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ABSTRACT

The paper examines the long-term implications of various reform options on retirement entry decisions and the actual retirement age of older workers. It focuses on the changes in pension legislation since 1992 and the reform options discussed by the German Social Security Reform Commission installed in 2002 ("Rürup Commission"). Our simulations show that the early-retirement adjustment factors introduced by the 1992 pension reform will raise the average effective retirement age for men by almost two years. The two-year increase in all relevant age limits proposed by the "Rürup Commission" would raise retirement age of men by another eight months.

JEL classification: D1; J26; H55

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Pension Reform in Germany:
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1 Introduction

The option of early retirement is a highly prized, but at the same time highly costly, social achievement in Germany. With an increasingly aging population and the precarious financial state of the public pension system, these costs are once again the focus of discussion about pension reform, especially as the government committed itself to take adjustment measures should contributions exceed 20% of gross income in the year 2020 (22% in the year 2030) or pension benefits fall below a certain minimum level, defined as 67% of net pensions by the Riester reform in 2001, and as 46% of tax-adjusted gross pensions in the "Sustainability Law" of 2004. The latest forecasts based on new population and labor force projections show that, barring further reform, these two goals are incompatible and further reform is required.

Since the 2004 reform has kept the retirement age largely untouched, the reform discussion is shifting once again to the pivotal retirement age, currently age 65. An increase in the age of retirement will boost the number of contributors to the system whilst simultaneously reducing the number of beneficiaries. This is particularly attractive from a financial point of view in a system, which is not fully actuarially neutral, since changing the ratio of contributors to beneficiaries will then also improve the financial balance of the system. Bearing increasing life expectancy in mind, raising the age of retirement would also appear to be a rather natural reform option. What is more, there is no sign that an increase in the age of retirement is likely to be prevented by deteriorating health. On the contrary, age-specific rates of illness have dropped even faster than mortality rates (Cutler und Sheiner, 1998).

The aim of this paper is to provide an econometric estimate of the long-term impact of various reform options on retirement decisions in Germany, especially on the distribution of actual retirement ages and its mean, the effective average retirement age. "Long term" is defined as the state of play after all transitional regulations and behavioral changes have taken effect. We present a model which relates the actual retirement decisions of older workers, as observed in the data provided by the 1984-1997 German Socio-Economic Panel (GSOEP), to the relevant statutory pension rules. We then use this model to predict future retirement decisions under

reformed pension rules. We do not model the full budget implications of these changes in retirement behavior. This is a complicated exercise due to complex interactions of the pension budget with other parts of the German social safety net, and is left to future research.[1]

Our approach takes as point of departure the econometric analysis by Börsch-Supan, Schnabel, Kohnz and Mastrobuoni (2004) which was undertaken in the framework of an international project on the causes and implications of early retirement[2]. In contrast to this international comparative analysis, however, the present paper takes account of the institutional peculiarities applying in Germany and, specifically, addresses the 1992 and 1999 reforms as well as the proposals discussed by the "Commission for Sustainability in Financing the German Social Security System", referred to in the following as the "Rürup Commission". Some of these proposals have been adopted as recommendations by the Commission, while other proposals did not find a majority in the Commission. The reform options encompass an increase in the normal pension age by one or two years, adjustment factors of between 4.5 and 6% per year of earlier retirement, and the introduction of actuarial individual pension accounts based on the Swedish model[3] with their implied adjustment factors and no predefined "normal" retirement age. While none of these proposals have been explicitly put into the pension reform law of 2004, it includes a clause that will provide for a formal review of the system of retirement ages by 2008.

The paper is structured as follows: Section 2 describes the institutional framework determining retirement in Germany. Section 3 looks at the reform options analyzed by us. Section 4 presents the data, model specifications, and the results of estimates. Section 5 discusses the simulations which represent the core aspect of our work. Finally, we present a summary of the most important findings.

2 The German public pension system

The largest part of the German public pension system is the "public retirement insurance" ("Gesetzliche Rentenversicherung", GRV). It covers about 85% of the German workforce. Most of these are private sector workers but the GRV also includes those public sector workers who are not civil servants. Civil servants, about 7% of the workforce, have their own

[1] See Börsch-Supan, Kohnz and Schnabel (2004) for a first and preliminary analysis.

[2] Refer to the chapter on different countries in Gruber and Wise (1999, 2004a and b).

[3] *Notional Defined Contribution* (NDC) System, see Section 3.

pension system. The self-employed, about 9% of the workforce, are mainly self-insured although some of them also participate in the public retirement insurance system. For the average worker, occupational pensions do not play a major role in the German system of old-age provision, neither do individual retirement accounts yet, but their importance is increasing since the last reform in 1999/2001.

Our sample, taken from the German Socio-Economic Panel (GSOEP) 1984-1997, includes only cohorts that enter retirement until 1997. Therefore, in our retrospective econometric analysis, we model retirement entry decisions on the basis of the 1972 legislation. Because most parts of the 1992 reform have not been phased in by 1997, the 1972 legislation is relevant for our sample and therefore described in the following section. Where necessary, however, we mention those institutional changes which have been legislated in the 1992 and 1999 reforms. We limit our description to the possible *pathways* into retirement, which are particularly relevant for our analysis[4], whereas a detailed description of retirement *payments*, which go into our estimations as well, can be found in Börsch-Supan, Schnabel, Kohnz and Mastrobuoni (2004). A detailed description of the recent history of institutional changes can be found in the comprehensive survey by Börsch-Supan and Wilke (2003).

2.1 Private sector pensions

First, we describe *old age pensions*. Until 1972, retirement was mandatory at age 65. In 1972, several early retirement options were introduced, „early" defined as before age 65, the „normal" retirement age. Since then the system of the GRV pays old age pensions for employees from age 60 on if certain conditions are met. A main feature of the German old-age pensions is "flexible retirement" from age 63 for workers with a long service history. Moreover, retirement at age 60 is possible for women, unemployed and workers who cannot be appropriately employed for health or labor market reasons.

In addition, pre-retirement (i.e., retirement before age 60) is possible using other parts of the public transfer system, mainly unemployment compensation. Labor force exit before age 60 is frequent: about 45% of all men call themselves „retired" at age 59. Only about half of them retire because of disability; the other 50% make use of one of the many official and unofficial

[4] The estimation includes workers, employees and civil servants, whereas the simulation that predicts the impact of different reform options on the public retirement insurance, is limited to data of workers and employees.

pre-retirement schemes, i.e. unemployment compensation in combination with severance pay[5].

Because of the numerous exceptions that enable retirement entry before age 65, the reforms of 1992 and 1999 introduced an increase of retirement age limits to age 65. The system has been simplified, because there will be no exceptions for unemployed, part-time employees and women anymore. After a transitional period retirement entry rules of these persons will be adjusted to those of long-time insured. If adjustments (see below) are accepted, long-time insured can choose early retirement from age 62 on. Similarly disabled people can obtain old age pensions at age 63 and with adjustments even at age 60. The transitional rules of retirement entry are displayed in figure 1.

Insert Figure 1

The 1992 reform introduced explicit adjustment factors for retirement before age 65. Before 1992, adjustment of benefits to retirement age was only implicit via years of service. There were no actuarial adjustments at all. The 1992 social security reform will change this stepwise by the year 2004. Age 65 will then act as the "pivotal age" for benefit computations.

Table 1 displays the retirement-age-specific adjustments for a worker who has earnings that remain constant after age 60. The table relates the retirement income for retirement at age 65 to the retirement income for retirement at earlier or later ages, and compares the implicit adjustments after 1972 with the total adjustments after the 1992 social security reform is fully phased in. As references, actuarially fair adjustments at a 3% discount rate are shown as well[6].

According to the 1992 reform benefits will be reduced by 0.3% per month (maximum 10,8%) for each year of earlier retirement. The 1992 reform also introduced rewards for later retirement in a systematic way. For each year of retirement postponed past the minimum age indicated in Table 1, the pension is increased by 0.5% per month or 6% p.a.

Insert Table 1

Besides old age pensions the contributions to the German retirement insurance also finance *disability benefits* to workers of all ages. These are converted into old age pensions latest at age 65.

[5] For a comprehensive illustration of retirement entry rules see also Reimann (2003).

[6] A higher discount rate yields steeper adjustments.

The disability pathway provided a frequently used option into early retirement (besides the flexible retirement option) before the "pivot age" of 65. A person who was not able to carry on a regular employment received full old age benefits, the so called disability pension ("Erwerbsunfähigkeitsrente", EU). A person that could work only half of the time or less compared to a healthy person received two-thirds of old age benefits ("Berufsunfähigkeits-rente", BU). In the 1970s and early 1980s, the German jurisdiction has interpreted both rules very broadly, in particular the applicability of the first rule.

The previous rules governing total and partial disability pensions, as well as the special old-age pension for those aged 60 or over suffering from partial or total disability, were abolished in 2001 based on the 1999 Pension Reform Act. However, generous hardship and other provisions designed to protect confidence in the system mean that the old rules will continue to be effective over a relatively long transitional period (some rules until 2017). After this period, insured beneficiaries are still able to draw pension benefits for partial or full disability until the age of 65 but under different conditions[7]. One main aspect is that the current labor market situation needs not to be taken into account any more. Moreover, if a pension is claimed for disability prior to the age of 63, deductions from benefits similar to those which apply to old-age pensions payable to the long-term insured are phased in until 2004. The pension adjustment factor for each calendar month for which pension is drawn for a partial or full disability prior to age 63 is –0.3% and a maximum of –10.8% (see Table 1).

Besides the above mentioned retirement pathways *survivor pensions* are paid to spouses if the insured husband dies. Survivor pensions are 60% of the husband's applicable pension for spouses that are age 45 and over or if children are in the household („große Witwenrente"), otherwise 25% („kleine Witwenrente"). For couples married after the year 2001 a new law has to be applied: survivor pensions are not 60% any more but only 55% of the husband's disability pension. In return, however, the number of children is now taken positively into account when determining survivor benefits.

Survivor benefits are a large component of the public pension budget and of total pension wealth. Certain earnings tests apply if the surviving spouse has her own income, e.g. her own pension. This is only relevant for a very small (below 10%) share of widows. Only since recently, male and female survivors are treated symmetrically. Additionally, spouses can choose whether to receive a survivor pension or a newly introduced pension-splitting.

[7] They are now referred to as partial or full "Erwerbsminderungsrente (EM)".

The average retirement age in 1999 was 59.7 years for men and 60.7 years for women. These numbers refer to West Germany. In the East, retirement age was 57.9 years for men and 58.2 years for women. The fraction of those who enter retirement through a disability pension has declined and was 29% in 1998. Only about 20% of all entrants used the "normal" pathway of an old-age pension at age 65. The most popular retirement age is age 60[8].

2.2 Public sector pensions

As opposed to employees, civil servants do not pay explicit contributions for their pensions as the other employees in the private and public sectors do[9]. Instead, the "gross" wage for civil servants is lower than the gross wage of other public sector employees with a comparable education. The generosity of gross pensions received by civil servants vis-à-vis the private sector workers is partially offset by the preferential tax treatment of private sector pensions.

There are three pathways for civil servants: the standard, the early, and the disability retirement option. The standard retirement age is 65. Before July 1, 1997 the early retirement age for civil servants was 62 and thus 1 year less than the early retirement age in the social security system. In 1997 early retirement age was raised to 63. Adjustment factors for early retirement phased in linearly between the years 1998 and 2003, and will reach 0.3 percentage points per month of early retirement, the same as in the private sector[10].

The average retirement age for civil servants in the year 1999 was 58.9 years and thus almost one year lower than in the private sector. Disability is the most important pathway to retirement for civil servants: 47% of those who retired in the year 1999 used disability retirement. Only about 9% of civil servants retired at the regular retirement age of 65[11].

[8] Cf. Börsch-Supan and Schnabel (1999) for a distribution of pathways to retirement over time.

[9] Civil servants are also exempt from unemployment insurance contributions, since civil servants have a life-time job guarantee. The government pays a certain fraction of health expenses of the civil servant and his or her dependents (ranging from 50 to 80%). The rest has to be covered by private insurance.

[10] Very specific rules apply to some civil servants. E.g., the regular retirement age for police officers is age 60; for soldiers it is even lower and depends on their rank.

[11] Cf. "Zweiter Versorgungsbericht der Bundesregierung", Bundesdrucksache 14/7220, 19.10.2001.

3 Pension reform scenarios

As stated in the introduction, this generous system is financially unsustainable due to the pressures exerted by the rapid aging process of the German population.[12] Various incremental reform steps have been legislated and are currently being phased in, other new reform steps are under discussion. The aim of this paper is to estimate the long-term impact of these reform measures on the retirement decisions of older workers in Germany.

We consider six possible reform measures. As a reference scenario, we examine the pension reforms already implemented in 1992 and 1999 which, however, will only take effect after a long transitional period (Figure 1). We then examine four reform proposals involving higher actuarial adjustment factors and higher statutory retirement ages. Finally, we consider how retirement probabilities respond to the introduction of an individual pension account system based on the Swedish model. These six reform scenarios are defined in more detail in the following.

The core aspects of the *reference scenario* encompass an increase of the early retirement ages, the introduction of actuarial adjustment factors in the 1992 pension reform described in Section 2, and the new rules designed to accelerate the implementation of the 1992 reform which took effect in 1999. We will not predict the transition path. Instead, we simulate the long-term impact of the reforms after full implementation. We have modeled the following rules for the reference scenario:

- The adjustment factors for early retirement introduced by the 1992 reform amount to 3.6% (not exceeding a maximum of 10.8%) for each year of early retirement. The adjustment factors introduced in 1992 only began to be implemented on an incremental basis subsequent to the period covered by our sample and will only take full effect after 2017 (see Figure 1). A long-term insured employee will then only be able to take retirement, with a maximum deduction of 10.8%, at the age of 62.
- Adjustment factors will now also be introduced for each calendar month during which an insured person claims a disability pension prior to the age of 63. These adjustment factors are the same as those for old-age pensions: 0.3% per month and a maximum of 10.8%.

[12] See Börsch-Supan (2000a) for a concise account of the demographic and economic problems confronting the German public pension system.

- Reductions in widow/widower's pensions from 60% to 55% of the spouse's partial disability pension[13].
- "Child-raising pension" and unemployment pensions are no longer effective. The only channels now open to all claimants are those of early retirement for the long-term insured, the partially or severely disabled.

This reference scenario describes the retirement probabilities generated if the statutory status quo in 2003 remains unchanged and no new reform measures are passed.

We then compare these outcomes with five reform elements. To begin with we wish to examine the effects which higher *actuarial adjustment factors* have on retirement decisions[14].

- *Variant adjustment factor of 4.5%:* Compared with the reference scenario which provides for deductions of 3.6% p.a., this scenario is based on deductions of 4.5% p.a., and a maximum of 13.5%. All the other rules are identical to those in the reference scenario.
- *Variant adjustment factor of 6.0%:* This scenario introduces deductions of 6.0% p.a. (maximum 18%). All other factors remain unchanged.

There was no majority in the "Rürup Commission" for these proposed increases in the actuarial adjustment factors. The actuarial adjustment is highly unpopular, and the recent increase from 0 to 3.6% percent is still not fully phased in. Therefore, little is known about the actual response to this recent reform step.

Next, we examine how a further increase in the *statutory retirement ages* would effect actual retirement ages. A rule of thumb used by the Federal Ministry for Health and Social Security (BMGS) states that, in response to a change in the retirement rules, one third of workers retire at the new retirement age, one third continue to retire at the old age of retirement and accept the deductions which this implies, and one third avoid the new rules by claiming benefits for disability. The next two variants examine the validity of this rule of thumb. Note that these changes affect not only the "normal" retirement age but the entire system of statutory retirement entry ages.

[13] As our estimates specify the incentives to retire of married people as a unit, we take account of the survivor's pension rules but not of pension splitting.

[14] Börsch-Supan and Schnabel (1998) describe the direct effects of these adjustment factors on the total value of German pension benefits. With regard to the "right level of adjustment factors" in Germany see also Ohsmann, Stolz and Thiede (2003).

- *Variant age limit +1*: All the age limits reached after the transition period shown in Figure 1 are increased by one year. As a result, the normal pension age, for example, is raised from age 65 to 66, and the earliest retirement age for the long-term employed from age 62 to 63, etc. Only the contributory periods for old-age pensions of partially and fully disabled persons remain unchanged at age 60.

- *Variant age limit +2:* Increase in all age limits by 2 years. All other factors remain unchanged. This is the proposal submitted by the "Rürup Commission".

Finally, as an alternative to these parametric reforms, we model the transition from the current defined benefit system to a "notional defined contribution (NDC)" system which, while retaining the essential features of the current public pension system, would be, as its proponents argue, more sustainable, more flexible, and more transparent[15]. Notional defined contributions involve an "individual pension accounts system" in which pension entitlements would be based on the actual amount of contributions paid in to an otherwise unchanged, i.e. pay-as-you-go, pension system. Paid contributions would be accumulated on individual pension accounts where they would receive fictitious ("notional") interest based on the rate of return provided by the pay-as-you-go system. As a rule, the interest rate would correspond to the growth rate of the total wage bill, responding to both demographic and employment changes. Assets bearing fictitious interest of this type would be converted, on retirement, into a lifelong pension annuity based on actuarial calculations. The level of pension would depend on remaining life expectancy and would therefore respond to demographic factors.

- *Variant NDC system*: In this case we take account of a system which is again based on the 1992 and 1999 legislative reforms. The most significant difference between this and the reference scenario is the change in the actuarial adjustment factors which are implicitly based on the internal rate of interest in the NDC system and remaining life expectancy. This system does not, therefore, have fixed adjustment factors. They increase with age and decrease with increasing life expectancy. The latter effect is almost exactly compensated by the declining internal rate of return, so that the age-specific adjustment factors are roughly constant over time. In 2015, 65 year old workers will receive about 7.7 percent higher pensions if they postpone their retirement by one year, while workers, who shift their retirement from age 62 to 63, will receive 7.2 percent higher benefits.

[15] See Börsch-Supan (2003) and Clemens (2003) regarding the introduction of an NDC system in Germany.

A similar system has been legislated in Sweden about ten years ago[16]. A reform package along these lines was also passed in Italy in 1995.

4 Econometric estimation of the incentive effects to retire

The methodology follows the seminal work by Stock and Wise (1990). They introduced the *option value* as a central incentive variable that captures the impact of pension rules on retirement behavior.

Earlier analyses of the German pension system using this framework were carried out by Börsch-Supan (1992), Schmidt (1995), Börsch-Supan and Schmidt (1996), Siddiqui (1997), and Börsch-Supan (2000b and 2001). Our work is directly linked to the work of Börsch-Supan, Schnabel, Kohnz and Mastrobuoni (2004), which is part of an international project about the causes and consequences of early retirement. We improve on this work along the following lines: First, we use estimations of cumulative retirement entry probabilities instead of hazard rates, which they employ. Cumulative retirement entry probabilities turn out to generate more robust estimation results for Germany than hazard rates. Second, we employ a broader sample that ascertains a representative estimation of retirement entry decisions of German workers and employees. Finally, we concentrate on the special features and institutional conditions in Germany and simulate the concrete reform options mentioned in section 3 rather than the synthetic hypothetical reform proposals in Gruber and Wise's (2004a) international comparisons.

In the following we will first describe the data and methodology, then the econometric estimation procedure and finally our base model estimates.

4.1 Data and methodology

The German Socio-Economic Panel (GSOEP) is an annual panel study of some 6,000 households and some 15,000 individuals[17]. The panel started in 1984; 14 waves through 1997 are used[18]. The GSOEP data provide a detailed account of income and employment status.

[16] See Palmer (2000), Settergren (2001) and Wadensjö (2003) for the workings of and initial experiences with the Swedish system.

[17] Burkhauser (1991) provides an English-language description, code books and links to an internationally accessible GSOEP version. Börsch-Supan (2000b) discusses the merits and limits of the GSOEP data for studies of retirement behavior.

[18] Ending in 1997 gives us a clean estimate of the actual pension rules in place.

We constructed an unbalanced panel of all persons aged 55 through 70 in West Germany for which earnings data is available[19]. This panel includes 2,223 individuals with 14,401 observations. Average observation time is 6.5 years. The panel is left-censored as we include only persons who have worked at least one year during our window in order to reconstruct an earning history[20]. Aggregate information on average earnings, system entries, and actual distribution of retirement age by year is provided by the Association of German Retirement Insurance Organizations ("Verband deutscher Versicherungsträger", VDR).

Dependent variable

The variable to be explained is old age labor force status. Because Germany has very few part-time employees, we model only two states – fully in labor force and fully retired. The definition of „retired" is problematic, because there exist different alternatives. Retirement definitions commonly employed in the literature include inter alia the retirement status self-reported by the respondent, the fact that there are few work hours, or the receipt of retirement benefits, among other definitions. We use the first concept, which is self-reported status, and include pre-retirement, mainly financed by a mixture of unemployment compensation and severance pay, in our definition of retirement.

Explanatory variables

Our main explanatory variable is the option value established by Stock and Wise (1990). This "incentive variable of the retirement decision" evaluates all current and future payments of the different retirement pathways less possible contributions that have to be paid, and compares these present values to the utility aspect of leisure when being retired. We explain in the following how to calculate these present values under different retirement pathways.

Handling of multiple retirement programs

At least theoretically, a worker at age 55 has the choice between three retirement programs:

- old-age pensions starting with age 60,
- disability pensions, and
- pre-retirement schemes.

[19] We excluded East Germany because retirement patterns in the East are dominated by the transition problems to a market economy. See Börsch-Supan and Schmidt (1996) for a comparison.

[20] See Börsch-Supan, Schnabel, Kohnz and Mastrobuoni (2004) for a detailed construction of the earnings history.

The set of choices is actually larger because some of these programs have several branch programs (within old-age pensions: unemployment, long service life, etc.) as was depicted in Figure 1. We refer to these choices as "pathways". It is important to notice that all of these pathways pay the same benefit, once a person is eligible[21].

In practice, there is no free choice since most of these pathways are subject to eligibility criteria. Among those, we distinguish between "strict eligibility rules" that are tied to objective variables such as age, gender and previous contribution history, and "soft eligibility rules" that are subject to discretionary decisions[22], notably the determination of a workers' disability status[23].

In the construction of social security wealth and the incentive variables, see below, we need to compute expected pension benefits which depend on the choice of pathway. In the computation of this expected value, we use the observed frequencies as weights. Let's suppose, the observed frequency of disability status at age 59 is 33%, and the sample person is not eligible for any other pathway at that age. Then expected benefits at age 59 for this person will be a third of the (common) benefit level[24].

Construction of social security wealth

A key statistic in our computation of budget impacts is the change in the net present value of all future benefits when retirement is postponed, (which is the present value of all future benefits less contribution payments). In a slight misuse of terminology, we call the net present value of all future benefits "social security wealth" (SSW).

We define social security wealth as the expected present discounted value of benefits (*YRET*) minus applicable contributions that are levied on gross earnings ($c \cdot YLAB$). Seen from the perspective of a worker who is S years old and plans to retire at age R, social security wealth (*SSW*) is

$$SSW_S(R) = \sum_{t=R}^{\infty} YRET_t(R) \cdot a_t \cdot \delta^{t-S} \; - \; \sum_{t=S}^{R-1} c_t \cdot YLAB_t \cdot a_t \cdot \delta^{t-S}, \qquad (1)$$

with: *SSW* net present discounted value of retirement benefits

[21] Strictly speaking, pre-retirement programs can have any benefit level because they are negotiated between workers and employers. In practice, however, the outcome of these negotiations is guided by the public insurance benefits.

[22] See Schnabel (1999) for details.

[23] Under the 1972 legislation "disability" depends on health as well as labor market characteristics.

[24] Börsch-Supan (2001) provides an instrumental variables interpretation of this method and explores the sensitivity with respect to a more sophisticated choice of instruments.

S	planning age,
R	retirement age,
$YLAB_t$	gross labor income at age *t,*
$YRET_t(R)$	net pension income at age *t* for retirement at age *R,*
c_t	contribution rate to pension system at age *t,*
a_t	probability to survive at least until age *t* given survival until age *S,*
δ	discount factor = 1/(1+*r*).

We choose the usual discount rate of 3%. Conditional survival probabilities are computed from the standard life tables of the German Bureau of the Census ("Statistisches Bundesamt"). SSW depends also on the joint survival probabilities of spouses through survivor pensions[25]. We assume independence of survival of spouses to compute the joint probability.

We also have to predict future contribution rates and pensions. In order to obtain consistent policy simulations, they are simulated using the macroeconomic pension model underlying Birg and Börsch-Supan (1999). This internal consistency is important. Assume a policy proposal, which reduces the replacement rate by x%. This immediately lowers the contribution rates by the same x% if the system is pay-as-you-go and financed through contributions. The effect on SSW is ambiguous and varies by cohort.

The option value of delayed retirement

Economic incentives to retire also include the value of leisure in retirement. It is captured in the option value to postpone retirement (Stock and Wise, 1990). This value expresses for each retirement age the trade-off between retiring now (resulting in a stream of retirement benefits that depends on this retirement age) and keeping all options open for some later retirement date (with associated streams of first labor, then retirement incomes for all possible later retirement ages).

The option value function adds utility from consumption and leisure to the financial incentives. Let $V_t(R)$ denote the expected discounted future utility at age t if the worker retires at age R, specified as follows:

$$V_S(R) = \sum_{t=S}^{R-1} \mathrm{u}(YLAB_t^{NET}) \cdot a_t \cdot \delta^{t-S} + \alpha \sum_{t=R}^{\infty} \mathrm{u}(YRET_t(R)) \cdot a_t \cdot \delta^{t-S}, \qquad (2)$$

with $YLAB_t^{NET}$ after–tax labor income at age t, t = S...R-1,

[25] For the significance of this extension, see Coile (1999).

$YRET_t(R)$	after–tax pension income at age t, $t \geq R$,
α	relative utility of leisure, to be estimated.

Utility from consumption is represented by an isoelastic utility function in after-tax income, $u(Y) = Y^{\gamma}$. To capture utility from leisure, utility during retirement is weighted by $\alpha>1$, where $1/\alpha$ is the marginal disutility of work.

The option value for a specific age is defined as the difference between the maximum attainable consumption utility if the worker postpones retirement to some later year minus the utility of consumption that the worker can afford if the worker would retire now. Let *R*(s)* denote the optimal retirement age if the worker postpones retirement past age *s*, i.e., argmax[$V_s(r)$] for $r>s$. With this notation, the option value is

$$G(s) = V_s(R^*(s)) - V_s(s)\,. \qquad (3)$$

Since a worker is likely to retire as soon as the utility of the option to postpone retirement becomes smaller than the utility of retiring now, retirement probabilities should depend negatively on the option value.

The option value captures the economic incentives created by the pension system and the labor market because the retirement income $YRET_t(R)$ depends on retirement age according to the adjustment factors in Table 1 and on previous labor income by the benefit computations[26].

We compute the option value for every person in our sample, using the applicable pension regulations and the imputed earnings histories. The parameters chosen are a discount rate δ of 3% and a curvature parameter γ of 1.0, while the relative utility parameter α has been estimated by a grid search algorithm and amounts to 2.8.[27] Additional private pension income is ignored because it represents only a very small proportion of retirement income in Germany.

Other explanatory variables

Besides the option value and the social security wealth, the usual socio-demographic variables such as age, gender and marital status are incorporated in our regression analysis. The

[26] Benefits are computed on a life-time contribution basis. They are the product of four elements: (1) the employee's relative wage position, averaged over the entire earnings history, (2) the number of years of service life, (3) several adjustment factors, and (4) the average pension level. For more details see Börsch-Supan, Schnabel, Kohnz and Mastrobuoni (2004).

[27] For details of the grid search see Börsch-Supan, Schnabel, Kohnz and Mastrobuoni (2004) for details.

complexity of possible age effects is modeled by a set of age-specific dummy variables. Moreover, we include wealth (variables for labor income, financial assets and homeownership) and a self-assessed health measure. We do not use the legal disability status as a measure of health since this is endogenous to the retirement decision. The desire for early retirement may prompt workers to seek disability status, and frequently the employer helps in this process to alleviate restructuring. Until recently, disability status was granted for labor market reasons without a link to health.

4.2 Econometric estimation method

We estimate a decision model with labor status "retired" as dependent variable that covers normal retirement as well as different forms of early retirement. We link the explanatory variables to the dependent variable by a binary probit model. Using this simple functional form has two disadvantages from a theoretical point of view.

First, a cross-sectional probit model does some injustice to the panel nature of our data and probably underestimates the true effect, see Börsch-Supan (2001), who experiments with several specifications of panel probit models with parametrized correlation patterns over time. He demonstrates that the effects of the incentive variables are slightly strengthened, however, the results did not change significantly.

Second, the probit functional form ignores the structure of the dynamic optimization that underlies the workers decision when to retire[28]. Inserting the option value in this type of a regression model, however, can be interpreted as a flexible discrete-time duration model explaining the timing of retirement entry. Previous investigations have shown that this pragmatic approach generates robust estimates of the average effects of the incentive variables on retirement, although it is likely to fail predicting the individual variation as precisely as the true dynamic optimization model.[29]

In order to correct for possible sample bias we weight the dependent variable, the observations of retired and non-retired persons, by aggregate sample frequencies computed from the VDR statistics which include all retirement entries of the public retirement insurance

[28] The full underlying dynamic programming model has been estimated by Rust and Phelan (1997).

[29] See Lumbsdaine, Stock and Wise (1992) for a comprehensive account of the relative predictive properties of three competing approaches: the full dynamic optimization model, the FIML-option value model, and our discrete choice cum option value approach.

system[30]. Therefore, after scaling our sample using age specific weights we are able to reproduce representative retirement probabilities for our base model based on the 1972 legislation.

Our estimation approach is slightly different from the one applied in Gruber and Wise (2003a and b). The international comparisons in Gruber and Wise use the probability to enter retirement (the hazard rate) as a dependent variable, which is the probability to be retired, given that the sample person has worked during the year before. Therefore, they include repeated observations of the same person only while this person is employed.

In contrast, our estimation sample includes repeated observations of the same person while this person is employed and retired, since retirement is not necessarily an absorbing state. Hence, our dependent variable is the probability to be retired, given that the sample person has worked until the beginning of our window period (age 53):

p_t = Prob(retired in t | worked until 53),

which is the cumulative distribution function. Given the estimated probability of being retired, we then compute the probability to retire, given that the sample person has not been retired before, as the differences of the cumulative distribution function at each age between 54 and 72:

$q_t = p_t - p_{t-1}$ = Prob(retired in t | not retired in t-1).

The probability of choosing a retirement age a is then q_a and the expected retirement age is $\Sigma\, q_a \cdot a$.

We compared both estimation approaches. For Germany the estimated and simulated cumulative probabilities of retiring are more robust than those estimated by a hazard model[31].

4.3 Base model estimates

Table 2 shows full regression results. A positive coefficient indicates that the explanatory variable increases the probability of being retired.[32] In addition to the option values, health

[30] *"Rentenversicherung in Zeitreihen"* various issues.

[31] More "robust" in the following sense: The methodology in Gruber and Wise (2003a and b) produces quite a few individual negative retirement probabilities when they are computed from the hazards since no adding up constraint is imposed on several observations of the same individual in our panel data. This is not the case in our approach, although we also ignore the implicit adding up constraints when computing $q_t = p_t - p_{t-1}$.

[32] The estimated coefficients represent the marginal effects of each variable on the implicit indirect utilities in the discrete choice equations. Their absolute values have therefore no easily intuitive interpretation. Hence, the

and an array of socio-economic variables, we include a full set of age dummies to non-parametrically capture all other unmeasured effects on the retirement decision that are systematically related to age. Because of the different employment histories of men and women resulting in very different claims on the retirement insurance and different incentives to retire, we have separate regressions for males and females.

The incentive variable (option value) and the set of age dummies are highly significant for both male and female. For males the age dummies clearly elevate the probabilities to retire after ages 60, 63 and 65, the earliest retirement ages under the various pathways. Self-reported health is also highly significant: healthier workers retire substantially later than those males who report poor health.

Married males do not have a different retirement behavior than single males. However, if there is (still) a child in the household retirement is more likely to be deferred. The effect of a university degree on retirement age is very strong and is present although we have an income measure as an additional control.

The wealth effects on retirement is clearly significant: persons with higher wealth (homeownership, financial securities) afford an earlier retirement. The income effect is not significant for males. Note that the higher opportunity costs of retirement have already been accounted for in the option value variable and in the wealth variables. Hence, the effect of higher labor income is over and above those variables and therefore only significant for income squared at the 10% level.

Two dummy variables are indicating the former labor force status. These variables take the value one if the person is currently (or used to be) self employed or a civil servant. The model indicates that self employed tend to work longer, while civil servants retire earlier, even after all other variables such as pension rules and income levels have been accounted for.

For females the peaks of the age dummies are much more pronounced at age 60 and 65, in accordance with an accentuation of habitual effects over and above the economic incentives created by different pension rules for women. Compared to males the coefficient on social security wealth is not significant for females. A probable explanation is the fact that women have a less continuous working life biography.

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reader should focus on their signs and their level of significance but not on their absolute values. Descriptive statistics of the variables used in table 2 can be found in the appendix, table 4.

Most socio-economic variables have similar effects in size compared with the male sample but are more significant. This is especially the case for the effect of being married: married women retire later, probably because they have raised children and therefore an interrupted earnings record such that they are not yet eligible for retirement at age 60. This effect dominates the effect that married women, who are in general younger than their husbands, often try to retire approximately at the same time as their husbands.[33] There is no additional effect of having kids on the retirement decision of women. The fact of being married appears to absorb the effect of having kids in the households for the cohorts in our sample.

Insert Table 2

5 Simulations of reform variants

We now apply the estimated coefficients to several simulation experiments mentioned in section 3. We first simulate the 1992 and 1999 reform as our reference scenario such as if they were already fully implemented. Note that until 1997, the end of our sample period, the rules of the 1992 pension reform have not been fully phased in. On top of the reference scenario we simulate the implementation of different actuarial adjustment factors and a change in the regular statutory retirement age of 65 by one or two years. Finally we demonstrate the impact of installing a *Notional Defined Contribution* (NDC) System.

We apply the parameter values estimated in Section 4.3 to each reform scenario to calculate the retirement probabilities for the ages 54 to 72, based on the assumption that an employee has previously worked up to the age of 53. We calculate the incentive variables implicit in each reform scenario, i.e. a new option value and a new social security wealth for each of the individuals in our sample. The age indicators in the scenarios involving an increase in retirement age are also increased by one or two years in the forecast as these capture the habitual effect of, for example, the statutory pension age.

Our results are shown in Table 3 and Figures 2 and 3**.** Table 3 summarizes the key data for the distribution of retirement ages, separately for men and women – i.e. the average retirement age and the percentage of people retiring before the ages of 60, 62 or 65.

[33] Note that we do not consider joint retirement decisions of married couples. In case of marriage we include the social security wealth variable of the married partner. However, the effect is insignificant.

The overall distribution of new retirees is shown in diagrammatic form in Figures 2 und 3, again separately for men and women. The graphs on the left show the distribution of retirement ages, i.e. the probability that a person will enter retirement at a specific age. The graphs on the right show the accumulated retirement probabilities, i.e. the probability with which a person of a specified age has retired, for each age. Our calculations include all people retiring between the ages of 54 and 72 who draw an old-age pension or disability benefits.

We first present the results for male workers and then refer to the tables and charts to discuss how the introduction of actuarial adjustment factors and the changes in initial retirement rules impact the number of people entering retirement.

Based on the status quo established by the 1972 reform – i.e. the main provisions affecting the people in our observation period - the full implementation of the 1992 and 1999 reforms would lift the average male retirement age by almost two years from age 61.2 to 63. The impact on women, as shown below, is much weaker. An increase in the average age of retirement is thus foreseeable in the future on the basis of existing legislation alone and is already apparent in the latest figures issued by the VDR (Reimann, 2003).

An upward shift in the entire fabric of age limits by two years increases the average effective retirement age for men by a further 9 months from age 63 to 63.7. Figure 2 (below left) clearly illustrates how the two ages at which most insured persons retire – at age 60 or 65 – increase by two years. However, some people draw benefits for loss of earning capacity or put up with the actuarial deductions attached to earlier retirement rather than going along with this shift in age limits. The resulting increase in the effective age of retirement is somewhat greater than suggested by the BMGS, the German ministry of social security. Its rule of thumb states that in response to a change in the retirement rules, one third of workers retire at the new retirement age, one third continue to retire at the old age of retirement and accept the deductions which this implies, and one third avoid the new rules by claiming benefits for disability. This rule of thumb would suggest an increase in the average retirement age of less than 8 months.

The introduction of higher adjustment factors also has a very distinctive impact on retirement decisions. Deductions of 4.5% increase the average retirement age by nine months from age 63 to 63.7. Deductions of 6% have a considerably stronger incentive effect and even lift the average retirement age up to age 64.9. As shown by Figure 2, more people retire at age 65 and fewer at age 60 or 61.

Women respond less strongly than men to a shift in age limits. Under the 1972 pension legislation, the average age of retirement for women is age 61.7 and will only rise by 0.7 years to age 62.4 when all the Riester and 1999 pension reform rules are implemented in full.

A shift in the entire fabric of age limits for women by one year produces a postponement of 3 months and the average age of retirement moves up from age 62.4 to 62.6. A shift of two years is accompanied by a stronger drift towards disability benefits; the average age of retirement in this scenario is only 62.3, and thus remains to all intents and purposes unchanged.

This behavior is very clearly illustrated by Figure 3 (below left): In the basic scenario, most women retire between the ages of 60 and 65. A shift in the age limits by one (or two) years also postpones the bulk of retirements among women by the same one (or two) year period. However, not everybody retires later; some people claim disability benefits earlier (the second "peak" flattens out as the age limits are progressively increased, while the first "peak" rises). This is the primary effect for women.

The incentive effect of higher adjustment factors is also weaker for women: a deduction of 4.5% increases the average age of retirement by 3 months from age 62.4 to 62.7. A deduction of 6% increases the average retirement age by six months to age 63.2.

Finally, our simulations demonstrate that the introduction of the NDC system would also have a major impact on the average age of retirement in comparison with the Riester and 1999 reforms (refer to Table 3). The average age of retirement increases by more than two years for men from age 63 to 65.3 and less dramatically by almost one year for women from age 62.4 to 63.3. Of the five reform elements examined, this variant generates the highest average retirement age and, as such, evidently has the most powerful incentive effects. As demonstrated by Figures 2 and 3, the distribution of new retirements is similar to that in the scenario involving higher adjustment factors. This applies equally to men and women.

This is hardly surprising given that the NDC system in fact differs both in technical respects and from the underlying transfer philosophy of the pay-as-you-go system. However, as the earnings points rules embodied in the German PAYG system resemble fairly closely the actuarial principle of equivalence between contributions and benefits, the main difference between the two systems is that the NDC system includes adjustment factors which are actuarially fair and thus considerably higher than in the reference scenario.

Insert Table 3

Insert Figure 2

Insert Figure 3

It is important to bear in mind that the estimates summarized in this paper are based on the behavior of employees and employers from the mid-1980s to 1990s. The future behavior particularly of female workers may well change significantly, i.e. more closely resemble that of male workers, in the period 2005 to 2025 to which the projections in this paper apply.

6 Summary and conclusions

The accelerating process of population aging will have a momentous impact on the financial sustainability of the German pay-as-you-go pension system. The increase in the old age dependency ratio means that the pensions of a growing number of people at retirement age will have to be financed by a smaller workforce. Quite apart from these demographic problems, there are also strong incentive effects favoring early retirement built into the German pension system; these incentives increase the old age dependency ratio even more than would be dictated by demographic factors alone.

We have modeled and estimated the influence of pension legislation on retirement decisions in Germany. Retirement probability is summarized as a function of an incentive variable which encompasses pension legislation and other control variables. As incentive variables we use the option value of postponing retirement by one year. This model is then used to simulate various reforms to the retirement rules: the 1992 and 1999 reforms, as well as a range of reform variants offered for discussion by the "Rürup Commission", including an increase in standard retirement age limits, in the actuarial adjustment factors, and the implementation of a notional defined contribution (NDC) system modeled after the Swedish pension system.

Our calculations show that the introduction of an actuarial adjustment factor of 3.6% p.a. and other changes to the retirement rules already introduced by the 1992 and 1999 reforms will, over the next few years, increase the average effective retirement age for men by almost two years and that for women by a considerably lower period of almost 9 months.

A shift in the structure of age limits as a whole by a further two years would postpone the effective retirement age of men by, on average, around 9 months, and would have little or no effect on the retirement age of women. Alternatively, an increase of the actuarial adjustment factor from 3.6% to 6% would increase the average age of retirement by almost 2 years. This

effect would be considerably weaker for women, nevertheless, their average age of retirement would increase by around one year.

These results illustrate that an increased actuarial adjustment factor and an increase in the retirement age based on higher remaining life expectancy offer major potential for postponing the effective age of retirement. This is an important finding. Since the pension system from which we depart is grossly non-actuarial, that is, the present discounted value of pension benefits decreases substantially with the age of retirement, an increase in the effective retirement age will reduce the financial burden of the public pension system.[34] From an economic perspective, therefore, these policy options offer suitable measures which help to put the German pay-as-you-go public pension system on a path on which it can regain its financial sustainability.

[34] Börsch-Supan and Schnabel (1998) provide empirical estimates and graphical representations of the decline in the present value of benefits with retirement age. It is important to note that the budget effect is caused by the current actuarial non-neutrality of the German pension system. It vanishes once the system has gained actuarial neutrality, see e.g. Breyer and Kifman (2002) for a theoretical analysis and Gruber and Wise (2004b) in their introduction to an empirical international comparison on the size of these budget effects. The exact quantification of the budget effects is subject of current research. Börsch-Supan, Kohnz and Schnabel (2004b) provide preliminary budget effect estimations based on a simplified model of the German social security system.

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Figure 1: Statutory retirement age

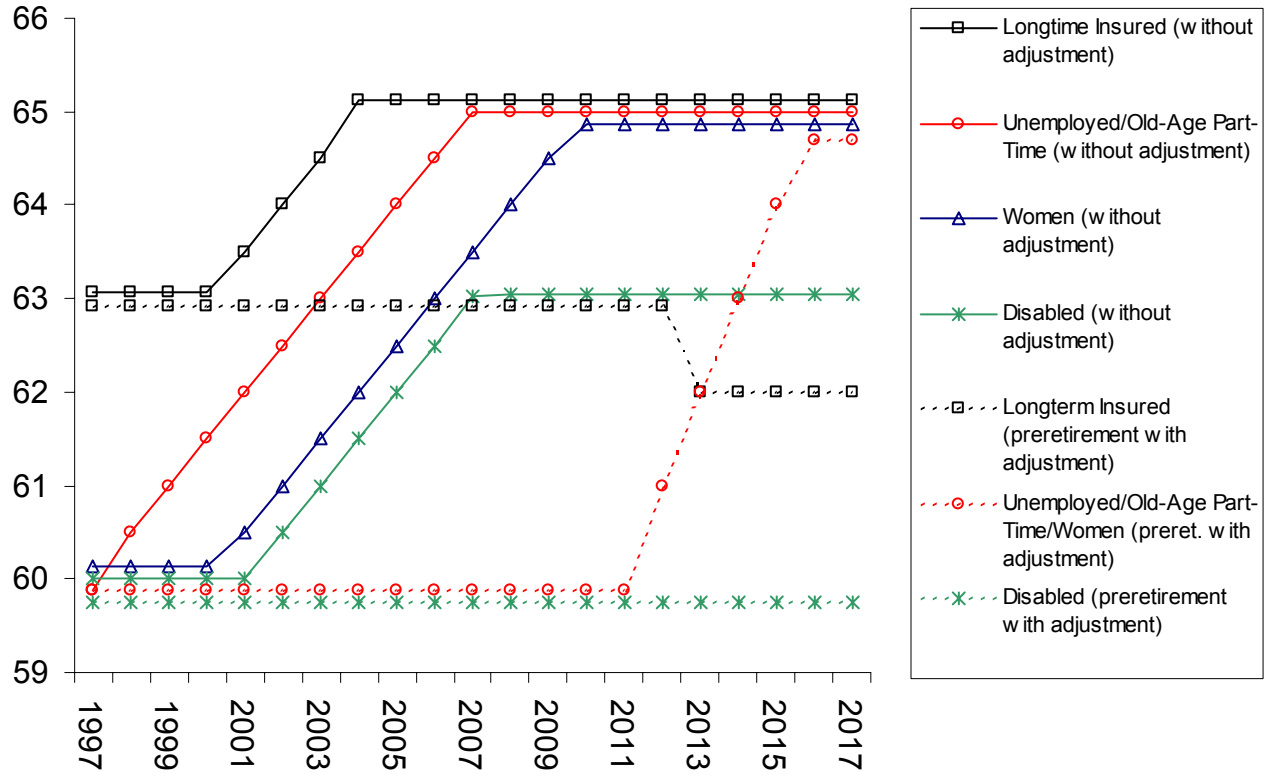


Table 1: Adjustment of public pensions by retirement age

Pension as a percentage of the pension that one would obtain if one had retired at age 65			
age	**pre-1992[a)]**	**post-1992[b)]**	**Actuarial fair[c)]**
62	100.0	89.2	80,5
63	100.0	92.8	86,3
64	100.0	96.4	92,8
65	100.0	100.0	100,0
66	107.2	106.0	108,1
67	114.4	112.0	117,2
68	114.4	118.0	127,4
69	114.4	124.0	139,1

Notes: a) GRV 1972–1992. b) GRV after 1992 reform has fully phased in. c) Evaluated at a 3% discount rate.
Source: Börsch-Supan and Schnabel (1999).

Table 2: Regression output

	Males			Females		
Variable	**Coef.**	**Std. Err.**	**p-value**	**Coef.**	**Std. Err.**	**p-value**
Optval	-0.0059	0.0013	0.000	-0.0032	0.0008	0.000
Social security wealth (SSW)	-0.0024	0.0008	0.004	0.0009	0.0005	0.104
SSW partner	0.0005	0.0003	0.103	-0.0000	0.0020	0.904
Age=55	0.3625	0.2203	0.100	0.3051	0.1306	0.020
Age=56	0.6844	0.2145	0.001	0.4446	0.1306	0.001
Age=57	0.5875	0.2169	0.007	0.5508	0.1313	0.000
Age=58	0.5806	0.314	0.012	0.5793	0.1349	0.000
Age=59	0.5704	0.2488	0.022	0.5816	0.1379	0.000
Age=60	1.4219	0.2731	0.000	2.0101	0.1474	0.000
Age=61	1.6412	0.2818	0.000	2.1777	0.1532	0.000
Age=62	1.7481	0.2835	0.000	2.2630	0.1625	0.000
Age=63	2.1266	0.2821	0.000	2.3174	0.1782	0.000
Age=64	2.4431	0.3063	0.000	2.2424	0.1782	0.000
Age=65	3.7217	0.2826	0.000	3.9161	0.1852	0.000
Age=66	3.8238	0.3478	0.000	3.9738	0.2246	0.000
Age=67	4.0512	0.4963	0.000	3.9634	0.2594	0.000
Age=68	3.3760	0.3962	0.000	4.0071	0.2690	0.000
Age=69	3.9929	0.4532	0.000	4.2637	0.2807	0.000
Age=70	4.3736	0.5045	0.000	4.3696	0.3374	0.000
Age=71	4.5816	0.5141	0.000	4.8642	0.37988	0.000
Age=72	5.3190	0.4838	0.000	6.2926	0.4182	0.000
Health status	-0.1326	0.01311	0.000	-0.1447	0.01566	0.000
Married	-0.1265	0.1450	0.383	-0.9660	0.1118	0.000
University degree	-0.5660	0.2695	0.036	-1.0109	0.2228	0.000
Skill	-0.1406	0.0931	0.134	-0.1203	0.0600	0.045
Homeownership	0.3670	0.0800	0.000	-0.1927	0.0602	0.001
No financial assets	-0.1681	0.1486	0.258	-0.1420	0.942	0.132
Financial securities	0.2272	0.0876	0.010	0.1418	0.0682	0.038
Period of insurance	0.0350	0.0247	0.156	0.0460	0.0092	0.000
Period of insurance squ.	-0.0007	0.0004	0.094	-0.0008	0.0002	0.000
Labor income	0.0113	0.0098	0.251	0.0117	0.0049	0.017
Labor income squared	0.0001	0.0001	0.063	0.0000	0.0000	0.000
Self-employed	-0.4578	0.1702	0.007	-0.7856	0.1276	0.000
Civil service	0.6214	0.1561	0.000	0.9769	0.2891	0.001
Kids	-0.3633	0.0867	0.000	-0.0777	0.0651	0.233
Constant	0.0372	0.4834	0.939	-0.1622	0.2238	0.469
No. of obs.		2321			4206	

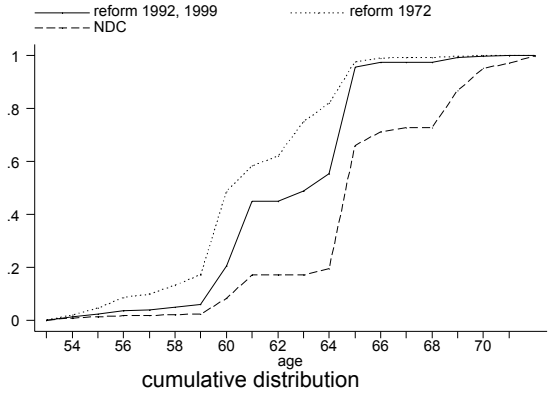
Source: GSOEP, working sample, 1984-1997.

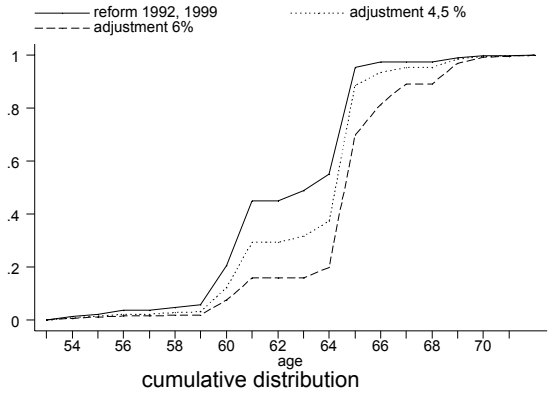
Table 3: The impact of different reform options on retirement age

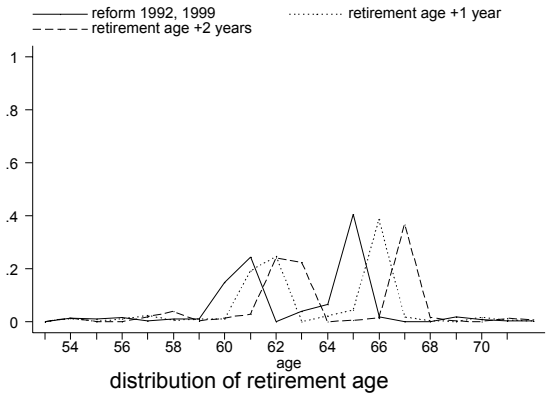
	Mean retirement-age	Percentage of persons who retire before age 60	Percentage of persons who retire before age 62	Percentage of persons who retire before age 65
Men:				
1972 legislation	61,2 *	17,2 %	58,2 %	81,9 %
Pension reforms 1992 + 1999	63,0	4,7 %	42,4 %	51,7 %
... plus adjustment costs of 4,5%	63,7	3,2 %	31,3 %	37,4 %
... plus adjustment costs of 6%	64,9	2,1 %	18,6 %	20,0 %
... plus „pivotal age“ +1 year	63,3	5,8 %	26,0 %	52,6 %
... plus „pivotal age“ +2 years	63,7	7,2 %	11,3 %	53,4 %
NDC System	65,3	2,3 %	19,2 %	19,4 %
Women:				
1972 legislation	61,7*	10,8 %	58,6 %	66,9 %
Pension reforms 1992 + 1999	62,4	6,3 %	52,4 %	54,8 %
... plus adjustment costs of 4,5%	62,7	5,3 %	48,6 %	50,1 %
... plus adjustment costs of 6%	63,2	4,1 %	42,0 %	42,9 %
... plus „pivotal age“ +1 year	62,6	6,7 %	42,8 %	55,0 %
... plus „pivotal age“ +2 years	62,3	6,9 %	9,4 %	55,1 %
NDC System	63,3	4,2 %	41,8 %	41,8 %

*) These values correspond to the mean retirement age calculated from the VDR statistics of 1995, based on old age pensions and disability entries for all persons aged 54 to 72.

Figure 2: Predicted distribution of retirement ages, men







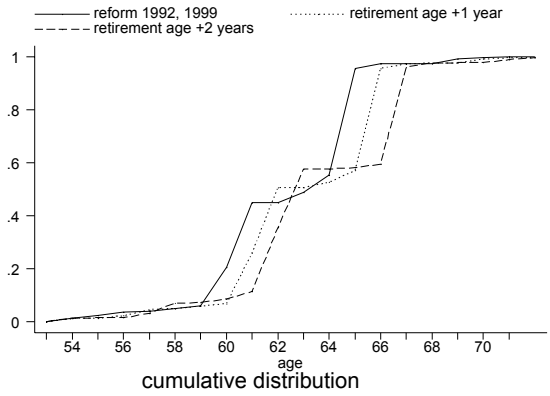
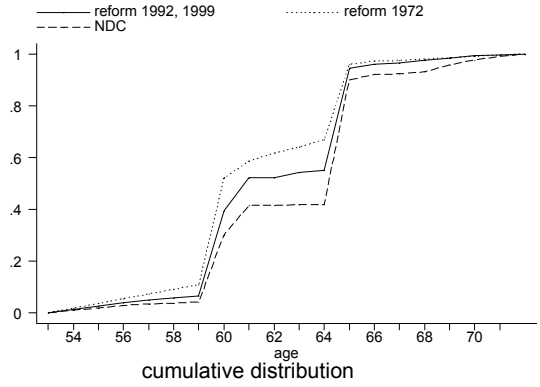
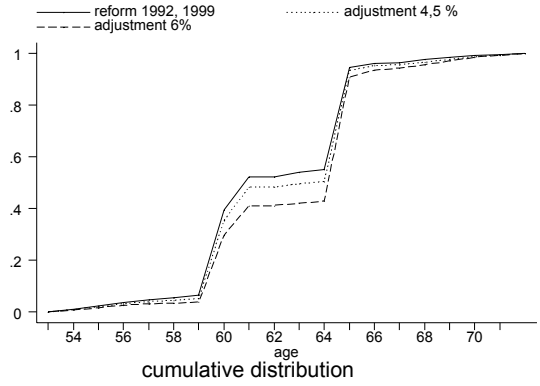
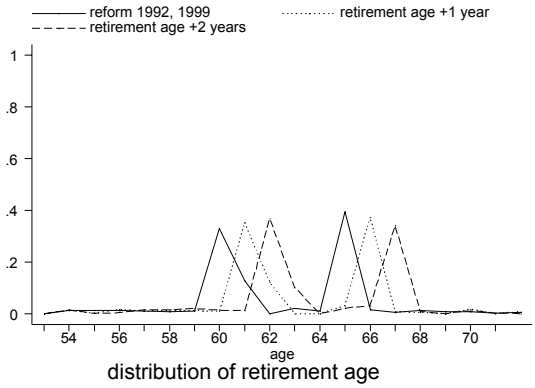
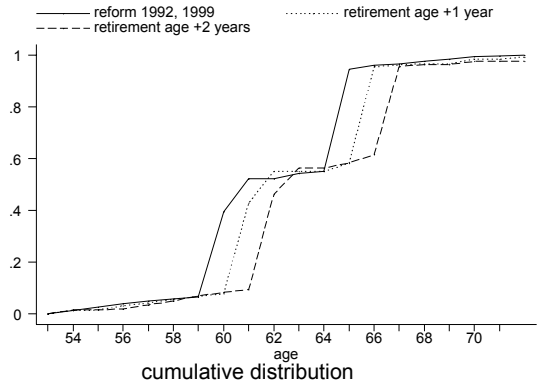


Figure 3: Predicted distribution of retirement ages, women









Appendix

Table 4: Descriptive statistics of variables used in table 2

	Males		Females	
Variable	**Mean**	**Std. Err.**	**Mean**	**Std. Err.**
out of labor	0.3997	0.0106	0.3117	0.0074
Optval	184.6162	3.6062	141.3610	9.9247
Social security wealth	301.3927	3.1347	129.8944	1.8196
Social sec. wealth, sqrd.	52.3736	2.3016	218.5025	2.8887
Health status	8.2234	0.0629	9.1967	0.0321
Married	0.9471	0.0048	0.9133	0.0044
University degree	0.0793	0.0057	0.0378	0.0030
Skill	0.8498	0.0113	0.4784	0.0090
Homeownership	0.4876	0.0106	0.5166	0.0078
No financial assets	0.0850	0.0059	0.1046	0.0048
Financial securities	0.2512	0.0092	0.2257	0.0066
Period of insurance	39.9206	0.1453	21.0235	0.2005
Period of insurance squ.	1640.0540	9.2452	604.2722	9.6815
Income	55.6362	0.4903	29.6392	1.0617
Income squared	3637.4740	73.0634	5452.5820	1756.9060
Self-employed	0.0716	0.0054	0.0859	0.0044
Civil service	0.1189	0.0069	0.0101	0.0016
Kids	0.3121	0.0098	0.3032	0.0072
No. of obs.	2321		4206	

Source: GSOEP, working sample, 1984-1997

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