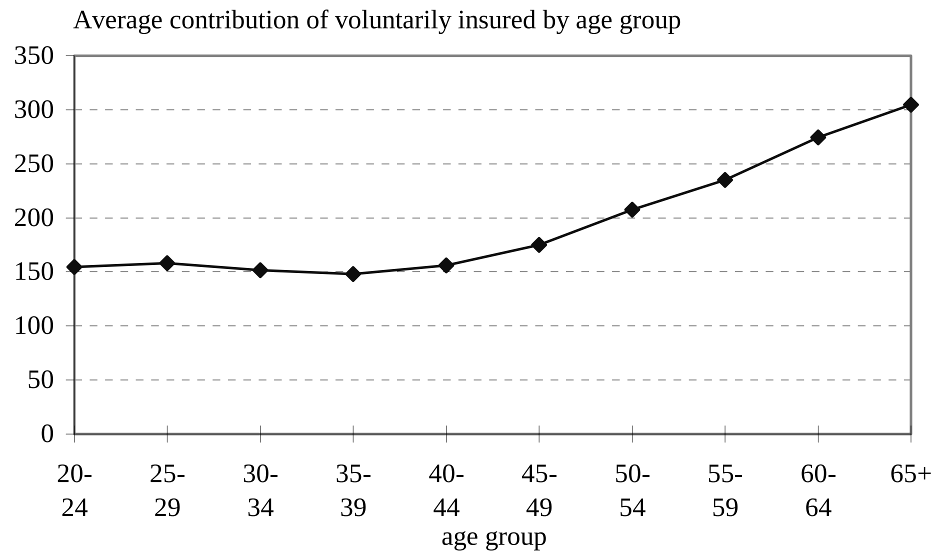
Figure 7: The decline in Voluntary Contributions 1984-1995. Percentage of voluntarily insured persons who contribute more than the minimum amount.

After having examined the time series evidence, I now turn to the cross-sectional evidence, which is also indicative of behavioral responses to incentives of the public pension system. Figure 7 displays the average voluntary contributions of West-German males by cohorts. In the year 1994, young cohorts contributed only half of what older cohorts contributed. Such a cohort effect may result from the decreasing rates of return of the pension system over time. Of course, what appears to be a cohort effect in figure 7 may as well be a combination of a life-cycle (or age) effect and a cohort effect. Both effects cannot be separately identified by cross-section data. The life-cycle effect means that, while workers of a given cohort are aging, they increase their contributions. The cohort effect means that younger cohorts contribute less on average at any given age than older cohorts. A potential life-cycle effect stems from the fact that contributions made early in the life-cycle yield a lower return than later contributions if the growth of average benefits decreases over time. Both effects work in the same direction. Note, that a cohort effect in this setting is not a pure phrasing of some

[10] There has been a tightening of eligibility for disability insurance for voluntary members in the year 1984. This institutional change made the system less attractive for younger cohorts of self-employed. In a microeconoemetric analysis that exploits the quasi-experimental nature of this institutional change I study the incentive effects of the pension system in more detail (Schnabel 1998).

unknown underlying heterogeneity but instead, it has a substantive meaning, since it can be related to a specific economic content.

Similar results can be obtained by examining the fraction of persons who contribute the minimum or the maximum amount, respectively. Figure 9 shows the pattern.



Note: 1. Average contributions of voluntarily insured West-German males in 1994. Computed from administrative records using the whole population. 2. The minimum amount in 1994 was DM 107.52. Source: VDR Statistik, Vol.115.

Figure 8: Average Voluntary Contributions by age groups in 1994

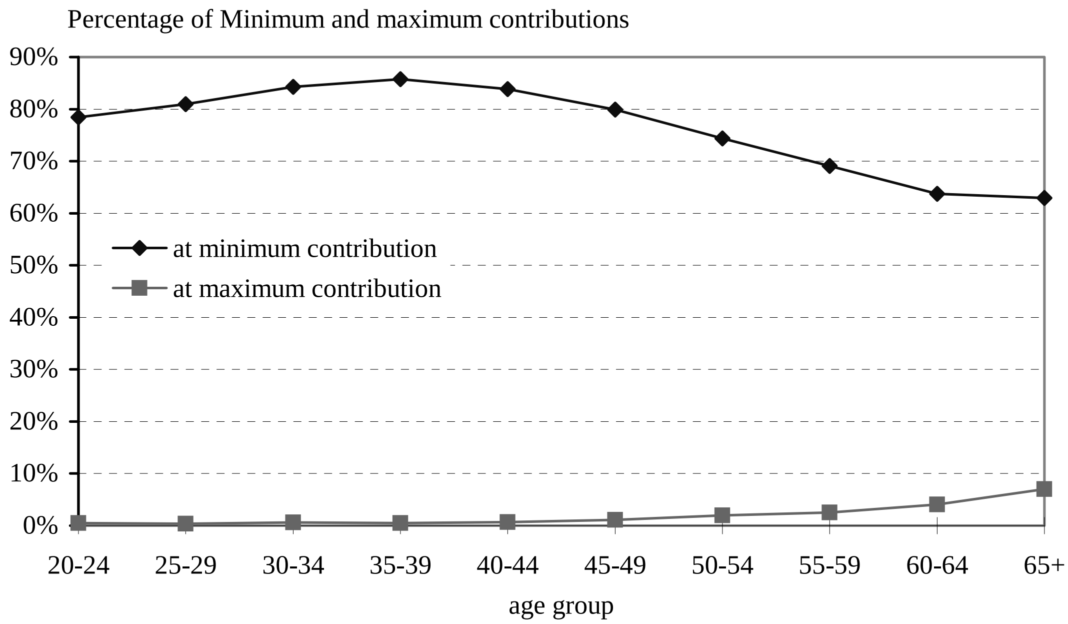


Figure 9: Minimum and Maximum Contributions by Age. Source: VDR Statistik, Vol. 115.

A further question is to assess how labor supply is going to respond to increasing contribution rates that are perceived as increasing taxes by economic decision makers. Unfortunately, the empirical results from the microeconometric literature on labor supply in Germany are mixed. There seems to be consensus on a relatively strong positive wage elasticity of labor supply of married women. However, there is less agreement on the labor supply of men and unmarried women; it seems that their labor supply is relatively inelastic compared to married women (Franz 1994). One explanation is that married women are the ones who make the marginal decisions, since their marginal wage rate is lower than their husbands'.

Labor supply responses do not necessarily take the form of reduced labor supply. They can also show up as a substitution away from (social security) taxable employment. This can be achieved by self-employment, by a tax-exempt second job, and last but not least by moonlighting. The macroeconomic evidence points into this direction: since 1992, employment in West-Germany has fallen in an unprecedented way. For the first time in West-German history, the number of employed persons has been decreasing in five consecutive years. However, this employment crisis is *only* due to a dramatic reduction of *full-time dependent* employment, which is subject to mandatory social security contributions („Vollzeit-sozialversicherungpflichtig Beschäftigte"). This part of employment - the basis of the social security system - has decreased by 10 percent (or 2 Million jobs) within five years. All other components of aggregate employment have risen markedly, but not enough to compensate the loss.[11] Self-employment, insured and non-insured part-time employment have reached new highs. This development may be the beginning of a substitution process which eventually may destroy the basis of the social security system.

[11] Own calculations based on the labor market statistics of the German Bureau of the Census 1998.

6 Conclusions

This paper assesses the returns of the PAYG pensions system under the current legislation. The main findings are that real rates of return are rapidly falling, because contribution rates increase in the course of population aging. The cohorts that face rising contributions during their working life are not compensated for this burden by higher pension benefits during their pension age. This does not only create a problem of intergenerational equity. More important may be the increasing inefficiency, since the incentives to contribute are deteriorating. The current system of net wage adjustment will guarantee the solvency of the system only in a formal sense. To the extend that the tax base of the PAYG-system is eroding - and there is already evidence that it does - the solvency boils down to sharing a shrinking cake among retirees and workers. The simulations are „optimistic“ in that they assume implicitly that labor supply does not respond to increasing contribution rates *and* declining rates of return.

A simple conclusion for economic policy seems to be to search for ways to mitigate the decline of returns. In a related paper (Schnabel 1997), I study the consequences of holding the contribution rate constant as an alternative to the current system. If the workers substitute towards private saving, this reform would amount to a smooth switch towards a partly funded system. Although such a reform improves the economic well-being of younger cohorts in terms of net present value, it *does not* improve the returns of the PAYG-system. The younger cohorts would be better off because of decisively lower contributions. In this context, a further interesting empirical research question is, to which extend individuals substitute private savings for PAYG-pension contributions when the relative level of the PAYG-pension benefits is reduced.

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Appendix

Figure A-1: Pension Values (aktuelle Rentenwerte)

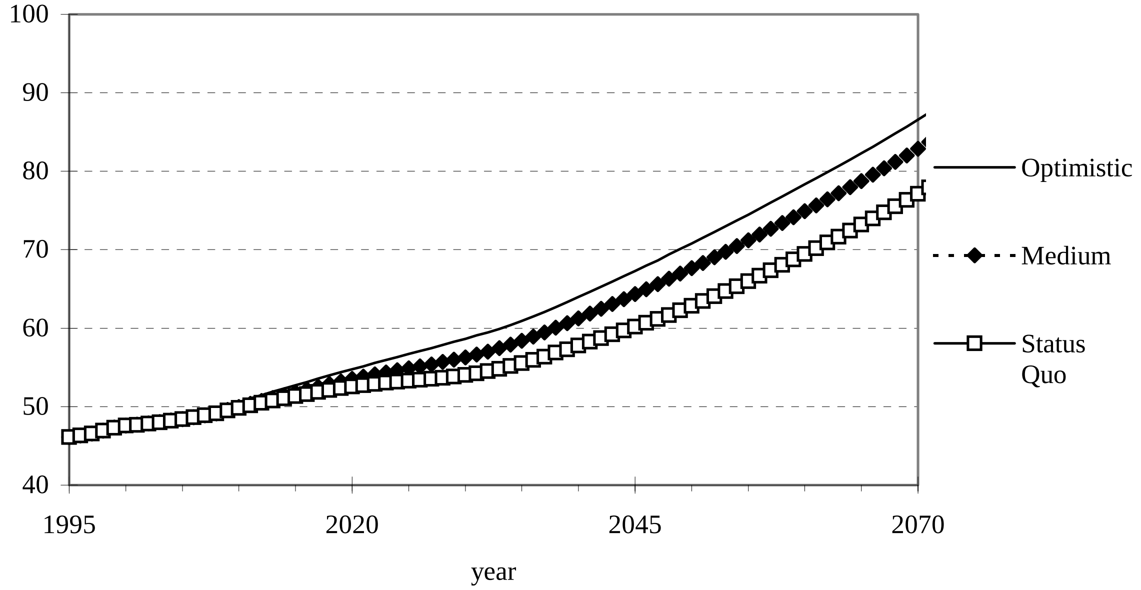

Figure A-2: Rate of Return by Birth Cohort
Status Quo Scenario

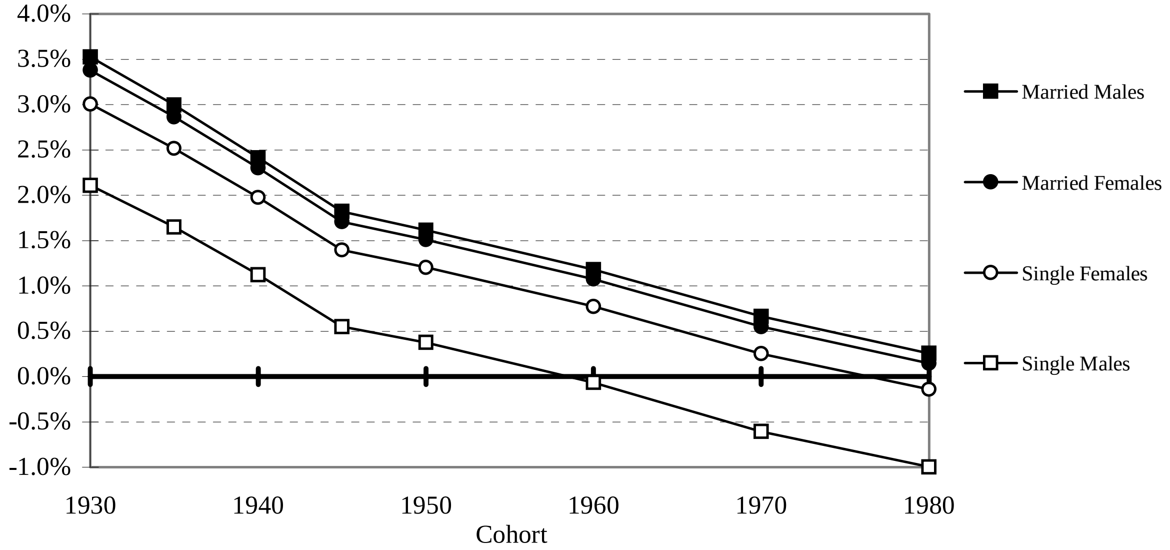

Figure A-3: Rates of Return by Birth Cohorts
- Medium Scenario

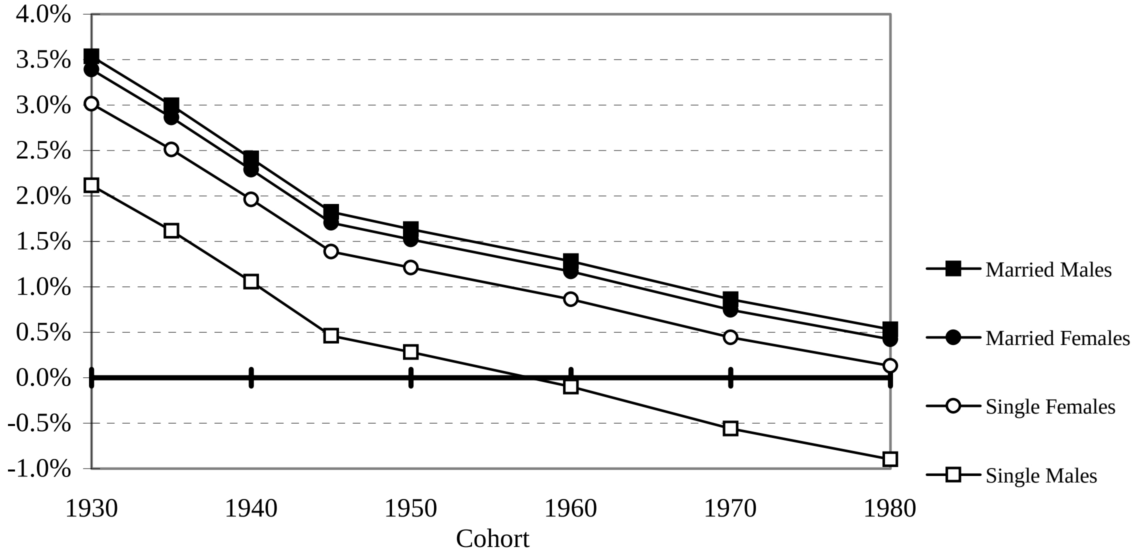

Figure A-4: Rates of Return by Birth Cohorts
- Optimistic Scenario